Multi-Phased Remedial Investigation (RI)
of Surface and Subsurface Contamination of Soldier Creek
at Tinker AFB, Oklahoma
U.S. Air Force Installation Restoration Program

FINAL

RISK ASSESSMENT REPORT

FEBRUARY 1993

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SOLDIER CREEK RI/FS (NPL Site)
Prepared for: Tinker Air Force Base through
U.S. Army Corps of Engineers
Tulsa District

FINAL
RISK ASSESSMENT REPORT
TINKER AFB - SOLDIER CREEK RI/FS

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EXECUTIVE SUMMARY

This report presents the results of the risk assessment for the Soldier Creek Site at Tinker Air Force Base (AFB). The overall purpose of the risk assessment is to determine, by medium, the potential adverse effects of the Soldier Creek Site contamination on human health and the environment.

The process of determining the chemicals of potential concern for the Soldier Creek Site included a detailed evaluation of the analytical data, a careful analysis of the sources of contamination and areas that the sources impact, and a review of site characteristics. The objectives of this process were to identify a set of chemicals that are likely to be site-related and to affirm that reported concentrations are of acceptable quality for use in the quantitative human health risk assessment.

The exposure assessment is an estimate of the type and magnitude of exposures to people from the chemicals of potential concern at the Soldier Creek Site. The results of the exposure assessment were combined with chemical-specific toxicity information to characterize potential risk.

The toxicity assessment weighs the evidence for the potential of particular chemicals to cause adverse health effects in exposed populations, and to provide an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood or severity of adverse health effects.

The risk of adverse noncarcinogenic effects from chemical exposure is expressed in terms of the Hazard Quotient (HQ). All the HQ values for chemicals within each exposure pathway are summed to yield the hazard index (HI). An HI value of less than 1.0 indicates little concern for noncarcinogenic effects, while an HI value greater than or equal to 1.0 indicates an increased level of concern.

An evaluation of the noncarcinogenic risk calculations shows the hazard index for each of the eight residential wells sampled are all less than 1.0, indicating little concern for noncarcinogens. An evaluation of noncarcinogenic risks for current off-base residents indicates that both the perched aquifer and top of regional aquifer

zones exhibit HIs greater than 1.0. The regional aquifer zone HI is less than 1.0. The surface water and shallow sediment (0-6 inches) HIs are all at least one order of magnitude less than 1.0. For current on-base workers using the perched aquifer zone water for showering (an exposure pathway that is not occurring) the HI is greater than 1.0. For current on-base workers performing construction work in the creek, the surface water and shallow sediment (0-6 inches) HIs are all at least two orders of magnitude less than 1.0.

An evaluation of noncarcinogenic risks for future off-base residents indicates that all three aquifer zones have associated noncarcinogenic HIs greater than 1.0 for future residential use. The HIs for all surface water and deep sediments (0-5 feet) are at least one order of magnitude less than 1.0. In future exposure scenarios that assume on-base workers will drink water from and shower in water from the aquifer zones, the perched aquifer and top of regional aquifer zones have associated HIs greater than 1.0. Exposure scenarios where future on-base workers are performing construction work in the creek, the HIs for surface water, and deep sediments (0-5 feet) are at least two orders of magnitude below 1.0.

In summary, noncarcinogenic risks exist in excess of the level of concern for current off-base residents for exposure to the perched aquifer and the top of regional aquifer zones, current on-base workers using the perched aquifer zone (not currently a complete pathway), future off-base residents for exposure to all three aquifer zones, and future on-base workers for exposure to the perched aquifer and top of regional aquifer zones.

The risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer during his or her lifetime from that exposure. According to U.S. Environmental Protection Agency (EPA) policy, the target total individual carcinogenic risk resulting from exposures at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site may range from 1×10^{-4} (one in ten thousand) to 1×10^{-6} (one in one million). Thus, remedial alternatives should be capable of reducing total potential carcinogenic risks to individuals to levels within this range.

An evaluation of carcinogenic risks for current exposures associated with the eight residential well samples indicates that one of the samples (G06) has associated risks equal to 1×10^{-6} (one in one million), and one (G07) has a risk of 5×10^{-5} (five in one hundred thousand). An evaluation of carcinogenic risks for current off-base residents indicates that all three aquifer zones exhibit risks greater than the 1×10^{-6} (one in one million) level. The perched aquifer risk is estimated to be 1×10^{-2} (one in one hundred), the top of regional aquifer zone risk is estimated to be 2×10^{-3} (two in one thousand), and the regional aquifer zone carcinogenic risk is estimated to be 3×10^{-4} (three in ten thousand). The surface water and shallow sediment (0-6 inches) carcinogenic risks are all less than 1×10^{-6} (one in one million) for all off-base segments of Soldier Creek. For current on-base workers showering in water from the aquifer zones (an exposure pathway that is not occurring), all three zones have estimated carcinogenic risks greater than 1×10^{-6} (one in one million), including 4×10^{-3} (four in one thousand) for the perched aquifer, 6×10^{-4} (six in ten thousand) for the top of regional aquifer zone, and 1×10^{-4} (one in ten thousand) for the regional aquifer zone. The surface water and shallow sediment (0-6 inches) risks for on-base workers performing construction work in the creek are all less than 1×10^{-6} (one in one million).

An evaluation of carcinogenic risks for future off-base residents (the most conservative scenario presented) indicates estimated carcinogenic risks associated with the perched aquifer of 1×10^{-2} (one in one hundred), the top of regional aquifer zone of 5×10^{-3} (five in one thousand), and the regional aquifer zone of 7×10^{-4} (seven in ten thousand). The estimated risk associated with surface water and deep sediment (0-5 feet) exposure is less than 1×10^{-6} (one in one million). Estimates of carcinogenic risks for future on-base workers drinking water from and showering in water from the aquifer zones indicates that all three aquifers have potential carcinogenic risks greater than the 1×10^{-6} (one in one million) level. The perched aquifer yields an estimated risk of 5×10^{-3} (five in one thousand), the top of regional aquifer zone has an estimated risk of 1×10^{-3} (one in one thousand), and the regional aquifer zone has an estimated risk of 2×10^{-4} (two in ten thousand). The estimated risks associated with exposure to surface water and deep sediments (0-5 feet) for on-base workers performing construction work in the creek are less than 1×10^{-6} (one in one million).

In conclusion, exposure to chemicals of concern in the surface water and sediments has a low potential carcinogenic risk in all scenarios. Exposure to chemicals of concern in the perched aquifer, top of regional aquifer zone, or regional aquifer zone at the Soldier Creek Site has the potential for carcinogenic risk greater than 1×10^{-6} (one in one million) for all scenarios.

Since exposure to chemicals of concern in the Solider Creek Site aquifer zones results in potential noncarcinogenic risks at a level greater than 1.0 for certain scenarios and potential carcinogenic risks greater than 1×10^{-6} (one in one million) for all scenarios, remediation of groundwater at the site will be dealt with separately from surface water and sediment. Exposure to chemicals of concern in Soldier Creek Site surface water and sediment has low potential noncarcinogenic and carcinogenic risks for all scenarios.

The environmental assessment provides a qualitative assessment of potential impacts to biotic receptors due to chemicals of concern present at the Soldier Creek Site. Soldier Creek feeds into Crutcho Creek which feeds into the North Canadian River. The North Canadian River supports a variety of aquatic species. The concentrations of metals found in the surface water and sediments are of potential environmental concern.

ABBREVIATIONS AND ACRONYMS

AFB	Air Force Base
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BCF	Bioconcentration Factor
BOD_5	Five-day Biochemical Oxygen Demand
BVWST	B&V Waste Science and Technology Corp.
C	Concentration
CAA	Clean Air Act
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COD	Chemical Oxygen Demand
COE	U.S. Army Corps of Engineers, Tulsa District
CRDL	Contract Required Detection Limit
CWA	Clean Water Act
DI	Daily Intake
DO	Dissolved Oxygen
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
EWI	Equal-Width Increment
F	Degrees Fahrenheit
FFA	Federal Facilities Agreement
FS	Feasibility Study
HEA	Health Effects Assessments
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HIF	Human Intake Factor
HPLC	High-Performance Liquid Chromatography
HQ	Hazard Quotient
IRIS	Intregrated Risk Information System
IRP	Installation Restoration Program
IWTP	Industrial Wastewater Treatment Plant
Kg	Kilogram
L	Liter
LC_{50}	Lethal Concentration Yielding 50% Mortality
LD_{50}	Lethal Dose Yielding 50% Mortality
LDRs	Land Disposal Restrictions

LOEL	Lowest Observed Effect Level
m^3	Cubic meter
MALs	Maximum Allowable Limits
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
mg	Milligram
ml	Milliliter
M&I	Manufacturing and Industrial
mph	Miles per hour
MRL	Minimal Risk Level
NAAQSs	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOEL	No Observed Effect Level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
ONHI	Oklahoma Natural Heritage Inventory
OSDH	Oklahoma State Department of Health
OSWER	Office of Solid Waste and Environmental Response
OWRB	Oklahoma Water Resources Board
PAH	Polycyclic Aromatic Hydrocarbon
ppm	Parts per million
QA/QC	Quality Assurance/Quality Control
RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfund
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RMLs	Recommended Maximum Levels
SARA	Superfund Amendments and Reauthorization Act
SAS	Special Analytical Services
SDWA	Safe Drinking Water Act
SF	Slope Factor
SMCLs	Secondard Maximum Contaminant Levels
SPHEM	Superfund Public Health Evaluation Manual
SWDA	Solid Waste Disposal Act
TAL	Target Analyte List
TBC	To Be Considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
t-1,2-DCE	Trans-1,2-dichloro ne

TOC	Total Organic Carbon
TSS	Total Suspended Solids
USC	United States Code
USGS	United States Geological Survey
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter

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1.0 INTRODUCTION

This report presents the results of the risk assessment for the Soldier Creek Site at Tinker Air Force Base (AFB). A comprehensive description of the site location and history can be found in the Remedial Investigation (RI) report (BVWST, 1993). This section presents a summary of the Soldier Creek Site location and history, a discussion of the authority for the work, objectives and scope of the risk assessment, and organization of the baseline risk assessment.

1.1 Summary of Soldier Creek Site Location and History

Tinker AFB is located southeast of the Oklahoma City metropolitan area, bordering on Del City and Midwest City in central Oklahoma as illustrated on Figure 1-1 (page 1-2). The main portion of Soldier Creek is located to the east of Tinker AFB; however, two tributaries (West and East Soldier Creek) originate on the Base. Soldier Creek flows to the north from its headwaters near Southwest 59th Street to its confluence with Crutcho Creek approximately six miles downstream. The Soldier Creek Site includes Soldier Creek, its tributaries, and any area underlying or adjacent to the waterway that may be contaminated by the migration of hazardous substances, pollutants, or contaminations from Tinker AFB (EPA, 1988a).

For purposes of the Tinker AFB - Soldier Creek Remedial Investigation/Feasibility Study (RI/FS) project, West Soldier Creek is identified as the tributary that originates on the west side of Building 3001 and flows northward to its confluence with Soldier Creek approximately two miles downstream. East Soldier Creek is identified as the tributary which flows northward along the east side of Building 3001 and past the Industrial Wastewater Treatment Plant (IWTP) from its origin just to the north of Building 3705 to its confluence with Soldier Creek, approximately one mile downstream. For the purposes of the RI, the study areas primarily consist of the tributaries that directly receive discharges or runoff from Tinker AFB (West and East Soldier Creek) and the main stem of Solider Creek from its headwaters downstream to East Reno Avenue, as illustrated on Figure 1-2 (page 1-3).

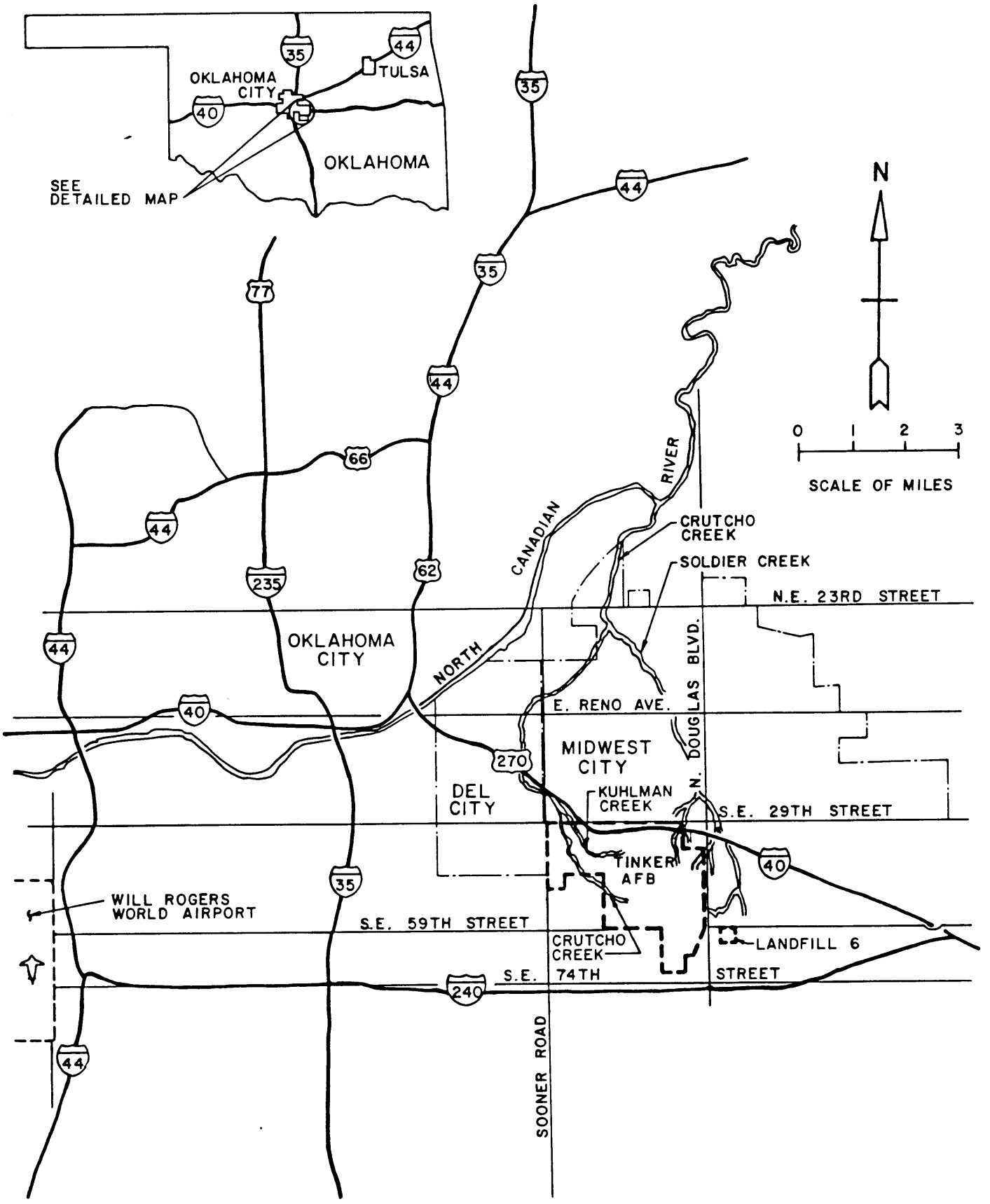

FIGURE 1-1
SITE VICINITY
TINKER AFB - SOLDIER CREEK RI/FS
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CAD DWG NO 001267
DATE: 1-22 PVT
PLOT SCALE: 1=1

WEST SOLDIER CREEK

TINKER AIR FORCE BASE

MAIN SOLDIER CREEK

INDUSTRIAL WASTEWATER TREATMENT PLANT

EAST SOLDIER CREEK

BUILDING 3001

SOUTHWEST TANK AREA

TRIBUTARY "B"

TRIBUTARY "A"

M13 M12 M11 M10 M09 M08 M07 M06 M05 M04 M03 M02 M01

W09 W08 W07 W06 W05 W04 W03 W02 W01

C02 C03 C01

G06 G01 G07 G03 G08 G02 G04 G05

TOB-1 TOB-2 TOB-3 TOB-4 TOB-5 TOB-6 TOB-7 TOB-8 TOB-9 TOB-10 TOB-11 TOB-12 TOB-13 TOB-14 TOB-15 TOB-16 TOB-17 TOB-18 TOB-19 TOB-20 TOB-21 TOB-22

E13 E12 E11 E10 E09 E08 E07 E06 E05 E04 E03 E02 E01

B03 B02 B01

A03 A02 A01

D01

LEGEND

- SOLDIER CREEK AND TRIBUTARIES
- UNDERGROUND PORTION OF CREEK
- BOUNDARY OF TINKER AIR FORCE BASE
- G01 ON-BASE GROUNDWATER SAMPLING LOCATION
- M10 ON-BASE SEDIMENT SAMPLING LOCATION
- TOB-14 OFF-BASE GROUNDWATER SAMPLING LOCATION
- 1-1 3001 AND IWTP GROUNDWATER SAMPLING LOCATION

REFERENCE: TULSA COE, 1991a.
TULSA COE, 1991b.

N

2000' 1000' 0 2000' 4000'

FIGURE 1-2
SITE LOCATION AND PHASE I AND PHASE II SAMPLING LOCATIONS
TINKER AFB - SOLDIER CREEK RI/FS

Soldier Creek and its tributaries receive surface runoff from approximately 9,000 acres. Areas on Tinker AFB that contribute runoff or discharge to Soldier Creek and its tributaries include the eastern-most runway areas, the Building 3001 complex, and the IWTP. The Building 3001 complex consists of an aircraft overhaul and modification complex to support the mission of the Oklahoma City Air Logistics Center. The IWTP, located in the northeastern portion of the Base, receives industrial process discharge waters from the Building 3001 complex through a series of underground lines. Once received at the plant, these waters are treated and combined with treated sanitary wastewater before discharge to East Soldier Creek under a National Pollutant Discharge Elimination System (NPDES) permit.

Tinker AFB was activated in March 1942 under the name of the Midwest Air Depot. During World War II, the depot was responsible for reconditioning, modifying, and modernizing aircraft, vehicles, and equipment. The primary mission has not changed. Tinker AFB is still a major industrial complex for overhauling, modifying, and repairing military aircraft engines and accessory items.

As part of the overall Air Force Installation Restoration Program (IRP), Tinker AFB began investigation of previously used waste disposal sites in 1981 (EPA, 1988a). A Base wide sampling program was conducted in 1983. Analytical results from the sampling program indicated trichloroethene was present in the groundwater. Remedial investigations were conducted by Tinker AFB through the Tulsa District Corps of Engineers (COE) from 1986 to 1989 to determine the nature and extent of groundwater contamination in the Building 3001 complex area. These investigations determined that chromium, in addition to the trichloroethene, was a contaminant of concern in the groundwater. On July 22, 1987, Building 3001 Site and the Soldier Creek Site were added to the National Priorities List (NPL).

1.2 Authority for the Work

The U.S. Environmental Protection Agency (EPA) Region VI, the Oklahoma State Department of Health (OSDH), and the U.S. Department of the Air Force, Tinker AFB signed a Federal Facilities Agreement (FFA) (Administration Docket Number NPL-U3-2-27) under the Comprehensive Environmental Response, Compensation,

and Liability Act of 1980 (CERCLA) Section 120 and the Superfund Amendments and Reauthorization Act of 1986 (SARA) on December 9, 1988.

1.3 Risk Assessment Objectives

The risk assessment evaluates, by medium, the potential adverse effects of Soldier Creek Site contamination on human health and the environment. To satisfy this overall purpose, the following objectives for the risk assessment have been established:

- Determine receptor populations that may be exposed to contamination within Soldier Creek.

- Quantitatively assess the potential risk for each human receptor population based on the nature and extent of contamination found within each medium of interest.

- Qualitatively assess the potential risk to exposed terrestrial and aquatic populations based on the nature and extent of contamination found within each medium of interest.

A revision of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (EPA, 1991a) states that the purpose of the remedial process is to implement remedies that reduce, control, or eliminate risk to human health and the environment.

This risk assessment provides an evaluation of potential risk to human health and the environment from exposure or potential exposure to the contaminants at the Soldier Creek Site. The risk assessment results will document the magnitude of risk at the site and the cause of that risk. The results will help determine what response actions may be necessary for remediation and aid in establishing and modifying the remediation goals. A flow chart of the risk assessment process is presented on Figure 1-3 (page 1-6).

SOURCE: EPA, 1989a

FIGURE 1-3
FLOW CHART OF THE RISK ASSESSMENT PROCESS
TINKER AFB-SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

1.4 Scope of the Risk Assessment

The scope of this risk assessment is limited to the potential risks to human health and the environment from exposure to contaminants in sediment, surface water and groundwater associated with the Soldier Creek Site. The potential risks developed in this risk assessment are those directly related to contaminants in the media at this site. This human health and environmental risk assessment has been derived from data collected during Phases I and II of the RI for Soldier Creek for the site (BVWST, 1993), round 1 analytical data from the Groundwater Investigations Northeast of the Base (Tulsa COE, 1991a), and the analytical data from the IWTP RI (Tulsa COE, 1991b).

The procedures used in the performance of this risk assessment and its scope are consistent with and based on EPA guidance procedures and policies for the performance of risk assessments at hazardous waste sites. The primary guidance documents relied upon were the Risk Assessment Guidance for Superfund (RAGS); Volume I, Human Health Evaluation Manual (EPA, 1989a); Volume II Environmental Evaluation Manual; (EPA, 1989b), and related documents.

1.5 Organization of the Baseline Risk Assessment

The baseline risk assessment for the Soldier Creek Site consists of the following:

- Identification of Chemicals of Potential Concern.
- Exposure Assessment.
- Toxicity Assessment.
- Risk Characterization.
- Environmental Evaluation.
- Summary.

The identification of chemicals of potential concern section is the first step in the risk assessment. This step in the risk assessment process involves gathering and analyzing the site data relevant to the human health and the environment and identifying those chemicals to be included in the risk assessment evaluation. This process is in the data collection and evaluation portions of the risk assessment process as illustrated on Figure 1-3 (page 1-6). Chemicals of potential concern for each medium at the

Soldier Creek Site are identified in Section 2.0 of this report. The criteria used to determine the chemicals of potential concern are also presented in Section 2.0 of this report.

The exposure assessment is conducted to estimate the magnitude of potential current and future human exposures to contaminants at the site for each medium, the frequency and duration of these exposures, and the pathways that result in human exposures. In the exposure assessment, conservative estimates of exposure are developed for both current and future land use assumptions. Future exposure is estimated to provide an understanding of potential future exposures to contaminants. Conducting an exposure assessment involves analyzing contaminant releases, identifying exposed populations, identifying potential pathways of exposure, estimating exposure point concentrations for specific pathways, and estimating contaminant intakes for specific pathways. The results of the exposure assessment are pathway-specific intakes for current and future exposures to contaminants at the site. The exposure assessment for the Soldier Creek Site is presented in Section 3.0 of this report.

In the toxicity assessment, the types of adverse health effects associated with chemical exposures, the relationship between magnitude of exposure and adverse effects, and the related uncertainties involved are determined. Risk assessments rely heavily on existing toxicity information developed for specific chemicals. The two primary sources for this information are the EPA's Integrated Risk Information System data base (IRIS) and the Health Effects Assessment Summary Tables (HEAST). The toxicity components in a risk assessment fall into two categories: those related to noncarcinogenic risk, and those related to carcinogenic risk. To evaluate noncarcinogenic risk, the intake of a contaminant is compared with the corresponding reference dose (RfD) for that contaminant. The RfD is a best estimate of the level at which there will be no observed adverse effect to the exposed population. To evaluate carcinogenic risk, the intake of a contaminant is adjusted with the slope factor (SF) for that contaminant. The SF is a best estimate of the carcinogenic potency of a contaminant, or its ability to cause cancers in an exposed population. For humans, the RfDs and SFs are derived from human epidemiology studies and animal dose-response relationships. The toxicity assessment for the Soldier Creek Site is presented in Section 4.0 of this report.

The risk characterization section of the baseline risk assessment summarizes and combines the exposure and toxicity assessments to characterize baseline risks. During risk characterization, chemical-specific toxicity information is compared with the estimated exposure levels to determine whether contaminants at the site pose current and future risks that are of a magnitude to be of concern. The risk characterization is presented in Section 5.0 of this report.

The environmental assessment (EA) for the Soldier Creek Site is a qualitative appraisal of the actual or potential effects of a hazardous waste site on plants and animals other than people and domesticated species. The goal of an environmental assessment is to describe effects on the natural environment associated with the releases of contaminants or with actions designed to remediate the site.

Information provided by the environmental assessment may be used to:

- Decide if remedial action is necessary based on environmental considerations.
- Evaluate the potential environmental effects of the remedial action itself.
- Provide information necessary for mitigation of an environmental threat.
- Design monitoring strategies for assessing the progress and effectiveness of remediation.

A qualitative environmental assessment for the Soldier Creek Site is presented in Section 6.0 of this report.

2.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

This section summarizes the work performed during the Phase I and II RI field activities completed during July 1990 and June 1991, respectively.

2.1 Phase I -- Remedial Investigation

This subsection describes the work performed during field activities associated with Phase I of the RI completed during July 1990. Phase I of the RI included a sediment investigation, surface water investigation, surface water flow investigation, and a limited groundwater investigation.

2.1.1 Sediment Investigation

Forty-one sediment sampling locations were investigated during Phase I of the RI. These Phase I sampling locations are illustrated on Figure 1-2 (page 1-3). Sediment samples were collected at 0-6 inches and 6-12 inches. A 6-12 inch sediment sample was not obtained at locations E01 and E04 because of a clay soil layer present at the 6-inch depth.

Composite sediment samples were collected at each sampling location with each sampling location divided into subsamples across a transect. The samples were collected using the Equal-Width Increment (EWI) method, as described in the "National Handbook of Recommended Method For Water Data Acquisition" (USGS, 1980). Each of the composited samples were submitted to a Contract Laboratory Program (CLP) laboratory and analyzed for acid, base/neutral extractable organic compounds on the Target Compound List (TCL), and metals and cyanide on the Target Analyte List (TAL) using Routine Analytical Services (RAS) detection limits. In addition, Special Analytical Services (SAS) analyses, including Atterberg limits, sediment particle sizes, permeability, and density, were performed on samples collected from locations C01, E07, E09, M05, M08, M09, M13, and W06. Sediment analytical results obtained are presented on figures in Volume 2 and tables in Appendix B, Volume 3 of the Remedial Investigation report (BVWST, 1993).

One grab sample, at each depth, was taken before collection of the composite sample to be analyzed for volatile organic compounds on the TCL using RAS detection

limits. The grab was collected from the subsample location along the transect most likely to con n volatile organic contamination based on stream morphology and visual inspection.

A background sediment sample was collected from location C01 in the same manner as the sediment matrix samples and analyzed for the same parameters as sediment samples collected from the other 40 locations.

Five duplicate sediment samples were collected to assess the combined effects of sample collection. The duplicates were collected from both depths at locations E02, E06, E08, and M08. The fifth duplicate was collected at location W06 for the 0-6 inch depth and at location W08 for the 6-12 inch depth. At W06, bedrock was indicated at the 6-12 inch depth, therefore a duplicate sample was not collected at that depth. All duplicates were analyzed for the same chemical and physical parameters as their corresponding samples.

One sediment equipment rinsate blank was prepared and analyzed to determine the extent to which field procedures contributed to sample contamination. The blank was prepared for location M08 using the same sampling method used to collect the sediment samples and was analyzed for the same chemical parameters.

2.1.2 Surface Water Investigation

Forty-one surface water locations corresponding to the same sediment sampling locations were investigated during Phase I of the RI. These locations are shown on Figure 1-2 (page 1-3). Ten of the 41 sampling locations A01, A02, A03, B01, B02, B03, M02, M03, W01, and W09 did not contain water; therefore, no surface water samples were obtained.

At each of the remaining 31 surface water sampling locations, one grab and one composite sample were collected from the mid-water column depth. The discrete grab surface water sample was collected at the point along the transect most likely to contain volatile organic contamination based on stream morphology and visual observation. The grab sample was analyzed for volatile organic compounds on the TCL.

Surface water subsamples were then taken at each subsample location across the transect and composited into one sample. Each of the composited surface water samples was submitted to the CLP laboratory and analyzed for acid, base/neutral extractables on the TCL, and metals and cyanide on the TAL. In addition, SAS analyses, including alkalinity, hardness, chemical oxygen demand (COD), total suspended solids (TSS), five-day biochemical oxygen demand (BOD_5), total organic carbon (TOC), oil and grease, and nitrates, were performed on samples from eight of the sampling locations (C01, E07, E09, M05, M08, M09, M13, and W06). Surface water analytical results obtained are presented on figures in Volume 2 and tables in Appendix B of Volume 3, the Remedial Investigation report (BVWST, 1993).

During composite sampling procedures additional composited surface water was collected in a separate stainless steel pan and tested for temperature, dissolved oxygen (DO), specific conductivity, and pH.

A background surface water sample was collected from location C01 in the same manner and analyzed for the same parameters as surface water samples collected from the other 30 locations.

Five duplicate surface water samples were collected to assess the combined effects of sample collection. The duplicates were collected at locations E02, E06, E08, M08, and W08 and were analyzed for the same chemical and water quality parameters as their corresponding samples.

One surface water equipment rinsate blank was prepared and analyzed to determine the extent to which field procedures contributed to sample contamination. The blank was prepared for location M08 using the sample method used for the surface water samples and was analyzed for the same chemical and water quality parameters.

Three surface water trip blanks were prepared by a CLP laboratory, shipped to the Soldier Creek Site, and shipped back to the CLP laboratory in the coolers containing samples for volatile organic analyses. The purpose of the trip blanks was to determine if any contamination in the samples was caused by transportation of the samples.

2.1.3 Surface Water Flow Investigation

Surface water velocity and stream water depth were assessed in the field at all surface water sampling locations and at stations located every 500 feet along Soldier Creek (including those tributaries that emanate from Tinker AFB) from its headwaters located just north of Landfill 6 to East Reno Avenue. A summary of these measurements is included in Appendix B of the Remedial Investigation report (BVWST, 1993).

2.1.4 Groundwater Investigation

Groundwater samples were collected at eight existing off-base private wells located within the Soldier Creek drainage system, as shown on Figure 1-2 (page 1-3). Groundwater temperature, specific conductivity, and pH measurements were taken at each well. Groundwater samples from each of the eight wells were analyzed for compounds on the TCL and TAL including volatile organics, acid, base/neutral extractables, metals, and cyanide using SAS detection limits. Groundwater samples collected from four wells (G02, G03, G07, and G08) were filtered for metals analysis to determine the total metals adsorbed onto soil particles and the fraction in the dissolved phase. The groundwater analytical results are shown in Appendix A of this report.

No background groundwater sample was collected because previous groundwater investigations at Tinker AFB have determined background groundwater concentrations for the vicinity. Tables 2-2 through 2-4 (pages 2-15 through 2-17) include background groundwater concentrtions. Background groundwater concentrations for the area in the vicinity of Tinker AFB were obtained from the Off-Base Groundwater Investigations Northeast of the Base report (Tulsa COE, 1991b). Monitoring well TOB-21B was selected as a background monitoring well for the perched aquifer and monitoring wells TOB-14A and B, TOB-15A and B, and TOB-16A and B were selected as background monitoring wells for the top of regional and regional aquifer zones. These wells were selected because available data indicated that these wells are located outside the aquifer zone influence of known on-base contamination.

One duplicate groundwater sample was taken at well G08 to assess the combined effects of sample collection. The duplicate sample was collected using the same

procedures and analyzed for the same chemical parameters as the groundwater samples.

One groundwater equipment rinsate blank was collected at well G07 and analyzed to determine the extent to which field procedures contributed to sample contamination. The blank sample was prepared using the same procedure and analyzed for the same chemical parameters as the groundwater samples.

Two groundwater trip blanks were analyzed for volatile organics to determine if any contamination in the samples was caused by transportation of samples. The trip blanks were prepared by the CLP laboratory and shipped to the appropriate sampling locations. Each trip blank was sent with its shipment of groundwater samples.

2.2 Phase II -- Remedial Investigation

This section describes the work performed during field activities associated with Phase II of the RI completed during June 1991 (BVWST, 1993 and Tulsa COE, 1991a). Phase II of the RI included a sediment investigation, surface water investigation, surface water flow investigation, and groundwater investigation.

2.2.1 Sediment Investigation

Seventeen sediment sampling locations were investigated during Phase II of the RI. These seventeen locations are shown on Figure 1-2 (page 1-3). These sediment sampling locations were chosen to collect data that would allow the Phase II RI objectives to be obtained.

At each sampling location, one discrete grab sediment sample was collected at each of five depths (0-1, 1-2, 2-3, 3-4, and 4-5 feet) and analyzed for volatile organics on the TCL. This grab sediment sample was collected at the subsample location that was judged to most likely contain volatile organic contamination based on stream morphology and visual observations. For example, if the creek contained a meander at a sampling location, the grab sediment sample was collected on the outside portion of the creek meander or in visually discolored sediment.

Composite sediment samples across a transect were collected at five depths (0-1, 1-2, 2-3, 3-4, and 4-5 feet) and analyzed for the metals lead, chromium, antimony, and cadmium using SAS detection limits. One sample from each subsample depth (0-1, 1-2, 2-3, 3-4, and 4-5 feet) was collected and composited at five locations and analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) analysis. In addition, one sample from one subsample depth was collected and composited from 12 sample locations and analyzed using the TCLP. The TCLP results were not used in the risk assessment process. At the on-base locations, in addition to volatile organic and metal analyses, samples were collected from each of the five depths and analyzed for acid, base/neutral extractables on the TCL. In addition, SAS analyses, including Atterberg limits, grain particle size distribution, total organic carbon and density, were performed on all collected sediment samples.

Composite sediment samples were collected at each sampling location with each sampling location divided into subsamples across the creek transect. All sediment samples and subsamples were taken with a standard 2-foot split spoon. The number of subsamples used to form a composite depended on the width of the creek at each sample location. The same number of subsamples at each specific location was collected as was collected in the Phase I field investigation. There were a minimum of three subsamples collected, spaced at a distance of 5 feet apart. At sample locations having a stream width less than 10 feet, subsamples were taken at the creek banks and in the middle of the creek. The samples were collected using the EWI method, as described in the "National Handbook of Recommended Methods For Water Data Acquisition" (USGS, 1980).

Four sediment background samples were collected from locations C01 (previously sampled during Phase I of the RI), C02, C03, and D01. The precise locations of these off-base background samples were determined during the field investigation. These background sediment samples were collected in the same manner and analyzed for the same parameters as sediment samples.

Duplicate sediment samples were collected from locations C02, M08, M07, E13, E12, E06, and W06. All duplicate samples were collected at the 0-1 foot interval, except at E06 where an extra duplicate was col' ted in the 1-2 foot interval. The duplicate sample analytical results were used t assess the combined effects of sample

collection, handling, and analysis on data precision. These duplicate samples were analyzed for the same chemical parameters as the sediment samples.

Two sediment equipment rinsate blanks were prepared and analyzed to determine the extent to which field procedures contributed to sample contamination. One rinsate blank was collected using the surface water sampling equipment and procedures and the second rinsate sample was collected by pouring high performance liquid chromatography (HPLC) water through the split spoon into a previously decontaminated stainless steel bowl and transferring to the sample bottles.

2.2.2 Surface Water Investigation

Thirty-five surface water samples including quality control and background samples were collected at the same 17 sampling locations as the sediment samples. Composite surface water samples across the stream transect were collected at one depth (mid-water column) at each sampling location. All composite surface water samples were analyzed for the metals, lead, chromium, antimony, and cadmium. In addition, SAS analyses including alkalinity, hardness, COD, TSS, BOD_5, TOC, and nitrates, were performed on each sample.

At each sampling location, a discrete grab surface water sample was collected and analyzed for volatile organics on the TCL. This grab surface water sample was collected at the subsample location that was determined in the field to most likely contain volatile organic contamination based on stream morphology and visual observations. Temperature, specific conductivity, DO, and pH measurements were taken in the field at each surface water sample location after the collection of surface water samples.

Four surface water background samples were collected off-base at the same locations as the sediment background samples. The background surface water samples were collected in the same manner and analyzed for the same parameters as surface water samples discussed previously.

Two duplicate surface water samples were collected at locations C02 and M08. The duplicate samples were used to assess the combined effects of sample collection,

handling, and analysis on data precision. These duplicate samples were analyzed for the same chemical parameters as the surface water samples.

Two surface water equipment rinsate blanks were prepared using the same sampling method used in collecting the surface water samples. These blanks were collected and analyzed to determine the extent to which field procedures contributed to sample contamination. These blank samples were analyzed for the same chemical analyses as the matrix surface water samples.

A water trip blank was prepared by the CLP laboratory, shipped to the Soldier Creek Site, and shipped back to the CLP laboratory with each of six shipments of surface water samples. The purpose of the trip blank was to determine if any contamination in the samples was caused by transportation of the samples.

2.2.3 Surface Water Flow Investigation

Soldier Creek surface water velocity was determined in the field at each Phase II surface water sampling location. These measurements allowed computation of rates and volumes of flow which will allow for qualitative determinations of losing and gaining portions of Soldier Creek. A summary of these measurements is shown in Appendix B, Volume 3 of the Remedial Investigation report (BVWST, 1993).

2.2.4 Groundwater Investigation

The following paragraphs summarize the activities associated with the Off-Base Groundwater Investigations Northeast of the Base (Tulsa COE, 1991a). The 22 groundwater monitoring well cluster locations that were investigated during the off-base groundwater investigation are shown on Figure 1-2 (page 1-3). The groundwater monitoring well sampling was completed to aid in determining the extent of off-base groundwater contamination potentially attributable to Tinker AFB and the Soldier Creek Site.

Wells were installed in the perched aquifer if present, the top of regional aquifer zone, and the regional aquifer zone. Groundwater level, geophysical logs, and groundwater samples were collected at the newly installed groundwater monitoring well locations. Groundwater samples were analyzed for metals, volatile organics, semi-volatile organics, pH, and conductivity.

For quality assurance/quality control purposes, one groundwater duplicate sample was collected for every 10 groundwater samples in triplicate. One sample from the triplicate was sent to the COE's Southwest Division Laboratory as an audit sample for the contract laboratory, and the other two samples of the triplicate were sent to the analytical laboratory as a matrix sample and a quality control sample. Duplicates were collected and tested for the same parameters as in the groundwater samples.

In addition to the duplicate groundwater samples, equipment blanks for water samples were collected. These samples consisted of American Society for Testing and Materials (ASTM) Type II reagent water poured over or through non-dedicated sampling equipment, such as bailers, to verify the sampling techniques. The equipment blanks were collected and analyzed for the same chemical parameters as the groundwater samples. Equipment blanks were collected at a frequency of one blank for every 20 matrix samples.

A trip blank was shipped with each shipping container containing groundwater samples to be analyzed for volatile organics. This trip blank was analyzed for volatile organics to aid in determining if cross-contamination occurred during shipping. The trip blank consisted of ASTM Type II reagent water sealed into a sample vial in the field laboratory.

2.2.5 Subsurface Soil Investigation

Soil samples were collected every 5 feet from the surface to the total well depth at locations TOB-W11, TOB-W14, TOB-W15, and TOB-W16. The soil samples were analyzed for the presence of metals, volatile organics, semi-volatile organics, pH, and conductivity. Cores were collected from selected boreholes for physical descriptions, correlating with geophysical logs, and physical testing for engineering properties, including Atterburg limits and moisture content.

2.3 Evaluation and Selection of Chemicals of Potential Concern

The process of determining the chemicals of potential concern for the Soldier Creek Site included a detailed evaluation of the analytical data, a careful analysis of the sources of contamination and areas that the sources impact, and a review of site characteristics. This evaluation is consistent with the methods presented in the

RAGS manual (EPA, 1989a). This process includes gathering all available data from site investigations and sorting the data by medium, evaluating the analytical methods used, evaluating the quality of data with respect to sample quantitation limits, evaluating the quality of data with respect to qualifiers and codes, evaluating the quality of data with respect to blanks, comparing potential site-related contamination with background concentrations, developing a set of data for use in the risk assessment, and if appropriate, further limiting the number of chemicals to be carried through the risk assessment.

The objectives of this evaluation process are to identify a set of chemicals that are likely to be site-related and to affirm that reported concentrations are of acceptable quality for use in the quantitative risk assessment as presented in Section 5.0 of this report. Chemicals remaining in the quantitative risk assessment are referred to as "chemicals of potential concern."

Appendix A presents the data for each segment and medium followed by the rationale for the selection of chemicals of potential concern. Analytes and compounds that were undetected for a segment and medium were eliminated from the Appendix A tables. The compounds that were detected were eliminated for only two reasons: if they were a common laboratory contaminant and were detected only at concentrations of less than ten times blank values, or if metals were detected at levels that were not greater than three times the background levels determined from background sample location data presented in Appendix A. Table 2-1 (page 2-12) presents the chemicals of concern that were carried through the risk assessment process for each medium. It should be noted that "chromium" in this risk assessment is analagous to total chromium. Chromium III and chromium VI were not anlayzed separately.

For the risk assessment, the Soldier Creek Site was divided into nine stream segments based on stream morphology and sampling location as shown on Figure 2-1 (page 2-11). The primary reason the surface water and sediment evaluation is divided into these segments is to identify the areas of the stream containing the majority of the site risks. It should be emphasized that these segments are still quite large, most nearly 1/2 mile long. This approach also could facilitate, if necessary, a cleanup that is focused, resulting in the most benefit to human health and the environment. This

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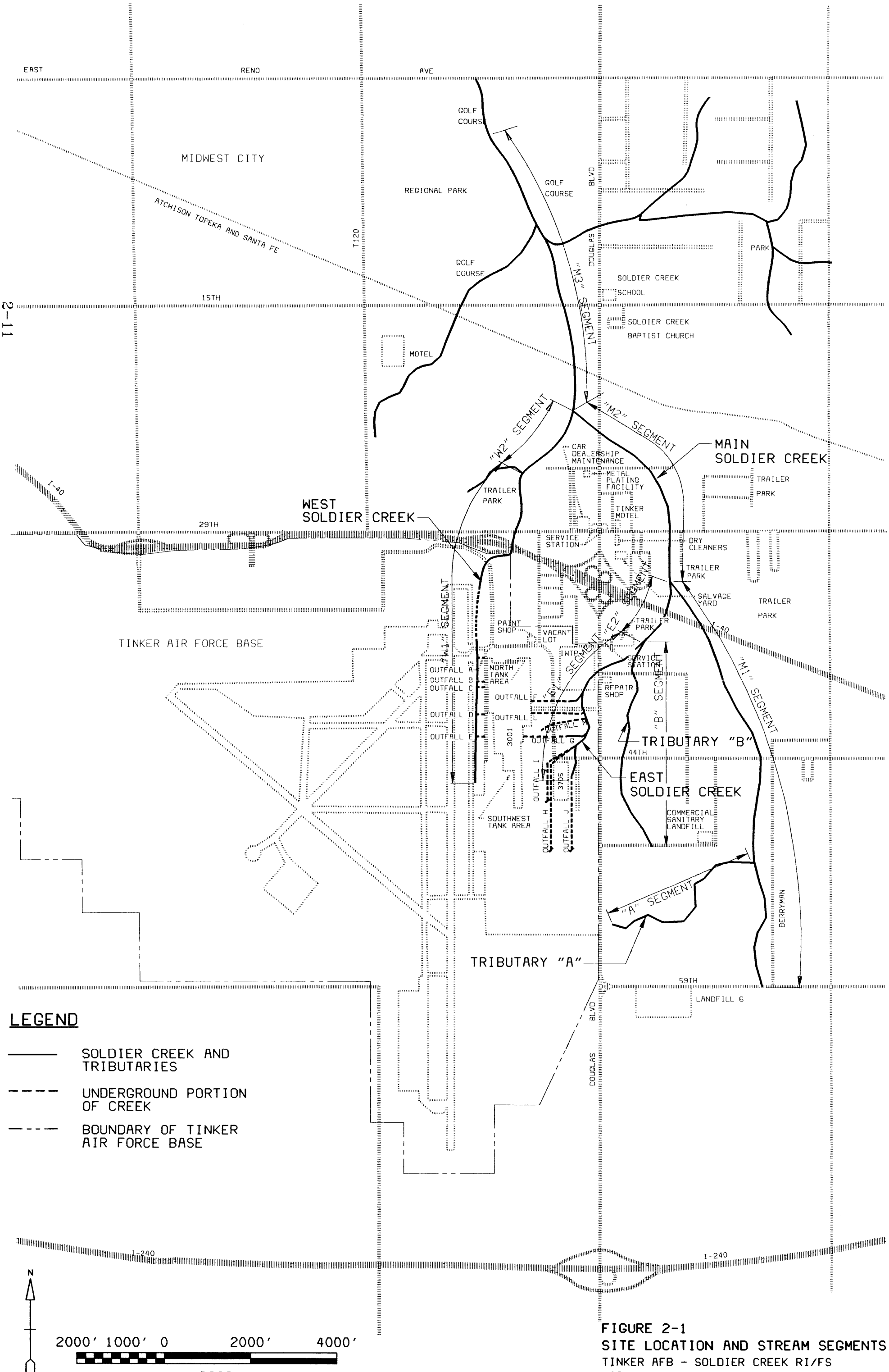

FIGURE 2-1
SITE LOCATION AND STREAM SEGMENTS
TINKER AFB - SOLDIER CREEK RI/FS

TABLE 2-1
CHEMICALS OF POTENTIAL CONCERN
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

GROUNDWATER - PERCHED AQUIFER	GROUNDWATER - REGIONAL AQUIFER ZONE	SURFACE WATER	SEDIMENT
VOLATILE ORGANICS	VOLATILE ORGANICS	VOLATILE ORGANICS	VOLATILE ORGANICS
1,1-DICHLOROETHENE	BENZENE	ACETONE	ACETONE
TRANS-1,2-DICHLOROETHENE	CHLOROBENZENE	BENZENE	BENZENE
TETRACHLOROETHENE	1,1-DICHLOROETHANE	BROMODICHLOROMETHANE	CARBON DISULFIDE
1,1,1-TRICHLOROETHANE	1,1-DICHLOROETHENE	BROMOFORM	CHLOROBENZENE
TRICHLOROETHENE	CIS-1,2-DICHLOROETHENE	CARBON DISULFIDE	CHLOROETHANE
SEMI-VOLATILE ORGANICS	TRANS-1,2-DICHLOROETHENE	CHLOROBENZENE	CHLOROFORM
BIS(2-ETHYLHEXYL)PHTHALATE	1,2-DICHLOROPROPANE	CHLOROFORM	1,2-DICHLOROETHENE (TOTAL)
METALS	METHYLENE CHLORIDE	DIBROMOCHLOROMETHANE	ETHYLBENZENE
ARSENIC	TETRACHLOROETHENE	1,2-DICHLOROETHENE (TOTAL)	METHYLENE CHLORIDE
BARIUM	1,1,1-TRICHLOROETHANE	METHYLENE CHLORIDE	TETRACHLOROETHENE
CHROMIUM	TRICHLOROETHENE	TETRACHLOROETHENE	TOLUENE
COPPER	1,2,4-TRIMETHYLBENZENE	TOLUENE	TRICHLOROETHENE
LEAD	VINYL CHLORIDE	1,1,1-TRICHLOROETHANE	VINYL ACETATE
NICKEL	SEMI-VOLATILE ORGANICS	TRICHLOROETHENE	XYLENE (TOTAL)
SELENIUM	1,2-DICHLOROBENZENE	XYLENE (TOTAL)	SEMI-VOLATILE ORGANICS
	1,4-DICHLOROBENZENE	SEMI-VOLATILE ORGANICS	2-METHYLPHENOL
	METALS	BENZO(G,H,I)PERYLENE	4-METHYLPHENOL
	BARIUM	BENZOIC ACID	2,4-DIMETHYLPHENOL
	LEAD	CHRYSENE	ACENAPHTHENE
	NICKEL	FLUORANTHENE	ANTHRACENE
	SELENIUM	PYRENE	BENZO(A)ANTHRACENE
		METALS	BENZO(B)FLUORANTHENE
		ALUMINUM	BENZO(K)FLUORANTHENE
		ARSENIC	BENZO(G,H,I)PERYLENE
		BARIUM	BENZO(A)PYRENE
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	BERYLLIUM	BIS(2-ETHYLHEXYL)PHTHALATE
		CADMIUM	BUTYLBENZYLPHTHALATE
	VOLATILE ORGANICS	CALCIUM	2-CHLORONAPHTHALENE
	BENZENE	CHROMIUM	CHRYSENE
	CHLOROBENZENE	COBALT	DIBENZ (A,H) ANTHRACENE
	CHLOROFORM	COPPER	DIBENZOFURAN
	1,1-DICHLOROETHANE	CYANIDE	1,3-DICHLOROBENZENE
	1,1-DICHLOROETHENE	IRON	1,4-DICHLOROBENZENE
	CIS-1,2-DICHLOROETHENE	LEAD	1,2-DICHLOROBENZENE
	TRANS-1,2-DICHLOROETHENE	MAGNESIUM	3,3'-DICHLOROBENZIDINE
	1,2-DICHLOROPROPANE	MANGANESE	DI-N-BUTYLPHTHALATE
	ETHYLBENZENE	NICKEL	DI-N-OCTYL PHTHALATE
	METHYLENE CHLORIDE	POTASSIUM	FLUORANTHENE
	TETRACHLOROETHENE	SELENIUM	FLUORENE
	1,1,1-TRICHLOROETHANE	SILVER	INDENO(1,2,3-CD)PYRENE
	TRICHLOROETHENE	SODIUM	NAPHTHALENE
	1,2,4-TRIMETHYLBENZENE	VANADIUM	2-METHYLNAPHTHALENE
	TOLUENE	ZINC	PHENANTHRENE
	VINYL CHLORIDE		PYRENE
	XYLENE (TOTAL)		METALS
	SEMI-VOLATILE ORGANICS		ALUMINUM
	BIS(2-ETHYLHEXYL)PHTHALATE		ARSENIC
	1,2-DICHLOROBENZENE		BARIUM
	1,3-DICHLOROBENZENE		CADMIUM
	1,4-DICHLOROBENZENE		CALCIUM
	DI-N-OCTYLPHTHALATE		CHROMIUM
	NAPHTHALENE		COBALT
	METALS		COPPER
	ARSENIC		CYANIDE
	BARIUM		IRON
	CHROMIUM		LEAD
	COPPER		MAGNESIUM
	LEAD		MANGANESE
	NICKEL		MERCURY
			NICKEL
			POTASSIUM
			SELENIUM
			SILVER
			VANADIUM
			ZINC

would result in the problem areas of the stream receiving appropriate remedial action, while segments that show little or no risk could be left alone. The segments include two on-base segments (E1 and W1) and seven off-base segments (A, B, E2, M1, M2, M3, and W2) with the following sample locations on each segment:

- A - Segment: All sampling locations along "A" segment of Main Soldier Creek, including A01, A02, and A03.

- B - Segment: All sampling locations along "B" segment of Main Soldier Creek, including B01, B02, and B03.

- E1 - Segment: Sampling locations along East Soldier Creek to the confluence of East and "B" segment of Soldier Creek, including E01 through E11.

- E2 - Segment: Sampling locations along East Soldier Creek to the confluence of East and Main Soldier Creek, including E12 and E13.

- M1 - Segment: Sampling locations along Main Soldier Creek, including M01 through M06.

- M2 - Segment: Sampling locations along Main Soldier Creek, including M07 through M09.

- M3 - Segment: Sampling locations along Main Soldier Creek, including M10 through M13.

- W1 - Segment: Sampling locations along West Soldier Creek to the confluence of West Soldier Creek and the unnamed tributary, including W01 through W07.

- W2 - Segment: Sampling locations along West Soldier Creek to the confluence of West and Main Soldier Creek, including W08 and W09.

A summary of the data used in the quantitative baseline risk assessment for the Soldier Creek Site is presented in Tables 2-2 through 2-31 (pages 2-15 through 2-44). The analytical data for groundwater was collected during Phase I of the Soldier Creek Site RI, the Off-Base Groundwater Investigation Northeast of Base (Tulsa COE, 1991a) and the IWTP remedial investigation (Tulsa COE, 1991b).

The Soldier Creek Site field investigation activities were conducted to determine the nature and extent of contamination in the surface water and sediments of the site. Surface soil, subsurface soil, and air sampling was not included as part of the approved scope of the Soldier Creek Site Phase I or Phase II field investigation. Since no data from these media were collected, surface soil, subsurface soil, and air exposure routes were not evaluated in this risk assessment.

TABLE 2-2
SUMMARY OF GROUNDWATER DATA - PERCHED AQUIFER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimun Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
1,1-DICHLOROETHENE	2/18	10	5	73.9	( )
TRANS-1,2-DICHLOROETHENE	2/18	10	5	54.0	( )
TETRACHLOROETHENE	5/18	10	1.4	2900.0	( )
1,1,1-TRICHLOROETHANE	1/18	10	2	5.0	NA
TRICHLOROETHENE	5/18	10	0.6	179000.0	( )
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	6/18	10	2	250.0	16.6
METALS					
ARSENIC	3/18	10	1.3	5.0	( )
BARIUM	18/18	200	14	1610.0	( )
CHROMIUM	7/18	10	5	128000.0	( )
COPPER	4/18	25	10	52.0	( )
LEAD	2/18	5	2.5	26.0	( )
NICKEL	4/18	40	18	43.2	( )
SELENIUM	4/18	5	1.3	10.0	( )

Data Qualifer Legend

( ) - Not Detected
NA - Not Analyzed For.

TABLE 2-3
SUMMARY OF GROUNDWATER DATA - TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimun Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Levels (ug/L)
VOLATILE ORGANICS					
BENZENE	5/31	10	0.7	5.8	( )
CHLOROBENZENE	14/52	10	2.54	1100.0	( ) - 3
CHLOROFORM	3/24	10	0.64	5.0	( )
1,1-DICHLOROETHANE	11/20	10	2	178.0	NA
1,1-DICHLOROETHENE	12/51	10	0.2	48.0	( )
CIS-1,2-DICHLOROETHENE	5/35	10	0.76	21.0	( )
TRANS-1,2-DICHLOROETHENE	14/51	10	0.3	2161.0	( )
1,2-DICHLOROPROPANE	4/36	10	3	73.0	( )
ETHYLBENZENE	4/33	10	0.61	6.1	( )
METHYLENE CHLORIDE	12/47	10	0.2	44.0	( ) - 1.9
TETRACHLOROETHENE	15/52	10	0.2	920.0	( ) - 1.4
1,1,1-TRICHLOROETHENE	11/38	10	0.2	150.0	( )
TRICHLOROETHENE	16/51	10	0.1	18000.0	( )
1,2,4-TRIMETHYLBENZENE	4/32	0.5	0.1	6.5	( )
TOLUENE	10/23	10	0.4	27.4	( )
VINYL CHLORIDE	8/51	10	0.8	1615.0	( )
XYLENE (TOTAL)	5/32	10	0.2	24.8	( )
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	24/37	10	2	1100.0	( ) - 64
1,2-DICHLOROBENZENE	6/52	10	1	420.0	( )
1,3-DICHLOROBENZENE	3/32	10	0.52	5.0	( )
1,4-DICHLOROBENZENE	9/52	10	1	220.0	( ) - 0.7
DI-N-OCTYLPHTHALATE	12/22	10	5	85.0	( ) - 13
NAPHTHALENE	1/22	10	1.3	5.0	( )
METALS					
ARSENIC	14/31	10	1.1	42.0	( ) - 3.4
BARIUM	47/51	200	79	3460.0	( ) - 816
CHROMIUM	26/51	10	5	6520.0	( ) - 27
COPPER	15/31	25	11	32.0	( ) - 28
LEAD	8/51	5	2	34.0	( )
NICKEL	21/51	40	20	305.0	( ) - 26

( ) - Not Detected
NA - Not Analyzed For.

TABLE 2-4
SUMMARY OF GROUNDWATER DATA - REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimun Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Levels (ug/L)
VOLATILE ORGANIC					
BENZENE	1/21	10	1.32	5	( )
CHLOROBENZENE	11/34	10	2	480	( )
1,1-DICHLOROETHANE	3/13	10	0.7	13	NA
1,1-DICHLOROETHENE	4/34	10	3.32	24	( )
CIS-1,2-DICHLOROETHENE	2/21	10	5	31.5	( )
TRANS-1,2-DICHLOROETHENE	10/34	10	0.96	113	( )
1,2-DICHLOROPROPANE	2/33	10	0.91	14	( )
METHYLENE CHLORIDE	12/34	10	0.2	98	( )
TETRACHLOROETHENE	7/34	10	1	200	( )
1,1,1-TRICHLOROETHANE	2/13	10	5	9	NA
TRICHLOROETHENE	16/34	10	0.88	1100	( )
1,2,4-TRIMETHYLBENZENE	1/21	0.5	0.25	0.88	( )
VINYL CHLORIDE	4/34	10	5	79	( )
SEMIVOLATILE ORGANICS					
1,2-DICHLOROBENZENE	5/34	10	2	150	( )
1,4-DICHLOROBENZENE	5/34	10	1	52	( )
METALS					
BARIUM	33/34	200	41	6060	254 - 405
LEAD	7/34	5	0.5	62	( )
NICKEL	13/34	40	18	272	( ) - 31
SELENIUM	1/21	5	5	6.8	( )

Data Qualifer Legend

( ) - Not Detected
NA - Not Analyzed For.

TABLE 2-5
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT A
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
NOT ANALYZED*					
SEMI-VOLATILE ORGANICS					
NOT ANALYZED*					
METALS					
NOT ANALYZED*					

Data Qualifier Legend

* - No surface water was present.

TABLE 2-6
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT B
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
NONE DETECTED*					
SEMI-VOLATILE ORGANICS					
NONE DETECTED*					
METALS					
ARSENIC	1/1	10	7.4	7.4	( )

Data Qualifier Legend

( ) - Not Detected.
* - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-7
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT E1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
BROMODICHLOROMETHANE	3/14	10	3	6	( )
BROMOFORM	3/14	10	4	15	( )
CARBON DISULFIDE	1/14	10	1	5	( )
CHLOROFORM	5/14	10	0.7	6	( )
DIBROMOCHLOROMETHANE	3/14	10	4	5	( )
TETRACHLOROETHENE	3/14	10	1	5	( )
1,1,1-TRICHLOROETHANE	1/14	10	2	5	( )
SEMI-VOLATILE ORGANICS					
BENZO(G,H,I)PERYLENE	1/13	10	5	6	( )
BENZOIC ACID	1/13	10	1	5	( )
CHRYSENE	1/13	10	5	5	( )
METALS					
ARSENIC	3/11	10	5	6.8	( )
CHROMIUM	14/14	10	11.4	156	( ) - 3.8
COPPER	7/11	25	12.5	242	( )
NICKEL	3/11	40	9.2	32.6	( )
SELENIUM	9/11	5	2.5	20.9	( )
SILVER	1/11	10	2.1	5	( )
VANADIUM	8/11	50	2	26	2.6

Data Qualifier Legend

( ) - Not Detected.

TABLE 2-8
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT E2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
ACETONE	1/4	10	5	60	( )
BENZENE	1/4	10	1	5	( )
METHYLENE CHLORIDE	2/4	10	3	620	( )
1,1,1-TRICHLOROETHANE	2/4	10	2	5	( )
TOLUENE	1/4	10	4	5	( )
XYLENE (TOTAL)	1/4	10	2	5	( )
SEMI-VOLATILE ORGANICS					
BENZOIC ACID	1/4	10	0.4	5	( )
METALS					
ALUMINUM	2/2	200	206	408	907
BARIUM	2/2	200	256	280	350
CADMIUM	1/4	5	2.5	9.4	( )
CALCIUM	2/2	5000	47000	47500	64300
CHROMIUM	4/4	10	18.2	34.9	3.8
IRON	2/2	100	162	346	1760
MAGNESIUM	2/2	3	21900	22100	21600
MANGANESE	2/2	5000	189	298	1000
POTASSIUM	2/2	15	5780	6290	921
SELENIUM	1/2	5000	2.5	5.8	( )
SODIUM	2/2	5	120000	130000	21400

Data Qualifier Legend

( ) - Not Detected.

TABLE 2-9
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT M1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
NONE DETECTED*					
SEMI-VOLATILE ORGANICS					
BENZOIC ACID	1/4	10	0.4	5	( )
METALS					
BARIUM	4/4	200	8.11	1900	350
CHROMIUM	2/4	10	5	14.1	3.8
LEAD	4/4	3	2.6	22.3	3.9

Data Qualifier Legend

( ) - Not Detected.
* - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-10
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT M2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
ACETONE	1/6	10	5	7	( )
BENZENE	1/6	10	2	5	( )
CARBON DISULFIDE	1/6	10	0.7	5	( )
CHLOROBENZENE	1/6	10	2	5	( )
1,1,1-TRICHLOROETHANE	3/6	10	1	5	( )
TRICHLOROETHENE	1/6	10	2	5	( )
TOLUENE	2/6	10	4	5	( )
SEMI-VOLATILE ORGANICS					
NONE DETECTED*					
METALS					
CADMIUM	3/3	5	1.1	2.5	( )
CHROMIUM	6/6	10	8.9	41.5	3.8
NICKEL	3/3	40	10.8	18.4	( )
SELENIUM	2/3	5	2.5	6.7	( )
SODIUM	3/3	5000	92100	122000	21400

Data Qualifier Legend

( ) - Not Detected.
* - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-11
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT M3
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
CHLOROFORM	2/4	10	2	5	( )
SEMI-VOLATILE ORGANICS					
NONE DETECTED*					
METALS					
CHROMIUM	4/4	10	12.7	41.1	3.8
CYANIDE	1/4	10	5	18	( )
POTASSIUM	4/4	5000	5360	5670	921
SELENIUM	4/4	5	3.7	6.8	( )
SODIUM	4/4	5000	76900	80900	21400

Data Qualifier Legend

( ) - Not Detected.
* - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-12
SUMMARY OF SURFACE WATER DATA RISK SEGMENT W1
TINKER AFB - SOLDIER CRE RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
CARBON DISULFIDE	1/8	10	1	5	( )
1,2-DICHLOROETHENE (TOTAL)	2/8	10	5	14	( )
TRICHLOROETHENE	1/8	10	2	5	( )
TETRACHLOROETHENE	1/8	10	1	5	( )
SEMI-VOLATILE ORGANICS					
FLUORANTHENE	1/5	10	1	5	( )
PYRENE	1/5	10	1	5	( )
METALS					
ALUMINUM	5/5	200	147	7430	907
BERYLLIUM	1/5	5	1	2.5	( )
CADMIUM	1/8	5	2.5	56.9	( )
CHROMIUM	6/8	10	5	628	3.8
COBALT	4/5	50	5.7	324	( )
COPPER	1/5	25	12.5	985	( )
CYANIDE	1/5	10	5	18	( )
IRON	5/5	100	66.9	8450	1730
LEAD	5/8	3	1.1	325	3.9
NICKEL	3/5	40	20	3560	( )
SELENIUM	2/5	5	2.2	7.8	( )
SILVER	1/5	10	5	13.1	( )
VANADIUM	4/5	50	15.2	67	2.6
ZINC	5/5	20	19.9	2400	24.5

Data Qualifier Legend

( ) - Not Detected.

TABLE 2-13
SUMMARY OF SURFACE WATER DATA - RISK SEGMENT W2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/L)	Minimum Concentration Detected (ug/L)	Maximum Concentration Detected (ug/L)	Background Level (ug/L)
VOLATILE ORGANICS					
NONE DETECTED*					
SEMI-VOLATILE ORGANICS					
NONE DETECTED*					
METALS					
CHROMIUM	1/1	10	5	31.2	3.8

Data Qualifier Legend

( ) - Not Detected.
* - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-14
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT A
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NOT ANALYZED**					
SEMI-VOLATILE ORGANICS					
NOT ANALYZED**					
METALS*					
NOT ANALYZED**					

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - No surface water was present.

TABLE 2-15
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT B
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NOT ANALYZED**					
SEMI-VOLATILE ORGANICS					
NOT ANALYZED**					
METALS*					
NOT ANALYZED**					

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - No surface water was present.

TABLE 2-16
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT E1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
CHLOROBENZENE	5/22	10	5	78000	( )
CHLOROETHANE	1/22	10	5	86	( )
CHLOROFORM	19/22	10	5	9200	5
1,2-DICHLOROETHENE (TOTAL)	3/22	10	5	180000	( )
METHYLENE CHLORIDE	19/22	10	5	140000	26
TETRACHLOROETHENE	2/22	10	5	83000	11
TOLUENE	2/22	10	5	980	6
VINYL ACETATE	1/22	10	0.9	5	( )
TRICHLOROETHENE	1/22	10	5	4100	( )
XYLENE (TOTAL)	2/22	10	1	1000	6
SEMI-VOLATILE ORGANICS					
2-METHYLPHENOL	1/21	330	68	165	( )
4-METHYLPHENOL	1/21	330	160	165	( )
2,4-DIMETHYLPHENOL	1/21	330	98	165	( )
ACENAPHTHENE	10/21	330	17	250	( )
ANTHRACENE	13/21	330	63	1500	( )
BENZO(A)ANTHRACENE	16/21	330	46	4800	( )
BENZO(B)FLUORANTHENE	16/21	330	28	5000	( )
BENZO(K)FLUORANTHENE	16/21	330	46	5300	( )
BENZO(G,H,I)PERYLENE	16/21	330	140	1300	( )
BENZO(A)PYRENE	18/21	330	27	4100	( )
BIS(2-ETHYLHEXYL)PHTHALATE	20/31	330	165	7000	120
BUTYLBENZYLPHTHALATE	2/21	330	29	165	( )
2-CHLORONAPHTHALENE	4/21	330	165	1600	( )
CHRYSENE	17/21	330	63	5400	( )
DIBENZ (A,H) ANTHRACENE	2/21	330	48	165	( )
DIBENZOFURAN	7/21	330	35	340	( )
1,3-DICHLOROBENZENE	2/21	330	64	280	( )
1,4-DICHLOROBENZENE	2/21	330	120	4400	( )
1,2-DICHLOROBENZENE	2/21	330	130	3100	( )
DI-N-BUTYLPHTHALATE	15/21	330	15	165	( )
DI-N-OCTYL PHTHALATE	13/21	330	14	380	( )
FLUORANTHENE	18/21	330	130	11000	( )
FLUORENE	4/21	330	73	165	( )
INDENO(1,2,3-CD)PYRENE	13/21	330	140	2100	( )
NAPHTHALENE	10/21	330	110	600	( )
2-METHYLNAPHTHALENE	9/21	330	14	1900	( )
PHENANTHRENE	19/21	330	51	6700	( )
PYRENE	19/21	330	130	10000	( )
METALS*					
BARIUM	21/21	100	271	2910	76.2
CADMIUM	26/29	2.5	0.84	428	2.08
CALCIUM	21/21	2500	1580	72500	4070
CHROMIUM	29/29	5	14.9	1230	9.6
COPPER	21/21	12.5	9	600	36.6
CYANIDE	2/29	2.5	0.25	6.5	( )
LEAD	29/29	1.5	7.1	586	54.3
MAGNESIUM	21/21	2500	1220	6880	( )
MANGANESE	21/21	7.5	116	1330	100
NICKEL	21/21	20	5.7	593	( )
SILVER	16/21	5	0.62	24.7	( )
ZINC	21/21	10	20.8	587	13.9

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-17
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT E2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
CHLOROFORM	4/13	10	4	24	( )
XYLENE (TOTAL)	2/13	10	0.7	5	( )
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	4/13	330	240	690	( )
DI-N-BUTYLPHTHALATE	2/13	330	14	165	( )
DI-N-OCTYL PHTHALATE	4/13	330	17	33	( )
FLUORANTHENE	1/13	330	83	165	( )
PYRENE	1/13	330	18	165	( )
METALS*					
BARIUM	4/4	100	153	993	76.2
CADMIUM	7/13	2.5	0.77	10.1	2.08
CHROMIUM	13/13	1.5	8.4	89	9.6

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-18
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT M1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	9/12	330	165	930	( )
METALS*					
ARSENIC	12/12	5	1.5	6.8	1.6
BARIUM	12/12	100	110	431	76.2
CADMIUM	2/12	2.5	1.25	53.4	2.08
CHROMIUM	12/12	5	7.1	829	9.60
MANGANESE	12/12	7.5	70.6	1090	1160
NICKEL	12/12	20	2.8	122	8.6
VANADIUM	12/12	25	9.5	43.8	9.4

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-19
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT M2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
BENZENE	1/20	10	1	5	( )
CHLOROFORM	7/20	10	0.6	6	( )
TETRACHLOROETHENE	1/20	10	2	5	11
XYLENE (TOTAL)	2/20	10	1	6	( )
SEMI-VOLATILE ORGANICS					
BENZO(A)PYRENE	1/6	330	140	330	( )
BIS(2-ETHYLHEXYL)PHTHALATE	6/6	330	90	670	( )
DI-N-BUTYLPHTHALATE	2/6	330	23	165	( )
DI-N-OCTYL PHTHALATE	2/6	330	18	165	( )
FLUORANTHENE	1/6	330	26	165	( )
METALS*					
BARIUM	6/6	100	214	488	76.2
CADMIUM	8/20	2.5	0.99	32.6	2.08
CALCIUM	6/6	2500	1380	32300	4070
CHROMIUM	20/20	5	4.6	650	9.6
MANGANESE	6/6	7.5	123	840	100
MERCURY	1/6	0.1	0.05	0.28	0.06

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-20
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT M3
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
CHLOROBENZENE	1/8	10	5	8	( )
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	7/8	330	165	1400	( )
METALS*					
BARIUM	8/8	100	118	692	( ) - 76.2

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-21
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT W1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
CARBON DISULFIDE	2/20	10	0.9	36	( )
CHLOROFORM	14/20	10	2	45	( )
ETHYLBENZENE	2/20	10	3	5	( )
TETRACHLOROETHENE	2/20	10	3	5	11
TOLUENE	5/20	10	5	620	6
XYLENE (TOTAL)	3/20	10	2	69	( )
SEMI-VOLATILE ORGANICS					
ACENAPHTHENE	3/12	330	69	1100	( )
ANTHRACENE	6/12	330	59	1000	( )
BENZO(A)ANTHRACENE	6/12	330	165	4200	( )
BENZO(B)FLUORANTHENE	5/12	330	165	9200	( )
BENZO(K)FLUORANTHENE	3/12	330	165	1400	( )
BENZO(A)PYRENE	6/12	330	160	4400	( )
BENZO(G,H,I)PERYLENE	4/12	330	120	4100	( )
BIS(2-ETHYLHEXYL)PHTHALATE	10/12	330	60	46000	( )
BUTYLBENZYLPHTHALATE	1/12	330	165	720	( )
CHRYSENE	7/12	330	165	7100	( )
DIBENZOFURAN	2/12	330	165	480	( )
1,3-DICHLOROBENZENE	1/12	330	165	210	( )
1,4-DICHLOROBENZENE	1/12	330	165	2200	( )
1,2-DICHLOROBENZENE	1/12	330	165	220	( )
3,3'-DICHLOROBENZIDINE	1/12	330	165	1700	( )
DI-N-BUTYLPHTHALATE	3/12	330	165	2200	( )
DI-N-OCTYL PHTHALATE	2/12	330	165	250	( )
FLUORANTHENE	9/12	330	95	11000	( )
FLUORENE	3/12	330	110	880	( )
INDENO(1,2,3-CD)PYRENE	5/12	330	100	3800	( )
2-METHYLNAPHTHALENE	2/12	330	165	800	( )
NAPHTHALENE	3/12	330	44	690	( )
PHENANTHRENE	9/12	330	15	6000	( )
PYRENE	7/12	330	110	4600	( )
METALS*					
ALUMINUM	12/12	100	423	42300	4060
ARSENIC	7/12	5	0.97	5.7	1.6
BARIUM	12/12	100	63	1120	76.2
CADMIUM	17/21	2.5	1	93.4	2.08
CALCIUM	12/12	2500	1170	41500	4070
CHROMIUM	21/21	5	11.6	2020	9.6
COBALT	11/12	25	4.5	52.1	3.1
COPPER	12/12	12.5	6.6	320	36.6
LEAD	21/21	1.5	3.2	243	54.3
MAGNESIUM	12/12	2500	179	15400	1160
MANGANESE	12/12	7.5	8.8	956	100
MERCURY	8/12	0.1	0.05	1.4	0.06
NICKEL	12/12	20	4.9	2270	8.6
POTASSIUM	12/12	2500	99.3	2300	552
SELENIUM	4/12	2.5	0.56	10.2	0.25
SILVER	7/12	5	0.49	112	0.91
VANADIUM	12/12	25	2.9	52.9	9.4
ZINC	12/12	10	13.9	640	13.9

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-22
SUMMARY OF 0-5' SEDIMENT DATA - RISK SEGMENT W2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
ACENAPHTHENE	1/4	330	83	165	( )
ANTHRACENE	1/4	330	44	165	( )
BENZO(A)ANTHRACENE	1/4	330	140	165	( )
BENZO(B)FLUORANTHENE	1/4	330	165	190	( )
BENZO(K)FLUORANTHENE	1/4	330	165	180	( )
BENZO(A)PYRENE	1/4	330	160	165	( )
BIS(2-ETHYLHEXYL)PHTHALATE	4/4	330	970	4200	( )
CHRYSENE	1/4	330	165	210	( )
DI-N-OCTYL PHTHALATE	1/4	330	110	165	( )
FLUORANTHENE	2/4	330	98	420	( )
FLUORENE	1/4	330	76	165	( )
2-METHYLNAPHTHALENE	2/4	330	25	1300	( )
NAPHTHALENE	1/4	330	82	165	( )
PHENANTHRENE	2/4	330	59	260	( )
PYRENE	2/4	330	91	530	( )
METALS*					
BARIUM	4/4	100	167	426	76.2
CADMIUM	1/5	2.5	1.25	12.7	2.08
CALCIUM	4/4	2500	1530	43300	4070
CHROMIUM	4/4	5	0	527	9.6
MAGNESIUM	4/4	2500	1360	14500	1160
MERCURY	1/4	0.1	0.05	2.6	0.06
SILVER	1/4	5	2.5	4.6	0.91

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-23
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT A
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
BENZO(A)ANTHRACENE	1/3	330	45	165	( )
BENZO(B)FLUORANTHENE	1/3	330	120	165	( )
BENZO(K)FLUORANTHENE	1/3	330	165	230	( )
BIS(2-ETHYLHEXYL)PHTHALATE	2/3	330	165	520	( )
CHRYSENE	1/3	330	165	190	( )
DI-N-BUTYLPHTHALATE	1/3	330	20	165	( )
FLUORANTHENE	1/3	330	165	210	( )
PYRENE	1/3	330	165	190	( )
METALS*					
BARIUM	3/3	100	130	386	64.4
MANGANESE	3/3	7.5	123	444	100
ZINC	3/3	10	6.7	51.9	13.9

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-24
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT B
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
ACETONE	2/3	10	5	1700	( )
CHLOROFORM	2/3	10	4	28	( )
METHYLENE CHLORIDE	2/3	10	5	100	( )
TOLUENE	1/3	10	2	5	( )
SEMI-VOLATILE ORGANICS					
ANTHRACENE	1/3	330	10	165	( )
BIS(2-ETHYLHEXYL)PHTHALATE	3/3	330	190	670	( )
BUTYLBENZYLPHTHALATE	1/3	330	76	165	( )
DI-N-BUTYLPHTHALATE	2/3	330	27	165	( )
DI-N-OCTYL PHTHALATE	1/3	330	25	165	( )
FLUORANTHENE	2/3	330	26	165	( )
PHENANTHRENE	2/3	330	9	165	( )
PYRENE	1/3	330	110	165	( )
METALS*					
BARIUM	3/3	100	215	973	64.4
CHROMIUM	3/3	5	12	84.8	8.4
LEAD	3/3	1.5	2.2	29.6	6.7
MANGANESE	3/3	7.5	364	388	100
ZINC	3/3	10	27.3	130	13.9

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-25
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT E1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
CHLOROBENZENE	3/11	10	5	78000	( )
CHLOROETHANE	1/11	10	5	86	( )
CHLOROFORM	11/11	10	5	9200	( )
1,2-DICHLOROETHENE (TOTAL)	2/11	10	5	180000	( )
METHYLENE CHLORIDE	8/11	10	5	140000	( )
TRICHLOROETHENE	2/11	10	5	4100	( )
TETRACHLOROETHENE	1/11	10	5	83000	( )
XYLENE (TOTAL)	2/11	10	4	1000	( )
VINYL ACETATE		10	0.9	5	
SEMI-VOLATILE ORGANICS					
ACENAPHTHENE	6/11	330	17	250	( )
ANTHRACENE	9/11	330	63	1500	( )
BENZO(A)ANTHRACENE	7/11	330	46	4800	( )
BENZO(B)FLUORANTHENE	8/11	330	39	5000	( )
BENZO(K)FLUORANTHENE	8/11	330	46	5300	( )
BENZO(G,H,I)PERYLENE	8/11	330	140	1300	( )
BENZO(A)PYRENE	11/11	330	27	4100	( )
BIS(2-ETHYLHEXYL)PHTHALATE	11/11	330	280	5000	( )
BUTYLBENZYLPHTHALATE	1/11	330	29	165	( )
2-CHLORONAPHTHALENE	3/11	330	165	1600	( )
CHRYSENE	11/11	330	63	5400	( )
DIBENZOFURAN	5/11	330	35	340	( )
1,3-DICHLOROBENZENE	1/11	330	64	165	( )
1,4-DICHLOROBENZENE	1/11	330	120	165	( )
1,2-DICHLOROBENZENE	1/11	330	130	165	( )
DI-N-BUTYLPHTHALATE	7/11	330	20	165	( )
DI-N-OCTYLPHTHALATE	7/11	330	30	380	( )
FLUORANTHENE	11/11	330	130	11000	( )
FLUORENE	3/11	330	73	165	( )
INDENO(1,2,3-CD)PYRENE	7/11	330	140	2100	( )
2-METHYLNAPHTHALENE	3/11	330	29	630	( )
NAPHTHALENE	5/11	330	165	460	( )
PHENANTHRENE	11/11	330	51	6700	( )
PYRENE	11/11	330	130	10000	( )
METALS*					
ARSENIC	11/11	5	1.3	9.7	1.6
BARIUM	11/11	100	271	2910	64.4
CADMIUM	11/11	2.5	1.3	324	1
CHROMIUM	11/11	5	15.6	1190	8.4
COBALT	11/11	25	3.5	17.3	3.1
COPPER	11/11	12.5	12.3	600	36.6
CYANIDE	1/11	2.5	1.25	6.5	( )
IRON	11/11	50	3750	41200	5780
LEAD	11/11	1.5	12.5	586	6.7
MAGNESIUM	11/11	2500	1660	5820	1160
MANGANESE	11/11	7.5	118	1000	100
MERCURY	5/11	0.1	0.05	2.6	0.06
NICKEL	11/11	20	5.7	325	8
SELENIUM	6/11	2.5	0.69	6.6	0.25
SILVER	8/11	5	1.1	24.7	0.53
VANADIUM	11/11	25	9.8	50.6	9.4
ZINC	11/11	10	26.3	587	13.9

Data Qualifier Legend

( ) - Not Detected.

* - Metals are in units of mg/kg.

TABLE 2-26
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGME 2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	2/2	330	240	690	( )
FLUORANTHENE	1/2	330	83	165	( )
PYRENE	1/2	330	18	165	( )
METALS*					
BARIUM	2/2	100	192	993	64.4
CHROMIUM	2/2	5	11.6	59.3	8.4

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-27
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT M1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	4/6	330	165	750	( )
METALS*					
ARSENIC	6/6	5	1.5	6.8	1.6
BARIUM	6/6	100	188	431	64.4
CADMIUM	1/6	2.5	1.25	53.4	1
CHROMIUM	6/6	5	7.4	829	8.4
LEAD	6/6	1.5	5.4	63.6	6.7
MANGANESE	6/6	7.5	99.8	1090	1160
NICKEL	6/6	20	6.8	110	8
SILVER	5/6	5	0.77	14.5	0.53
VANADIUM	6/6	25	13.1	43.8	9.4

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-28
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT M2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
BENZO(A)PYRENE	1/3	330	165	330	( )
BIS(2-ETHYLHEXYL)PHTHALATE	3/3	330	90	670	( )
DI-N-BUTYLPHTHALATE	1/3	330	30	165	( )
DI-N-OCTYL PHTHALATE	1/3	330	19	165	( )
METALS*					
BARIUM	3/3	100	214	488	64.4
CALCIUM	3/3	2500	2030	22600	4070
CHROMIUM	3/3	5	20.9	38.5	8.4
MANGANESE	3/3	7.5	124	840	100

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-29
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT M3
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
BIS(2-ETHYLHEXYL)PHTHALATE	3/4	330	165	380	( )
METALS*					
BARIUM	4/4	100	162	692	64.4

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

TABLE 2-30
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT W1
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
ACETONE	5/6	10	5	240	( )
CARBON DISULFIDE	1/6	10	5	36	( )
ETHYLBENZENE	1/6	10	4	5	( )
TOLUENE	3/6	10	4	150	( )
XYLENE (TOTAL)	1/6	10	5	60	( )
SEMI-VOLATILE ORGANICS					
ACENAPHTHENE	1/6	330	165	1100	( )
ANTHRACENE	2/6	330	59	1000	( )
BENZO(A)ANTHRACENE	2/6	330	165	4200	( )
BENZO(B)FLUORANTHENE	3/6	330	165	9200	( )
BENZO(K)FLUORANTHENE	2/6	330	165	1400	( )
BENZO(G,H,I)PERYLENE	3/6	330	120	4100	( )
BENZO(A)PYRENE	3/6	330	160	4400	( )
BIS(2-ETHYLHEXYL)PHTHALATE	5/6	330	60	46000	( )
BUTYLBENZYLPHTHALATE	1/6	330	165	720	( )
CHRYSENE	3/6	330	165	7100	( )
DIBENZOFURAN	1/6	330	165	480	( )
1,3-DICHLOROBENZENE	1/6	330	165	210	( )
1,4-DICHLOROBENZENE	1/6	330	165	2200	( )
1,2-DICHLOROBENZENE	1/6	330	165	220	( )
3,3'-DICHLOROBENZIDINE	1/6	330	165	1700	( )
DI-N-BUTYLPHTHALATE	2/6	330	165	2200	( )
DI-N-OCTYLPHTHALATE	1/6	330	165	250	( )
FLUORANTHENE	5/6	330	95	11000	( )
FLUORENE	1/6	330	165	880	( )
INDENO(1,2,3-CD)PYRENE	3/6	330	100	3800	( )
2-METHYLNAPHTHALENE	1/6	330	165	800	( )
NAPHTHALENE	1/6	330	165	690	( )
PHENANTHRENE	5/6	330	15	6000	( )
PYRENE	3/6	330	110	3300	( )
METALS*					
BARIUM	6/6	100	63	605	64.4
CADMIUM	4/6	2.5	1	93.4	1
CALCIUM	6/6	2500	1170	24800	4070
CHROMIUM	6/6	5	11.6	2020	8.4
COBALT	5/6	25	4.8	52.1	3.1
COPPER	6/6	50	7.9	320	36.6
LEAD	6/6	1.5	3.2	243	6.7
MAGNESIUM	6/6	2500	179	15400	1160
MANGANESE	6/6	7.5	8.8	956	100
MERCURY	4/6	5	0.12	2.5	0.06
NICKEL	6/6	20	4.9	2270	8
POTASSIUM	6/6	2500	99.3	2300	552
SELENIUM	2/6	2.5	0.56	2.3	0.25
SILVER	3/6	5	0.7	112	0.53
ZINC	6/6	10	13.9	543	13.9

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.

TABLE 2-31
SUMMARY OF 0-6" SEDIMENT DATA - RISK SEGMENT W2
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit (ug/kg)	Minimum Concentration Detected (ug/kg)	Maximum Concentration Detected (ug/kg)	Background Level (ug/kg)
VOLATILE ORGANICS					
NONE DETECTED**					
SEMI-VOLATILE ORGANICS					
ACENAPHTHENE	1/2	330	83	165	()
ANTHRACENE	1/2	330	44	165	()
BENZO(A)ANTHRACENE	1/2	330	140	165	()
BENZO(B)FLUORANTHENE	1/2	330	165	190	()
BENZO(K)FLUORANTHENE	1/2	330	165	180	()
BENZO(A)PYRENE	1/2	330	160	165	()
BIS(2-ETHYLHEXYL)PHTHALATE	2/2	330	4000	4200	()
CHRYSENE	1/2	330	165	210	()
FLUORANTHENE	1/2	330	165	420	()
FLUORENE	1/2	330	76	165	()
2-METHYLNAPHTHALENE	1/2	330	165	1300	()
NAPHTHALENE	1/2	330	82	165	()
PHENANTHRENE	1/2	330	165	260	()
PYRENE	1/2	330	165	530	()
METALS*					
BARIUM	2/2	100	252	426	64.4
CADMIUM	1/2	2.5	1.25	12.7	1
CALCIUM	2/2	2500	2900	39600	4070
CHROMIUM	2/2	5	20.9	527	8.4
LEAD	2/2	1.5	3.5	55	6.7
MAGNESIUM	2/2	2500	1630	6940	1160
MANGANESE	2/2	7.5	241	424	100
NICKEL	2/2	20	21.3	36	8
SILVER	1/2	5	2.5	4.6	0.53

Data Qualifier Legend

( ) - Not Detected.
* - Metals are in units of mg/kg.
** - RI Report, Appendix B, Volume 3, BVWST, 1992.

3.0 EXPOSURE ASSESSMENT

3.1 Overview of Exposure Assessment

The objective of the exposure assessment is to estimate the type and magnitude of exposures to the chemicals of potential concern that are present at or migrating from a site. The results of the exposure assessment are then combined with chemical-specific toxicity information to characterize potential risk (EPA, 1989a). The assessment of exposures presented in this section is based upon and consistent with current EPA guidance on risk assessment. The Office of Solid Waste and Emergency Response (OSWER) directive entitled "Standard Default Exposure Factors," issued on March 25, 1991, was the primary source used to derive exposure parameters (OSWER, 1991).

The exposure assessment process involved four main steps, characterization of the exposure setting, identification of the exposure pathways, quantification of the exposure, and identification of uncertainties in the exposure assessment.

3.2 Characterization of the Exposure Settings

3.2.1 Physical Setting

Tinker AFB lies within an area representing a transition from residential and industrial/commercial land use on the north and west to agricultural land use to the east and south. Soldier Creek, which flows northwest through the area, appears to be bordered mainly by recreational and residential areas with some supporting commercial and industrial land use (Midwest City, 1984, and Oklahoma City, date unknown). Drainage into West Soldier Creek flows north from Tinker AFB through mostly residential areas. Some industry is present within the Soldier Creek drainage basin. Three schools, Soldier Creek Elementary, Steed Elementary, and Monroney Junior High exist within the drainage basin.

Tinker AFB is in a regional area characterized by nearly level to gently rolling hills, broad flat plains, and well-entrenched main streams. Local relief is primarily the result of dissection by erosional activity and stream channel development. At Tinker AFB, ground elevations range from 1,210 feet (on the northwest portion of the Base)

to about 1,320 feet mean sea level (at the southeast corner of the Base) (Radian, 1985).

The principal surface water drainage ways for Tinker AFB are Crutcho, Kuhlman, and Soldier Creeks. The extreme southern part of the Base is drained by Elm Creek, an intermittent stream, that flows to the south and discharges into Stanley Draper Lake. Most of the Base is drained by Crutcho Creek and its tributary, Kuhlman Creek. Crutcho Creek flows to the north and northwest and discharges into the North Canadian River. Soldier Creek, the focus of this study, is mainly to the east of Tinker AFB. Soldier Creek flows to the north and discharges into Crutcho Creek approximately three miles upstream of the confluence of Crutcho Creek and the North Canadian River. Two tributaries of Soldier Creek receive surface water drainage from the eastern portion of Tinker AFB. East Soldier Creek, located on Tinker AFB, collects runoff from roads, parking areas, and buildings on the eastern portion of the Base, as well as discharge from several storm drains from the Building 3001 area. NPDES permitted discharges from the industrial wastewater and sewage treatment plants are also released into East Soldier Creek. West Soldier Creek, also located on Tinker AFB, collects runoff from the runaway system and receives storm drain discharges from Building 3001.

The following information summarizes the various species of mammals, birds, insects, aquatic life, and plants present on and around Tinker AFB. Information was obtained from the "F16 Beddown Environmental Assessment" prepared by Argonne National Laboratories for Tinker AFB (Tulsa COE, 1988a) and from the Oklahoma Natural Heritage Inventory (ONHI, 1989).

Several federally listed threatened or endangered bird species may occasionally occur in the Tinker AFB area. The threatened species are the Arctic peregrine falcon and piping plover. The endangered species are the bald eagle, American peregrine falcon, whooping crane, and the interior population of the least tern. However, the potential for the occurrence of these species in the immediate vicinity of Tinker AFB is low because preferred habitat and known areas of congregation for these species are not located near the Base (Tulsa COE, 1988a).

Although no endangered plant species have been reported for the Tinker AFB area (Township 11 North (T11N), Range 2 West (R2W), Oklahoma County), three species should be given special attention because of potential endangered and threatened species listing in the future. Two populations of the Oklahoma Beardtongue (*Penstemon oklahomensis*) were confirmed within T11N, R2W, Oklahoma County. Because this plant species is suffering a decline in population caused by loss of habitat, it is currently being studied to determine if it should be petitioned for inclusion on the U.S. Fish and Wildlife Service's list of endangered or threatened species (ONHI, 1989). Ozark poverty grass (*Sporobolus ozarkanus*) and a sedge (*Carex fissa*) are candidate 2 species for federal listing as endangered or threatened species.

Although no populations of Ozark poverty grass or (*Carex fissa*) are confirmed within T11N, R2W, Oklahoma County, this area is within the known range of the species (ONHI, 1989).

One species of insect that is unconfirmed in the area, but is likely to occur in a habitat similar to Oklahoma Beardtongue, is the Prairie Mole Cricket (*Gryllotalpa major*). It is a Candidate 2 species for federal listing (ONHI, 1989).

Mammals common to habitats at Tinker AFB include the eastern fox squirrel, thirteen-lined ground squirrel, plains pocket gopher, eastern cottontail rabbit, white-footed mouse, striped skunk, raccoon, opossum, Norway rat, and the house mouse. The habitats most suited for wildlife occur primarily in mowed grassy fields and undeveloped areas associated with drainages (Tulsa COE, 1988a).

The most common species of birds from the Oklahoma City area that are common to habitat types occurring at Tinker AFB are the Canada goose, killdeer, rock dove, mourning dove, common night hawk, chimney swift, scissor-tailed flycatcher, American crow, American robin, European starling, common grackle, and the house sparrow. The area is in the central flyway for migratory waterfowl (Tulsa COE, 1988a).

Creeks and ponds constitute the aquatic habitats on Tinker AFB. Ponds are managed for largemouth bass and channel catfish. Other fish that could occur in these habitats include red shiner, plains minnow, carp, black bullhead, green sunfish and bluegill (Tulsa COE, 1988a). These ponds are located on the west side of Tinker Air Force Base, west of West Soldier Creek. The ponds are upgradient of the Site and are not impacted by Soldier Creek.

Most of the on-base vegetated areas are mowed and landscaped. Little natural habitat exists. The varieties of grass present include bluestem, poverty grass, triple awn, and Johnson. Scattered trees and shrubs occur around many buildings and the golf course and on less developed portions of the Base. The largest wooded habitats occur along the watercourses. Woody species include oaks, elms, willows, cottonwoods, box elders, sycamores, redbuds, ashes, and sumacs (Tulsa COE, 1988a).

As described in the geology and hydrogeology assessment presented in Section 3.0 of the RI report (BVWST, 1993), the geology at the Soldier Creek Site consists of interbedded sandstone, siltstone, and shale layers overlain by a thin veneer of soil at most locations. Bedrock is exposed at some locations along East, West, and Main Soldier Creeks. Where sediments exist, they are composed of sand, silt, and clay.

Previous investigations have focused on three primary aquifer systems at Tinker AFB. From shallowest to deepest in elevation, these include the perched aquifer if present, top of regional aquifer zone, and regional aquifer zone. The three units have average depths below the ground surface of 15, 30, and 110 feet respectively. Groundwater in the perched aquifer flows semi-radially to the north, northeast, and northwest, from a groundwater mound under Building 3001 that extends to the northeast towards the IWTP. The hydraulic conductivity of the perched aquifer is 1.0×10^{-2} cm/sec. In the vicinity of Soldier Creek, groundwater in the top of regional aquifer zone flows to the northwest, west, and southwest from a high centered over East Soldier Creek near its exit from the Base. The hydraulic conductivity of the top of regional aquifer zone is 9×10^{-4} cm/sec. Because of a groundwater high in the northeast portion of the Base that extends to Interstate 40, groundwater in the regional aquifer zone appears to flow to the west, east, and northeast. The hydraulic conductivity in the regional aquifer zone is 3.5×10^{-4} cm/sec.

The perched aquifer is perched upon a shale layer that appears to be discontinuous across the Soldier Creek Site. This shale layer is interbedded with a shaley siltstone at some locations, particularly East Soldier Creek. In general, the shale is silty and blocky. Vertical migration rates of approximately 6 feet per year are estimated to occur between the perched and top of regional aquifer zone (Tulsa COE, 1988a). Horizontal flow in the perched aquifer migrates at a rate of approximately 41 feet per year (Tulsa COE, 1991a).

The top of regional aquifer zone is characterized as a semi-confined, leaky aquifer. Horizontal flow in this zone migrates at a rate of 27 feet per year (Tulsa COE, 1991a). Impermeable layers between the top of regional and regional aquifer zones are laterally discontinuous across the Soldier Creek Site. At areas where an impermeable layer is not present, there is open hydraulic communication between the zones. Similar groundwater flow patterns and consistent groundwater chemical data between the zones indicates that the zones interact freely. On a local scale, shale units act as barriers to vertical groundwater migration but may not extend laterally for large horizontal distances. This would allow the water, and possibly contaminants, to move downward through a series of lateral movements (Tulsa COE, 1991b). The vertical and horizontal migration rates in the regional aquifer zone are approximately 4 - 6 feet and 7.5 feet per year, respectively.

Meteorological information for the Soldier Creek Site was compiled from weather data for the years 1956 through 1989 recorded at the Will Rogers World Airport (National Climatic Data Center, 1989, 1988, and 1985). The Will Rogers World Airport is approximately 10 miles west of Tinker AFB, as shown on Figure 1-1 (page 1-2). The meteorological information from Will Rogers World Airport was supplemented by weather data recorded at Tinker AFB for the years 1981 through 1990 (Tinker AFB, 1981-1990).

The mean annual precipitation for Will Rogers World Airport is 32.15 inches based on data from 1981 through 1990. From 1981 to 1990, the average annual precipitation was 39.20 inches for Will Rogers World Airport and 40.33 inches for Tinker AFB, which is slightly greater than the long-term mean. The difference in reported annual precipitation for the two airports ranged from 2.5 to 17.8 percent

over the eight-year period, with Tinker AFB typically reporting higher annual precipitation than Will Rogers World Airport.

According to data for Will Rogers World Airport, the highest average monthly precipitation is 5.21 inches and occurs in May. June, September, and April also have relatively high average precipitation with 4.00, 3.23, and 3.18 inches, respectively. Months with lowest average monthly precipitation are January, February, and December with averages 1.26, 1.27, and 1.49 inches, respectively. The average monthly precipitation for the remainder of the year is between approximately 2 to 3 inches.

Snowfall typically occurs in the months of November through March with only trace amounts falling in October and April. The average yearly snowfall is 9.4 inches with the majority falling in January (average 3.1 inches) and February (average 2.6 inches).

The average annual temperature recorded at Will Rogers World Airport is 60.1 Fahrenheit (F). The warmest months of the year are June and July with mean temperatures of 81.6 F and 81.3 F, respectively. The coldest months are January and December with mean temperatures of 36.9 F and 39.8, respectively. The normal daily maximum temperatures are highest in July (93.5 F) and August (92.8 F) and lowest in January (25.2 F), February (29.4 F), and December (29.1 F). This corresponds with the mean number of days per month with temperatures over 90 F. Both July and August have an average of approximately 23 days over 90 F. January and December have an average of over 20 days each with minimum temperatures below 32 F. The highest recorded temperature, 110 F, occurred in August 1980. The lowest recorded temperature, -4 F, occurred in January 1988.

The annual mean wind speed is 12.4 miles per hour (mph) from the south-southeast. During January and February the prevailing wind direction is from the north. During the months of November and December, the prevailing wind direction is from the south. Highest mean monthly wind speeds occur in March and April with magnitudes of 14.6 and 14.4 mph, respectively. The prevailing wind direction during these months is from the south-southeast.

3.2.2 Potentially Exposed Populations Relative Location with Respect to Site

Human populations that may be exposed to onsite contaminants include workers working in and around the creek installing or repairing pipelines that pass under Soldier Creek. The workers could come in contact with contaminated water in Soldier Creek and sediment around the creek.

Human populations that may be exposed to contaminants from Soldier Creek off-site include residents that live near the site and residents that are involved in recreational activities near the site.

The potential exists that future land use activities would alter current exposure scenarios. Future onsite populations that could potentially be exposed include employees working onsite and residents living on the site.

Residential development of the areas around the site is possible and is the most conservative future population. Therefore, future off-site populations that could be exposed include residents living near the site and residents with wells screened downgradient of the site.

3.3 Identification of Exposure Pathways

3.3.1 Sources and Mechanisms of Chemical Release to the Environment

The sources of contaminant release for the Soldier Creek Site are described in the RI report (BVWST, 1993). There are on-base and off-base potential sources of contamination. The on-base sources of contamination include the outfalls from Building 3001, Building 3001, southwest tank area, north tank area, and the IWTP. The outfalls from Building 3001 have been rerouted to prevent dicharge to East and West Solider Creek. The remediation design for the cleanup of Building 3001 has been completed and construction of the groundwater treatment plant has begun with a planned completion date of February 15, 1993. The southwest tank area is presently being investigated in accordance with underground storage tank regulations. The north tank area has been identified as a separate operable unit and is presentely being investigated. The IWTP currently discharges treated waters to East Soldier Creek under an NPDES permit and an RI is being performed at the IWTP. The off-base potential sources of contamination include a paint shop, vacant lot (former site of trailer park), auto repair shop, service stations, and a salvage yard. All of the off-

base potential sources of contamination except the vacant lot are currently in operation.

The evaluation of a contaminant release and transport mechanism here does not necessarily imply that a complete exposure pathway related to the mechanism evaluated exists. The chemicals of potential concern for the Soldier Creek Site include volatile and semi-volatile organic compounds and metals. The following five transport mechanisms are most likely to occur:

- Leaching from contaminated sediment.
- Excavation of contaminated sediment (future land use).
- Surface water runoff.
- Groundwater flow (present and future).
- Groundwater seepage to surface water.

3.3.2 Fate and Transport of Chemicals of Potential Concern

The fate and transport characteristics for the chemicals of potential concern that are the primary risk contaminants for the Soldier Creek Site are presented in Appendix D. This information was used in evaluating the potential for site contaminants to migrate from the sources of contamination to some point of exposure.

3.3.3 Exposure Pathways and Routes

Exposure pathways describe the movement of contaminants from sources to exposure points where exposed populations (receptors) come in contact with the contaminant. This movement usually involves the release of contaminants from the source to an intermediate environmental transport medium between the source and the receptor point. Exposure routes are the modes of contact with and intake of contaminated media and contaminants at the exposure points. The following sections evaluate exposure points and exposure routes to determine what pathways of exposure exist. In evaluating risks for the Soldier Creek Site, the stream was divided into nine stream segments based on stream morphology. These segments were previously described in Subsection 2.3. Tables 3-1 (pages 3-10 through 3-11) and 3-2 (pages 3-12 through 3-13) present a summary of exposure pathways that are evaluated in the risk assessment.

Due to the nature of the data, including data obtained from residential groundwater wells and groundwater monitoring wells, risks for two separate populations were calculated. It is important to note that human populations in the area are supplied with water from the producing zone of the Garber-Wellington aquifer. One population of people (child and adult combined) was examined in the following "reasonable maximum exposure" (RME) current scenarios based on groundwater analytical results from the eight residential wells sampled during Phase I of the RI:

- Child (1-6 years) and Adult (6-30 years) Ingestion -- Drinking Water.
- Child (1-6 years) and Adult (6-30 years) Dermal Contact -- Shower.
- Child (1-6 years) and Adult (6-30 years) Inhalation -- Shower.

The second population, which included two groups of people (child combined with adult, and adult), was examined in the following separate RME current and future scenarios based on data from the first round of Off-Base Groundwater Investigations Northeast of Base (Tulsa COE, 1991a) and IWTP analytical data for the perched aquifer, top of regional aquifer zone, and regional aquifer zone collected in April 1990 (Tulsa COE, 1991b):

- Child Combined with Adult.
  - -- Child (1-6 years) and Adult (6-30 years) Off-base Ingestion (Future Risks) -- Drinking Water.
  - -- Child (1-6 years) and Adult (6-30 years) Off-base Dermal Contact (Current and Future Risks) -- Shower.
  - -- Child (1-6 years) and Adult (6-30 years) Off-base Inhalation (Current and Future Risks) -- Shower.
- Adult Worker.
  - -- Adult (25 years) On-base Ingestion (Future Risks) -- Drinking Water.
  - -- Adult (25 years) On-base Dermal Contact (Current and Future Risks) -- Shower.

TABLE 3-1
SUMMARY OF EXPOSURE PATHWAYS - CURRENT LAND USE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POTENTIALLY EXPOSED POPULATION	EXPOSURE ROUTE AND POINT	MEDIUM	PATHWAY QUANTITATIVELY EVALUATED	REASON FOR SELECTION OR EXCLUSION
Residents (Offbase)	Ingestion of, direct contact with, and inhalation of contaminants from downgradient wells.	Phase I Groundwater Residential Wells	Yes	Eight well tap samples will be evaluated.
Residents (Offbase)	Ingestion of garden produce irrigated from downgradient wells.	Phase I Groundwater Residential Wells	No	Exposure potential considered to be low compared to residential scenario above.
Residents (Offbase)	Ingestion of contaminants from downgradient wells.	Perched Aquifer	No	No residences currently using the perched aquifer as a drinking water source.
Residents (Offbase)	Direct contact with, and inhalation of contaminants from downgradient wells.	Perched Aquifer	Yes	Residences could be using the perched aquifer for miscellaneous home uses, and this conservatively approximates the exposure.
Residents (Offbase)	Ingestion of contaminants from downgradient wells.	Top of Regional Aquifer Zone	No	No residences currently using the top of regional aquifer zone as a drinking water source.
Residents (Offbase)	Direct contact with, and inhalation of contaminants from downgradient wells.	Top of Regional Aquifer Zone	Yes	Residences could be using the top of regional aquifer zone for miscellaneous home uses, and this conservatively approximates the exposure.
Residents (Offbase)	Ingestion of contaminants from downgradient wells.	Regional Aquifer Zone	No	No residences currently using the regional aquifer zone as a drinking water source.
Residents (Offbase)	Direct contact with, and inhalation of contaminants from downgradient wells.	Regional Aquifer Zone	Yes	Residences could be using the regional aquifer zone for miscellaneous home uses, and this conservatively approximates the exposure.
Residents (Offbase)	Incidental ingestion and dermal contact with contaminants in surface water while swimming.	Offbase Stream Segments M2, M3, E2 and W2.	Yes	These segments are accessible and useable for swimming.
Residents (Offbase)	Incidental ingestion and dermal contact with contaminants in surface water while wading.	Offbase Stream Segments A, B, and M1	Yes	These segments are accessible and useable for wading.

TABLE 3-1 (CONTINUED)
SUMMARY OF EXPOSURE PATHWAYS - CURRENT LAND USE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POTENTIALLY EXPOSED POPULATION	EXPOSURE ROUTE AND POINT	MEDIUM	PATHWAY QUANTITATIVELY EVALUATED	REASON FOR SELECTION OR EXCLUSION
Residents (Offbase)	Incidental ingestion and dermal contact with contaminants in surface sediment (0 to 6") while swimming or wading.	Offbase Stream Segments A, B, M1, M2, M3, E2, and W2.	Yes	These segments are accessible and useable for swimming and wading.
Worker (Onbase)	Ingestion of contaminants from downgradient wells.	Perched Aquifer	No	No workers currently using the perched aquifer as a drinking water source.
Worker (Onbase)	Direct contact with, and inhalation of contaminants from downgradient wells.	Perched Aquifer	Yes	Workers could be using the perched aquifer for miscellaneous work uses, and this conservatively approximates the exposure.
Worker (Onbase)	Ingestion of contaminants from downgradient wells.	Top of Regional Aquifer Zone	No	No workers currently using the top of regional aquifer zone as a drinking water source.
Worker (Onbase)	Direct contact with, and inhalation of contaminants from downgradient wells.	Top of Regional Aquifer Zone	Yes	Workers could be using the top of regional aquifer zone for miscellaneous work uses, and this conservatively approximates the exposure.
Worker (Onbase)	Ingestion of contaminants from downgradient wells.	Regional Aquifer Zone	No	No workers currently using the regional aquifer zone as a drinking water source.
Worker (Onbase)	Direct contact with, and inhalation of contaminants from downgradient wells.	Regional Aquifer Zone	Yes	Workers could be using the regional aquifer zone for miscellaneous work uses, and this conservatively approximates the exposure.
Worker (Onbase)	Incidental ingestion and dermal contact with contaminants in surface water while performing construction or repair.	Onbase Stream Segments E1 and W1.	Yes	These segments are accessible during construction work.
Worker (Onbase)	Incidental ingestion and dermal contact with contaminants in surface sediment (0-6") while performing construction or repair.	Onbase Stream Segments E1 and W1.	Yes	These segments are accessible during construction work.

TABLE 3-2
SUMMARY OF EXPOSURE PATHWAYS - FUTURE LAND USE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POTENTIALLY EXPOSED POPULATION	EXPOSURE ROUTE AND POINT	MEDIUM	PATHWAY QUANTITATIVELY EVALUATED	REASON FOR SELECTION OR EXCLUSION
Residents (Offbase)	Ingestion of, direct contact with, and inhalation of contaminants from downgradient wells.	Perched Aquifer	Yes	This will conservatively approximate the future possibility of residential exposure.
Residents (Offbase)	Ingestion of garden produce irrigated from downgradient wells.	Perched Aquifer	No	Exposure potential considered to be low compared to residential scenario above.
Residents (Offbase)	Ingestion of, direct contact with, and inhalation of contaminants from downgradient wells.	Top of Regional Aquifer Zone	Yes	This will conservatively approximate the future possibility of residential exposure.
Residents (Offbase)	Ingestion of garden produce irrigated from downgradient wells.	Top of Regional Aquifer Zone	No	Exposure potential considered to be low compared to residential scenario above.
Residents (Offbase)	Ingestion of, direct contact with, and inhalation of contaminants from downgradient wells.	Regional Aquifer Zone	Yes	This will conservatively approximate the future possibility of residential exposure.
Residents (Offbase)	Ingestion of garden produce irrigated from downgradient wells.	Regional Aquifer Zone	No	Exposure potential considered to be low compared to residential scenario above.
Residents (Offbase)	Incidental ingestion and dermal contact with contaminants in surface water while swimming.	Offbase Stream Segments M2, M3, E2 and W2.	Yes	These segments are accessible and useable for swimming.
Residents (Offbase)	Incidental ingestion and dermal contact with contaminants in surface water while wading.	Offbase Stream Segments A, B, and M1	Yes	These segments are accessible and useable for wading.
Residents (Offbase)	Incidental ingestion and dermal contact with contaminants in deeper sediment (0 to 5') while swimming or wading.	Offbase Stream Segments A, B, M1, M2, M3, E2, and W2.	Yes	These segments are accessible and useable for swimming and wading.

TABLE 3-2 (CONTINUED)
SUMMARY OF EXPOSURE PATHWAYS - FUTURE LAND USE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POTENTIALLY EXPOSED POPULATION	EXPOSURE ROUTE AND POINT	MEDIUM	PATHWAY QUANTITATIVELY EVALUATED	REASON FOR SELECTION OR EXCLUSION
Worker (Onbase)	Ingestion of, direct with, and inhalation of contaminants from downgradient wells.	Perched Aquifer	Yes	This will conservatively approximate the future possibility of worker exposure.
Worker (Onbase)	Ingestion of, direct with, and inhalation of contaminants from downgradient wells.	Top of Regional Aquifer Zone	Yes	This will conservatively approximate the future possibility of worker exposure.
Worker (Onbase)	Ingestion of, direct with, and inhalation of contaminants from downgradient wells.	Regional Aquifer Zone	Yes	This will conservatively approximate the future possibility of worker exposure.
Worker (Onbase)	Incidental ingestion and dermal contact with contaminants in surface water while performing construction or repair.	Onbase Stream Segments E1 and W1.	Yes	These segments are accessible during construction work.
Worker (Onbase)	Incidental ingestion and dermal contact with contaminants in deeper sediment (0-5') while performing construction or repair.	Onbase Stream Segments E1 and W1.	Yes	These segments are accessible during construction work.

-- Adult (25 years) On-base Inhalation (Current and Future Risks) -- Shower.

One population, including two groups of people (child combined with adult and adult worker), was examined in the following separate RME current and future scenarios based on analytical results from Phases I and II of the RI:

- Child combined with Adult.
  - -- Child (1-6 years) and Adult (6-30 years) Off-base segments M2, M3, E2, and W2 Ingestion and Dermal Contact (Current and Future Risks) -- Swimming.

  - -- Child (1-6 years) and Adult (6-30 years) Off-base segments A, B, and M1 Incidental Ingestion and Dermal Contact (Current and Future Risks) -- Wading.

- Adult.
  - -- Adult Worker (25 years) On-base segments E1 and W1 Incidental Ingestion and Dermal Contact (Current and Future Risks) -- Construction Work.

One population including two groups of people (child combined with adult, and adult worker) were examined in the following separate RME current and future scenarios based on analytical results from Phases I and II of the RI:

- Child combined with Adult.
  - -- Child (1-6 years) and Adult (6-30 years) Off-base segments A, B, M1, M2, M3, E2, and W2 Incidental Ingestion and Dermal Contact [Current Risk Sediment (0-6 inches)] -- Swimming and Wading.

  - -- Child (1-6 years) and Adult (6-30 years) Off-base segments A, B, M1, M2, M3, E2, and W2 Incidental Ingestion and Dermal Contact [Future Risks Sediment (0-5 feet)] -- Swimming and Wading.

- Adult.
  - -- Adult Worker (25 years) On-base segments E1 and W1 Incidental Ingestion and Dermal Contact [Current Risk Sediment (0-6 inches)] -- Construction Work.

  - -- Adult Worker (25 years) On-base segments E1 and W1 Incidental Ingestion and Dermal Contact [Future Risk Sediment (0-5 feet)] -- Construction Work.

3.4 Quantification of Exposure

For a quantitative risk characterization, estimates of exposure levels for each contaminant are required. The following is the basic equation used to calculate human intake of an environmental contaminant:

$$DI = C \times HIF$$

where

DI = daily intake (mg of chemical per kg of body weight per day),
C = concentration of the chemical in mg/kg (ppm), and
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 the current EPA methodology (EPA, 1989a), 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. This section describes the manner in which the exposure concentrations and the human intake factors were derived.

3.4.1 Exposure Concentration

The concentration term in the intake equation generally utilizes the arithmetic average of the concentration that is contacted over the exposure period. Because of the uncertainty associated with any estimate of exposure concentrations, the 95 percent upper one-sided confidence limit on the arithmetic mean was used for this

variable. Standard statistical methods (t-test) were used to calculate the upper one-sided confidence limit on the arithmetic mean, and where this value exceeded the highest observed concentration, the highest observed concentration was used as the exposure point concentration (EPA, 1989a). Contaminant concentrations reported as "not detected" were reported as one half the contract required detection limit (CRDL) for the quantification of exposure point concentrations. Appendix A presents the data used to calculate the 95 percent upper confidence limits along with an evaluation of those contaminants that were carried through the quantitative risk assessment.

Appendix B presents the exposure concentrations derived for each medium. The estimates of future groundwater, surface water, and sediment exposure concentrations presented in Appendix B 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 volatile organics, are subject to a variety of degradation processes.

3.4.2 Human Intake Factors

HIFs are site-specific terms that quantify the degree of contact between humans and environmental media at the exposure points. The EPA has developed several guidance documents that provide information for deriving HIFs. The RAGS manual (EPA, 1989a) summarizes much of the information in other sources and was used as the primary source of information to derive HIFs for this risk assessment. Appendix C presents the assumptions and details of the HIF derivation for the Soldier Creek risk assessment. Table 3-3 (pages 3-17 through 3-18) presents the nonstandard exposure assumptions for all exposure scenarios that were evaluated in the risk assessment. All assumptions are presented in the bottom sections of the tables in Appendix C, along with specific references as to where the assumptions came from. The air exposures resulting from showering require a method to convert the concentration of contaminants in water to the concentration in air. This is done using standard methodology from the RAGS manual (EPA, 1989a), using 200L of water in the shower and a 12 cubic meter bathroom. Assumed volatization rates are presented on Table 3-3 (pages 3-18 through 3-19) and in the appropriate Appendix C tables.

3.4.3 Average Daily Intake Values

Based on the equations presented in Appendix C, average daily intakes were calculated using the exposure point concentrations presented in Appendix B. The results of these calculations are presented in Appendix C.

3.5 Uncertainties in Exposure Assessment

Estimated average daily exposure levels to chemicals of concern at this site are uncertain for a number of reasons. The most important of these are summarized below:

- Four of the residential groundwater samples (G02, G03, G07, and G08) were filtered. This will tend to underestimate the risks from metals because some of the metals may be adsorbed onto soil or sediment particles in the water.

- 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 upper 95th percentile confidence limit of the mean concentration values were used in dose calculations. This is likely to result in an overestimation of the actual average dose.

- Contaminant concentrations that could occur under the future land use scenario are highly uncertain. Contaminant concentrations in sediment five feet below the ground surface were included in the data set, and it was assumed that the highest soil contaminant concentrations would eventually be exposed on the surface during excavation in the construction/work scenario. This will result in an overestimation of the actual average dose.

- Contaminant concentrations in groundwater for future use were assumed to be the same as currently onsite, with no adjustment caused by dilution, biodegradation, or volatilization. This will result in an overestimation of the actual average dose.

TABLE 3-3
NON-STANDARD EXPOSURE ASSUMPTIONS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

MEDIA	POPULATION	SCENARIO	PATHWAY	ASSUMPTION	RATIONALE
WELL WATER	OFF-BASE CHILD AND ADULT	CURRENT	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
			INHALATION	VOLATILIZATION RATES: 0.0% FOR METALS 10.0% FOR SEMI-VOLATILES 100% FOR VOLATILES	CONSERVATIVE BEST ESTIMATES BASED ON PROFESSIONAL JUDGEMENT
			DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
PERCHED AQUIFER	OFF-BASE CHILD AND ADULT	FUTURE	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
		CUR & FUT*	INHALATION	VOLATILIZATION RATES (ABOVE)	CONSERVATIVE ESTIMATE
		CUR & FUT	DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
	ON-BASE ADULT WORKER	FUTURE	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
		CUR & FUT	INHALATION	VOLATILIZATION RATES (ABOVE)	CONSERVATIVE ESTIMATE
		CUR & FUT	DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
TOP OF REGIONAL AQUIFER ZONE	OFF-BASE CHILD AND ADULT	FUTURE	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
		CUR & FUT	INHALATION	VOLATILIZATION RATES (ABOVE)	CONSERVATIVE ESTIMATE
		CUR & FUT	DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
	ON-BASE ADULT WORKER	FUTURE	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
		CUR & FUT	INHALATION	VOLATILIZATION RATES (ABOVE)	CONSERVATIVE ESTIMATE
		CUR & FUT	DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE ESTIMATE
REGIONAL AQUIFER ZONE	OFF-BASE CHILD AND ADULT	FUTURE	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
		CUR & FUT	INHALATION	VOLATILIZATION RATES (ABOVE)	CONSERVATIVE ESTIMATE
		CUR & FUT	DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
	ON-BASE ADULT WORKER	FUTURE	INGESTION	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
		CUR & FUT	INHALATION	VOLATILIZATION RATES (ABOVE)	CONSERVATIVE ESTIMATE
		CUR & FUT	DERMAL CONTACT	NO NONSTANDARD ASSUMPTIONS	CONSERVATIVE APPROACH
SURFACE WATER	OFF-BASE CHILD AND ADULT	CUR & FUT	INCIDENTAL INGESTION (SWIMMING OR WADING)	CHILD EXPOSURE TIME = 6HRS/DAY	CONSERVATIVE ESTIMATE INTENDED TO PROTECT THE CHILD SWIMMER
				ADULT EXPOSURE TIME = 2HRS/DAY	CONSERVATIVE ESTIMATE INTENDED TO PROTECT THE ADULT SWIMMER
				CHILD EXPOSURE FREQ = 17 DAYS/YR	BASED ON 1 DAY/WEEK FOR 17 WEEKS OF SUMMER
				ADULT EXPOSURE FREQ = 4 DAYS/YR	BASED ON 1 DAY/MONTH FOR 4 MONTHS OF SUMMER
			DERMAL CONTACT (SWIMMING OR WADING)	CHILD EXPOSURE TIME = 6HRS/DAY	CONSERVATIVE ESTIMATE INTENDED TO PROTECT THE CHILD SWIMMER
				ADULT EXPOSURE TIME = 2HRS/DAY	CONSERVATIVE ESTIMATE INTENDED TO PROTECT THE ADULT SWIMMER
				CHILD EXPOSURE FREQ = 17 DAYS/YR	BASED ON 1 DAY/WEEK FOR 17 WEEKS OF SUMMER
				ADULT EXPOSURE FREQ = 4 DAYS/YR	BASED ON 1 DAY/MONTH FOR 4 MONTHS OF SUMMER
	ON-BASE ADULT WORKER	CUR & FUT	INCIDENTAL INGESTION (CONSTRUCTION WORK)	INGESTION RATE = 0.005 L/DAY	BASED ON 10% OF SWIMMING SCENARIO
				EXPOSURE FREQUENCY = 1 DAY/YR	ESTIMATE INTENDED TO PROTECT A WORKER REPAIRING PIPES
			DERMAL CONTACT (CONSTRUCTION WORK)	EXPOSURE FREQUENCY = 1 DAY/YR	ESTIMATE INTENDED TO PROTECT A WORKER REPAIRING PIPES
				EXPOSURE TIME = 8 HRS/DAY	BASED ON 8 HOUR WORKDAY

* CUR = Current
FUT = Future

TABLE 3-3 (CONTINUED)
NON-STANDARD EXPOSURE ASSUMPTIONS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

MEDIA	POPULATION	SCENARIO	PATHWAY	ASSUMPTION	RATIONALE
SEDIMENT	OFF-BASE CHILD AND ADULT	CUR & FUT	INCIDENTAL INGESTION (SWIMMING AND WADING)	CHILD EXPOSURE FREQ = 17 DAYS/YR	BASED ON 1 DAY/WEEK FOR 17 WEEKS OF SUMMER
				ADULT EXPOSURE FREQ = 4 DAYS/YR	BASED ON 1 DAY/MONTH FOR 4 MONTHS OF SUMMER
			DERMAL CONTACT (SWIMMING AND WADING)	CHILD EXPOSURE FREQ = 17 DAYS/YR	BASED ON 1 DAY/WEEK FOR 17 WEEKS OF SUMMER
				ADULT EXPOSURE FREQ = 4 DAYS/YR	BASED ON 1 DAY/MONTH FOR 4 MONTHS OF SUMMER
	ON-BASE ADULT WORKER	CUR & FUT	INCIDENTAL INGESTION (CONSTRUCTION WORK)	EXPOSURE FREQUENCY = 1 DAY/YR	ESTIMATE INTENDED TO PROTECT A WORKER REPAIRING PIPES
			DERMAL CONTACT (CONSTRUCTION WORK)	EXPOSURE FREQUENCY = 1 DAY/YR	ESTIMATE INTENDED TO PROTECT A WORKER REPAIRING PIPES

* CUR = Current
FUT = Future

- To simplify exposure calculations for chronic and lifetime exposures, the assumption was made that all contaminant concentrations will remain constant. This is likely to result in an overestimation of chronic or lifetime exposure for volatile organic compounds because these are expected to break down or volatilize relatively quickly. It is also likely to lead to an overestimation of exposure to semi-volatile overall compounds, even though polycyclic aromatic hydrocarbons (PAHs) and other semi-volatiles undergo slower breakdown in sediment and are less volatile in nature. These factors are not expected to have much of an effect on the exposure calculations for metals, as they are typically persistent in soils.

- Worker activity patterns include assumed values for duration and frequency of time at the site and degree of contact with the sediment and surface water. Although these are uncertain, the values selected are believed to be conservative, leading to an overestimation of the actual average dose.

- Dermal uptake of chemicals from groundwater, sediment, and surface water is especially difficult to estimate, because this depends on both the characteristics of the specific chemical and the media. The absorbance values used to estimate dermal uptake are highly uncertain and are almost certainly conservative, leading to an overestimation of the average actual dose.

- When deriving concentrations of chemicals of concern, all chemicals that are not detected were assumed to be present at one half the CRDL. Whether this assumption results in an overestimation or an underestimation of actual dose is not known.

4.0 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for the chemicals of potential concern to cause adverse effects in exposed populations 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 (EPA, 1989a). Appendix D provides a summary of important information on the chemicals of potential concern that are major risk contributors at the Soldier Creek Site. The information presented is intended to provide an overview of key observations and issues on the toxicity of each of these chemicals.

4.1 Summary of Critical Toxicity Values

Health risks for chemicals exhibiting noncarcinogenic effects were evaluated using reference doses (RfDs) developed by the EPA RfD work group or obtained from health effects assessments (HEAs). The RfD is an estimate of the daily exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime. RfDs are expressed in units of mg/kg/day and include exposure to sensitive subpopulations within their derivation. The RfDs are usually derived from human studies involving workplace exposures or from animal studies. They 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 slope factors (SFs) developed by the carcinogen assessment group of EPA. 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 of a chemical 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 it has no threshold, passing through the origin. Although it is recognized that there are some grounds for debating these

assumptions, this approach is currently the most appropriate means for estimating cancer risks in exposed humans.

The EPA has developed a weight-of-evidence classification system for potential carcinogens. Using 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 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.

Table 4-1 (pages 4-3 through 4-5) presents oral and dermal RfDs and inhalation RfCs for chemicals designated as chemicals of potential concern for the Soldier Creek Site. Table 4-1 (pages 4-3 through 4-5) also presents oral, dermal, and inhalation SFs.

The dermal exposures at this site require dermal RfDs and SFs. Since the EPA 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 dermal RfDs and SFs were derived by simple extrapolation from oral RfDs and SFs. For RfDs, this was done by multiplying the oral RfD value by the oral absorption fraction. For SFs, this was done by dividing the oral SF by the oral absorption fraction. This absorption fraction has been assumed to be 0.8 for volatiles, 0.5 for semi-volatiles, and 0.2 for metals, which are most likely conservative estimates intended to approximate the absorption fraction actually absorbed into the body. No extrapolation from oral SFs to dermal SFs was performed for PAHs, because they have their effect at the point of contact (skin, stomach, lungs), and inter-route extrapolation is inappropriate for these

TABLE 4-1

CHEMICAL-SPECIFIC TOXICITY VALUES: CURRENT 9/1/91

TINKER AFB - SOLDIER CREEK RI/FS

RISK ASSESSMENT REPORT

CHEMICALS OF POTENTIAL CONCERN	INGESTION EXPOSURES					INHALATION EXPOSURES					DERMAL EXPOSURES			
	SLOPE FACTOR kg(day)/mg	WT OF EV	CHRONIC RfD mg/kg/day	REF	TARGET ORGAN SYSTEM	SLOPE FACTOR kg(day)/mg	WT OF EV	CHRONIC RfC mg/cu m	REF	TARGET ORGAN SYSTEM	SLOPE FACTOR kg(day)/mg	CHRONIC RfD mg/kg/day	PERMEABILITY CONSTANT	REF
Vinyl Chloride	1.9E+00	A		H	lung	2.9E-01	A		H	liver	2.4E+00		0.00832	B
Chloroethane								1.0E+01	I	fetal effects			0.00901	B
Methylene Chloride	7.5E-03	B2	6.0E-02	I	liver	1.4E-02	B2	3.0E+00	I/H	lung, liver / NA	9.4E-03	4.8E-02	0.00512	B
Acetone			1.0E-01	I	liver,kidney							8.0E-02		
Carbon Disulfide			1.0E-01	I	fetotoxic			1.0E-02	H	NA		8.0E-02	0.53	A
1,1-Dichloroethene	6.0E-01	C	9.0E-03	I	adrenal/liver	1.2E+00	C		H	kidney	7.5E-01	7.2E-03	0.00599	B
1,1-Dichloroethane			1.0E-01	H	NA			5.0E-01	H	kidney		8.0E-02	0.0126	B
1,2-Dichloroethene(cis)			1.0E-02	H	red blood cells							8.0E-03	0.0168	B
1,2-Dichloroethene(trans)			2.0E-02	H	serum chemistry							1.6E-02	0.0168	B
1,2-Dichloroethane	9.1E-02	B2		I	circulatory system	9.1E-02	B2		I	circulatory system	1.1E-01		0.00967	B
Chloroform	6.1E-03	B2	1.0E-02	I	kidney/fetotoxic,liver	8.1E-02	B2		I	liver	7.6E-03	8.0E-03	0.00958	B
1,1,1-Trichloroethane		D	9.0E-02	I	liver		D	1.0E+00	H	liver		7.2E-02	0.0176	B
Vinyl Acetate			1.0E+00	H	NA			2.0E-01	I	nasal lesions		8.0E-01		
Bromodichloromethane	1.3E-01	B2	2.0E-02	I	liver/kidney		B2		H	NA	1.6E-01	1.6E-02	0.00618	B
1,2-Dichloropropane	6.8E-02	B2		H	liver		B2		H	NA	8.5E-02		0.0225	B
Trichloroethene	1.1E-02	B2		H	liver	1.7E-02	B2		H	lung	1.4E-02		0.0162	B
Dibromochloromethane	8.4E-02	C	2.0E-02	I	liver		C		H	NA	1.0E-01	1.6E-02	0.00411	B
Benzene	2.9E-02	A		I	leukemia	2.9E-02	A		I	leukemia	3.6E-02		0.111	A
Bromoform	7.9E-03	B2	2.0E-02	I	large intestine/liver	3.9E-03	B2		H	NA	9.9E-03	1.6E-02	0.00273	B
Tetrachloroethene	5.1E-02	B2	1.0E-02	H/I	liver/liver	3.3E-03	B2		H	leukemia, liver	6.4E-02	8.0E-03	0.0454	B
1,1,2,2-Tetrachloroethane	2.0E-01	C		I	liver	2.0E-01	C		I	liver	2.5E-01		0.00927	B
Toluene		D	2.0E-01	I	liver,kidney			2.0E+00	H	CNS, eye, nose		1.6E-01	1.01	A
Chlorobenzene			2.0E-02	H/I	dvlpmnt/liver,kidney			2.0E-02	H	liver, kidney		1.6E-02	0.0404	B
Ethylbenzene		D	1.0E-01	I	liver,kidney							8.0E-02	1.37	A
Xylene (total)		D	2.0E+00	I	body wt,activity			3.0E-01	H	CNS, nose, throat		1.6E+00	0.000552	B
1,3-Dichlorobenzene		D		I									0.0573	B
1,4-Dichlorobenzene	2.4E-02	C		H			C	7.0E-01	H	NA/liver, kidney	4.8E-02		0.0804	B
1,2-Dichlorobenzene		D	9.0E-02	I/H	liver			2.0E-01	H	low body weight		4.5E-02	0.0289	B
2-Methylphenol		C	5.0E-02	I	dec body wt,neurotox		C		H	NA		2.5E-02	0.0157	A
4-Methylphenol		C	5.0E-02	I	dec body wt,neurotox		C		H	NA		2.5E-02	0.0175	A
2,4-Dimethylphenol			2.0E-02	I	blood,neurotoxin							1.0E-02	0.11	A
Benzoic Acid		D	4.0E+00	I	generalized							2.0E+00	0.712	B

TABLE 4-1 (Continued)
CHEMICAL-SPECIFIC TOXICITY VALUES: CURRENT 9/1/91
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

CHEMICALS OF POTENTIAL CONCERN	INGESTION EXPOSURES					INHALATION EXPOSURES					DERMAL EXPOSURES			
	SLOPE FACTOR kg(day)/mg	WT OF EV	CHRONIC RfD mg/kg/day	REF	TARGET ORGAN SYSTEM	SLOPE FACTOR kg(day)/mg	WT OF EV	CHRONIC RfC mg/cu m	REF	TARGET ORGAN SYSTEM	SLOPE FACTOR kg(day)/mg	CHRONIC RfD mg/kg/day	PERMEABILITY CONSTANT	REF
Naphthalene		D	4.0E-03	H	dec wt gain							2.0E-03	0.0659	B
2-Methylnaphthalene														
2-Chloronaphthalene														
1,2,4 Trimethylbenzene														
1,1,1 Trimethylbenzene														
Acenaphthene			6.0E-02	H	liver							3.0E-02		
Dibenzofuran														
Fluorene		D	4.0E-02	I	red blood cells							2.0E-02		
Phenanthrene		D		I									0.232	B
Anthracene		D	3.0E-01	I	NA							1.5E-01		
Di-n-Butylphthalate		D	1.0E-01	I	inc mortality							5.0E-02	1.88	B
Fluoranthene		D	4.0E-02	I	liver,kidney,blood							2.0E-02	0.297	B
Pyrene			3.0E-02	I	kidney							1.5E-02		
Butyl Benzyl Phthalate		C	2.0E-01	I	liver							1.0E-01		
3,3'-Dichlorobenzidine	4.5E-01	B2		H	mammary						9.0E-01		0.0582	B
Benzo(a)Anthracene	1.2E+01	B2		M	NA	6.1E+00	B2			NA			0.00792	B
Chrysene	1.2E+01	B2		M	NA	6.1E+00	B2			NA			0.62	B
bis(2-Ethylhexyl)Phthalate	1.4E-02	B2	2.0E-02	H	liver/liver		B2			NA	2.8E-02	1.0E-02	0.00321	B
Di-n-Octyl Phthalate			2.0E-02	H	liver,kidney							1.0E-02		
Benzo(b)Fluoranthene	1.2E+01	B2		M	NA	6.1E+00	B2			NA			0.62	B
Benzo(k)Fluoranthene	1.2E+01	B2		M	NA	6.1E+00	B2			NA				
Benzo(a)Pyrene	1.2E+01	B2		M	NA	6.1E+00	B2			NA			0.9	B
Indeno(1,2,3-cd)Pyrene	1.2E+01	B2		M	NA	6.1E+00	B2			NA			1.31	B
Dibenzo(a,h)Anthracene	1.2E+01	B2		M	NA	6.1E+00	B2			NA				
Benzo(g,h,i)Perylene														
Aluminum														
Antimony			4.0E-04	I	serum chemistry							8.0E-05		
Arsenic		A	1.0E-03	H	skin	5.0E+01	A		H	respiratory tract		2.0E-04	0.000857	B
Barium			7.0E-02	I	increased BP			5.0E-04	H	fetotoxic		1.4E-02		
Beryllium	4.3E+00	B2	5.0E-03	I	NA	8.4E+00	B2		H	lung	2.1E+01	1.0E-03	0.00216	B
Cadmium		B1	5.0E-04	I	kidney	6.1E+00	B1		I	respiratory tract		1.0E-04	0.000506	B
Calcium														

TABLE 4-1 (Continued)
CHEMICAL-SPECIFIC TOXICITY VALUES: CURRENT 9/1/91
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

CHEMICALS OF POTENTIAL CONCERN	INGESTION EXPOSURES					INHALATION EXPOSURES					DERMAL EXPOSURES			
	SLOPE FACTOR kg(day)/mg	WT OF EV	CHRONIC RfD mg/kg/day	REF	TARGET ORGAN SYSTEM	SLOPE FACTOR kg(day)/mg	WT OF EV	CHRONIC RfC mg/cu m	REF	TARGET ORGAN SYSTEM	SLOPE FACTOR kg(day)/mg	CHRONIC RfD mg/kg/day	PERMEABILITY CONSTANT	REF
Chromium			5.0E-03	I	NA	4.1E+01	A	2.0E-06	I/H	lung / nasal mucosa		1.0E-03	0.0021	A
Cobalt													0.00055	A
Copper		D											0.00101	B
Iron														
Lead													0.000134	B
Magnesium														
Manganese		D	1.0E-01	I	CNS			4.0E-04	I	respiratory tract, CNS		2.0E-02		
Mercury		D	3.0E-04	H	kidney			3.0E-04	H	neurotoxicity		6.0E-05	0.000147	B
Nickel			2.0E-02	H	dec body wt	8.4E-01	A		H	respiratory tract		4.0E-03	0.00108	B
Potassium														
Selenium													0.00081	B
Silver		D	3.0E-03	I	argyria							6.0E-04	0.000539	B
Sodium														
Vanadium			7.0E-03	H	NA							1.4E-03		
Zinc			2.0E-01	I/H	red blood cells		D		I			4.0E-02	0.00098	B
Cyanide		D	2.0E-02	I	thyroid,neurotoxin							4.0E-03	0.0017	B

NOTES:
A - PREDICTED VALUE LISTED IN "EPA RESEARCH AND DEVELOPMENT, INTERIM GUIDANCE FOR DERMAL EXPOSURE ASSESSMENT", MARCH, 1991 (EPA, 1991b)
B - MODELED VALUE LISTED IN "EPA RESEARCH AND DEVELOPMENT, INTERIM GUIDANCE FOR DERMAL EXPOSURE ASSESSMENT", MARCH, 1991 (EPA, 1991b)
I - INTEGRATED RESEARCH INFORMATION SYSTEM, (AS OF 9/1/91) (EPA, 1991c)
H - HEALTH EFFECTS ASSESSMENT SUMMARY TABLES (1ST QUARTER, FY 1991) (EPA, 1991d)
M - MEMO ON CARCINOGENICITY OF BENZO(A)PYRENE AND PAHS, PEI-FUNG HURST, MAR 22, 1991 (EPA, 1991e)
WT OF EV = EPA's WEIGHT OF EVIDENCE CLASSIFICATION

ABBREVIATIONS:
RfC = REFERENCE CONCENTRATION
RfD = REFERENCE DOSE
NA = NOT AVAILABLE
dvlpmnt = DEVELOPMENTAL
wt = WEIGHT
dec = DECREASED
inc = INCREASED
BP = BLOOD PRESSURE
CNS = CENTRAL NERVOUS SYSTEM

carcinogenic compounds (EPA, 1989a). The results of these extrapolations are presented in Table 4-1 (pages 4-3 through 4-5).

4.2 Uncertainities in Toxicology Prediction of Health Effects

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. For example, the SFs for evaluation of carcinogenic PAHs are currently under review by the EPA. This review also includes consideration of the PAHs currently on the TCL. 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 the toxicity values may include (EPA, 1989a) using dose-response information from effects observed at high doses to predict the adverse health effects that may occur following 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, and using dose-response information from homogeneous animal populations to predict the effects likely to be observed in the general population consisting of individuals with a wide range of sensitivities.

The evaluation of carcinogenic risks from exposure to PAHs involves a high level of uncertainty. Adequate studies capable of deriving SFs are not available. For this reason, carcinogenic PAHs are assigned a SF equivalent to benzo(a)pyrene, which has been studied in some depth. This is a conservative approach because benzo(a)pyrene is believed to be the most powerful PAH carcinogen.

There is also uncertainty in the evaluation of chromium due to the fact that chromium III and chromium VI were not differentiated. The toxicity values employed are those associated with chromium VI, which is a conservative assumption that is likely to overestimate risks from chromium exposure.

5.0 RISK CHARACTERIZATION

A detailed risk characterization for the Soldier Creek Site is presented in this section.

5.1 Evaluation of Noncarcinogenic Risks

The risk of adverse noncarcinogenic effects from chemical exposure is expressed in terms of the hazard quotient (HQ). The HQ is the ratio of the estimated dose of a chemical that a human receives to the RfD, the estimated dose below which it is unlikely for even sensitive populations to experience adverse health effects. The HQ is estimated as follows (EPA, 1989a):

HQ = DI/RfD,

Where

HQ = hazard quotient (unitless),
DI = daily intake (mg/kg/day), and
RfD = reference dose (mg/kg/day).

The HQ values for all the chemicals within each exposure pathway are summed to yield the hazard index (HI). A HI value of less than 1.0 indicates little concern for noncarcinogenic effects, and a HI value equal to or greater than 1.0 indicates an increased level of concern.

Using the HQ equation, the DI values from Appendix C, and the RfD values in Table 4-1 (pages 4-3 through 4-5), a HI for each of the exposure scenarios considered in this risk assessment was estimated for each contaminant of potential concern associated with each exposure pathway and exposure point. Only chronic HIs were derived, as the subchronic risks will always be equal to or less than the chronic risks. This will slightly overestimate risks associated with exposures to children. The results of these estimates are presented in Appendix C and are summarized in Tables 5-1 (pages 5-2 through 5-4), and 5-2 (pages 5-5 through 5-6).

TABLE 5-1
SUMMARY OF NONCARCINOGENIC RISKS, CURRENT LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK (HI)
OFF SITE RESIDENTS	GROUNDWATER, TAP G01	INGESTION	4E-01
		DERMAL CONTACT-SHOWER	3E-03
		INHALATION-SHOWER	---
		TAP RISK (HI):	4E-01
	GROUNDWATER, TAP G02	INGESTION	3E-01
		DERMAL CONTACT-SHOWER	2E-03
		INHALATION-SHOWER	---
		TAP RISK (HI):	3E-01
	GROUNDWATER, TAP G03	INGESTION	1E-01
		DERMAL CONTACT-SHOWER	8E-04
		INHALATION-SHOWER	---
		TAP RISK (HI):	1E-01
	GROUNDWATER, TAP G04	INGESTION	4E-01
		DERMAL CONTACT-SHOWER	3E-03
		INHALATION-SHOWER	---
		TAP RISK (HI):	4E-01
	GROUNDWATER, TAP G05	INGESTION	5E-01
		DERMAL CONTACT-SHOWER	4E-03
		INHALATION-SHOWER	---
		TAP RISK (HI):	5E-01
	GROUNDWATER, TAP G06	INGESTION	1E-01
		DERMAL CONTACT-SHOWER	1E-03
		INHALATION-SHOWER	2E-04
		TAP RISK (HI):	2E-01
	GROUNDWATER, TAP G07	INGESTION	3E-01
		DERMAL CONTACT-SHOWER	4E-03
		INHALATION-SHOWER	---
		TAP RISK (HI):	3E-01
	GROUNDWATER, TAP G08	INGESTION	6E-01
		DERMAL CONTACT-SHOWER	5E-03
		INHALATION-SHOWER	---
		TAP RISK (HI):	6E-01

TABLE 5-1 (Continued)
SUMMARY OF NONCARCINOGENIC RISKS, CURRENT LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK (HI)
OFF SITE RESIDENTS	GROUNDWATER - PERCHED AQUIFER	DERMAL CONTACT-SHOWER	3E+00
		INHALATION-SHOWER	6E-04
		AQUIFER RISK (HI):	3E+00
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	1E-01
		INHALATION-SHOWER	1E+00
		AQUIFER RISK (HI):	1E+00
	GROUNDWATER - REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	3E-02
		INHALATION-SHOWER	4E-01
		AQUIFER RISK (HI):	4E-01
	SURFACE WATER - SEGMENT A	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	SURFACE SEDIMENT - SEGMENT A	INCIDENTAL INGESTION	1E-03
		DERMAL CONTACT	4E-03
		SEGMENT A RISK (HI)	5E-03
	SURFACE WATER - SEGMENT B	INCIDENTAL INGESTION-WADING	1E-04
		DERMAL CONTACT-WADING	8E-04
	SURFACE SEDIMENT - SEGMENT B	INCIDENTAL INGESTION	4E-03
		DERMAL CONTACT	1E-02
		SEGMENT B RISK (HI)	2E-02
	SURFACE WATER - SEGMENT M1	INCIDENTAL INGESTION-WADING	5E-04
		DERMAL CONTACT-WADING	3E-03
	SURFACE SEDIMENT - SEGMENT M1	INCIDENTAL INGESTION	2E-02
		DERMAL CONTACT	6E-02
		SEGMENT M1 RISK (HI)	8E-02
	SURFACE WATER - SEGMENT M2	INCIDENTAL INGESTION-SWIMMING	2E-03
		DERMAL CONTACT-SWIMMING	5E-03
	SURFACE SEDIMENT - SEGMENT M2	INCIDENTAL INGESTION	3E-03
		DERMAL CONTACT	9E-03
		SEGMENT M2 RISK (HI)	2E-02
	SURFACE WATER - SEGMENT M3	INCIDENTAL INGESTION-SWIMMING	1E-02
		DERMAL CONTACT-SWIMMING	3E-03
	SURFACE SEDIMENT - SEGMENT M3	INCIDENTAL INGESTION	1E-03
		DERMAL CONTACT	4E-03
		SEGMENT M3 RISK (HI)	2E-02
	SURFACE WATER - SEGMENT E2	INCIDENTAL INGESTION-SWIMMING	7E-03
		DERMAL CONTACT-SWIMMING	7E-03
	SURFACE SEDIMENT - SEGMENT E2	INCIDENTAL INGESTION	3E-03
		DERMAL CONTACT	1E-02
		SEGMENT E2 RISK (HI)	3E-02
	SURFACE WATER - SEGMENT W2	INCIDENTAL INGESTION-SWIMMING	1E-03
		DERMAL CONTACT-SWIMMING	2E-03
	SURFACE SEDIMENT - SEGMENT W2	INCIDENTAL INGESTION	2E-02
		DERMAL CONTACT	5E-02
		SEGMENT W2 RISK (HI)	7E-02

TABLE 5-1 (Continued)
SUMMARY OF NONCARCINOGENIC RISKS, CURRENT LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK (HI)
ON SITE WORKERS	GROUNDWATER - PERCHED AQUIFER	DERMAL CONTACT-SHOWER	1E+00
		INHALATION-SHOWER	2E-04
		AQUIFER RISK (HI):	2E+00
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	3E-01
		INHALATION-SHOWER	4E-01
		AQUIFER RISK (HI):	7E-01
	GROUNDWATER - REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	2E-01
		INHALATION-SHOWER	2E-01
		AQUIFER RISK (HI):	4E-01
	SURFACE WATER, SEGMENT E1	INCIDENTAL INGESTION	5E-06
		DERMAL CONTACT	7E-04
	SURFACE SEDIMENT, SEGMENT E1	INCIDENTAL INGESTION	2E-05
		DERMAL CONTACT	1E-02
		SEGMENT E1 RISK (HI):	1E-02
	SURFACE WATER, SEGMENT W1	INCIDENTAL INGESTION	4E-05
		DERMAL CONTACT	4E-03
	SURFACE SEDIMENT, SEGMENT W1	INCIDENTAL INGESTION	8E-04
		DERMAL CONTACT	1E-02
		SEGMENT W1 RISK (HI):	2E-02

TABLE 5-2
SUMMARY OF NONCARCINOGENIC RISKS, FUTURE LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK (HI)
OFF SITE RESIDENTS	GROUNDWATER - PERCHED AQUIFER	INGESTION	1E+02
		DERMAL CONTACT-SHOWER	3E+00
		INHALATION-SHOWER	6E-04
		AQUIFER RISK (HI):	1E+02
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	INGESTION	5E+00
		DERMAL CONTACT-SHOWER	3E-01
		INHALATION-SHOWER	4E-01
		AQUIFER RISK (HI):	6E+00
	GROUNDWATER - REGIONAL AQUIFER ZONE	INGESTION	9E-01
		DERMAL CONTACT-SHOWER	3E-02
		INHALATION-SHOWER	4E-01
		AQUIFER RISK (HI):	1E+00
	SURFACE WATER, SEGMENT A	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	DEEP SEDIMENT, SEGMENT A	INCIDENTAL INGESTION	---
		DERMAL CONTACT	---
		SEGMENT A RISK (HI):	---
	SURFACE WATER, SEGMENT B	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	DEEP SEDIMENT, SEGMENT B	INCIDENTAL INGESTION	---
		DERMAL CONTACT	---
		SEGMENT B RISK (HI):	---
	SURFACE WATER, SEGMENT M1	INCIDENTAL INGESTION-WADING	5E-04
		DERMAL CONTACT-WADING	3E-03
	DEEP SEDIMENT, SEGMENT M1	INCIDENTAL INGESTION	1E-02
		DERMAL CONTACT	4E-02
		SEGMENT M1 RISK (HI):	6E-02
	SURFACE WATER, SEGMENT M2	INCIDENTAL INGESTION-SWIMMING	2E-03
		DERMAL CONTACT-SWIMMING	5E-03
	DEEP SEDIMENT, SEGMENT M2	INCIDENTAL INGESTION	5E-03
		DERMAL CONTACT	2E-02
		SEGMENT M2 RISK (HI):	3E-02
	SURFACE WATER, SEGMENT M3	INCIDENTAL INGESTION-SWIMMING	1E-02
		DERMAL CONTACT-SWIMMING	3E-03
	DEEP SEDIMENT, SEGMENT M3	INCIDENTAL INGESTION	7E-04
		DERMAL CONTACT	2E-03
		SEGMENT M3 RISK (HI):	2E-02
	SURFACE WATER, SEGMENT E2	INCIDENTAL INGESTION-SWIMMING	7E-03
		DERMAL CONTACT-SWIMMING	6E-03
	DEEP SEDIMENT, SEGMENT E2	INCIDENTAL INGESTION	4E-03
		DERMAL CONTACT	1E-02
		SEGMENT E2 RISK (HI):	3E-02
	SURFACE WATER, SEGMENT W2	INCIDENTAL INGESTION-SWIMMING	1E-03
		DERMAL CONTACT-SWIMMING	2E-03
	DEEP SEDIMENT, SEGMENT W2	INCIDENTAL INGESTION	1E-02
		DERMAL CONTACT	4E-02
		SEGMENT W2 RISK (HI):	5E-02

TABLE 5-2 (Continued)
SUMMARY OF NONCARCINOGENIC RISKS, FUTURE LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK (HI)
ON SITE WORKERS	GROUNDWATER - PERCHED AQUIFER	INGESTION	4E+01
		DERMAL CONTACT-SHOWER	1E+00
		INHALATION-SHOWER	2E-04
		AQUIFER RISK (HI):	4E+01
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	INGESTION	2E+00
		DERMAL CONTACT-SHOWER	3E-01
		INHALATION-SHOWER	4E-01
		AQUIFER RISK (HI):	2E+00
	GROUNDWATER - REGIONAL AQUIFER ZONE	INGESTION	3E-01
		DERMAL CONTACT-SHOWER	2E-01
		INHALATION-SHOWER	2E-01
		AQUIFER RISK (HI):	7E-01
	SURFACE WATER, SEGMENT E1	INCIDENTAL INGESTION	5E-06
		DERMAL CONTACT	7E-04
	DEEP SEDIMENT, SEGMENT E1	INCIDENTAL INGESTION	5E-04
		DERMAL CONTACT	7E-03
		SEGMENT E1 RISK (HI):	8E-03
	SURFACE WATER, SEGMENT W1	INCIDENTAL INGESTION	4E-05
		DERMAL CONTACT	4E-03
	DEEP SEDIMENT, SEGMENT W1	INCIDENTAL INGESTION	3E-04
		DERMAL CONTACT	5E-03
		SEGMENT W1 RISK (HI):	1E-02

An evaluation of the results of the risk estimates presented in Table 5-1 (pages 5-2 through 5-4), indicates that hazard indices for current exposures associated with the eight residential well samples are all less than 1.0, the level of concern for noncarcinogens. An evaluation of noncarcinogenic risks for current off-base residents indicates that both the perched aquifer and top of regional aquifer zone exhibit HIs greater than 1.0. The perched aquifer HI results primarily from the risks associated with chromium, and the top of regional aquifer zone HI is primarily the result of risks associated with chlorobenzene, 1,1,1-trichloroethane, and tetrachloroethene (in descending order of risk-magnitude). The regional aquifer zone HI is less than 1.0. The surface water and shallow sediment (0-6 inches) HIs are all at least one order of magnitude less than 1.0 for current off-base residents in stream segments A, B, M1, M2, M3, E2, and W2.

For current on-base workers using the perched aquifer water for showering (an exposure pathway that is not occurring) the HI is greater than 1.0 (from the same contaminants as listed above). For current on-base workers performing construction or repair work in the creek, the surface water and shallow sediment (0-6 inches) HIs are all at least two orders of magnitude less than 1.0. This includes stream segments E1 and W1.

An evaluation of noncarcinogenic risks for future off-base residents indicates that all three aquifers have associated noncarcinogenic HIs greater than 1.0 for future residential use. In the perched aquifer, this risk is primarily associated with chromium and tetrachloroethene. In the top of regional aquifer zone, the primary noncarcinogenic risk contributors include chromium, chlorobenzene, tetrachloroethene, trans-1,2-dichloroethene, barium, arsenic, and bis(2-ethylhexyl)phthalate. In the regional aquifer zone, noncarcinogenic risks are primarily the result of risks assoicated with chlorobenzene and barium. All surface water and deep sediments (0-5 feet) scenarios have associated noncarcinogenic HIs that are less than 1.0.

For future on-base workers drinking water from or showering in water from the aquifer zones, the perched aquifer and top of regional aquifer zone HIs are greater than 1.0. The HIs for surface water and deep sediment (0-5 feet) exposures resulting

from performing construction or repair work in the creek are at least two orders of magnitude less than 1.0.

5.2 Evaluation of Carcinogenic Risks

The risk of cancer from exposure to a chemical is described in terms of the probability that an individual exposed will develop cancer during his or her lifetime from that exposure. This value is calculated from the average daily intake over a lifetime using the chronic daily intake (CDI) and the slope factor for the chemical as follows (EPA, 1989a):

$$\text{Risk} = \text{CDI} \times \text{SF},$$

Where

CDI = chronic daily intake (mg/kg/day), and
SF = slope factor (kg-day/mg).

Using this equation and employing the CDI values estimated for lifetime exposure (Appendix C) along with the SF values (Table 4-1, pages 4-3 through 4-5), carcinogenic risks were estimated for lifetime exposures that may occur at the Soldier Creek Site. A summary of the results is presented in Tables 5-3 (pages 5-9 through 5-11) and 5-4 (pages 5-12 through 5-13). It is important to note that the carcinogenic risk estimates presented in Tables 5-3 (pages 5-9 through 5-11) and 5-4 (pages 5-12 through 5-13) represent the summation of the individual risks associated with each of the chemicals of potential concern for which cancer information is adequately available.

An evaluation of carcinogenic risks for current exposures associated with the eight residential well samples indicates that one of the samples (G06) has associated risks equal to 1×10^{-6} (one in one million) and one (G07) has a risk of 5×10^{-5} (five in one hundred thousand). The well G06 risk is primarily due to methylene chloride and the well G07 risk is primarily due to 1,2-dichloroethane and tetrachloroethene.

An evaluation of carcinogenic risks for current off-base residents indicates that all three aquifer zones exhibit risks greater than 1×10^{-6} (one in one million). The

TABLE 5-3
SUMMARY OF CARCINOGENIC RISKS, CURRENT LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK
OFF SITE RESIDENTS	GROUNDWATER, TAP G01	INGESTION	---
		DERMAL CONTACT-SHOWER	---
		INHALATION-SHOWER	---
		TAP RISK:	0E+00
	GROUNDWATER, TAP G02	INGESTION	---
		DERMAL CONTACT-SHOWER	---
		INHALATION-SHOWER	---
		TAP RISK:	0E+00
	GROUNDWATER, TAP G03	INGESTION	---
		DERMAL CONTACT-SHOWER	---
		INHALATION-SHOWER	---
		TAP RISK:	0E+00
	GROUNDWATER, TAP G04	INGESTION	4E-07
		DERMAL CONTACT-SHOWER	5E-09
		INHALATION-SHOWER	---
		TAP RISK:	4E-07
	GROUNDWATER, TAP G05	INGESTION	4E-07
		DERMAL CONTACT-SHOWER	5E-09
		INHALATION-SHOWER	---
		TAP RISK:	4E-07
	GROUNDWATER, TAP G06	INGESTION	4E-07
		DERMAL CONTACT-SHOWER	5E-09
		INHALATION-SHOWER	1E-06
		TAP RISK:	1E-06
	GROUNDWATER, TAP G07	INGESTION	2E-05
		DERMAL CONTACT-SHOWER	6E-07
		INHALATION-SHOWER	3E-05
		TAP RISK:	5E-05
	GROUNDWATER, TAP G08	INGESTION	---
		DERMAL CONTACT-SHOWER	---
		INHALATION-SHOWER	---
		TAP RISK:	0E+00

TABLE 5-3 (Continued)
SUMMARY OF CARCINOGENIC RISKS, CURRENT LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK
OFF SITE RESIDENTS	GROUNDWATER - PERCHED AQUIFER	DERMAL CONTACT-SHOWER	2E-04
		INHALATION-SHOWER	1E-02
		AQUIFER RISK:	1E-02
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	9E-05
		INHALATION-SHOWER	2E-03
		AQUIFER RISK:	2E-03
	GROUNDWATER - REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	1E-05
		INHALATION-SHOWER	3E-04
		AQUIFER RISK:	3E-04
	SURFACE WATER, SEGMENT A	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	SURFACE SEDIMENT, SEGMENT A	INCIDENTAL INGESTION	5E-07
		DERMAL CONTACT	5E-09
		SEGMENT A RISK:	5E-07
	SURFACE WATER, SEGMENT B	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	SURFACE SEDIMENT, SEGMENT B	INCIDENTAL INGESTION	5E-10
		DERMAL CONTACT	7E-09
		SEGMENT B RISK:	7E-09
	SURFACE WATER, SEGMENT M1	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	SURFACE SEDIMENT, SEGMENT M1	INCIDENTAL INGESTION	4E-10
		DERMAL CONTACT	4E-09
		SEGMENT M1 RISK:	4E-09
	SURFACE WATER, SEGMENT M2	INCIDENTAL INGESTION-SWIMMING	1E-08
		DERMAL CONTACT-SWIMMING	2E-07
	SURFACE SEDIMENT, SEGMENT M2	INCIDENTAL INGESTION	2E-07
		DERMAL CONTACT	6E-09
		SEGMENT M2 RISK:	5E-07
	SURFACE WATER, SEGMENT M3	INCIDENTAL INGESTION-SWIMMING	2E-09
		DERMAL CONTACT-SWIMMING	4E-09
	SURFACE SEDIMENT, SEGMENT M3	INCIDENTAL INGESTION	3E-10
		DERMAL CONTACT	4E-09
		SEGMENT M3 RISK:	1E-08
	SURFACE WATER, SEGMENT E2	INCIDENTAL INGESTION-SWIMMING	3E-07
		DERMAL CONTACT-SWIMMING	5E-07
	SURFACE SEDIMENT, SEGMENT E2	INCIDENTAL INGESTION	5E-10
		DERMAL CONTACT	6E-09
		SEGMENT E2 RISK:	8E-07
	SURFACE WATER, SEGMENT W2	INCIDENTAL INGESTION-SWIMMING	---
		DERMAL CONTACT-SWIMMING	---
	SURFACE SEDIMENT, SEGMENT W2	INCIDENTAL INGESTION	6E-07
		DERMAL CONTACT	4E-08
		SEGMENT W2 RISK:	6E-07

TABLE 5-3 (Continued)
SUMMARY OF CARCINOGENIC RISKS, CURRENT LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK
ON SITE WORKERS	GROUNDWATER - PERCHED AQUIFER	DERMAL CONTACT-SHOWER	1E-04
		INHALATION-SHOWER	4E-03
		TOTAL RISK:	4E-03
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	4E-05
		INHALATION-SHOWER	5E-04
		TOTAL RISK:	6E-04
	GROUNDWATER - REGIONAL AQUIFER ZONE	DERMAL CONTACT-SHOWER	6E-06
		INHALATION-SHOWER	1E-04
		TOTAL RISK:	1E-04
	SURFACE WATER, SEGMENT E1	INCIDENTAL INGESTION	4E-09
		DERMAL CONTACT	2E-08
	SURFACE SEDIMENT, SEGMENT E1	INCIDENTAL INGESTION	8E-08
		DERMAL CONTACT	9E-08
		TOTAL RISK:	2E-07
	SURFACE WATER, SEGMENT W1	INCIDENTAL INGESTION	8E-10
		DERMAL CONTACT	1E-07
	SURFACE SEDIMENT, SEGMENT W1	INCIDENTAL INGESTION	1E-07
		DERMAL CONTACT	3E-08
		TOTAL RISK:	3E-07

TABLE 5-4
SUMMARY OF CARCINOGENIC RISKS, FUTURE LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK
OFF SITE RESIDENTS	GROUNDWATER - PERCHED AQUIFER	INGESTION	3E-03
		DERMAL CONTACT-SHOWER	1E-04
		INHALATION-SHOWER	6E-03
		AQUIFER RISK:	9E-03
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	INGESTION	5E-03
		DERMAL CONTACT-SHOWER	1E-04
		INHALATION-SHOWER	2E-03
		AQUIFER RISK:	7E-03
	GROUNDWATER - REGIONAL AQUIFER ZONE	INGESTION	4E-04
		DERMAL CONTACT-SHOWER	1E-05
		INHALATION-SHOWER	3E-04
		AQUIFER RISK:	7E-04
	SURFACE WATER, SEGMENT A	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	DEEP SEDIMENT, SEGMENT A	INCIDENTAL INGESTION	---
		DERMAL CONTACT	---
		SEGMENT A RISK:	---
	SURFACE WATER, SEGMENT B	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	DEEP SEDIMENT, SEGMENT B	INCIDENTAL INGESTION	---
		DERMAL CONTACT	---
		SEGMENT B RISK:	---
	SURFACE WATER, SEGMENT M1	INCIDENTAL INGESTION-WADING	---
		DERMAL CONTACT-WADING	---
	DEEP SEDIMENT, SEGMENT M1	INCIDENTAL INGESTION	3E-10
		DERMAL CONTACT	4E-09
		SEGMENT M1 RISK:	4E-09
	SURFACE WATER, SEGMENT M2	INCIDENTAL INGESTION-SWIMMING	2E-08
		DERMAL CONTACT-SWIMMING	3E-07
	DEEP SEDIMENT, SEGMENT M2	INCIDENTAL INGESTION	2E-07
		DERMAL CONTACT	5E-09
		SEGMENT M2 RISK:	4E-07
	SURFACE WATER, SEGMENT M3	INCIDENTAL INGESTION-SWIMMING	2E-09
		DERMAL CONTACT-SWIMMING	4E-09
	DEEP SEDIMENT, SEGMENT M3	INCIDENTAL INGESTION	5E-10
		DERMAL CONTACT	6E-[illegible]
		SEGMENT M3 RISK:	1E-08
	SURFACE WATER, SEGMENT E2	INCIDENTAL INGESTION-SWIMMING	3E-07
		DERMAL CONTACT-SWIMMING	5E-07
	DEEP SEDIMENT, SEGMENT E2	INCIDENTAL INGESTION	5E-10
		DERMAL CONTACT	6E-09
		SEGMENT E2 RISK:	8E-07
	SURFACE WATER, SEGMENT W2	INCIDENTAL INGESTION-SWIMMING	---
		DERMAL CONTACT-SWIMMING	---
	DEEP SEDIMENT, SEGMENT W2	INCIDENTAL INGESTION	6E-07
		DERMAL CONTACT	4E-08
		SEGMENT W2 RISK:	6E-07

TABLE 5-4 (Continued)
SUMMARY OF CARCINOGENIC RISKS, FUTURE LAND USE
GROUNDWATER, SURFACE WATER, AND SEDIMENT EXPOSURES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

POPULATION	MEDIUM	EXPOSURE PATHWAY	RISK
ON SITE WORKERS	GROUNDWATER - PERCHED AQUIFER	INGESTION	1E-03
		DERMAL CONTACT-SHOWER	1E-04
		INHALATION-SHOWER	4E-03
		AQUIFER RISK:	5E-03
	GROUNDWATER - TOP OF REGIONAL AQUIFER ZONE	INGESTION	9E-04
		DERMAL CONTACT-SHOWER	4E-05
		INHALATION-SHOWER	5E-04
		AQUIFER RISK:	1E-03
	GROUNDWATER - REGIONAL AQUIFER ZONE	INGESTION	1E-04
		DERMAL CONTACT-SHOWER	6E-06
		INHALATION-SHOWER	1E-04
		AQUIFER RISK:	2E-04
	SURFACE WATER, SEGMENT E1	INCIDENTAL INGESTION	4E-09
		DERMAL CONTACT	2E-08
	DEEP SEDIMENT, SEGMENT E1	INCIDENTAL INGESTION	5E-08
		DERMAL CONTACT	4E-08
		SEGMENT E1 RISK:	1E-07
	SURFACE WATER, SEGMENT W1	INCIDENTAL INGESTION	8E-10
		DERMAL CONTACT	1E-07
	DEEP SEDIMENT, SEGMENT W1	INCIDENTAL INGESTION	8E-08
		DERMAL CONTACT	2E-08
		SEGMENT W1 RISK:	2E-07

perched aquifer risk (1 x 10^{-2}, or one in one hundred) is primarily due totrichloroethene. The top of regional aquifer zone risk (2 x 10^{-3} or two in one thousand) is primarily due to vinyl chloride, 1,1-dichloroethene, 1,1,1-trichloroethene, vinyl chloride, and chloroform. The regional aquifer zone carcinogenic risk (3 x 10^{-4}, or three in ten thousand) is primarily due to vinyl chloride, 1,1-dichloroethene, trichloroethene, and tetrachloroethene. The surface water and shallow sediment (0-6") carcinogenic risks are all less than 1 x 10^{-6} (one in one million) for all off-base segments (A, B, M1, M2, M3, E2, and W2) of Soldier Creek.

For current on-base workers showering in water from the aquifer zones (an exposure pathway that is not occurring), all three aquifer zones have estimated carcinogenic risks significantly greater than 1 x 10^{-6} (one in one million), including 4 x 10^{-3} (four in one thousand) for the perched aquifer, 6 x 10^{-4} (six in ten thousand) for the top of regional aquifer zone, and 1 x 10^{-4} (one in ten thousand) for the regional aquifer zone. The risk contributors include trichloroethene, tetrachloroethene, and 1,1-dichloroethene in the perched aquifer; vinyl chloride, trichloroethene, and 1,1-dichloroethene in the top of regional aquifer zone; and vinyl chloride, 1,1-dichloroethene, trichloroethene, and tetrachloroethene in the regional aquifer zone. The surface water and shallow sediment (0-6 inches) risks for workers performing construction work in the creek are all less than 1 x 10^{-6} (one in one million).

An evaluation of carcinogenic risks for future off-base residents (the most conservative scenario presented) indicates carcinogenic risks associated with the perched aquifer of 1 x 10^{-2} (one in one hundred), the top of regional aquifer zone of 5 x 10^{-3} (five in one thousand), and the regional aquifer zone of 7 x 10^{-4} (seven in ten thousand). The contaminants associated with these risk values are the same as presented above. The estimated risk associated with surface water and deep sediment (0-5 feet) exposure is less than 1 x 10^{-6} (one in one million).

An evaluation of estimated carcinogenic risks for future on-base workers drinking water from and showering in water from the aquifer zones indicates that all three aquifer zones have potential carcinogenic risks greater than 1 x 10^{-6} (one in one million). The carcinogenic risk associated with the perched aquifer is estimated to be 5 x 10^{-3} (five in one thousand), the top of regional aquifer zone has an associated risk of 1 x 10^{-3} (one in one thousand), and the risk associated with the regional

aquifer zone is estimated at 2×10^{-4} (two in ten thousand). The contaminants that drive these risk values are trichloroethene, tetrachloroethene, and 1,1-dichloroethene in the perched aquifer; vinyl chloride, trichloroethene, 1,1-dichloroethene, and tetrachloroethene in the top of regional aquifer zone; and vinyl chloride, 1,1-dichloroethene, trichloroethene, and tetrachloroethene in the regional aquifer zone. The estimated risks associated with exposure to surface water and deep sediments (0-5 feet) for on-base workers performing construction work in the creek are less than 1×10^{-6} (one in one million) for both the E1 and W1 stream segments.

According to EPA policy, the target total individual carcinogenic risk resulting from exposures at a CERCLA site may range from 1×10^{-4} (one in ten thousand) to 1×10^{-6} (one in one million) (EPA, 1989a). Thus, potential remedial alternatives should be capable of reducing total potential carcinogenic risks to individuals to levels within this range. EPA further suggests that the 10^{-6} (one in one million) risk level should be used as a starting point.

In conclusion, each portion of the aquifer system at the Soldier Creek Site has the potential for carcinogenic risk greater than 1×10^{-6} (one in one million) for all scenarios; exposure to the surface water and sediments has a low potential for carcinogenic risks in all scenarios.

5.3 Cleanup Levels

Risk-based cleanup levels have been calculated and are presented in Appendix C, Tables C-1 through C-5 (pages C-1 through C-6). The cleanup levels are calculated for each of the five media of concern: the perched aquifer, the top of regional aquifer zone, the regional aquifer zone, surface water and sediment. Only groundwater cleanup levels are exceeded at the Soldier Creek Site. It is for this reason that remediation of groundwater will be evaluated separately from surface water and sediment for the Soldier Creek Site. Two carcinogenic cleanup levels have been calculated, one for a cleanup to a carcinogenic risk of 1×10^{-4} (one in ten thousand) and one to a cleanup level of 1×10^{-6} (one in one million). These two values bracket the acceptable risk range as defined by EPA. The three aquifer zones all show contaminants present in excess of both the noncarcinogenic cleanup level

and the carcinogenic cleanup levels. Surface water and sediment contamination levels are all well below the carcinogenic and noncarcinogenic cleanup levels.

5.4 Uncertainties in the Risk Characterization

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

- Chemicals not included.
- Exposure pathways not considered.
- Derivation of exposure point concentrations.
- Intake uncertainty.
- Toxicological dose-response and toxicity value uncertainty.
- Synercistic effects of multiple contaminants.

The quantitative risk characterization processes that were identified include the fact that the slope factors used to calculate oral carcinogenic risks for carcinogenic PAH compounds were based on benzo(a)pyrene. There are also uncertainties associated with summing cancer risks or hazard indices for different chemicals. This assumption of dose additivity ignores possible synergism or antagonism among chemicals and differences in mechanisms of action and metabolism. It is not known what effects these uncertanties have on the total risk estimation.

Another important uncertainty concerns the fact that risk calculations for dermal exposure to carcinogenic PAHs were not performed. It is likely that risk for exposure to carcinogenic PAHs is underestimated. However, because carcinogenic PAHs are not one of the primary contributors to carcinogenic risk at the Soldier Creek Site, these factors are relatively less important in the overall view of risk levels. These uncertainties and the uncertainties discussed in previous sections need to be considered when evaluating the results of the risk assessment and when making risk management decisions for the site.

6.0 ENVIRONMENTAL ASSESSMENT

6.1 Overview

This section provides an assessment of potential impacts to biotic receptors due to contaminants present at the Soldier Creek Site. This assessment utilizes data from Phases I and II of the RI field investigation for the site. In this analysis, contaminants of potential concern identified for the human health risk assessment were not necessarily the same as those used for the environmental assessment. Further discussions of chemicals of concern are presented in Subsection 6.3. The assessment is comprised of five major sections: overview, site and study area description, chemicals of concern, exposure characterization, and risk characterization. The assessments of risk are limited primarily to the population (species) level because data on community and ecosystem level responses to environmental pollutants generally are lacking. However, where possible, the implications of population level impacts on the community or ecosystem are discussed.

6.1.1 Objectives

The objective of the environmental assessment is to determine the extent of potential environmental injury caused by contaminant releases at the Soldier Creek Site. The objective is attained by documenting injury to environmental receptors (i.e., natural resources including air, surface water, groundwater, soil, geological units, agricultural operations, and naturally occurring communities), assessing the impact to receptors of continued release and exposure, and assessing potential for environmental recovery.

6.1.2 Scope of the Investigation

This environmental assessment incorporates data collected during Phases I and II of the RI field investigation along with information from other studies and literature resources to provide an assessment of potential impacts to biota in and around Soldier Creek due to releases of contaminants from the Soldier Creek Site. Detailed field surveys and toxicity testing were not completed as part of the scope of this assessment.

The groundwater, surface water, and sediment samples were analyzed for volatile and semi-volatile organic and inorganic compounds.

6.2 Site and Study Area Description

6.2.1 Zoning/Site Description

A detailed description of the site and the surrounding area has been included in Subsection 3.2 of this report.

6.2.2 Climatology

A discussion of climatology has been included in Subsection 3.2 of this report.

6.2.3 Water Classification

The Oklahoma Water Resources Board has designated Soldier Creek, Crutcho Creek, and the North Canadian River (from State Highway 99 to Carbon Reservoir Dam) under water quality management Segment 520520 (OWRB, 1989a). Beneficial uses of the North Canadian River from the State Highway 99 Bridge to the Portland Street Bridge include emergency water supply, primary warm water fishery, agriculture, manufacturing and industrial (M&I) process and cooling water, primary recreation and aesthetics. Crutcho Creek from North Canadian River to SE 15th Street has beneficial uses including primary warm water fishery, agriculture, M&I process and cooling water, primary recreation, and aesthetics. Crutcho Creek upstream from SE 15th Street has beneficial uses including habitat limited fishery, agriculture, M&I process and cooling water, secondary recreation, and aesthetics. The Stinahcomb Wildlife Refuge is within the 520520 water quality management segment.

6.2.4 Management or Preserve Areas and Parks

No management or preserve areas were identified in the area of the Soldier Creek Site.

6.2.5 Critical or Sensitive Species and Habitats

Twelve Oklahoma species have been listed on the Federal Endangered Species list. They include species of four mammals, seven birds, and one reptile. Two fish species have been classified as threatened, the leopard darter (*Percina pantherina*) and the ozark cavefish (*Amblyospsis rosae*). Mammals that are considered endangered are the grey bat (*Myotis grisescens*), the Indiana bat (*Myotis sodalis*), the Ozark big-eared bat (*Pleocotus townsendii ingens*), and the black-footed ferret (*Mustela nigripes*).

Endangered bird species include the American peregrine falcon (*Falcon peregrinus anatum*), the bald eagle (*Haliaeetus leucocephalus*), the whooping crane (*Grus americana*), the interior least tern (*Stema antillarum*), and the red-cockaded woodpecker (*Picoides borealis*). The American alligator (*Alligator mississippiensis*) is the endangered reptile (ONHI, 1989).

The Oklahoma Natural Heritage Inventory (ONHI) found four significant species in the area. The Oklahoma beardtongue (*Penstemon oklahomensis*) is a rare state plant species. The Prairie mole cricket (*Gryllotalpa major*) is a seriously imperiled state species. Ozark poverty grass (*Sporobolus ozarkanus*) is an imperiled state plant species. Sedge (*Carex fissa*) is a rare state plant species.

6.3 Chemicals of Concern

6.3.1 Chemicals and Concentrations

The chemicals of concern for the environmental assessment were selected on the basis of the positive identification of the chemical in the samples collected during the RI. Special consideration was made for environmental exposure media that have the greatest potential for injury to environmental receptors. In certain cases, contaminants that were identified in samples were also selected because of their known toxicity to animal species. A list of the chemicals of concern for the environmental assessment is provided in Tables 6-1 (page 6-4) and 6-2 (page 6-5).

6.3.2 Toxicity and Chemical Characteristics

This section includes a brief description of the toxicity of the chemicals of environmental concern.

Organic Chemicals. Acetone. Bioconcentration in aquatic organisms and adsorption to sediment should not be significant. In the atmosphere, acetone will be lost by photolysis and reaction with photochemically produced hydroxyl radicals. The estimated half-life from these combined processes averages 22 days and is shorter in summer and longer in winter. Acetone will also be washed from the atmosphere by rain. Occupational exposure to acetone will be by dermal contact with solvents containing the chemical and inhalation of the vapor (Howard, 1989).

TABLE 6-1
SURFACE WATER CHEMICALS OF CONCERN
FOR ENVIRONMENTAL ASSESSMENT
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

VOLATILES	SEMI-VOLATILES	METALS
1,1,1-Trichloroethane	Bis(2-ethylhexyl)phthalate	Aluminum
1,2-Dichloroethane	Di-n-octylphthalate	Antimony
Acetone	Polycyclic Aromatic Hydrocarbons (PAHs)	Arsenic
Benzene		Barium
Bromodichloroethane		Beryllium
Bromoform		Cadmium
Carbon Disulfide		Chromium
Chlorobenzene		Cobalt
Dibromochloromethane		Copper
Methylene Chloride		Cyanide
Tetrachloroethene		Iron
Toluene		Lead
Trichloroethene		Manganese
Xylene		Nickel
		Potassium
		Selenium
		Silver
		Sodium
		Vanadium
		Zinc

TABLE 6-2
SEDIMENT CHEMICALS OF CONCERN
FOR ENVIRONMENTAL ASSESSMENT
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

VOLATILES	SEMI-VOLATILES	METALS
1,2-Dichloroethane	1,2-Dichlorobenzene	Aluminum
Acetone	1,3-Dichlorobenzene	Antimony
Benzene	1,4-Dichlorobenzene	Arsenic
Bromoform	3-3'-Dichlorobenzidine	Barium
Carbon Disulfide	Bis(2-ethylhexyl)phthalate	Beryllium
Chlorobenzene	Butylbenzylphthalate	Cadmium
Chloroethane	Dibenzofuran	Chromium
Methylene Chloride	Di-n-butylphthalate	Cobalt
Tetrachloroethene	Di-n-octylphthalate	Copper
Toluene	Polycyclic Aromatic Hydrocarbons (PAHs)	Cyanide
Trichloroethene		Iron
Vinyl Acetate		Lead
Xylene		Magnesium
		Manganese
		Mercury
		Nickel
		Potassium
		Selenium
		Silver
		Sodium
		Thallium
		Vanadium
		Zinc

The tendancy of a chemical to concentrate in living tissues is called the bioconcentration factor (BCF). The BCF is a quotient of the concentration of the chemical in one or more of the tissues of an aquatic organism divided by the average concentration in the solution in which the organism had been living (EPA, 1987a). BCFs are directly proportional to octanol/water coefficients. Using the recommended log octanol/water partition coefficient (log Kow), the potential for acetone bioconcentration in fish is negligible. One experimental study of bioconcentration in adult haddock at 7-9C (static test) resulted in a BCF of 0.69 (Howard, 1989).

Benzene. Data are not considered sufficient to develop ambient water quality criteria for benzene (EPA, 1987a). The toxicity of a chemical can be expressed in terms of the LOEL, or lowest observed effect level. The LOEL is the lowest experimental concentration at which a chemical causes an observable change in the species under investigation (Travis, 1988). The acute LOEL is 15,300 ug/L for juvenile trout (the most sensitive species tested). No data are available on chronic effects to freshwater aquatic life (EPA, 1990a).

The available data for benzene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 5,100 ug/L. No definitive data are available concerning the chronic toxicity of benzene to sensitive saltwater aquatic life, but adverse effects occur at concentrations as low as 700 ug/L with a fish species exposed for 168 days. A BCF of 4.4 was found in a 48-hour static exposure of Pacific herring to benzene (EPA, 1990a).

Benzene has high acute toxicity to aquatic life. It can cause death in plants and roots and membrane damage in leaves of various agricultural crops. No data are available on the short-term effects of benzene on birds or land animals. Benzene has high chronic toxicity to aquatic life. No data are available on the long-term effects of benzene on plants, birds, or land animals (EPA, 1990a).

Benzene is moderately soluble in water; concentrations of between 1 to 1,000 milligrams will mix with a liter of water. Benzene is slightly persistent in water, with a half-life of between 2 to 20 days. About 99.5 percent of benzene will eventually end up in air; the rest will end up in the water. The concentration of benzene found

in fish tissues is expected to be somewhat higher than the average concentration of benzene in the water from which the fish was taken (EPA, 1990a).

Bis(2-ethylhexyl)phthalate and Di-n-octylphthalate. No ambient water quality criteria are available for these contaminants. EPA reports acute and chronic LOELs for phthalate esters for aquatic organisms of 940 and 3 ug/L, respectively (EPA, 1985b). The concentration of a chemical can be expressed in terms of the LC_{50}, which is the dose lethal to 50 percent of the animals being tested. *Daphnia magna* exposed to bis(2-ethylhexyl)phthalate had a lethal concentration with an associated LC_{50} of 11,000 ug/L (Kamrin, 1988). Chronic toxicity was observed at 8.4 ug/L in rainbow trout (EPA, 1985b). *Daphnia magna* had significant adverse reproductive effects at 3 ug/L (EPA, 1985b).

The available data for phthalate esters indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 2,944 ug/L. No data are available concerning the chronic toxicity of phthalate esters to sensitive saltwater aquatic life, but toxicity to one species of algae occurs at concentrations as low as 3.4 ug/L.

Bioconcentration factors for fish and aquatic invertebrates range from 54 to 2,680 (EPA, 1980). Bis(2-ethylhexyl)phthalate has a log Kow of 5.11, indicating a high potential for bioaccumulation as is demonstrated by a BCF in scud (*Gammarus pseudolimnaeus*) of 13,600 after seven days of exposure to 0.1 ug/L. While this is high, it is somewhat offset by a biologic half-life of about four weeks. A BCF of 800 was found in fathead minnows exposed to 2.5 ug/L bis(2-ethylhexyl)phthalate for 28 days. The weighted average BCF for the edible portions of all freshwater and estuarine species consumed in the United States was 130 (EPA, 1985b).

Bromodichloromethane. No information was found concerning the adverse environmental effects of bromodichloromethane.

Bromoform. No information was found concerning the adverse environmental effects of bromoform.

Carbon Disulfide. Carbon disulfide has moderate acute and high chronic toxicity to aquatic life. No data were available on the short- or long-term effects of carbon disulfide to plants, birds, or land animals (EPA, 1990a).

Chlorobenzene. Chlorobenzene has moderate acute toxicity to aquatic life. The acute toxicity of chlorobenzene in small mammals was found to be low. Mice exposed for two hours to chlorobenzene were found to have an estimated acute inhalation LC_{50} of 20 mg/l (4,300 ppm). In acute (single exposure) studies in cats, all animals died 2 hours after removal from exposure following inhalation of 8,000 ppm and after seven hours at 3,700 ppm (ATSDR, 1990). Insufficient data are available to evaluate or predict the short-term effects of chlorobenzene to plants, birds, or land animals.

Chlorobenzene has moderate chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the long-term effects of chlorobenzene to plants, birds, or land animals. It is moderately soluble in water. Concentrations of between 1 and 1,000 mg/l will mix with water. Chlorobenzene is slightly persistent in water, with a half-life of between 2 to 20 days. About 99.25 percent of chlorobenzene will eventually end up in air; the rest will end up in the water (EPA, 1990a).

Chloroform. Chloroform has moderate acute and chronic toxicity to aquatic life. Chloroform has caused damage to various plants, including brittleness in roots and chromosomal damage. No data are available on the short- or long-term effects of chloroform on birds or land animals (EPA, 1990a).

Chloroform has little or no tendency to bioconcentrate. The following fish BCFs have been determined: bluegill sunfish (*Lepomis macrochirus*), 3.34-10.35; rainbow trout (*Salmo gairdneri*), 1.6-2.5; bluegill (*Lepomis macrochirus*), 2.9-3.1; largemouth bass (*Micropterus salmoides*), 3.3-3.7 (Howard, 1989).

1,2-Dichlorobenzene. 1,2-Dichlorobenzene has moderate acute toxicity to aquatic life and has caused injury, stunting, and harvest yield decrease in various agricultural crops. Insufficient data are available to evaluate or predict the short-term effects of 1,2-dichlorobenzene to birds or land animals. 1,2-Dichlorobenzene has moderate

chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the long-term effects of 1,2-dichlorobenzene to plants, birds, or land animals.

1,2-Dichlorobenzene is slightly soluble in water. Concentrations of less than 1 mg/l will dissolve in water. It is slightly persistent in water, with a half-life of between 2 to 20 days. About 97.5 percent of 1,2-dichlorobenzene will end up in water, about 0.5 percent will end up in terrestrial soil, and the rest will end up in aquatic sediments. Some bioaccumulation is expected in fish (EPA, 1990a).

1,2-Dichloroethene. Bioconcentration factors in fish ranging between 5 and 23 have been estimated for the 1,2-dichloroethene isomers using linear regression equations based on log Kow and water solubility data. These BCFs suggest that these compounds do not bioconcentrate significantly in aquatic organisms. Based on this information, there is little potential for biomagnification within the food chain (ATSDR, 1989).

Ethylbenzene. No information on the toxicity of ethylbenzene to terrestrial wildlife was available (EPA, 1985b). Laboratory studies have found an oral LD_{50} of 3,000 mg/kg in the rat. Test animals subjected to both acute and chronic exposures developed liver and kidney pathologies and nervous system disorders. No toxic effects were seen during a six-month oral exposure of 13.6 and 136 mg ethylbenzene/kg of body weight/day to rats (EPA, 1985b).

Ethylbenzene was acutely toxic to freshwater species at levels greater than 32 mg/L. No chronic toxicity was reported, but the highest test dose (440 ug/L) was only one-hundredth of the 96-hour LC_{50} for the particular species being tested. No studies on the bioaccumulation of ethylbenzene were reported in the information reviewed, but a bioconcentration factor of 95 was calculated using the log octanol/water partition coefficient. The ambient water quality criterion for acute freshwater toxicity is 32,000 ug/L and 430 ug/L for acute saltwater toxicity (EPA, 1985b).

Methylene Chloride. The available data for halomethanes indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 11,000 ug/L and would occur at lower concentrations among species that are more sensitive than those

tested. No data are available concerning the chronic toxicity of halomethanes to sensitive freshwater aquatic life.

The available data for halomethanes indicate that acute and chronic toxicity to saltwater aquatic life occurs at concentrations as low as 12,000 and 6,400 ug/L, respectively, and would occur at lower concentrations among species that are more sensitive than those tested. A decrease in algal cell numbers occurs at concentrations as low as 11,500 ug/L (EPA, 1990a).

Polycyclic Aromatic Hydrocarbons (PAHs). PAHs are lipophilic and therefore are accumulated in plants. Plants have the ability to absorb PAHs from soil or by atmospheric deposition and translocate them to other parts of the plant. In vegetation, levels of benzo(a)pyrene range from 10-20 ug/kg dry weight; higher concentrations of benzo(a)pyrene in fruits and vegetables have been reported in produce harvested from suburban gardens and gardens near industrial areas. Lettuce contained the largest amount: 23 ug/kg dry weight in the suburbs, and 150 ug/kg dry weight in industrial areas. It has been reported that only 10 percent of the benzo(a)pyrene content externally applied to a variety of garden vegetables can be removed by washing with cold water following external applications. In addition, PAHs have been found in phytoplankton and specifically in diatoms and green algae (Forrest et al., 1989).

Many PAHs are well-documented carcinogens in mammalian systems and mutagens in a variety of bioassays. Plants have been viewed as potential carriers or modifiers of PAHs in the food chain. Little attention has been paid to the effects of PAHs on plants. Neither the extent to which plant growth is altered by PAHs nor the biological consequences as a result of bioaccumulation have been elucidated. The growth effect of various PAHs on hydrocultures of tobacco, rye, radish, and algae were studied. The PAH-induced growth stimulation of plants correlated with the relative carcinogenic potency of the PAHs in animals (Forrest et al., 1989).

Contamination of soils with petroleum hydrocarbons has an influence on plant growth. It was reported that when soils are severely contaminated with petroleum hydrocarbons, vegetative growth usually is greatly decreased or eliminated. After the PAH source is removed, the growth of vegetation is often greater than on adjacent

uncontaminated soil. It was speculated that enhanced growth in the contaminated soil could be explained by an increase in nitrogen and water-holding capacity of the soil as a result of increased microbiological activity (Forrest et al., 1989). PAH-induced tumors have been reported in plants and fungi. It has been reported that PAH-containing mudwaste pollution from the coal chemical industry produced tumorous growth on the marine alga, *Porphyra tenera*. Two neutral-pH components were isolated and identified as the tumor-promoting factors. Mushrooms have also been reported to develop tumors as a result of growth on PAH-contaminated soil (Forrest et al., 1989).

In two separate investigations, PAHs induced plant morphogenesis in vitro. Vegetative bud induction by benz[a]anthracene was reported in tobacco callus in the absence of exogenous plant growth regulators. In a similar experiment, 7,12-dimethylbenz[a]anthracene induction of vegetative bud formation was observed in *Haworthia callus* (Forrest et al., 1989).

In terrestrial species, the primary toxic effect of PAH exposure is tumor development. Chronic oral doses of 7,12-dimethylbenzanthracene at 0.04 ug/kg have induced cancer in laboratory rodents. Much higher doses have induced cancer following short-term exposures. Food consumption in deer mice and house mice was decreased following oral exposure for five days to 825 or 1,213 mg/kg of 2-methoxynaphthalene. In birds, exposure to diets containing various PAHs at a total concentration of 4,000 ppm caused increased liver weights and blood flow to the liver.

Toluene. Toluene has moderate acute toxicity to aquatic life. Toluene has caused leaf membrane damage in plants. Insufficient data are available to evaluate or predict the short-term effects of toluene to birds or land animals. Toluene has moderate chronic toxicity to aquatic life.

Insufficient data are available to evaluate or predict the long-term effects of toluene to plants, birds, or land animals (EPA, 1990a).

Little information is available on the toxicity of toluene to terrestrial species. Rabbits given a single oral dose of 275 mg/kg body weight excreted 74 percent of the total dose within 24 hours, indicating a short biologic half-life. Oral LD_{50} for rats range

from 4,300 to 7,500 mg/kg. A no observed effect level (NOEL) of 30 mg/kg/day has been reported for a study with rats. Information on avian toxicity is not available (EPA 1981).

Toluene is slightly soluble and non-persistent in water. It has a half-life in water of less than two days. About 99.5 percent of toluene will eventually end up in air; the rest will end up in water. The concentration of toluene found in fish tissues is expected to be somewhat higher than the average concentration of toluene in the water from which the fish was taken (EPA, 1990a).

The available data for toluene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 17,500 ug/L. No data are available concerning the chronic toxicity of toluene to sensitive freshwater aquatic life. The available data for toluene indicate that acute and chronic toxicity to saltwater aquatic life occurs at concentrations as low as 6,300 and 5,000 ug/L, respectively (EPA, 1990a).

1,1,1-Trichloroethane. The available freshwater data for chlorinated ethanes indicate that toxicity increases greatly with increasing chlorination and that acute toxicity occurs at concentrations as low as 118,000 ug/L for 1,2-dichloroethane, 18,000 ug/L for two trichloroethanes, 9,320 ug/L for two tetrachloroethanes, 7,240 ug/L for pentachloroethane, and 980 ug/L for hexachloroethane. Chronic toxicity occurs at concentrations as low as 20,000 ug/L for 1,2-dichloroethane, 9,400 ug/L for 1,1,2-trichloroethane, 2,400 ug/L for 1,1,2,2-tetrachloroethane, 1,100 ug/L for pentachloroethane, and 540 ug/L for hexachloroethane (EPA, 1990a).

The available saltwater data for chlorinated ethanes indicate that toxicity increases greatly with increasing chlorination and that acute toxicity to fish and invertebrate species occurs at concentrations as low as 113,000 ug/L for 1,2-dichloroethane, 31,200 ug/L for 1,1,1-trichloroethane, 9,020 ug/L for 1,1,2,2-tetrachloroethane, 390 ug/L for pentachloroethane, and 940 ug/L for hexachloroethane. Chronic toxicity occurs at concentrations as low as 281 ug/L for pentachloroethane (EPA, 1990a).

Trichloroethene. Trichloroethene has moderate acute toxicity to aquatic life. Insufficient data are available to evaluate or predict the short-term effects of trichloroethene to plants, birds, or land animals. Trichloroethene has moderate

chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the long-term effects of trichloroethene to plants, birds, or land animals (EPA, 1990a).

Trichloroethene is moderately soluble in water; concentrations of between 1 to 1,000 milligrams will mix with a liter of water. Trichloroethene is non-persistent in water, with a half-life of less than two days. About 99.6 percent of trichloroethene will eventually end up in air; the rest will end up in the water. The concentration of trichloroethene found in fish tissues is expected to be somewhat higher than the average concentration of trichloroethene in the water from which the fish was taken (EPA, 1990a).

Xylenes (o,m,p). Xylene is a mixture of the three isomers of xylene (ortho, meta, para), with possible trace amounts of ethylbenzene. Most of the xylene is released into the atmosphere where it may photochemically degrade by reaction with hydroxyl radicals (half-life 1.0-18 hours). The dominant removal process in water is volatilization. Xylene is moderately mobile in soil and may leach into groundwater where it has been known to be detectable for several years, although there is evidence that it biodegrades in both soil and groundwater. This may be because xylene degrades under aerobic conditions and denitrifying conditions appear to be required when oxygen is lacking. Bioconcentration is not expected to be significant. The primary source of exposure is from the air, especially where emissions from petroleum products or motor vehicles are high or solvents containing xylene are used (Howard, 1989).

Xylene has high acute and chronic toxicity to aquatic life. Xylene causes injury to various agricultural and ornamental crops. Insufficient data are available to evaluate or predict the short- or long-term effects of xylene to birds or land animals. Little bioconcentration has been observed: BCF is 1.33 and 0.79 for eels and clams, respectively. Based on the measured log Kow, one would estimate that the BCF in fish would be 2.12 (Howard, 1989).

Inorganic Chemicals. Antimony. No information was found concerning the adverse environmental effects of antimony.

Arsenic. Arsenic is a naturally occurring element, which is used to make glass, cloth, and electrical semiconductors. It is also commonly used in fungicides, wood preservatives, growth stimulants for plants and animals, and in veterinary uses. Arsenic metabolism and effects are significantly influenced by the animal/plant tested, the route of administration, the physical and chemical form of the arsenic, and the dose. Inorganic arsenic compounds are more toxic than organic arsenic compounds. Arsenic has high acute toxicity to aquatic life, birds, and land animals. Except where soil arsenic content is high (around smelters and where arsenic-based pesticides have been used heavily), arsenic does not accumulate in plants to toxic levels. Where soil arsenic content is high, growth and crop yields can be decreased. Arsenic has high chronic toxicity to aquatic life and moderate chronic toxicity to birds and land animals (EPA, 1990a).

Arsenic and its salts have low solubility in water (<1 mg/L). It is highly persistent in water, with a half-life of more than 200 days. It is also expected to be found at higher levels in fish tissue than in the surrounding waters (EPA, 1990a).

Barium. No information was found concerning the adverse environmental effects of barium.

Cadmium. In fresh waters, cadmium toxicity is influenced by water hardness -- the harder the water, the lower the toxicity. Cadmium has high acute toxicity to aquatic life. No data are available on the short-term effects of cadmium on plants, birds, or land animals. Cadmium has high chronic toxicity to aquatic life. No data are available on the long-term effects of cadmium to plants, birds, or land animals (EPA, 1990a).

Cadmium is slightly soluble in water. The solubility in water is less than 1 mg/L. It is highly persistent in water, with a half-life of more than 200 days. It is also expected to be found at higher levels in fish tissue than in the surrounding waters (EPA, 1990a).

Chromium. Chromium is a metallic element that exists mainly in the 3+ (III) or 6+ (VI) oxidation states in natural bodies of water, and each form can be converted to the other form under appropriate environmental conditions. Chromium is more toxic

in soft water than in hard water. Chromium (VI) has high acute toxicity to aquatic life, and chromium (III) has moderate acute toxicity to aquatic life. Chromium (III) and chromium (VI) both have high chronic toxicity to aquatic life. No data are available on the short- or long-term effects of chromium to plants, birds, or land animals (EPA, 1990a).

Water solubility of chromium and its salts ranges from low to high. It is highly persistent in water, with a half-life of more than 200 days. It is also expected to be found at higher levels in fish tissue than in the surrounding waters (EPA, 1990a).

Cobalt. Cobalt is a natural element present in certain ores of the earth's crust and is essential to life in trace amounts. Cobalt and its salts have high acute and chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the short- and long-term effects of cobalt and its salts to plants, birds, or land animals (EPA, 1990a).

The water solubility of cobalt and its salts range from highly soluble to practically insoluble. Cobalt and its salts are highly persistent in water, with a half-life of more than 200 days. It is also expected to be found at higher levels in fish tissue than in the surrounding waters (EPA, 1990a).

Copper. The toxicity of copper and its compounds to aquatic life varies with the physical and chemical conditions of the water. Factors such as water hardness, alkalinity and pH influence copper toxicity. At low concentrations it is an essential element for both plants and animals. At slightly higher concentrations it is toxic to aquatic life. Copper and its compounds have high acute and chronic toxicity to aquatic life. No data are available on the short- and long-term effects of copper to plants, birds, or land animals (EPA, 1990a).

Copper and its salts are highly soluble in water (up to 1,000 mg/l). It is also highly persistent with a half-life of more than 200 days. It is also expected to be found at higher levels in fish tissue than in the surrounding waters (EPA, 1990a).

Lead. Toxicity of lead to aquatic life is affected by water hardness -- the softer the water, the greater the toxicity. Insufficient data are available to evaluate or predict

the short-term effects of lead and its compounds to plants, birds, or land animals. Lead and its compounds have high chronic toxicity to aquatic life. Lead and its compounds cause nerve and behavioral effects in humans and could cause similar long-term effects in birds and land animals (EPA, 1990a).

Lead and its compounds range in their respective water solubilities from highly soluble to practically insoluble. It is also highly persistent with a half-life of more than 200 days. It is also expected to be found at higher levels in fish tissue than in the surrounding waters (EPA, 1990a).

Manganese. Manganese occurs in many minerals that are widely distributed in the earth's crust and, in trace amounts, is an essential element for both plants and animals. The many different possible manganese compounds may enter the aquatic environment from natural and industrial sources. Manganese and its compounds have moderate acute and chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the short- and long-term effects to plants, birds, or land animals (EPA, 1990a).

Manganese and its compounds range in their respective water solubilities from very soluble to insoluble. It is also highly persistent with a half-life of more than 200 days. Manganese is expected to be found at about the same levels in fish tissue as in the surrounding waters (EPA, 1990a).

Nickel. No information was found concerning the adverse environmental effects of nickel.

Selenium. In aerobic waters and at high pH, selenium is present in the selenite (+4) or selenate (+6) oxidation state. These chemical species are very soluble, and it is probable that most of the selenium released into the aquatic environment is transported in these forms to the oceans. Under reducing conditions and at low pH, elemental selenium or metal selenides can be formed. Similar chemical speciation patterns affect the transport of selenium in soil. In poorly aerated, acidic soils, insoluble forms predominate. In well-aerated, alkaline soils, soluble forms of selenium subject to leaching and compounds readily taken up by plants tend to be formed (EPA, 1990a).

Selenium is strongly adsorbed to hydrous metal oxides, while clays and organic materials have a lesser affinity. Sorption by bed sediments or suspended solids and precipitation with hydrous iron oxides are probably the major control on mobility of selenium in aerobic water. However, most selenium in aquatic systems is probably transported as the dissolved species. Experimental studies indicate that selenium is quite mobile in clays, especially under alkaline conditions (EPA, 1990a).

Selenium is bioaccumulated by aquatic and terrestrial organisms. Although dietary intake is thought to be the most important source of selenium in many organisms, little biomagnification appears to take place. Conversion of selenium to inert and insoluble forms may occur in terrestrial and aquatic organisms. However, selenium can be methylated by a variety of organisms, including benthic microflora. In a reducing environment, hydrogen selenide (H_2Se) may be formed. Both the methylated forms and H_2Se are volatile and can be released to the atmosphere. Consequently, remobilization of selenium from aquatic and terrestrial systems, through biotransformation to volatile forms and subsequent atmospheric transport, can result in significant recycling (Howard, 1989).

Silver. Silver is highly persistent in water, with a half-life of more than 200 days. The toxicity of silver to aquatic life is probably dependent on water hardness -- the harder the water, the higher the concentration of silver needed to be toxic. Insufficient data are available to evaluate or predict the short-term effects of silver and its compounds to plants, birds, or land animals. Silver and its compounds have high chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the long-term effects of silver to plants, birds, or land animals (EPA, 1990a).

Vanadium. No information on the fate of vanadium in the environment was found in the literature.

Vanadium is poisonous to all animals, except in very small doses, no matter how it is administered. The pentavalent compounds, such as vanadium pentoxide and vanadates, are more toxic than other forms (ACGIH, 1986).

Zinc. The toxicity of zinc to aquatic life is related to water hardness, with increased toxicity occurring in softer waters. Zinc and its salts have high acute and chronic toxicity to aquatic life. Insufficient data are available to evaluate or predict the short- or long-term effects of zinc and its compounds to plants, birds, or land animals (EPA, 1990a).

Zinc exists as a variety of salts, many of which are highly soluble in water. It is also highly persistent with a half-life of more than 200 days. Zinc is expected to be found at about the same levels in fish tissue as in the surrounding waters (EPA, 1990a).

6.4 Exposure Characterization

6.4.1 Potential Receptors

In this section, the plant and animal species which are either documented to occur or expected to occur at the Soldier Creek Site are identified.

Birds. Approximately 400 species are officially found in Oklahoma. Several major families of birds may be found in the Oklahoma City area. Table 6-3 (pages 6-19 through 6-20), lists species that are common to the region.

Mammals. More than 100 mammals are found in Oklahoma. Most Oklahoma mammals are completely fur-covered, while others display only sparse patches of fur. Table 6-4 (page 6-21), list species which are common to the site area.

Amphibians and Reptiles. A great number of amphibians and reptiles are native to Oklahoma. Typical species that might be found at the Soldier Creek Site vicinity are listed in Table 6-5 (page 6-22).

Plants. The forest trees of Oklahoma, as cited in the List of Tree Species and as summarized here, total 164 species (143 native and 21 introduced) in 71 genera (61 native and 10 introduced) and in 42 plant families (39 native and 3 introduced). Twenty-one introduced species, are sufficiently common for inclusion, though only a few are widely naturalized (Little, 1985).

TABLE 6-3
BIRD SPECIES FOUND IN THE SOLDIER CREEK SITE AREA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	SCIENTIFIC NAME
Pelicans and Cormorants	
American White Pelican	*Pelecanus erythrorhynches*
Double Crested Cormorant	*Phatacrocurzx auritus*
Wading Birds	
Great Egret	*Casmerodium albus*
Snowy Egret	*Egretta Thula*
Little Blue Heron	*Florida caerulea*
Cattle Egret	*Bubulous ibis*
Black-Crowned Night Heron	*Nycticorax nycticurax*
Water Fowl	
Canada Goose	*Branta canadensis*
Green Winged Teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Blue Winged Teal	*Anas discurs*
Northern Shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
American Widgeon	*Anas americana*
Redhead	*Aythya american*
Lesserscrap	*Aythya affinis*
Common Merganser	*Mergus merganser*
Roddyduck	*Oxyura jamaicensis*
Vultures, Hawks, and Falcons	
Mississippi Kite	*Ictinis mississippiensis*
Red Tailed Hawk	*Buteo jamaicensis*
Quail	
Northern Bobwhite	*Colinus viginiarus*
Cranes and Rails	
American Coat	*Fulica Americana*
Shore Birds	
Killdeer	*Charadrius vociferus*
American Arocat	*Recurvirostra americana*
Lesser Yellowlegs	*Tringa flaripes*
Spotted Sandpiper	*Actitis macularia*
Western Sandpiper	*Caldris mauri*
Least Sandpiper	*Caldris minutilla*
White Rumped Sandpiper	*Caldris Fuscicullis*
Bairds Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Stilt	*Micropalama himantopus*
Wilson's Phalarope	*Steganopus tricolor*

TABLE 6-3 (Continued)
BIRD SPECIES FOUND IN THE SOLDIER CREEK SITE AREA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	SCIENTIFIC NAME
Gulls and Terns	
Franklin's Gull	*Larus pipixcan*
Ring-billed Gull	*Lauus delewarensis*
Herring Gull	*Larus argentatus*
Foster's Tern	*Stema forsteri*
Black Tern	*Chlidonizas niger*
Interior Least Tern	*Sterna antillarum*
Doves	
Rock Dove	*Columbia livia*
Mourning Dove	*Zenaida macroura*
Cuckoos	
Yellow-billed Cuckoo	*Coccyzus americanus*
Nighthawks, Swifts, and Hummingbirds	
Common Nighthawk	*Chordeiles minor*
Chimney Swift	*Chaetura pelagica*
Woodpeckers	
Northern Flicker	*Colaptes auratus*
Flycatchers	
Western Kingbird	*Tyrannus verticalis*
Eastern Kingbird	*Tyrannus tyrannus*
Scissor-tailed Flycather	*Muscivora forficata*

Source:
ODWC, 1984; ODWC, Date Unknown a

TABLE 6-4
OKLAHOMA MAMMALS COMMON TO SOLDIER CREEK SITE REGION
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	SCIENTIFIC NAME
Eastern Fox Squirrel	*Sciurus niger*
Southern Flying Squirrel	*Glaucomys volans*
13-Lined Ground Squirrel	*Cittellus tridecomlineatus*
Plains Pocket Gopher	*Geomys bursarius*
Eastern Cotton Tail	*Syvilagus floridanus*
Blacktailed Jack Rabbit	*Lepus california*
Beaver	*Castor canadonsis*
Muskrat	*Ondatra zibethica*
White Footed Mouse	*Permyscus leucopus*
Least Shrew	*Cryptotis parva*
Eastern Mole	*Scalopus aquaticus*
Oppossum	*Didelphis marsupialis*
Armadillo	*Dasypus novemcintus*
Striped Skunk	*Methitis mephitis*
Spotted Skunk	*Spilogale putorius*
Badger	*Taxidea taxus*
Longtail Weasel	*Mustella Frenata*
Mink	*Mustela vison*
Racoon	*Procyon lotor*
Bobcat	*Lynx rufs*
Coyote	*Canis latrans*
Whitetail Deer	*Odocoileus viginianus*
Shorttail Shrew	*Blarina brevicauda*
Red Bat	*Lasiurus borealis*
Silver-Haired Bat	*Lasionyctens noctivagans*
Hoary Bat	*Lasiurus cinereus*
Western Big-Eared Bat	*Plecotus townsendi*
River Otter	*Lutra canadensis*
Deer Mouse	*Peromyscus maniculatus*
Brush Mouse	*Peromyscus boylei*
Hispid Cotton Rat	*Sigmodon hispidus*

Source:
ODWC, Date Unknown b

TABLE 6-5
AMPHIBIANS AND REPTILES FOUND IN THE SOLDIER CREEK SITE AREA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	SCIENTIFIC NAME
AMPHIBIANS:	
Woodhouse's Toad	*Bufo woodhousei*
Northern Cricket Frog	*Acris crapitans*
Spotted Chorus Frog	*Pseudacris clarki*
REPTILES:	
Snapping Turtle	*Chelydra serpentina*
Yellow Mud Turtle	*Kinosternon Flavescans*
Western Box Turtle	*Terrapene ornata*
Smooth Softshell Turtle	*Trionyx muticus*
Spiny Softsheel Turtle	*Trionyx spinifarus*
Collared Lizard	*Crotaphytus collaris*
Lesser Earless Lizard	*Holbrookia maculata*
Texas Horned Lizard	*Phrynosoma cornutum*
Racerunner	*Cnemidophonus sexlineatus*
Great Plains Skink	*Eumeces obsoletus*
Ground Skink	*Scinella lateralis*
Texas Blind Snake	*Leptotyphlops dulcis*
Ringneck Snake	*Diadophis punctatus*
Corn Snake	*Elaphe guttata*
Rat Snake	*Elaphe obsoleta*
Eastern Hognose Snake	*Heterodon simus*
Prairie Kingsnake	*Lampropeltis callagaster*
Mike Snake	*Lampropeltis triangulum*
Coachwhip	*Masticophis flagellum*
Plain-bellied Water Snake	*Nerodia erythrogaster*
Diamondback Water Snake	*Nerodia rhombifera*
Graham's Crayfish Snake	*Regina grahami*
Ground Snake	*Sonura semiannulata*
Brown Snake	*Storeria dekayi*
Garter Snake	*Thamnophis sirtalis*
Western Diamondback Rattlesnake	*Crotalus atrox*
Copperhead	*Agkistrodon contortrix*

Largest genera of native trees are oak (*Quercus*), 21 native tree species (also 1 shrub species); hawthorn or red haw (*Crataegus*), 13 species (also 1 shrub species); hickory and pecan 9 species (*Carya*), plum and cherry (*Prunus*), 7 species; maple (*Acer*), juniper (*Juniperus*), and elm (*Ulmus*), 5 species each; and hackberry (*Celtis*), ash (*Fraxinus*), pine (*Pinus*), and willow (*Salix*), 4 species each (Little, 1985). Oklahoma is home to a wide variety of native trees and shrubs. Table 6-6 (pages 6-24 through 6-25), includes typical species that may be encountered at the Soldier Creek Site.

The North Canadian River may contain any number of the fish species that are native to the area of Oklahoma surrounding the Soldier Creek Site (Miller, 1980). They are presented in Table 6-7 (page 6-26).

6.4.2 Exposure Pathways

This section identifies exposure pathways for animals and plants at or around Tinker AFB and the Solider Creek Site area. There are a number of direct and indirect pathways by which wildlife can be exposed to the contaminants of concern at the Soldier Creek Site. Direct pathways would include dermal contact or ingestion of contaminated media such as soil, sediment, or water. For this environmental assessment, indirect pathways are those in which an animal consumes other previously contaminated organisms.

Exposure to various contaminated media and exposure routes may differ between various organisms because of their physiological and behavioral differences. For example, fish may be exposed to contaminants directly by absorption of contaminated water and indirectly by ingestion of other previously contaminated organisms. Likewise, duck species rely on both aquatic animals (i.e., insects, crustaceans, and snails) and plants for some portion of their dietary intake. However, the percentage of animal food versus plant food in the diet differs from species to species. Variables such as these must be considered in assessing exposure to ecological receptors.

TABLE 6-6
TREES AND SHRUBS FOUND IN THE SOLDIER CREEK SITE REGION
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	SCIENTIFIC NAME
Cypress Family (Cupressaceae)	
Eastern Red Cedar	*Juniperus virginiana*
Willow Family (Salicaceae)	
Eastern Cottonwood	*Populus deltoides*
Black Willow	*Salix niger*
Walnut Family (Juglandaceae)	
Pecan	*Carya illinoensis*
Black walnut	*Jaglans niger*
Beech Family (Fagaceae)	
Bur Oak	*Quercus macrocarpa*
Blackjack Oak	*Quercus marilandica*
Chinkpin Oak	*Quercus muehlenbergii*
Post Oak	*Quercus stellata*
Elm Family (Ulmaceae)	
Sugar Berry	*Celtis laevigata*
Hack Berry	*Celtis occidentalis*
Netleaf Hackberry	*Celtis reticulata*
American Elm	*Ulmas americana*
Slippery Elm	*Ulmas rubra*
Mulberry Family (Moraceae)	
Red Mulberry	*Moras rubra*
Rose Family (Rosaceae)	
Downy Hawthorn	*Crataegus mollis*
Chicksaw Plum	*Prunus angustifolia*
Mexican Plum	*Prunus mexicana*
Legume Family (Leguminosae)	
Eastern Redbud	*Cercis canadensis*
Honey Locust	*Gleditsia triacanthos*
Kentucky Coffeetree	*Gymnocladus dioicus*
Rue Family (Rutaceae)	
Common Hoptree	*Ptelea trifoliata*
Cashew Family (Anacardiacea)	
Shining Sumac	*Rhus copallina*
Smooth Sumac	*Rhus glabra*
Bittersweet Family (Celastracae)	
Eastern Burningbush	*Euonymus atropurpureus*

TABLE 6-6 (Continued)
TREES AND SHRUBS FOUND IN THE SOLDIER CREEK SITE REGION
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	*SCIENTIFIC NAME*
Maple Family (Aceraceae)	
Boxelder	*Acer negunds*
Hosechestnut Family (Hippocastanaceae)	
Texas buckeye	*Aesulus glabra*
Soapberry Family (Sapindaceae)	
Chittamwood	*Sapindus drummondii*
Dogwood Family (Cornaceae)	
Roughleaf Dogwood	*Cornus drummondii*
Sapodilla Family (Sapotaceae)	
Chittamwood	*Bumelia lanuginosa*
Olive family (Oleaceae)	
Green Ash	*Faxinus pennsylvanica*
Madder Family (Rubiaceae)	
Button Bush	*Cephalanthus occidentalis*

Source:
Oklahoma Forestry Division, 1985

TABLE 6-7
CANADIAN RIVER FISH
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

COMMON NAME	SCIENTIFIC NAME	NUMBER OF SPECIES
Gars	*Lepisosteidae*	1
Freshwater Eels	*Anguillidae*	1
Herrings	*Clupeidae*	1
Carps and Minnows	*Cyprinidae*	11
Suckers	*Catostomidae*	2
Catfishes	*Ictaluridae*	4
Killifishes	*Cyprinoduntidae*	1
Silversides	*Atherinidae*	1
Sunfishes	*Centrarchidae*	7
Drums	*Sciaenidae*	1

Some chemicals of concern at the site are known to bioaccumulate in various organisms, thus increasing the chance for organism exposure through the food chain. Consequently, predators exclusively using the habitat around the Soldier Creek Site may potentially be at greater risk because they may be exposed both to contaminated biota and contaminated surface water.

Fish and a variety of other species of flora and fauna found in and around Soldier Creek are likely to be impacted by contaminants found at the site. An area of approximately 9000 acres on Tinker AFB contributes runoff and discharge to Soldier Creek and its tributaries. The creek is, therefore, most likely impacted by contaminants in the runoff and drainage from this area. Exposure of organisms to contaminants in the creek may result from dermal contact, ingestion, and respiration.

Exposure of Plants. Plants may be directly exposed to contaminants in sediment and water. Plants located in contaminated soils may uptake contaminants directly through the roots. Surface water runoff from contaminated areas may percolate into plant root zones, and plants may also be exposed to these contaminants as they are taken up through the roots. Vegetation along Soldier Creek may be exposed from contamination in the water and surrounding soils and sediments. Phytotoxicity data are limited and plant uptake values vary greatly from species to species.

Exposure of Insects. Direct exposure of insects to contaminants may occur through dermal absorption, ingestion, and respiration. Insects that burrow (e.g., ants, and spiders) may be in contact with contaminated soil or sediments. Chemicals may then be absorbed or respired. Insects that reside in or around Soldier Creek (mosquitos, midges, dragonflies, damselflies, etc.) may be exposed by contact with contaminated water, sediments, and the benthic layer. Respiration in and ingestion of the contaminated surface water may also be a source of exposure. Ingestion of plants that have accumulated contaminants may also be another route of exposure. Biomagnification may not be a major factor in the exposure of insects to contaminants because of their place in lower trophic levels.

Exposure of Amphibians and Reptiles. Amphibians and reptiles may be directly exposed to contaminants by dermal contact, ingestion, and inhalation. Direct contact

with contaminated soil or sediments could frequently occur among burrowing snakes and turtles. Snakes that reside in burrows may have a high exposure to contaminants through dermal contact and inhalation of contaminated dust and volatilized organics. Reptile and amphibian eggs may also be exposed to chemicals from contaminated soils and sediments. Amphibians (e.g., toads and frogs) may have exposure to contaminants from dermal contact, ingestion, and respiration of contaminants in contaminated water. Also, amphibians may have exposure to contaminants from contact with and ingestion of soil and sediments. Reptiles may also have exposure from contact with and ingestion of contaminated water. Concentrations of contaminants in soils, sediments, and surface water greatly contribute to the total chemical exposure of these groups (amphibians and reptiles). This phenomenon is primarily caused by high dermal exposure of these animals to these media. Indirect exposure to chemicals of concern may occur by ingestion of contaminated vegetation or prey. Biomagnification of chemicals that bioaccumulate may also be seen as trophic levels increase.

Exposure of Mammals. Terrestrial mammals may be directly exposed to contaminants by dermal absorption, ingestion or inhalation. Certain animals (e.g., mice and gophers) reside in burrows, which may expose them to dermal contact with contaminated soil along with inhalation of contaminated dust or volatilized organics. Other animals (e.g., skunks, and squirrels) have habits, such as digging, that may expose them to dermal contact and inhalation of contaminants. Mammals that reside in and around Soldier Creek (e.g., minks, beavers, and opossums) have a high dermal exposure to surface water and sediment contaminants. Rabbits and raccoons groom frequently and are likely to ingest contaminated soil while grooming. Species which use contaminated surface water in Soldier Creek as a source of water might also be exposed to chemicals through dermal contact and ingestion.

Indirect exposure of terrestrial mammals may occur by ingestion of contaminated food or water. Omnivorous (e.g., skunks, bats, armadillos, and opossum) or herbivorous mammals (e.g., rabbits, muskrats, and squirrels) could be exposed to contaminants by ingesting vegetation that has accumulated contaminants of concern. In addition, contaminated soil that lies upon vegetation consumed by animals may also be a route of exposure to contaminants. Mammals that are carnivorous (e.g., weasels and shrews) or omnivorous (e.g., skunks, bats, armadillos, and opossums) may

be exposed to contaminants through ingestion of prey that has accumulated contamination (biomagnification). Chemicals that bioaccumulate may result in biomagnification through the higher trophic levels.

Exposure of Birds. Birds may be exposed either directly or indirectly to contaminants at the Soldier Creek Site. Direct pathways for birds include ingestion of contaminants in sediments or water and dermal contact with contaminated sediments or water. Activities such as bathing, wading, swimming, and diving contribute to the dermal exposure to contaminated water and sediment. The diet of water fowl (aquatic insects) also contributes to the ingestion exposure.

Birds may be indirectly exposed to chemicals by ingesting contaminated food. A large portion of the diet of most birds consists of insects and plants. Predatory birds may also be exposed to contaminants by food (fish, small birds, small mammals, reptiles, and amphibians). Available data are not sufficient to estimate uptake and accumulation of contaminants in these food sources. Exposure by this pathway is greatest in those species that consume food items that tend to bioaccumulate or bioconcentrate contaminants. Biomagnification can be seen as the trophic levels increase. Predatory birds would probably be most affected due their place on the food chain.

6.5 Risk Characterization

6.5.1 Risks to Aquatic Species

Soldier Creek feeds into Crutcho Creek which feeds into the North Canadian River. The North Canadian River supports a variety of aquatic species. The levels of metals found in the surface water and sediments are of environmental concern. Six metals (chromium, lead, cadmium, nickel, zinc, and copper) were found in Soldier Creek surface water at levels higher than federal water quality criteria (Table 6-8, page 6-30). Five metals (barium, cadmium, chromium, lead, and selenium) were found in levels higher than the Oklahoma raw water numerical criteria (Table 6-8, page 6-30). Two metals (selenium and silver) were found at levels higher than the Oklahoma numerical criteria for toxic substances (Table 6-8, page 6-30). These metals were also detected at relatively high levels in the sediment.

TABLE 6-8
APPLICABLE SURFACE WATER CONTAMINANT CRITERIA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

AMBIENT WATER QUALITY CRITERIA[1]			
	Concentration (ug/L)		
Chemical of Concern	Acute	Chronic	Soldier Creek Maximum Concentration (ug/L)
Chromium	16	11	628
Cadmium	1.8	0.66	56.9
Copper	9.2	6.5	985
Nickel	1,100	56	3,560
Lead	34	1.3	325
Zinc	180	47	2,400

OKLAHOMA RAW WATER NUMERICAL CRITERIA[2]		
Chemical of Concern	Criteria Concentration (ug/L)	Soldier Creek Maximum Concentration (ug/L)
Barium	1,000	1,900
Cadmium	20	56.9
Chromium	50	628
Lead	100	325
Selenium	10	20.9

OKLAHOMA NUMERICAL CRITERIA FOR TOXIC SUBSTANCES[3]			
	Effect Concentration (ug/L)		
Chemical of Concern	Acute	Chronic	Soldier Creek Maximum Concentration (ug/L)
Selenium	20	5	20.9
Silver	1.232	0.49	13.1

1 -- Ambient Water Quality Criteria (EPA, 1989c).
2 - Oklahoma Raw Water Numerical Criteria (OWRB, 1989a).
3 - Oklahoma Numerical Criteria for Toxic Substances (OWRB, 1989a).

Acute and chronic toxicity effects can be observed in freshwater organisms at the levels of some of the metals found in Soldier Creek.

The cadmium acute LC_{50} for freshwater fish and invertebrates generally ranged from 100 to 1,000 ug/L; salmonids are much more sensitive than other organisms. Saltwater species were in general 10-fold more tolerant to the acute effects of cadmium. Chronic tests have been performed and show that cadmium has cumulative toxicity and acute-chronic ratios that range from 66 to 431. Bioconcentration factors were generally less than 1,000 but were high as 10,000 for some freshwater fish species (Clement, 1985).

Water hardness, temperature, dissolved oxygen, species, and age of the test organism modify the toxic effects of chromium on aquatic life. Chromium III appears to be more acutely toxic to fish than chromium VI; the reverse is true in long term chronic exposure studies (Clement, 1985). Acute LC_{50} for freshwater species ranges from 15.3 ug/L for *Daphnia magna* to 1,870,000 mg/l for stonefly *Nephasganophora capiteta*. Chronic effects for freshwater species range from <2.5 ug/L for *Daphnia magna* to 1,987 ug/L for the fathead minnow *Pimephales promelas*. Mean acute toxicity values for a large number of freshwater animals range from 7.2 ug/L for *Daphnia pulicaria* to 10,200 ug/L for the bluegill. Toxicity tends to decrease as hardness, alkalinity and total organic carbon increase. Chronic values for a variety of freshwater species range from 3.9 ug/L for brook trout to 60.4 ug/L for northern pike. Hardness does not appear to affect chronic toxicity. The acute-chronic ratios for different species range from 3 to 156. The more sensitive species tend to have lower ratios than the less sensitive species. In addition, the ratio seems to increase with hardness (Clement, 1985).

Freshwater vertebrates and invertebrates are more sensitive to lead in soft water than in hard water. At a hardness of about 50 mg/liter $CaCO_3$, the median effect concentrations for nine families range from 140 ug/L to 236,600 ug/L. Chronic values for *Daphnia magna* and the rainbow trout are 12.26 and 83.08 ug/L, respectively, at a hardness of about 50 mg/liter. Acute-chronic ratios calculated for three freshwater species ranged from 18 to 62. Bioconcentration factors, ranging from 42 for young

brook trout to 1,700 for a snail, were reported. Freshwater algae show an inhibition of growth at concentrations above 500 ug/L (Clement, 1985).

In freshwater, nickel toxicity depends on hardness; nickel tends to be more toxic in softer water. Acute values for exposure to a variety of nickel salts, expressed as nickel, range from 510 ug/L for *Daphnia magna* to 46,200 ug/L for banded killifish at comparable hardness levels. Chronic values range from 14.8 ug/L for *Daphnia magna* in soft water to 530 ug/L for the fathead minnow in hard water. Acute-chronic ratios for *Daphnia magna* range from 14 in hard water to 83 in soft water, and are approximately 50 in both hard and soft water for the fathead minnow. Residue data for the fathead minnow indicate a bioconcentration factor of 61. Freshwater algae experience reduced growth at nickel concentrations as low as 100 ug/L (Clement, 1985).

Silver acute toxicity values for freshwater invertebrates range from 0.25 ug/L for *Daphnia magna* to 4,500 ug/L for the scud *Gammarus pseudolimnaeus*. Acute values for fish range from 3.9 ug/L for the fathead minnow in soft water to 280 ug/L for rainbow trout in hard water. In fresh water, the acute toxicity of silver appears to decrease as hardness increases. Soluble compounds, such as silver nitrate, are generally much more toxic than insoluble compounds. Chronic values ranging from 2.6 to 29 ug/L are reported for *Daphnia magna*. Two early life stage studies with rainbow trout report chronic values of 0.12 ug/L. Acute chronic ratios for *Daphnia magna* and rainbow trout are 2.0 and 54, respectively. Freshwater aquatic plants appear to be more resistant to silver than the more sensitive animals (Clement, 1985).

Zinc produces acute toxicity in freshwater organisms over a range of concentrations from 90 to 58,100 ug/L and appears to be less toxic in harder water. Acute toxicity is similar for freshwater fish and invertebrates. Chronic toxicity values range from 47 to 852 ug/L and appear to be relatively unaffected by hardness. A final acute-chronic ratio for freshwater species of 3.0 has been reported. Although most freshwater plants appear to be insensitive to zinc, one species, the alga *Selenastrum capricornutum*, exhibited toxic effects at concentrations from 30 to 700 ug/L. Reported acute toxicity values range from 2,730 to 83,000 ug/L for saltwater fish and

from 166 to 55,000 ug/L for invertebrate saltwater species. Zinc produces chronic toxicity in the mysid shrimp species. The final acute-chronic ratio for toxicity in the mysid shrimp species is 3.0. Toxic effects are observed in saltwater plant species at zinc concentrations of 50 to 25,000 ug/L. Bioconcentration factors of edible portions of aquatic organisms range from 43 for the soft-shell clam to 16,700 for the oyster (Clement, 1985).

It is difficult to ascertain the risks particular to the Tinker AFB ecological niche or to Soldier Creek or the North Canadian River. Though comparison of site data with water quality criteria establishes that Soldier Creek poses a general environmental threat to its aquatic animal and plant population, such values are not available for the sediments and other exposure media. In addition, site-specific data regarding the particular aquatic species and their interaction with the contaminated media at this location are not available.

6.5.2 Risks of Terrestrial Species

Estimates of risks to terrestrial species are difficult to determine because of a lack of environmental toxicity data. Species that are members of the ecosystem surrounding Soldier Creek will have an increased exposure to the metal contaminants in the water. Site-specific information is not available regarding the particular members of the Soldier Creek ecosystem, the interaction between the species, and the uses of the contaminated water by these animal and plant species. More information is required to fully define the risk to terrestrial inhabitants.

7.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section identifies the applicable or relevant and appropriate requirements (ARARs) for the Soldier Creek Site. EPA Region VI has delegated the authority to establish ARARs for the Soldier Creek Site to the State of Oklahoma. Tinker AFB and the State of Oklahoma have worked together to establish the ARARs for the site. The Final Risk Assessment report will identify contaminant-specific ARARs, action-specific ARARs, and location-specific ARARs. No location-specific ARARs have been identified. The action-specific ARARs will be addressed in the Feasibility Study report.

Section 121(d) of CERCLA, as amended by SARA, states that any remedial action selected for a site must, at a minimum, attain a degree of cleanup that ensures protection of human health and the environment. In addition, at the completion of the remedial action, a level or standard of control under federal or state environmental law must be attained and meet legally "applicable or relevant and appropriate requirements" for any hazardous substance, contaminant, or pollutant that remains onsite.

The EPA interim final guidances "CERCLA Compliance with Other Laws Manual Part I" (EPA, 1988a) and "CERCLA Compliance with Other Laws Manual Part II: Clean Air Act and Other Environmental Statutes and State Requirements" (EPA, 1989d) establishes how requirements of federal and state laws are identified and applied to remedial actions at hazardous waste sites. ARARs are identified by applying a two-tier test to first determine whether the requirement is applicable and second, if it is not applicable, to determine whether a requirement is relevant and appropriate. The guidance manual gives the following definitions of "applicable" and "relevant and appropriate" requirements.

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address

a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstances at a CERCLA site.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, although not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

The judgment of the relevance and appropriateness of a requirement can be made on the basis of several factors, including the characteristics of the remedial action, the hazardous substances in question, or the physical situation of the site. It is possible that only portions of requirements may be relevant and appropriate for a remedial action; however, any requirement or portion thereof that is determined to be relevant and appropriate must be complied with to the same degree as if it was applicable.

There are three types of ARARs. The first type, contaminant-specific ARARs, establish health and risk-based concentration limits for the various environmental media present at a site. The contaminant-specific ARARs may set a level of cleanup or discharge. The second type, action-specific ARARs, establish controls on the remedial activities that are a part of the remedial solution. These controls can include compliance with transportation, treatment, storage, and disposal requirements. The third type, location-specific ARARs, set limitations on remedial activities due to site characteristics which can include restrictions for activities in wetlands, flood plains, and historical sites.

In addition to legally binding laws and regulations (ARARs) that address hazardous substances, remedial actions, location, and other circumstances at a typical CERCLA site, many federal and state environmental and public health programs also develop criteria, advisories, guidance, and proposed standards to better protect human health and the environment. Although not legally binding, these factors, called To Be Considered (TBC), may provide useful information or recommend procedures. For example, although a particular advisory may not be legally binding and fully current,

it may provide the best available standard for a particular chemical for which no binding standard exists. Proposed rules can also be TBCs.

The potential ARARs and TBCs identified for the Soldier Creek Site are described in the following subsections.

7.1 Contaminant-Specific Applicable or Relevant and Appropriate Requirements

Contaminant-specific ARARs set levels that are considered protective of human health and the environment for contaminants of concern in a designated medium or that indicate an acceptable level of discharge if discharge occurs as part of a remedial activity. If a contaminant has more than one ARAR as a requirement, the most stringent one is usually required for compliance.

The media of concern, as discussed in the RI report (BVWST, 1993) are surface water, sediment, and groundwater. The potential federal and state contaminant-specific ARARs and TBCs for these media are shown in Tables 7-1 (page 7-4) and 7-2 (page 7-6). No federal or state regulations have been promulgated that establish contaminant-specific ARARs for sediment. The contaminant-specific federal and state regulations and the TBCs for the Soldier Creek Site are discussed in the succeeding subsections.

7.1.1 Safe Drinking Water Act

Maximum contaminant levels (MCLs) have been adopted under the Safe Drinking Water Act (SDWA) as enforceable standards for public drinking water systems (USC, 1988a). MCLs are based on the allowable lifetime exposure to a contaminant for a 70 kilogram adult who is assumed to consume 2 liters of water per day. MCLs take into account the technical and economic feasibility of removing the contaminant from the water and must be set as close as possible to the maximum contaminant level goal (MCLG), given the best available technology and treatment techniques. The primary jurisdictional requirement to determine applicability is that MCLs apply to public water systems having at least 15 service connections or serving at least 25 persons. MCLs are relevant and appropriate for contaminated groundwater that may be used as a source of drinking water. The off-base, private groundwater wells use

TABLE 7-1
POTENTIAL FEDERAL CONTAMINANT-SPECIFIC ARARs AND TBCs
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

Standard, Requirement, Criterion, or Limitation	Description	Applicable/Relevant and Appropriate	Comment
Safe Drinking Water Act [40 United States Code (USC) Sect. 300]			
National Primary Drinking Water Standards [40 Code of Federal Regulations (CFR) Part 141] (EPA, 1991f)	Establishes health-based standards for public water systems known as maximum contaminant levels (MCLs). Also, establishes drinking water quality goals known as Maximum Contaminant Level Goals (MCLGs), that are set at levels of no known or anticipated adverse health effects with an adequate margin of safety.	No/Yes	Groundwater from the production zone, which is below the three aquifer zones of concern at the Soldier Creek Site, is used as a drinking water supply for nearby residences. The MCLs may be relevant and appropriate for groundwater at the site. MCLGs are To Be Considered (TBCs) for the site.
National Secondary Drinking Water Standards (40 CFR Part 143)(EPA, 1991g)	Establishes welfare-based standards for public water systems known as Secondary Maximum Contaminant Levels (SMCLs).		
Federal Water Pollution Control Act (Clean Water Act)(33 USC Sect. 1251-1376)			
Water Quality Criteria (40 CFR Part 131) (EPA, 1991k)	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	No/Yes	Water quality criteria are relevant and appropriate for the Soldier Creek Site. If a National Pollution Discharge Elimination System permit is needed for treated effluent discharge, water quality criteria must be met.
EPA Guidelines Establishing Test Procedures for the Analysis of Pollutants (40 CFR Part 136)(EPA, 1990b)	Regulations on test procedures for analysis of pollutants.	No/Yes	If an alternative involved monitoring, testing procedures guideline would be followed.
Resource Conservation and Recovery Act (42 USC 6901-6987)			
Identification and Listing of Hazardous Waste (40 CFR Part 261)(EPA, 1991l)	Defines those solid wastes that are subject to regulation as hazardous waste under 40 CFR Parts 262-265 and Parts 124, 270, and 271.	Yes/No	Listed contaminants have been detected at the Soldier Creek Site.
Land Disposal Restrictions (LDRs) (40 CFR Part 268)(EPA, 1991h)	Establishes restrictions for the land disposal of listed and characteristic waste.	Yes/No	Because listed wastes were found at the Soldier Creek Site, LDRs would be applicable to the treatment or removal of sediment, and groundwater and surface water treatment residuals.

TABLE 7-1 (Continued)
POTENTIAL FEDERAL CONTAMINANT-SPECIFIC
ARARs AND TBCs
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

Standard, Requirement, Criterion, or Limitation	Description	Applicable/Relevant and Appropriate	Comment
Clean Air Act (42 USC Sect. 7401 - 7642)			
National Primary and Secondary Ambient Air Quality Standards (NAAQSs)(40 CFR Part 50) (EPA, 1987b)	Establishes standards for ambient air quality to protect public health and welfare (including standards for particulate matter and lead). The performance standard for attainment of particulate matter limitations is defined in 40 CFR Part 50, Appendix J.	Yes/No	If remediation involves activities that created emissions, these standards may be applicable. For excavation and grading, fugitive dust emissions must not exceed NAAQSs requirements for particulate matter. For incineration, the emission of volatile organic compounds, metals, and particulate matter must not exceed NAAQSs.
EPA Designation, Reportable Quantities, and Notification (40 CFR Part 302)(EPA, 1991j)	Designation of reportable quantities and notification requirements for hazardous substances under CERCLA.	Yes/No	If an alternative caused any discharge, these standards may be applicable.
Regulations on Standards of Performance for New Stationary Sources (40 CRF Part 60) (EPA, 1991m)	Establishes standards for stationary sources of air pollution including incinerators (Subpart E).	Yes/No	Remediation involving incineration must meet the applicable standards.
Regulations on National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61) (EPA, 1991i)	Establishes standards for various hazardous air pollutants and sources.	Yes/No	If an alternative included an activity that would release the established air pollutants, these standards would be applicable.

TABLE 7-2
POTENTIAL STATE CONTAMINANT-SPECIFIC
ARARs AND TBCs
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

Standard, Requirement, Criterion, or Limitation	Description	Applicable/Relevant and Appropriate	Comment
Oklahoma Water Quality Standards (182 Oklahoma Statute Supplement 1988, Section 926.1-926.13)	Establishes numerical water quality criteria for groundwater and surface waters based on use classifications. The uses designated for an unlisted surface water, which is the designation of Soldier Creek, are agricultural, industrial and manufacturing process and cooling water, aesthetics, habitat limited fishery, and secondary body contact recreation.	Yes/No	The water quality standards are applicable to the water quality of Soldier Creek. If an alternative involved the discharge of treated groundwater into Soldier Creek, the effluent would have to comply with these standards if they are more stringent than federal standards.
Oklahoma Drinking Water Regulations (Oklahoma State Department of Health)	Establishes maximum allowable levels or primary drinking water standards to protect the public health and to ensure the safety of public water supplies.	Yes/No	The groundwater at the Soldier Creek Site is used as a drinking water source for residences near the site.
Oklahoma Groundwater Quality Standards (Oklahoma Water Resources Board)	Establishes numerical criteria for contaminants detected in or having potential to enter groundwater.	Yes/No	The groundwater at the Soldier Creek Site is used as a drinking water source for residences near the site.
Oklahoma Clean Air Act/Oklahoma Air Pollution Regulations (Oklahoma State Department of Health)	Establishes quantitative limits for air emissions from specific sources and for specific contaminants, including organic materials, volatile organic compounds, solvents, and other hazardous and toxic air pollutants.	Yes/No	Some contaminants may be released into the air as a result of remedial action activities. If these regulations were more stringent than federal air standards, Oklahoma Ambient Air Quality Standards would be applicable.
Oklahoma Controlled Industrial Waste Disposal Act/ Oklahoma Industrial Waste Management Regulations (Oklahoma State Department of Health)	Incorporates portions of RCRA pertaining to hazardous waste, including the rule establishing restrictions for the land disposal of listed and characteristic waste (LDRs).	Yes/No	Because listed wastes were found at the Soldier Creek Site, LDRs would be applicable to the removal or treatment of sediment, and groundwater and surface water treatment residuals.

groundwater as a drinking water source for nearby residences; therefore, MCLs may be relevant and appropriate to the site. MCL values for groundwater at the Soldier Creek Site are listed in Table 7-3 (page 7-8).

MCLGs are nonenforceable health goals for public water systems that are set at levels that have no known or anticipated adverse health effects. MCLGs for substances considered to be probable human carcinogens are zero. MCLGs for other substances are based on chronic toxicity or other data. According to the NCP, MCLGs that are greater than zero are relevant and appropriate for groundwater that is used as a drinking water source. The groundwater from off-base, private wells at the Soldier Creek Site is used as a drinking water source; therefore, MCLGs are TBCs for the site. MCLG values that have been established or proposed for groundwater contaminants of concern at the Soldier Creek Site are listed in Table 7-3 (page 7-8).

National secondary drinking water regulations consist of secondary maximum contaminant levels (SMCLs) for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water (color, odor, and taste). SMCLs are nonenforceable limits intended as guidelines for use by states in regulating water supplies. SMCLs apply to public water systems with measurements taken at the tap of any system user. For the Soldier Creek Site, SMCLs may be relevant and appropriate depending on the technologies employed to remediate the site.

7.1.2 Clean Water Act

CERCLA Section 121 states that remedial actions shall attain federal water quality criteria where they are relevant and appropriate under the circumstances of the release or threatened release (USC, 1990a). This determination is to be based on the designated or potential use of the water, the media affected, the purpose of the criteria, and current information. Water quality criteria are standards developed under the Clean Water Act (CWA) Section 304 and are used by states, in conjunction with a designated use for a stream segment, to establish water quality standards under CWA Section 303. In determining the applicability or relevance and appropriateness of water quality criteria, the most important factors to consider are the designated uses of the water and the purposes for which the potential requirements are intended. A water quality criterion for aquatic life may be found

TABLE 7-3
NUMERICAL VALUES FOR POTENTIAL CONTAMINANT-SPECIFIC
ARARs AND TBCs FOR GROUNDWATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

Contaminants of Concern(a)	EPA Maximum Contaminant Level Goals (MCLGs)(b)(c) ug/L	EPA Maximum Contaminant Levels (MCLs)(b) ug/L	Oklahoma Water Quality Criteria(e) ug/L	Oklahoma Maximum Allowable Levels (MALs)(f) ug/L	Oklahoma Recommended Maximum Levels (RMLs)(f) ug/L	Risk-based Cleanup Levels ug/L
Volatiles						
Benzene	0	0	0.2	5	--	0.75
Chlorobenzene	100	100(d)	0.7	--	--	110
Chloroform	--	100	10	100	--	0.42
1,1-Dichloroethane	--	--	0.3	--	--	1,600
1,1-Dichloroethene	7	7	0.6	7	--	0.024
cis-1,2-Dichloroethene	70	70(d)	0.5	--	--	290
trans-1,2-Dichloroethene	100	100(d)	0.4	--	--	590
1,2-Dichloropropane	0	5	0.3	--	--	1
Ethylbenzene	700	700	0.4	--	--	690
Methylene Chloride	0(d)	5(d)	10	--	--	2
Tetrachloroethene	0(d)	5(d)	1.6	--	--	1.1
1,1,1-Trichloroethane	200	200	0.3	200	--	1,900
Trichloroethene	0	5	0.3	5	--	1.6
1,2,4-Trimethylbenzene	--	--	--	--	--	--
Toluene	2,000(d)	2,000(d)	0.5	--	--	1,520
Vinyl Chloride	0	2	1.9	2	--	0.028
Xylene	10,000(d)	10,000(d)	0.8	--	--	1,900
Semi-Volatiles						
Bis(2-Ethylhexyl)phthalate	--	--	--	--	--	5
1,2-Dichlorobenzene	--	--	--	--	--	2,100
1,3-Dichlorobenzene	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	2.2
Di-n-Octylphthalate	--	--	--	--	--	610
Naphthalene	--	--	--	--	--	97
Inorganics						
Arsenic	0(d)	50	--	50	--	30
Barium	--	1,000	--	1,000	--	2,100
Chromium	--	50	--	50	--	150
Copper	--	1,000	--	--	1,000	--
Lead	0(d)	50	--	--	--	5
Nickel	--	--	--	--	--	--
Selenium	50	50	--	10	--	--

(a) Contaminants of concern include all constituents detected in the groundwater.
(b) EPA, 1991
(c) MCLGs are standards to be considered (TBCs)
(d) Proposed Values
OWRB, 1989b
SDH, 1990a
- indicates that no standard is provided

relevant and appropriate when there are environmental factors that are being considered at a site, such as protection of aquatic organisms. With respect to the use of water quality criteria for protection of human health, levels are provided for exposure both from drinking water and consuming aquatic organisms (primarily fish). Whether a water quality criterion is relevant and appropriate and which form of the criterion is appropriate depends on the likely route(s) of exposure.

At the Soldier Creek Site, ambient water quality criteria (AWQC) are relevant and appropriate. The State of Oklahoma has developed water quality standards for state surface waters and the State of Oklahoma has not designated a specific use for Soldier Creek. AWQC are enforceable only if a designated use has been determined by the state (EPA, 1988). Soldier Creek is capable of supporting only limited aquatic life; however, the State of Oklahoma requires Soldier Creek to meet the state criteria for limited fishery and secondary body contact recreation requirements (OWRB, 1989a). AWQC values are presented in Table 7-4 (page 7-10).

Sampling and analytical testing for contaminants from Soldier Creek Site media may be required during remedial actions to address the contamination problem. EPA Regulations on Test Procedures for the Analysis of Pollutants listed under 40 Code of Federal Regulations (CFR) Part 136, which specifies chemical-specific testing procedures for the analysis of pollutants, would be relevant and appropriate, especially if an alternative involves surface water or groundwater monitoring.

7.1.3 Solid Waste Disposal Act [as Amended by the Resource Conservation and Recovery Act (RCRA)]

Under the Solid Waste Disposal Act (SWDA), land disposal restrictions (LDRs) establish provisions for restricting the land disposal of listed and characteristic RCRA hazardous wastes (USC, 1988b). "Listed Wastes" are those wastes identified under 40 CFR Part 261 as being generated by a specific process or containing a specific chemical that exhibits the characteristics of toxicity, ignitability, corrosivity, or reactivity. "Characteristic wastes" are other types of waste that exhibit the characteristics of toxicity, ignitability, corrosivity, or reactivity.

LDRs establish prohibitions on the placement of hazardous wastes, including no land disposal of certain wastes, or treatment standards that must be attained before land

TABLE 7-4
NUMERICAL VALUES FOR POTENTIAL CONTAMINANT-SPECIFIC
ARARs AND TBCs FOR SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

Chemical of Concern (a)	Potential Cleanup Levels											
	Risk-based Cleanup Level(b) ug/L			Oklahoma Raw Water Numerical Criteria (OWRB, 1989a) ug/l	Oklahoma Numerical Criteria for Toxic Substances (OWRB, 1989a		Ambient Water Quality Criteria (EPA, 1986a)					
							For Toxic Protectio		For Carcinogenic Protection		Protection of Freshwater Aquatic Life	
					Acute ug/l	Chronic ug/l	Ingesting Water and Organisms ug/l	Ingesting Organisms Only ug/l	Ingesting Water and Organisms ug/l	Ingesting Organisms Only ug/l	Acute ug/l	Chronic ug/l
	Carcinogenic		Noncarcinogenic									
	1x10-4	1x10-6										
Volatile Organics												
Acetone	--	--	500,000	--	--	--	--	--	--	--	--	--
Benzene	2,000	20	--	--	--	2,200	--	--	0.66(b)	40(b)	5,300(c)	--
Bromodichloromethane	170,000	1,700	--	--	--	--	--	--	--	--	--	--
Bromoform	3,300,000	33,000	--	--	--	--	--	--	--	--	--	--
Carbon Disulfide	--	--	5,300	--	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	13,000	--	--	--	488	15,050	--	--	19,500(c)	--
Chloroform	76,000	760	--	--	--	--	--	--	0.19	15.7	28,900(c)	--
Dibromochloromethane	200,000	2,000	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	89,000	890	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethene (total)	--	--	150,000	--	--	--	--	--	0.033(b)	1.85(b)	11,600(c)	--
1,1,1-Trichloroethane	--	--	100,000	--	--	--	--	--	--	--	--	--
Trichloroethene	28,000	280	--	--	--	--	--	--	2.7(b)	80.7(b)	45,000(c)	21,900(c)
Tetrachloroethene	31,000	310	--	--	--	--	--	--	0.8(b)	8.85(b)	5,280(c)	840(c)
Toluene	--	--	5,600	--	--	875	14,300	424,000	--	--	17,500(c)	--
Xylene (total)	--	--	11,000,000	--	--	--	--	--	--	--	--	--
Semi-Volatile Organics												
Benzo(g,h,i)Perylene	--	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	100,000	--	--	--	--	--	--	--	--	--
Chrysene	120,000	1,200	--	--	--	--	--	--	--	--	3,980(c)	--
Fluoranthene	--	--	22,000	--	--	--	42	54	--	--	--	--
Pyrene	--	--	5,900,000	--	--	--	--	--	--	--	--	--

(a) Contaminants of concern include all constituents detected in the surface water.
(b) Human health criteria for carcinogens reported for three risk levels. The 10E(-6) risk level is presented.
(c) Insufficient data available to develop criteria. Value presented is the lowest observed effect level.
(d) Hardness-dependent criteria (225 mg/l actual Soldier Creek hardness value used to develop).
(e) Hardness-dependent criteria (50mg/l used to develop).

TABLE 7-4 (Continued)
NUMERICAL VALUES FOR POTENTIAL CONTAMINANT-SPECIFIC
ARARs AND TBCs FOR SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

Chemical of Concern (a)	Potential Cleanup Levels											
	Risk-based Cleanup Level(b) ug/L			Oklahoma Raw Water Numerical Criteria (OWRB, 1989a) ug/l	Oklahoma Numerical Criteria for Toxic Substances (OWRB, 1989a		Ambient Water Quality Criteria (EPA, 1986a)					
							For Toxic Protectio		For Carcinogenic Protection		Protection of Freshwater Aquatic Life	
					Acute ug/l	Chronic ug/l	Ingesting Water and Organisms ug/l	Ingesting Organisms Only ug/l	Ingesting Water and Organisms ug/l	Ingesting Organisms Only ug/l	Acute ug/l	Chronic ug/l
	Carcinogenic		Noncarcinogenic									
	1x10-4	1x10-6										
Metals												
Aluminum	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	--	--	8,100	100	360	190	--	--	0.0022(b)	0.0175(b)	--	--
Barium	--	--	250,000	1,000	--	--	1,000	--	--	--	--	--
Beryllium	2,000	20	--	--	--	--	--	--	0.0037(b)	0.064(b)	130(c)	5.3(c)
Cadmium	--	--	2,100	20	130(d)(e)	2.90(d)(e)	10	--	--	--	1.8(e)	0.66(e)
Calcium	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	--	--	11,000	50	--	--	50	--	--	--	16(c)	11(c)
Cobalt	--	--	--	--	--	--	--	--	--	--	--	--
Copper	--	--	--	1,000	59.1(d)	35.5(d)	--	--	--	--	9.2(e)	6.5(e)
Cyanide	--	--	49,000	200	45.9	10.7	200	--	--	--	22(e)	5.2
Iron	--	--	--	--	--	--	--	--	--	--	--	--
Lead	--	--	--	100	373(d)	14.9(d)	50	--	--	--	34(e)	1.3(e)
Magnesium	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	350,000	--	--	--	50	100	--	--	--	--
Nickel	--	--	62,000	--	3894(d)	433(d)	13.4	100	--	--	1,100(e)	56(e)
Selenium	--	--	--	10	20	5	10	--	--	--	260(c)	35(c)
Silver	--	--	350,000	50	31.6(d)	0.49	50	--	--	--	1.2(e)	0.12(e)
Sodium	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	--	--	560,000	--	--	--	--	--	--	--	--	--
Zinc	--	--	13,000,000	5,000	322(d)	291(d)	--	--	--	--	180(e)	47(e)

(a) Contaminants of concern include all constituents detected in the surface water.
(b) Human health criteria for carcinogens reported for three risk levels. The 10E(-6) risk level is presented.
(c) Insufficient data available to develop criteria. Value presented is the lowest observed effect level.
(d) Hardness-dependent criteria (hardness value of 330 mg/L used to develop).
(e) Hardness-dependent criteria (50mg/l used to develop).

disposal. According to the provisions of 40 CFR Part 268, effective November 8, 1986, contaminated soil or debris resulting from a CERCLA response action that contain listed solvent waste residues are prohibited from land disposal. Other potential characteristic wastes may be regulated by LDR treatment standards. Applicability to treatment standards of potentially characteristic wastes would be determined during remedial design or remedial action. The LDRs are considered applicable to excavated sediment treated on-base or off-base and to groundwater and surface water treatment residuals.

7.1.4 Clean Air Act

The EPA, under the Clean Air Act (CAA), has established primary and secondary national ambient air quality standards to protect public health and welfare (USC, 1990b). The national primary ambient air quality standards (NAAQSs) define levels of air quality necessary to protect public health and include an adequate margin of safety. The secondary ambient air quality standards are levels of air quality necessary to protect public welfare from any known or anticipated adverse effects from a pollutant. The New Source Performance Standards and the National Emission Standards for Hazardous Air Pollutants may also be applicable during remediation. NAAQSs have been established for sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead. NAAQSs may be relevant and appropriate to the Soldier Creek Site during remedial action if an alternative involves the production of an air emission.

7.1.5 EPA Designation, Reportable Quantities, and Notification

Reportable quantities for identified substances in Section 101(14) of CERCLA and hazardous substances listed in Section 311(b)(2)(a) of the CWA have been set forth and adopted (EPA, 1991j). Requirements of notification for an unregulated release of these substances have been established and implemented. Any facility releasing a quantity equal to or exceeding the reportable quantity within a 24-hour period must notify the EPA's National Response Center. The EPA Designation, Reportable Quantities, and Notification Regulation may be relevant and appropriate for the Soldier Creek Site, depending on the remedial action taken.

7.1.6 Oklahoma Water Quality Standards

The State of Oklahoma has established water quality standards for surface waters and describes the beneficial use categories for such waters and the criteria necessary to support these uses (OWRB, 1989a). Soldier Creek is an unlisted surface water; therefore, its beneficial uses are categorized as agriculture, industrial and municipal process and cooling water, and aesthetics and the stream is assumed to support limited fishery and secondary body contact recreation. Water quality standards have been established for many of the contaminants present at Soldier Creek Site. The standards are categorized into three criteria: raw water numerical criteria, dissolved oxygen criteria, and toxic substances numerical criteria.

Raw water numerical criteria, listed in Table 7-4 (page 7-10), are the enforceable maximum concentrations for substances found in surface waters designated as public and private water supplies. The Oklahoma Water Quality Standards require that the quality of public and private water supplies shall be protected, maintained, and improved, when feasible. The toxic substances numerical criteria and dissolved oxygen criteria, also listed in Table 7-4 (page 7-10), apply to all waters with designated beneficial use subcategories of fish and wildlife propagation. The Oklahoma Water Quality Standards require that surface waters shall not exhibit acute toxicity or exhibit chronic toxicity outside the mixing zone. These standards are applicable to the remediation of the surface waters in Soldier Creek; however, enforcement action typically only occurs when permitted limits are exceeded at specific points of compliance.

7.1.7 Oklahoma Drinking Water Regulations

The State of Oklahoma has established and adopted maximum allowable levels (MALs) for primary drinking water standards as enforceable standards to protect the public health, and to ensure the safety of public water supplies (OSDH, 1990a). MALs apply to public water systems having at least 10 service connections or serving at least 25 persons. MALs are relevant and appropriate for contaminated groundwater that may be used as a source of drinking water. The groundwater at the Soldier Creek Site is a drinking water source for nearby residences; therefore, MALs may be relevant and appropriate to the site. MALs for contaminants detected in groundwater at the Soldier Creek Site are listed in Table 7-3 (page 7-8).

State secondary standards consist of recommended maximum levels (RMLs) for specific contaminants and water characteristics that may affect the aesthetic qualities of drinking water (color, odor, and taste). Achieving RMLs is not mandatory when applying for new or revised system permits; however, applicants are required to address the feasibility of meeting these levels. For the Soldier Creek Site, RMLs may be relevant and appropriate depending on the technologies employed to remediate the site.

7.1.8 Oklahoma Groundwater Quality Standards

The State of Oklahoma has established numerical criteria for contaminant concentrations detected in or having potential to enter the groundwater (OWRB, 1989b). Standards have been established to prevent the changing of chemical properties of existing fresh groundwater. Groundwater is considered fresh groundwater if the well removing the water has an average yield of 150 gallons per minute or greater which would include the production wells in the vicinity of Soldier Creek Site. These standards would be applicable for remedial action goals if they are lower than MCLs. Many of the contaminants with established Oklahoma groundwater quality standards have been detected in the groundwater samples at the Soldier Creek Site. The values for the numerical water quality criteria are listed in Table 7-3 (page 7-8).

7.1.9 Oklahoma Clean Air Act/Oklahoma Air Pollution Regulations

The State of Oklahoma has established ambient air quality standards and operating permit guidelines for facilities emitting contaminants under the Oklahoma Clean Air Act (OSDH, 1990b). These standards and guidelines would be applicable if remedial actions at the Soldier Creek Site were to emit contaminants into the air and the requirements were more stringent than the federal air regulations.

7.1.10 Oklahoma Industrial Waste Management Regulations

Under the Oklahoma Controlled Industrial Waste Disposal Act, the Oklahoma Industrial Waste Management Regulations have incorporated by reference specific portions of the RCRA Hazardous Waste Regulations and the federal Underground Injection Control Program, with some exceptions and additions (OSDH, 1990c). The regulations pertaining to LDRs are incorporated into the state regulations in their

entirety. The LDRs would be applicable if remedial actions at the Soldier Creek Site involved the on-base or off-base treatment of excavated sediment and groundwater and surface water treatment residuals.

7.1.11 Risk-based Cleanup Levels

Risk-based cleanup levels were determined by back-calculating the equations used in the risk assessment process. The back calculations represent the reverse of the process used to calculate the potential carcinogenic and non-carcinogenic risks in the risk assessment. Cleanup levels were determined for all compounds detected in Soldier Creek Site media and are presented in Table 7-3 (page 7-8) for groundwater, Table 7-4 (page 7-10) for surface water, and Table 7-5 (page 7-16) for sediment. These cleanup levels are TBCs for the Soldier Creek Site because they are site-specific levels developed based on existing site conditions and contaminant characteristics. TBCs are not considered legally binding.

7.2 Action-Specific Applicable or Relevant and Appropriate Requirements

The action-specific ARARs will be identified in the Feasibility Study report.

7.3 Location-Specific Applicable or Relevant and Appropriate Requirements

No location-specific ARARs have been identified at this time.

TABLE 7-5
NUMERICAL VALUES FOR POTENTIAL CONTAMINANT-SPECIFIC ARARS
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Chemical of Concern(a)	Cleanup Level (b) (mg/kg)		
	Carcinogenic		Noncarcinogenic
	1x10-4	1x10-6	
Volatile Organics			
Acetone	--	--	41,000
Benzene	3,300	33	--
Carbon Disulfide	--	--	570,000
Chlorobenzene	--	--	8,300
Chloroethane	--	--	--
Chloroform	16,000	160	--
1,2-Dichloroethene (total)	--	--	57,000
Ethylbenzene	--	--	570,000
Methylene Chloride	13,000	130	--
Tetrachloroethene	1,900	19	--
Toluene	--	--	83,000
Trichloroethene	140,000	1,400	--
Vinyl Acetate	--	--	1,000,000(b)
Xylene (total)	--	--	830,000
Semi-Volatile Organics			
Acenaphthene	--	--	38,000
Anthracene	--	--	190,000
Benzo(a)Anthracene	160	1.6	--
Benzo(a)Pyrene	160	1.6	--
Benzo(b)Fluoranthene	160	1.6	--
Benzo(k)Fluoranthene	160	1.6	--

Chemical of Concern(a)	Cleanup Level (b) (mg/kg)		
	Carcinogenic		Noncarcinogenic
	1x10-4	1x10-6	
Benzo(g,h,i)Perylene	--	--	--
Bis(2-ethylhexyl)Phthalate	10,000	100	--
Butylbenzylphthalate	--	--	130,000
2-Chloronaphthalene	--	--	--
Chrysene	160	1.6	--
Dibenzo(a,h)Anthracene	12,000	120	--
Dibenzofuran	--	--	--
1,3-Dichlorobenzene	--	--	--
1,4-Dichlorobenzene	100,000	1,000	--
1,2-Dichlorobenzene	--	--	790,000
3,3-Dichlorobenzidine	5,500	55	--
2,4-Dimethylphenol	--	--	180,000
Di-n-Butylphthalate	--	--	63,000
Di-n-Octylphthalate	--	--	13,000
Fluoranthene	--	--	25,000
Fluorene	--	--	25,000
Indeno(1,2,3-C,D)pyrene	12,000	120	--
2-Methylnaphthalene	--	--	--
2-Methylphenol	--	--	440,000
4-Methylphenol	--	--	440,000
Naphthalene	--	--	2,500
Phenanthrene	--	--	--

Chemical of Concern(a)	Cleanup Level (b) (mg/kg)		
	Carcinogenic		Noncarcinogenic
	1x10-4	1x10-6	
Pyrene	30,000	300	--
Metals			
Aluminum	--	--	--
Arsenic	--	--	2,100
Barium	--	--	140,000
Cadmium	--	--	1,000
Calcium	--	--	--
Chromium	--	--	10,000
Cobalt	--	--	--
Copper	--	--	--
Cyanide	--	--	670,000
Lead	--	--	--
Magnesium	--	--	--
Manganese	--	--	210,000
Mercury	--	--	620
Nickel	--	--	41,000
Potassium	--	--	--
Selenium	--	--	--
Silver	--	--	6,200
Vanadium	--	--	14,000
Zinc	--	--	410,000

(a) Chemicals of concern include all constituents detected in the sediment.

(b) Risk calculation indicated maximum concentration of 1,000,000 mg/kg.

-- Indicates that the contaminant was detected in the sediment but a risk-based cleanup level could not be developed because slope factors are not available for these constituents.

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APPENDIX A

EVALUATION OF CHEMICALS DETECTED AT SOLDIER CREEK

A.0 EVALUATION OF CHEMICALS DETECTED AT SOLDIER CREEK

Appendix A contains summaries of all data that were used to generate quantitative risk estimates. The data is grouped by medium and risk segment, except that the groundwater data is grouped by medium only. The data from the eight tap samples are used individually to calculate risks associated with potential exposures from these taps. Each data table is followed by a table that presents the rationale for identification of chemicals of potential concern. Volatile and semi-volatile organics were only eliminated if they are common laboratory contaminants as defined in Appendix VII of "Guidance for Data Useability in Risk Assessment", Interim Final (EPA, 1990c) and were detected at sample concentrations of less than ten times the associated blank sample. Metals were only eliminated if they were detected at less than three times background levels. The following tables are presented in Appendix A:

- Tables A-1 through A-7 - Groundwater Data and Rationale for Selection of Chemicals of Potential Concern.

- Tables A-8 through A-21 - Surface Water Data and Rationale for Selection of Chemicals of Potential Concern.

- Tables A-22 through A-40 - Deep Sediment (0-5') Data and Rationale for Selection of Chemicals of Potential Concern.

- Tables A-41 through A-54 - Shallow Sediment (0-6") Data and Rationale for Selection of Chemicals of Potential Concern.

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TABLE A-1
GROUNDWATER DATA FOR RESIDENTIAL WELL SAMPLES
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Upgradient 21B	7/90 G01	7/90 G02+	7/90 G03+	7/90 G04	7/90 G05	7/90 G06	7/90 G07+	7/90 G08+
VOLATILE ORGANICS (ug/L)											
ACETONE	1/8	10	NA	()	16.00	()	()	()	()	()	()
1,2-DICHLOROETHANE	1/8	10	NA	()	()	()	()	()	()	14.00	()
METHYLENE CHLORIDE	2/8	10	()	()	22.00 U	()	()	()	4.00	()	()
TETRACHLOROETHENE	1/8	10	()	()	()	()	()	()	()	2.00	()
SEMI-VOLATILE ORGANICS (ug/L)											
BIS(2-ETHYLHEXYL)PHTHALATE	4/8	10	16.6	()	()	()	2.00	2.00	5.00 U	()	1.00 U
METALS (ug/L)											
BARIUM	8/8	200	()	663.00	397.00	157.00	628.00	1040.00	304.00	686.00	1220.00
CALCIUM	8/8	5000	NA	67300.00	61500.00	94500.00	64600.00	63600.00	27700.00	77600.00	66300.00
COBALT	6/8	50	NA	7.80 U	()	4.60 U	3.30 U	3.30 U	()	8.00 U	3.70
COPPER	1/8	25	()	()	()	()	27.00	()	()	()	()
IRON	8/8	100	NA	34.80 U	51.30 UJ	77.50 UJ	60.70 UJ	33.70 U	116.00	40.30 U	37.80 U
LEAD	2/8	5	()	()	()	()	2.70 J	()	()	()	5.80
MAGNESIUM	8/8	5000	NA	30100.00	31700.00	46600.00	38900.00	30200.00	12300.00	35700.00	30400.00
MERCURY	4/8	0.2	NA	0.75 J	1.10 J	0.34 J	1.10 J	()	()	()	()
NICKEL	2/8	40	()	24.60	()	()	()	()	()	16.50 U	()
POTASSIUM	6/8	5000	NA	527.00 U	358.00 U	627.00 U	()	()	708.00 U	605.00 U	379.00 U
SODIUM	7/8	5000	NA	18300.00	24500.00	()	22400.00	13100.00	13700.00	34500.00	24900.00
VANADIUM	7/8	20	NA	9.20 U	5.60 U	7.30 U	4.20 U	()	()	4.60 U	4.40 U
ZINC	8/8	20	NA	36.00	58.10 J	87.30 J	17.60 U	2.80 U	31.20	75.50	46.50

Data Qualifer Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
+ - Unfiltered for Inorganic Analyses
NA - Not Analyzed For.

TABLE A-2
GROUNDWATER DATA FOR PERCHED AQUIFER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Upgradient 21B	1B	02/91 2B	02/91 3B	02/91 4B	02/91 5B	02/91 6B	02/91 7B	02/91 8B	02/91 9B	03/91 22B	04/90 1-1B
VOLATILE ORGANICS (ug/L)														
1,1-DICHLOROETHENE	2/18	10	()	DRY	()	()	()	()	()	()	()	()	DRY	()
TRANS-1,2-DICHLOROETHENE	2/18	10	()	DRY	()	()	()	()	()	()	()	()	DRY	()
METHYLENE CHLORIDE	3/18	10	()	DRY	()	()	()	()	()	()	()	()	DRY	2 J
TETRACHLOROETHENE	5/18	10	()	DRY	()	()	()	1.4	()	()	()	()	DRY	()
1,1,1-TRICHLOROETHANE	1/18	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	()
TRICHLOROETHENE	5/18	10	()	DRY	0.6	()	()	()	()	()	()	()	DRY	()
SEMI-VOLATILE ORGANICS (ug/L)														
BIS(2-ETHYLHEXYL)PHTHALATE	6/18	10	16.6	DRY	63	9 J	()	250	()	()	NA	()	DRY	()
DI-N-BUTYLPHTHALATE	1/18	10	10.5	DRY	()	()	()	()	()	()	NA	()	DRY	NA
METALS (ug/L)														
ARSENIC	3/18	10	()	DRY	1.3	()	()	()	()	()	3.3	1.5	DRY	NA
BARIUM	18/18	200	()	DRY	1420	1610	127	713	71	146	443	79	DRY	138
CHROMIUM	7/18	10	()	DRY	()	()	()	36	()	()	17	()	DRY	()
COPPER	4/18	25	()	DRY	22	()	10	19	()	()	52	()	DRY	NA
LEAD	2/18	5	()	DRY	26	()	26	()	()	()	()	()	DRY	()
NICKEL	4/18	40	()	DRY	21	()	()	30	()	()	18	()	DRY	(
SELENIUM	4/18	5	()	DRY	()	()	1.9	()	9.5	1.3	()	6.8	DRY	N

Data Qualifer Legend

() - Not Detected.
J - The associated value is an estimated quantity.
B - Analyte is found in the associated blank as well as in the sample.
NA - Not Analyzed For.

TABLE A-2 (Continued)
GROUNDWATER DATA FOR PERCHED AQUIFER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

	04/90	07/90	04/90	07/90	08/90	06/90	06/90	09/90	08/90
	IWTP DATA								
ANALYTE	1-10B	1-11B	1-15B	19B	22B	34A	35A	1-60B	72B
VOLATILE ORGANICS (ug/L)									
1,1-DICHLOROETHENE	()	()	10 J	()	()	73.9	()	()	()
TRANS-1,2-DICHLOROETHENE	()	()	54	()	()	24	()	()	()
METHYLENE CHLORIDE	7 B	()	84 B	()	()	()	()	()	()
TETRACHLOROETHENE	()	()	36	2 J	()	2900	7.7	()	()
1,1,1-TRICHLOROETHANE	()	()	()	2 J	()	()	()	()	()
TRICHLOROETHENE	()	()	720	41	()	179000	1010	()	()
SEMI-VOLATILE ORGANICS (ug/L)									
BIS(2-ETHYLHEXYL)PHTHALATE	()	10 J	()	2 J	16	()	()	()	()
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (ug/L)									
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	783	222	171	102	538	14	87	344	558
CHROMIUM	()	()	254	185	()	128000	11	28	()
COPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	()	()	()	()	()	()	()	()	()
NICKEL	()	()	43.2	()	()	()	()	()	()
SELENIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA

Data Qualifer Legend

() - Not Detected.
J - The associated value is an estimated quantity.
B - Analyte is found in the associated blank as well as in the sample.
NA - Not Analyzed For.

TABLE A-3
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN IN
GROUNDWATER DATA FOR PERCHED AQUIFER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
1,1-DICHLOROETHENE	Yes - Found only in downgradient.
TRANS-1,2-DICHLOROETHENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TETRACHLOROETHENE	Yes - Found only in downgradient.
1,1,1-TRICHLOROETHANE	Yes - Found only in downgradient.
TRICHLOROETHENE	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
METALS	
ARSENIC	Yes - Found only in downgradient.
BARIUM	Yes - Found only in downgradient.
CHROMIUM	Yes - Found only in downgradient.
COPPER	Yes - Found only in downgradient.
LEAD	Yes - Found only in downgradient.
NICKEL	Yes - Found only in downgradient.
SELENIUM	Yes - Found only in downgradient.

TABLE A-4
GROUNDWATER DATA FOR
TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	03/91 Upgradient 14A	02/91 15A	02/91 16A	01/91 1A	02/91 2A	02/91 3A	02/91 4A	02/91 5A	02/91 6A	02/91 7A	02/91 8A
VOLATILE ORGANICS (ug/L)													
BENZENE	5/31	10	()	()	()	()	()	()	()	()	0.7	()	()
CHLOROBENZENE	14/52	10	()	3	()	()	()	()	()	()	()	()	()
CHLOROFORM	3/24	10	()	()	()	()	()	()	()	2.5	()	()	()
1,1-DICHLOROETHANE	11/20	10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	12/51	10	()	()	()	()	()	()	0.2 J	()	7	()	()
CIS-1,2-DICHLOROETHENE	5/35	10	()	()	()	()	()	()	()	()	21	()	()
TRANS-1,2-DICHLOROETHENE	14/51	10	()	()	()	()	()	()	0.3 J	()	0.4 J	()	()
1,2-DICHLOROPROPANE	4/36	10	()	()	()	()	()	()	()	()	4	()	()
ETHYLBENZENE	4/33	10	()	()	()	()	()	()	()	()	()	()	()
METHYLENE CHLORIDE	12/47	10	()	1.9	0.26 BJ	()	()	()	0.4 BJ	()	0.2 BJ	()	()
TETRACHLOROETHENE	15/52	10	()	1.4	()	()	()	()	()	()	0.2 J	()	()
1,1,1-TRICHLOROETHENE	11/38	10	()	()	()	()	9.3	()	()	9.3	0.2	()	()
TRICHLOROETHENE	16/51	10	()	()	()	()	()	()	0.1 J	()	12	()	()
1,2,4-TRIMETHYLBENZENE	4/32	0.5	()	()	()	()	()	()	0.1 J	()	()	()	0.66
TOLUENE	10/23	10	()	()	()	()	0.9	2.3	()	0.9	0.4 J	()	()
VINYL CHLORIDE	8/51	10	()	()	()	()	()	()	()	()	119	()	()
XYLENE (TOTAL)	5/32	10	()	()	()	()	()	()	0.2 J	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/L)													
BIS(2-ETHYLHEXYL)PHTHALATE	24/37	10	()	46	64	45	36	1100	5 BJ	56	58	9.5	48.2
1,2-DICHLOROBENZENE	6/52	10	()	()	()	()	()	()	()	()	()	()	()
1,3-DICHLOROBENZENE	3/32	10	()	()	()	()	()	()	()	()	()	()	()
1,4-DICHLOROBENZENE	9/52	10	()	0.7	()	()	()	()	()	()	()	()	()
DI-N-OCTYLPHTHALATE	12/22	10	()	()	13	()	13	()	5 J	21	()	13.4	13.4
NAPHTHALENE	1/22	10	()	()	()	()	()	()	()	()	()	()	()
METALS (ug/L)													
ARSENIC	14/31	10	()	3.4	()	()	()	9.6	9.6	42	()	()	()
BARIUM	47/51	200	()	578	816	1370	3460	204	204	617	()	1700	()
CHROMIUM	26/51	10	()	()	27	23	41	31	31	43	()	46	()
COPPER	15/31	25	()	()	28	14	17	19	19	36	()	()	()
LEAD	8/51	5	()	()	()	20	24	()	()	34	()	()	()
NICKEL	21/51	40	()	()	26	()	()	20	20	18	()	()	()
SELENIUM	3/25	5	()	1.5	()	()	()	()	()	1.4	()	()	()

Data Qualifer Legend

- ( ) - Not Detected
- J - The associated value is an estimated quantity.
- B - Analyte is found in the associated blank as well as in the sample.
- E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
- NA - Not Analyzed For.

TABLE A-4 (Continued)
GROUNDWATER DATA FOR
TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

	03/91	02/91	02/91	02/91	02/91	02/91	03/91	02/91	03/91	03/91	04/90	09/89	07/90	04/90	
											IWTP DATA				I
ANALYTE	9A	11A	12A	13A	17A	18A	19A	20A	21A	22A	1-1A	1-10A	1-11A	1-15A	
VOLATILE ORGANICS (ug/L)															
BENZENE	()	()	()	5.80	()	()	()	1.46	()	()	NA	NA	NA	NA	
CHLOROBENZENE	()	()	()	()	()	()	()	2.54	()	()	()	()	760	31	
CHLOROFORM	0.64	()	()	1.1	()	()	()	()	()	()	NA	NA	NA	NA	
1,1-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	()	()	27	2	J
1,1-DICHLOROETHENE	()	()	()	()	()	()	()	()	()	()	()	()	48	()	
CIS-1,2-DICHLOROETHENE	0.76	()	()	5.3	()	()	()	9.09	()	()	NA	NA	NA	NA	
TRANS-1,2-DICHLOROETHENE	()	()	()	()	()	()	()	1.16	()	()	10 J	()	600	33	
1,2-DICHLOROPROPANE	()	()	()	()	()	()	()	()	()	()	()	()	()	()	
ETHYLBENZENE	()	()	()	6.1	()	()	()	2.10	()	()	NA	NA	NA	NA	
METHYLENE CHLORIDE	()	()	0.7	()	()	()	()	()	()	3.76	()	3 BJ	()	10	B
TETRACHLOROETHENE	1.02	()	()	()	()	()	()	()	()	()	35 J	()	920	7	
1,1,1-TRICHLOROETHENE	()	9.3	()	()	()	()	()	()	()	()	NA	NA	NA	NA	
TRICHLOROETHENE	4.71	()	()	1.4	()	()	()	()	()	()	870	()	820	200	E
1,2,4-TRIMETHYLBENZENE	()	()	()	6.52	()	()	()	()	()	()	NA	NA	NA	NA	
TOLUENE	()	0.9	()	27.4	0.9	()	0.82	9.56	1.03	()	NA	NA	NA	NA	
VINYL CHLORIDE	()	()	()	0.80	()	()	()	()	()	()	()	()	110	()	
XYLENE (TOTAL)	()	()	()	24.8	()	()	()	8.77	()	()	NA	NA	NA	NA	
SEMI-VOLATILE ORGANICS (ug/L)															
BIS(2-ETHYLHEXYL)PHTHALATE	()	2.8	()	24	18	4.9	18	33.8	13.9	14.6	()	()	()	()	
1,2-DICHLOROBENZENE	()	()	()	()	()	()	()	()	()	()	()	()	97	()	
1,3-DICHLOROBENZENE	0.52	()	()	()	()	()	()	()	()	()	NA	NA	NA	NA	
1,4-DICHLOROBENZENE	()	()	()	()	()	()	()	()	()	()	()	()	61	()	
DI-N-OCTYLPHTHALATE	()	5.5	()	85	19	()	13	38.5	23.2	()	NA	NA	NA	NA	
NAPHTHALENE	()	()	()	1.3	()	()	()	()	()	()	NA	NA	NA	NA	
METALS (ug/L)															
ARSENIC	8.2	12.5	()	2.2	()	2.6	NA	5.7	1.1	()	NA	NA	NA	NA	
BARIUM	657	198	2500	553	900	282	NA	224	1200	179	676	300	294	1010	
CHROMIUM	()	16	()	10	()	15	NA	()	()	()	()	()	195	19.8	
COPPER	()	30	()	39	()	()	NA	15	21	()	NA	NA	NA	NA	
LEAD	()	()	20	()	()	()	NA	()	()	()	()	()	()	()	
NICKEL	()	()	()	()	()	()	NA	()	()	()	15.2	()	440	37.2	
SELENIUM	()	1.6	()	()	()	()	NA	()	()	()	NA	NA	NA	NA	

Data Qualifer Legend

() - Not Detected
J - The associated value is an estimated quantity.
B - Analyte is found in the associated blank as well as in the sample.
E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
NA - Not Analyzed For.

TABLE A-4 (Continued)
GROUNDWATER DATA FOR
TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

	07/90		08/90	2/91	2/91	2/91	2/91	2/91	2/91	2/91	2/91	3/91	2/91	06/90	06/90	09/90
	WTP DATA															
ANALYTE	19A		22A	11B	12B	13B	14B	15B	16B	17B	18B	19B	20B	34B	35B	1-49
VOLATILE ORGANICS (ug/L)																
BENZENE	NA		NA	()	()	1.1	()	()	()	()	()	()	0.75	NA	NA	NA
CHLOROBENZENE	()		()	()	27.1	()	()	()	()	()	()	()	82.6	111	()	701
CHLOROFORM	NA		NA											NA	()	NA
1,1-DICHLOROETHANE	()		()											()	()	7.9
1,1-DICHLOROETHENE	41	J	()	()	()	()	()	()	()	()	()	()	1.66	()	NA	6.9
CIS-1,2-DICHLOROETHENE	NA		NA	()	()	()	()	()	()	()	()	()	3.62	NA	()	NA
TRANS-1,2-DICHLOROETHENE	440		()	()	()	()	()	()	()	()	()	()	()	()	NA	5.7
1,2-DICHLOROPROPANE	()		()											()	NA	()
ETHYLBENZENE	NA		NA	()	()	4.1	()	()	()	0.61	()	()	()	NA	()	NA
METHYLENE CHLORIDE	()		()	1.01	()	()	()	()	()	()	()	()	()	()	()	22.6
TETRACHLOROETHENE	660		()	()	()	()	()	()	()	()	()	()	()	44.8	()	130
1,1,1-TRICHLOROETHENE	150		()											()	1910	()
TRICHLOROETHENE	3800		()	()	()	()	()	()	()	()	()	()	()	18000	NA	275
1,2,4-TRIMETHYLBENZENE	NA		NA	()	()	2.8	()	()	()	()	()	()	()	NA	NA	NA
TOLUENE	NA		NA											NA	()	NA
VINYL CHLORIDE	()		()	()	()	()	()	()	()	()	()	()	()	()	NA	73.8
XYLENE (TOTAL)	NA		NA	()	()	2.5	()	()	()	()	()	()	2.94	NA	NA	NA
SEMI-VOLATILE ORGANICS (ug/L)																
BIS(2-ETHYLHEXYL)PHTHALATE	2	J	19											()	()	13
1,2-DICHLOROBENZENE	()		()	()	6.06	()	()	()	()	()	()	()	11.1	()	()	420
1,3-DICHLOROBENZENE	NA		NA	()	0.94	()	()	()	()	()	()	()	2.08	NA	NA	NA
1,4-DICHLOROBENZENE	()		()	()	7.17	()	()	()	()	()	()	()	17.2	()	()	220
DI-N-OCTYLPHTHALATE	NA		NA											NA	NA	NA
NAPHTHALENE	NA		NA											NA	NA	NA
METALS (ug/L)																
ARSENIC	NA		NA	()	()	()	()	()	1.2	()	1.1	3.3	1.5	NA	NA	NA
BARIUM	2080		646	432	1380	755	249	666	1040	770	602	724	79	112	87	935
CHROMIUM	19		()	()	()	()	()	()	()	()	()	()	()	6520	11	150
COPPER	NA		NA	()	32	27	12	()	()	()	20	11	()	NA	NA	NA
LEAD	()		()	()	()	()	()	()	()	()	()	()	()	()	()	()
NICKEL	()		()	()	24	41	()	()	()	()	()	()	()	()	()	216
SELENIUM	NA		NA											NA	NA	NA

Data Qualifer Legend

() - Not Detected
J - The associated value is an estimated quantity.
B - Analyte is found in the associated blank as well as in the sample.
E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
NA - Not Analyzed For.

TABLE A-4 (Continued)
GROUNDWATER DATA FOR
TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	A	07/90 IWTP DATA 1-50A	09/90 IWTP DATA 1-51A	09/90 1-52A	09/90 1-53A	09/90 1-59A	09/90 1-60A	09/90 1-49B	07/90 IWTP DATA 1-50B	09/90 IWTP DATA 1-51B	09/90 1-52B	09/90 1-53B
VOLATILE ORGANICS (ug/L)												
BENZENE		NA	NA	NA	NA	NA	NA					
CHLOROBENZENE		1100	851	15	()	10	()	()	660	4 J	()	()
CHLOROFORM		NA	NA	NA	NA	NA	NA				()	()
1,1-DICHLOROETHANE		78	178	2 J	()	6	7	6.2	18 J	4 J	()	()
1,1-DICHLOROETHENE		36 J	32 J	()	()	14	12	11.1	6 J	()	()	()
CIS-1,2-DICHLOROETHENE		NA	NA	NA	NA	NA	NA				()	()
TRANS-1,2-DICHLOROETHENE		1300	2161	()	()	61	56	()	670	3 J	()	()
1,2-DICHLOROPROPANE		39 J	73 J	()	()	()	3 J					
ETHYLBENZENE		NA	NA	NA	NA	NA	NA					
METHYLENE CHLORIDE		26 J	44 BJ	()	()	3 BJ	2 J					
TETRACHLOROETHENE		180	120	()	()	60	119	149	120	()	()	()
1,1,1-TRICHLOROETHENE		9 J	()	()	()	9	4 J	5.8	10 J	()	()	()
TRICHLOROETHENE		920	630	()	()	65	172	36.5	68	2 J	()	()
1,2,4-TRIMETHYLBENZENE		NA	NA	NA	NA	NA	NA					
TOLUENE		NA	NA	NA	NA	NA	NA					
VINYL CHLORIDE		340	1615	()	()	7 J	()	()	150	()	()	()
XYLENE (TOTAL)		NA	NA	NA	NA	NA	NA					
SEMI-VOLATILE ORGANICS (ug/L)												
BIS(2-ETHYLHEXYL)PHTHALATE		2 J	()	6 J	12	()	()					
1,2-DICHLOROBENZENE		170	()	1 J	()	()	()	()	5 J	()	()	()
1,3-DICHLOROBENZENE		NA	NA	NA	NA	NA	NA					
1,4-DICHLOROBENZENE		70	98	1 J	()	()	()	()	5 J	()	()	()
DI-N-OCTYLPHTHALATE		NA	NA	NA	NA	NA	NA					
NAPHTHALENE		NA	NA	NA	NA	NA	NA					
METALS (ug/L)												
ARSENIC		NA	NA	NA	NA	NA	NA					
BARIUM		1570	1440	245	834	215	2440	181	2700	507	563	555
CHROMIUM		34	11	498	21	599	134	227	()	42	30	277
COPPER		NA	NA	NA	NA	NA	NA					
LEAD		()	()	23	()	32	39	()	()	()	25	()
NICKEL		149	284	65	18	139	408	305	40	44	263	54
SELENIUM		NA	NA	NA	NA	NA	NA					

Data Qualifer Legend

() - Not Detected
J - The associated value is an estimated quantity.
B - Analyte is found in the associated blank as well as in the sample.
E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
NA - Not Analyzed For.

TABLE A-5
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN IN
GROUNDWATER DATA FOR TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
BENZENE	Yes - Found only in downgradient.
CHLOROBENZENE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found only in downgradient.
1,1-DICHLOROETHANE	Yes - Found only in downgradient.
1,1-DICHLOROETHENE	Yes - Found only in downgradient.
CIS-1,2-DICHLOROETHENE	Yes - Found only in downgradient.
TRANS-1,2-DICHLOROETHENE	Yes - Found only in downgradient.
1,2-DICHLOROPROPANE	Yes - Found only in downgradient.
ETHYLBENZENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	Yes - Detected downgradient.
TETRACHLOROETHENE	Yes - Found only in downgradient.
1,1,1-TRICHLOROETHANE	Yes - Found only in downgradient.
TRICHLOROETHENE	Yes - Found only in downgradient.
1,2,4-TRIMETHYLBENZENE	Yes - Found only in downgradient.
TOLUENE	Yes - Found only in downgradient.
VINYL CHLORIDE	Yes - Found only in downgradient.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
1,2-DICHLOROBENZENE	Yes - Found only in downgradient.
1,3-DICHLOROBENZENE	Yes - Found only in downgradient.
1,4-DICHLOROBENZENE	Yes - Found only in downgradient.
DI-N-OCTYLPHTHALATE	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
METALS	
ARSENIC	Yes - Found at significantly greater (>3x) background.
BARIUM	Yes - Found at significantly greater (>3x) background.
CHROMIUM	Yes - Found at significantly greater (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found only in downgradient.
NICKEL	Yes - Found only in downgradient.
SELENIUM	No - Not significantly greater than (<3x) background.

TABLE A-6
GROUNDWATER DATA FOR
REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Upgradient 14C	15C	16C	1C	2C	3C	4C	5C	6C
VOLATILE ORGANICS (ug/L)											
BENZENE	1/21	10	()	()	()	()	()	()	()	()	1.32
CHLOROBENZENE	11/34	10	()	()	()	()	()	()	()	()	40.8
1,1-DICHLOROETHANE	3/13	10	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	4/34	10	()	()	()	()	()	()	()	()	3.32
CIS-1,2-DICHLOROETHENE	2/21	10	()	()	()	()	()	()	()	()	13.5
TRANS-1,2-DICHLOROETHENE	10/34	10	()	()	()	()	()	()	()	()	()
1,2-DICHLOROPROPANE	2/33	10	()	()	()	()	()	()	()	()	0.91
METHYLENE CHLORIDE	12/34	10	()	()	()	()	()	()	0.2 BJ	()	3.13
TETRACHLOROETHENE	7/34	10	()	()	()	()	()	()	()	()	3.96
1,1,1-TRICHLOROETHANE	2/13	10	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRICHLOROETHENE	16/34	10	()	()	()	()	()	()	()	()	4.8
1,2,4-TRIMETHYLBENZENE	1/21	0.5	()	()	()	()	()	()	()	()	0.88
TOLUENE	4/21	10	2.19	()	()	()	()	0.6	()	()	()
VINYL CHLORIDE	4/34	10	()	()	()	()	()	()	()	()	11
SEMI-VOLATILE ORGANICS (ug/L)											
BIS(2-ETHYLHEXYL)PHTHALATE	24/34	10	()	11	()	81.4	15	21	11 BJ	36	3.6
DI-N-BUTYLPHTHALATE	2/21	10	()	()	()	()	()	()	()	()	()
1,2-DICHLOROBENZENE	5/34	10	()	()	()	()	()	()	()	()	5.29
1,4-DICHLOROBENZENE	5/34	10	()	()	()	()	()	()	()	()	1.8
DIETHYLPHTHALATE	2/34	10	()	10	()	()	()	()	16	()	()
DI-2-ETHYLHEXYLPHTHALATE	6/21	10	()	()	()	()	()	()	5 J	()	()
METALS (ug/L)											
ARSENIC	14/21	10	()	3	2.6	3.9	1.1	6	7.3	7	()
BARIUM	33/34	200	281	405	254	172	633	454	670	462	6060
CHROMIUM	26/34	10	139	56	()	14	13	61	39	38	24
COPPER	11/21	25	15	55	21	()	76	56	39	118	()
LEAD	7/34	5	()	()	()	()	()	()	24	()	43
NICKEL	13/34	40	()	31	()	()	()	29	21	24	()
SELENIUM	1/21	5	()	()	()	()	()	()	()	()	()

Data Qualifer Legend

- ( ) - Not Detected
- J - The associated value is an estimated quantity.
- B - Analyte is found in the associated blank as well as in the sample.
- E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
- NA - Not Analyzed For.

TABLE A-6 (Continued)
GROUNDWATER DATA FOR
REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	7C	8C	9C	11C	12C	13C	17C	18C	19C	20C	21C	22C	IWTP DATA 1-10C
VOLATILE ORGANICS (ug/L)													
BENZENE	()	()	()	()	()	()	()	()	()	()	()	()	NA
CHLOROBENZENE	()	3.98	()	()	()	()	()	()	()	()	()	()	()
1,1-DICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	()
1,1-DICHLOROETHENE	()	()	()	()	()	()	()	()	()	()	()	()	()
CIS-1,2-DICHLOROETHENE	()	31.5	()	()	()	()	()	()	()	()	()	()	NA
TRANS-1,2-DICHLOROETHENE	()	0.96	()	()	()	()	()	()	()	()	()	()	3 J
1,2-DICHLOROPROPANE	()	()	()	()	()	()	()	()	()	()	()	()	()
METHYLENE CHLORIDE	()	21	()	()	()	()	0.5	()	()	()	0.5	()	8 B
TETRACHLOROETHENE	()	()	()	()	()	()	()	()	()	()	()	()	()
1,1,1-TRICHLOROETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	()
TRICHLOROETHENE	()	26.8	0.88	()	()	()	()	()	()	()	()	()	6
1,2,4-TRIMETHYLBENZENE	()	()	()	()	()	()	()	()	()	()	()	()	NA
TOLUENE	()	5.02	()	()	()	()	()	()	()	()	0.53	()	NA
VINYL CHLORIDE	()	()	()	()	()	()	()	()	()	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/L)													
BIS(2-ETHYLHEXYL)PHTHALATE	10	9.1	18.2	18.2	()	10 J	3 J	9	52	11.9	()	25.9	NR
DI-N-BUTYLPHTHALATE	4	5.7	()	()	()	()	()	()	()	()	()	()	NA
1,2-DICHLOROBENZENE	()	()	()	()	()	()	()	()	()	()	()	()	NR
1,4-DICHLOROBENZENE	()	()	()	()	()	NA	()	()	()	()	()	()	NR
DIMETHYLPHTHALATE	()	()	()	()	()	()	()	()	()	()	()	()	NR
DI-N-OCTYLPHTHALATE	()	()	()	()	()	4 J	3 J	7.9	()	()	()	6.4	NA
METALS (ug/L)													
ARSENIC	3.1	()	()	2.9	()	2.2	4.3	()	2.6	3.5	2.1	7.3	NA
BARIUM	1720	()	1770	664	283	989	545	2210	452	620	207	788	459
CHROMIUM	56	()	42	()	()	44	19	29	()	21	()	20	()
COPPER	15	()	23	()	21	25	()	()	()	()	()	()	NA
LEAD	62	()	()	()	()	()	()	()	()	34	()	28	()
NICKEL	23	()	()	()	()	20	()	()	()	()	()	()	()
SELENIUM	()	()	()	()	()	()	()	()	6.8	()	()	()	NA

Data Qualifer Legend

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E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
NA - Not Analyzed For.

TABLE A-6 (Continued)
GROUNDWATER DATA FOR
REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	IWTP DATA										
	1-11C	1-15C	19C	34C	35C	1-49C	1-50C	1-51C	1-52C	1-53C	1-59C	1-60C
VOLATILE ORGANICS (ug/L)												
BENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLOROBENZENE	19	6	293	19.1	7.2	86.6	480	239	()	()	2 J	()
1,1-DICHLOROETHANE	()	0.7 J	()	()	()	()	()	4	()	()	13	()
1,1-DICHLOROETHENE	13	()	()	()	()	()	7 J	()	()	()	24	()
CIS-1,2-DICHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	69	24	10.1	()	()	()	16 J	18	3 J	()	113	14
1,2-DICHLOROPROPANE	()	()	()	()	()	()	()	()	()	()	14	()
METHYLENE CHLORIDE	28	98	19.2	()	()	()	()	2 BJ	()	()	1 BJ	3 BJ
TETRACHLOROETHENE	67	()	()	24.7	()	49.9	200	()	()	()	38	1 J
1,1,1-TRICHLOROETHANE	5 J	()	()	()	()	()	()	()	()	()	9	()
TRICHLOROETHENE	320	250 E	848	1100	331	98.7	290	8 J	3 J	6.6	69	32
1,2,4-TRIMETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOLUENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VINYL CHLORIDE	()	()	79	()	()	13.1	()	6	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/L)												
BIS(2-ETHYLHEXYL)PHTHALATE	3 J	()	20	()	()	10	5 J	3 J	164	()	10	()
DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	2 J	()	150	()	()	20	52	()	()	()	()	()
1,4-DICHLOROBENZENE	1 J	()	52	()	()	10	22	()	()	()	()	()
DIMETHYLPHTHALATE	()	()	()	()	()	()	()	()	()	()	()	()
DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (ug/L)												
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	341	618	440	161	1440	237	350	1360	307	579	229	959
CHROMIUM	104	31.2	55	12.9	37.2	()	19	()	91	45	408	63
COPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	()	20	()	()	()	()	()	()	()	()	()	27
NICKEL	()	272	47	()	()	()	29	71	18	()	39	31
SELENIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Data Qualifer Legend

( ) - Not Detected
J - The associated value is an estimated quantity.
B - Analyte is found in the associated blank as well as in the sample.
E - Identifies compounds whose concentrations exceed the calibrated range of the instrument for that specific analysis.
NA - Not Analyzed For.

TABLE A-7
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN IN
GROUNDWATER DATA FOR REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
BENZENE	Yes - Found only in downgradient.
CHLOROBENZENE	Yes - Found only in downgradient.
1,1-DICHLOROETHANE	Yes - Found only in downgradient.
1,1-DICHLOROETHENE	Yes - Found only in downgradient.
CIS-1,2-DICHLOROETHENE	Yes - Found only in downgradient.
TRANS-1,2-DICHLOROETHENE	Yes - Found only in downgradient.
1,2-DICHLOROPROPANE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	Yes - Found only in downgradient.
TETRACHLOROETHENE	Yes - Found only in downgradient.
1,1,1-TRICHLOROETHANE	Yes - Found only in downgradient.
TRICHLOROETHENE	Yes - Found only in downgradient.
1,2,4-TRIMETHYLBENZENE	Yes - Found only in downgradient.
TOLUENE	No - Common Laboratory Contaminant.
VINYL CHLORIDE	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	No - Common Laboratory Contaminant.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
1,2-DICHLOROBENZENE	Yes - Found only in downgradient.
1,4-DICHLOROBENZENE	Yes - Found only in downgradient.
DIMETHYLPHTHALATE	No - Common Laboratory Contaminant.
DI-N-OCTYLPHTHALATE	No - Common Laboratory Contaminant.
METALS	
ARSENIC	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) bakcground.
CHROMIUM	No - Not significantly greater than (<3x) background.
COPPER	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found only in downgradient.
NICKEL	Yes - Found at significantly greater than (>3x) bakcground.

TABLE A-8
SURFACE WATER BACKGROUND DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	PHASE I C01	PHASE II C01	PHASE II C02	PHASE II C03	PHASE II D01
VOLATILE ORGANICS (ug/L)							
BROMODICHLOROMETHANE	1/5	10	( )	( )	( )	0.9	( )
CHLOROBENZENE	1/5	10	( )	( )	( )	( )	1.00
CHLOROFORM	1/5	10	( )	( )	( )	9.00	( )
1,2-DICHLOROETHENE (TOTAL)	1/5	10	( )	( )	( )	( )	( )
METHYLENE CHLORIDE	1/5	10	( )	( )	( )	( )	( )
SEMI-VOLATILE ORGANICS (ug/L)							
METALS (ug/L)							
ALUMINUM	1/1	200	907.00 J	NA	NA	NA	NA
ANTIMONY	0/5	60	( )	( )	( )	( )	( )
ARSENIC	0/1	10	( )	NA	NA	NA	NA
BARIUM	1/1	200	350.00	NA	NA	NA	NA
BERYLLIUM	0/1	5	( )	NA	NA	NA	NA
CADMIUM	0/5	5	( )	( )	( )	( )	( )
CALCIUM	1/1	5000	64300.00	NA	NA	NA	NA
CHROMIUM	1/1	10	3.80	( )	( )	( )	( )
COBALT	1/1	50	4.90 U	NA	NA	NA	NA
COPPER	0/1	25	( )	NA	NA	NA	NA
CYANIDE	0/5	10	( )	( )	( )	( )	( )
IRON	1/1	100	1730.00	NA	NA	NA	NA
LEAD	5/5	3	3.90	2.90	6.00	1.40 J	2.70 J
MAGNESIUM	1/1	5000	21600.00	NA	NA	NA	NA
MANGANESE	1/1	15	1000.00	NA	NA	NA	NA
NICKEL	0/1	40	( )	NA	NA	NA	NA
POTASSIUM	1/1	5000	921.00	NA	NA	NA	NA
SELENIUM	0/1	5	( )	NA	NA	NA	NA
SILVER	0/1	10	( )	NA	NA	NA	NA
SODIUM	1/1	5000	21400.00 J	NA	NA	NA	NA
VANADIUM	1/1	50	2.60	NA	NA	NA	NA
ZINC	1/1	20	24.50	NA	NA	NA	NA

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
NA - Not Analyzed For.

TABLE A-9
RISK SEGMENT A
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANIC	
NOT ANALYZED	
SEMI-VOLATILE ORGANICS	
NOT ANALYZED	
METALS	
NOT ANALYZED	

TABLE A-10
RISK SEGMENT B
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I B01
VOLATILE ORGANICS				
SEMI-VOLATILE ORGANICS				
METALS (ug/L)				
ALUMINUM	1/1	200	907.00 J	465.00
ARSENIC	1/1	10	( )	7.40
BARIUM	1/1	200	350.00	811.00
CALCIUM	1/1	5000	64300.00	62600.00
IRON	1/1	100	1730.00	1940.00
LEAD	1/1	3	3.90	2.60
MAGNESIUM	1/1	5000	21600.00	24000.00
MANGANESE	1/1	15	1000.00	1500.00
POTASSIUM	1/1	5000	921.00	3310.00
SODIUM	1/1	5000	21400.00 J	36300.00

Data Qualifier Legend

( ) - Not Detected.
J - Below Contract Required Detection Limit but observed by the laboratory.

TABLE A-11
RISK SEGMENT B
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANIC	
NO ANALYTES DETECTED	
SEMI-VOLATILE ORGANICS	
NO ANALYTES DETECTED	
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ARSENIC	Yes - Found only in downgradient.
BARIUM	No - Not significantly greater than (<3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
SODIUM	No - Not significantly greater than (<3x) background.

TABLE A-12
RISK SEGMENT E1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I E01	PHASE I E02	PHASE I E03	PHASE II E03	PHASE I E04	PHASE I E05
VOLATILE ORGANICS (ug/L)									
ACETONE	3/14	10	()	()	()	5.00 J	41.00	()	()
BROMODICHLOROMETHANE	3/14	10	()	()	()	()	()	()	()
BROMOFORM	3/14	10	()	()	()	()	15.00	()	()
CARBON DISULFIDE	1/14	10	()	()	()	()	1.00	()	()
CHLOROFORM	5/14	10	()	0.70 U	1.00 U	5.00 UJ	()	()	()
DIBROMOCHLOROMETHANE	3/14	10	()	()	()	()	()	()	()
METHYLENE CHLORIDE	6/14	10	()	3.00	6.00	2.00 UJ	4.00 U	()	()
TETRACHLOROETHENE	3/14	10	()	()	()	()	()	()	()
1,1,1-TRICHLOROETHANE	1/14	10	()	()	()	()	()	()	()
TOLUENE	2/14	10	()	()	1.00 J	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/L)									
BENZO(G,H,I)PERYLENE	1/13	10	()	()	()	()	NA	()	6.00
BENZOIC ACID	1/13	10	()	()	()	()	NA	()	()
BIS(2-ETHYLHEXYL)PHTHALATE	6/13	10	()	()	5.00	3.00	NA	()	1.00
CHRYSENE	1/13	10	()	()	()	()	NA	()	5.00
DI-N-OCTYL PHTHALATE	2/13	10	()	()	()	()	NA	()	()
METALS (ug/L)									
ALUMINUM	11/11	200	907.00 J	338.00	342.00	181.00 U	NA	203.00	179.00 UJ
ARSENIC	3/11	10	()	()	()	()	NA	()	6.80 UJ
BARIUM	11/11	200	350.00	533.00	514.00	445.00	NA	455.00	452.00
CALCIUM	11/11	5000	64300.00	45000.00	46900.00	34900.00	NA	79400.00	80800.00
CHROMIUM	14/14	10	3.80	11.40	13.50	15.80	36.90	25.80	22.40
COBALT	7/11	50	4.90 U	()	()	()	NA	()	6.10 U
COPPER	7/11	25	()	()	()	242.00 J	NA	98.50 J	82.60
IRON	11/11	100	1730.00	358.00	373.00	442.00	NA	138.00	160.00
LEAD	12/14	3	3.90	4.10 J	6.80	4.00	()	()	1.10 UJ
MAGNESIUM	11/11	5000	21600.00	21000.00	22000.00	16400.00	NA	38200.00	40800.00
MANGANESE	11/11	15	1000.00	81.00	84.60	31.40	NA	28.40	22.30
NICKEL	3/11	40	()	()	()	()	NA	()	()
POTASSIUM	11/11	5000	921.00	3540.00 U	4000.00 U	1350.00 U	NA	5010.00	4830.00 U
SELENIUM	9/11	5	()	()	()	3.80 U	NA	15.40	20.90 J
SILVER	1/11	10	()	()	()	()	NA	()	()
SODIUM	11/11	5000	21400.00 J	21900.00 J	22800.00	25300.00	NA	61400.00	55400.00
VANADIUM	8/11	50	2.60	11.60 U	13.00 U	20.90 U	NA	()	5.00 U
ZINC	11/11	20	24.50	78.90	78.90	76.60	NA	47.40	26.80

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R - The data are unusable (compound may or may not be present). Resampling and reanalyses is necessary for verification.
NA - Not Analyzed For.

TABLE A-12 (Continued)
RISK SEGMENT E1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	PHASE I E06	PHASE II E06	PHASE I E07	PHASE I E08	PHASE I E09	PHASE I E10	PHASE I E11	PHASE II E11
VOLATILE ORGANICS (ug/L)								
ACETONE	()	()	()	()	()	()	()	32.00 U
BROMODICHLOROMETHANE	()	()	()	()	6.00	4.00	3.00 UJ	()
BROMOFORM	()	7.00	()	()	()	()	4.00 J	()
CARBON DISULFIDE	()	()	()	()	()	()	()	()
CHLOROFORM	()	()	()	()	6.00 U	()	3.00 J	()
DIBROMOCHLOROMETHANE	()	()	()	()	5.00	5.00	4.00 J	()
METHYLENE CHLORIDE	()	14.00	()	()	()	()	()	310.00
TETRACHLOROETHENE	()	()	()	()	3.00	3.00	1.00 J	()
1,1,1-TRICHLOROETHANE	()	()	()	()	2.00	()	()	()
TOLUENE	()	()	()	()	()	()	()	4.00
SEMI-VOLATILE ORGANICS (ug/L)								
BENZO(G,H,I)PERYLENE	()	()	()	() R	() R	() R	()	NA
BENZOIC ACID	()	()	()	() R	1.00 R	() R	()	NA
BIS(2-ETHYLHEXYL)PHTHALATE	()	()	2.00	2.00 R	() R	() R	14.00 J	NA
CHRYSENE	()	()	()	() R	() R	() R	()	NA
DI-N-OCTYL PHTHALATE	()	()	()	() R	0.80 R	0.60 R	()	NA
METALS (ug/L)								
ALUMINUM	375.00 J	NA	373.00 J	643.00 J	413.00 J	1080.00 J	56.90 U	NA
ARSENIC	6.40 U	NA	()	5.50 U	()	()	()	NA
BARIUM	590.00	NA	449.00	539.00	342.00	474.00	313.00	NA
CALCIUM	79400.00	NA	39100.00	74800.00	44900.00	55800.00	48100.00	NA
CHROMIUM	21.40	20.50	18.00	29.90	51.60	156.00	42.50	28.10 J
COBALT	5.50 U	NA	4.20 U	8.50 U	7.40 U	11.20 U	9.20 U	NA
COPPER	119.00	NA	21.10 U	78.80	()	20.70 U	()	NA
IRON	195.00	NA	172.00	800.00	323.00	1180.00	144.00	NA
LEAD	3.20 J	3.50 J	4.40 J	6.60 J	3.80 J	6.20 J	2.00 U	4.0 J
MAGNESIUM	39400.00	NA	19800.00	37400.00	22800.00	23700.00	22600.00	NA
MANGANESE	30.80	NA	11.70 U	106.00	280.00	493.00	428.00	NA
NICKEL	()	NA	()	()	20.80 U	32.60 U	9.20 U	NA
POTASSIUM	4640.00 U	NA	1620.00 U	4220.00 U	6640.00	6680.00	5870.00	NA
SELENIUM	18.50 J	NA	4.60 UJ	9.90 J	7.00 J	7.50 J	4.30	NA
SILVER	()	NA	()	()	()	2.10 UJ	()	NA
SODIUM	73000.00	NA	16400.00	55100.00	112000.00	103000.00	89500.00	NA
VANADIUM	10.70 U	NA	26.00 U	()	2.00 U	3.60 U	()	NA
ZINC	44.40	NA	36.30	51.00	22.70	39.80	13.20 U	NA

Data Qualifier Legend

() - Not Detected.
J - Below Contract Required Detection Limit but observed by the laboratory.
U - Detected by the CLP laboratory; classified as not detected via BVWST data validation.

UJ - The associated value is an estimated quantity detected by CLP laboratory; classified as not detected via BVWST data validation.
R - The data are unusable (compound may or may not be present). Resampling and reanalyses is necessary for verification.
NA - Not Analyzed For.

TABLE A-13
RISK SEGMENT E1
RATIONALE FOR IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
BROMODICHLOROMETHANE	Yes - Found only in downgradient.
BROMOFORM	Yes - Found only in downgradient.
CARBON DISULFIDE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found only in downgradient.
DIBROMOCHLOROMETHANE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TETRACHLOROETHENE	Yes - Found only in downgradient.
1,1,1-TRICHLOROETHANE	Yes - Found only in downgradient.
TOLUENE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BENZO(G,H,I)PERYLENE	Yes - Found only in downgradient.
BENZOIC ACID	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	No - Common Laboratory Contaminant.
CHRYSENE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	No - Common Laboratory Contaminant.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ARSENIC	Yes - Found only in downgradient.
BARIUM	No - Not significantly greater than (<3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COBALT	No - Not significantly greater than (<3x) background.
COPPER	Yes - Found only in downgradient.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	Yes - Found only in downgradient.
POTASSIUM	No - Not significantly greater than (<3x) background.
SELENIUM	Yes - Found only in downgradient.
SILVER	Yes - Found only in downgradient.
SODIUM	No - Not significantly greater than (<3x) background.
VANADIUM	Yes - Found at significantly greater than (>3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-14
RISK SEGMENT E2
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I E12	PHASE II E12	PHASE I E13	PHASE II E13
VOLATILE ORGANICS (ug/L)							
ACETONE	1/4	10	()	()	60.00	()	()
BENZENE	1/4	10	()	()	()	()	1.00
METHYLENE CHLORIDE	2/4	10	()	()	620.00	()	3.00 U
1,1,1-TRICHLOROETHANE	2/4	10	()	()	5.00	()	2.00
TOLUENE	1/4	10	()	()	()	()	4.00
XYLENE (TOTAL)	1/4	10	()	()	()	()	2.00
SEMI-VOLATILE ORGANICS (ug/L)							
BENZOIC ACID			()	0.40 J	()	()	()
METALS (ug/L)							
ALUMINUM	2/2	200	907.00 J	206.00	NA	408.00	NA
BARIUM	2/2	200	350.00	280.00	NA	256.00	NA
CADMIUM	1/4	5	()	()	9.4 J	()	()
CALCIUM	2/2	5000	64300.00	47500.00	NA	47000.00	NA
CHROMIUM	4/4	10	3.80	21.50	34.9 J	18.20	30.4 J
IRON	2/2	100	1730.00	346.00	NA	162.00	NA
LEAD	4/4	3	3.90	2.20 UJ	4.80	2.10 UJ	3.30 J
MAGNESIUM	2/2	5000	21600.00	22100.00	NA	21900.00	NA
MANGANESE	2/2	15	1000.00	298.00	NA	189.00	NA
POTASSIUM	2/2	5000	921.00	6290.00	NA	5780.00	NA
SELENIUM	1/2	5	()	5.80	NA	()	NA
SODIUM	2/2	5000	21400.00 J	120000.00	NA	130000.00	NA

Data Qualifier Legend

() - Not detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimated and may be inaccurate or imprecise.
NA - Not Analyzed For.

TABLE A-15
RISK SEGMENT E2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	Yes - Found only in downgradient.
BENZENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	Yes - Found only in downgradient.
1,1,1-TRICHLOROETHANE	Yes - Found only in downgradient.
TOLUENE	Yes - Found only in downgradient.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BENZOIC ACID	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	No - Not significantly greater than (<3x) background.
CADMIUM	Yes - Found only in downgradient.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COBALT	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
POTASSIUM	Yes - Found at significantly greater than (>3x) background.
SELENIUM	Yes - Found only in downgradient.
SODIUM	Yes - Found at significantly greater than (>3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-16
RISK SEGMENT M1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I M01	PHASE I M04	PHASE I M05	PHASE I M06
VOLATILE ORGANICS (ug/L)							
SEMI-VOLATILE ORGANICS (ug/L)							
BENZOIC ACID	1/4	10	( )	( )	( )	( )	0.40
BIS(2-ETHYLHEXYL)PHTHALATE	3/4	10	( )	6.00 U	1.00 U	3.00 U	( )
DI-N-BUTYLPHTHALATE	1/4	10	( )	( )	( )	0.40 U	( )
METALS (ug/L)							
ALUMINUM	4/4	200	907.00 J	780.00 J	3850.00 J	465.00	1900.00
BARIUM	4/4	200	350.00	375.00	1900.00	8.11	704.00
CALCIUM	4/4	5000	64300.00	31200.00	64500.00	62600.00	51100.00
CHROMIUM	2/4	10	3.80	14.10	( )	( )	9.00 U
IRON	4/4	100	1730.00	429.00 J	3730.00 J	1940.00	4550.00
LEAD	4/4	3	3.90	5.00 J	9.10	2.60 U	22.30
MAGNESIUM	4/4	5000	21600.00	19900.00	36300.00	24000.00	17900.00
MANGANESE	4/4	15	1000.00	34.30	1420.00	1500.00	3060.00
SODIUM	4/4	5000	21400.00 J	31400.00 J	21100.00 J	36300.00	26700.00
ZINC	4/4	20	24.50	29.90	17.10 U	4.50 UJ	20.10

Data Qualifier Legend

( ) – Not Detected.
J – The associated value is an estimated quantity.
U – For material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ – The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

TABLE A-17
RISK SEGMENT M1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BENZOIC ACID	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	No - Common Laboratory Contaminant.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
SODIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-18
RISK SEGMENT M2
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I M07	PHASE II M07	PHASE I M08	PHASE II M08	PHASE I M09	PHASE II M09
VOLATILE ORGANICS (ug/L)									
ACETONE	1/6	10	()	()	7.00	()	()	()	()
BENZENE	1/6	10	()	()	()	()	()	()	2.0
CARBON DISULFIDE	1/6	10	()	()	()	()	()	()	0.7
CHLOROBENZENE	1/6	10	()	()	()	()	()	()	2.0
METHYLENE CHLORIDE	4/6	10	()	()	2.00 U	()	1.00	2.00 J	0.9
1,1,1-TRICHLOROETHANE	3/6	10	()	()	2.00	()	3.00	()	1.0
TRICHLOROETHENE	1/6	10	()	()	()	()	()	()	2.0
TOLUENE	2/6	10	()	()	5.00	()	()	()	4.0
SEMI-VOLATILE ORGANICS (ug/L)									
BIS(2-ETHYLHEXYL)PHTHALATE	1/3	10	()	()	NA	10.00	NA	()	NA
METALS (ug/L)									
ALUMINUM	3/3	200	907.00 J	415.00	NA	222.00 J	NA	97.20 U	NA
BARIUM	3/3	200	350.00	267.00	NA	299.00	NA	279.00	NA
CADMIUM	1/6	5	()	()	()	()	()	()	()
CALCIUM	3/3	5000	64300.00	48000.00	NA	46800.00	NA	44700.00	NA
CHROMIUM	6/6	10	3.80	18.50	24.5 J	36.60	21.9	41.50	8.90 UJ
IRON	3/3	100	1730.00	176.00	NA	200.00	NA	304.00	NA
LEAD	5/6	3	3.90	1.80 UJ	()	1.10 UJ	3.9 J	1.30 U	2.5 UJ
MAGNESIUM	3/3	5000	21600.00	21700.00	NA	21500.00	NA	20500.00	NA
MANGANESE	3/3	15	1000.00	157.00	NA	493.00	NA	714.00	NA
NICKEL	3/3	40	()	15.90 U	NA	10.80 J	NA	18.40 U	NA
POTASSIUM	3/3	5000	921.00	5150.00	NA	5440.00	NA	5500.00	NA
SELENIUM	2/3	5	()	()	NA	6.70	NA	4.80 U	NA
SODIUM	3/3	5000	21400.00 J	122000.00	NA	112000.00	NA	92100.00	NA
VANADIUM	1/3	50	2.60	()	NA	3.20 J	NA	()	NA
ZINC	3/3	20	24.50	11.10 U	NA	20.40	NA	10.40 U	NA

Data Qualifer Legend

() - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimated and may be inaccurate or imprecise.
NA - Not Analyzed For.

TABLE A-19
RISK SEGMENT M2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	Yes - Found only in downgradient.
BENZENE	Yes - Found only in downgradient.
CARBON DISULFIDE	Yes - Found only in downgradient.
CHLOROBENZENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
1,1,1-TRICHLOROETHANE	Yes - Found only in downgradient.
TRICHLOROETHENE	Yes - Found only in downgradient.
TOLUENE	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	No - Common Laboratory Contaminant.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	No - Not significantly greater than (<3x) background.
CADMIUM	Yes - Found only in downgradient.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found significantly greater than (>3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	Yes - Found only in downgradient.
POTASSIUM	No - Not significantly greater than (<3x) background.
SELENIUM	Yes - Found only in downgradient.
SODIUM	Yes - Found significantly greater than (>3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-20
RISK SEGMENT M3
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	6/90 PHASE I M10	6/90 PHASE I M11	6/90 PHASE I M12	6/90 PHASE I M13
VOLATILE ORGANICS (ug/L)							
CHLOROFORM	2/4	10	( )	2.00 J	( )	2.00	5.00
METHYLENE CHLORIDE	1/4	10	( )	( )	( )	4.00	( )
SEMI-VOLATILE ORGANICS (ug/L)							
BIS(2-ETHYLHEXYL)PHTHALATE	1/4	10	( )	( )	( )	6.00	( )
DI-N-BUTYLPHTHALATE	1/4	10	( )	( )	0.30	( )	( )
METALS (ug/L)							
ALUMINUM	4/4	200	907.00 J	82.40 U	339.00	253.00	341.00
BARIUM	4/4	200	350.00	263.00	286.00	298.00	306.00
CALCIUM	4/4	5000	64300.00	42800.00	45800.00 J	46800.00	47200.00
CHROMIUM	4/4	10	3.80	41.10	30.50	21.60	12.70
CYANIDE	1/4	10	( )	( )	( )	( )	18.00 J
IRON	4/4	100	1730.00	333.00 J	402.00 J	359.00 J	429.00
LEAD	4/4	3	3.90	2.20 U	2.50 UJ	3.00	1.20 UJ
MAGNESIUM	4/4	5000	21600.00	20400.00	21100.00	21500.00	21500.00
MANGANESE	4/4	15	1000.00	713.00	674.00	618.00	485.00
POTASSIUM	4/4	5000	921.00	5380.00	5670.00	5360.00	5550.00
SELENIUM	4/4	5	( )	6.80	4.40 U	4.30	3.70 UJ
SODIUM	4/4	5000	21400.00 J	80500.00	76900.00	77700.00	80900.00
ZINC	4/4	20	24.50	17.50 U	11.20 U	8.20 U	25.20

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimated and may be inaccurate or imprecise.

TABLE A-21
RISK SEGMENT M3
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
CHLOROFORM	Yes - Found downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	No - Common Laboratory Contaminant.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	No - Not significantly greater than (<3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found significantly greater than (>3x) background.
CYANIDE	Yes - Found significantly greater than (>3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
POTASSIUM	Yes - Found significantly greater than (>3x) background.
SELENIUM	Yes - Found significantly greater than (>3x) background.
SODIUM	Yes - Found significantly greater than (>3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-22
RISK SEGMENT W1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I W02	PHASE I W03	PHASE II W03	PHASE I W04
VOLATILE ORGANICS (ug/L)							
ACETONE	2/8	10	()	()	()	()	()
CARBON DISULFIDE	1/8	10	()	()	()	1.00	()
1,2-DICHLOROETHENE (TOTAL)	2/8	10	()	()	8.00	()	()
METHYLENE CHLORIDE	4/8	10	()	()	14.00	2.00	5.00
TRICHLOROETHENE	1/8	10	()	()	()	()	()
TETRACHLOROETHENE	1/8	10	()	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/L)							
BIS(2-ETHYLHEXYL)PHTHALATE	5/5	10	()	2.00	8.00	NA	7.00
DI-N-OCTYL PHTHALATE	1/5	10	()	()	()	NA	0.20
FLUORANTHENE	1/5	10	()	()	1.00	NA	()
PYRENE	1/5	10	()	()	1.00	NA	()
METALS (ug/L)							
ALUMINUM	5/5	200	907.00 J	224.00	7430.00	NA	163.00 U
BARIUM	5/5	200	350.00	447.00	1020.00	NA	129.00 U
BERYLLIUM	1/5	5	()	()	1.00 UJ	NA	()
CADMIUM	1/8	5	()	()	56.90	()	()
CALCIUM	5/5	5000	64300.00	61700.00	117000.00	NA	81700.00
CHROMIUM	6/8	10	3.80	16.90	628.00	8.0 J	6.30 U
COBALT	4/5	50	4.90 U	()	324.00	NA	50.00
COPPER	1/5	25	()	()	985.00 J	NA	()
CYANIDE	1/5	10	()	()	()	()	()
IRON	5/5	100	1730.00	296.00	8450.00	NA	1550.00
LEAD	5/8	3	3.90	2.70 UJ	325.00 J	34.5 J	1.10 UJ
MAGNESIUM	5/5	5000	21600.00	26400.00	29300.00	NA	26300.00
MANGANESE	5/5	15	1000.00	36.30	177.00	NA	142.00
NICKEL	2/5	40	()	()	3560.00	NA	523.00
SELENIUM	3/5	5	()	()	7.80	NA	2.20 UJ
SILVER	1/5	10	()	()	13.10	NA	()
SODIUM	5/5	5000	21400.00 J	15100.00	21300.00	NA	31300.00
VANADIUM	4/5	50	2.60	20.70	67.00	NA	()
ZINC	5/5	20	24.50	68.60	2400.00	NA	261.00

Data Qualifier Legend

() - Not detected.
J - The associated value is an estimated quantity.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NA - Not Analyzed For.

TABLE A-22 (Continued)
RISK SEGMENT W1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	PHASE II W04	PHASE I W06	PHASE II W06	PHASE I W07	PHASE II W07
VOLATILE ORGANICS (ug/L)					
ACETONE	34.00	()	()	()	4.00 U
CARBON DISULFIDE	()	()	()	()	()
1,2-DICHLOROETHENE (TOTAL)	14.00	()	()	()	()
METHYLENE CHLORIDE	()	()	()	()	2.00 U
TRICHLOROETHENE	2.00	()	()	()	()
TETRACHLOROETHENE	1.00	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/L)					
BIS(2-ETHYLHEXYL)PHTHALATE	NA	4.00	NA	5.00	NA
DI-N-OCTYL PHTHALATE	NA	()	NA	()	NA
FLUORANTHENE	NA	()	NA	()	NA
PYRENE	NA	()	NA	()	NA
METALS (ug/L)					
ALUMINUM	NA	147.00 UJ	NA	505.00 J	NA
BARIUM	NA	317.00	NA	311.00	NA
BERYLLIUM	NA	()	NA	()	NA
CADMIUM	()	()	()	()	()
CALCIUM	NA	54900.00	NA	63000.00	NA
CHROMIUM	11.2	7.40 U	()	27.20	()
COBALT	NA	5.70 U	NA	10.60 U	NA
COPPER	()	()	()	()	NA
CYANIDE	NA	()	NA	18.00	()
IRON	NA	66.90 U	NA	512.00	NA
LEAD	7.9 J	()	()	14.20	13.7
MAGNESIUM	NA	27000.00	NA	29200.00	NA
MANGANESE	NA	13.40 U	NA	168.00	NA
NICKEL	NA	()	NA	()	NA
SELENIUM	NA	3.30 U	NA	()	NA
SILVER	NA	()	NA	()	NA
SODIUM	NA	55000.00	NA	79400.00	NA
VANADIUM	NA	20.80 U	NA	15.20 U	NA
ZINC	NA	19.90 U	NA	38.90	NA

Data Qualifier Legend

() - Not detecte '
J - The asso ''ue is an estimated quantity.
UJ - The ma' alyzed for, but was not detected. The associated value is an estir .ay be inaccurate or imprecise.
NA - Not Anal, zed For.

TABLE A-23
RISK SEGMENT W1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CARBON DISULFIDE	Yes - Found only in downgradient.
1,2-DICHLOROETHENE (TOTAL)	Yes - Found downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TRICHLOROETHENE	Yes - Found only in downgradient.
TETRACHLOROETHENE	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	No - Common Laboratory Contaminant.
DI-N-OCTYL PHTHALATE	No - Common Laboratory Contaminant.
FLUORANTHENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	Yes - Found significantly greater than (>3x) background.
BARIUM	No - Not significantly greater than (<3x) background.
BERYLLIUM	Yes - Found only in downgradient.
CADMIUM	Yes - Found only in downgradient.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found significantly greater than (>3x) background.
COBALT	Yes - Found significantly greater than (>3x) background.
COPPER	Yes - Found only in downgradient.
CYANIDE	Yes - Found only in downgradient.
IRON	Yes - Found significantly greater than (>3x) background.
LEAD	Yes - Found significantly greater than (>3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	Yes - Found only in downgradient.
SELENIUM	Yes - Found only in downgradient.
SILVER	Yes - Found only in downgradient.
SODIUM	No - Not significantly greater than (<3x) background.
VANADIUM	Yes - Found significantly greater than (>3x) background.
ZINC	Yes - Found significantly greater than (>3x) background.

TABLE A-24
RISK SEGMENT W2
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	PHASE I W08	PHASE II W08
VOLATILE ORGANICS (ug/L)					
CHLOROFORM	1/2	10	( )	0.40 J	( )
METHYLENE CHLORIDE	2/2	10	( )	6.00 J	1.00 U
SEMI-VOLATILE ORGANICS (ug/L)					
METALS (ug/L)					
ALUMINUM	1/1	200	907.00 J	398.00 J	NA
BARIUM	1/1	200	350.00	375.00	NA
CALCIUM	1/1	5000	64300.00	61300.00	NA
CHROMIUM	1/2	10	3.80	31.20	( )
IRON	1/1	100	1730.00	409.00	NA
LEAD	1/2	3	3.90	10.40	( )
MAGNESIUM	1/1	5000	21600.00	27600.00	NA
MANGANESE	1/1	15	1000.00	335.00	NA
POTASSIUM	1/1	5000	921.00	5360.00	NA
SODIUM	1/1	5000	21400.00 J	70500.00	NA
ZINC	1/1	20	24.50	38.20	NA

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was nalyzed for, but was not detected above the level of the associated value. The assoicated value is either the sample quantitation limit or the sample detection limit.
NA - Not Analyzed For.

TABLE A-25
RISK SEGMENT W2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
CHLOROFORM	No - Common laboratory contaminant.
METHYLENE CHLORIDE	No - Common laboratory contaminant.
SEMI-VOLATILE ORGANICS	
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	No - Not significantly greater than (<3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found significantly greater than (>3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
SODIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-26
BACKGROUND ANALYTICAL RESULTS FOR EVALUATION OF 0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	C01 0-6"		6-12"		0-1'		1-2'		2-3'		3-4'		4-5'	
VOLATILE ORGANICS (ug/kg)																
ACETONE	8/22	10	( )		9.00	U	44.00		8.00		( )		( )		12.00	
CHLOROFORM	9/22	10	5.00	UJ	5.00	UJ	( )		2.00		1.00		1.00		( )	
METHYLENE CHLORIDE	13/22	10	10.00	UJ	9.00	U	26.00		1.00		( )		( )		2.00	
TETRACHLOROETHENE	5/22	10	( )		( )		( )		( )		( )		( )		( )	
TOLUENE	5/22	10	( )		( )		( )		2.00		( )		( )		( )	
XYLENE (TOTAL)	8/22	10	( )		( )		( )		1.00		1.00		1.00		2.00	
SEMI-VOLATILE ORGANIGS (ug/kg)																
BIS(2-ETHYLHEXYL)PHTHALATE	1/2	330	( )		( )		NA		NA		NA		NA		NA	
METALS (mg/kg)																
ALUMINUM	2/2	100	4050.00	J	4060.00	J	NA		NA		NA		NA		NA	
ANTIMONY	0/2	30	( )		( )	(150)*	NA		NA		NA		NA		NA	
ARSENIC	2/2	5	1.60	U	1.60	U	NA		NA		NA		NA		NA	
BARIUM	2/2	100	64.40		76.20		NA		NA		NA		NA		NA	
BERYLLIUM	2/2	2.5	0.27	U	0.25	U	NA		NA		NA		NA		NA	
CADMIUM	5/22	2.5	*1.00		( )		( )		( )		2.08	J	( )		( )	
CALCIUM	2/2	2500	4070.00	J	775.00	J	NA		NA		NA		NA		NA	
CHROMIUM	21/22	5	8.40		8.00		6.30	J	6.80	J	7.30		6.60	J	4.80	
COBALT	2/2	25	3.10	U	2.50		NA		NA		NA		NA		NA	
COPPER	2/2	12.5	36.60		14.80		NA		NA		NA		NA		NA	
CYANIDE ***	0/2	2.5	( )		( )		NA		NA		NA		NA		NA	
IRON	2/2	50	5780.00		10700.00		NA		NA		NA		NA		NA	
LEAD	21/22	1.5	6.70	J	7.70	J	6.50		5.80		43.10		37.40		5.50	
MAGNESIUM	2/2	2500	1160.00	U	734.00	U	NA		NA		NA		NA		NA	
MANGANESE	2/2	7.5	100.00		56.40		NA		NA		NA		NA		NA	
MERCURY	0/2	0.1	( )		( )	(0.06)*	NA		NA		NA		NA		NA	
NICKEL	2/2	20	8.00	U	8.60	U	NA		NA		NA		NA		NA	
POTASSIUM	2/2	2500	552.00	U	495.00	U	NA		NA		NA		NA		NA	
SELENIUM	0/2	2.5	( )		( )	(0.25)*	NA		NA		NA		NA		NA	
SILVER	2/2	5	0.53	U	0.91	U	NA		NA		NA		NA		NA	
SODIUM	2/2	2500	289.00	U	214.00	U	NA		NA		NA		NA		NA	
THALLIUM ***	0/2	5	( )		( )		NA		NA		NA		NA		NA	
VANADIUM	2/2	25	9.40	U	8.80	U	NA		NA		NA		NA		NA	
ZINC	2/2	10	13.90		10.20		NA		NA		NA		NA		NA	

Data Qualifier Legend

( ) - Not detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NA - Not Analyzed For.
* - Connor & Shacklette (1975) mean value in soil.
*** - No background data available.

TABLE A-26 (Continued)
BACKGROUND ANALYTICAL RESULTS FOR
EVALUATION OF 0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	C02 0-1'	1-2'	2-3'	3-4'	4-5'	C03 0-1'	1-2'	2-3'	3-4'	4-5'
VOLATILE ORGANICS (ug/kg)										
ACETONE	47.00 UJ	()	()	()	()	16.00	()	()	()	()
CHLOROFORM	()	1.00	()	2.00	0.6	()	()	()	()	()
METHYLENE CHLORIDE	15.00 UJ	17.00	()	13.00	()	3.00	3.00	3.00	5.00	5.00
TETRACHLOROETHENE	()	7.00	8.00	11.00	2.00	()	2.00	()	()	()
TOLUENE	2.00 UJ	6.00	3.00	()	3.00	()	()	()	()	()
XYLENE (TOTAL)	0.8 UJ	5.00	5.00	()	6.00	()	()	()	()	()
SEMI-VOLATILE ORGANIGS (ug/kg)										
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
METALS (mg/kg)										
ALUMINUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ANTIMONY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ARSENIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CADMIUM	1.3 J	1.2 J	()	()	1.2 J	()	()	()	()	()
CALCIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHROMIUM	7.2 J	9.6 J	7.6 J	7.1 J	7.6 J	5.6 J	5.3 J	4.6 J	7.1 J	7.4 J
COBALT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CYANIDE ***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IRON	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LEAD	54.3	12.4	10.9	10.8	33.0 J	7.6 J	4.5 J	4.0 J	7.7 J	5.4 J
MAGNESIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SILVER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SODIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
THALLIUM ***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Data Qualifier Legend

() - Not detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NA - Not Analyzed For.
* - Connor & Shacklette (1975) mean value in soil.
*** - No background data available. Upgradient values for 0-5'.

TABLE A-26 (Continued)
BACKGROUND ANALYTICAL RESULTS FOR
EVALUATION OF 0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	D01 0-1'	1-2'	2-3'	3-4'	4-5'
VOLATILE ORGANICS (ug/kg)					
ACETONE	( )	( )	( )	51.00 J	3.00 J
CHLOROFORM	2.00	( )	( )	( )	( )
METHYLENE CHLORIDE	( )	( )	( )	( )	( )
TETRACHLOROETHENE	( )	( )	( )	( )	( )
TOLUENE	( )	( )	( )	( )	( )
XYLENE (TOTAL)	( )	( )	( )	( )	( )
SEMI-VOLATILE ORGANIGS (ug/kg)					
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA
METALS (mg/kg)					
ALUMINUM	NA	NA	NA	NA	NA
ANTIMONY	NA	NA	NA	NA	NA
ARSENIC	NA	NA	NA	NA	NA
BARIUM	NA	NA	NA	NA	NA
BERYLLIUM	NA	NA	NA	NA	NA
CADMIUM	1.1 J	( )	( )	( )	( )
CALCIUM	NA	NA	NA	NA	NA
CHROMIUM	9.3 J	8.8 J	( )	6.9 J	8.4 J
COBALT	NA	NA	NA	NA	NA
COPPER	NA	NA	NA	NA	NA
CYANIDE ***	NA	NA	NA	NA	NA
IRON	NA	NA	NA	NA	NA
LEAD	28.6 J	38.9 J	( )	30.0 J	15.2 J
MAGNESIUM	NA	NA	NA	NA	NA
MANGANESE	NA	NA	NA	NA	NA
MERCURY	NA	NA	NA	NA	NA
NICKEL	NA	NA	NA	NA	NA
POTASSIUM	NA	NA	NA	NA	NA
SELENIUM	NA	NA	NA	NA	NA
SILVER	NA	NA	NA	NA	NA
SODIUM	NA	NA	NA	NA	NA
THALLIUM ***	NA	NA	NA	NA	NA
VANADIUM	NA	NA	NA	NA	NA
ZINC	NA	NA	NA	NA	NA

Data Qualifier Legend

( ) - Not detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NA - Not Analyzed For.
* - Connor & Shacklette (1975) mean value in soil.
*** - No background data available. Upgradient values for 0-5'.

TABLE A-27
RISK SEGMENT A
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	A01 0-6"	6-12"	A02 0-6"	6-12"	A03 0-6"	6-12"
VOLATILE ORGANICS (ug/kg)									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS (ug/kg)									
NOT ANALYZED									
METALS (mg/kg)									
NOT ANALYZED									

TABLE A-28
RISK SEGMENT A
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
NOT ANALYZED	
SEMI-VOLATILE ORGANICS	
NOT ANALYZED	
METALS	
NOT ANALYZED	

TABLE A-29
RISK SEGMENT B
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	B01 0-6"	B01 6-12"	B02 0-6"	B02 6-12"	B03 0-6"	B03 6-12"
VOLATILE ORGANICS (ug/kg)									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS (ug/kg)									
NOT ANALYZED									
METALS (mg/kg)									
NOT ANALYZED									

TABLE A-30
RISK SEGMENT B
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
NOT ANALYZED	
SEMI-VOLATILE ORGANICS	
NOT ANALYZED	
METALS	
NOT ANALYZED	

TABLE A-31
RISK SEGMENT E1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	E01 0-6"	E02 0-6"	E03 6-12"	E03 0-6"	E03 6-12"	E04 1-2'	E04 0-6"	E04 6-12"
VOLATILE ORGANICS (ug/kg)											
ACETONE	17/22	10	51.00 J	350.00 J	22.00 J	170.00 J	( )	( )	NA	150.00 J	NA
CHLOROBENZENE	5/22	10	( )	( )	( )	( )	78000.00 J	2300.00 J	NA	( )	NA
CHLOROETHANE	1/22	10	( )	( )	( )	( )	( )	( )	NA	( )	NA
CHLOROFORM	19/22	10	5.00 UJ	42.00 J	6.00 UJ	18.00 U	9200.00 J	1300.00 U	NA	7.00 UJ	NA
1,2-DICHLOROETHENE (TOTAL)	3/22	10	( )	( )	( )	( )	180000.00	3400.00 J	NA	( )	NA
METHYLENE CHLORIDE	19/22	10	26.00	95.00 J	85.00 J	44.00 J	140000.00 J	6400.00 J	NA	24.00 J	NA
TETRACHLOROETHENE	2/22	10	11.00	( )	( )	( )	83000.00 J	2700.00 J	NA	( )	NA
TOLUENE	2/22	10	6.00	( )	( )	( )	( )	980.00 J	NA	( )	NA
VINYL ACETATE	1/22	10	( )	( )	( )	( )	( )	( )	NA	( )	NA
TRICHLOROETHENE	1/22	10	( )	( )	( )	( )	4100.00 J	( )	NA	( )	NA
XYLENE (TOTAL)	2/22	10	6.00	( )	4.00 J	( )	( )	( )	NA	( )	NA
SEMI-VOLATILE ORGANICS (ug/kg)											
ACENAPHTHENE	10/21	330	( )	70.00	70.00	( )	( )	( )	NA	250.00	( )
ANTHRACENE	13/21	330	( )	78.00	140.00	( )	1500.00	340.00	NA	450.00	( )
BENZO(A)ANTHRACENE	16/21	330	( )	290.00	370.00	( )	4800.00	1600.00	NA	1500.00	( )
BENZO(B)FLUORANTHENE	16/21	330	( )	270.00	190.00	( )	5000.00	1500.00	NA	( )	( )
BENZO(K)FLUORANTHENE	12/21	330	( )	370.00	450.00	( )	5300.00	1900.00	NA	( )	( )
BENZO(G,H,I)PERYLENE	13/21	330	( )	150.00	140.00	( )	1300.00	1000.00	NA	1300.00	( )
BENZO(A)PYRENE	18/21	330	( )	240.00	200.00	( )	4100.00	1300.00	NA	1500.00	( )
BIS(2-ETHYLHEXYL)PHTHALATE	20/31	330	120.00	480.00	3300.00	200.00 U	3200.00	6100.00	NA	3300.00	5.00 U
BUTYLBENZYLPHTHALATE	2/21	330	( )	29.00	( )	( )	( )	( )	NA	( )	( )
2-CHLORONAPHTHALENE	4/21	330	( )	( )	( )	( )	( )	( )	NA	( )	( )
CHRYSENE	17/21	330	( )	400.00	440.00	( )	5400.00	2100.00	NA	1900.00	( )
DIBENZ (A,H) ANTHRACENE	2/21	330	( )	( )	( )	( )	( )	( )	NA	( )	( )
DIBENZOFURAN	7/21	330	( )	41.00	35.00	( )	340.00	250.00	NA	310.00	( )
1,3-DICHLOROBENZENE	2/21	330	( )	( )	( )	( )	( )	280.00	NA	( )	( )
1,4-DICHLOROBENZENE	2/21	330	( )	( )	( )	( )	( )	4400.00	NA	( )	( )
1,2-DICHLOROBENZENE	2/21	330	( )	( )	( )	( )	( )	3100.00	NA	( )	( )
2,4-DIMETHYLPHENOL	1/21	330	( )	( )	( )	( )	( )	( )	NA	( )	( )
DI-N-BUTYLPHTHALATE	15/21	330	( )	42.00	20.00	15.00	96.00	( )	NA	( )	40.00
DI-N-OCTYL PHTHALATE	13/21	330	( )	31.00	54.00	17.00	( )	( )	NA	( )	( )
FLUORANTHENE	18/21	330	( )	870.00	1100.00	( )	11000.00	4600.00	NA	4100.00	( )
FLUORENE	4/21	330	( )	73.00	86.00	( )	( )	( )	NA	( )	( )
INDENO(1,2,3-CD)PYRENE	12/21	330	( )	150.00	140.00	( )	2100.00	980.00	NA	( )	( )
2-METHYLPHENOL	1/21	330	( )	( )	( )	( )	( )	( )	NA	( )	( )
4-METHYLPHENOL	1/21	330	( )	( )	( )	( )	( )	( )	NA	( )	( )
NAPHTHALENE	10/21	330	( )	260.00	( )	( )	( )	390.00	NA	430.00	( )
2-METHYLNAPHTHALENE	9/21	330	( )	94.00	( )	( )	( )	1900.00	NA	( )	82.00
PHENANTHRENE	19/21	330	( )	550.00	850.00	( )	6700.00	2100.00	NA	3200.00	67.00
PYRENE	19/21	330	( )	740.00	980.00	( )	10000.00	4800.00	NA	3700.00	160.00
METALS (mg/kg)											
ALUMINUM	21/21	100	4060.00 J	4310.00	3780.00	6680.00	2400.00	2590.00	NA	3790.00	5160.00
ANTIMONY	3/29	30	5.00	( )	( )	7.80 U	18.80	13.00 U	( )	( )	( )
ARSENIC	17/21	5	1.60 U	1.70 U	1.30 U	( )	9.70	12.00	NA	2.00 U	1.50 UJ
BARIUM	21/21	100	76.20	542.00	1130.00	1490.00	2910.00	2040.00	NA	470.00	558.00
BERYLLIUM	16/21	2.5	0.27 U	0.28 U	( )	0.52 UJ	( )	( )	NA	( )	( )
CADMIUM	26/29	2.5	2.08	2.50	1.40	( )	8.00	10.80	1.1	16.80	15.90
CALCIUM	21/21	2500	4070.00 J	49400.00	21000.00	1580.00	72500.00	66800.00	NA	31800.00	26000.00
CHROMIUM	29/29	5	9.60 J	17.90	15.60	33.60	430.00	677.00	106.9	266.00	299.00
COBALT	21/21	25	3.10 U	5.20 U	4.80 U	8.60 U	17.30	16.70	NA	5.30 U	8.00 U
COPPER	21/21	12.5	36.60	12.30	145.00	9.00	600.00	206.00	NA	81.80	151.00
CYANIDE	2/29	2.5	( )	( )	( )	( )	( )	( )	( )	( )	( )
IRON	21/21	50	10700.00	5670.00	3750.00	8400.00	41200.00	12300.00	NA	4190.00	5690.00
LEAD	29/29	1.5	54.30	13.40 J	12.90	7.20	255.00	497.00	30.0	121.00	169.00
MAGNESIUM	21/21	2500	1160.00 U	3680.00	2250.00	2840.00	5820.00	6880.00	NA	2530.00	3720.00
MANGANESE	21/21	7.5	100.00	497.00	1000.00	1330.00	428.00	293.00	NA	118.00	185.00
MERCURY	9/21	0.1	0.06	0.20	0.49	0.24	2.60	1.00	NA	0.49	1.20
NICKEL	21/21	20	8.60 U	8.60 U	9.00 U	18.70	325.00	593.00	NA	32.30	17.30
SELENIUM	8/21	2.5	0.29	( )	( )	0.58 J	6.60	3.70	NA	0.69 U	( )
SILVER	16/21	5	0.91 U	( )	1.30 U	0.75 U	5.40	7.80	NA	1.40 U	2.70 U
VANADIUM	21/21	25	9.40 U	11.50 U	9.80 U	10.70 U	50.60	30.60	NA	12.80	14.90
ZINC	21/21	10	13.90	52.30	42.80	20.80	360.00	207.00	NA	181.00	211.00

Data Qualifer Legend

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UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

NA - Not Analyzed For.

TABLE A-31 (Continued)
RISK SEGMENT E1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	E05 0-6"	E05 6-12"	E06 0-6"	E06 6-12"	E06 0-1'	E06 1-2'	E06 2-3'	E06 3-4'	E06 4-5'	E07 0-6"	E07 6-12"
VOLATILE ORGANICS (ug/kg)											
ACETONE	240.00	120.00 J	( )	130.00 J	30.00	( )	35.00	( )	( )	81.00 J	93.00 J
CHLOROBENZENE	( )	( )	( )	( )	10	( )	( )	( )	( )	( )	( )
CHLOROETHANE	( )	( )	86.00	( )	( )	( )	( )	( )	( )	( )	( )
CHLOROFORM	7.00 U	37.00 J	( )	43.00 J	( )	( )	( )	( )	( )	30.00 J	31.00 J
1,2-DICHLOROETHENE (TOTAL)	( )	( )	38.00	( )	( )	( )	( )	( )	( )	( )	( )
METHYLENE CHLORIDE	33.00	26.00 J	190.00	33.00 J	15.00	22.00	19.00	14.00	( )	( )	12.00 J
TETRACHLOROETHENE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
TOLUENE	( )	5.00 J	( )	( )	( )	( )	( )	( )	( )	( )	( )
VINYL ACETATE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
TRICHLOROETHENE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
XYLENE (TOTAL)	( )	( )	1000.00	( )	( )	1.00	( )	( )	( )	( )	( )
SEMI-VOLATILE ORGANICS (ug/kg)											
ACENAPHTHENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	17.00	69.00
ANTHRACENE	( )	( )	130.00	( )	NA	NA	NA	NA	NA	63.00	110.00
BENZO(A)ANTHRACENE	46.00	91.00	510.00	53.00	NA	NA	NA	NA	NA	280.00	380.00
BENZO(B)FLUORANTHENE	39.00	( )	470.00	56.00	NA	NA	NA	NA	NA	280.00	410.00
BENZO(K)FLUORANTHENE	46.00	( )	750.00	( )	NA	NA	NA	NA	NA	280.00	370.00
BENZO(G,H,I)PERYLENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	150.00	240.00
BENZO(A)PYRENE	27.00	59.00 J	520.00	( )	NA	NA	NA	NA	NA	230.00	320.00
BIS(2-ETHYLHEXYL)PHTHALATE	590.00	270.00	2800.00	320.00	NA	NA	NA	NA	NA	1400.00	1000.00
BUTYLBENZYLPHTHALATE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	32.00
2-CHLORONAPHTHALENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	830.00	690.00
CHRYSENE	63.00	( )	870.00	81.00	NA	NA	NA	NA	NA	340.00	460.00
DIBENZ (A,H) ANTHRACENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	48.00
DIBENZOFURAN	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	51.00
1,3-DICHLOROBENZENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
1,4-DICHLOROBENZENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
1,2-DICHLOROBENZENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
2,4-DIMETHYLPHENOL	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
DI-N-BUTYLPHTHALATE	( )	34.00	110.00	37.00	NA	NA	NA	NA	NA	( )	69.00
DI-N-OCTYL PHTHALATE	( )	28.00	120.00	14.00	NA	NA	NA	NA	NA	30.00	18.00
FLUORANTHENE	130.00	240.00	1500.00	130.00	NA	NA	NA	NA	NA	660.00	1100.00
FLUORENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	120.00
INDENO(1,2,3-CD)PYRENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	140.00	240.00
2-METHYLPHENOL	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
4-METHYLPHENOL	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
NAPHTHALENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	380.00	300.00
2-METHYLNAPHTHALENE	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	23.00
PHENANTHRENE	72.00	170.00	600.00	68.00	NA	NA	NA	NA	NA	360.00	880.00
PYRENE	140.00	300.00	1500.00	180.00	NA	NA	NA	NA	NA	370.00	1000.00
METALS (mg/kg)											
ALUMINUM	2820.00	5210.00	2850.00	7550.00	NA	NA	NA	NA	NA	8560.00	5600.00
ANTIMONY	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
ARSENIC	1.60 U	1.40 U	1.80 U	3.10	NA	NA	NA	NA	NA	1.50 U	( )
BARIUM	614.00	509.00	563.00	548.00	NA	NA	NA	NA	NA	319.00	535.00
BERYLLIUM	0.28 U	0.44 U	0.26 U	0.55 U	NA	NA	NA	NA	NA	0.57 U	0.40 U
CADMIUM	1.30	0.84 U	4.30	1.70	2.8	1.1	1.1	( )	( )	4.00	4.40
CALCIUM	56600.00	14700.00	18800.00	4970.00	NA	NA	NA	NA	NA	11300.00	12400.00
CHROMIUM	29.20	22.90	51.70	27.40	57.3	59.5	17.5	19.5	14.9	59.10	167.00
COBALT	3.50 U	4.00 U	4.30 U	6.50 U	NA	NA	NA	NA	NA	5.70 U	2.80 U
COPPER	16.10	13.60	122.00	23.90	NA	NA	NA	NA	NA	41.20	40.20
CYANIDE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
IRON	4590.00	6460.00	4180.00	8420.00	NA	NA	NA	NA	NA	9480.00	5760.00
LEAD	12.50	18.30	49.00 J	15.40	46.7 J	35.1 J	15.8 J	14.0	12.6	66.90	15.40
MAGNESIUM	2020.00	1670.00	3460.00	2540.00	NA	NA	NA	NA	NA	2920.00	1800.00
MANGANESE	215.00	236.00	218.00	415.00	NA	NA	NA	NA	NA	158.00	184.00
MERCURY	( )	( )	( )	( )	NA	NA	NA	NA	NA	( )	( )
NICKEL	5.70 U	7.50 U	20.00	14.30	NA	NA	NA	NA	NA	31.40	15.70
SELENIUM	0.84 U	( )	1.10 U	( )	NA	NA	NA	NA	NA	( )	( )
SILVER	( )	( )	1.10 U	0.78 U	NA	NA	NA	NA	NA	1.70 U	0.62 U
VANADIUM	15.50	15.70	14.30	19.40	NA	NA	NA	NA	NA	17.20	12.40
ZINC	54.20	22.50	76.80	26.80	NA	NA	NA	NA	NA	63.00	25.50

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TABLE A-31 (Continued)
RISK SEGMENT E1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	E08 0-6"	E08 6-12"	E09 0-6"	E09 6-12"	E10 0-6"	E10 6-12"	E11 0-6"	E11 6-12"	0-1'	1-2'
VOLATILE ORGANICS (ug/kg)										
ACETONE	110.00 J	87.00 J	( )	290.00 J	140.00 J	( )	210.00 J	260.00 J	35.0	5.0
CHLOROBENZENE	68.00 J	55.00 J	( )	( )	29.00 J	( )	( )	( )	( )	( )
CHLOROETHANE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
CHLOROFORM	31.00 J	31.00 J	1200.00	43.00 J	50.00 J	610.00	5.00 UJ	26.00 J	( )	( )
1,2-DICHLOROETHENE (TOTAL)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
METHYLENE CHLORIDE	12.00 J	11.00 J	( )	35.00 J	32.00 J	270.00	25.00 J	( )	5.0	51.0
TETRACHLOROETHENE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
TOLUENE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
VINYL ACETATE	( )	( )	( )	( )	( )	( )	0.90 J	( )	( )	( )
TRICHLOROETHENE	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
XYLENE (TOTAL)	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
SEMI-VOLATILE ORGANICS (ug/kg)										
ACENAPHTHENE	( )	50.00	120.00	200.00	150.00	150.00	( )	( )	NA	NA
ANTHRACENE	110.00	( )	140.00	270.00	220.00	310.00	( )	( )	NA	NA
BENZO(A)ANTHRACENE	( )	280.00	730.00	740.00	600.00	690.00	( )	( )	NA	NA
BENZO(B)FLUORANTHENE	670.00	520.00	920.00	880.00	500.00	900.00	( )	( )	NA	NA
BENZO(K)FLUORANTHENE	770.00	270.00	960.00	910.00	( )	( )	( )	( )	NA	NA
BENZO(G,H,I)PERYLENE	440.00	310.00	630.00	510.00	280.00	400.00	( )	( )	NA	NA
BENZO(A)PYRENE	580.00	340.00	770.00	800.00	510.00	640.00	62.00	310.00	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	5000.00	990.00	1900.00	350.00	4900.00	7000.00	280.00	250.00	NA	NA
BUTYLBENZYLPHTHALATE	( )	( )	( )	( )	( )	( )	( )	( )	NA	NA
2-CHLORONAPHTHALENE	1600.00	370.00	1300.00	1000.00	( )	660.00	( )	( )	NA	NA
CHRYSENE	810.00	520.00	1200.00	980.00	600.00	780.00	71.00	( )	NA	NA
DIBENZ (A,H) ANTHRACENE	( )	( )	( )	110.00	( )	( )	( )	( )	NA	NA
DIBENZOFURAN	( )	( )	( )	( )	45.00	( )	( )	( )	NA	NA
1,3-DICHLOROBENZENE	( )	( )	( )	31.00	64.00	( )	( )	( )	NA	NA
1,4-DICHLOROBENZENE	( )	( )	( )	170.00	120.00	52.00	( )	( )	NA	NA
1,2-DICHLOROBENZENE	( )	( )	( )	49.00	130.00	30.00	( )	( )	NA	NA
2,4-DIMETHYLPHENOL	( )	( )	( )	160.00	( )	( )	( )	( )	NA	NA
DI-N-BUTYLPHTHALATE	( )	64.00	86.00	( )	69.00	41.00	28.00	30.00	NA	NA
DI-N-OCTYL PHTHALATE	380.00	64.00	( )	( )	300.00	120.00	69.00	18.00	NA	NA
FLUORANTHENE	4900.00	1700.00	4000.00	3100.00	1900.00	2000.00	160.00	( )	NA	NA
FLUORENE	( )	( )	( )	200.00	110.00	170.00	( )	( )	NA	NA
INDENO(1,2,3-CD)PYRENE	400.00	260.00	570.00	500.00	270.00	360.00	( )	( )	NA	NA
2-METHYLPHENOL	( )	( )	( )	68.00	( )	( )	( )	( )	NA	NA
4-METHYLPHENOL	( )	( )	( )	98.00	( )	( )	( )	( )	NA	NA
NAPHTHALENE	460.00	370.00	250.00	600.00	( )	110.00	( )	( )	NA	NA
2-METHYLNAPHTHALENE	630.00	240.00	( )	55.00	29.00	14.00	( )	( )	NA	NA
PHENANTHRENE	1100.00	670.00	1400.00	1900.00	890.00	910.00	51.00	( )	NA	NA
PYRENE	1500.00	1000.00	2300.00	2300.00	1500.00	1800.00	130.00	( )	NA	NA
METALS (mg/kg)										
ALUMINUM	4610.00	3730.00	8180.00	5140.00	3170.00	3780.00	8660.00	8440.00	NA	NA
ANTIMONY	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )
ARSENIC	( )	( )	2.40 U	1.80 UJ	1.70 U	1.30 U	1.50 U	1.30 U	NA	NA
BARIUM	271.00	330.00	533.00	467.00	307.00	309.00	1070.00	482.00	NA	NA
BERYLLIUM	0.41 U	0.38 U	0.62 U	0.49 U	0.31 U	0.39 U	0.68 U	0.63	NA	NA
CADMIUM	24.60	75.40	324.00	428.00	70.90	40.70	10.50	12.10	7.9 J	2.6 J
CALCIUM	17400.00	5040.00	13800.00	6870.00	23500.00	7320.00	6830.00	2320.00	NA	NA
CHROMIUM	125.00	603.00	1190.00	1230.00	423.00	202.00	68.40	102.00	87.2 J	21.3 J
COBALT	4.60 U	5.80 U	7.50 U	6.80 U	5.50 U	3.90 U	7.70 U	5.10 U	NA	NA
COPPER	32.10	26.20	132.00	76.20	43.80	16.60	14.40	15.60	NA	NA
CYANIDE	6.50 J	3.40 J	( )	( )	( )	( )	( )	( )	( )	( )
IRON	5250.00	6660.00	8470.00	6150.00	5100.00	5480.00	8390.00	8270.00	NA	NA
LEAD	42.80	7.10	586.00	326.00	46.00	39.20	13.30	19.80	7.7	9.3 J
MAGNESIUM	1660.00	2190.00	4380.00	2170.00	2900.00	1220.00 U	4270.00	1870.00	NA	NA
MANGANESE	318.00	577.00	314.00	282.00	618.00	325.00	297.00	116.00	NA	NA
MERCURY	0.34	0.25	( )	( )	( )	( )	( )	( )	( )	( )
NICKEL	39.70	156.00	136.00	53.10	157.00	89.40	24.90	20.50	NA	NA
SELENIUM	( )	( )	0.91 U	( )	1.60	( )	( )	( )	NA	NA
SILVER	1.60 U	7.30	24.70	13.50	6.70	6.00	( )	( )	NA	NA
VANADIUM	14.40	14.30	25.30	19.40	16.40	18.50	21.40	22.20	NA	NA
ZINC	66.20	85.80	587.00	361.00	87.20	38.70	26.30 J	33.00 J	NA	NA

Data Qualifer Legend

( ) - Not Detected.

J - The associated value is an estimated quantity.

U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

NA - Not Analyzed For.

FILE: S2RISKE1

TABLE A-32
RISK SEGMENT E1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISKA SSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CHLOROBENZENE	Yes - Found only in downgradient.
CHLOROETHANE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found downgradient.
1,2-DICHLOROETHENE (TOTAL)	Yes - Found only in downgradient.
METHYLENE CHLORIDE	Yes - Found downgradient.
TETRACHLOROETHENE	Yes - Found downgradient.
TOLUENE	Yes - Found downgradient.
TRICHLOROETHENE	Yes - Found only in downgradient.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
ACENAPHTHENE	Yes - Found only in downgradient.
ANTHRACENE	Yes - Found only in downgradient.
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(G,H,I)PERYLENE	Yes - Found only in downgradient.
BENZ0(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLEXYL)PHTHALATE	Yes - Found only in downgradient.
BUTYLBENZYLPHTHALATE	Yes - Found only in downgradient.
2-CHLORONAPHTHALENE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
DIBENZOFURAN	Yes - Found only in downgradient.
1,3-DICHLOROBENZENE	Yes - Found only in downgradient.
1,4-DICHLOROBENZENE	Yes - Found only in downgradient.
1,2-DICHLOROBENZENE	Yes - Found only in downgradient.
2,4-DIMETHYLPHENOL	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
FLUORENE	Yes - Found only in downgradient.
INDENO(1,2,3-CD)PYRENE	Yes - Found only in downgradient.
2-METHYLNAPHTHALENE	Yes - Found only in downgradient.
2-METHYLPHENOL	Yes - Found only in downgradient.
4-METHYLPHENOL	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ANTIMONY	No - Not significantly greater than (<3x) background.
ARSENIC	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
BERYLLIUM	No - Not significantly greater than (<3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	Yes - Found at significantly greater than (>3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COBALT	No - Not significantly greater than (<3x) background.
COPPER	Yes - Found at significantly greater than (>3x) background.
CYANIDE	Yes - Found only in downgradient.
IRON	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	Yes - Found at significantly greater than (>3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
MERCURY	No - Not significantly greater than (<3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
SELENIUM	No - Not significantly greater than (<3x) background.
SILVER	Yes - Found at significantly greater than (>3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	Yes - Found at significantly greater than (>3x) background.

TABLE A-33
RISK SEGMENT E2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	E12 0-6"	6-12"	0-1'	1-2'	2-3'	3-4'
VOLATILE ORGANICS (ug/kg)									
ACETONE	7/13	10	51.00	130.00 J	140.00 J	( )	( )	43.00	51.00
CHLOROFORM	4/13	10	5.00 UJ	5.00 UJ	4.00 U	( )	( )	( )	( )
METHYLENE CHLORIDE	12/13	10	26.00 UJ	8.00 J	8.00 J	9.00	19.00	23.00	19.00
XYLENE (TOTAL)	2/13	10	( )	( )	( )	( )	( )	1.00	0.70
SEMI-VOLATILE ORGANICS (ug/kg)									
BIS(2-ETHYLHEXYL)PHTHALATE	4/13	330	( )	690.00	240.00	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	2/13	330	( )	27.00	( )	NA	NA	NA	NA
DI-N-OCTYL PHTHALATE	4/13	330	( )	33.00	25.00	NA	NA	NA	NA
FLUORANTHENE	1/13	330	( )	83.00	( )	NA	NA	NA	NA
PYRENE	1/13	330	( )	18.00	( )	NA	NA	NA	NA
METALS (mg/kg)									
ALUMINUM	4/4	100	4060.00	12300.00	5820.00	NA	NA	NA	NA
BARIUM	4/4	100	76.20	993.00	488.00	NA	NA	NA	NA
CADMIUM	7/13	2.5	2.08	2.40 U	0.77 U	10.10 J	7.60 J	4.00 J	1.70 J
CALCIUM	4/4	2500	4070.00	2640.00	2280.00	NA	NA	NA	NA
CHROMIUM	13/13	5	9.60	59.30	15.70	89.00 J	58.30 J	27.60 J	26.30 J
COPPER	4/4	12.5	36.60	18.90	12.80	NA	NA	NA	NA
IRON	4/4	50	10700.00	13000.00	7800.00	NA	NA	NA	NA
LEAD	13/13	1.5	54.30	10.50	6.60	17.50	22.70	8.10	4.50
MAGNESIUM	4/4	2500	1160.00	2380.00	1550.00	NA	NA	NA	NA
MANGANESE	4/4	7.5	100.00	186.00	191.00	NA	NA	NA	NA
NICKEL	4/4	20	8.60	26.60	11.40	NA	NA	NA	NA
POTASSIUM	4/4	2500	552.00	1550.00	681.00 U	NA	NA	NA	NA
VANADIUM	4/4	25	9.40	28.90	18.50	NA	NA	NA	NA
ZINC	4/4	10	13.90	20.60 J	13.00 J	NA	NA	NA	NA

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NA - Not Analyzed For.

TABLE A-33 (Continued)
RISK SEGMENT E2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	E13 0-6"		6-12"		0-1'		1-2'		2-3'		3-4'		4-5'	
VOLATILE ORGANICS (ug/kg)														
ACETONE	210.00	J	150.00	J	( )		( )		( )		4.00		NA	
CHLOROFORM	5.00	UJ	24.00	J	( )		( )		( )		( )		NA	
METHYLENE CHLORIDE	14.00	J	7.00	J	5.00		15.00	U	15.00	U	15.00	U	NA	
XYLENE (TOTAL)	( )		( )		( )		( )		( )		( )		NA	
SEMI-VOLATILE ORGANICS (ug/kg														
BIS(2-ETHYLHEXYL)PHTHALATE	240.00		380.00		NA		NA		NA		NA		NA	
DI-N-BUTYLPHTHALATE	( )		14.00		NA		NA		NA		NA		NA	
DI-N-OCTYL PHTHALATE	17.00		33.00		NA		NA		NA		NA		NA	
FLUORANTHENE	( )		( )		NA		NA		NA		NA		NA	
PYRENE	( )		( )		NA		NA		NA		NA		NA	
METALS (mg/kg)														
ALUMINUM	9650.00		7820.00		NA		NA		NA		NA		NA	
BARIUM	192.00		153.00		NA		NA		NA		NA		NA	
CADMIUM	( )		( )		2.35	J	( )		( )		( )		( )	
CALCIUM	779.00	U	925.00	U	NA		NA		NA		NA		NA	
CHROMIUM	11.60		11.10		11.70	J	9.30	J	8.40	J	11.10	J	9.30	J
COPPER	6.60		6.80		NA		NA		NA		NA		NA	
IRON	8600.00		8190.00		NA		NA		NA		NA		NA	
LEAD	8.10		5.30		19.30		9.50	J	13.50	J	5.90	J	5.10	J
MAGNESIUM	1490.00		1310.00		NA		NA		NA		NA		NA	
MANGANESE	219.00		266.00		NA		NA		NA		NA		NA	
NICKEL	9.60	U	8.60	U	NA		NA		NA		NA		NA	
POTASSIUM	1160.00	U	851.00	U	NA		NA		NA		NA		NA	
VANADIUM	19.60		19.50		NA		NA		NA		NA		NA	
ZINC	13.90		13.00	J	NA		NA		NA		NA		NA	

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
NA - Not Analyzed For.

TABLE A-34
RISK SEGMENT E2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CHLOROFORM	Yes - Found downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
VINYL ACETATE	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.

TABLE A-35
RISK SEGMENT M1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	7/90 M01 0-6"	7/90 M01 6-12"	7/90 M02 0-6"	7/90 M02 6-12"	7/90 M03 0-6"	7/90 M03 6-12"
VOLATILE ORGANICS (ug/kg)									
ACETONE	6/12	10	( )	13.00	4.00	6.00 J	( )	( )	( )
METHYLENE CHLORIDE	12/12	10	10.00 UJ	20.00	17.00 U	13.00 UJ	18.00 U	9.00 UJ	15.00 J
SEMI-VOLATILE ORGANICS (ug/kg)									
BIS(2-ETHYLHEXYL)PHTHALATE	9/12	330	( )	( )	170.00	320.00	620.00	750.00	930.00
DI-N-BUTYLPHTHALATE	2/12	330	( )	( )	( )	( )	( )	( )	( )
DI-N-OCTYL PHTHALATE	1/12	330	( )	( )	( )	( )	( )	( )	( )
METALS (mg/kg)									
ALUMINUM	12/12	100	4060.00	11000.00 J	9960.00	10600.00 J	9580.00	3980.00 J	2070.00
ARSENIC	12/12	5	1.60	4.50 J	3.10	3.00 J	2.30 UJ	4.30	1.80 UJ
BARIUM	12/12	100	76.20	274.00 J	212.00	354.00 J	398.00	212.00 J	110.00
CADMIUM	2/12	2.5	2.08	( )	( )	( )	( )	( )	( )
CALCIUM	12/12	2500	4070.00	1220.00	12300.00	1610.00	1460.00	691.00	748.00 U
CHROMIUM	12/12	5	9.60 J	14.40	18.60	14.50	13.30	10.90	7.10
COPPER	11/12	12.5	36.60	6.90	10.80	8.00	7.50	( )	( )
IRON	12/12	50	10700.00	13800.00 J	11800.00 J	10700.00 J	9540.00	9190.00 J	3980.00
LEAD	12/12	1.5	54.30	13.00 J	17.20 J	11.10 J	7.50 J	14.00 J	3.90
MAGNESIUM	12/12	2500	1160.00	1330.00 J	1270.00	1440.00 J	1350.00 J	458.00 U	214.00 U
MANGANESE	12/12	7.5	100.00	183.00 J	109.00 J	254.00 J	449.00 J	577.00 J	182.00 J
MERCURY	1/12	0.1	4.60	( )	( )	( )	0.30	( )	( )
NICKEL	12/12	20	8.60	11.40	9.80	12.70	11.80	7.40 U	2.80 U
POTASSIUM	12/12	2500	552.00	1010.00 U	1050.00 U	1310.00	1320.00	480.00 U	290.00 U
SELENIUM	1/12	2.5	4.30	( )	( )	( )	( )	0.77 U	( )
VANADIUM	12/12	25	9.40	24.50 J	29.40 J	21.20 J	19.90	22.50 J	9.50 UJ
ZINC	12/12	10	13.90	14.50 J	15.50	21.50 J	18.00	8.70 J	3.50 U

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quanitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R - The data are unusable (compound may or may not be present). Resampling and reanalyses is necessary for verification.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-35 (Continued)
RISK SEGMENT M1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	7/90 M04 0-6"		7/90 6-12"		7/90 M05 0-6"		7/90 6-12"		7/90 M06 0-6"		7/90 6-12"	
VOLATILE ORGANICS (ug/kg)												
ACETONE	( )		( )		28.00		41.00		290.00	J	150.00	J
METHYLENE CHLORIDE	16.00	J	20.00	J	31.00	U	37.00	U	11.00	J	13.00	J
SEMI-VOLATILE ORGANICS (ug/kg)												
BIS(2-ETHYLHEXYL)PHTHALATE	310.00		( )		220.00		200.00		( )		170.00	
DI-N-BUTYLPHTHALATE	( )		( )		19.00		( )		21.00		( )	
DI-N-OCTYL PHTHALATE	( )		( )		( )		( )		( )		20.00	
METALS (mg/kg)												
ALUMINUM	8010.00	J	9840.00		4080.00		5110.00		7470.00		4720.00	
ARSENIC	6.80	J	2.90	J	1.50	U	1.50	U	3.60	J	2.10	U
BARIUM	431.00	J	354.00		188.00		224.00		293.00		257.00	
CADMIUM	( )		( )		( )		( )		53.40		24.40	
CALCIUM	2070.00		1180.00	U	1190.00	U	1520.00		2130.00		1270.00	
CHROMIUM	14.40		14.30		7.40		7.80		829.00		644.00	
COPPER	7.30		7.30		10.20		10.70		23.60		18.30	
IRON	14900.00	J	11900.00		4490.00		4960.00		9150.00		6880.00	
LEAD	9.40	J	7.30	J	5.40		4.80		63.60		24.90	
MAGNESIUM	1350.00	J	1240.00		919.00	U	1200.00	U	1490.00		1060.00	U
MANGANESE	1090.00	J	908.00	J	99.80		70.60		196.00		167.00	
MERCURY	( )		( )		( )		( )		( )		( )	
NICKEL	10.10		13.40		6.80	U	8.50	U	110.00		122.00	
POTASSIUM	915.00	U	1040.00	U	537.00	U	715.00	U	998.00	U	648.00	U
SELENIUM	( )		( )		( )		( )		( )		( )	
VANADIUM	43.80	J	21.50		13.10		14.70		23.10		19.60	
ZINC	14.40	J	14.40		10.30	J	12.10	J	45.20	J	27.20	

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated valu
The associated value is either the sample quanitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is
an estimate and may be inaccurate or imprecise.
R - The data are unusable (compound may or may not be present).
Resampling and reanalyses is necessary for verification.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-36
RISK SEGMENT M1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
DI-N-OCTYL PHTHALATE	No - Common Laboratory Contaminant.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ARSENIC	Yes - Found at significantly greater than (>3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
MERCURY	No - Not significantly greater than (<3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
SELENIUM	No - Not significantly greater than (<3x) background.
VANADIUM	Yes - Found at significantly greater than (>3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-37
RISK SEGMENT M2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	7/90 M07 0-6"	7/90 6-12"	6/91 0-1'	6/91 1-2'	6/91 2-3'
VOLATILE ORGANICS (ug/kg)								
ACETONE	7/20	10	51.00	240.00 J	190.00 J	12.00	()	37.00
BENZENE	1/20	10	()	()	()	()	()	()
CHLOROFORM	7/20	10	5.00 UJ	5.00 UJ	5.00 U	()	0.60	()
METHYLENE CHLORIDE	11/20	10	26.00 UJ	15.00 J	18.00 J	5.00	()	30.00
TETRACHLOROETHENE	1/20	10	11.00	()	()	()	2.00	()
TOLUENE	1/20	10	6.00	()	()	()	3.00	()
XYLENE (TOTAL)	2/20	10	()	()	()	()	6.00	()
SEMI-VOLATILE ORGANICS (ug/kg)								
BENZO(A)PYRENE	1/6	330	()	330.00	140.00	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	6/6	330	()	90.00	160.00	NA	NA	NA
DI-N-BUTYLPHTHALATE	2/6	330	()	30.00	23.00	NA	NA	NA
DI-N-OCTYL PHTHALATE	2/6	330	()	19.00	18.00	NA	NA	NA
FLUORANTHENE	1/6	330	()	()	26.00	NA	NA	NA
METALS (mg/kg)								
ALUMINUM	6/6	100	4060.00	8040.00	6660.00	NA	NA	NA
ARSENIC	5/6	50	1.60	1.50 U	3.10	NA	NA	NA
BARIUM	6/6	100	76.20	214.00	259.00	NA	NA	NA
CADMIUM	8/20	2.5	2.08	2.30	32.60	()	()	()
CALCIUM	6/6	2500	4070.00	2260.00	2670.00	NA	NA	NA
CHROMIUM	20/20	5	9.60	38.50	650.00	13.50 J	11.90 J	15.60 J
COPPER	6/6	12.5	36.60	8.30	23.10	NA	NA	NA
IRON	6/6	50	10700.00	8010.00	7010.00	NA	NA	NA
LEAD	20/20	1.5	54.30	6.80	26.90	7.50 J	11.60 J	5.40 J
MAGNESIUM	6/6	2500	1160.00	1570.00	1300.00	NA	NA	NA
MANGANESE	6/6	7.5	100.00	124.00	207.00	NA	NA	NA
MERCURY	1/6	0.1	*0.06	()	()	NA	NA	NA
NICKEL	6/6	20	8.60	12.60	9.40 U	NA	NA	NA
SILVER	2/6	5	0.91	()	3.60	NA	NA	NA
VANADIUM	6/6	25	9.40	18.60	18.70	NA	NA	NA
ZINC	6/6	10	13.90	17.80 J	43.00 J	NA	NA	NA

Data Qualifier Legend

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* - Connor & Shacklette (1975) mean value in soil.
NA - Not Analyzed For.

TABLE A-37 (Continued)
RISK SEGMENT M2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	6/91 3-4'	6/91 4-5'	7/90 M08 0-6"	7/90 6-12"	6/91 0-1'	6/91 1-2'	6/91 2-3'	6/91 3-4'
VOLATILE ORGANICS (ug/kg)								
ACETONE	( )	( )	85.00 J	170.00 J	( )	( )	( )	8.00
BENZENE	( )	( )	( )	( )	( )	( )	( )	( )
CHLOROFORM	( )	( )	5.00 UJ	6.00 U	( )	( )	( )	( )
METHYLENE CHLORIDE	( )	0.80	25.00 J	31.00 J	24.00	( )	( )	( )
TETRACHLOROETHENE	( )	( )	( )	( )	( )	( )	( )	( )
TOLUENE	( )	( )	( )	( )	( )	( )	( )	( )
XYLENE (TOTAL)	( )	( )	( )	( )	( )	( )	( )	( )
SEMI-VOLATILE ORGANICS (ug/kg)								
BENZO(A)PYRENE	NA	NA	( )	( )	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	210.00	290.00	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	NA	NA	( )	( )	NA	NA	NA	NA
DI-N-OCTYL PHTHALATE	NA	NA	( )	( )	NA	NA	NA	NA
FLUORANTHENE	NA	NA	( )	( )	NA	NA	NA	NA
METALS (mg/kg)								
ALUMINUM	NA	NA	3640.00 J	4480.00 J	NA	NA	NA	NA
ARSENIC	NA	NA	1.50 U	1.70 U	NA	NA	NA	NA
BARIUM	NA	NA	351.00	286.00	NA	NA	NA	NA
CADMIUM	( )	( )	1.70	( )	( )	.99 UJ	( )	1.1 UJ
CALCIUM	NA	NA	2030.00 J	1380.00 J	NA	NA	NA	NA
CHROMIUM	9.90 J	8.00 J	34.50	9.00	9.60 J	9.50 J	9.30 J	12.50 J
COPPER	NA	NA	7.50	6.30	NA	NA	NA	NA
IRON	NA	NA	4820.00	4690.00	NA	NA	NA	NA
LEAD	16.60 J	6.30 J	7.70 J	5.10 J	8.00 J	6.50 J	4.80 J	14.50 J
MAGNESIUM	NA	NA	919.00 U	971.00 U	NA	NA	NA	NA
MANGANESE	NA	NA	431.00	123.00	NA	NA	NA	NA
MERCURY	NA	NA	( )	0.28	NA	NA	NA	NA
NICKEL	NA	NA	9.40 U	6.10 U	NA	NA	NA	NA
SILVER	NA	NA	( )	( )	NA	NA	NA	NA
VANADIUM	NA	NA	11.80 U	12.00	NA	NA	NA	NA
ZINC	NA	NA	13.90	9.00	NA	NA	NA	NA

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* - Connor & Shacklette (1975) mean value in soil.
NA - Not Analyzed For.

TABLE A-37 (Continued)
RISK SEGMENT M2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	6/90 M09 0-6*		6/90 6-12*		6/91 0-1'		6/91 1-2'		6/91 2-3'		6/91 3-4'		6/91 4-5'	
VOLATILE ORGANICS (ug/kg)														
ACETONE	()		()		()		()		()		()		()	
BENZENE	()		()		1.00		()		()		()		()	
CHLOROFORM	5.00	UJ	5.00	U	()		()		()		()		()	
METHYLENE CHLORIDE	8.00	J	3.00	J	5.00		()		()		()		()	
TETRACHLOROETHENE	()		()		()		()		()		()		()	
TOLUENE	()		()		()		()		()		()		()	
XYLENE (TOTAL)	()		()		1.00		()		()		()		()	
SEMI-VOLATILE ORGANICS (ug/kg)														
BENZO(A)PYRENE	()		()		NA		NA		NA		NA		NA	
BIS(2-ETHYLHEXYL)PHTHALATE	670.00		650.00		NA		NA		NA		NA		NA	
DI-N-BUTYLPHTHALATE	()		()		NA		NA		NA		NA		NA	
DI-N-OCTYL PHTHALATE	()		()		NA		NA		NA		NA		NA	
FLUORANTHENE	()		()		NA		NA		NA		NA		NA	
METALS (mg/kg)														
ALUMINUM	6980.00	J	6390.00	J	NA		NA		NA		NA		NA	
ARSENIC	5.10	J	()		NA		NA		NA		NA		NA	
BARIUM	488.00	J	387.00	J	NA		NA		NA		NA		NA	
CADMIUM	1.60		()		2.50	J	()		2.00	J	()		()	
CALCIUM	22600.00	J	32300.00		NA		NA		NA		NA		NA	
CHROMIUM	20.90	J	11.20	J	39.00	J	8.40	J	25.10	J	10.70	J	4.60	J
COPPER	16.60	J	10.30	J	NA		NA		NA		NA		NA	
IRON	8620.00		6100.00		NA		NA		NA		NA		NA	
LEAD	7.60	J	8.30	J	12.30	J	7.00	J	8.40	J	4.90	J	4.10	J
MAGNESIUM	3380.00		3140.00		NA		NA		NA		NA		NA	
MANGANESE	840.00	J	242.00	J	NA		NA		NA		NA		NA	
MERCURY	()		()		NA		NA		NA		NA		NA	
NICKEL	10.70		6.40	U	NA		NA		NA		NA		NA	
SILVER	()		1.20	U	NA		NA		NA		NA		NA	
VANADIUM	13.10	J	11.40	UJ	NA		NA		NA		NA		NA	
ZINC	17.00		21.50		NA		NA		NA		NA		NA	

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NA - Not Analyzed For.

TABLE A-38
RISK SEGMENT M2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
BENZENE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TETRACHLOROETHENE	Yes - Found downgradient.
TOLUENE	No - Common Laboratory Contaminant.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
BENZO(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ARSENIC	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	Yes - Found at significantly greater than (>3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
MERCURY	Yes - Found at significantly greater than (>3x) background.
NICKEL	No - Not significantly greater than (<3x) background.
SILVER	No - Not significantly greater than (<3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-39
RISK SEGMENT M3
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	M10 0-6"	M10 6-12"	M11 0-6"	M11 6-12"
VOLATILE ORGANICS (ug/kg)							
ACETONE	5/8	10	( )	( )	( )	110.00	23.00 J
CHLOROBENZENE	1/8	10	( )	( )	( )	( )	( )
METHYLENE CHLORIDE	7/8	10	10.00 UJ	4.00 J	4.00 J	10.00 J	2.00 J
TOLUENE	5/8	10	( )	11.00	10.00 J	4.00 J	12.00 J
SEMI-VOLATILE ORGANICS (ug/kg)							
BIS(2-ETHYLHEXYL)PHTHALATE	7/8	330	( )	330.00	190.00	230.00	1400.00
METALS (mg/kg)							
ALUMINUM	8/8	100	4060.00	4610.00 J	4830.00 J	6110.00 J	5180.00 J
ARSENIC	5/8	5	1.60	2.20 U	( )	2.30 U	( )
BARIUM	8/8	100	76.20	383.00 J	285.00 J	319.00 J	118.00 J
CADMIUM	5/8	2.5	2.08	0.94 U	( )	( )	0.55 U
CALCIUM	8/8	2500	4070.00	13500.00 J	9430.00 J	3100.00 J	1280.00 J
CHROMIUM	8/8	5	9.60 J	12.50 J	10.10 J	12.20 J	4.90 J
COPPER	8/8	25	36.60	22.00 J	20.50 J	8.60 J	3.80 J
IRON	8/8	50	10700.00	4750.00	5610.00	5610.00	2250.00
LEAD	8/8	1.5	54.30	6.90 J	6.60 J	8.60 J	4.30 J
MAGNESIUM	8/8	2500	1160.00	2620.00	2360.00	1900.00	797.00
MANGANESE	8/8	7.5	100.00	171.00 J	114.00 J	356.00 J	76.60 J
NICKEL	8/8	20	8.60	9.70 U	7.00 U	10.80	4.20 U
POTASSIUM	7/8	2500	552.00	527.00 U	598.00 U	424.00 U	191.00 U
ZINC	8/8	10	13.90	16.10	16.60	19.00	9.50

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate an may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-39 (Continued)
RISK SEGMENT M3
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	M12 0-6"		6-12"		M13 0-6"		6-12"	
VOLATILE ORGANICS (ug/kg)								
ACETONE	8.00	J	( )		20.00	UJ	26.00	U
CHLOROBENZENE	( )		8.00		( )		( )	
METHYLENE CHLORIDE	( )		3.00	J	12.00	U	12.00	U
TOLUENE	( )		( )		12.00		( )	
SEMI-VOLATILE ORGANICS (ug/kg)								
BIS(2-ETHYLHEXYL)PHTHALATE	380.00		380.00		( )		200.00	
METALS (mg/kg)								
ALUMINUM	1750.00	J	3900.00	J	3930.00		4300.00	J
ARSENIC	1.70	U	2.40	J	( )		1.50	U
BARIUM	692.00	J	253.00	J	162.00		121.00	
CADMIUM	1.20	U	1.80		0.86	U	( )	
CALCIUM	1460.00	J	1840.00	J	1070.00		1070.00	U
CHROMIUM	21.80	J	28.10	J	16.40		14.70	
COPPER	4.80	U	5.10	UJ	15.60		13.90	
IRON	2480.00		5480.00		5520.00		5240.00	
LEAD	8.60	J	6.20	J	5.50		5.40	
MAGNESIUM	549.00	U	965.00	UJ	1160.00		1200.00	U
MANGANESE	61.20	J	101.00	J	73.30		59.90	
NICKEL	3.60	U	6.90	U	9.60		11.20	
POTASSIUM	( )		419.00	U	703.00		801.00	U
ZINC	10.20		12.70		13.80		53.10	

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TABLE A-40
RISK SEGMENT M3
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CHLOROBENZENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TOLUENE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ARSENIC	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	No - Not significantly greater than (<3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	No - Not significantly greater than (<3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-41
RISK SEGMENT W1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background		7/90 W01 0-6"		7/90 6-12"		7/90 W02 0-6"		7/90 6-12"		7/90 W03 0-6"	
VOLATILE ORGANICS (ug/kg)														
ACETONE	16/20	10	51.00	J	240.00	J	130.00		14.00		( )		22.00	
CARBON DISULFIDE	2/20	10	( )		( )		( )		( )		( )		( )	
CHLOROFORM	14/20	10	5.00	UJ	19.00	UJ	7.00	U	8.00	UJ	39.00	J	9.00	U
ETHYLBENZENE	2/20	10	( )		( )		( )		( )		( )		4.00	
METHYLENE CHLORIDE	16/20	10	26.00	UJ	42.00	UJ	13.00	U	34.00	UJ	90.00	J	110.00	
TETRACHLOROETHENE	2/20	10	11.00		( )		( )		( )		( )		( )	
TOLUENE	5/20	10	6.00		4.00	J	( )		150.00	J	620.00	J	8.00	
XYLENE (TOTAL)	3/20	10	( )		( )		( )		( )		( )		60.00	
SEMI-VOLATILE ORGANICS (ug/kg)														
ACENAPHTHENE	3/12	330	( )		( )		( )		( )		( )		1100.00	
ANTHRACENE	6/12	330	( )		59.00		( )		( )		400.00		1000.00	
BENZO(A)ANTHRACENE	6/12	330	( )		220.00		( )		( )		1700.00		4200.00	
BENZO(B)FLUORANTHENE	5/12	330	( )		200.00		( )		( )		2400.00		9200.00	
BENZO(K)FLUORANTHENE	3/12	330	( )		190.00		( )		( )		( )		( )	
BENZO(A)PYRENE	6/12	330	( )		160.00		( )		( )		1600.00		4400.00	
BENZO(G,H,I)PERYLENE	4/12	330	( )		120.00		( )		( )		( )		4100.00	
BIS(2-ETHYLHEXYL)PHTHALATE	10/12	330	( )		60.00		( )		210.00		570.00		15000.00	
BUTYLBENZYLPHTHALATE	1/12	330	( )		( )		( )		( )		( )		720.00	
CHRYSENE	7/12	330	( )		240.00		( )		( )		2200.00		7100.00	
DIBENZOFURAN	2/12	330	( )		( )		( )		( )		( )		480.00	
1,3-DICHLOROBENZENE	1/12	330	( )		( )		( )		( )		( )		( )	
1,4-DICHLOROBENZENE	1/12	330	( )		( )		( )		( )		( )		( )	
1,2-DICHLOROBENZENE	1/12	330	( )		( )		( )		( )		( )		( )	
3,3'-DICHLOROBENZIDINE	1/12	330	( )		( )		( )		( )		( )		1700.00	
DI-N-BUTYLPHTHALATE	3/12	330	( )		( )		( )		( )		( )		2200.00	
DI-N-OCTYL PHTHALATE	2/12	330	( )		( )		( )		( )		( )		( )	
FLUORANTHENE	9/12	330	( )		530.00		( )		95.00		2900.00		11000.00	
FLUORENE	3/12	330	( )		( )		( )		( )		( )		880.00	
INDENO(1,2,3-CD)PYRENE	5/12	330	( )		100.00		( )		( )		810.00		3800.00	
2-METHYLNAPHTHALENE	2/12	330	( )		( )		( )		( )		( )		800.00	
NAPHTHALENE	3/12	330	( )		( )		( )		( )		( )		690.00	
PHENANTHRENE	9/12	330	( )		310.00		( )		43.00		1700.00		6000.00	
PYRENE	7/12	330	( )		540.00		( )		110.00		2700.00		( )	
METALS (mg/kg)														
ALUMINUM	12/12	100	4060.00		12800.00	J	7810.00	J	423.00	J	4020.00	J	6660.00	
ANTIMONY	5/21	30	*150.00		( )		6.60		( )		( )		22.10	
ARSENIC	7/12	5	1.60		( )		( )		( )		( )		3.30	
BARIUM	12/12	100	76.20		200.00	J	146.00	UJ	63.00	J	92.40	J	351.00	
CADMIUM	17/21	2.5	2.08		1.00	U	( )		( )		6.50		39.50	
CALCIUM	12/12	2500	4070.00		24800.00	J	10700.00	J	1170.00	J	6190.00	J	11100.00	
CHROMIUM	21/21	5	9.60	J	18.60		14.80		11.60		129.00		286.00	
COBALT	11/12	25	3.10		10.80		5.90	U	( )		4.50	U	52.10	
COPPER	12/12	12.5	36.60		24.60		15.80		13.50		18.90		320.00	
IRON	12/12	50	10700.00		10200.00		8840.00		827.00		5740.00		6460.00	
LEAD	21/21	1.5	54.30		18.70		8.50		3.20		159.00		243.00	
MAGNESIUM	12/12	2500	1160.00		15400.00		5800.00		179.00	U	4220.00		3460.00	
MANGANESE	12/12	7.5	100.00		956.00		390.00		8.80	U	225.00		154.00	
MERCURY	8/12	0.1	*0.06		0.12	U	0.12		0.22	U	0.24		1.40	
NICKEL	12/12	20	8.60		22.50		15.40		4.90	U	199.00		2270.00	
POTASSIUM	12/12	2500	552.00		2300.00		1650.00		99.30	U	682.00	U	741.00	U
SELENIUM	4/12	2.5	*0.25		( )		( )		( )		( )		2.30	
SILVER	7/12	5	0.91		0.70		( )		( )		3.20		112.00	
VANADIUM	12/12	25	9.40		18.80		19.70		2.90	U	28.30		26.10	
ZINC	12/12	10	13.90		37.30		24.60		29.00		71.10		543.00	

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.
NA - Not Analyzed For.

TABLE A-41 (Continued)
RISK SEGMENT W1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	7/90 6-12"		6/91 0-1'		7/90 W04 0-6"		7/90 6-12"		6/91 0-1'		6/91 1-2'		7/90 W06 0-6"		7/90 6-12"	
VOLATILE ORGANICS (ug/kg)																
ACETONE	340.00		( )		26.00		420.00	J	NA		4.00	J	5.00	J	20.00	J
CARBON DISULFIDE	( )		( )		( )		( )		NA		( )		36.00	J	( )	
CHLOROFORM	39.00		( )		9.00	U	45.00	J	NA		( )		3.00	UJ	5.00	U
ETHYLBENZENE	3.00		( )		( )		( )		NA		( )		( )		( )	
METHYLENE CHLORIDE	140.00		( )		39.00		110.00	J	NA		( )		( )		4.00	U
TETRACHLOROETHENE	( )		( )		( )		( )		NA		5.00	J	( )		( )	
TOLUENE	11.00		( )		( )		( )		NA		( )		( )		( )	
XYLENE (TOTAL)	69.00		( )		( )		( )		NA		( )		( )		( )	
SEMI-VOLATILE ORGANICS (ug/kg)																
ACENAPHTHENE	280.00		NA		( )		( )		NA		NA		( )		( )	
ANTHRACENE	580.00		NA		( )		120.00		NA		NA		( )		( )	
BENZO(A)ANTHRACENE	1900.00		NA		( )		560.00		NA		NA		( )		( )	
BENZO(B)FLUORANTHENE	( )		NA		1800.00		670.00		NA		NA		( )		( )	
BENZO(K)FLUORANTHENE	( )		NA		1400.00		700.00		NA		NA		( )		( )	
BENZO(A)PYRENE	1800.00		NA		1400.00		640.00		NA		NA		( )		( )	
BENZO(G,H,I)PERYLENE	1500.00		NA		850.00		( )		NA		NA		( )		( )	
BIS(2-ETHYLHEXYL)PHTHALATE	3000.00		NA		46000.00		8000.00		NA		NA		( )		930.00	
BUTYLBENZYLPHTHALATE	( )		NA		( )		( )		NA		NA		( )		( )	
CHRYSENE	2400.00		NA		2000.00		570.00		NA		NA		( )		( )	
DIBENZOFURAN	290.00		NA		( )		( )		NA		NA		( )		( )	
1,3-DICHLOROBENZENE	( )		NA		210.00		( )		NA		NA		( )		( )	
1,4-DICHLOROBENZENE	( )		NA		2200.00		( )		NA		NA		( )		( )	
1,2-DICHLOROBENZENE	( )		NA		220.00		( )		NA		NA		( )		( )	
3,3'-DICHLOROBENZIDINE	( )		NA		( )		( )		NA		NA		( )		( )	
DI-N-BUTYLPHTHALATE	810.00		NA		370.00		( )		NA		NA		( )		( )	
DI-N-OCTYL PHTHALATE	250.00		NA		250.00		( )		NA		NA		( )		( )	
FLUORANTHENE	6000.00		NA		8500.00		6300.00		NA		NA		( )		( )	
FLUORENE	460.00		NA		( )		( )		NA		NA		( )		( )	
INDENO(1,2,3-CD)PYRENE	1300.00		NA		960.00		( )		NA		NA		( )		( )	
2-METHYLNAPHTHALENE	( )		NA		( )		( )		NA		NA		( )		( )	
NAPHTHALENE	340.00		NA		( )		( )		NA		NA		( )		( )	
PHENANTHRENE	4200.00		NA		1100.00		570.00		NA		NA		( )		( )	
PYRENE	4600.00		NA		3300.00		1300.00		NA		NA		( )		( )	
METALS (mg/kg)																
ALUMINUM	3410.00		NA		7510.00		5470.00		NA		NA		4900.00	J	5640.00	
ANTIMONY	( )		( )		( )		9.80	U	( )		( )		( )		7.00	U
ARSENIC	( )		NA		3.40		5.70		NA		NA		0.97	U	1.50	UJ
BARIUM	110.00		NA		320.00		1120.00		NA		NA		393.00		228.00	
CADMIUM	6.4		11.0	J	93.40		42.50		9.80		15.70		( )		( )	
CALCIUM	12900.00		NA		5620.00		10800.00		NA		NA		7800.00	J	12300.00	J
CHROMIUM	34.40		115.0	J	2020.00		758.00		77.80	J	186.00	J	23.60		18.10	
COBALT	6.50	U	NA		9.80	U	33.80		NA		NA		6.10	U	6.90	U
COPPER	81.7		NA		31.30		115.00		NA		NA		7.90		6.60	
IRON	4180.00		NA		9150.00		7010.00		NA		NA		5870.00		7100.00	
LEAD	65.00		57.2	J	57.00		102.00		152.00		41.70		16.70		7.70	
MAGNESIUM	3040.00		NA		2440.00		1860.00	U	NA		NA		4620.00		7100.00	
MANGANESE	178.00		NA		481.00		232.00		NA		NA		245.00		391.00	
MERCURY	( )		NA		0.28		0.20		NA		NA		( )		( )	
NICKEL	109.00		NA		63.40		511.00		NA		NA		19.00		18.40	
POTASSIUM	660.00	U	NA		1250.00	U	659.00	U	NA		NA		971.00	U	944.00	U
SELENIUM	( )		NA		0.56	U	10.20		NA		NA		( )		( )	
SILVER	8.10		NA		9.10		22.40		NA		NA		( )		( )	
VANADIUM	13.00		NA		20.70		52.90		NA		NA		16.30		18.30	
ZINC	92.90		NA		44.20		640.00		NA		NA		22.20		19.10	

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.
NA - Not Analyzed For.

TABLE A-41 (Continued)
RISK SEGMENT W1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	6/91 0-1'	7/90 W07 0-6"	7/90 6-12"	6/91 0-1'	6/91 1-2'	6/91 2-3'	6/91 3-4'	6/91 4-5'
VOLATILE ORGANICS (ug/kg)								
ACETONE	38.00	( )	( )	4.00 UJ	10.00 J	14.00 J	22.00 J	1.00 J
CARBON DISULFIDE	( )	( )	( )	( )	( )	0.90 UJ	( )	( )
CHLOROFORM	( )	5.00 UJ	5.00 U	( )	( )	2.00 UJ	2.00 UJ	2.00 UJ
ETHYLBENZENE	( )	( )	( )	( )	( )	( )	( )	( )
METHYLENE CHLORIDE	6.00	5.00 J	13.00 U	2.00 UJ	6.00 J	4.00 UJ	3.00 UJ	4.00 UJ
TETRACHLOROETHENE	( )	( )	( )	( )	( )	3.00	( )	( )
TOLUENE	( )	( )	( )	( )	( )	( )	( )	( )
XYLENE (TOTAL)	( )	( )	( )	( )	2.00	( )	( )	( )
SEMI-VOLATILE ORGANICS (ug/kg)								
ACENAPHTHENE	NA	( )	69.00	NA	NA	NA	NA	NA
ANTHRACENE	NA	( )	120.00	NA	NA	NA	NA	NA
BENZO(A)ANTHRACENE	NA	( )	210.00	NA	NA	NA	NA	NA
BENZO(B)FLUORANTHENE	NA	( )	( )	NA	NA	NA	NA	NA
BENZO(K)FLUORANTHENE	NA	( )	( )	NA	NA	NA	NA	NA
BENZO(A)PYRENE	NA	( )	( )	NA	NA	NA	NA	NA
BENZO(G,H,I)PERYLENE	NA	( )	( )	NA	NA	NA	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	NA	1500.00	880.00	NA	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	NA	( )	( )	NA	NA	NA	NA	NA
CHRYSENE	NA	( )	210.00	NA	NA	NA	NA	NA
DIBENZOFURAN	NA	( )	( )	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	NA	( )	( )	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	NA	( )	( )	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	NA	( )	( )	NA	NA	NA	NA	NA
3,3'-DICHLOROBENZIDINE	NA	( )	( )	NA	NA	NA	NA	NA
DI-N-BUTYLPHTHALATE	NA	( )	( )	NA	NA	NA	NA	NA
DI-N-OCTYL PHTHALATE	NA	( )	( )	NA	NA	NA	NA	NA
FLUORANTHENE	NA	110.00	560.00	NA	NA	NA	NA	NA
FLUORENE	NA	( )	110.00	NA	NA	NA	NA	NA
INDENO(1,2,3-CD)PYRENE	NA	( )	( )	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	NA	( )	440.00	NA	NA	NA	NA	NA
NAPHTHALENE	NA	( )	44.00	NA	NA	NA	NA	NA
PHENANTHRENE	NA	15.00	480.00	NA	NA	NA	NA	NA
PYRENE	NA	( )	660.00	NA	NA	NA	NA	NA
METALS (mg/kg)								
ALUMINUM	NA	42300.00 J	3620.00	NA	NA	NA	NA	NA
ANTIMONY	( )	( )	6.30	( )	( )	( )	( )	( )
ARSENIC	NA	2.00 U	1.50 U	NA	NA	NA	NA	NA
BARIUM	NA	605.00	686.00	NA	NA	NA	NA	NA
CADMIUM	1.50	1.10 U	3.20	2.80 J	10.60 J	6.00 J	1.40 J	2.20 J
CALCIUM	NA	2740.00 J	41500.00 J	NA	NA	NA	NA	NA
CHROMIUM	38.70	184.00	110.00	67.00 J	168.00 J	163.00 J	36.80 J	27.10 J
COBALT	NA	4.80 U	4.50 U	NA	NA	NA	NA	NA
COPPER	NA	21.00	16.00	NA	NA	NA	NA	NA
IRON	NA	7110.00	4820.00	NA	NA	NA	NA	NA
LEAD	37.80	6.40	115.00 J	114.00	45.10 J	73.10 J	28.80	36.40
MAGNESIUM	NA	1400.00	2620.00	NA	NA	NA	NA	NA
MANGANESE	NA	134.00	161.00	NA	NA	NA	NA	NA
MERCURY	NA	( )	0.12 U	NA	NA	NA	NA	NA
NICKEL	NA	12.50	18.00	NA	NA	NA	NA	NA
POTASSIUM	NA	944.00 U	691.00 U	NA	NA	NA	NA	NA
SELENIUM	NA	( )	0.73 U	NA	NA	NA	NA	NA
SILVER	NA	( )	0.49 U	NA	NA	NA	NA	NA
VANADIUM	NA	13.30	14.10	NA	NA	NA	NA	NA
ZINC	NA	13.90	33.50	NA	NA	NA	NA	NA

Data Qualifier Legend
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* - Connor & Shacklette (1975) mean value in soil.
NA - Not Analyzed For.

TABLE A-42
RISK SEGMENT W1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CARBON DISULFIDE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found downgradient.
ETHYLBENZENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TETRACHLOROETHENE	Yes - Found downgradient.
TOLUENE	Yes - Found downgradient.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
ACENAPHTHENE	Yes - Found only in downgradient.
ANTHRACENE	Yes - Found only in downgradient.
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(A)PYRENE	Yes - Found only in downgradient.
BENZO(G,H,I)PERYLENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
BUTYLBENZYLPHTHALATE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
DIBENZOFURAN	Yes - Found only in downgradient.
1,3-DICHLOROBENZENE	Yes - Found only in downgradient.
1,4-DICHLOROBENZENE	Yes - Found only in downgradient.
1,2-DICHLOROBENZENE	Yes - Found only in downgradient.
3,3'-DICHLOROBENZIDINE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
FLUORENE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
INDENO(1,2,3-CD)PYRENE	Yes - Found only in downgradient.
2-METHYLNAPHTHALENE	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	Yes - Found at significantly greater than (>3x) background.
ANTIMONY	No - Not significantly greater than (<3x) background.
ARSENIC	Yes - Found at significantly greater than (>3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	Yes - Found at significantly greater than (>3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COBALT	Yes - Found at significantly greater than (>3x) background.
COPPER	Yes - Found at significantly greater than (>3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	Yes - Found at significantly greater than (>3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
MERCURY	Yes - Found at significantly greater than (>3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
POTASSIUM	Yes - Found at significantly greater than (>3x) background.
SELENIUM	Yes - Found at significantly greater than (>3x) background.
SILVER	Yes - Found at significantly greater than (>3x) background.
VANADIUM	Yes - Found at significantly greater than (>3x) background.
ZINC	Yes - Found at significantly greater than (>3x) background.

TABLE A-43
RISK SEGMENT W2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background	6/90 W08 0-6"	6/90 6-12"	6/91 0-1'	6/90 W09 0-6"	6/90 6-12"
VOLATILE ORGANICS (ug/kg)								
ACETONE	2/5	10	51.00	6.00 J	10.00 J	( )	( )	( )
CHLOROFORM	4/5	10	5.00 UJ	6.00 UJ	5.00 U	( )	4.00 U	4.00 U
METHYLENE CHLORIDE	4/5	10	26.00 UJ	8.00 UJ	9.00 U	( )	15.00 UJ	9.00 U
SEMI-VOLATILE ORGANICS (ug/kg)								
ACENAPHTHENE	1/4	330	( )	83.00	( )	NA	( )	( )
ANTHRACENE	1/4	330	( )	44.00	( )	NA	( )	( )
BENZO(A)ANTHRACENE	1/4	330	( )	140.00	( )	NA	( )	( )
BENZO(B)FLUORANTHENE	1/4	330	( )	190.00	( )	NA	( )	( )
BENZO(K)FLUORANTHENE	1/4	330	( )	180.00	( )	NA	( )	( )
BENZO(A)PYRENE	1/4	330	( )	160.00	( )	NA	( )	( )
BIS(2-ETHYLHEXYL)PHTHALATE	4/4	330	( )	4000.00	970.00	NA	4200.00	2400.00
CHRYSENE	1/4	330	( )	210.00	( )	NA	( )	( )
DI-N-OCTYL PHTHALATE	1/4	330	( )	( )	( )	NA	( )	110.00
FLUORANTHENE	2/4	330	( )	420.00	98.00	NA	( )	( )
FLUORENE	1/4	330	( )	76.00	( )	NA	( )	( )
2-METHYLNAPHTHALENE	2/4	330	( )	1300.00	25.00	NA	( )	( )
NAPHTHALENE	1/4	330	( )	82.00	( )	NA	( )	( )
PHENANTHRENE	2/4	330	( )	260.00	59.00	NA	( )	( )
PYRENE	2/4	330	( )	530.00	91.00	NA	( )	( )
METALS (mg/kg)								
ALUMINUM	4/4	100	4060.00	4490.00 J	6000.00 J	NA	9300.00 J	3930.00 J
BARIUM	4/4	100	76.20	426.00	379.00	NA	252.00	167.00
CADMIUM	1/5	2.5	2.08	12.70	( )	( )	( )	( )
CALCIUM	4/4	2500	4070.00	2900.00 J	1530.00 J	NA	39600.00 J	43300.00 J
CHROMIUM	4/4	5	9.60 J	527.00	36.50	15.70 J	20.90	12.80
COPPER	4/4	12.5	36.60	28.30	11.10	NA	11.50	8.30
IRON	4/4	50	10700.00	5140.00	6370.00	NA	7650.00	2630.00
LEAD	5/5	1.5	54.30	55.00	10.40	3.70	3.50	3.70 UJ
MAGNESIUM	4/4	2500	1160.00	1630.00	1360.00	NA	6940.00	14500.00
MANGANESE	4/4	7.5	100.00	241.00	327.00	NA	424.00	1080.00
MERCURY	1/4	0.1	*0.06	( )	2.60	NA	( )	( )
NICKEL	4/4	20	8.60	36.00	9.80	NA	21.30	9.90
POTASSIUM	4/4	2500	552.00	576.00 U	802.00 U	NA	1560.00	665.00 U
SILVER	1/4	5	0.91	4.60	( )	NA	( )	( )
VANADIUM	4/4	25	9.40	16.30	14.60	NA	15.50	5.80 U
ZINC	4/4	10	13.90	49.50	19.30	NA	18.40	9.00

Data Qualifer Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
UJ - The mateiral was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.
NA - Not Analyzed For.

TABLE A-44
RISK SEGMENT W2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-5' SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CHLOROFORM	No - Not detected.
METHYLENE CHLORIDE	No - Not detected.
SEMI-VOLATILE ORGANICS	
ACENAPHTHENE	Yes - Found only in downgradient.
ANTHRACENE	Yes - Found only in downgradient.
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
FLUORENE	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
2-METHYLNAPHTHALENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	No - Not significantly greater than (<3x) background.
CALCIUM	Yes - Found at significantly greater than (>3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	Yes - Found at significantly greater than (>3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
MERCURY	Yes - Found at significantly greater than (>3x) background.
NICKEL	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
SILVER	Yes - Found at significantly greater than (>3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-45
RISK SEGMENT A
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	A01	A02	A03
VOLATILE ORGANICS (ug/kg)						
ACETONE	1/3	10	( )	6.00	( )	( )
METHYLENE CHLORIDE	3/3	10	10.00 UJ	3.00	24.00	6.00
SEMI-VOLATILE ORGANICS (ug/kg)						
BENZO(A)ANTHRACENE	1/3	330	( )	45.00	( )	( )
BENZO(B)FLUORANTHENE	1/3	330	( )	120.00	( )	( )
BENZO(K)FLUORANTHENE	1/3	330	( )	230.00	( )	( )
BIS(2-ETHYLHEXYL)PHTHALATE	2/3	330	( )	( )	310.00	520.00
CHRYSENE	1/3	330	( )	190.00	( )	( )
DI-N-BUTYLPHTHALATE	1/3	330	( )	( )	( )	20.00
FLUORANTHENE	1/3	330	( )	210.00	( )	( )
PYRENE	1/3	330	( )	190.00	( )	( )
METALS (mg/kg)						
ALUMINUM	3/3	100	4050.00	17600.00 J	4350.00 J	3920.00 J
ARSENIC	3/3	5	1.60	4.40	1.60 U	1.30 U
BARIUM	3/3	100	64.40	386.00 J	130.00 J	140.00 J
CALCIUM	3/3	2500	4070.00	4900.00	805.00 U	687.00 U
CHROMIUM	3/3	5	8.40	21.80	8.40	6.20
COPPER	3/3	12.5	36.60	21.50	8.10	4.80 U
IRON	3/3	50	5780.00	15400.00 J	5120.00 J	4120.00 J
LEAD	3/3	1.5	6.70	19.60 J	20.40	2.90
MAGNESIUM	3/3	2500	1160.00	4470.00	526.00 U	486.00 U
MANGANESE	3/3	7.5	100.00	444.00 J	150.00 J	123.00 J
NICKEL	3/3	20	8.00	19.90	5.50 U	5.00 U
POTASSIUM	3/3	2500	552.00	2170.00	570.00 U	511.00 U
VANADIUM	3/3	25	9.40	30.90 J	12.50 U	9.10 U
ZINC	3/3	10	13.90	51.90 J	6.70 J	7.40 J

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R - The data are unusable (compound may or may not be present). Resampling and reanalyses is necessary for verification.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-46
RISK SEGMENT A
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) downgradient.
ARSENIC	No - Not significantly greater than (<3x) downgradient.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	No - Not significantly greater than (<3x) downgradient.
CHROMIUM	No - Not significantly greater than (<3x) downgradient.
COPPER	No - Not significantly greater than (<3x) downgradient.
IRON	No - Not significantly greater than (<3x) downgradient.
LEAD	No - Not significantly greater than (<3x) downgradient.
MAGNESIUM	No - Not significantly greater than (<3x) downgradient.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
NICKEL	No - Not significantly greater than (<3x) downgradient.
POTASSIUM	No - Not significantly greater than (<3x) downgradient.
VANADIUM	No - Not significantly greater than (<3x) downgradient.
ZINC	Yes - Found at significantly greater than (>3x) background.

TABLE A-47
RISK SEGMENT B
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	7/90 B01	7/90 B02	7/90 B03
VOLATILE ORGANICS (ug/kg)						
ACETONE	2/3	10	( )	14.00	1700.00	( )
CHLOROFORM	3/3	10	5.00 UJ	5.00 U	28.00	4.00 UJ
METHYLENE CHLORIDE	2/3	10	10.00 UJ	29.00 U	100.00	( )
TOLUENE	1/3	10	( )	2.00	( )	( )
SEMI-VOLATILE ORGANICS (ug/kg)						
ANTHRACENE	1/3	330	( )	( )	( )	10.00
BIS(2-ETHYLHEXYL)PHTHALATE	3/3	330	( )	190.00	670.00	230.00
BUTYLBENZYLPHTHALATE	1/3	330	( )	( )	( )	76.00
DI-N-BUTYLPHTHALATE	2/3	330	( )	( )	27.00	30.00
DI-N-OCTYL PHTHALATE	1/3	330	( )	( )	( )	25.00
FLUORANTHENE	2/3	330	( )	26.00	( )	100.00
PHENANTHRENE	2/3	330	( )	9.00	( )	51.00
PYRENE	1/3	330	( )	( )	( )	110.00
METALS (mg/kg)						
ALUMINUM	3/3	100	4050.00	10900.00	6710.00	9060.00
ARSENIC	3/3	5	1.60	2.30	2.00 U	2.10 U
BARIUM	3/3	100	64.40	215.00	973.00	379.00
CADMIUM	3/3	2.5	*1.00	3.60	0.69 U	2.90
CALCIUM	3/3	2500	4070.00	4410.00	6610.00	10500.00
CHROMIUM	3/3	5	8.40	84.80	12.00	55.60
COPPER	3/3	12.5	36.60	35.70	16.00	19.10
IRON	3/3	50	5780.00	11700.00	7240.00	8490.00
LEAD	3/3	1.5	6.70	2.20	29.60	20.20
MAGNESIUM	3/3	2500	1160.00	2060.00	2910.00	4690.00
MANGANESE	3/3	7.5	100.00	364.00	387.00	388.00
NICKEL	3/3	20	8.00	9.60	10.00	19.80
POTASSIUM	3/3	2500	552.00	1320.00	916.00 U	1340.00
VANADIUM	3/3	25	9.40	26.50	17.50	20.40
ZINC	3/3	10	13.90	130.00 J	27.30 J	36.90 J

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.
B - Compound also found in the laboratory blank.

TABLE A-48
RISK SEGMENT B
RATIONALE FOR IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found downgradient.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TOLUENE	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
ANTHRACENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
BUTYLBENZYLPHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) downgradient.
ARSENIC	No - Not significantly greater than (<3x) downgradient.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	No - Not significantly greater than (<3x) downgradient.
CALCIUM	No - Not significantly greater than (<3x) downgradient.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) downgradient.
IRON	No - Not significantly greater than (<3x) downgradient.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) downgradient.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
NICKEL	No - Not significantly greater than (<3x) downgradient.
POTASSIUM	No - Not significantly greater than (<3x) downgradient.
VANADIUM	No - Not significantly greater than (<3x) downgradient.

TABLE A-49
RISK SEGMENT E1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	E01	E02	E03	E04	E05
VOLATILE ORGANICS (ug/kg)								
ACETONE	8/11	10	( )	350.00 J	22.00 J	( )	150.00 J	240.00
CHLOROBENZENE	3/11	10	( )	( )	( )	78000.00 J	( )	( )
CHLOROETHANE	1/11	10	( )	( )	( )	( )	( )	( )
CHLOROFORM	11/11	10	5.00 UJ	42.00 J	6.00 UJ	9200.00 J	7.00 UJ	7.00 U
1,2-DICHLOROETHENE (TOTAL)	2/11	10	( )	( )	( )	180000.00	( )	( )
METHYLENE CHLORIDE	8/11	10	10.00 UJ	95.00 J	85.00 J	140000.00 J	24.00 J	33.00
TRICHLOROETHENE	2/11	10	( )	( )	( )	4100.00 J	( )	( )
TETRACHLOROETHENE	1/11	10	( )	( )	( )	83000.00 J	( )	( )
VINYL ACETATE		10	( )	( )	( )	( )	( )	( )
XYLENE (TOTAL)	2/11	10	( )	( )	4.00 J	( )	( )	( )
SEMI-VOLATILE ORGANICS (ug/kg)								
ACENAPHTHENE	6/11	330	( )	70.00	70.00	( )	250.00	( )
ANTHRACENE	9/11	330	( )	78.00	140.00	1500.00	450.00	( )
BENZO(A)ANTHRACENE	7/11	330	( )	290.00	370.00	4800.00	1500.00	46.00
BENZO(B)FLUORANTHENE	8/11	330	( )	270.00	190.00	5000.00	( )	39.00
BENZO(K)FLUORANTHENE	8/11	330	( )	370.00	450.00	5300.00	( )	46.00
BENZO(G,H,I)PERYLENE	8/11	330	( )	150.00	140.00	1300.00	1300.00	( )
BENZO(A)PYRENE	11/11	330	( )	240.00	200.00	4100.00	1500.00	27.00
BIS(2-ETHYLHEXYL)PHTHALATE	11/11	330	( )	480.00	3300.00	3200.00	3300.00	590.00
BUTYLBENZYLPHTHALATE	1/11	330	( )	29.00	( )	( )	( )	( )
2-CHLORONAPHTHALENE	3/11	530	( )	( )	( )	( )	( )	( )
CHRYSENE	11/11	330	( )	400.00	440.00	5400.00	1900.00	63.00
DIBENZOFURAN	5/11	330	( )	41.00	35.00	340.00	310.00	( )
1,3-DICHLOROBENZENE	1/11	530	( )	( )	( )	( )	( )	( )
1,4-DICHLOROBENZENE	1/11	530	( )	( )	( )	( )	( )	( )
1,2-DICHLOROBENZENE	1/11	530	( )	( )	( )	( )	( )	( )
DI-N-BUTYLPHTHALATE	7/11	330	( )	42.00	20.00	96.00	( )	( )
DI-N-OCTYLPHTHALATE	7/11	330	( )	31.00	54.00	( )	( )	( )
FLUORANTHENE	11/11	330	( )	870.00	1100.00	11000.00	4100.00	130.00
FLUORENE	3/11	330	( )	73.00	86.00	( )	( )	( )
INDENO(1,2,3-CD)PYRENE	7/11	330	( )	150.00	140.00	2100.00	( )	( )
2-METHYLNAPHTHALENE	3/11	530	( )	94.00	( )	( )	( )	( )
NAPHTHALENE	5/11	530	( )	260.00	( )	( )	430.00	( )
PHENANTHRENE	11/11	330	( )	550.00	850.00	6700.00	3200.00	72.00
PYRENE	11/11	330	( )	740.00	980.00	10000.00	3700.00	140.00
METALS (mg/kg)								
ALUMINUM	11/11	100	4050.00	4310.00	3780.00	2400.00	3790.00	2820.00
ANTIMONY	1/11	30	*150.00	( )	( )	18.80	( )	( )
ARSENIC	10/11	5	1.60	1.70 U	1.30 U	9.70	2.00 U	1.60 U
BARIUM	11/11	100	64.40	542.00	1130.00	2910.00	470.00	614.00
CADMIUM	11/11	2.5	*1.00	2.50	1.40	8.00	16.80	1.30
CALCIUM	11/11	2500	40970.00	49400.00	21000.00	72500.00	31800.00	56600.00
CHROMIUM	11/11	5	8.40	17.90	15.60	430.00	266.00	29.20
COBALT	11/11	25	3.10	5.20 U	4.80 U	17.30	5.30 U	3.50 U
COPPER	11/11	12.5	36.60	12.30	145.00	600.00	81.80	16.10
CYANIDE	1/11	2.5	( )	( )	( )	( )	( )	( )
IRON	11/11	50	5780.00	5670.00	3750.00	41200.00	4190.00	4590.00
LEAD	11/11	1.5	6.70	13.40 J	12.90	255.00	121.00	12.50
MAGNESIUM	11/11	2500	1160.00	3680.00	2250.00	5820.00	2530.00	2020.00
MANGANESE	11/11	7.5	100.00	497.00	1000.00	428.00	118.00	215.00
MERCURY	5/11	0.1	*0.06	0.20	0.49	2.60	0.49	( )
NICKEL	11/11	20	8.00	8.60 U	9.00 U	325.00	32.30	5.70 U
SELENIUM	6/11	2.5	*0.25	( )	( )	6.60	0.69 U	0.84 U
SILVER	8/11	5	0.53	( )	1.30 U	5.40	1.40 U	( )
VANADIUM	11/11	25	9.40	11.50 U	9.80 U	50.60	12.80	15.50
ZINC	11/11	10	13.90	52.30	42.80	360.00	181.00	54.20

Data Qualifer Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - s not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-49 (Continued)
RISK SEGMENT E1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	E06	E07	E08	E09	E10	E11
VOLATILE ORGANICS (ug/kg)						
ACETONE	()	81.00 J	110.00 J	()	140.00 J	210.00 J
CHLOROBENZENE	()	()	68.00 J	()	29.00 J	()
CHLOROETHANE	86.00	()	()	()	()	()
CHLOROFORM	()	30.00 J	31.00 J	1200.00	50.00 J	5.00 UJ
1,2-DICHLOROETHENE (TOTAL)	38.00	()	()	()	()	()
METHYLENE CHLORIDE	190.00	()	12.00 J	()	32.00 J	25.00 J
TRICHLOROETHENE	()	()	()	()	()	()
TETRACHLOROETHENE	()	()	()	()	()	()
VINYL ACETATE	()	()	()	()	()	0.90 J
XYLENE (TOTAL)	1000.00	()	()	()	()	()
SEMI-VOLATILE ORGANICS (ug/kg)						
ACENAPHTHENE	()	17.00	()	120.00	150.00	()
ANTHRACENE	130.00	63.00	110.00	140.00	220.00	()
BENZO(A)ANTHRACENE	510.00	280.00	()	730.00	600.00	()
BENZO(B)FLUORANTHENE	470.00	280.00	670.00	920.00	500.00	()
BENZO(K)FLUORANTHENE	750.00	280.00	770.00	960.00	()	()
BENZO(G,H,I)PERYLENE	()	150.00	440.00	630.00	280.00	()
BENZO(A)PYRENE	520.00	230.00	580.00	770.00	510.00	62.00
BIS(2-ETHYLHEXYL)PHTHALATE	2800.00	1400.00	5000.00	1900.00	4900.00	280.00
BUTYLBENZYLPHTHALATE	()	()	()	()	()	()
2-CHLORONAPHTHALENE	()	830.00	1600.00	1300.00	()	()
CHRYSENE	870.00	340.00	810.00	1200.00	600.00	71.00
DIBENZOFURAN	()	()	()	()	45.00	()
1,3-DICHLOROBENZENE	()	()	()	()	64.00	()
1,4-DICHLOROBENZENE	()	()	()	()	120.00	()
1,2-DICHLOROBENZENE	()	()	()	()	130.00	()
DI-N-BUTYLPHTHALATE	110.00	()	()	86.00	69.00	28.00
DI-N-OCTYLPHTHALATE	120.00	30.00	380.00	()	300.00	69.00
FLUORANTHENE	1500.00	660.00	4900.00	4000.00	1900.00	160.00
FLUORENE	()	()	()	()	110.00	()
INDENO(1,2,3-CD)PYRENE	()	140.00	400.00	570.00	270.00	()
2-METHYLNAPHTHALENE	()	()	630.00	()	29.00	()
NAPHTHALENE	()	380.00	460.00	250.00	()	()
PHENANTHRENE	600.00	360.00	1100.00	1400.00	890.00	51.00
PYRENE	1500.00	370.00	1500.00	2300.00	1500.00	130.00
METALS (mg/kg)						
ALUMINUM	2850.00	8560.00	4610.00	8180.00	3170.00	8660.00
ANTIMONY	()	()	()	()	()	()
ARSENIC	1.80 U	1.50 U	()	2.40 U	1.70 U	1.50 U
BARIUM	563.00	319.00	271.00	533.00	307.00	1070.00
CADMIUM	4.30	4.00	24.60	324.00	70.90	10.50
CALCIUM	18800.00	11300.00	17400.00	13800.00	23500.00	6830.00
CHROMIUM	51.70	59.10	125.00	1190.00	423.00	68.40
COBALT	4.30 U	5.70 U	4.60 U	7.50 U	5.50 U	7.70 U
COPPER	122.00	41.20	32.10	132.00	43.80	14.40
CYANIDE	()	()	6.50 J	()	()	()
IRON	4180.00	9480.00	5250.00	8470.00	5100.00	8390.00
LEAD	49.00 J	66.90	42.80	586.00	46.00	13.30
MAGNESIUM	3460.00	2920.00	1660.00	4380.00	2900.00	4270.00
MANGANESE	218.00	158.00	318.00	314.00	618.00	297.00
MERCURY	()	()	0.34	()	()	()
NICKEL	20.00	31.40	39.70	136.00	157.00	24.90
SELENIUM	1.10 U	()	()	0.91 U	1.60	()
SILVER	1.10 U	1.70 U	1.60 U	24.70	6.70	()
VANADIUM	14.30	17.20	14.40	25.30	16.40	21.40
ZINC	76.80	63.00	66.20	587.00	87.20	26.30 J

Data Qualifer Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated val
The associated value is either the sample quantitation limit or the sample detection limit.
UJ - as not detected. The associated value is
an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-50
RISK SEGMENT E1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
CHLOROBENZENE	Yes - Found only in downgradient.
CHLOROETHANE	Yes - Found only in downgradient.
CHLOROFORM	Yes - Found downgradient.
1,2-DICHLOROETHENE (TOTAL)	Yes - Found only in downgradient.
METHYLENE CHLORIDE	Yes - Found downgradient.
TRICHLOROETHENE	Yes - Found only in downgradient.
TETRACHLOROETHENE	Yes - Found only in downgradient.
VINYL ACETATE	Yes - Found only in downgradient.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
ACENAPHTHENE	Yes - Found only in downgradient.
ANTHRACENE	Yes - Found only in downgradient.
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(G,H,I)PERYLENE	Yes - Found only in downgradient.
BENZO(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
BUTYLBENZYLPHTHALATE	Yes - Found only in downgradient.
2-CHLORONAPHTHALENE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
DIBENZOFURAN	Yes - Found only in downgradient.
1,3-DICHLOROBENZENE	Yes - Found only in downgradient.
1,4-DICHLOROBENZENE	Yes - Found only in downgradient.
1,2-DICHLOROBENZENE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYLPHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
FLUORENE	Yes - Found only in downgradient.
INDENO(1,2,3-CD)PYRENE	Yes - Found only in downgradient.
2-METHYLNAPHTHALENE	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ANTIMONY	No - Not significantly greater than (<3x) background.
ARSENIC	Yes - Found at significantly greater than (>3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found only in downgradient.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COBALT	Yes - Found at significantly greater than (>3x) background.
COPPER	Yes - Found at significantly greater than (>3x) background.
CYANIDE	Yes - Found only in downgradient.
IRON	Yes - Found at significantly greater than (>3x) background.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	Yes - Found at significantly greater than (>3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
MERCURY	Yes - Found at significantly greater than (>3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
SELENIUM	Yes - Found at significantly greater than (>3x) background.
SILVER	Yes - Found at significantly greater than (>3x) background.
VANADIUM	Yes - Found at significantly greater than (>3x) background.
ZINC	Yes - Found at significantly greater than (>3x) background.

TABLE A-51
RISK SEGMENT E2
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	7/90 E12	7/90 E13
VOLATILE ORGANICS (ug/kg)					
ACETONE	2/2	10	( )	130.00 J	210.00 J
METHYLENE CHLORIDE	2/2	10	10.00 UJ	8.00 J	14.00 J
SEMI-VOLATILE ORGANICS (ug/kg)					
BIS(2-ETHYLHEXYL)PHTHALATE	2/2	330	( )	690.00	240.00
DI-N-BUTYLPHTHALATE	1/2	330	( )	27.00	( )
DI-N-OCTYL PHTHALATE	2/2	330	( )	33.00	17.00
FLUORANTHENE	1/2	330	( )	83.00	( )
PYRENE	1/2	330	( )	18.00	( )
METALS (mg/kg)					
ALUMINUM	2/2	100	4050.00	12300.00	9650.00
BARIUM	2/2	100	64.40	993.00	192.00
CADMIUM	1/2	2.5	*1.00	2.90	( )
CALCIUM	2/2	2500	4070.00	2640.00	779.00 U
CHROMIUM	2/2	5	8.40	59.30	11.60
COPPER	2/2	12.5	36.60	18.90	6.60
IRON	2/2	50	5780.00	13000.00	8600.00
LEAD	2/2	1.5	6.70	10.50	8.10
MAGNESIUM	2/2	2500	1160.00	2380.00	1490.00
MANGANESE	2/2	7.5	100.00	186.00	219.00
NICKEL	2/2	20	8.00	26.60	9.60 U
POTASSIUM	2/2	2500	552.00	1550.00	1160.00 U
VANADIUM	2/2	25	9.40	28.90	19.60
ZINC	2/2	10	13.90	20.60 J	13.90

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value The associated value is either the sample quanititation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-52
RISK SEGMENT E2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
DI-N-OCTYL PHTHALATE	No - Common Laboratory Contaminant.
FLUORANTHENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found significantly greater than (>3x) background.
BERYLLIUM	No - Not significantly greater than (<3x) background.
CADMIUM	No - Not significantly greater than (<3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-53
RISK SEGMENT M1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	M01	M02	M03	M04	M05	M06
VOLATILE ORGANICS (ug/kg)									
ACETONE	4/6	10	( )	13.00	6.00 J	( )	( )	28.00	290.00 J
METHYLENE CHLORIDE	6/6	10	10.00 UJ	20.00	13.00 UJ	9.00 UJ	16.00 J	31.00 U	11.00 J
SEMI-VOLATILE ORGANICS (ug/kg)									
BIS(2-ETHYLHEXYL)PHTHALATE	4/6	330	( )	( )	320.00	750.00	310.00	220.00	( )
DI-N-BUTYLPHTHALATE	2/6	330	( )	( )	( )	( )	( )	19.00	21.00
DI-N-OCTYLPHTHALATE	1/6	330	( )	( )	( )	( )	( )	( )	38.00
METALS (mg/kg)									
ALUMINUM	6/6	100	4050.00	11000.00 J	10600.00 J	3980.00 J	8010.00 J	4080.00	7470.00
ARSENIC	6/6	5	1.60	4.50 J	3.00 J	4.30	6.80 J	1.50 U	3.60 J
BARIUM	6/6	100	64.40	274.00 J	354.00 J	212.00 J	431.00 J	188.00	293.00
CADMIUM	1/6	2.5	*1.00	( )	( )	( )	( )	( )	53.40
CALCIUM	6/6	2500	4070.00	1220.00	1610.00	691.00 U	2070.00	1190.00 U	2130.00
CHROMIUM	6/6	5	8.40	14.40	14.50	10.90	14.40	7.40	829.00
COPPER	5/6	12.5	36.60	6.90	8.00	( )	7.30	10.20	23.60
IRON	6/6	50	5780.00	13800.00 J	10700.00 J	9190.00 J	14900.00 J	4490.00	9150.00
LEAD	6/6	1.5	6.70	13.00 J	11.10 J	14.00 J	9.40 J	5.40	63.60
MAGNESIUM	6/6	2500	1160.00	1330.00 J	1440.00 J	458.00 U	1350.00 J	919.00 U	1490.00
MANGANESE	6/6	7.5	100.00	183.00 J	254.00 J	577.00 J	1090.00 J	99.80	196.00
NICKEL	6/6	20	8.00	11.40	12.70	7.40 U	10.10	6.80 U	110.00
POTASSIUM	6/6	2500	552.00	1010.00 U	1310.00	480.00 U	915.00 U	537.00 U	998.00 U
SILVER	5/6	5	0.53	1.10 U	1.10 U	0.77 U	1.10	( )	14.50
VANADIUM	6/6	25	9.40	24.50 J	21.20 J	22.50 J	43.80 J	13.10	23.10
ZINC	6/6	10	13.90	14.50 J	21.50 J	8.70 J	14.40 J	10.30 J	45.20 J

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quanitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R - The data are unusable (compound may or may not be present). Resampling and reanalyses is necessary for verification.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-54
RISK SEGMENT M1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	No - Common Laboratory Contaminant.
DI-N-OCTYL PHTHALATE	No - Common Laboratory Contaminant.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ARSENIC	Yes - Found at significantly greater than (>3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
SILVER	Yes - Found at significantly greater than (>3x) background.
VANADIUM	Yes - Found at significantly greater than (>3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-55
RISK SEGMENT M2
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Upgradient C01	M07	M08	M09
VOLATILE ORGANICS (ug/kg)						
ACETONE	2/3	10	()	240.00 J	85.00 J	()
METHYLENE CHLORIDE	3/3	10	10.00 UJ	15.00 J	25.00 J	8.00 J
SEMI-VOLATILE ORGANICS (ug/kg)						
BENZO(A)PYRENE	1/3	330	()	330.00	()	()
BIS(2-ETHYLHEXYL)PHTHALATE	3/3	330	()	90.00	210.00	670.00
DI-N-BUTYLPHTHALATE	1/3	330	()	30.00	()	()
DI-N-OCTYL PHTHALATE	1/3	330	()	19.00	()	()
METALS (mg/kg)						
ALUMINUM	3/3	100	4050.00	8040.00	3640.00 J	6980.00 J
ARSENIC	3/3	5	1.60	1.50 U	1.50 U	5.10 J
BARIUM	3/3	100	64.40	214.00	351.00	488.00 J
CADMIUM	3/3	2.5	*1.00	2.30	1.70	1.60
CALCIUM	3/3	2500	4070.00	2260.00	2030.00 J	22600.00 J
CHROMIUM	3/3	5	8.40	38.50	34.50	20.90 J
COPPER	3/3	12.5	36.60	8.30	7.50	16.60 J
IRON	3/3	50	5780.00	8010.00	4820.00	8620.00
LEAD	3/3	1.5	6.70	6.80	7.70 J	7.60 J
MAGNESIUM	3/3	2500	1160.00	1570.00	919.00 U	3380.00
MANGANESE	3/3	7.5	100.00	124.00	431.00	840.00 J
NICKEL	3/3	20	8.00	12.60	9.40 U	10.70
VANADIUM	3/3	250	9.40	18.60	11.80 U	13.10 J
ZINC	3/3	10	13.90	17.80 J	13.90	17.00

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-56
RISK SEGMENT M2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BENZO(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYL PHTHALATE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than 3x upgradient.
ARSENIC	No - Not significantly greater than 3x upgradient.
BARIUM	Yes - Found at significantly greater than upgradient.
CADMIUM	No - Not significantly greater than 3x background.
CALCIUM	Yes - Found at significantly greater than upgradient.
CHROMIUM	Yes - Found at significantly greater than upgradient.
COPPER	No - Not significantly greater than 3x upgradient.
IRON	No - Not significantly greater than 3x upgradient.
LEAD	No - Not significantly greater than 3x upgradient.
MAGNESIUM	No - Not significantly greater than 3x upgradient.
MANGANESE	Yes - Found at significantly greater than upgradient.
NICKEL	No - Not significantly greater than 3x upgradient.
VANADIUM	No - Not significantly greater than 3x upgradient.
ZINC	No - Not significantly greater than 3x upgradient.

TABLE A-57
RISK SEGMENT M3
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	6/90 M10	6/90 M11	6/90 M12	6/90 M13
VOLATILE ORGANICS (ug/kg)							
ACETONE	3/4	10	( )	( )	110.00	8.00 J	20.00 U
METHYLENE CHLORIDE	3/4	10	10.00 UJ	4.00 J	10.00 J	( )	12.00 U
TOLUENE	3/4	10	( )	11.00	4.00 J	( )	12.00
SEMI-VOLATILE ORGANICS (ug/kg)							
BIS(2-ETHYLHEXYL)PHTHALATE	3/4	330	( )	330.00	230.00	380.00	( )
METALS (mg/kg)							
ALUMINUM	4/4	100	4050.00	4610.00 J	6110.00 J	1750.00 J	3930.00
BARIUM	4/4	100	64.40	383.00 J	319.00 J	692.00 J	162.00
CALCIUM	4/4	2500	4070.00	13500.00 J	3100.00 J	1460.00 J	1070.00
CHROMIUM	4/4	5	8.40	12.50 J	12.20 J	21.80 J	16.40
COPPER	4/4	25	36.60	22.00 J	8.60 J	4.80 U	15.60
IRON	4/4	50	5780.00	4750.00	5610.00	2480.00	5520.00
LEAD	4/4	1.5	6.70	6.90 J	8.60 J	8.60 J	5.50
MAGNESIUM	4/4	2500	1160.00	2620.00	1900.00	549.00 U	1160.00
MANGANESE	4/4	7.5	100.00	171.00 J	356.00 J	61.20 J	73.30
NICKEL	4/4	20	8.00	9.70 U	10.80	3.60 U	9.60
POTASSIUM	3/4	2500	552.00	527.00 U	424.00 U	( )	703.00
ZINC	4/4	10	13.90	16.10	19.00	10.20	13.80

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-58
RISK SEGMENT M3
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
TOLUENE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	No - Not significantly greater than (<3x) background.
CHROMIUM	No - Not significantly greater than (<3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	No - Not significantly greater than (<3x) background.
MAGNESIUM	No - Not significantly greater than (<3x) background.
MANGANESE	No - Not significantly greater than (<3x) background.
NICKEL	No - Not significantly greater than (<3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

TABLE A-59
RISK SEGMENT W1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	7/90 W01	7/90 W02	7/90 W03	7/90 W04	7/90 W06	7/90 W07
VOLATILE ORGANICS (ug/kg)									
ACETONE	5/6	10	()	240.00 J	14.00	22.00	26.00	5.00 J	()
CARBON DISULFIDE	1/6	10	()	()	()	()	()	36.00 J	()
ETHYLBENZENE	1/6	10	()	()	()	4.00	()	()	()
METHYLENE CHLORIDE	4/6	10	10.00 UJ	42.00 UJ	34.00 UJ	110.00	39.00	()	5.00 J
TOLUENE	3/6	10	()	4.00 J	150.00 J	8.00	()	()	()
XYLENE (TOTAL)	1/6	10	()	()	()	60.00	()	()	()
SEMI-VOLATILE ORGANICS (ug/kg)									
ACENAPHTHENE	1/6	330	()	()	()	1100.00	()	()	()
ANTHRACENE	2/6	330	()	59.00	()	1000.00	()	()	()
BENZO(A)ANTHRACENE	2/6	330	()	220.00	()	4200.00	()	()	()
BENZO(B)FLUORANTHENE	3/6	330	()	200.00	()	9200.00	1800.00	()	()
BENZO(K)FLUORANTHENE	2/6	330	()	190.00	()	()	1400.00	()	()
BENZO(G,H,I)PERYLENE	3/6	330	()	120.00	()	4100.00	850.00	()	()
BENZO(A)PYRENE	3/6	330	()	160.00	()	4400.00	1400.00	()	()
BIS(2-ETHYLHEXYL)PHTHALATE	5/6	330	()	60.00	210.00	15000.00	46000.00	()	1500.00
BUTYLBENZYLPHTHALATE	1/6	330	()	()	()	720.00	()	()	()
CHRYSENE	3/6	330	()	240.00	()	7100.00	2000.00	()	()
DIBENZOFURAN	1/6	330	()	()	()	480.00	()	()	()
1,3-DICHLOROBENZENE	1/6	330	()	()	()	()	210.00	()	()
1,4-DICHLOROBENZENE	1/6	330	()	()	()	()	2200.00	()	()
1,2-DICHLOROBENZENE	1/6	330	()	()	()	()	220.00	()	()
3,3'-DICHLOROBENZIDINE	1/6	330	()	()	()	1700.00	()	()	()
DI-N-BUTYLPHTHALATE	2/6	330	()	()	()	2200.00	370.00	()	()
DI-N-OCTYLPHTHALATE	1/6	330	()	()	()	()	250.00	()	()
FLUORANTHENE	5/6	330	()	530.00	95.00	11000.00	8500.00	()	110.00
FLUORENE	1/6	330	()	()	()	880.00	()	()	()
INDENO(1,2,3-CD)PYRENE	3/6	330	()	100.00	()	3800.00	960.00	()	()
2-METHYLNAPHTHALENE	1/6	330	()	()	()	800.00	()	()	()
NAPHTHALENE	1/6	330	()	()	()	690.00	()	()	()
PHENANTHRENE	5/6	330	()	310.00	43.00	6000.00	1100.00	()	15.00
PYRENE	3/6	330	()	540.00	110.00	()	3300.00	()	()
METALS (mg/kg)									
ALUMINUM	6/6	100	4050.00	12800.00 J	423.00 J	6660.00	7510.00	4900.00 J	42300.00 J
ANTIMONY	1/6	30	*150.00	()	()	22.10	()	()	()
ARSENIC	4/6	5	1.60	()	()	3.30	3.40	0.97 U	2.00 U
BARIUM	6/6	100	64.40	200.00 J	63.00 J	351.00	320.00	393.00	605.00
CADMIUM	4/6	2.5	*1.00	1.00 U	()	39.50	93.40	()	1.10 U
CALCIUM	6/6	2500	4070.00	24800.00 J	1170.00 J	11100.00	5620.00	7800.00 J	2740.00 J
CHROMIUM	6/6	5	8.40	18.60	11.60	286.00	2020.00	23.60	184.00
COBALT	5/6	25	3.10	10.80	()	52.10	9.80 U	6.10 U	4.80 U
COPPER	6/6	12.5	36.60	24.60	13.50	320.00	31.30	7.90	21.00
IRON	6/6	50	5780.00	10200.00	827.00	6460.00	9150.00	5870.00	7110.00
LEAD	6/6	1.5	6.70	18.70	3.20	243.00	57.00	16.70	6.40
MAGNESIUM	6/6	2500	1160.00	15400.00	179.00 U	3460.00	2440.00	4620.00	1400.00
MANGANESE	6/6	7.5	100.00	956.00	8.80 U	154.00	481.00	245.00	134.00
MERCURY	4/6	5	*0.06	0.12 U	0.22 U	1.40	0.28	()	()
NICKEL	6/6	20	8.00	22.50	4.90 U	2270.00	63.40	19.00	12.50
POTASSIUM	6/6	2500	552.00	2300.00	99.30 U	741.00 U	1250.00 U	971.00 U	944.00 U
SELENIUM	2/6	2.5	*0.25	()	()	2.30	0.56 U	()	()
SILVER	3/6	5	0.53	0.70	()	112.00	9.10	()	()
VANADIUM	6/6	25	9.40	18.80	2.90 U	26.10	20.70	16.30	13.30
ZINC	6/6	10	13.90	37.30	29.00	543.00	44.20	22.20	13.90

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-60
RISK SEGMENT W1
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	Yes - Found only in downgradient.
CARBON DISULFIDE	Yes - Found only in downgradient.
ETHYLBENZENE	Yes - Found only in downgradient.
METHYLENE CHLORIDE	Yes - Found downgradient.
TOLUENE	Yes - Found only in downgradient.
XYLENE (TOTAL)	Yes - Found only in downgradient.
SEMI-VOLATILE ORGANICS	
ACENAPHTHENE	Yes - Found only in downgradient.
ANTHRACENE	Yes - Found only in downgradient.
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(G,H,I)PERYLENE	Yes - Found only in downgradient.
BENZO(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
BUTYLBENZYLPHTHALATE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
DIBENZOFURAN	Yes - Found only in downgradient.
1,3-DICHLOROBENZENE	Yes - Found only in downgradient.
1,4-DICHLOROBENZENE	Yes - Found only in downgradient.
1,2-DICHLOROBENZENE	Yes - Found only in downgradient.
3,3'-DICHLOROBENZIDINE	Yes - Found only in downgradient.
DI-N-BUTYLPHTHALATE	Yes - Found only in downgradient.
DI-N-OCTYLPHTHALATE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
FLUORENE	Yes - Found only in downgradient.
INDENO(1,2,3-CD)PYRENE	Yes - Found only in downgradient.
2-METHYLNAPHTHALENE	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
ANTIMONY	No - Not significantly greater than (<3x) background.
ARSENIC	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at significantly greater than (>3x) background.
CADMIUM	Yes - Found at significantly greater than (>3x) background.
CALCIUM	Yes - Found at significantly greater than (>3x) background.
CHROMIUM	Yes - Found at significantly greater than (>3x) background.
COBALT	Yes - Found at significantly greater than (>3x) background.
COPPER	Yes - Found at significantly greater than (>3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found at significantly greater than (>3x) background.
MAGNESIUM	Yes - Found at significantly greater than (>3x) background.
MANGANESE	Yes - Found at significantly greater than (>3x) background.
MERCURY	Yes - Found at significantly greater than (>3x) background.
NICKEL	Yes - Found at significantly greater than (>3x) background.
POTASSIUM	Yes - Found at significantly greater than (>3x) background.
SELENIUM	Yes - Found at significantly greater than (>3x) background.
SILVER	Yes - Found at significantly greater than (>3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	Yes - Found at significantly greater than (>3x) background.

TABLE A-61
RISK SEGMENT W2
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Frequency of Detection	Detection Limit	Background C01	6/90 W08	6/90 W09
VOLATILE ORGANICS (ug/kg)					
ACETONE	1/2	10	( )	6.00 J	( )
METHYLENE CHLORIDE	2/2	10	10.00 UJ	8.00 UJ	15.00 U
SEMI-VOLATILE ORGANICS (ug/kg)					
ACENAPHTHENE	1/2	330	( )	83.00	( )
ANTHRACENE	1/2	330	( )	44.00	( )
BENZO(A)ANTHRACENE	1/2	330	( )	140.00	( )
BENZO(B)FLUORANTHENE	1/2	330	( )	190.00	( )
BENZO(K)FLUORANTHENE	1/2	330	( )	180.00	( )
BENZO(A)PYRENE	1/2	330	( )	160.00	( )
BIS(2-ETHYLHEXYL)PHTHALATE	2/2	330	( )	4000.00	4200.00
CHRYSENE	1/2	330	( )	210.00	( )
FLUORANTHENE	1/2	330	( )	420.00	( )
FLUORENE	1/2	330	( )	76.00	( )
2-METHYLNAPHTHALENE	1/2	330	( )	1300.00	( )
NAPHTHALENE	1/2	330	( )	82.00	( )
PHENANTHRENE	1/2	330	( )	260.00	( )
PYRENE	1/2	330	( )	530.00	( )
METALS (mg/kg)					
ALUMINUM	2/2	100	4050.00	4490.00 J	9300.00 J
BARIUM	2/2	100	64.40	426.00	252.00
CADMIUM	1/2	2.5	*1.00	12.70	( )
CALCIUM	2/2	2500	4070.00	2900.00 J	39600.00
CHROMIUM	2/2	5	8.40	527.00	20.90
COPPER	2/2	12.5	36.60	28.30	11.50
IRON	2/2	5	5780.00	5140.00	7650.00
LEAD	2/2	1.5	6.70	55.00	3.50
MAGNESIUM	2/2	2500	1160.00	1630.00	6940.00
MANGANESE	2/2	7.5	100.00	241.00	424.00
NICKEL	2/2	20	8.00	36.00	21.30
POTASSIUM	2/2	2500	552.00	576.00 U	1560.00
SILVER	1/2	5	0.53	4.60	( )
VANADIUM	2/2	25	9.40	16.30	15.50
ZINC	2/2	10	13.90	49.50	18.40

Data Qualifier Legend

( ) - Not Detected.
J - The associated value is an estimated quantity.
U - The material was analyzed for, but was detected valve the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
* - Connor & Shacklette (1975) mean value in soil.

TABLE A-62
RISK SEGMENT W2
RATIONALE FOR IDENTIFICATION OF
CHEMICALS OF POTENTIAL CONCERN
IN 0-6" SEDIMENTS
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	RATIONALE
VOLATILE ORGANICS	
ACETONE	No - Common Laboratory Contaminant.
METHYLENE CHLORIDE	No - Common Laboratory Contaminant.
SEMI-VOLATILE ORGANICS	
ACENAPHTHENE	Yes - Found only in downgradient.
ANTHRACENE	Yes - Found only in downgradient.
BENZO(A)ANTHRACENE	Yes - Found only in downgradient.
BENZO(B)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(K)FLUORANTHENE	Yes - Found only in downgradient.
BENZO(A)PYRENE	Yes - Found only in downgradient.
BIS(2-ETHYLHEXYL)PHTHALATE	Yes - Found only in downgradient.
CHRYSENE	Yes - Found only in downgradient.
FLUORANTHENE	Yes - Found only in downgradient.
FLUORENE	Yes - Found only in downgradient.
2-METHYLNAPHTHALENE	Yes - Found only in downgradient.
NAPHTHALENE	Yes - Found only in downgradient.
PHENANTHRENE	Yes - Found only in downgradient.
PYRENE	Yes - Found only in downgradient.
METALS	
ALUMINUM	No - Not significantly greater than (<3x) background.
BARIUM	Yes - Found at greater than (>3x) background.
CADMIUM	Yes - Found at greater than (>3x) background.
CALCIUM	Yes - Found at greater than (>3x) background.
CHROMIUM	Yes - Found at greater than (>3x) background.
COPPER	No - Not significantly greater than (<3x) background.
IRON	No - Not significantly greater than (<3x) background.
LEAD	Yes - Found at greater than (>3x) background.
MAGNESIUM	Yes - Found at greater than (>3x) background.
MANGANESE	Yes - Found at greater than (>3x) background.
NICKEL	Yes - Found at greater than (>3x) background.
POTASSIUM	No - Not significantly greater than (<3x) background.
SILVER	Yes - Found at greater than (>3x) background.
VANADIUM	No - Not significantly greater than (<3x) background.
ZINC	No - Not significantly greater than (<3x) background.

APPENDIX B

DETERMINATION OF EXPOSURE POINT CONCENTRATIONS

B.0 DETERMINATION OF EXPOSURE POINT CONCENTRATIONS

Appendix B summarizes the data presented in Appendix A and presents the 95% upper confidence limit (UCL) value, the maximum detected concentration, and the exposure point concentration used in the calculation of risks. If the 95% UCL exceeds the maximum concentration, then the maximum value was used in the risk assessment as the exposure point concentration. The 95% UCL was calculated using the "T" table (Table B-i) and the following formula:

$$95\%\ UCL = \overline{X} + T\,\frac{s}{\sqrt{n}}$$

Where:

$\overline{X}$ = The mean
T = The value off of the T-Table on the following page
s = The Sample Standard Deviation
n = Degrees of Freedom

For values entered as "Not Detected", 1/2 the detection limit was used to approximate that sample's value.

TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT
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TABLE B-1
GROUNDWATER DATA FOR PERCHED AQUIFER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
1,1-DICHLOROETHENE	1.56E+01	7.39E+01	1.56E+01
TRANS-1,2-DICHLOROETHENE	1.36E+01	5.40E+01	1.36E+01
TETRACHLOROETHENE	4.40E+02	2.90E+03	4.40E+02
1,1,1-TRICHLOROETHANE	5.23E+00	5.00E+00	5.00E+00
TRICHLOROETHENE	2.69E+04	1.79E+05	2.69E+04
SEMI-VOLATILE ORGANICS (ug/L)			
BIS(2-ETHYLHEXYL)PHTHALATE	4.61E+01	2.50E+02	4.61E+01
METALS (ug/L)			
ARSENIC	4.83E+00	5.00E+00	4.83E+00
BARIUM	6.05E+02	1.61E+03	6.05E+02
CHROMIUM	1.92E+04	1.28E+05	1.92E+04
COPPER	2.71E+01	5.20E+01	2.71E+01
LEAD	8.15E+00	2.60E+01	8.15E+00
NICKEL	2.41E+01	4.32E+01	2.41E+01
SELENIUM	6.04E+00	9.50E+00	5.34E+00

TABLE B-2
GROUNDWATER DATA FOR TOP OF REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
BENZENE	4.93E+00	5.80E+00	4.93E+00
CHLOROBENZENE	1.66E+02	1.10E+03	1.66E+02
CHLOROFORM	4.98E+00	5.00E+00	4.98E+00
1,1-DICHLOROETHANE	4.03E+01	1.78E+02	4.03E+01
1,1-DICHLOROETHENE	1.11E+01	4.80E+01	1.11E+01
CIS-1,2-DICHLOROETHENE	6.60E+00	2.10E+01	6.60E+00
TRANS-1,2-DICHLOROETHENE	2.22E+02	2.16E+03	2.22E+02
1,2-DICHLOROPROPANE	1.20E+01	7.30E+01	1.20E+01
ETHYLBENZENE	5.08E+00	6.10E+00	5.08E+00
METHYLENE CHLORIDE	9.39E+00	4.40E+01	9.39E+00
TETRACHLOROETHENE	1.03E+02	9.20E+02	1.03E+02
1,1,1-TRICHLOROETHANE	1.70E+01	1.50E+02	1.70E+01
TRICHLOROETHENE	1.32E+03	1.80E+04	1.32E+03
1,2,4-TRIMETHYLBENZENE	9.29E-01	6.52E+00	9.29E-01
TOLUENE	7.26E+00	2.74E+01	7.26E+00
VINYL CHLORIDE	1.21E+02	1.62E+03	1.21E+02
XYLENE (TOTAL)	6.82E+00	2.48E+01	6.82E+00
SEMI-VOLATILE ORGANICS (ug/L)			
BIS(2-ETHYLHEXYL)PHTHALATE	1.07E+02	1.10E+03	1.07E+02
1,2-DICHLOROBENZENE	3.73E+01	4.20E+02	3.73E+01
1,3-DICHLOROBENZENE	4.99E+00	5.00E+00	4.99E+00
1,4-DICHLOROBENZENE	2.40E+01	2.20E+02	2.40E+01
DI-N-OCTYLPHTHALATE	2.38E+01	8.50E+01	2.38E+01
NAPHTHALENE	5.15E+00	5.00E+00	5.00E+00
METALS (ug/L)			
ARSENIC	8.87E+00	4.20E+01	8.87E+00
BARIUM	1.06E+03	3.46E+03	1.06E+03
CHROMIUM	4.66E+02	6.52E+03	4.66E+02
COPPER	2.05E+01	3.20E+01	2.05E+01
LEAD	7.66E+00	3.40E+01	7.66E+00
NICKEL	1.37E+02	3.05E+02	1.37E+02

TABLE B-3
GROUNDWATER DATA FOR REGIONAL AQUIFER ZONE
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
BENZENE	5.15E+00	5.00E+00	5.00E+00
CHLOROBENZENE	7.38E+01	4.80E+02	7.38E+01
1,1-DICHLOROETHANE	6.51E+00	1.30E+01	6.51E+00
1,1-DICHLOROETHENE	7.00E+00	2.40E+01	7.00E+00
CIS-1,2-DICHLOROETHENE	9.59E+00	3.15E+01	9.59E+00
TRANS-1,2-DICHLOROETHENE	1.89E+01	1.13E+02	1.89E+01
1,2-DICHLOROPROPANE	5.73E+00	1.40E+01	5.73E+00
METHYLENE CHLORIDE	1.44E+01	9.80E+01	1.44E+01
TETRACHLOROETHENE	2.76E+01	2.00E+02	2.76E+01
1,1,1-TRICHLOROETHANE	5.86E+00	9.00E+00	5.86E+00
TRICHLOROETHENE	1.89E+02	1.10E+03	1.89E+02
1,2,4-TRIMETHYLBENZENE	3.46E-01	8.80E-01	3.46E-01
VINYL CHLORIDE	1.19E+01	7.90E+01	1.19E+01
SEMI-VOLATILE ORGANICS (ug/L)			
1,2-DICHLOROBENZENE	2.04E+01	1.50E+02	2.04E+01
1,4-DICHLOROBENZENE	1.01E+01	5.20E+01	1.01E+01
METALS (ug/L)			
BARIUM	1.18E+03	6.06E+03	1.18E+03
LEAD	1.41E+01	6.20E+01	1.41E+01
NICKEL	4.63E+01	2.72E+02	4.63E+01
SELENIUM	5.27E+00	6.80E+00	5.27E+00

TABLE B-4
RISK SEGMENT A
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS			
NOT ANALYZED			
SEMI-VOLATILE ORGANICS			
NOT ANALYZED			
METALS (ug/L)			
NOT ANALYZED			

TABLE B-5
RISK SEGMENT B
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS			
NO CHEMICALS OF CONCERN			
METALS (ug/L)			
ARSENIC		7.40E+00	7.40E+00

TABLE B-6
RISK SEGMENT E1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
BROMODICHLOROMETHANE	5.17E+00	6.00E+00	5.17E+00
BROMOFORM	7.07E+00	1.50E+01	7.07E+00
CARBON DISULFIDE	5.22E+00	5.00E+00	5.00E+00
CHLOROFORM	5.09E+00	6.00E+00	5.09E+00
DIBROMOCHLOROMETHANE	5.06E+00	5.00E+00	5.00E+00
TETRACHLOROETHENE	5.01E+00	5.00E+00	5.00E+00
1,1,1-TRICHLOROETHANE	5.17E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/L)			
BENZO(G,H,I)PERYLENE	5.23E+00	6.00E+00	5.23E+00
BENZOIC ACID	5.27E+00	5.00E+00	5.00E+00
CHRYSENE	5.00E+00	5.00E+00	5.00E+00
METALS (ug/L)			
ARSENIC	5.69E+00	6.80E+00	5.69E+00
CHROMIUM	5.26E+01	1.56E+02	5.26E+01
COPPER	1.04E+02	2.42E+02	1.04E+02
NICKEL	2.31E+01	3.26E+01	2.31E+01
SELENIUM	1.24E+01	2.09E+01	1.24E+01
SILVER	5.21E+00	5.00E+00	5.00E+00
VANADIUM	2.04E+01	2.60E+01	2.04E+01

TABLE B-7
RISK SEGMENT E2
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
ACETONE	5.11E+01	6.00E+01	5.11E+01
BENZENE	6.35E+00	5.00E+00	5.00E+00
METHYLENE CHLORIDE	5.20E+02	6.20E+02	5.20E+02
1,1,1-TRICHLOROETHANE	6.01E+00	5.00E+00	5.00E+00
TOLUENE	5.34E+00	5.00E+00	5.00E+00
XYLENE (TOTAL)	6.01E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/L)			
BENZOIC ACID	6.56E+00	5.00E+00	5.00E+00
METALS (ug/L)			
ALUMINUM	9.45E+02	4.08E+02	4.08E+02
BARIUM	3.44E+02	2.80E+02	2.80E+02
CADMIUM	8.28E+00	9.40E+00	8.28E+00
CALCIUM	4.88E+04	4.75E+04	4.75E+04
CHROMIUM	3.53E+01	3.49E+01	3.49E+01
IRON	8.35E+02	3.46E+02	3.46E+02
MAGNESIUM	2.26E+04	2.21E+04	2.21E+04
MANGANESE	5.88E+02	2.98E+02	2.98E+02
POTASSIUM	7.65E+03	6.29E+03	6.29E+03
SELENIUM	1.46E+01	5.80E+00	5.80E+00
SODIUM	1.57E+05	1.30E+05	1.30E+05

TABLE B-8
RISK SEGMENT M1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/L)			
BENZOIC ACID	6.56E+00	5.00E+00	5.00E+00
METALS (ug/L)			
BARIUM	1.71E+03	1.90E+03	1.71E+03
CHROMIUM	1.34E+01	1.41E+01	1.34E+01
LEAD	2.01E+01	2.23E+01	2.01E+01

TABLE B-9
RISK SEGMENT M2
SURFACE WATER DATA
TINKER - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
ACETONE	6.00E+00	7.00E+00	6.00E+00
BENZENE	5.51E+00	5.00E+00	5.00E+00
CARBON DISULFIDE	5.73E+00	5.00E+00	5.00E+00
CHLOROBENZENE	5.51E+00	5.00E+00	5.00E+00
1,1,1-TRICHLOROETHANE	4.95E+00	5.00E+00	4.95E+00
TRICHLOROETHENE	5.51E+00	5.00E+00	5.00E+00
TOLUENE	5.17E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/L)			
NO CHEMICALS OF CONCERN			
METALS (ug/L)			
CADMIUM	2.74E+00	2.50E+00	2.50E+00
CHROMIUM	3.52E+01	4.15E+01	3.52E+01
NICKEL	2.16E+01	1.84E+01	1.84E+01
SELENIUM	8.21E+00	6.70E+00	6.70E+00
SODIUM	1.34E+05	1.22E+05	1.22E+05

TABLE B-10
RISK SEGMENT M3
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
CHLOROFORM	5.54E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/L)			
NO CHEMICALS OF CONCERN			
METALS (ug/L)			
CHROMIUM	4.08E+01	4.11E+01	4.08E+01
CYANIDE	1.59E+01	1.80E+01	1.59E+01
POTASSIUM	5.66E+03	5.67E+03	5.66E+03
SELENIUM	6.41E+00	6.80E+00	6.41E+00
SODIUM	8.13E+04	8.09E+04	8.09E+04

TABLE B-11
RISK SEGMENT W1
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
CARBON DISULFIDE	5.45E+00	5.00E+00	5.00E+00
1,2-DICHLOROETHENE (TOTAL)	8.65E+00	1.40E+01	8.65E+00
TRICHLOROETHENE	5.34E+00	5.00E+00	5.00E+00
TETRACHLOROETHENE	5.45E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/L)			
FLUORANTHENE	5.91E+00	5.00E+00	5.00E+00
PYRENE	5.91E+00	5.00E+00	5.00E+00
METALS (ug/L)			
ALUMINUM	4.75E+03	7.43E+03	4.75E+03
BERYLLIUM	2.84E+00	2.50E+00	2.50E+00
CADMIUM	2.22E+01	5.69E+01	2.22E+01
CHROMIUM	2.07E+02	6.28E+02	2.07E+02
COBALT	2.13E+02	3.24E+02	2.13E+02
COPPER	6.22E+02	9.85E+02	6.22E+02
CYANIDE	1.15E+01	1.80E+01	1.15E+01
IRON	5.56E+03	8.45E+03	5.56E+03
LEAD	1.10E+02	3.25E+02	1.10E+02
NICKEL	2.30E+03	3.56E+03	2.30E+03
SELENIUM	5.90E+00	7.80E+00	5.90E+00
SILVER	1.01E+01	1.31E+01	1.01E+01
VANADIUM	4.99E+01	6.70E+01	4.99E+01
ZINC	1.54E+03	2.40E+03	1.54E+03

TABLE B-12
RISK SEGMENT W2
SURFACE WATER DATA
TINKER AFB - SOLDIER CREEK RI/
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/L)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/L)			
NO CHEMICALS OF CONCERN			
METALS (ug/L)			
CHROMIUM	1.01E+02	3.12E+01	3.12E+01

TABLE B-13
RISK SEGMENT A
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NOT ANALYZED			
SEMI-VOLATILE ORGANICS (ug/kg)			
NOT ANALYZED			
METALS (mg/kg)			
NOT ANALYZED			

TABLE B-14
RISK SEGMENT B
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NOT ANALYZED			
SEMI-VOLATILE ORGANICS (ug/kg)			
NOT ANALYZED			
METALS (mg/kg)			
NOT ANALYZED			

TABLE B-15
RISK SEGMENT E1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
CHLOROBENZENE	7.91E+03	7.80E+04	7.91E+03
CHLOROETHANE	1.31E+01	8.60E+01	1.31E+01
CHLOROFORM	1.06E+03	9.20E+03	1.06E+03
1,2-DICHLOROETHENE (TOTAL)	1.82E+04	1.80E+05	1.82E+04
METHYLENE CHLORIDE	1.43E+04	1.40E+05	1.43E+04
TETRACHLOROETHENE	8.42E+03	8.30E+04	8.42E+03
TOLUENE	1.03E+02	9.80E+02	1.03E+02
VINYL ACETATE	5.11E+00	5.00E+00	5.00E+00
TRICHLOROETHENE	4.15E+02	4.10E+03	4.15E+02
XYLENE (TOTAL)	1.05E+02	1.00E+03	1.05E+02
SEMI-VOLATILE ORGANICS (ug/kg)			
2-METHYLPHENOL	1.68E+02	1.65E+02	1.65E+02
4-METHYLPHENOL	1.65E+02	1.65E+02	1.65E+02
2,4-DIMETHYLPHENOL	1.67E+02	1.65E+02	1.65E+02
ACENAPHTHENE	1.62E+02	2.50E+02	1.62E+02
ANTHRACENE	3.60E+02	1.50E+03	3.60E+02
BENZO(A)ANTHRACENE	1.05E+03	4.80E+03	1.05E+03
BENZO(B)FLUORANTHENE	1.04E+03	5.00E+03	1.04E+03
BENZO(K)FLUORANTHENE	1.09E+03	5.30E+03	1.09E+03
BENZO(G,H,I)PERYLENE	5.28E+02	1.30E+03	5.28E+02
BENZO(A)PYRENE	9.53E+02	4.10E+03	9.53E+02
BIS(2-ETHYLHEXYL)PHTHALATE	2.89E+03	7.00E+03	2.89E+03
BUTYLBENZYLPHTHALATE	1.67E+02	1.65E+02	1.65E+02
2-CHLORONAPHTHALENE	4.99E+02	1.60E+03	4.99E+02
CHRYSENE	1.29E+03	5.40E+03	1.29E+03
DIBENZ (A,H) ANTHRACENE	1.67E+02	1.65E+02	1.65E+02
DIBENZOFURAN	1.90E+02	3.40E+02	1.90E+02
1,3-DICHLOROBENZENE	1.79E+02	2.80E+02	1.79E+02
1,4-DICHLOROBENZENE	7.13E+02	4.40E+03	7.13E+02
1,2-DICHLOROBENZENE	5.44E+02	3.10E+03	5.44E+02
DI-N-BUTYLPHTHALATE	1.06E+02	1.65E+02	1.06E+02
DI-N-OCTYL PHTHALATE	1.58E+02	3.80E+02	1.58E+02
FLUORANTHENE	3.06E+03	1.10E+04	3.06E+03
FLUORENE	1.63E+02	1.65E+02	1.63E+02
INDENO(1,2,3-CD)PYRENE	5.30E+02	2.10E+03	5.30E+02
NAPHTHALENE	3.05E+02	6.00E+02	3.05E+02
2-METHYLNAPHTHALENE	3.91E+02	1.90E+03	3.91E+02
PHENANTHRENE	1.66E+03	6.70E+03	1.66E+03
PYRENE	2.51E+03	1.00E+04	2.51E+03
METALS (mg/kg)			
BARIUM	1.01E+03	2.91E+03	1.01E+03
CADMIUM	6.78E+01	4.28E+02	6.78E+01
CALCIUM	3.04E+04	7.25E+04	3.04E+04
CHROMIUM	3.25E+02	1.23E+03	3.25E+02
COPPER	1.36E+02	6.00E+02	1.36E+02
CYANIDE	1.81E+00	6.50E+00	1.81E+00
LEAD	1.33E+02	5.86E+02	1.33E+02
MAGNESIUM	3.53E+03	6.88E+03	3.53E+03
MANGANESE	4.99E+02	1.33E+03	4.99E+02
NICKEL	1.36E+02	5.93E+02	1.36E+02
SILVER	6.68E+00	2.47E+01	6.68E+00
ZINC	1.81E+02	5.87E+02	1.81E+02

TABLE B-16
RISK SEGMENT E2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
CHLOROFORM	9.36E+00	2.40E+01	9.36E+00
XYLENE (TOTAL)	5.15E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/kg)			
BIS(2-ETHYLHEXYL)PHTHALATE	6.37E+02	6.90E+02	6.37E+02
DI-N-BUTYLPHTHALATE	1.91E+02	1.65E+02	1.65E+02
DI-N-OCTYL PHTHALATE	3.60E+01	3.30E+01	3.30E+01
FLUORANTHENE	1.93E+02	1.65E+02	1.65E+02
METALS (mg/kg)			
BARIUM	9.13E+02	9.93E+02	9.13E+02
CADMIUM	4.21E+00	1.01E+01	4.21E+00
CHROMIUM	3.95E+01	8.90E+01	3.95E+01

TABLE B-17
RISK SEGMENT M1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
BIS(2-ETHYLHEXYL)PHTHALATE	4.87E+02	9.30E+02	4.87E+02
METALS (mg/kg)			
ARSENIC	3.91E+00	6.80E+00	3.91E+00
BARIUM	3.25E+02	4.31E+02	3.25E+02
CADMIUM	1.58E+01	5.34E+01	1.58E+01
CHROMIUM	2.81E+02	8.29E+02	2.81E+02
MANGANESE	5.31E+02	1.09E+03	5.31E+02
NICKEL	4.88E+01	1.22E+02	4.88E+01
VANADIUM	2.64E+01	4.38E+01	2.64E+01

TABLE B-18
RISK SEGMENT M2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
BENZENE	5.15E+00	5.00E+00	5.00E+00
CHLOROFORM	5.22E+00	6.00E+00	5.22E+00
TETRACHLOROETHENE	5.11E+00	5.00E+00	5.00E+00
XYLENE (TOTAL)	5.21E+00	6.00E+00	5.21E+00
SEMI-VOLATILE ORGANICS (ug/kg)			
BENZO(A)PYRENE	2.46E+02	3.30E+02	2.46E+02
BIS(2-ETHYLHEXYL)PHTHALATE	5.53E+02	6.70E+02	5.53E+02
DI-N-BUTYLPHTHALATE	1.78E+02	1.65E+02	1.65E+02
DI-N-OCTYL PHTHALATE	1.78E+02	1.65E+02	1.65E+02
FLUORANTHENE	1.89E+02	1.65E+02	1.65E+02
METALS (mg/kg)			
BARIUM	4.12E+02	4.88E+02	4.12E+02
CADMIUM	5.69E+00	3.26E+01	5.69E+00
CALCIUM	2.16E+04	3.23E+04	2.16E+04
CHROMIUM	1.03E+02	6.50E+02	1.03E+02
MANGANESE	5.54E+02	8.40E+02	5.54E+02
MERCURY	1.66E-01	2.80E-01	1.66E-01

TABLE B-19
RISK SEGMENT M3
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
CHLOROBENZENE	6.09E+00	8.00E+00	6.09E+00
SEMI-VOLATILE ORGANICS (ug/kg)			
BIS(2-ETHYLHEXYL)PHTHALATE	6.84E+02	1.40E+03	6.84E+02
METALS (mg/kg)			
BARIUM	4.17E+02	6.92E+02	4.17E+02

TABLE B-20
RISK SEGMENT W1
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
CARBON DISULFIDE	9.07E+00	3.60E+01	9.07E+00
CHLOROFORM	1.64E+01	4.50E+01	1.64E+01
ETHYLBENZENE	5.04E+00	5.00E+00	5.00E+00
TETRACHLOROETHENE	5.07E+00	5.00E+00	5.00E+00
TOLUENE	9.74E+01	6.20E+02	9.74E+01
XYLENE (TOTAL)	1.79E+01	6.90E+01	1.79E+01
SEMI-VOLATILE ORGANICS (ug/kg)			
ACENAPHTHENE	3.68E+02	1.10E+03	3.68E+02
ANTHRACENE	3.93E+02	1.00E+03	3.93E+02
BENZO(A)ANTHRACENE	1.36E+03	4.20E+03	1.36E+03
BENZO(B)FLUORANTHENE	2.44E+03	9.20E+03	2.44E+03
BENZO(K)FLUORANTHENE	4.82E+02	1.40E+03	4.82E+02
BENZO(A)PYRENE	1.47E+03	4.40E+03	1.47E+03
BENZO(G,H,I)PERYLENE	1.17E+03	4.10E+03	1.17E+03
BIS(2-ETHYLHEXYL)PHTHALATE	1.22E+04	4.60E+04	1.22E+04
BUTYLBENZYLPHTHALATE	2.84E+02	7.20E+02	2.84E+02
CHRYSENE	2.18E+03	7.10E+03	2.18E+03
DIBENZOFURAN	2.44E+02	4.80E+02	2.44E+02
1,3-DICHLOROBENZENE	1.75E+02	2.10E+02	1.75E+02
1,4-DICHLOROBENZENE	6.00E+02	2.20E+03	6.00E+02
1,2-DICHLOROBENZENE	1.77E+02	2.20E+02	1.77E+02
3,3'-DICHLOROBENZIDINE	4.93E+02	1.70E+03	4.93E+02
DI-N-BUTYLPHTHALATE	6.71E+02	2.20E+03	6.71E+02
DI-N-OCTYL PHTHALATE	1.94E+02	2.50E+02	1.94E+02
FLUORANTHENE	4.71E+03	1.10E+04	4.71E+03
FLUORENE	3.42E+02	8.80E+02	3.42E+02
INDENO(1,2,3-CD)PYRENE	1.15E+03	3.80E+03	1.15E+03
2-METHYLNAPHTHALENE	3.27E+02	8.00E+02	3.27E+02
NAPHTHALENE	2.87E+02	6.90E+02	2.87E+02
PHENANTHRENE	2.07E+03	6.00E+03	2.07E+03
PYRENE	1.83E+03	4.60E+03	1.83E+03
METALS (mg/kg)			
ALUMINUM	1.44E+04	4.23E+04	1.44E+04
ARSENIC	3.20E+00	5.70E+00	3.20E+00
BARIUM	5.20E+02	1.12E+03	5.20E+02
CADMIUM	2.06E+01	9.34E+01	2.06E+01
CALCIUM	1.80E+04	4.15E+04	1.80E+04
CHROMIUM	3.81E+02	2.02E+03	3.81E+02
COBALT	2.08E+01	5.21E+01	2.08E+01
COPPER	1.02E+02	3.20E+02	1.02E+02
LEAD	8.94E+01	2.43E+02	8.94E+01
MAGNESIUM	6.40E+03	1.54E+04	6.40E+03
MANGANESE	4.23E+02	9.56E+02	4.23E+02
MERCURY	4.35E-01	1.40E+00	4.35E-01
NICKEL	6.07E+02	2.27E+03	6.07E+02
POTASSIUM	1.26E+03	2.30E+03	1.26E+03
SELENIUM	3.34E+00	1.02E+01	3.34E+00
SILVER	3.03E+01	1.12E+02	3.03E+01
VANADIUM	2.67E+01	5.29E+01	2.67E+01
ZINC	2.44E+02	6.40E+02	2.44E+02

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TABLE B-21
RISK SEGMENT W2
0-5' SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
ACENAPHTHENE	1.93E+02	1.65E+02	1.65E+02
ANTHRACENE	2.06E+02	1.65E+02	1.65E+02
BENZO(A)ANTHRACENE	1.73E+02	1.65E+02	1.65E+02
BENZO(B)FLUORANTHENE	1.86E+02	1.90E+02	1.86E+02
BENZO(K)FLUORANTHENE	1.78E+02	1.80E+02	1.78E+02
BENZO(A)PYRENE	1.67E+02	1.65E+02	1.65E+02
BIS(2-ETHYLHEXYL)PHTHALATE	4.67E+03	4.20E+03	4.20E+03
CHRYSENE	2.03E+02	2.10E+02	2.03E+02
DI-N-OCTYL PHTHALATE	1.84E+02	1.65E+02	1.65E+02
FLUORANTHENE	3.79E+02	4.20E+02	3.79E+02
FLUORENE	1.95E+02	1.65E+02	1.65E+02
2-METHYLNAPHTHALENE	1.11E+03	1.30E+03	1.11E+03
NAPHTHALENE	1.93E+02	1.65E+02	1.65E+02
PHENANTHRENE	2.59E+02	2.60E+02	2.59E+02
PYRENE	4.71E+02	5.30E+02	4.71E+02
METALS (mg/kg)			
BARIUM	4.45E+02	4.26E+02	4.26E+02
CADMIUM	8.42E+00	1.27E+01	8.42E+00
CALCIUM	4.86E+04	4.33E+04	4.33E+04
CHROMIUM	3.37E+02	5.27E+02	3.37E+02
MAGNESIUM	1.34E+04	1.45E+04	1.34E+04
MERCURY	2.19E+00	2.60E+00	2.19E+00
SILVER	4.26E+00	4.60E+00	4.26E+00

TABLE B-22
RISK SEGMENT A
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
BENZO(A)ANTHRACENE	2.42E+02	1.65E+02	1.65E+02
BENZO(B)FLUORANTHENE	1.94E+02	1.65E+02	1.65E+02
BENZO(K)FLUORANTHENE	2.50E+02	2.30E+02	2.30E+02
BIS(2-ETHYLHEXYL)PHTHALATE	6.33E+02	5.20E+02	5.20E+02
CHRYSENE	1.98E+02	1.90E+02	1.90E+02
DI-N-BUTYLPHTHALATE	2.58E+02	1.65E+02	1.65E+02
FLUORANTHENE	2.24E+02	2.10E+02	2.10E+02
PYRENE	1.98E+02	1.90E+02	1.90E+02
METALS (mg/kg)			
BARIUM	4.63E+02	3.86E+02	3.86E+02
MANGANESE	5.39E+02	4.44E+02	4.44E+02
ZINC	6.57E+01	5.19E+01	5.19E+01

TABLE B-23
RISK SEGMENT B
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
ACETONE	2.22E+03	1.70E+03	1.70E+03
CHLOROFORM	3.52E+01	2.80E+01	2.80E+01
METHYLENE CHLORIDE	1.28E+02	1.00E+02	1.00E+02
TOLUENE	6.92E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/kg)			
ANTHRACENE	2.64E+02	1.65E+02	1.65E+02
BIS(2-ETHYLHEXYL)PHTHALATE	8.12E+02	6.70E+02	6.70E+02
BUTYLBENZYLPHTHALATE	2.22E+02	1.65E+02	1.65E+02
DI-N-BUTYLPHTHALATE	2.07E+02	1.65E+02	1.65E+02
DI-N-OCTYL PHTHALATE	2.55E+02	1.65E+02	1.65E+02
FLUORANTHENE	2.14E+02	1.65E+02	1.65E+02
PHENANTHRENE	2.11E+02	1.65E+02	1.65E+02
PYRENE	2.00E+02	1.65E+02	1.65E+02
METALS (mg/kg)			
BARIUM	1.19E+03	9.73E+02	9.73E+02
CHROMIUM	1.13E+02	8.48E+01	8.48E+01
LEAD	4.08E+01	2.96E+01	2.96E+01
MANGANESE	4.03E+02	3.88E+02	3.88E+02
ZINC	1.60E+02	1.30E+02	1.30E+02

TABLE B-24
RISK SEGMENT E1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
CHLOROBENZENE	1.99E+04	7.80E+04	1.99E+04
CHLOROETHANE	2.57E+01	8.60E+01	2.57E+01
CHLOROFORM	2.47E+03	9.20E+03	2.47E+03
1,2-DICHLOROETHENE (TOTAL)	4.60E+04	1.80E+05	4.60E+04
METHYLENE CHLORIDE	3.58E+04	1.40E+05	3.58E+04
TRICHLOROETHENE	1.05E+03	4.10E+03	1.05E+03
TETRACHLOROETHENE	2.12E+04	8.30E+04	2.12E+04
XYLENE (TOTAL)	2.59E+02	1.00E+03	2.59E+02
VINYL ACETATE	5.30E+00	5.00E+00	5.00E+00
SEMI-VOLATILE ORGANICS (ug/kg)			
ACENAPHTHENE	1.71E+02	2.50E+02	1.71E+02
ANTHRACENE	5.14E+02	1.50E+03	5.14E+02
BENZO(A)ANTHRACENE	1.61E+03	4.80E+03	1.61E+03
BENZO(B)FLUORANTHENE	1.56E+03	5.00E+03	1.56E+03
BENZO(K)FLUORANTHENE	1.68E+03	5.30E+03	1.68E+03
BENZO(G,H,I)PERYLENE	6.90E+02	1.30E+03	6.90E+02
BENZO(A)PYRENE	1.43E+03	4.10E+03	1.43E+03
BIS(2-ETHYLHEXYL)PHTHALATE	3.38E+03	5.00E+03	3.38E+03
BUTYLBENZYLPHTHALATE	1.75E+02	1.65E+02	1.65E+02
2-CHLORONAPHTHALENE	7.50E+02	1.60E+03	7.50E+02
CHRYSENE	1.93E+03	5.40E+03	1.93E+03
DIBENZOFURAN	2.14E+02	3.40E+02	2.14E+02
1,3-DICHLOROBENZENE	1.72E+02	1.65E+02	1.65E+02
1,4-DICHLOROBENZENE	1.68E+02	1.65E+02	1.65E+02
1,2-DICHLOROBENZENE	1.68E+02	1.65E+02	1.65E+02
DI-N-BUTYLPHTHALATE	1.32E+02	1.65E+02	1.32E+02
DI-N-OCTYLPHTHALATE	2.10E+02	3.80E+02	2.10E+02
FLUORANTHENE	4.51E+03	1.10E+04	4.51E+03
FLUORENE	1.64E+02	1.65E+02	1.64E+02
INDENO(1,2,3-CD)PYRENE	7.19E+02	2.10E+03	7.19E+02
2-METHYLNAPHTHALENE	2.72E+02	6.30E+02	2.72E+02
NAPHTHALENE	3.16E+02	4.60E+02	3.16E+02
PHENANTHRENE	2.50E+03	6.70E+03	2.50E+03
PYRENE	3.62E+03	1.00E+04	3.62E+03
METALS (mg/kg)			
ARSENIC	3.84E+00	9.70E+00	3.84E+00
BARIUM	1.21E+03	2.91E+03	1.21E+03
CADMIUM	9.47E+01	3.24E+02	9.47E+01
CHROMIUM	4.35E+02	1.19E+03	4.35E+02
COBALT	8.57E+00	1.73E+01	8.57E+00
COPPER	2.05E+02	6.00E+02	2.05E+02
CYANIDE	2.59E+00	6.50E+00	2.59E+00
IRON	1.50E+04	4.12E+04	1.50E+04
LEAD	2.05E+02	5.86E+02	2.05E+02
MAGNESIUM	3.93E+03	5.82E+03	3.93E+03
MANGANESE	5.19E+02	1.00E+03	5.19E+02
MERCURY	8.12E-01	2.60E+00	8.12E-01
NICKEL	1.26E+02	3.25E+02	1.26E+02
SELENIUM	2.55E+00	6.60E+00	2.55E+00
SILVER	8.43E+00	2.47E+01	8.43E+00
VANADIUM	2.52E+01	5.06E+01	2.52E+01
ZINC	2.41E+02	5.87E+02	2.41E+02

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TABLE B-25
RISK SEGMENT E2
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
BIS(2-ETHYLHEXYL)PHTHALATE	1.89E+03	6.90E+02	6.90E+02
FLUORANTHENE	3.83E+02	1.65E+02	1.65E+02
PYRENE	5.56E+02	1.65E+02	1.65E+02
METALS (mg/kg)			
BARIUM	3.12E+03	9.93E+02	9.93E+02
CHROMIUM	1.86E+02	5.93E+01	5.93E+01

TABLE B-26
RISK SEGMENT M1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
BIS(2-ETHYLHEXYL)PHTHALATE	5.03E+02	7.50E+02	5.03E+02
METALS (mg/kg)			
ARSENIC	5.40E+00	6.80E+00	5.40E+00
BARIUM	3.66E+02	4.31E+02	3.66E+02
CADMIUM	2.75E+01	5.34E+01	2.75E+01
CHROMIUM	4.23E+02	8.29E+02	4.23E+02
LEAD	3.74E+01	6.36E+01	3.74E+01
MANGANESE	7.09E+02	1.09E+03	7.09E+02
NICKEL	6.01E+01	1.10E+02	6.01E+01
SILVER	7.80E+00	1.45E+01	7.80E+00
VANADIUM	3.31E+01	4.38E+01	3.31E+01

TABLE B-27
RISK SEGMENT M2
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
BENZO(A)PYRENE	3.81E+02	3.30E+02	3.30E+02
BIS(2-ETHYLHEXYL)PHTHALATE	8.39E+02	6.70E+02	6.70E+02
DI-N-BUTYLPHTHALATE	2.51E+02	1.65E+02	1.65E+02
DI-N-OCTYL PHTHALATE	2.58E+02	1.65E+02	1.65E+02
METALS (mg/kg)			
BARIUM	5.82E+02	4.88E+02	4.88E+02
CALCIUM	2.89E+04	2.26E+04	2.26E+04
CHROMIUM	4.69E+01	3.85E+01	3.85E+01
MANGANESE	1.07E+03	8.40E+02	8.40E+02

TABLE B-28
RISK SEGMENT M3
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
BIS(2-ETHYLHEXYL)PHTHALATE	3.90E+02	3.80E+02	3.80E+02
METALS (mg/kg)			
BARIUM	6.51E+02	6.92E+02	6.51E+02

TABLE B-29
RISK SEGMENT W1
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
ACETONE	1.28E+02	2.40E+02	1.28E+02
CARBON DISULFIDE	2.06E+01	3.60E+01	2.06E+01
ETHYLBENZENE	5.17E+00	5.00E+00	5.00E+00
TOLUENE	7.81E+01	1.50E+02	7.81E+01
XYLENE (TOTAL)	3.26E+01	6.00E+01	3.26E+01
SEMI-VOLATILE ORGANICS (ug/kg)			
ACENAPHTHENE	6.35E+02	1.10E+03	6.35E+02
ANTHRACENE	5.76E+02	1.00E+03	5.76E+02
BENZO(A)ANTHRACENE	2.20E+03	4.20E+03	2.20E+03
BENZO(B)FLUORANTHENE	4.92E+03	9.20E+03	4.92E+03
BENZO(K)FLUORANTHENE	7.88E+02	1.40E+03	7.88E+02
BENZO(G,H,I)PERYLENE	2.23E+03	4.10E+03	2.23E+03
BENZO(A)PYRENE	2.48E+03	4.40E+03	2.48E+03
BIS(2-ETHYLHEXYL)PHTHALATE	2.56E+04	4.60E+04	2.56E+04
BUTYLBENZYLPHTHALATE	4.44E+02	7.20E+02	4.44E+02
CHRYSENE	3.92E+03	7.10E+03	3.92E+03
DIBENZOFURAN	3.23E+02	4.80E+02	3.23E+02
1,3-DICHLOROBENZENE	1.88E+02	2.10E+02	1.88E+02
1,4-DICHLOROBENZENE	1.19E+03	2.20E+03	1.19E+03
1,2-DICHLOROBENZENE	1.93E+02	2.20E+02	1.93E+02
3,3'-DICHLOROBENZIDINE	9.36E+02	1.70E+03	9.36E+02
DI-N-BUTYLPHTHALATE	1.21E+03	2.20E+03	1.21E+03
DI-N-OCTYLPHTHALATE	2.08E+02	2.50E+02	2.08E+02
FLUORANTHENE	7.50E+03	1.10E+04	7.50E+03
FLUORENE	5.24E+02	8.80E+02	5.24E+02
INDENO(1,2,3-CD)PYRENE	2.09E+03	3.80E+03	2.09E+03
2-METHYLNAPHTHALENE	4.84E+02	8.00E+02	4.84E+02
NAPHTHALENE	4.29E+02	6.90E+02	4.29E+02
PHENANTHRENE	3.21E+03	6.00E+03	3.21E+03
PYRENE	1.78E+03	3.30E+03	1.78E+03
METALS (mg/kg)			
BARIUM	4.73E+02	6.05E+02	4.73E+02
CADMIUM	5.40E+01	9.34E+01	5.40E+01
CALCIUM	1.59E+04	2.48E+04	1.59E+04
CHROMIUM	1.07E+03	2.02E+03	1.07E+03
COBALT	3.08E+01	5.21E+01	3.08E+01
COPPER	1.71E+02	3.20E+02	1.71E+02
LEAD	1.34E+02	2.43E+02	1.34E+02
MAGNESIUM	9.12E+03	1.54E+04	9.12E+03
MANGANESE	6.13E+02	9.56E+02	6.13E+02
MERCURY	2.10E+00	2.50E+00	2.10E+00
NICKEL	1.15E+03	2.27E+03	1.15E+03
POTASSIUM	1.65E+03	2.30E+03	1.65E+03
SELENIUM	1.77E+00	2.30E+00	1.77E+00
SILVER	5.81E+01	1.12E+02	5.81E+01
ZINC	2.88E+02	5.43E+02	2.88E+02

TABLE B-30
RISK SEGMENT W2
0-6" SEDIMENT DATA
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	95% UPPER CONFIDENCE LIMIT	MAXIMUM VALUE	RISK ASSESSMENT CONCENTRATION
VOLATILE ORGANICS (ug/kg)			
NO CHEMICALS OF CONCERN			
SEMI-VOLATILE ORGANICS (ug/kg)			
ACENAPHTHENE	3.83E+02	1.65E+02	1.65E+02
ANTHRACENE	4.86E+02	1.65E+02	1.65E+02
BENZO(A)ANTHRACENE	2.31E+02	1.65E+02	1.65E+02
BENZO(B)FLUORANTHENE	2.56E+02	1.90E+02	1.90E+02
BENZO(K)FLUORANTHENE	2.20E+02	1.80E+02	1.80E+02
BENZO(A)PYRENE	1.78E+02	1.65E+02	1.65E+02
BIS(2-ETHYLHEXYL)PHTHALATE	4.73E+03	4.20E+03	4.20E+03
CHRYSENE	3.30E+02	2.10E+02	2.10E+02
FLUORANTHENE	1.10E+03	4.20E+02	4.20E+02
FLUORENE	4.01E+02	1.65E+02	1.65E+02
2-METHYLNAPHTHALENE	4.32E+03	1.30E+03	1.30E+03
NAPHTHALENE	3.86E+02	1.65E+02	1.65E+02
PHENANTHRENE	5.12E+02	2.60E+02	2.60E+02
PYRENE	1.50E+03	5.30E+02	5.30E+02
METALS (mg/kg)			
BARIUM	8.88E+02	4.26E+02	4.26E+02
CADMIUM	4.31E+01	1.27E+01	1.27E+01
CALCIUM	1.37E+05	3.96E+04	3.96E+04
CHROMIUM	1.87E+03	5.27E+02	5.27E+02
LEAD	1.92E+02	5.50E+01	5.50E+01
MAGNESIUM	2.10E+04	6.94E+03	6.94E+03
MANGANESE	9.10E+02	4.24E+02	4.24E+02
NICKEL	7.51E+01	3.60E+01	3.60E+01
SILVER	1.02E+01	4.60E+00	4.60E+00

APPENDIX C

EXPOSURE AND RISK CALCULATIONS

C.0 EXPOSURE AND RISK CALCULATIONS

The first five tables in Appendix C present risk-based cleanup levels for each chemical carried through the risk assessment for each medium. The three aquifer zones have risk-based cleanup levels established for each zone, but the risk-based cleanup level is the same in all three aquifer zones for each contaminant. If the risk-based cleanup level was exceeded for the contaminant, the "MAX>CL?" column has a "Yes". A "No" indicates that the risk-based cleanup level was not exceeded.

The remaining tables in Appendix C present the exposure assessment results and the quantitation of risks. Each table presents the exposure assumptions and formulas used to generate the human intake factors and risks for both noncarcinogenic and carcinogenic risks. The "Risk Assessment Concentration" column comes directly from the column of the same title in Appendix B.

The "Human Intake Factor" (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 reference doses (RfDs), slope factors and permeability constants come from Table 4-1 in the text. The formulas used to generate noncarcinogenic and carcinogenic risks are also presented at the bottom of each table. The risks from each chemical are summed to yield the final pathway risk. The pathway risks are summed in Tables 5-1 through 5-4 in the text. The following tables are presented in Appendix C:

- Tables C-1 through C-5 - Cleanup Levels.
- Tables C-6 through C-29 - Residential Well Sample Risks.
- Tables C-30 through C-35 - Perched Aquifer Risks.
- Tables C-36 through C-41 - Top of Regional Aquifer Zone Risks.
- Tables C-42 through C-47 - Regional Aquifer Zone Risks.
- Tables C-48 through C-65 - Surface Water Risks.
- Tables C-66 through C-83 - Deep Sediment (0-5') Risks.
- Tables C-84 through C-101 - Surface Sediment (0-6") Risks.

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TABLE C-1
RISK SEGMENT PERCHED AQUIFER
RISK-BASED CLEANUP LEVELS FOR CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Risk Assessment Conc. (mg/L)	Maximum Detected (mg/L)	Total Non-carcinogenic Risk(a)	Total Carcinogenic Risk(b)	Non-carcinogenic Cleanup Level (mg/L)(c)	Max >CL? (d)	Carcinogenic Cleanup Level (mg/L) (1.00E-6)(e)	Max >CL?	Carcinogenic Cleanup Level (mg/L) (1.00E-4)(f)	Max >CL?
VOLATILE ORGANIC										
BENZENE	5.0E-03	5.0E-03		6.7E-06			7.5E-04	YES	7.5E-02	NO
CHLOROBENZENE	6.2E-02	6.6E-01	5.8E-01		1.1E-01	YES				
1,1-DICHLOROETHANE	7.4E-03	1.8E-02	4.8E-03		1.6E+00	NO				
1,1-DICHLOROETHENE	1.1E-02	7.4E-02	4.0E-02	4.6E-04	2.7E-01	NO	2.4E-05	YES	2.4E-03	YES
CIS-1,2-DICHLOROETHENE	5.0E-03	5.0E-03	1.7E-02		2.9E-01	NO				
TRANS-1,2-DICHLOROETHENE	6.1E-02	6.7E-01	1.0E-01		5.9E-01	YES				
ETHYLBENZENE	5.0E-03	5.0E-03	7.3E-03		6.9E-01	NO				
TETRACHLOROETHENE	2.5E-01	2.9E+00	9.1E-01	2.2E-04	2.8E-01	YES	1.1E-03	YES	1.1E-01	YES
1,1,1-TRICHLOROETHANE	5.9E-03	1.0E-02	3.1E-03		1.9E+00	NO				
TRICHLOROETHENE	1.5E+01	1.8E+02		9.4E-03			1.6E-03	YES	1.6E-01	YES
1,2,4-TRIMETHYLBENZENE	6.4E-04	2.8E-03								
VINYL CHLORIDE	1.7E-02	1.5E-01		6.0E-04			2.8E-05	YES	2.8E-03	YES
XYLENE (TOTAL)	5.0E-03	5.0E-03	2.7E-03		1.9E+00	NO				
SEMI-VOLATILE ORGANICS										
1,2-DICHLOROBENZENE	5.5E-03	1.1E-02	2.7E-03		2.1E+00	NO				
1,3-DICHLOROBENZENE	5.0E-03	5.0E-03								
1,4-DICHLOROBENZENE	6.1E-03	1.7E-02	1.3E-04	2.7E-06	4.6E+01	NO	2.2E-03	YES	2.2E-01	NO
METALS										
ARSENIC	4.5E-03	5.0E-03	1.5E-01		3.0E-02	NO				
BARIUM	7.4E-01	2.7E+00	3.5E-01		2.1E+00	YES				
CHROMIUM	1.1E+01	1.3E+02	7.0E+01		1.5E-01	YES				
COPPER	2.2E-02	5.2E-02								
LEAD	6.6E-03	2.6E-02								
NICKEL	5.9E-02	3.1E-01	9.7E-02		6.1E-01	NO				
SELENIUM	4.1E-03	9.5E-03								

(a) Total noncarcinogenic risks are the summation of three exposure pathways, Ingestion, Dermal Contact in the shower, and Inhalation in the shower.

(b) Total carcinogenic risks are the summation of three exposure pathways, Ingestion, Dermal Contact in the shower, and Inhalation in the shower.

(c) Cleanup level = (Risk Assessment Conc./risk)(HI) where HI = 1.0

(d) This column indicates whether the cleanup level is exceeded for each contaminant.

(e) Cleanup level = (Risk Assessment Conc./risk)(1.00E-6)

(f) Cleanup level = (Risk Assessment Conc./risk)(1.00E-4)

TABLE C-2
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
RISK-BASED CLEANUP LEVELS FOR CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Risk Assessment Conc. (mg/L)	Maximum Detected (mg/L)	Total Non-carcinogenic Risk(a)	Total Carcinogenic Risk(b)	Non-carcinogenic Cleanup Level (mg/L)(c)	Max >CL? (d)	Carcinogenic Cleanup Level (mg/L) (1.00E-6)(e)	Max >CL?	Carcinogenic Cleanup Level (mg/L) (1.00E-4)(f)	Max >CL?
VOLATILE ORGANICS										
BENZENE	5.1E-03	5.80E+00		6.9E-06			7.5E-04	YES	7.5E-02	YES
CHLOROBENZENE	2.0E-01	1.10E+03	1.9E+00		1.1E-01	YES				
CHLOROFORM	5.0E-03	5.00E+00	1.7E-02	1.2E-05	3.0E-01	YES	4.2E-04	YES	4.2E-02	YES
1,1-DICHLOROETHANE	4.4E-02	1.78E+02	2.8E-02		1.6E+00	YES				
1,1-DICHLOROETHENE	1.3E-02	4.80E+01	4.8E-02	5.5E-04	2.7E-01	YES	2.4E-05	YES	2.4E-03	YES
CIS-1,2-DICHLOROETHENE	7.6E-03	2.10E+01	2.6E-02		2.9E-01	YES				
TRANS-1,2-DICHLOROETHENE	2.8E-01	2.16E+03	4.7E-01		5.9E-01	YES				
1,2-DICHLOROPROPANE	1.2E-02	7.30E+01		1.2E-05			1.0E-03	YES	1.0E-01	YES
ETHYLBENZENE	5.2E-03	6.10E+00	7.6E-03		6.9E-01	YES				
METHYLENE CHLORIDE	9.3E-03	4.40E+01	5.6E-03	4.7E-06	1.7E+00	YES	2.0E-03	YES	2.0E-01	YES
TETRACHLOROETHENE	1.3E-01	9.20E+02	4.7E-01	1.1E-04	2.8E-01	YES	1.1E-03	YES	1.1E-01	YES
1,1,1-TRICHLOROETHANE	1.7E-02	1.50E+02	9.1E-03		1.9E+00	YES				
TRICHLOROETHENE	1.8E+00	1.80E+04		1.1E-03			1.6E-03	YES	1.6E-01	YES
1,2,4-TRIMETHYLBENZENE	1.1E-03	6.52E+00								
TOLUENE	7.2E-03	2.74E+01	4.7E-03		1.5E+00	YES				
VINYL CHLORIDE	1.6E-01	1.62E+03	0.0E+00	5.5E-03			2.8E-05	YES	2.8E-03	YES
XYLENE (TOTAL)	8.1E-03	2.48E+01	4.2E-03		1.9E+00	YES				
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	1.1E-01	1.10E+03	1.7E-01	2.1E-05	6.1E-01	YES	5.0E-03	YES	5.0E-01	YES
1,2-DICHLOROBENZENE	4.8E-02	4.20E+02	2.3E-02		2.1E+00	YES				
1,3-DICHLOROBENZENE	5.0E-03	5.00E+00								
1,4-DICHLOROBENZENE	3.0E-02	2.20E+02	6.6E-04	1.4E-05	4.6E+01	YES	2.2E-03	YES	2.2E-01	YES
DI-N-OCTYLPHTHALATE	2.4E-02	8.50E+01	3.9E-02		6.1E-01	YES				
NAPHTHALENE	5.0E-03	5.00E+00	5.2E-02		9.7E-02	YES				
METALS										
ARSENIC	1.2E-02	4.20E+01	3.9E-01		3.0E-02	YES				
BARIUM	1.1E+00	3.46E+03	5.2E-01		2.1E+00	YES				
CHROMIUM	6.1E-01	6.52E+03	4.0E+00		1.5E-01	YES				
LEAD	8.6E-03	3.40E+01								
NICKEL	9.6E-02	4.40E+02	1.6E-01		6.1E-01	YES				

(a) Total noncarcinogenic risks are the summation of three exposure pathways, Ingestion, Dermal Contact in the shower, and Inhalation in the shower.

(b) Total carcinogenic risks are the summation of three exposure pathways, Ingestion, Dermal Contact in the shower, and Inhalation in the shower.

(c) Cleanup level = (95%UCL/risk)(HI) where HI = 1.0

(d) This column determines if the cleanup level is exceeded for each contaminant.

(e) Cleanup level = (95%UCL/risk)(1.00E-6)

(f) Cleanup level = (95%UCL/risk)(1.00E-4)

TABLE C-3
RISK SEGMENT REGIONAL AQUIFER ZONE
RISK-BASED CLEANUP LEVELS FOR CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE	Mean at 95% (mg/L)	Maximum Detected (mg/L)	Total Non-carcinogenic Risk(a)	Total Carcinogenic Risk(b)	Non-carcinogenic Cleanup Level (mg/L)(c)	Max >CL? (d)	Carcinogenic Cleanup Level (mg/L) (1.00E-6)(e)	Max >CL?	Carcinogenic Cleanup Level (mg/L) (1.00E-4)(f)	Max >CL?
VOLATILE ORGANICS										
BENZENE	5.0E-03	5.0E-03		6.7E-06			7.5E-04	YES	7.5E-02	NO
CHLOROBENZENE	7.4E-02	4.8E-01	7.0E-01		1.1E-01	YES				
1,1-DICHLOROETHANE	6.5E-03	1.3E-02	4.2E-03		1.6E+00	NO				
1,1-DICHLOROETHENE	7.0E-03	2.4E-02	2.6E-02	3.0E-04	2.7E-01	NO	2.4E-05	YES	2.4E-03	YES
CIS-1,2-DICHLOROETHENE	9.6E-03	3.2E-02	3.3E-02		2.9E-01	NO				
TRANS-1,2-DICHLOROETHENE	1.9E-02	1.1E-01	3.2E-02		5.9E-01	NO				
1,2-DICHLOROPROPANE	5.7E-03	1.4E-02		5.8E-06			9.9E-04	YES	9.9E-02	NO
METHYLENE CHLORIDE	1.4E-02	9.8E-02	8.7E-03	7.2E-06	1.7E+00	NO	2.0E-03	YES	2.0E-01	NO
TETRACHLOROETHENE	2.8E-02	2.0E-01	1.0E-01	2.5E-05	2.8E-01	NO	1.1E-03	YES	1.1E-01	YES
1,1,1-TRICHLOROETHANE	5.9E-03	9.0E-03	3.1E-03		1.9E+00	NO				
TRICHLOROETHENE	1.9E-01	1.1E+00		1.2E-04			1.6E-03	YES	1.6E-01	YES
1,2,4-TRIMETHYLBENZENE	3.5E-04	8.8E-04								
VINYL CHLORIDE	1.2E-02	7.9E-02		4.2E-04			2.8E-05	YES	2.8E-03	YES
SEMI-VOLATILE ORGANICS										
1,2-DICHLOROBENZENE	2.0E-02	1.5E-01	9.8E-03		2.1E+00	NO				
1,4-DICHLOROBENZENE	1.0E-02	5.2E-02	2.2E-04	4.5E-06	4.6E+01	NO	2.2E-03	YES	2.2E-01	NO
METALS										
BARIUM	1.2E+00	6.1E+00	5.5E-01		2.1E+00	YES				
LEAD	1.4E-02	6.2E-02								
NICKEL	4.6E-02	2.7E-01	7.6E-02		6.1E-01	NO				
SELENIUM	5.3E-03	6.8E-03								

(a) Total noncarcinogenic risks are the summation of three exposure pathways, Ingestion, Dermal Contact in the shower, and Inhalation in the shower.
(b) Total carcinogenic risks are the summation of three exposure pathways, Ingestion, Dermal Contact in the shower, and Inhalation in the shower.
(c) Cleanup level = (Risk Assessment Conc./risk)(HI) where HI = 1.0
(d) This column determines if the cleanup level is exceeded for each contaminant.
(e) Cleanup level = (Risk Assessment Conc./risk)(1.00E-6)
(f) Cleanup level = (Risk Assessment Conc./risk)(1.00E-4)

TABLE C-4
RISK-BASED CLEANUP LEVELS FOR SURFACE WATER
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE (a)	Risk Assessment Conc. (mg/L)	Total Non-carcinogenic Risk(b)	Total Carcinogenic Risk(c)	Non-carcinogenic Cleanup Level (mg/L)(d)	Carcinogenic Cleanup Level (mg/L) (1.00E-6)(e)	Carcinogenic Cleanup Level (mg/L) (1.00E-4)(f)
VOLATILE ORGANICS						
ACETONE	5.1E-02	1.0E-04		5.0E+02		
BENZENE	5.0E-03		2.5E-07		2.0E-02	2.0E+00
BROMODICHLOROMETHANE	5.2E-03	6.2E-06	3.0E-09	8.4E+02	1.7E+00	1.7E+02
BROMOFORM	7.1E-03	3.8E-06	2.1E-10	1.9E+03	3.3E+01	3.3E+03
CARBON DISULFIDE	5.0E-03	9.4E-04		5.3E+00		
CHLOROBENZENE	5.0E-03	4.0E-04		1.3E+01		
CHLOROFORM	5.0E-03	2.5E-04	6.6E-09	2.0E+01	7.6E-01	7.6E+01
DIBROMOCHLOROMETHANE	5.0E-03	4.0E-06	2.5E-09	1.3E+03	2.0E+00	2.0E+02
1,2-DICHLOROETHENE (TOTAL)	8.6E-03	5.6E-05		1.5E+02		
METHYLENE CHLORIDE	5.2E-01	3.0E-03	5.9E-07	1.7E+02	8.9E-01	8.9E+01
TETRACHLOROETHENE	5.0E-03	8.7E-05	1.6E-08	5.7E+01	3.1E-01	3.1E+01
1,1,1-TRICHLOROETHANE	5.0E-03	4.4E-05		1.1E+02		
TRICHLOROETHENE	5.0E-03		1.8E-08		2.8E-01	2.8E+01
TOLUENE	5.0E-03	8.9E-04		5.6E+00		
XYLENE (TOTAL)	5.0E-03	4.7E-07		1.1E+04		
SEMI-VOLATILE ORGANICS						
BENZO(G,H,I)PERYLENE	5.2E-03					
BENZOIC ACID	5.0E-03	5.0E-05		1.0E+02		
CHRYSENE	5.0E-03		4.2E-09		1.2E+00	1.2E+02
FLUORANTHENE	5.0E-03	2.3E-04		2.2E+01		
PYRENE	5.0E-03	8.5E-07		5.9E+03		
METALS						
ALUMINUM	4.1E-01					
ARSENIC	7.4E-03	9.2E-04		8.1E+00		
BARIUM	2.8E-01	1.1E-03		2.5E+02		
BERYLLIUM	2.5E-03	1.7E-05	1.3E-07	1.5E+02	2.0E-02	2.0E+00
CADMIUM	8.3E-03	4.0E-03		2.1E+00		
CALCIUM	4.8E+01					
CHROMIUM	3.5E-02	3.3E-03		1.1E+01		
COBALT	2.1E-01					
COPPER	6.2E-01					
CYANIDE	1.6E-02	3.2E-04		4.9E+01		
IRON	3.5E-01					
LEAD	2.0E-02					
MAGNESIUM	2.2E+01					
MANGANESE	3.0E-01	8.4E-04		3.5E+02		
NICKEL	1.8E-02	3.0E-04		6.2E+01		
POTASSIUM	6.3E+00					
SELENIUM	6.7E-03					
SILVER	1.0E-02	2.8E-05		3.5E+02		
SODIUM	1.3E+02					
VANADIUM	5.0E-02	8.9E-05		5.6E+02		
ZINC	1.5E+00	1.2E-04		1.3E+04		

(a) Analytes are evaluated using the most conservative scenario for each analyte.

(b) Total noncarcinogenic risks are the summation of two exposure pathways, Incidental Ingestion, and Dermal Contact.

(c) Total carcinogenic risks are the summation of two exposure pathways, Incidental Ingestion, and Dermal Contact.

(d) Cleanup level = (Risk Assessment Conc./risk)(HI) where HI = 1.0

(e) Cleanup level = (Risk Assessment Conc./risk)(1.00E-6)

(f) Cleanup level = (Risk Assessment Conc./risk)(1.00E-4)

TABLE C-5
RISK-BASED CLEANUP LEVELS FOR SEDIMENT
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE (a)	Risk Assessment Conc. (mg/kg)	Total Non-carcinogenic Risk(b)	Total Carcinogenic Risk(c)	Non-carcinogenic Cleanup Level (mg/kg)(d)	Carcinogenic Cleanup Level (mg/kg) (1.00E-6)(e)	Carcinogenic Cleanup Level (mg/kg) (1.00E-4)(f)
VOLATILE ORGANICS						
ACETONE	1.7E+00	4.1E-05		4.1E+04		
BENZENE	5.0E-03		1.5E-10		3.3E+01	3.3E+03
CARBON DISULFIDE	2.1E-02	3.6E-08		5.7E+05		
CHLOROBENZENE	6.1E-03	7.4E-07		8.3E+03		
CHLOROETHANE	1.3E-02					
CHLOROFORM	2.8E-02	6.8E-06	1.8E-10	4.1E+03	1.6E+02	1.6E+04
1,2-DICHLOROETHENE (TOTAL)	1.8E+01	3.2E-04		5.7E+04		
ETHYLBENZENE	5.0E-03	8.8E-09		5.7E+05		
METHYLENE CHLORIDE	1.0E-01	4.0E-06	7.8E-10	2.5E+04	1.3E+02	1.3E+04
TETRACHLOROETHENE	5.0E-03	1.2E-06	2.7E-10	4.1E+03	1.9E+01	1.9E+03
TRICHLOROETHENE	4.1E-01		2.9E-10		1.4E+03	1.4E+05
TOLUENE	5.0E-03	6.0E-08		8.3E+04		
VINYL ACETATE	5.0E-03	8.8E-10		5.7E+06		
XYLENE (TOTAL)	5.2E-03	6.3E-09		8.3E+05		
SEMI-VOLATILE ORGANICS						
ACENAPHTHENE	1.7E-01	4.4E-06		3.8E+04		
ANTHRACENE	1.7E-01	8.8E-07		1.9E+05		
BENZO(A)ANTHRACENE	1.7E-01		1.0E-07		1.6E+00	1.6E+02
BENZO(A)PYRENE	2.5E-01		1.5E-07		1.6E+00	1.6E+02
BENZO(B)FLUORANTHENE	1.9E-01		1.1E-07		1.6E+00	1.6E+02
BENZO(K)FLUORANTHENE	1.8E-01		1.1E-07		1.6E+00	1.6E+02
BIS(2-ETHYLHEXYL)PHTHALATE	4.2E+00	3.3E-04	4.0E-08	1.3E+04	1.0E+02	1.0E+04
BENZO(G,H,I)PERYLENE	1.2E+00					
BUTYLBENZYLPHTHALATE	1.7E-01	1.3E-06		1.3E+05		
2-CHLORONAPHTHALENE	5.0E-01					
CHRYSENE	2.0E-01		1.2E-07		1.6E+00	1.6E+02
DIBENZ(A,H)ANTHRACENE	1.7E-01		1.4E-09		1.2E+02	1.2E+04
DIBENZOFURAN	2.4E-01					
1,3-DICHLOROBENZENE	1.8E-01					
1,4-DICHLOROBENZENE	7.1E-01		6.9E-10		1.0E+03	1.0E+05
1,2-DICHLOROBENZENE	5.4E-01	6.8E-07		7.9E+05		
3,3'-DICHLOROBENZIDINE	4.9E-01		9.0E-09		5.5E+01	5.5E+03
DI-N-BUTYLPHTHALATE	1.7E-01	2.6E-06		6.3E+04		
DI-N-OCTYLPHTHALATE	1.7E-01	1.3E-05		1.3E+04		
FLUORANTHENE	3.8E-01	1.5E-05		2.5E+04		
FLUORENE	1.7E-01	6.6E-06		2.5E+04		
2-METHYLNAPHTHALENE	1.1E+00					
2-METHYLPHENOL	1.7E-01	3.7E-07		4.4E+05		
4-METHYLPHENOL	1.7E-01	3.7E-07		4.4E+05		
2,4-DIMETHYLPHENOL	1.7E-01	9.3E-07		1.8E+05		
INDENO(1,2,3-CD)PYRENE	1.1E+00		9.6E-09		1.2E+02	1.2E+04
NAPHTHALENE	1.7E-01	6.6E-05		2.5E+03		
PHENANTHRENE	2.6E-01					
PYRENE	4.7E-01	2.5E-05		1.9E+04		

(a) Analytes are evaluated using the most conservative scenario for each analyte.
(b) Total noncarcinogenic risks are the summation of two exposure pathways, Incidental Ingestion, and Dermal Contact.
(c) Total carcinogenic risks are the summation of two exposure pathways, Incidental Ingestion, and Dermal Contact.
(d) Cleanup level = (Risk Assessment Conc./risk)(HI) where HI = 1.0
(e) Cleanup level = (Risk Assessment Conc./risk)(1.00E-6)
(f) Cleanup level = (Risk Assessment Conc./risk)(1.00E-4)

TABLE C-5 (Continued)
RISK-BASED CLEANUP LEVELS FOR SEDIMENT
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

ANALYTE (a)	Risk Assessment Conc. (mg/kg)	Total Non-carcinogenic Risk(b)	Total Carcinogenic Risk(c)	Non-carcinogenic Cleanup Level (mg/kg)(d)	Carcinogenic Cleanup Level (mg/kg) (1.00E-6)(e)	Carcinogenic Cleanup Level (mg/kg) (1.00E-4)(f)
METALS						
ALUMINUM	1.4E+04					
ARSENIC	3.9E+00	1.9E-03		2.1E+03		
BARIUM	9.1E+02	6.3E-03		1.4E+05		
CADMIUM	1.6E+01	1.5E-02		1.0E+03		
CALCIUM	4.3E+04					
CHROMIUM	3.4E+02	3.3E-02		1.0E+04		
COBALT	2.1E+01					
COPPER	1.4E+02					
CYANIDE	1.8E+00	2.7E-06		6.7E+05		
IRON	1.5E+04					
LEAD	1.3E+02					
MAGNESIUM	1.3E+04					
MANGANESE	5.5E+02	2.7E-03		2.1E+05		
MERCURY	2.2E+00	3.6E-03		6.2E+02		
NICKEL	4.9E+01	1.2E-03		4.1E+04		
POTASSIUM	1.3E+03					
SELENIUM	3.3E+00					
SILVER	4.3E+00	6.9E-04		6.2E+03		
VANADIUM	2.6E+01	1.8E-03		1.4E+04		
ZINC	1.3E+02	3.2E-04		4.1E+05		

(a) Analytes are evaluated using the most conservative scenario for each analyte.
(b) Total noncarcinogenic risks are the summation of two exposure pathways, Incidental Ingestion, and Dermal Contact.
(c) Total carcinogenic risks are the summation of two exposure pathways, Incidental Ingestion, and Dermal Contact.
(d) Cleanup level = (Risk Assessment Conc./risk)(HI) where HI = 1.0
(e) Cleanup level = (Risk Assessment Conc./risk)(1.00E-6)
(f) Cleanup level = (Risk Assessment Conc./risk)(1.00E-4)

TABLE C-6
RISK SEGMENT WELL G01 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
BARIUM	6.63E-01	3.26E-02	2.16E-02	7.00E-02	3.09E-01	1.40E-02	9.28E-03	NA	
CALCIUM	6.73E+01	3.26E-02	2.19E+00	NA		1.40E-02	9.42E-01	NA	
MAGNESIUM	3.01E+01	3.26E-02	9.81E-01	NA		1.40E-02	4.21E-01	NA	
MERCURY	7.50E-04	3.26E-02	2.45E-05	3.00E-04	8.15E-02	1.40E-02	1.05E-05	NA	
NICKEL	2.46E-02	3.26E-02	8.02E-04	2.00E-02	4.01E-02	1.40E-02	3.44E-04	NA	
SODIUM	1.83E+01	3.26E-02	5.97E-01	NA		1.40E-02	2.56E-01	NA	
ZINC	3.60E-02	3.26E-02	1.17E-03	2.00E-01	5.87E-03	1.40E-02	5.04E-04	NA	
					4.4E-01				

DRINKING WATER INGESTION

	CW = Concentration of chemical in water (mg/L)
4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-7
RISK SEGMENT WELL G01 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
BARIUM	6.63E-01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	6.73E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	3.01E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MERCURY	7.50E-04	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
NICKEL	2.46E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
SODIUM	1.83E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
ZINC	3.60E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
	0.00E+00	INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

TABLE C-8
RISK SEGMENT WELL G01 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
BARIUM	6.63E-01	6.62E-02	8.00E-04	3.51E-05	1.40E-02	2.51E-03	2.84E-02	1.50E-05	NA	
CALCIUM	6.73E+01	6.62E-02	8.00E-04	3.56E-03	NA		2.84E-02	1.53E-03	NA	
MAGNESIUM	3.01E+01	6.62E-02	8.00E-04	1.59E-03	NA		2.84E-02	6.83E-04	NA	
MERCURY	7.50E-04	6.62E-02	1.47E-04	7.30E-09	6.00E-05	1.22E-04	2.84E-02	3.13E-09	NA	
NICKEL	2.46E-02	6.62E-02	1.08E-03	1.76E-06	4.00E-03	4.40E-04	2.84E-02	7.54E-07	NA	
SODIUM	1.83E+01	6.62E-02	8.00E-04	9.69E-04	NA		2.84E-02	4.15E-04	NA	
ZINC	3.60E-02	6.62E-02	9.80E-04	2.33E-06	4.00E-02	5.84E-05	2.84E-02	1.00E-06	NA	
						3.1E-03				

DERMAL CONTACT DUE TO SHOWERING

CW = Concentration of chemical in water (mg/L)

7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)-->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)-------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]

INTAKE = (CW * HIF * PC)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-9
RISK SEGMENT WELL G02 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Ri
VOLATILE ORGANICS									
ACETONE	1.60E-02	3.26E-02	5.22E-04	1.00E-01	5.22E-03	1.40E-02	2.24E-04	NA	
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
BARIUM	3.97E-01	3.26E-02	1.29E-02	7.00E-02	1.85E-01	1.40E-02	5.56E-03	NA	
CALCIUM	6.15E+01	3.26E-02	2.00E+00	NA		1.40E-02	8.61E-01	NA	
MAGNESIUM	3.17E+01	3.26E-02	1.03E+00	NA		1.40E-02	4.44E-01	NA	
MERCURY	1.10E-03	3.26E-02	3.59E-05	3.00E-04	1.20E-01	1.40E-02	1.54E-05	NA	
SODIUM	2.45E+01	3.26E-02	7.99E-01	NA		1.40E-02	3.43E-01	NA	
ZINC	5.81E-02	3.26E-02	1.89E-03	2.00E-01	9.47E-03	1.40E-02	8.13E-04	NA	
					3.2E-01				

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-10
RISK SEGMENT WELL G02 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
ACETONE	1.60E-02	3.80E-03	1.01E-03	NA			1.63E-03	4.34E-04	NA	
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
BARIUM	3.97E-01	3.80E-03	0.00E+00				1.63E-03	0.00E+00		
CALCIUM	6.15E+01	3.80E-03	0.00E+00				1.63E-03	0.00E+00		
MAGNESIUM	3.17E+01	3.80E-03	0.00E+00				1.63E-03	0.00E+00		
MERCURY	1.10E-03	3.80E-03	0.00E+00				1.63E-03	0.00E+00		
SODIUM	2.45E+01	3.80E-03	0.00E+00				1.63E-03	0.00E+00		
ZINC	5.81E-02	3.80E-03	0.00E+00				1.63E-03	0.00E+00		

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

TABLE C-11
RISK SEGMENT WELL G02 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
ACETONE	1.60E-02	6.62E-02	8.00E-04	8.47E-07	8.00E-02	1.06E-05	2.84E-02	3.63E-07	NA	
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
BARIUM	3.97E-01	6.62E-02	8.00E-04	2.10E-05	1.40E-02	1.50E-03	2.84E-02	9.01E-06	NA	
CALCIUM	6.15E+01	6.62E-02	8.00E-04	3.26E-03	NA		2.84E-02	1.40E-03	NA	
MAGNESIUM	3.17E+01	6.62E-02	8.00E-04	1.68E-03	NA		2.84E-02	7.19E-04	NA	
MERCURY	1.10E-03	6.62E-02	1.47E-04	1.07E-08	6.00E-05	1.78E-04	2.84E-02	4.59E-09	NA	
SODIUM	2.45E+01	6.62E-02	8.00E-04	1.30E-03	NA		2.84E-02	5.56E-04	NA	
ZINC	5.81E-02	6.62E-02	9.80E-04	3.77E-06	4.00E-02	9.42E-05	2.84E-02	1.61E-06	NA	
						1.8E-03				

DERMAL CONTACT DUE TO SHOWERING

CW = Concentration of chemical in water (mg/L)

7.20E+03 SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)

1.82E+04 SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)

3.50E+02 EF = 350 days/year - Exposure Frequency, (OSWER, 1991)

2.00E-01 ET = 0.2 hours/day - Exposure Time, (EPA 1989a)

5.00E+00 EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)

2.50E+01 EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)

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

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

1.00E-03 CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)

PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)--> 6.62E-02 HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]

HIF--(CARCINOGENIC)-------> 2.84E-02 HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]

INTAKE = (CW * HIF * PC)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-12
RISK SEGMENT WELL G03 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
BARIUM	1.57E-01	3.26E-02	5.12E-03	7.00E-02	7.31E-02	1.40E-02	2.20E-03	NA	
CALCIUM	9.45E+01	3.26E-02	3.08E+00	NA		1.40E-02	1.32E+00	NA	
MAGNESIUM	4.66E+01	3.26E-02	1.52E+00	NA		1.40E-02	6.52E-01	NA	
MERCURY	3.40E-04	3.26E-02	1.11E-05	3.00E-04	3.69E-02	1.40E-02	4.76E-06	NA	
ZINC	8.73E-02	3.26E-02	2.85E-03	2.00E-01	1.42E-02	1.40E-02	1.22E-03	NA	
					1.2E-01				

DRINKING WATER INGESTION

	CW = Concentration of chemical in water (mg/L)
4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-13
RISK SEGMENT WELL G03 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assesement Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
BARIUM	1.57E-01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	9.45E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	4.66E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MERCURY	3.40E-04	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
ZINC	8.73E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-14
RISK SEGMENT WELL G03 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
BARIUM	1.57E-01	6.62E-02	8.00E-04	8.31E-06	1.40E-02	5.94E-04	2.84E-02	3.56E-06	NA	
CALCIUM	9.45E+01	6.62E-02	8.00E-04	5.00E-03	NA		2.84E-02	2.14E-03	NA	
MAGNESIUM	4.66E+01	6.62E-02	8.00E-04	2.47E-03	NA		2.84E-02	1.06E-03	NA	
MERCURY	3.40E-04	6.62E-02	1.47E-04	3.31E-09	6.00E-05	5.51E-05	2.84E-02	1.42E-09	NA	
ZINC	8.73E-02	6.62E-02	9.80E-04	5.66E-06	4.00E-02	1.42E-04	2.84E-02	2.43E-06	NA	
						7.9E-04				

DERMAL CONTACT DUE TO SHOWERING
CW = Concentration of chemical in water (mg/L)

7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)-->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]

INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-15
RISK SEGMENT WELL G04 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-03	3.26E-02	6.52E-05	2.00E-02	3.26E-03	1.40E-02	2.80E-05	1.40E-02	3.92E-07
METALS									
BARIUM	6.28E-01	3.26E-02	2.05E-02	7.00E-02	2.92E-01	1.40E-02	8.79E-03	NA	
CALCIUM	6.46E+01	3.26E-02	2.11E+00	NA		1.40E-02	9.04E-01	NA	
COPPER	2.70E-02	3.26E-02	8.80E-04	NA		1.40E-02	3.78E-04	NA	
MAGNESIUM	3.89E+01	3.26E-02	1.27E+00	NA		1.40E-02	5.45E-01	NA	
MERCURY	1.10E-03	3.26E-02	3.59E-05	3.00E-04	1.20E-01	1.40E-02	1.54E-05	NA	
SODIUM	2.24E+01	3.26E-02	7.30E-01	NA		1.40E-02	3.14E-01	NA	
					4.2E-01				3.92E-07

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-16
RISK SEGMENT WELL G04 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-03	3.07E-03	1.02E-05	NA			1.32E-03	4.39E-06	NA	
METALS										
BARIUM	6.28E-01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	6.46E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
COPPER	2.70E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	3.89E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MERCURY	1.10E-03	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
SODIUM	2.24E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
6.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

FILE: NO18

TABLE C-17
RISK SEGMENT WELL G04 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-03	6.62E-02	3.21E-03	4.25E-07	1.00E-02	4.25E-05	2.84E-02	1.82E-07	2.80E-02	5.10E-09
METALS										
BARIUM	6.28E-01	6.62E-02	8.00E-04	3.32E-05	1.40E-02	2.37E-03	2.84E-02	1.42E-05	NA	
CALCIUM	6.46E+01	6.62E-02	8.00E-04	3.42E-03	NA		2.84E-02	1.47E-03	NA	
COPPER	2.70E-02	6.62E-02	1.01E-03	1.80E-06	NA		2.84E-02	7.73E-07	NA	
MAGNESIUM	3.89E+01	6.62E-02	8.00E-04	2.06E-03	NA		2.84E-02	8.83E-04	NA	
MERCURY	1.10E-03	6.62E-02	1.47E-04	1.07E-08	6.00E-05	1.78E-04	2.84E-02	4.59E-09	NA	
SODIUM	2.24E+01	6.62E-02	8.00E-04	1.19E-03	NA		2.84E-02	5.08E-04	NA	
						2.6E-03				5.1E-09

DERMAL CONTACT DUE TO SHOWERING
CW = Concentration of chemical in water (mg/L)

7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)-->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATc)(365)]

INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-18
RISK SEGMENT WELL G05 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-03	3.26E-02	6.52E-05	2.00E-02	3.26E-03	1.40E-02	2.80E-05	1.40E-02	3.92E-07
METALS									
BARIUM	1.04E+00	3.26E-02	3.39E-02	7.00E-02	4.84E-01	1.40E-02	1.46E-02	NA	
CALCIUM	6.36E+01	3.26E-02	2.07E+00	NA		1.40E-02	8.90E-01	NA	
MAGNESIUM	3.02E+01	3.26E-02	9.85E-01	NA		1.40E-02	4.23E-01	NA	
SODIUM	1.31E+01	3.26E-02	4.27E-01	NA		1.40E-02	1.83E-01	NA	
					4.9E-01				3.9E-07

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-19
RISK SEGMENT WELL G05 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-03	3.07E-03	1.02E-05	NA			1.32E-03	4.39E-06	NA	
METALS										
BARIUM	1.04E+00	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	6.36E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	3.02E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
SODIUM	1.31E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER,1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

TABLE C-20
RISK SEGMENT WELL G05 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E-03	6.62E-02	3.21E-03	4.25E-07	1.00E-02	4.25E-05	2.84E-02	1.82E-07	2.80E-02	5.10E-09
METALS										
BARIUM	1.04E+00	6.62E-02	8.00E-04	5.51E-05	1.40E-02	3.93E-03	2.84E-02	2.36E-05	NA	
CALCIUM	6.36E+01	6.62E-02	8.00E-04	3.37E-03	NA		2.84E-02	1.44E-03	NA	
MAGNESIUM	3.02E+01	6.62E-02	8.00E-04	1.60E-03	NA		2.84E-02	6.85E-04	NA	
SODIUM	1.31E+01	6.62E-02	8.00E-04	6.94E-04	NA		2.84E-02	2.97E-04	NA	
						4.0E-03				5.1E-09

DERMAL CONTACT DUE TO SHOWERING

	CW = Concentration of chemical in water (mg/L)
7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF---(NON-CARCINOGENIC)--->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF---(CARCINOGENIC)-------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]

INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-21
RISK SEGMENT WELL G06 (PHASE I DATA)
INGESTION C CONTAMINANTS IN DRINKING WATER
OFF-BASE C .D AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
METHYLENE CHLORIDE	4.00E-03	3.26E-02	1.30E-04	6.00E-02	2.17E-03	1.40E-02	5.60E-05	7.50E-03	4.20E-07
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
BARIUM	3.04E-01	3.26E-02	9.91E-03	7.00E-02	1.42E-01	1.40E-02	4.26E-03	NA	
CALCIUM	2.77E+01	3.26E-02	9.03E-01	NA		1.40E-02	3.88E-01	NA	
IRON	1.16E-01	3.26E-02	3.78E-03	NA		1.40E-02	1.62E-03	NA	
MAGNESIUM	1.23E+01	3.26E-02	4.01E-01	NA		1.40E-02	1.72E-01	NA	
SODIUM	1.37E+01	3.26E-02	4.47E-01	NA		1.40E-02	1.92E-01	NA	
ZINC	3.12E-02	3.26E-02	1.02E-03	2.00E-01	5.09E-03	1.40E-02	4.37E-04	NA	
					1.5E-01				4.2E-07

DRINKING WATER INGESTION

	CW = Concentration of chemical in water (mg/L)
4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-22
RISK SEGMENT WELL G06 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
METHYLENE CHLORIDE	4.00E-03	3.07E-03	2.05E-04	3.00E+00	1.29E+00	1.59E-04	1.32E-03	8.78E-05	1.40E-02	1.23E-06
SEMI-VOLATILE ORGANICS										
NOT DETECTED										
METALS										
BARIUM	3.04E-01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	2.77E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
IRON	1.16E-01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	1.23E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
SODIUM	1.37E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
ZINC	3.12E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
						1.6E-04				1.2E-06

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

TABLE C-23
RISK SEGMENT WELL G06 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
METHYLENE CHLORIDE	4.00E-03	6.62E-02	5.12E-03	1.36E-06	4.80E-02	2.82E-05	2.84E-02	5.81E-07	9.40E-03	5.46E-09
SEMI-VOLATILE ORGANICS										
NOT DETECTED										
METALS										
BARIUM	3.04E-01	6.62E-02	8.00E-04	1.61E-05	1.40E-02	1.15E-03	2.84E-02	6.90E-06	NA	
CALCIUM	2.77E+01	6.62E-02	8.00E-04	1.47E-03	NA		2.84E-02	6.29E-04	NA	
IRON	1.16E-01	6.62E-02	8.00E-04	6.14E-06	NA		2.84E-02	2.63E-06	NA	
MAGNESIUM	1.23E+01	6.62E-02	8.00E-04	6.51E-04	NA		2.84E-02	2.79E-04	NA	
SODIUM	1.37E+01	6.62E-02	8.00E-04	7.25E-04	NA		2.84E-02	3.11E-04	NA	
ZINC	3.12E-02	6.62E-02	9.80E-04	2.02E-06	4.00E-02	5.06E-05	2.84E-02	8.67E-07	NA	
						1.2E-03				5.5E-09

DERMAL CONTACT DUE TO SHOWERING
CW = Concentration of chemical in water (mg/L)

7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF---(NON-CARCINOGENIC)--->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF---(CARCINOGENIC)-------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]

INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-24
RISK SEGMENT WELL G07 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
1,2-DICHLOROETHANE	1.40E-02	3.26E-02	4.56E-04	NA		1.40E-02	1.96E-04	9.10E-02	1.78E-05
TETRACHLOROETHENE	2.00E-03	3.26E-02	6.52E-05	1.00E-02	6.52E-03	1.40E-02	2.80E-05	5.10E-02	1.43E-06
SEMI-VOLATILE ORGANICS									
NOT DETECTED									
METALS									
BARIUM	6.86E-01	3.26E-02	2.24E-02	7.00E-02	3.19E-01	1.40E-02	9.60E-03	NA	
CALCIUM	7.76E+01	3.26E-02	2.53E+00	NA		1.40E-02	1.09E+00	NA	
MAGNESIUM	3.57E+01	3.26E-02	1.16E+00	NA		1.40E-02	5.00E-01	NA	
SODIUM	3.45E+01	3.26E-02	1.12E+00	NA		1.40E-02	4.83E-01	NA	
ZINC	7.55E-02	3.26E-02	2.46E-03	2.00E-01	1.23E-02	1.40E-02	1.06E-03	NA	
					3.4E-01				1.9E-05

DRINKING WATER INGESTION

	CW = Concentration of chemical in water (mg/L)
4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)--->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-25
RISK SEGMENT WELL G07 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
1,2-DICHLOROETHANE	1.40E-02	3.07E-03	7.17E-04	NA			1.32E-03	3.07E-04	9.10E-02	2.80E-05
TETRACHLOROETHENE	2.00E-03	3.07E-03	1.02E-04	NA			1.32E-03	4.39E-05	3.30E-03	1.45E-07
SEMI-VOLATILE ORGANICS										
NOT DETECTED										
METALS										
BARIUM	6.86E-01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	7.76E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	3.57E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
SODIUM	3.45E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
ZINC	7.55E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
										2.81E-05

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

TABLE C-26
RISK SEGMENT WELL G07 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
1,2-DICHLOROETHANE	1.40E-02	6.62E-02	9.67E-03	8.96E-06	NA		2.84E-02	3.84E-06	1.10E-01	4.22E-07
TETRACHLOROETHENE	2.00E-03	6.62E-02	4.54E-02	6.01E-06	8.00E-03	7.51E-04	2.84E-02	2.58E-06	6.40E-02	1.65E-07
SEMI-VOLATILE ORGANICS										
NOT DETECTED										
METALS										
BARIUM	6.86E-01	6.62E-02	8.00E-04	3.63E-05	1.40E-02	2.59E-03	2.84E-02	1.56E-05	NA	
CALCIUM	7.76E+01	6.62E-02	8.00E-04	4.11E-03	NA		2.84E-02	1.76E-03	NA	
MAGNESIUM	3.57E+01	6.62E-02	8.00E-04	1.89E-03	NA		2.84E-02	8.10E-04	NA	
SODIUM	3.45E+01	6.62E-02	8.00E-04	1.83E-03	NA		2.84E-02	7.83E-04	NA	
ZINC	7.55E-02	6.62E-02	9.80E-04	4.90E-06	4.00E-02	1.22E-04	2.84E-02	2.10E-06	NA	
						3.5E-03				5.9E-07

DERMAL CONTACT DUE TO SHOWERING

CW = Concentration of chemical in water (mg/L)

7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)-->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)-------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATc)(365)]

INTAKE = (CW * HIF * PC)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-27
RISK SEGMENT WELL G08 (PHASE I DATA)
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NOT DETECTED									
SEMI-VOLATILE ORGANICS									
NOT DETECTED									
METALS									
BARIUM	1.22E+00	3.26E-02	3.98E-02	7.00E-02	5.68E-01	1.40E-02	1.71E-02	NA	
CALCIUM	6.63E+01	3.26E-02	2.16E+00	NA		1.40E-02	9.28E-01	NA	
COBALT	3.70E-03	3.26E-02	1.21E-04	NA		1.40E-02	5.18E-05	NA	
LEAD	5.80E-03	3.26E-02	1.89E-04	NA		1.40E-02	8.12E-05	NA	
MAGNESIUM	3.04E+01	3.26E-02	9.91E-01	NA		1.40E-02	4.26E-01	NA	
SODIUM	2.49E+01	3.26E-02	8.12E-01	NA		1.40E-02	3.49E-01	NA	
ZINC	4.65E-02	3.26E-02	1.52E-03	2.00E-01	7.58E-03	1.40E-02	6.51E-04	NA	
					5.8E-01				

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-28
RISK SEGMENT WELL G08 (PHASE I DATA)
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NOT DETECTED										
SEMI-VOLATILE ORGANICS										
NOT DETECTED										
METALS										
BARIUM	1.22E+00	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
CALCIUM	6.63E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
COBALT	3.70E-03	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
LEAD	5.80E-03	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
MAGNESIUM	3.04E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
SODIUM	2.49E+01	3.07E-03	0.00E+00				1.32E-03	0.00E+00		
ZINC	4.65E-02	3.07E-03	0.00E+00				1.32E-03	0.00E+00		

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)--->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Values
NA - Data Not Available

TABLE C-29
RISK SEGMENT WELL G08 (PHASE I DATA)
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NOT DETECTED										
SEMI-VOLATILE ORGANICS										
NOT DETECTED										
METALS										
BARIUM	1.22E+00	6.62E-02	8.00E-04	6.46E-05	1.40E-02	4.61E-03	2.84E-02	2.77E-05	NA	
CALCIUM	6.63E+01	6.62E-02	8.00E-04	3.51E-03	NA		2.84E-02	1.50E-03	NA	
COBALT	3.70E-03	6.62E-02	5.50E-04	1.35E-07	NA		2.84E-02	5.77E-08	NA	
LEAD	5.80E-03	6.62E-02	1.34E-04	5.14E-08	NA		2.84E-02	2.20E-08	NA	
MAGNESIUM	3.04E+01	6.62E-02	8.00E-04	1.61E-03	NA		2.84E-02	6.90E-04	NA	
SODIUM	2.49E+01	6.62E-02	8.00E-04	1.32E-03	NA		2.84E-02	5.65E-04	NA	
ZINC	4.65E-02	6.62E-02	9.80E-04	3.02E-06	4.00E-02	7.54E-05	2.84E-02	1.29E-06	NA	
						4.7E-03				

DERMAL CONTACT DUE TO SHOWERING
CW = Concentration of chemical in water (mg/L)
7.20E+03 SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04 SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02 EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01 ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00 EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01 EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01 ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01 ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03 CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)--> 6.62E-02 HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)-------> 2.84E-02 HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]
INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-30
RISK SEGMENT PERCHED AQUIFER
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANIC									
1,1-DICHLOROETHENE	1.56E-02	3.26E-02	5.08E-04	9.00E-03	5.65E-02	1.40E-02	2.18E-04	6.00E-01	1.31E-04
TRANS-1,2-DICHLOROETHENE	1.36E-02	3.26E-02	4.44E-04	2.00E-02	2.22E-02	1.40E-02	1.91E-04	NA	
TETRACHLOROETHENE	4.40E-01	3.26E-02	1.43E-02	1.00E-02	1.43E+00	1.40E-02	6.16E-03	5.10E-02	3.14E-04
1,1,1-TRICHLOROETHANE	5.00E-03	3.26E-02	1.63E-04	9.00E-02	1.81E-03	1.40E-02	7.00E-05	NA	
TRICHLOROETHENE	2.69E+01	3.26E-02	8.77E-01	NA		1.40E-02	3.77E-01	1.10E-02	4.14E-03
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	4.61E-02	3.26E-02	1.50E-03	2.00E-02	7.52E-02	1.40E-02	6.46E-04	1.40E-02	9.04E-06
METALS									
ARSENIC	4.83E-03	3.26E-02	1.58E-04	1.00E-03	1.58E-01	1.40E-02	6.77E-05	NA	
BARIUM	6.05E-01	3.26E-02	1.97E-02	7.00E-02	2.82E-01	1.40E-02	8.47E-03	NA	
CHROMIUM	1.92E+01	3.26E-02	6.26E-01	5.00E-03	1.25E+02	1.40E-02	2.69E-01	NA	
COPPER	2.71E-02	3.26E-02	8.84E-04	NA		1.40E-02	3.80E-04	NA	
LEAD	8.15E-03	3.26E-02	2.66E-04	NA		1.40E-02	1.14E-04	NA	
NICKEL	2.41E-02	3.26E-02	7.87E-04	2.00E-02	3.93E-02	1.40E-02	3.38E-04	NA	
SELENIUM	5.34E-03	3.26E-02	1.74E-04	NA		1.40E-02	7.48E-05	NA	
					1.3E+02				4.6E-03

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF---(NON-CARCINOGENIC)--->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-31
RISK SEGMENT PERCHED AQUIFER
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
1,1-DICHLOROETHENE	1.56E-02	3.07E-03	7.98E-04	NA			1.32E-03	3.42E-04	1.20E+00	4.11E-04
TRANS-1,2-DICHLOROETHENE	1.36E-02	3.07E-03	6.98E-04	NA			1.32E-03	2.99E-04	NA	
TETRACHLOROETHENE	4.40E-01	3.07E-03	2.25E-02	NA			1.32E-03	9.66E-03	3.30E-01	3.19E-05
1,1,1-TRICHLOROETHANE	5.00E-03	3.07E-03	2.56E-04	1.00E+00	4.29E-01	5.97E-04	1.32E-03	1.10E-04	NA	
TRICHLOROETHENE	2.69E+01	3.07E-03	1.38E+00	NA			1.32E-03	5.91E-01	1.70E+00	1.00E-02
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	4.61E-02	3.07E-03	2.36E-03	NA			1.32E-03	1.01E-03	NA	
METALS										
ARSENIC	4.83E-03	3.07E-03	2.48E-04	NA			1.32E-03	1.06E-04	5.00E+01	
BARIUM	6.05E-01	3.07E-03	3.10E-02	5.00E-04	2.14E-04		1.32E-03	1.33E-02	NA	
CHROMIUM	1.92E+01	3.07E-03	9.84E-01	2.00E-06	8.57E-07		1.32E-03	4.22E-01	4.10E+01	
COPPER	2.71E-02	3.07E-03	1.39E-03	NA			1.32E-03	5.95E-04	NA	
LEAD	8.15E-03	3.07E-03	4.17E-04	NA			1.32E-03	1.79E-04	NA	
NICKEL	2.41E-02	3.07E-03	1.24E-03	NA			1.32E-03	5.30E-04	8.40E-01	
SELENIUM	5.34E-03	3.07E-03	2.74E-04	NA			1.32E-03	1.17E-04	NA	
						6.0E-04				1.0E-02

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
	0.00E+00	INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

Assumed values
NA - Data Not Available

TABLE C-32
RISK SEGMENT PERCHED AQUIFER
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
1,1-DICHLOROETHENE	1.56E-02	6.62E-02	5.99E-03	6.18E-06	7.20E-03	8.58E-04	2.84E-02	2.65E-06	7.50E-01	1.99E-06
TRANS-1,2-DICHLOROETHENE	1.36E-02	6.62E-02	1.68E-02	1.52E-05	1.60E-02	9.47E-04	2.84E-02	6.50E-06	NA	
TETRACHLOROETHENE	4.40E-01	6.62E-02	4.54E-02	1.32E-03	8.00E-03	1.65E-01	2.84E-02	5.67E-04	6.40E-02	3.63E-05
1,1,1-TRICHLOROETHANE	5.00E-03	6.62E-02	1.76E-02	5.82E-06	7.20E-02	8.09E-05	2.84E-02	2.50E-06	NA	
TRICHLOROETHENE	2.69E+01	6.62E-02	1.62E-02	2.89E-02	NA		2.84E-02	1.24E-02	1.40E-02	1.73E-04
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	4.61E-02	6.62E-02	2.89E-02	8.82E-05	2.00E-02	4.41E-03	2.84E-02	3.78E-05	1.30E-01	4.91E-06
METALS										
ARSENIC	4.83E-03	6.62E-02	8.57E-04	2.74E-07	2.00E-04	1.37E-03	2.84E-02	1.17E-07	NA	
BARIUM	6.05E-01	6.62E-02	8.00E-04	3.20E-05	1.40E-02	2.29E-03	2.84E-02	1.37E-05	NA	
CHROMIUM	1.92E+01	6.62E-02	2.10E-03	2.67E-03	1.00E-03	2.67E+00	2.84E-02	1.14E-03	NA	
COPPER	2.71E-02	6.62E-02	1.01E-03	1.81E-06	NA		2.84E-02	7.77E-07	NA	
LEAD	8.15E-03	6.62E-02	1.34E-04	7.23E-08	NA		2.84E-02	3.10E-08	NA	
NICKEL	2.41E-02	6.62E-02	1.08E-03	1.73E-06	4.00E-03	4.31E-04	2.84E-02	7.39E-07	NA	
SELENIUM	5.34E-03	6.62E-02	8.10E-04	2.86E-07	NA		2.84E-02	1.23E-07	NA	
						2.8E+00				2.2E-04

DERMAL CONTACT DUE TO SHOWERING

	CW = Concentration of chemical in water (mg/L)
7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)-->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATC)(365)]
		INTAKE = (CW * HIF * PC)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
		RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-33
RISK SEGMENT PERCHED AQUIFER
INGESTION OF CONTAMINANTS IN DRINKING WATER
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
1,1-DICHLOROETHENE	1.56E-02	9.78E-03	1.53E-04	9.00E-03	1.70E-02	3.49E-03	5.45E-05	6.00E-01	3.27E-05
TRANS-1,2-DICHLOROETHENE	1.36E-02	9.78E-03	1.33E-04	2.00E-02	6.67E-03	3.49E-03	4.76E-05	NA	
TETRACHLOROETHENE	4.40E-01	9.78E-03	4.31E-03	1.00E-02	4.31E-01	3.49E-03	1.54E-03	5.10E-02	7.84E-05
1,1,1-TRICHLOROETHANE	5.00E-03	9.78E-03	4.89E-05	9.00E-02	5.44E-04	3.49E-03	1.75E-05	NA	
TRICHLOROETHENE	2.69E+01	9.78E-03	2.63E-01	NA		3.49E-03	9.40E-02	1.10E-02	1.03E-03
SEMI-VOLATILE ORGANICS									
	4.61E-02	9.78E-03	4.51E-04	2.00E-02	2.26E-02	3.49E-03	1.61E-04	1.40E-02	2.26E-06
METALS									
ARSENIC	4.83E-03	9.78E-03	4.73E-05	1.00E-03	4.73E-02	3.49E-03	1.69E-05	NA	
BARIUM	6.05E-01	9.78E-03	5.92E-03	7.00E-02	8.46E-02	3.49E-03	2.11E-03	NA	
CHROMIUM	1.92E+01	9.78E-03	1.88E-01	5.00E-03	3.76E+01	3.49E-03	6.71E-02	NA	
COPPER	2.71E-02	9.78E-03	2.65E-04	NA		3.49E-03	9.47E-05	NA	
LEAD	8.15E-03	9.78E-03	7.98E-05	NA		3.49E-03	2.85E-05	NA	
NICKEL	2.41E-02	9.78E-03	2.36E-04	2.00E-02	1.18E-02	3.49E-03	8.43E-05	NA	
SELENIUM	5.34E-03	9.78E-03	5.23E-05	NA		3.49E-03	1.87E-05	NA	
					3.8E+01				1.1E-03

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

1.00E+00	IR = 1.00 Liter/day (OSWER, 1991)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.50E+01	ED = 25 years - Exposure duration for adult,(OSWER, 1991)
7.00E+01	BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds (OSWER, 1991)

HIF---(NON-CARCINOGENIC)--->	9.78E-03	HIF = (IR * EF * ED / BW) / (ATN)(365)
HIF---(CARCINOGENIC)-------->	3.49E-03	HIF = (IR * EF * ED / BW) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-34
RISK SEGMENT PERCHED AQUIFER
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
1,1-DICHLOROETHENE	1.56E-02	1.22E-03	3.18E-04	NA			4.37E-04	1.14E-04	1.20E+00	1.36E-04
TRANS-1,2-DICHLOROETHENE	1.36E-02	1.22E-03	2.78E-04	NA			4.37E-04	9.95E-05	NA	
TETRACHLOROETHENE	4.40E-01	1.22E-03	8.99E-03	NA			4.37E-04	3.21E-03	3.30E-03	1.06E-05
1,1,1-TRICHLOROETHANE	5.00E-03	1.22E-03	1.02E-04	1.00E+00	4.29E-01	2.38E-04	4.37E-04	3.65E-05	NA	
TRICHLOROETHENE	2.69E+01	1.22E-03	5.50E-01	NA			4.37E-04	1.96E-01	1.70E-02	3.34E-03
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	4.61E-02	1.22E-03	9.42E-05	NA			4.37E-04	3.36E-05	NA	
METALS										
ARSENIC	4.83E-03	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	5.00E+01	
BARIUM	6.05E-01	1.22E-03	0.00E+00	5.00E-04	2.14E-04		4.37E-04	0.00E+00	NA	
CHROMIUM	1.92E+01	1.22E-03	0.00E+00	2.00E-06	8.57E-07		4.37E-04	0.00E+00	4.10E+01	
COPPER	2.71E-02	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
LEAD	8.15E-03	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
NICKEL	2.41E-02	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	8.40E-01	
SELENIUM	5.34E-03	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
						2.4E-04				3.5E-03

INHALATION DUE TO SHOWERING

CC = 16.7 L/cu.m - Conversion Factor (L/cu. m); (DATA*200L/12 cu. m), (EPA, 1989a)

0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %) #
1.00E-01	VRS = Volatilization Rate (Semi-volatiles = 10.0 %) #
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %) #
6.25E-01	IR = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA, 1989a)
2.00E-01	ET = 0.2 hours/day - Exposure Time for showering, (EPA, 1989a)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.50E+01	ED = 25 years - Exposure duration for adult worker, (OSWER, 1991)
7.00E+01	BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	1.22E-03	HIF = ((IR * ET * EF * ED / BW)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	4.37E-04	HIF = ((IR * ET * EF * ED / BW)) / (ATC)(365)
	0.00E+00	INTAKE = (CA * CC * VRM * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

Assumed values
NA - Data Not Available

TABLE C-35
RISK SEGMENT PERCHED AQUIFER
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
1,1-DICHLOROETHENE	1.56E-02	3.56E-02	5.99E-03	3.33E-06	7.20E-03	4.62E-04	1.27E-02	1.19E-06	7.50E-01	8.91E-07
TRANS-1,2-DICHLOROETHENE	1.36E-02	3.56E-02	1.68E-02	8.16E-06	1.60E-02	5.10E-04	1.27E-02	2.91E-06	NA	
TETRACHLOROETHENE	4.40E-01	3.56E-02	4.54E-02	7.12E-04	8.00E-03	8.90E-02	1.27E-02	2.54E-04	6.40E-02	1.63E-05
1,1,1-TRICHLOROETHANE	5.00E-03	3.56E-02	1.76E-02	3.13E-06	7.20E-02	4.35E-05	1.27E-02	1.12E-06	NA	
TRICHLOROETHENE	2.69E+01	3.56E-02	1.62E-02	1.55E-02	NA		1.27E-02	5.55E-03	1.40E-02	7.76E-05
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	4.61E-02	3.56E-02	2.89E-02	4.75E-05	2.00E-02	2.37E-03	1.27E-02	1.70E-05	1.40E-02	2.37E-07
METALS										
ARSENIC	4.83E-03	3.56E-02	8.57E-04	1.48E-07	2.00E-04	7.38E-04	1.27E-02	5.27E-08	NA	
BARIUM	6.05E-01	3.56E-02	8.00E-04	1.72E-05	1.40E-02	1.23E-03	1.27E-02	6.16E-06	NA	
CHROMIUM	1.92E+01	3.56E-02	2.10E-03	1.44E-03	1.00E-03	1.44E+00	1.27E-02	5.13E-04	NA	
COPPER	2.71E-02	3.56E-02	1.01E-03	9.75E-07	NA		1.27E-02	3.48E-07	NA	
LEAD	8.15E-03	3.56E-02	1.34E-04	3.89E-08	NA		1.27E-02	1.39E-08	NA	
NICKEL	2.41E-02	3.56E-02	1.08E-03	9.28E-07	4.00E-03	2.32E-04	1.27E-02	3.32E-07	NA	
SELENIUM	5.34E-03	3.56E-02	8.10E-04	1.54E-07	NA		1.27E-02	5.51E-08	NA	
						1.5E+00				9.5E-05

DERMAL CONTACT DUE TO SHOWERING (ADULT WORKER ONLY)

CW = Concentration of chemical in water (mg/L)

1.82E+04 SA = 18,200 sq.cm - Skin Surface Area Available for Contact (Adult), (EPA, 1989a)

2.50E+02 EF = 250 days/year - Exposure Frequency, (OSWER, 1991)

2.00E-01 ET = 0.2 min./hour - Exposure Time, (EPA, 1989a)

2.50E+01 ED = 25 years - Exposure duration for adult, (OSWER, 1991)

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

2.50E+01 ATN = 25 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)

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

1.00E-03 CF = Conversion Factor, (1L / 1000 cu.m)

PC = Permeability Constant (Chemical Specific)

HIF--(NON-CARCINOGENIC)--> 3.56E-02 HIF = ((SA * ET * EF * ED / BW) / (ATN)(365))CF

HIF--(CARCINOGENIC)--------> 1.27E-02 HIF = ((SA * ET * EF * ED / BW) / (ATC)(365))CF

INTAKE = (CW * HIF * PC)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-36
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
BENZENE	4.93E-03	3.26E-02	1.61E-04	NA		1.40E-02	6.91E-05	2.90E-02	2.00E-06
CHLOROBENZENE	1.66E-01	3.26E-02	5.43E-03	2.00E-02	2.71E-01	1.40E-02	2.33E-03	NA	
CHLOROFORM	4.98E-03	3.26E-02	1.62E-04	1.00E-02	1.62E-02	1.40E-02	6.98E-05	6.10E-03	4.26E-07
1,1-DICHLOROETHANE	4.03E-02	3.26E-02	1.32E-03	1.00E-01	1.32E-02	1.40E-02	5.65E-04	NA	
1,1-DICHLOROETHENE	1.11E-02	3.26E-02	3.61E-04	9.00E-03	4.01E-02	1.40E-02	1.55E-04	6.00E-01	9.29E-05
CIS-1,2-DICHLOROETHENE	6.60E-03	3.26E-02	2.15E-04	1.00E-02	2.15E-02	1.40E-02	9.23E-05	NA	
TRANS-1,2-DICHLOROETHENE	2.22E-01	3.26E-02	7.23E-03	2.00E-02	3.62E-01	1.40E-02	3.11E-03	NA	
1,2-DICHLOROPROPANE	1.20E-02	3.26E-02	3.90E-04	NA		1.40E-02	1.68E-04	6.80E-02	1.14E-05
ETHYLBENZENE	5.08E-03	3.26E-02	1.66E-04	1.00E-01	1.66E-03	1.40E-02	7.11E-05	NA	
METHYLENE CHLORIDE	9.39E-03	3.26E-02	3.06E-04	6.00E-02	5.10E-03	1.40E-02	1.31E-04	7.50E-03	9.86E-07
TETRACHLOROETHENE	1.03E-01	3.26E-02	3.35E-03	1.00E-02	3.35E-01	1.40E-02	1.44E-03	5.10E-02	7.33E-05
1,1,1-TRICHLOROETHANE	1.70E-02	3.26E-02	5.56E-04	9.00E-02	6.17E-03	1.40E-02	2.39E-04	NA	
TRICHLOROETHENE	1.32E+00	3.26E-02	4.31E-02	NA		1.40E-02	1.85E-02	1.10E-02	2.04E-04
1,2,4-TRIMETHYLBENZENE	9.29E-04	3.26E-02	3.03E-05	NA		1.40E-02	1.30E-05	NA	
TOLUENE	7.26E-03	3.26E-02	2.37E-04	2.00E-01	1.18E-03	1.40E-02	1.02E-04	NA	
VINYL CHLORIDE	1.21E-01	3.26E-02	3.95E-03	NA		1.40E-02	1.69E-03	1.90E+00	3.22E-03
XYLENE (TOTAL)	6.82E-03	3.26E-02	2.22E-04	2.00E+00	1.11E-04	1.40E-02	9.55E-05	NA	
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	1.07E-01	3.26E-02	3.47E-03	2.00E-02	1.74E-01	1.40E-02	1.49E-03	1.40E-02	2.09E-05
1,2-DICHLOROBENZENE	3.73E-02	3.26E-02	1.21E-03	9.00E-02	1.35E-02	1.40E-02	5.22E-04	NA	
1,3-DICHLOROBENZENE	4.99E-03	3.26E-02	1.63E-04	NA		1.40E-02	6.99E-05	NA	
1,4-DICHLOROBENZENE	2.40E-02	3.26E-02	7.83E-04	NA		1.40E-02	3.36E-04	2.40E-02	8.07E-06
DI-N-OCTYLPHTHALATE	2.38E-02	3.26E-02	7.77E-04	2.00E-02	3.88E-02	1.40E-02	3.34E-04	NA	
NAPHTHALENE	5.00E-03	3.26E-02	1.63E-04	4.00E-03	4.07E-02	1.40E-02	7.00E-05	NA	
METALS									
ARSENIC	8.87E-03	3.26E-02	2.89E-04	1.00E-03	2.89E-01	1.40E-02	1.24E-04	NA	
BARIUM	1.06E+00	3.26E-02	3.44E-02	7.00E-02	4.92E-01	1.40E-02	1.48E-02	NA	
CHROMIUM	4.66E-01	3.26E-02	1.52E-02	5.00E-03	3.04E+00	1.40E-02	6.52E-03	NA	
COPPER	2.05E-02	3.26E-02	6.69E-04	3.70E-02	1.81E-02	1.40E-02	2.87E-04	NA	
LEAD	7.66E-03	3.26E-02	2.50E-04	NA		1.40E-02	1.07E-04	NA	
NICKEL	1.37E-01	3.26E-02	4.48E-03	2.00E-02	2.24E-01	1.40E-02	1.92E-03	NA	
					5.4E+00				3.6E-03

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF---(NON-CARCINOGENIC)--->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

FILE:T1

TABLE C-37
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	5.14E-03	3.07E-03	2.63E-04	NA			1.32E-03	1.13E-04	2.90E-02	3.27E-06
CHLOROBENZENE	1.96E-01	3.07E-03	1.00E-02	2.00E-02	8.57E-03	1.17E+00	1.32E-03	4.30E-03	NA	
CHLOROFORM	4.98E-03	3.07E-03	2.55E-04	NA			1.32E-03	1.09E-04	8.10E-02	8.85E-06
1,1-DICHLOROETHANE	4.43E-02	3.07E-03	2.27E-03	5.00E-01	2.14E-01	1.06E-02	1.32E-03	9.72E-04	NA	
1,1-DICHLOROETHENE	1.30E-02	3.07E-03	6.66E-04	NA			1.32E-03	2.85E-04	1.20E+00	3.42E-04
CIS-1,2-DICHLOROETHENE	7.55E-03	3.07E-03	3.87E-04	NA			1.32E-03	1.66E-04	NA	
TRANS-1,2-DICHLOROETHENE	2.75E-01	3.07E-03	1.41E-02	NA			1.32E-03	6.03E-03	NA	
1,2-DICHLOROPROPANE	1.19E-02	3.07E-03	6.09E-04	NA			1.32E-03	2.61E-04	NA	
ETHYLBENZENE	5.21E-03	3.07E-03	2.67E-04	NA			1.32E-03	1.14E-04	NA	
METHYLENE CHLORIDE	9.32E-03	3.07E-03	4.77E-04	3.00E+00	1.29E+00	3.71E-04	1.32E-03	2.05E-04	1.40E-02	2.86E-06
TETRACHLOROETHENE	1.29E-01	3.07E-03	6.61E-03	NA			1.32E-03	2.83E-03	3.30E-03	9.34E-06
1,1,1-TRICHLOROETHANE	1.73E-02	3.07E-03	8.86E-04	1.00E+00	4.29E-01	2.07E-03	1.32E-03	3.80E-04	NA	
TRICHLOROETHENE	1.78E+00	3.07E-03	9.11E-02	NA			1.32E-03	3.91E-02	1.70E-02	6.64E-04
1,2,4-TRIMETHYLBENZENE	1.13E-03	3.07E-03	5.79E-05	NA			1.32E-03	2.48E-05	NA	
TOLUENE	7.20E-03	3.07E-03	3.69E-04	2.00E+00	8.57E-01	4.30E-04	1.32E-03	1.58E-04	NA	
VINYL CHLORIDE	1.57E-01	3.07E-03	8.04E-03	NA			1.32E-03	3.45E-03	3.00E-01	1.03E-03
XYLENE (TOTAL)	8.06E-03	3.07E-03	4.13E-04	3.00E-01	1.29E-01	3.21E-03	1.32E-03	1.77E-04	NA	
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	1.05E-01	3.07E-03	5.38E-04	NA			1.32E-03	2.30E-04	NA	
1,2-DICHLOROBENZENE	4.83E-02	3.07E-03	2.47E-04	2.00E-01	8.57E-02	2.89E-03	1.32E-03	1.06E-04	NA	
1,3-DICHLOROBENZENE	5.00E-03	3.07E-03	2.56E-05	NA			1.32E-03	1.10E-05	NA	
1,4-DICHLOROBENZENE	3.03E-02	3.07E-03	1.55E-04	7.00E-01	3.00E-01	5.17E-04	1.32E-03	6.65E-05	NA	
DI-N-OCTYLPHTHALATE	2.38E-02	3.07E-03	1.22E-04	NA			1.32E-03	5.22E-05	NA	
NAPHTHALENE	5.00E-03	3.07E-03	2.56E-05	NA			1.32E-03	1.10E-05	NA	
METALS										
ARSENIC	1.18E-02	3.07E-03	0.00E+00	NA			1.32E-03	0.00E+00	5.00E+01	
BARIUM	1.11E+00	3.07E-03	0.00E+00	5.00E-04	2.14E-04		1.32E-03	0.00E+00	NA	
CHROMIUM	6.11E-01	3.07E-03	0.00E+00	2.00E-06	8.57E-07		1.32E-03	0.00E+00	4.10E+01	
LEAD	8.56E-03	3.07E-03	0.00E+00	NA			1.32E-03	0.00E+00	NA	
NICKEL	9.56E-02	3.07E-03	0.00E+00	NA			1.32E-03	0.00E+00	8.40E-01	
						1.2E+00				2.1E-03

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF---(NON-CARCINOGENIC)--->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
	0.00E+00	INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

Assumed values
NA - Data Not Available

FILE: T2

TABLE C-38
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	4.93E-03	6.62E-02	1.11E-01	3.62E-05	NA		2.84E-02	1.55E-05	3.60E-02	5.59E-07
CHLOROBENZENE	1.66E-01	6.62E-02	4.04E-02	4.45E-04	1.60E-02	2.78E-02	2.84E-02	1.91E-04	NA	
CHLOROFORM	4.98E-03	6.62E-02	9.58E-03	3.16E-06	8.00E-03	3.95E-04	2.84E-02	1.35E-06	7.60E-03	1.03E-08
1,1-DICHLOROETHANE	4.03E-02	6.62E-02	1.26E-02	3.36E-05	8.00E-02	4.20E-04	2.84E-02	1.44E-05	NA	
1,1-DICHLOROETHENE	1.11E-02	6.62E-02	5.99E-03	4.39E-06	7.20E-03	6.09E-04	2.84E-02	1.88E-06	7.50E-01	1.41E-06
CIS-1,2-DICHLOROETHENE	6.60E-03	6.62E-02	1.68E-02	7.33E-06	8.00E-03	9.17E-04	2.84E-02	3.14E-06	NA	
TRANS-1,2-DICHLOROETHENE	2.22E-01	6.62E-02	1.68E-02	2.47E-04	1.60E-02	1.54E-02	2.84E-02	1.06E-04	NA	
1,2-DICHLOROPROPANE	1.20E-02	6.62E-02	2.25E-02	1.78E-05	NA		2.84E-02	7.64E-06	8.50E-02	6.49E-07
ETHYLBENZENE	5.08E-03	6.62E-02	1.37E+00	4.61E-04	8.00E-02	5.76E-03	2.84E-02	1.97E-04	NA	
METHYLENE CHLORIDE	9.39E-03	6.62E-02	5.12E-03	3.18E-06	4.80E-02	6.63E-05	2.84E-02	1.36E-06	9.40E-03	1.28E-08
TETRACHLOROETHENE	1.03E-01	6.62E-02	4.54E-02	3.08E-04	8.00E-03	3.86E-02	2.84E-02	1.32E-04	6.40E-02	8.46E-06
1,1,1-TRICHLOROETHANE	1.70E-02	6.62E-02	1.76E-02	1.99E-05	7.20E-02	2.76E-04	2.84E-02	8.51E-06	NA	
TRICHLOROETHENE	1.32E+00	6.62E-02	1.62E-02	1.42E-03	NA		2.84E-02	6.08E-04	1.40E-02	8.51E-06
1,2,4-TRIMETHYLBENZENE	9.29E-04	6.62E-02	8.00E-04	4.92E-08	NA		2.84E-02	2.11E-08	NA	
TOLUENE	7.26E-03	6.62E-02	1.01E+00	4.86E-04	1.60E-01	3.03E-03	2.84E-02	2.08E-04	NA	
VINYL CHLORIDE	1.21E-01	6.62E-02	8.32E-03	6.66E-05	NA		2.84E-02	2.86E-05	2.40E+00	6.85E-05
XYLENE (TOTAL)	6.82E-03	6.62E-02	5.52E-04	2.49E-07	1.60E+00	1.56E-07	2.84E-02	1.07E-07	NA	
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	1.07E-01	6.62E-02	3.21E-03	2.26E-05	1.00E-02	2.26E-03	2.84E-02	9.70E-06	2.80E-02	2.72E-07
1,2-DICHLOROBENZENE	3.73E-02	6.62E-02	2.89E-02	7.13E-05	4.50E-02	1.58E-03	2.84E-02	3.05E-05	NA	
1,3-DICHLOROBENZENE	4.99E-03	6.62E-02	5.73E-02	1.89E-05	NA		2.84E-02	8.11E-06	NA	
1,4-DICHLOROBENZENE	2.40E-02	6.62E-02	8.04E-02	1.28E-04	NA		2.84E-02	5.48E-05	4.80E-02	2.63E-06
DI-N-OCTYLPHTHALATE	2.38E-02	6.62E-02	8.00E-04	1.26E-06	1.00E-02	1.26E-04	2.84E-02	5.41E-07	NA	
NAPHTHALENE	5.00E-03	6.62E-02	6.59E-02	2.18E-05	2.00E-03	1.09E-02	2.84E-02	9.35E-06	NA	
METALS										
ARSENIC	8.87E-03	6.62E-02	8.00E-04	4.69E-07	2.00E-04	2.35E-03	2.84E-02	2.01E-07	NA	
BARIUM	1.06E+00	6.62E-02	8.57E-04	5.99E-05	1.40E-02	4.28E-03	2.84E-02	2.57E-05	NA	
CHROMIUM	4.66E-01	6.62E-02	8.00E-04	2.47E-05	1.00E-03	2.47E-02	2.84E-02	1.06E-05	NA	
COPPER	2.05E-02	6.62E-02	1.01E-03	1.37E-06	2.20E-02	6.24E-05	2.84E-02	5.88E-07	NA	
LEAD	7.66E-03	6.62E-02	8.00E-04	4.06E-07	NA		2.84E-02	1.74E-07	NA	
NICKEL	1.37E-01	6.62E-02	1.08E-03	9.83E-06	4.00E-03	2.46E-03	2.84E-02	4.21E-06	NA	
						1.4E-01				9.1E-05

DERMAL CONTACT DUE TO SHOWERING

CW = Concentration of chemical in water (mg/L)

7.20E+03 SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)

1.82E+04 SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)

3.50E+02 EF = 350 days/year - Exposure Frequency, (OSWER, 1991)

2.00E-01 ET = 0.2 hours/day - Exposure Time, (EPA 1989a)

5.00E+00 EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)

2.50E+01 EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)

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

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

1.00E-03 CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)

PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF---(NON-CARCINOGENIC)---> 6.62E-02 HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]

HIF---(CARCINOGENIC)-------> 2.84E-02 HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATc)(365)]

INTAKE = (CW * HIF * PC)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

RfD = (RfD * ABS Factor)

NA - Data Not Available

FILE: T3

TABLE C-39
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
INGESTION OF CONTAMINANTS IN DRINKING WATER
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
BENZENE	4.93E-03	9.78E-03	4.83E-05	NA		3.49E-03	1.72E-05	2.90E-02	5.00E-07
CHLOROBENZENE	1.66E-01	9.78E-03	1.63E-03	2.00E-02	8.14E-02	3.49E-03	5.82E-04	NA	
CHLOROFORM	4.98E-03	9.78E-03	4.88E-05	1.00E-02	4.88E-03	3.49E-03	1.74E-05	6.10E-03	1.06E-07
1,1-DICHLOROETHANE	4.03E-02	9.78E-03	3.95E-04	1.00E-01	3.95E-03	3.49E-03	1.41E-04	NA	
1,1-DICHLOROETHENE	1.11E-02	9.78E-03	1.08E-04	9.00E-03	1.20E-02	3.49E-03	3.87E-05	6.00E-01	2.32E-05
CIS-1,2-DICHLOROETHENE	6.60E-03	9.78E-03	6.45E-05	1.00E-02	6.45E-03	3.49E-03	2.30E-05	NA	
TRANS-1,2-DICHLOROETHENE	2.22E-01	9.78E-03	2.17E-03	2.00E-02	1.09E-01	3.49E-03	7.75E-04	NA	
1,2-DICHLOROPROPANE	1.20E-02	9.78E-03	1.17E-04	NA		3.49E-03	4.18E-05	6.80E-02	2.84E-06
ETHYLBENZENE	5.08E-03	9.78E-03	4.97E-05	1.00E-01	4.97E-04	3.49E-03	1.78E-05	NA	
METHYLENE CHLORIDE	9.39E-03	9.78E-03	9.19E-05	6.00E-02	1.53E-03	3.49E-03	3.28E-05	7.50E-03	2.46E-07
TETRACHLOROETHENE	1.03E-01	9.78E-03	1.00E-03	1.00E-02	1.00E-01	3.49E-03	3.59E-04	5.10E-02	1.83E-05
1,1,1-TRICHLOROETHANE	1.70E-02	9.78E-03	1.67E-04	9.00E-02	1.85E-03	3.49E-03	5.96E-05	NA	
TRICHLOROETHENE	1.32E+00	9.78E-03	1.29E-02	NA		3.49E-03	4.62E-03	1.10E-02	5.08E-05
1,2,4-TRIMETHYLBENZENE	9.29E-04	9.78E-03	9.09E-06	NA		3.49E-03	3.25E-06	NA	
TOLUENE	7.26E-03	9.78E-03	7.11E-05	2.00E-01	3.55E-04	3.49E-03	2.54E-05	NA	
VINYL CHLORIDE	1.21E-01	9.78E-03	1.18E-03	NA		3.49E-03	4.23E-04	1.90E+00	8.04E-04
XYLENE (TOTAL)	6.82E-03	9.78E-03	6.68E-05	2.00E+00	3.34E-05	3.49E-03	2.38E-05	NA	
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	1.07E-01	9.78E-03	1.04E-03	2.00E-02	5.21E-02	3.49E-03	3.72E-04	1.40E-02	5.21E-06
1,2-DICHLOROBENZENE	3.73E-02	9.78E-03	3.65E-04	9.00E-02	4.05E-03	3.49E-03	1.30E-04	NA	
1,3-DICHLOROBENZENE	4.99E-03	9.78E-03	4.89E-05	NA		3.49E-03	1.74E-05	NA	
1,4-DICHLOROBENZENE	2.40E-02	9.78E-03	2.35E-04	NA		3.49E-03	8.39E-05	2.40E-02	2.01E-06
DI-N-OCTYLPHTHALATE	2.38E-02	9.78E-03	2.33E-04	2.00E-02	1.17E-02	3.49E-03	8.33E-05	NA	
NAPHTHALENE	5.00E-03	9.78E-03	4.89E-05	4.00E-03	1.22E-02	3.49E-03	1.75E-05	NA	
METALS									
ARSENIC	8.87E-03	9.78E-03	8.68E-05	1.00E-03	8.68E-02	3.49E-03	3.10E-05	NA	
BARIUM	1.06E+00	9.78E-03	1.03E-02	7.00E-02	1.48E-01	3.49E-03	3.69E-03	NA	
CHROMIUM	4.66E-01	9.78E-03	4.56E-03	5.00E-03	9.11E-01	3.49E-03	1.63E-03	NA	
COPPER	2.05E-02	9.78E-03	2.01E-04	3.70E-02	5.43E-03	3.49E-03	7.17E-05	NA	
LEAD	7.66E-03	9.78E-03	7.50E-05	NA		3.49E-03	2.68E-05	NA	
NICKEL	1.37E-01	9.78E-03	1.35E-03	2.00E-02	6.73E-02	3.49E-03	4.80E-04	NA	
					1.6E+00				9.1E-04

DRINKING WATER INGESTION
CW = Concentration of chemical in water (mg/L)

1.00E+00	IR = 1.00 Liter/day (OSWER, 1991)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.50E+01	ED = 25 years - Exposure duration for adult,(OSWER, 1991)
7.00E+01	BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds (OSWER, 1991)

HIF---(NON-CARCINOGENIC)--->	9.78E-03	HIF = (IR * EF * ED / BW) / (ATN)(365)
HIF---(CARCINOGENIC)-------->	3.49E-03	HIF = (IR * EF * ED / BW) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

FILE: T4

TABLE C-40
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	4.93E-03	1.22E-03	1.01E-04	NA			4.37E-04	3.59E-05	2.90E-02	1.04E-06
CHLOROBENZENE	1.66E-01	1.22E-03	3.39E-03	2.00E-02	8.57E-03	3.96E-01	4.37E-04	1.21E-03	NA	
CHLOROFORM	4.98E-03	1.22E-03	1.02E-04	NA			4.37E-04	3.63E-05	8.10E-02	2.94E-06
1,1-DICHLOROETHANE	4.03E-02	1.22E-03	8.22E-04	5.00E-01	2.14E-01	3.84E-03	4.37E-04	2.94E-04	NA	
1,1-DICHLOROETHENE	1.11E-02	1.22E-03	2.25E-04	NA			4.37E-04	8.05E-05	1.20E+00	9.66E-05
CIS-1,2-DICHLOROETHENE	6.60E-03	1.22E-03	1.34E-04	NA			4.37E-04	4.80E-05	NA	
TRANS-1,2-DICHLOROETHENE	2.22E-01	1.22E-03	4.52E-03	NA			4.37E-04	1.61E-03	NA	
1,2-DICHLOROPROPANE	1.20E-02	1.22E-03	2.44E-04	NA			4.37E-04	8.71E-05	NA	
ETHYLBENZENE	5.08E-03	1.22E-03	1.04E-04	NA			4.37E-04	3.70E-05	NA	
METHYLENE CHLORIDE	9.39E-03	1.22E-03	1.91E-04	3.00E+00	1.29E+00	1.49E-04	4.37E-04	6.83E-05	1.40E-02	9.57E-07
TETRACHLOROETHENE	1.03E-01	1.22E-03	2.09E-03	NA			4.37E-04	7.47E-04	3.30E-03	2.47E-06
1,1,1-TRICHLOROETHANE	1.70E-02	1.22E-03	3.47E-04	1.00E+00	4.29E-01	8.11E-04	4.37E-04	1.24E-04	NA	
TRICHLOROETHENE	1.32E+00	1.22E-03	2.70E-02	NA			4.37E-04	9.63E-03	1.70E-02	1.64E-04
1,2,4-TRIMETHYLBENZENE	9.29E-04	1.22E-03	1.89E-05	NA			4.37E-04	6.76E-06	NA	
TOLUENE	7.26E-03	1.22E-03	1.48E-04	2.00E+00	8.57E-01	1.73E-04	4.37E-04	5.29E-05	NA	
VINYL CHLORIDE	1.21E-01	1.22E-03	2.47E-03	NA			4.37E-04	8.81E-04	3.00E-01	2.64E-04
XYLENE (TOTAL)	6.82E-03	1.22E-03	1.39E-04	3.00E-01	1.29E-01	1.08E-03	4.37E-04	4.97E-05	NA	
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	1.07E-01	1.22E-03	2.17E-04	NA			4.37E-04	7.76E-05	NA	
1,2-DICHLOROBENZENE	3.73E-02	1.22E-03	7.60E-05	2.00E-01	8.57E-02	8.86E-04	4.37E-04	2.71E-05	NA	
1,3-DICHLOROBENZENE	4.99E-03	1.22E-03	1.02E-05	NA			4.37E-04	3.63E-06	NA	
1,4-DICHLOROBENZENE	2.40E-02	1.22E-03	4.90E-05	7.00E-01	3.00E-01	1.63E-04	4.37E-04	1.75E-05	NA	
DI-N-OCTYLPHTHALATE	2.38E-02	1.22E-03	4.86E-05	NA			4.37E-04	1.73E-05	NA	
NAPHTHALENE	5.00E-03	1.22E-03	1.02E-05	NA			4.37E-04	3.64E-06	NA	
METALS										
ARSENIC	8.87E-03	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	5.00E+01	
BARIUM	1.06E+00	1.22E-03	0.00E+00	5.00E-04	2.14E-04		4.37E-04	0.00E+00	NA	
CHROMIUM	4.66E-01	1.22E-03	0.00E+00	2.00E-06	8.57E-07		4.37E-04	0.00E+00	4.10E+01	
COPPER	2.05E-02	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
LEAD	7.66E-03	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
NICKEL	1.37E-01	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	8.40E-01	
						4.0E-01				5.3E-04

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (L/cu. m); (DATA*200L/12 cu. m), (EPA, 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %) #
1.00E-01	VRS = Volatilization Rate (Semi-volatiles = 10.0 %) #
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %) #
6.25E-01	IR = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA, 1989a)
2.00E-01	ET = 0.2 hours/day - Exposure Time for showering, (EPA, 1989a)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.50E+01	ED = 25 years - Exposure duration for adult worker, (OSWER, 1991)
7.00E+01	BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	1.22E-03	HIF = (IR * ET * EF * ED / BW) / (ATN)(365)
HIF--(CARCINOGENIC)------->	4.37E-04	HIF = (IR * ET * EF * ED / BW) / (ATC)(365)
	0.00E+00	INTAKE = (CA * CC * VRM * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

Assumed values
NA - Data Not Available

FILE: T5

TABLE C-41
RISK SEGMENT TOP OF REGIONAL AQUIFER ZONE
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	4.93E-03	3.56E-02	1.11E-01	1.95E-05	NA		1.27E-02	6.97E-06	3.60E-02	2.51E-07
CHLOROBENZENE	1.66E-01	3.56E-02	4.04E-02	2.40E-04	1.60E-02	1.50E-02	1.27E-02	8.55E-05	NA	
CHLOROFORM	4.98E-03	3.56E-02	9.58E-03	1.70E-06	8.00E-03	2.13E-04	1.27E-02	6.07E-07	7.60E-03	4.61E-09
1,1-DICHLOROETHANE	4.03E-02	3.56E-02	1.26E-02	1.81E-05	8.00E-02	2.26E-04	1.27E-02	6.47E-06	NA	
1,1-DICHLOROETHENE	1.11E-02	3.56E-02	5.99E-03	2.36E-06	7.20E-03	3.28E-04	1.27E-02	8.43E-07	7.50E-01	6.32E-07
CIS-1,2-DICHLOROETHENE	6.60E-03	3.56E-02	1.68E-02	3.95E-06	8.00E-03	4.93E-04	1.27E-02	1.41E-06	NA	
TRANS-1,2-DICHLOROETHENE	2.22E-01	3.56E-02	1.68E-02	1.33E-04	1.60E-02	8.30E-03	1.27E-02	4.74E-05	NA	
1,2-DICHLOROPROPANE	1.20E-02	3.56E-02	2.25E-02	9.59E-06	NA		1.27E-02	3.42E-06	8.50E-02	2.91E-07
ETHYLBENZENE	5.08E-03	3.56E-02	1.37E+00	2.48E-04	8.00E-02	3.10E-03	1.27E-02	8.85E-05	NA	
METHYLENE CHLORIDE	9.39E-03	3.56E-02	5.12E-03	1.71E-06	4.80E-02	3.57E-05	1.27E-02	6.11E-07	9.40E-03	5.75E-09
TETRACHLOROETHENE	1.03E-01	3.56E-02	4.54E-02	1.66E-04	8.00E-03	2.08E-02	1.27E-02	5.93E-05	6.40E-02	3.79E-06
1,1,1-TRICHLOROETHANE	1.70E-02	3.56E-02	1.76E-02	1.07E-05	7.20E-02	1.48E-04	1.27E-02	3.82E-06	NA	
TRICHLOROETHENE	1.32E+00	3.56E-02	1.62E-02	7.63E-04	NA		1.27E-02	2.72E-04	1.40E-02	3.81E-06
1,2,4-TRIMETHYLBENZENE	9.29E-04	3.56E-02	8.00E-04	2.65E-08	NA		1.27E-02	9.45E-09	NA	
TOLUENE	7.26E-03	3.56E-02	1.01E+00	2.61E-04	1.60E-01	1.63E-03	1.27E-02	9.33E-05	NA	
VINYL CHLORIDE	1.21E-01	3.56E-02	8.32E-03	3.59E-05	NA		1.27E-02	1.28E-05	2.40E+00	3.07E-05
XYLENE (TOTAL)	6.82E-03	3.56E-02	5.52E-04	1.34E-07	1.60E+00	8.38E-08	1.27E-02	4.79E-08	NA	
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	1.07E-01	3.56E-02	3.21E-03	1.22E-05	1.00E-02	1.22E-03	1.27E-02	4.35E-06	2.8[illegible]02	1.22E-07
1,2-DICHLOROBENZENE	3.73E-02	3.56E-02	2.89E-02	3.84E-05	4.50E-02	8.52E-04	1.27E-02	1.37E-05		
1,3-DICHLOROBENZENE	4.99E-03	3.56E-02	5.73E-02	1.02E-05	NA		1.27E-02	3.64E-06		
1,4-DICHLOROBENZENE	2.40E-02	3.56E-02	8.04E-02	6.88E-05	NA		1.27E-02	2.46E-05	4.80E-02	1.18E-06
DI-N-OCTYLPHTHALATE	2.38E-02	3.56E-02	8.00E-04	6.79E-07	1.00E-02	6.79E-05	1.27E-02	2.42E-07	NA	
NAPHTHALENE	5.00E-03	3.56E-02	6.59E-02	1.17E-05	2.00E-03	5.87E-03	1.27E-02	4.19E-06	NA	
METALS										
ARSENIC	8.87E-03	3.56E-02	8.00E-04	2.53E-07	8.00E-05	3.16E-03	1.27E-02	9.02E-08	NA	
BARIUM	1.06E+00	3.56E-02	8.57E-04	3.22E-05	2.00E-04	1.61E-01	1.27E-02	1.15E-05	NA	
CHROMIUM	4.66E-01	3.56E-02	8.00E-04	1.33E-05	NA		1.27E-02	4.74E-06	NA	
COPPER	2.05E-02	3.56E-02	8.00E-04	1.01E-03	2.20E-02	4.59E-02	1.27E-02	2.09E-07	NA	
LEAD	7.66E-03	3.56E-02	8.00E-04	2.18E-07	NA		1.27E-02	7.80E-08	NA	
NICKEL	1.37E-01	3.56E-02	1.47E-04	7.20E-07	6.00E-05	1.20E-02	1.27E-02	2.57E-07	NA	
						2.8E-01				4.1E-05

DERMAL CONTACT DUE TO SHOWERING (ADULT WORKER ONLY)
CW = Concentration of chemical in water (mg/L)

1.82E+04	SA = 18,200 sq.cm - Skin Surface Area Available for Contact (Adult), (EPA, 1989a)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 min./hour - Exposure Time, (EPA, 1989a)
2.50E+01	ED = 25 years - Exposure duration for adult, (OSWER, 1991)
7.00E+01	BWA = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m)

PC = Permeablility Constant (Chemical Specific)

HIF---(NON-CARCINOGENIC)--->	3.56E-02	HIF = ((SA * ET * EF * ED / BW) / (ATN)(365))CF
HIF---(CARCINOGENIC)--------->	1.27E-02	HIF = ((SA * ET * EF * ED / BW) / (ATC)(365))CF

INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

FILE: T6

TABLE C-42
RISK SEGMENT REGIONAL AQUIFER ZONE
INGESTION OF CONTAMINANTS IN DRINKING WATER
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
BENZENE	5.00E-03	3.26E-02	1.63E-04	NA		1.40E-02	7.00E-05	2.90E-02	2.03E-06
CHLOROBENZENE	7.38E-02	3.26E-02	2.41E-03	2.00E-02	1.20E-01	1.40E-02	1.03E-03	NA	
1,1-DICHLOROETHANE	6.51E-03	3.26E-02	2.12E-04	1.00E-01	2.12E-03	1.40E-02	9.11E-05	NA	
1,1-DICHLOROETHENE	7.00E-03	3.26E-02	2.28E-04	9.00E-03	2.54E-02	1.40E-02	9.80E-05	6.00E-01	5.88E-05
CIS-1,2-DICHLOROETHENE	9.59E-03	3.26E-02	3.13E-04	1.00E-02	3.13E-02	1.40E-02	1.34E-04	NA	
TRANS-1,2-DICHLOROETHENE	1.89E-02	3.26E-02	6.16E-04	2.00E-02	3.08E-02	1.40E-02	2.65E-04	NA	
1,2-DICHLOROPROPANE	5.73E-03	3.26E-02	1.87E-04	NA		1.40E-02	8.02E-05	6.80E-02	5.45E-06
METHYLENE CHLORIDE	1.44E-02	3.26E-02	4.69E-04	6.00E-02	7.82E-03	1.40E-02	2.02E-04	7.50E-03	1.51E-06
TETRACHLOROETHENE	2.76E-02	3.26E-02	9.00E-04	1.00E-02	9.00E-02	1.40E-02	3.86E-04	5.10E-02	1.97E-05
1,1,1-TRICHLOROETHANE	5.86E-03	3.26E-02	1.91E-04	9.00E-02	2.12E-03	1.40E-02	8.20E-05	NA	
TRICHLOROETHENE	1.89E-01	3.26E-02	6.16E-03	NA		1.40E-02	2.65E-03	1.10E-02	2.91E-05
1,2,4-TRIMETHYLBENZENE	3.46E-04	3.26E-02	1.13E-05	NA		1.40E-02	4.84E-06	NA	
VINYL CHLORIDE	1.19E-02	3.26E-02	3.88E-04	NA		1.40E-02	1.67E-04	1.90E+00	3.17E-04
SEMI-VOLATILE ORGANICS									
1,2-DICHLOROBENZENE	2.04E-02	3.26E-02	6.65E-04	9.00E-02	7.39E-03	1.40E-02	2.86E-04	NA	
1,4-DICHLOROBENZENE	1.01E-02	3.26E-02	3.29E-04	NA		1.40E-02	1.41E-04	2.40E-02	3.39E-06
METALS									
BARIUM	1.18E+00	3.26E-02	3.85E-02	7.00E-02	5.50E-01	1.40E-02	1.65E-02	NA	
LEAD	1.41E-02	3.26E-02	4.60E-04	NA		1.40E-02	1.97E-04	NA	
NICKEL	4.63E-02	3.26E-02	1.51E-03	2.00E-02	7.55E-02	1.40E-02	6.48E-04	NA	
SELENIUM	5.27E-03	3.26E-02	1.72E-04	NA		1.40E-02	7.38E-05	NA	
					9.4E-01				4.4E-04

DRINKING WATER INGESTION

	CW = Concentration of chemical in water (mg/L)
4.35E-01	IRC = 0.435 Liter/day for ages 1-4 yrs. (EPA 1989b)
2.00E+00	IRA = 2.00 Liter/day, Adult - (EPA 1989a)
3.50E+02	EF = 350 Days/yr - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.26E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)------->	1.40E-02	HIF = ((IRC * EF * EDC / BWC) + (IRA * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-43
RISK SEGMENT REGIONAL AQUIFER ZONE
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	5.00E-03	3.07E-03	2.56E-04	NA			1.32E-03	1.10E-04	2.90E-02	3.18E-06
CHLOROBENZENE	7.38E-02	3.07E-03	3.78E-03	2.00E-02	8.57E-03	4.41E-01	1.32E-03	1.62E-03	NA	
1,1-DICHLOROETHANE	6.51E-03	3.07E-03	3.33E-04	5.00E-01	2.14E-01	1.56E-03	1.32E-03	1.43E-04	NA	
1,1-DICHLOROETHENE	7.00E-03	3.07E-03	3.58E-04	NA			1.32E-03	1.54E-04	1.20E+00	1.84E-04
CIS-1,2-DICHLOROETHENE	9.59E-03	3.07E-03	4.91E-04	NA			1.32E-03	2.10E-04	NA	
TRANS-1,2-DICHLOROETHENE	1.89E-02	3.07E-03	9.68E-04	NA			1.32E-03	4.15E-04	NA	
1,2-DICHLOROPROPANE	5.73E-03	3.07E-03	2.93E-04	NA			1.32E-03	1.26E-04	NA	
METHYLENE CHLORIDE	1.44E-02	3.07E-03	7.37E-04	3.00E+00	1.29E+00	5.73E-04	1.32E-03	3.16E-04	1.40E-02	4.42E-06
TETRACHLOROETHENE	2.76E-02	3.07E-03	1.41E-03	NA			1.32E-03	6.06E-04	3.30E-03	2.00E-06
1,1,1-TRICHLOROETHANE	5.86E-03	3.07E-03	3.00E-04	1.00E+00	4.29E-01	7.00E-04	1.32E-03	1.29E-04	NA	
TRICHLOROETHENE	1.89E-01	3.07E-03	9.68E-03	NA			1.32E-03	4.15E-03	1.70E-02	7.05E-05
1,2,4-TRIMETHYLBENZENE	3.46E-04	3.07E-03	1.77E-05	NA			1.32E-03	7.59E-06	NA	
VINYL CHLORIDE	1.19E-02	3.07E-03	6.09E-04	NA			1.32E-03	2.61E-04	3.00E-01	7.83E-05
SEMI-VOLATILE ORGANICS										
1,2-DICHLOROBENZENE	2.04E-02	3.07E-03	1.04E-04	2.00E-01	8.57E-02	1.22E-03	1.32E-03	4.48E-05	NA	
1,4-DICHLOROBENZENE	1.01E-02	3.07E-03	5.17E-05	7.00E-01	3.00E-01	1.72E-04	1.32E-03	2.22E-05	NA	
METALS										
BARIUM	1.18E+00	3.07E-03	0.00E+00	5.00E-04	2.14E-04		1.32E-03	0.00E+00	NA	
LEAD	1.41E-02	3.07E-03	0.00E+00	NA			1.32E-03	0.00E+00	NA	
NICKEL	4.63E-02	3.07E-03	0.00E+00	NA			1.32E-03	0.00E+00	8.40E-01	
SELENIUM	5.27E-03	3.07E-03	0.00E+00	NA			1.32E-03	0.00E+00	NA	
						4.5E-01				3.4E-04

INHALATION DUE TO SHOWERING

1.67E+01	CC = 16.7 L/cu.m - Conversion Factor (mg/cu. m); (DATA*200L/12 cu. m), (EPA 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %)#
1.00E-01	VRS = Volatilization Rate (Semi-Volatiles = 10.0 %)#
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %)#
6.25E-01	IRC = 0.625 cu. m/hr - Inhalation Rate (child, 6yrs old), (EPA 1989a)
6.25E-01	IRA = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA 1989a)
2.00E-01	ET = 0.2 hrs - Exposure Time for showering, (EPA 1989a)
3.50E+02	EF = 350 days/ year - Exposure Frequency, (OSWER, 1991)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER, 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER, 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds (OSWER,1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	3.07E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	1.32E-03	HIF = ((IRC * ET * EF * EDC / BWC) + (IRA * ET * EF * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * CC * VR * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

Assumed value
NA - Data Not Available

FILE: R2

TABLE C-44
RISK SEGMENT REGIONAL AQUIFER ZONE
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	5.00E-03	6.62E-02	1.11E-01	3.67E-05	NA		2.84E-02	1.57E-05	3.60E-02	5.67E-07
CHLOROBENZENE	7.38E-02	6.62E-02	4.04E-02	1.97E-04	1.60E-02	1.23E-02	2.84E-02	8.46E-05	NA	
1,1-DICHLOROETHANE	6.51E-03	6.62E-02	1.26E-02	5.43E-06	8.00E-02	6.79E-05	2.84E-02	2.33E-06	NA	
1,1-DICHLOROETHENE	7.00E-03	6.62E-02	5.99E-03	2.77E-06	7.20E-03	3.85E-04	2.84E-02	1.19E-06	7.50E-01	8.92E-07
CIS-1,2-DICHLOROETHENE	9.59E-03	6.62E-02	1.68E-02	1.07E-05	8.00E-03	1.33E-03	2.84E-02	4.57E-06	NA	
TRANS-1,2-DICHLOROETHENE	1.89E-02	6.62E-02	1.68E-02	2.10E-05	1.60E-02	1.31E-03	2.84E-02	9.01E-06	NA	
1,2-DICHLOROPROPANE	5.73E-03	6.62E-02	2.25E-02	8.53E-06	NA		2.84E-02	3.66E-06	8.50E-02	3.11E-07
METHYLENE CHLORIDE	1.44E-02	6.62E-02	5.12E-03	4.88E-06	4.80E-02	1.02E-04	2.84E-02	2.09E-06	9.40E-03	1.97E-08
TETRACHLOROETHENE	2.76E-02	6.62E-02	4.54E-02	8.29E-05	8.00E-03	1.04E-02	2.84E-02	3.55E-05	6.40E-02	2.27E-06
1,1,1-TRICHLOROETHANE	5.86E-03	6.62E-02	1.76E-02	6.83E-06	7.20E-02	9.48E-05	2.84E-02	2.93E-06	NA	
TRICHLOROETHENE	1.89E-01	6.62E-02	1.62E-02	2.03E-04	NA		2.84E-02	8.68E-05	1.40E-02	1.22E-06
1,2,4-TRIMETHYLBENZENE	3.46E-04	6.62E-02	8.00E-04	1.83E-08	NA		2.84E-02	7.85E-09	NA	
VINYL CHLORIDE	1.19E-02	6.62E-02	8.32E-03	6.55E-06	NA		2.84E-02	2.81E-06	2.40E+00	6.74E-06
SEMI-VOLATILE ORGANICS										
1,2-DICHLOROBENZENE	2.04E-02	6.62E-02	2.89E-02	3.90E-05	4.50E-02	8.67E-04	2.84E-02	1.67E-05	NA	
1,4-DICHLOROBENZENE	1.01E-02	6.62E-02	8.04E-02	5.37E-05	NA		2.84E-02	2.30E-05	4.80E-02	1.11E-06
METALS										
BARIUM	1.18E+00	6.62E-02	8.00E-04	6.25E-05	1.40E-02	4.46E-03	2.84E-02	2.68E-05	NA	
LEAD	1.41E-02	6.62E-02	1.34E-04	1.25E-07	NA		2.84E-02	5.36E-08	NA	
NICKEL	4.63E-02	6.62E-02	1.08E-03	3.31E-06	4.00E-03	8.27E-04	2.84E-02	1.42E-06	NA	
SELENIUM	5.27E-03	6.62E-02	8.10E-04	2.83E-07	NA		2.84E-02	1.21E-07	NA	
						3.2E-02				1.3E-05

DERMAL CONTACT DUE TO SHOWERING
CW = Concentration of chemical in water (mg/L)

7.20E+03	SAC = 7200 cu. cm - Skin Surface Area Available for Contact, (Child), (EPA 1989a)
1.82E+04	SAA = 18,200 cu. cm - Skin Surface Area Available for Contact (Adult), (EPA 1989a)
3.50E+02	EF = 350 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 hours/day - Exposure Time, (EPA 1989a)
5.00E+00	EDC = 5 years - Exposure duration for child (1-6 yrs), (OSWER 1991)
2.50E+01	EDA = 25 years - Exposure duration for adult (6-30 yrs), (OSWER 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER 1991)
3.00E+01	ATN = 30 years - Averaging Time for non-carcinogenic compounds, (OSWER 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic comounds, (OSWER 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m), (EPA 1989a)
	PC = Permeability Constant (Chemical Specific), (Table 4-1)

HIF--(NON-CARCINOGENIC)-->	6.62E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATN)(365)]
HIF--(CARCINOGENIC)------->	2.84E-02	HIF = CF[((SAC * ET * EF * EDC / BWC) + (SAA * ET * EF * EDA / BWA)) / (ATc)(365)]

INTAKE = (CW * HIF * PC)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)
RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-45
RISK SEGMENT REGIONAL AQUIFER ZONE
INGESTION OF CONTAMINANTS IN DRINKING WATER
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
BENZENE	5.00E-03	9.78E-03	4.89E-05	NA		3.49E-03	1.75E-05	2.90E-02	5.07E-07
CHLOROBENZENE	7.38E-02	9.78E-03	7.22E-04	2.00E-02	3.61E-02	3.49E-03	2.58E-04	NA	
1,1-DICHLOROETHANE	6.51E-03	9.78E-03	6.37E-05	1.00E-01	6.37E-04	3.49E-03	2.27E-05	NA	
1,1-DICHLOROETHENE	7.00E-03	9.78E-03	6.85E-05	9.00E-03	7.61E-03	3.49E-03	2.45E-05	6.00E-01	1.47E-05
CIS-1,2-DICHLOROETHENE	9.59E-03	9.78E-03	9.38E-05	1.00E-02	9.38E-03	3.49E-03	3.35E-05	NA	
TRANS-1,2-DICHLOROETHENE	1.89E-02	9.78E-03	1.85E-04	2.00E-02	9.25E-03	3.49E-03	6.60E-05	NA	
1,2-DICHLOROPROPANE	5.73E-03	9.78E-03	5.61E-05	NA		3.49E-03	2.00E-05	6.80E-02	1.36E-06
METHYLENE CHLORIDE	1.44E-02	9.78E-03	1.41E-04	6.00E-02	2.35E-03	3.49E-03	5.03E-05	7.50E-03	3.77E-07
TETRACHLOROETHENE	2.76E-02	9.78E-03	2.70E-04	1.00E-02	2.70E-02	3.49E-03	9.64E-05	5.10E-02	4.92E-06
1,1,1-TRICHLOROETHANE	5.86E-03	9.78E-03	5.73E-05	9.00E-02	6.37E-04	3.49E-03	2.05E-05	NA	
TRICHLOROETHENE	1.89E-01	9.78E-03	1.85E-03	NA		3.49E-03	6.60E-04	1.10E-02	7.27E-06
1,2,4-TRIMETHYLBENZENE	3.46E-04	9.78E-03	3.39E-06	NA		3.49E-03	1.21E-06	NA	
VINYL CHLORIDE	1.19E-02	9.78E-03	1.16E-04	NA		3.49E-03	4.16E-05	1.90E+00	7.90E-05
SEMI-VOLATILE ORGANICS									
1,2-DICHLOROBENZENE	2.04E-02	9.78E-03	2.00E-04	9.00E-02	2.22E-03	3.49E-03	7.13E-05	NA	
1,4-DICHLOROBENZENE	1.01E-02	9.78E-03	9.88E-05	NA		3.49E-03	3.53E-05	2.40E-02	8.47E-07
METALS									
BARIUM	1.18E+00	9.78E-03	1.15E-02	7.00E-02	1.65E-01	3.49E-03	4.12E-03	NA	
LEAD	1.41E-02	9.78E-03	1.38E-04	NA		3.49E-03	4.93E-05	NA	
NICKEL	4.63E-02	9.78E-03	4.53E-04	2.00E-02	2.27E-02	3.49E-03	1.62E-04	NA	
SELENIUM	5.27E-03	9.78E-03	5.16E-05	NA		3.49E-03	1.84E-05	NA	
					2.8E-01				1.1E-04

DRINKING WATER INGESTION

CW = Concentration of chemical in water (mg/L)

1.00E+00 IR = 1.00 Liter/day (OSWER, 1991)

2.50E+02 EF = 250 days/year - Exposure Frequency, (OSWER, 1991)

2.50E+01 ED = 25 years - Exposure duration for adult,(OSWER, 1991)

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

2.50E+01 ATN = 25 years - Averaging Time for non-carcinogenic compounds (OSWER, 1991)

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

HIF--(NON-CARCINOGENIC)--> 9.78E-03 HIF = (IR * EF * ED / BW) / (ATN)(365)

HIF--(CARCINOGENIC)-------> 3.49E-03 HIF = (IR * EF * ED / BW) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

NA - Data Not Available

TABLE C-46
RISK SEGMENT REGIONAL AQUIFER ZONE
INHALATION OF GROUNDWATER CONTAMINANTS DUE TO SHOWERING
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfC (mg/cu.m)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	5.00E-03	1.22E-03	1.02E-04	NA			4.37E-04	3.65E-05	2.90E-02	1.06E-06
CHLOROBENZENE	7.38E-02	1.22E-03	1.51E-03	2.00E-02	8.57E-03	1.76E-01	4.37E-04	5.38E-04	NA	
1,1-DICHLOROETHANE	6.51E-03	1.22E-03	1.33E-04	5.00E-01	2.14E-01	6.21E-04	4.37E-04	4.75E-05	NA	
1,1-DICHLOROETHENE	7.00E-03	1.22E-03	1.43E-04	NA			4.37E-04	5.11E-05	1.20E+00	6.13E-05
CIS-1,2-DICHLOROETHENE	9.59E-03	1.22E-03	1.96E-04	NA			4.37E-04	7.00E-05	NA	
TRANS-1,2-DICHLOROETHENE	1.89E-02	1.22E-03	3.86E-04	NA			4.37E-04	1.38E-04	NA	
1,2-DICHLOROPROPANE	5.73E-03	1.22E-03	1.17E-04	NA			4.37E-04	4.18E-05	NA	
METHYLENE CHLORIDE	1.44E-02	1.22E-03	2.94E-04	3.00E+00	1.29E+00	2.29E-04	4.37E-04	1.05E-04	1.40E-02	1.47E-06
TETRACHLOROETHENE	2.76E-02	1.22E-03	5.64E-04	NA			4.37E-04	2.01E-04	3.30E-03	6.64E-07
1,1,1-TRICHLOROETHANE	5.86E-03	1.22E-03	1.20E-04	1.00E+00	4.29E-01	2.79E-04	4.37E-04	4.27E-05	NA	
TRICHLOROETHENE	1.89E-01	1.22E-03	3.86E-03	NA			4.37E-04	1.38E-03	1.70E-02	2.34E-05
1,2,4-TRIMETHYLBENZENE	3.46E-04	1.22E-03	7.07E-06	NA			4.37E-04	2.52E-06	NA	
VINYL CHLORIDE	1.19E-02	1.22E-03	2.43E-04	NA			4.37E-04	8.68E-05	3.00E-01	2.60E-05
SEMI-VOLATILE ORGANICS										
1,2-DICHLOROBENZENE	2.04E-02	1.22E-03	4.17E-05	2.00E-01	8.57E-02	4.86E-04	4.37E-04	1.49E-05	NA	
1,4-DICHLOROBENZENE	1.01E-02	1.22E-03	2.06E-05	7.00E-01	3.00E-01	6.88E-05	4.37E-04	7.37E-06	NA	
METALS										
BARIUM	1.18E+00	1.22E-03	0.00E+00	5.00E-04	2.14E-04		4.37E-04	0.00E+00	NA	
LEAD	1.41E-02	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
NICKEL	4.63E-02	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	8.40E-01	
SELENIUM	5.27E-03	1.22E-03	0.00E+00	NA			4.37E-04	0.00E+00	NA	
						1.8E-01				1.1E-04

INHALATION DUE TO SHOWERING

	CC = 16.7 L/cu.m - Conversion Factor (L/cu. m); (DATA*200L/12 cu. m), (EPA, 1989a)
0.00E+00	VRM = Volatilization Rate (Metals = 0.0 %) #
1.00E-01	VRS = Volatilization Rate (Semi-volatiles = 10.0 %) #
1.00E+00	VRV = Volatilization Rate (Volatiles = 100.0 %) #
6.25E-01	IR = 0.625 cu. m/hr - Inhalation Rate (Adult), (EPA, 1989a)
2.00E-01	ET = 0.2 hours/day - Exposure Time for showering, (EPA, 1989a)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.50E+01	ED = 25 years - Exposure duration for adult worker, (OSWER, 1991)
7.00E+01	BW = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)

HIF--(NON-CARCINOGENIC)-->	1.22E-03	HIF = ((IR * ET * EF * ED / BW)) / (ATN)(365)
HIF--(CARCINOGENIC)-------->	4.37E-04	HIF = ((IR * ET * EF * ED / BW)) / (ATC)(365)
		INTAKE = (CA * CC * VRM * HIF)
	4.29E-01	RfD = (RfC * 30 cu.cm/day / 70 kg); (30 / 70) = 0.429
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

Assumed values
NA - Data Not Available

TABLE C-47
RISK SEGMENT REGIONAL AQUIFER ZONE
DERMAL CONTACT WITH GROUNDWATER CONTAMINANTS DUE TO SHOWERING
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	5.00E-03	3.56E-02	1.11E-01	1.98E-05	NA		1.27E-02	7.06E-06	3.60E-02	2.54E-07
CHLOROBENZENE	7.38E-02	3.56E-02	4.04E-02	1.06E-04	1.60E-02	6.64E-03	1.27E-02	3.79E-05	NA	
1,1-DICHLOROETHANE	6.51E-03	3.56E-02	1.26E-02	2.92E-06	8.00E-02	3.65E-05	1.27E-02	1.04E-06	NA	
1,1-DICHLOROETHENE	7.00E-03	3.56E-02	5.99E-03	1.49E-06	7.20E-03	2.07E-04	1.27E-02	5.33E-07	7.50E-01	4.00E-07
CIS-1,2-DICHLOROETHENE	9.59E-03	3.56E-02	1.68E-02	5.74E-06	8.00E-03	7.17E-04	1.27E-02	2.05E-06	NA	
TRANS-1,2-DICHLOROETHENE	1.89E-02	3.56E-02	1.68E-02	1.13E-05	1.60E-02	7.07E-04	1.27E-02	4.04E-06	NA	
1,2-DICHLOROPROPANE	5.73E-03	3.56E-02	2.25E-02	4.59E-06	NA		1.27E-02	1.64E-06	8.50E-02	1.39E-07
METHYLENE CHLORIDE	1.44E-02	3.56E-02	5.12E-03	2.63E-06	4.80E-02	5.47E-05	1.27E-02	9.38E-07	9.40E-03	8.82E-09
TETRACHLOROETHENE	2.76E-02	3.56E-02	4.54E-02	4.46E-05	8.00E-03	5.58E-03	1.27E-02	1.59E-05	6.40E-02	1.02E-06
1,1,1-TRICHLOROETHANE	5.86E-03	3.56E-02	1.76E-02	3.67E-06	7.20E-02	5.10E-05	1.27E-02	1.31E-06	NA	
TRICHLOROETHENE	1.89E-01	3.56E-02	1.62E-02	1.09E-04	NA		1.27E-02	3.89E-05	1.40E-02	5.45E-07
1,2,4-TRIMETHYLBENZENE	3.46E-04	3.56E-02	8.00E-04	9.86E-09	NA		1.27E-02	3.52E-09	NA	
VINYL CHLORIDE	1.19E-02	3.56E-02	8.32E-03	3.53E-06	NA		1.27E-02	1.26E-06	2.40E+00	3.02E-06
SEMI-VOLATILE ORGANICS										
1,2-DICHLOROBENZENE	2.04E-02	3.56E-02	2.89E-02	2.10E-05	4.50E-02	4.67E-04	1.27E-02	7.50E-06	NA	
1,4-DICHLOROBENZENE	1.01E-02	3.56E-02	8.04E-02	2.89E-05	NA		1.27E-02	1.03E-05	4.80E-02	4.96E-0.
METALS										
BARIUM	1.18E+00	3.56E-02	8.00E-04	3.36E-05	2.00E-04	1.68E-01	1.27E-02	1.20E-05	NA	
LEAD	1.41E-02	3.56E-02	1.34E-04	6.73E-08	NA		1.27E-02	2.40E-08	NA	
NICKEL	4.63E-02	3.56E-02	1.08E-03	1.78E-06	4.00E-03	4.45E-04	1.27E-02	6.36E-07	NA	
SELENIUM	5.27E-03	3.56E-02	8.10E-04	1.52E-07	NA		1.27E-02	5.43E-08	NA	
						1.8E-01				5.9E-06

DERMAL CONTACT DUE TO SHOWERING (ADULT WORKER ONLY)

	CW = Concentration of chemical in water (mg/L)
1.82E+04	SA = 18,200 sq.cm - Skin Surface Area Available for Contact (Adult), (EPA, 1989a)
2.50E+02	EF = 250 days/year - Exposure Frequency, (OSWER, 1991)
2.00E-01	ET = 0.2 min./hour - Exposure Time, (EPA, 1989a)
2.50E+01	ED = 25 years - Exposure duration for adult, (OSWER, 1991)
7.00E+01	BWA = 70 kg - Body Weight for adult, (OSWER, 1991)
2.50E+01	ATN = 25 years - Averaging Time for non-carcinogenic compounds, (OSWER, 1991)
7.00E+01	ATC = 70 years - Averaging Time for carcinogenic compounds, (OSWER, 1991)
1.00E-03	CF = Conversion Factor, (1L / 1000 cu.m)
	PC = Permeability Constant (Chemical Specific)

HIF--(NON-CARCINOGENIC)-->	3.56E-02	HIF = ((SA * ET * EF * ED / BW) / (ATN)(365))CF
HIF--(CARCINOGENIC)------->	1.27E-02	HIF = ((SA * ET * EF * ED / BW) / (ATC)(365))CF

INTAKE = (CW * HIF * PC)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

RfD = (RfD * ABS Factor)

NA - Data Not Available

TABLE C-48
RISK SEGMENT M2
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
ACETONE	6.00E-03	1.70E-04	1.02E-06	1.00E-01	1.02E-05	7.30E-05	4.38E-07	NA	
BENZENE	5.00E-03	1.70E-04	8.51E-07	NA		7.30E-05	3.65E-07	2.90E-02	1.06E-08
CARBON DISULFIDE	5.00E-03	1.70E-04	8.51E-07	1.00E-01	8.51E-06	7.30E-05	3.65E-07	NA	
CHLOROBENZENE	5.00E-03	1.70E-04	8.51E-07	2.00E-02	4.26E-05	7.30E-05	3.65E-07	NA	
1,1,1-TRICHLOROETHANE	4.95E-03	1.70E-04	8.42E-07	9.00E-02	9.36E-06	7.30E-05	3.61E-07	NA	
TRICHLOROETHENE	5.00E-03	1.70E-04	8.51E-07	NA		7.30E-05	3.65E-07	1.10E-02	4.01E-09
TOLUENE	5.00E-03	1.70E-04	8.51E-07	2.00E-01	4.26E-06	7.30E-05	3.65E-07	NA	
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
CADMIUM	2.50E-03	1.70E-04	4.26E-07	5.00E-04	8.51E-04	7.30E-05	1.82E-07	NA	
CHROMIUM	3.52E-02	1.70E-04	5.99E-06	5.00E-03	1.20E-03	7.30E-05	2.57E-06	NA	
NICKEL	1.84E-02	1.70E-04	3.13E-06	2.00E-02	1.57E-04	7.30E-05	1.34E-06	NA	
SELENIUM	6.70E-03	1.70E-04	1.14E-06	NA		7.30E-05	4.89E-07	NA	
SODIUM	1.22E+02	1.70E-04	2.08E-02	NA		7.30E-05	8.90E-03	NA	
					2.3E-03				1.5E-08

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)

5.00E-02	CR = 0.05 L/hr - Contact Rate (EPA, 1989a)
6.00E+00	ETC = 6 hrs/day - Exposure Time for a child #
2.00E+00	ETA = 2 hrs/day - Exposure Time for an adult #
1.70E+01	EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Exposure Duration for a child (0-6 yrs) (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------->	1.70E-04	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)---------->	7.30E-05	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-49
RISK SEGMENT M3
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
CHLOROFORM	5.00E-03	1.70E-04	8.51E-07	1.00E-02	8.51E-05	7.30E-05	3.65E-07	6.10E-03	2.22E-09
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
CHROMIUM	4.08E-02	1.70E-04	6.94E-06	5.00E-04	1.39E-02	7.30E-05	2.98E-06	NA	
CYANIDE	1.59E-02	1.70E-04	2.71E-06	2.00E-02	1.35E-04	7.30E-05	1.16E-06	NA	
POTASSIUM	5.66E+00	1.70E-04	9.64E-04	NA		7.30E-05	4.13E-04	NA	
SELENIUM	6.41E-03	1.70E-04	1.09E-06	NA		7.30E-05	4.68E-07	NA	
SODIUM	8.09E+01	1.70E-04	1.38E-02	NA		7.30E-05	5.90E-03	NA	
					1.4E-02				2.2E-09

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)

5.00E-02	CR = 0.05 L/hr - Contact Rate (EPA, 1989a)
6.00E+00	ETC = 6 hrs/day - Exposure Time for a child #
2.00E+00	ETA = 2 hrs/day - Exposure Time for an adult #
1.70E+01	EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Exposure Duration for a child (0-6 yrs) (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER,
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (OSWER,
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)---------->	1.70E-04	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)---------->	7.30E-05	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-50
RISK SEGMENT E2
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
ACETONE	5.11E-02	1.70E-04	8.70E-06	1.00E-01	8.70E-05	7.30E-05	3.73E-06	NA	
BENZENE	5.00E-03	1.70E-04	8.51E-07	NA		7.30E-05	3.65E-07	2.90E-02	1.06E-08
METHYLENE CHLORIDE	5.20E-01	1.70E-04	8.86E-05	6.00E-02	1.48E-03	7.30E-05	3.80E-05	7.50E-03	2.85E-07
1,1,1-TRICHLOROETHANE	5.00E-03	1.70E-04	8.51E-07	9.00E-02	9.46E-06	7.30E-05	3.65E-07	NA	
TOLUENE	5.00E-03	1.70E-04	8.51E-07	2.00E-01	4.26E-06	7.30E-05	3.65E-07	NA	
XYLENE (TOTAL)	5.00E-03	1.70E-04	8.51E-07	2.00E+00	4.26E-07	7.30E-05	3.65E-07	NA	
SEMI-VOLATILE ORGANICS									
BENZOIC ACID	5.00E-03	1.70E-04	8.51E-07	4.00E+00	2.13E-07	7.30E-05	3.65E-07	NA	
METALS									
ALUMINUM	4.08E-01	1.70E-04	6.94E-05	NA		7.30E-05	2.98E-05	NA	
BARIUM	2.80E-01	1.70E-04	4.77E-05	7.00E-02	6.81E-04	7.30E-05	2.04E-05	NA	
CADMIUM	8.28E-03	1.70E-04	1.41E-06	5.00E-04	2.82E-03	7.30E-05	6.04E-07	NA	
CALCIUM	4.75E+01	1.70E-04	8.09E-03	NA		7.30E-05	3.47E-03	NA	
CHROMIUM	3.49E-02	1.70E-04	5.94E-06	5.00E-03	1.19E-03	7.30E-05	2.55E-06	NA	
IRON	3.46E-01	1.70E-04	5.89E-05	NA		7.30E-05	2.52E-05	NA	
MAGNESIUM	2.21E+01	1.70E-04	3.76E-03	NA		7.30E-05	1.61E-03	NA	
MANGANESE	2.98E-01	1.70E-04	5.07E-05	1.00E-01	5.07E-04	7.30E-05	2.17E-05	NA	
POTASSIUM	6.29E+00	1.70E-04	1.07E-03	NA		7.30E-05	4.59E-04	NA	
SELENIUM	5.80E-03	1.70E-04	9.87E-07	NA		7.30E-05	4.23E-07	NA	
SODIUM	1.30E+02	1.70E-04	2.21E-02	NA		7.30E-05	9.48E-03	NA	
					6.8E-03				3.0E-07

INCIDENTAL INGESTION OF SURFACE WATER

CW = Concentration of chemical in water (mg/L)

5.00E-02 CR = 0.05 L/hr - Contact Rate (EPA, 1989a)

6.00E+00 ETC = 6 hrs/day - Exposure Time for a child #

2.00E+00 ETA = 2 hrs/day - Exposure Time for an adult #

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs) (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------> 1.70E-04 HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)

HIF--(CARCINOGENIC)----------> 7.30E-05 HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: SW3

TABLE C-51
RISK SEGMENT W2
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
NONE DETECTED									
METALS									
CHROMIUM	3.12E-02	1.70E-04	5.31E-06	5.00E-03	1.06E-03	7.30E-05	2.28E-06	NA	
					1.1E-03				

INCIDENTAL INGESTION OF SURFACE WATER

	CW = Concentration of chemical in water (mg/L)
5.00E-02	CR = 0.05 L/hr - Contact Rate (EPA, 1989a)
6.00E+00	ETC = 6 hrs/day - Exposure Time for a child #
2.00E+00	ETA = 2 hrs/day - Exposure Time for an adult #
1.70E+01	EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Exposure Duration for a child (0-6 yrs) (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------->	1.70E-04	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)---------->	7.30E-05	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)
		INTAKE = (CW * HIF)
		RISK (non-carcinogenic) = (INTAKE / RfD)
		RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-52
RISK SEGMENT M2
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
ACETONE	6.00E-03	2.80E-02	8.00E-04	1.35E-07	8.00E-02	1.68E-06	1.20E-02	5.77E-08	NA	
BENZENE	5.00E-03	2.80E-02	1.11E-01	1.56E-05	NA		1.20E-02	6.67E-06	3.60E-02	2.40E-07
CARBON DISULFIDE	5.00E-03	2.80E-02	5.30E-01	7.43E-05	8.00E-02	9.28E-04	1.20E-02	3.18E-05	NA	
CHLOROBENZENE	5.00E-03	2.80E-02	4.04E-02	5.66E-06	1.60E-02	3.54E-04	1.20E-02	2.43E-06	NA	
1,1,1-TRICHLOROETHANE	4.95E-03	2.80E-02	1.76E-02	2.44E-06	7.20E-02	3.39E-05	1.20E-02	1.05E-06	NA	
TRICHLOROETHENE	5.00E-03	2.80E-02	1.62E-02	2.27E-06	NA		1.20E-02	9.73E-07	1.40E-02	1.36E-08
TOLUENE	5.00E-03	2.80E-02	1.01E+00	1.42E-04	1.60E-01	8.85E-04	1.20E-02	6.07E-05	NA	
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
CADMIUM	2.50E-03	2.80E-02	5.06E-04	3.55E-08	1.00E-04	3.55E-04	1.20E-02	1.52E-08	NA	
CHROMIUM	3.52E-02	2.80E-02	2.10E-03	2.07E-06	1.00E-03	2.07E-03	1.20E-02	8.87E-07	NA	
NICKEL	1.84E-02	2.80E-02	1.08E-03	5.57E-07	4.00E-03	1.39E-04	1.20E-02	2.39E-07	NA	
SELENIUM	6.70E-03	2.80E-02	8.10E-04	1.52E-07	NA		1.20E-02	6.52E-08	NA	
SODIUM	1.22E+02	2.80E-02	8.00E-04	2.74E-03	NA		1.20E-02	1.17E-03	NA	
						4.8E-03				2.5E-07

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03	SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
1.82E+04	SAA = 18200 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), whole body, (EPA, 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 weeks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
6.00E+00	ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #
2.00E+00	ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #
5.00E+00	EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
2.80E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF
1.20E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

HIF---(NON-CARCINOGENIC)---------->
HIF---(CARCINOGENIC)---------->

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-53
RISK SEGMENT M3
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
CHLOROFORM	5.00E-03	2.80E-02	9.58E-03	1.34E-06	8.00E-03	1.68E-04	1.20E-02	5.75E-07	7.60E-03	4.37E-09
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
CHROMIUM	4.08E-02	2.80E-02	2.10E-03	2.40E-06	1.00E-03	2.40E-03	1.20E-02	1.03E-06	NA	
CYANIDE	1.59E-02	2.80E-02	1.70E-03	7.58E-07	4.00E-03	1.89E-04	1.20E-02	3.25E-07	NA	
POTASSIUM	5.66E+00	2.80E-02	8.00E-04	1.27E-04	NA		1.20E-02	5.44E-05	NA	
SELENIUM	6.41E-03	2.80E-02	8.10E-04	1.46E-07	NA		1.20E-02	6.24E-08	NA	
SODIUM	8.09E+01	2.80E-02	8.00E-04	1.81E-03	NA		1.20E-02	7.77E-04	NA	
						2.8E-03				4.4E-09

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03	SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
1.82E+04	SAA = 18200 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), whole body, (EPA, 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 weeks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
6.00E+00	ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #
2.00E+00	ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #
5.00E+00	EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
2.80E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF
1.20E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

HIF—(NON-CARCINOGENIC)----------> 2.80E-02
HIF—(CARCINOGENIC)----------> 1.20E-02

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

FILE: SW6

TABLE C-54
RISK SEGMENT E2
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg-kg/day)	RfD (mg-kg/day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
ACETONE	5.11E-02	2.80E-02	8.00E-04	1.15E-06	8.00E-02	1.43E-05	1.20E-02	4.91E-07	NA	
BENZENE	5.00E-03	2.80E-02	1.11E-01	1.56E-05	NA		1.20E-02	6.67E-06	3.60E-02	2.40E-07
METHYLENE CHLORIDE	5.20E-01	2.80E-02	5.12E-03	7.47E-05	4.80E-02	1.56E-03	1.20E-02	3.20E-05	9.40E-03	3.01E-07
1,1,1-TRICHLOROETHANE	5.00E-03	2.80E-02	1.76E-02	2.47E-06	7.20E-02	3.43E-05	1.20E-02	1.06E-06	NA	
TOLUENE	5.00E-03	2.80E-02	1.01E+00	1.42E-04	1.60E-01	8.85E-04	1.20E-02	6.07E-05	NA	
XYLENE (TOTAL)	5.00E-03	2.80E-02	5.52E-04	7.74E-08	1.60E+00	4.84E-08	1.20E-02	3.32E-08	NA	
SEMI-VOLATILE ORGANICS										
BENZOIC ACID	5.00E-03	2.80E-02	7.12E-01	9.98E-05	2.00E+00	4.99E-05	1.20E-02	4.28E-05	NA	
METALS										
ALUMINUM	4.08E-01	2.80E-02	8.00E-04	9.15E-06	NA		1.20E-02	3.92E-06	NA	
BARIUM	2.80E-01	2.80E-02	8.00E-04	6.28E-06	1.40E-02	4.48E-04	1.20E-02	2.69E-06	NA	
CADMIUM	8.28E-03	2.80E-02	5.06E-04	1.17E-07	1.00E-04	1.17E-03	1.20E-02	5.04E-08	NA	
CALCIUM	4.75E+01	2.80E-02	8.00E-04	1.07E-03	NA		1.20E-02	4.56E-04	NA	
CHROMIUM	3.49E-02	2.80E-02	2.10E-03	2.05E-06	1.00E-03	2.05E-03	1.20E-02	8.80E-07	NA	
IRON	3.46E-01	2.80E-02	8.00E-04	7.76E-06	NA		1.20E-02	3.33E-06	NA	
MAGNESIUM	2.21E+01	2.80E-02	8.00E-04	4.96E-04	NA		1.20E-02	2.12E-04	NA	
MANGANESE	2.98E-01	2.80E-02	8.00E-04	6.68E-06	2.00E-02	3.34E-04	1.20E-02	2.86E-06	NA	
POTASSIUM	6.29E+00	2.80E-02	8.00E-04	1.41E-04	NA		1.20E-02	6.04E-05	NA	
SELENIUM	5.80E-03	2.80E-02	8.10E-04	1.32E-07	NA		1.20E-02	5.64E-08	NA	
SODIUM	1.30E+02	2.80E-02	8.00E-04	2.92E-03	NA		1.20E-02	1.25E-03	NA	
						6.6E-03				5.4E-07

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03	SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
1.82E+04	SAA = 18200 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), whole body, (EPA, 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 weeks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
6.00E+00	ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #
2.00E+00	ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #
5.00E+00	EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
2.80E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF
1.20E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

HIF—(NON-CARCINOGENIC)----------> 2.80E-02
HIF—(CARCINOGENIC)----------> 1.20E-02

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

FILE: SW7

TABLE C-55
RISK SEGMENT W2
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO SWIMMING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
CHROMIUM	3.12E-02	2.80E-02	2.10E-03	1.84E-06	1.00E-03	1.84E-03	1.20E-02	7.87E-07	NA	
						1.8E-03				

DERMAL CONTACT WITH SURFACE WATER

CW = Concentration of chemical in water (mg/L)

PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03 SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)

1.82E+04 SAA = 18200 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), whole body, (EPA, 1989a)

1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 weeks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #

6.00E+00 ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #

2.00E+00 ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #

5.00E+00 EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03 CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)

HIF---(NON-CARCINOGENIC)----------> 2.80E-02 HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF

HIF---(CARCINOGENIC)----------> 1.20E-02 HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

INTAKE = (CW * PC * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-56
RISK SEGMENT A
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO WADING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS									
NOT ANALYZED									
METALS									
NOT ANALYZED									

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)
5.00E-03 CR = 0.005 L.hr - Contact Rate (10% of swimming scenario) #
6.00E+00 ETC = 6 hrs/day - Exposure Time for a child #
2.00E+00 ETA = 2 hrs/day - Exposure Time for an adult #
1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 weeks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Exposure Duration for a child, (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.70E-05 HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)----------> 7.30E-06 HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)
INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-57
RISK SEGMENT B
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO WADING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS									
NOT ANALYZED									
METALS									
ARSENIC	7.40E-03	1.70E-05	1.26E-07	1.00E-03	1.26E-04	7.30E-06	5.40E-08	NA	
					1.3E-04				

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)

5.00E-03	CR = 0.005 L.hr - Contact Rate (10% of swimming scenario) #
6.00E+00	ETC = 6 hrs/day - Exposure Time for a child #
2.00E+00	ETA = 2 hrs/day - Exposure Time for an adult #
1.70E+01	EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 weeks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Exposure Duration for a child, (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------->	1.70E-05	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)---------->	7.30E-06	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-58
RISK SEGMENT M1
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO WADING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS									
BENZOIC ACID	5.00E-03	1.70E-05	8.51E-08	4.00E+00	2.13E-08	7.30E-06	3.65E-08	NA	
METALS									
BARIUM	1.71E+00	1.70E-05	2.91E-05	7.00E-02	4.16E-04	7.30E-06	1.25E-05	NA	
CHROMIUM	1.34E-02	1.70E-05	2.27E-07	5.00E-03	4.55E-05	7.30E-06	9.74E-08	NA	
LEAD	2.01E-02	1.70E-05	3.42E-07	NA		7.30E-06	1.47E-07	NA	
					4.6E-04				

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)

5.00E-03	CR = 0.005 L.hr - Contact Rate (10% of swimming scenario) #
6.00E+00	ETC = 6 hrs/day - Exposure Time for a child #
2.00E+00	ETA = 2 hrs/day - Exposure Time for an adult #
1.70E+01	EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 weeks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Exposure Duration for a child, (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------->	1.70E-05	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATN)(365)
HIF---(CARCINOGENIC)---------->	7.30E-06	HIF = ((CR * ETC * EFC * EDC / BWC) + (CR * ETA * EFA * EDA / BWA)) / (ATC)(365)

INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-59
RISK SEGMENT A
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO WADING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NOT ANALYZED										
SEMI-VOLATILE ORGANICS										
NOT ANALYZED										
METALS										
NOT ANALYZED										

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03	SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03	SAA = 8620 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), hands, arms, lower legs, (EPA 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
6.00E+00	ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #
2.00E+00	ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #
5.00E+00	EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
2.50E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF
1.07E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

HIF---(NON-CARCINOGENIC)---------->
HIF---(CARCINOGENIC)---------->

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-60
RISK SEGMENT B
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO WADING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
NONE DETECTED										
METALS										
ARSENIC	7.40E-03	2.50E-02	8.57E-04	1.58E-07	2.00E-04	7.92E-04	1.07E-02	6.79E-08	NA	
						7.9E-04				

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03	SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03	SAA = 8620 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), hands, arms, lower legs, (EPA 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
6.00E+00	ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #
2.00E+00	ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #
6.00E+00	EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
HIF--(NON-CARCINOGENIC)----------> 2.50E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF
HIF--(CARCINOGENIC)----------> 1.07E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-61
RISK SEGMENT M1
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO WADING
OFF-BASE CHILD AND ADULT (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BENZOIC ACID	5.00E-03	2.50E-02	7.12E-01	8.89E-05	2.00E+00	4.44E-05	1.07E-02	3.81E-05	NA	
METALS										
BARIUM	1.71E+00	2.50E-02	8.00E-04	3.42E-05	1.40E-02	2.44E-03	1.07E-02	1.46E-05	NA	
CHROMIUM	1.34E-02	2.50E-02	2.10E-03	7.00E-07	1.00E-03	7.00E-04	1.07E-02	3.00E-07	NA	
LEAD	2.01E-02	2.50E-02	1.34E-03	6.72E-07	NA		1.07E-02	2.88E-07	NA	
						3.2E-03				

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

7.20E+03	SAC = 7200 sq cm - Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03	SAA = 8620 sq cm - Surface Area Available for Contact, (Adult: 6-30 yrs.), hands, arms, lower legs, (EPA 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
6.00E+00	ETC = 6 hrs/day - Exposure Time, (Child: 0-6 yrs.) #
2.00E+00	ETA = 2 hrs/day - Exposure Time, (Adult: 6-30 yrs.) #
5.00E+00	EDC = 5 yrs - Exposure duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
HIF---(NON-CARCINOGENIC)----------> 2.50E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATN)(365)] * CF
HIF---(CARCINOGENIC)----------> 1.07E-02	HIF = [((SAC * ETC * EFC * EDC / BWC) + (SAA * ETA * EFA * EDA / BWA)) / (ATC)(365)] * CF

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-62
RISK SEGMENT E1
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
BROMODICHLOROMETHANE	5.17E-03	1.96E-07	1.01E-09	2.00E-02	5.06E-08	6.99E-08	3.61E-10	1.30E-01	4.70E-11
BROMOFORM	7.07E-03	1.96E-07	1.38E-09	2.00E-02	6.92E-08	6.99E-08	4.94E-10	7.90E-03	3.91E-12
CARBON DISULFIDE	5.00E-03	1.96E-07	9.78E-10	1.00E-01	9.78E-09	6.99E-08	3.49E-10	NA	
CHLOROFORM	5.09E-03	1.96E-07	9.97E-10	1.00E-02	9.97E-08	6.99E-08	3.56E-10	6.10E-03	2.17E-12
DIBROMOCHLOROMETHANE	5.00E-03	1.96E-07	9.78E-10	2.00E-02	4.89E-08	6.99E-08	3.49E-10	8.40E-02	2.94E-11
TETRACHLOROETHENE	5.00E-03	1.96E-07	9.78E-10	1.00E-02	9.78E-08	6.99E-08	3.49E-10	5.10E-02	1.78E-11
1,1,1-TRICHLOROETHANE	5.00E-03	1.96E-07	9.78E-10	9.00E-02	1.09E-08	6.99E-08	3.49E-10	NA	
SEMI-VOLATILE ORGANICS									
BENZO(G,H,I)PERYLENE	5.23E-03	1.96E-07	1.02E-09	NA		6.99E-08	3.66E-10	NA	
BENZOIC ACID	5.00E-03	1.96E-07	9.78E-10	4.00E+00	2.45E-10	6.99E-08	3.49E-10	NA	
CHRYSENE	5.00E-03	1.96E-07	9.78E-10	NA		6.99E-08	3.49E-10	1.20E+01	4.19E-09
METALS									
ARSENIC	5.69E-03	1.96E-07	1.11E-09	1.00E-03	1.11E-06	6.99E-08	3.98E-10	NA	
CHROMIUM	5.26E-02	1.96E-07	1.03E-08	5.00E-03	2.06E-06	6.99E-08	3.67E-09	NA	
COPPER	1.04E-01	1.96E-07	2.03E-08	NA		6.99E-08	7.25E-09	NA	
NICKEL	2.31E-02	1.96E-07	4.52E-09	2.00E-02	2.26E-07	6.99E-08	1.61E-09	NA	
SELENIUM	1.24E-02	1.96E-07	2.43E-09	NA		6.99E-08	8.67E-10	NA	
SILVER	5.00E-03	1.96E-07	9.78E-10	3.00E-03	3.26E-07	6.99E-08	3.49E-10	NA	
VANADIUM	2.04E-02	1.96E-07	3.99E-09	7.00E-03	5.70E-07	6.99E-08	1.43E-09	NA	
					4.7E-06				4.3E-09

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)
5.00E-03 IR = 0.005 L/day - Ingestion Rate, (10% of swimming scenario) #
1.00E+00 EF = 1 day/yr - Exposure Frequency #
2.50E+01 EDA = 25 yrs - Exposure duration for adult, (OSWER, 1991)
7.00E+01 BWA = 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)

HIF--(NON-CARCINOGENIC)----------> 1.96E-07 HIF = (IR * EF * ED) / (BW * ATN * 365)
HIF--(CARCINOGENIC)----------> 6.99E-08 HIF = (IR * EF * ED) / (BW * ATC * 365)
INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-63
RISK SEGMENT W1
INCIDENTAL INGESTION OF CONTAMINANTS IN SURFACE WATER DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
CARBON DISULFIDE	5.00E-03	1.96E-07	9.78E-10	1.00E-01	9.78E-09	6.99E-08	3.49E-10	NA	
1,2-DICHLOROETHENE (TOTAL)	8.65E-03	1.96E-07	1.69E-09	1.00E-02	1.69E-07	6.99E-08	6.04E-10	NA	
TRICHLOROETHENE	5.00E-03	1.96E-07	9.78E-10	NA		6.99E-08	3.49E-10	1.10E-02	3.84E-12
TETRACHLOROETHENE	5.00E-03	1.96E-07	9.78E-10	1.00E-02	9.78E-08	6.99E-08	3.49E-10	5.10E-02	1.78E-11
SEMI-VOLATILE ORGANICS									
FLUORANTHENE	5.00E-03	1.96E-07	9.78E-10	4.00E-02	2.45E-08	6.99E-08	3.49E-10	NA	
PYRENE	5.00E-03	1.96E-07	9.78E-10	3.00E-02	3.26E-08	6.99E-08	3.49E-10	NA	
METALS									
ALUMINUM	4.75E+00	1.96E-07	9.30E-07	NA		6.99E-08	3.32E-07	NA	
BERYLLIUM	2.50E-03	1.96E-07	4.89E-10	5.00E-03	9.78E-08	6.99E-08	1.75E-10	4.30E+00	7.51E-10
CADMIUM	2.22E-02	1.96E-07	4.34E-09	5.00E-04	8.68E-06	6.99E-08	1.55E-09	NA	
CHROMIUM	2.07E-01	1.96E-07	4.05E-08	5.00E-03	8.10E-06	6.99E-08	1.45E-08	NA	
COBALT	2.13E-01	1.96E-07	4.16E-08	NA		6.99E-08	1.49E-08	NA	
COPPER	6.22E-01	1.96E-07	1.22E-07	NA		6.99E-08	4.34E-08	NA	
CYANIDE	1.15E-02	1.96E-07	2.26E-09	2.00E-02	1.13E-07	6.99E-08	8.06E-10	NA	
IRON	5.56E+00	1.96E-07	1.09E-06	NA		6.99E-08	3.89E-07	NA	
LEAD	1.10E-01	1.96E-07	2.16E-08	NA		6.99E-08	7.70E-09	NA	
NICKEL	2.30E+00	1.96E-07	4.50E-07	2.00E-02	2.25E-05	6.99E-08	1.61E-07	NA	
SELENIUM	5.90E-03	1.96E-07	1.15E-09	NA		6.99E-08	4.12E-10	NA	
SILVER	1.01E-02	1.96E-07	1.97E-09	3.00E-03	6.57E-07	6.99E-08	7.04E-10	NA	
VANADIUM	4.99E-02	1.96E-07	9.76E-09	7.00E-03	1.39E-06	6.99E-08	3.49E-09	NA	
ZINC	1.54E+00	1.96E-07	3.02E-07	2.00E-01	1.51E-06	6.99E-08	1.08E-07	NA	
					4.3E-05				7.7E-10

INCIDENTAL INGESTION OF SURFACE WATER
CW = Concentration of chemical in water (mg/L)

5.00E-03	IR = 0.005 L/day - Ingestion Rate, (10% of swimming scenario) #
1.00E+00	EF = 1 day/yr - Exposure Frequency #
2.50E+01	EDA = 25 yrs - Exposure duration for adult, (OSWER, 1991)
7.00E+01	BWA = 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)

HIF--(NON-CARCINOGENIC)---------->	1.96E-07	HIF = (IR * EF * ED) / (BW * ATN * 365)
HIF--(CARCINOGENIC)---------->	6.99E-08	HIF = (IR * EF * ED) / (BW * ATC * 365)

INTAKE = (CW * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-64
RISK SEGMENT E1
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO CONSTRUCTION WORK ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BROMODICHLOROMETHANE	5.17E-03	3.07E-03	6.18E-03	9.81E-08	1.60E-02	6.13E-06	1.10E-03	3.50E-08	8.50E-02	2.98E-09
BROMOFORM	7.07E-03	3.07E-03	2.73E-03	5.93E-08	1.60E-02	3.70E-06	1.10E-03	2.12E-08	9.90E-03	2.10E-10
CARBON DISULFIDE	5.00E-03	3.07E-03	5.30E-01	8.13E-06	8.00E-02	1.02E-04	1.10E-03	2.90E-06	NA	
CHLOROFORM	5.09E-03	3.07E-03	9.58E-03	1.50E-07	8.00E-03	1.87E-05	1.10E-03	5.35E-08	7.60E-03	4.06E-10
DIBROMOCHLOROMETHANE	5.00E-03	3.07E-03	4.11E-03	6.31E-08	1.60E-02	3.94E-06	1.10E-03	2.25E-08	1.10E-01	2.48E-09
TETRACHLOROETHENE	5.00E-03	3.07E-03	4.54E-02	6.97E-07	8.00E-03	8.71E-05	1.10E-03	2.49E-07	6.40E-02	1.59E-08
1,1,1-TRICHLOROETHANE	5.00E-03	3.07E-03	1.76E-02	2.70E-07	7.20E-02	3.75E-06	1.10E-03	9.64E-08	NA	
SEMI-VOLATILE ORGANICS										
BENZO(G,H,I)PERYLENE	5.23E-03	3.07E-03	8.00E-04	1.28E-08	NA		1.10E-03	4.59E-09	NA	
BENZOIC ACID	5.00E-03	3.07E-03	7.12E-01	1.09E-05	2.00E+00	5.46E-06	1.10E-03	3.90E-06	NA	
CHRYSENE	5.00E-03	3.07E-03	6.20E-01	9.51E-06	NA		1.10E-03	3.40E-06	NA	
METALS										
ARSENIC	5.69E-03	3.07E-03	8.57E-04	1.50E-08	2.00E-04	7.48E-05	1.10E-03	5.34E-09	NA	
CHROMIUM	5.26E-02	3.07E-03	2.10E-03	3.39E-07	1.00E-03	3.39E-04	1.10E-03	1.21E-07	NA	
COPPER	1.04E-01	3.07E-03	1.01E-03	3.21E-07	NA		1.10E-03	1.15E-07	NA	
NICKEL	2.31E-02	3.07E-03	1.08E-03	7.66E-08	4.00E-03	1.91E-05	1.10E-03	2.73E-08	NA	
SELENIUM	1.24E-02	3.07E-03	8.10E-04	3.08E-08	NA		1.10E-03	1.10E-08	NA	
SILVER	5.00E-03	3.07E-03	5.39E-04	8.27E-09	6.00E-04	1.38E-05	1.10E-03	2.95E-09	NA	
VANADIUM	2.04E-02	3.07E-03	8.00E-04	5.01E-08	1.40E-03	3.58E-05	1.10E-03	1.79E-08	NA	
						7.1E-04				2.2E-08

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

9.80E+03	SA = 9800 sq cm - Surface Area Available for Contact, (Adult), head, arms, hands, lowerlegs, (EPA, 1989a)
1.00E+00	EF = 1 day/yr - Exposure Frequency #
8.00E+00	ET = 8 hrs/day - Exposure Time #
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 = 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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
3.07E-03	HIF = [(SA * ET * EF * ED) / (BW * ATN * 365)] * CF (HIF--(NON-CARCINOGENIC)---------->)
1.10E-03	HIF = [(SA * ET * EF * ED) / (BW * ATC * 365)] * CF (HIF--(CARCINOGENIC)---------->)

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-65
RISK SEGMENT W1
DERMAL CONTACT WITH CONTAMINANTS IN SURFACE WATER DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT AND FUTURE SCENARIOS)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/L)	Human Intake Factor (L/kg-day)	Permeability Constant	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (L/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
CARBON DISULFIDE	5.00E-03	3.07E-03	5.30E-01	8.13E-06	8.00E-02	1.02E-04	1.10E-03	2.90E-06	NA	
1,2-DICHLOROETHENE (TOTAL)	8.65E-03	3.07E-03	1.68E-02	4.46E-07	8.00E-03	5.57E-05	1.10E-03	1.59E-07	NA	
TRICHLOROETHENE	5.00E-03	3.07E-03	1.62E-02	2.49E-07	NA		1.10E-03	8.88E-08	2.40E-02	2.13E-09
TETRACHLOROETHENE	5.00E-03	3.07E-03	4.54E-02	6.97E-07	6.40E-02	1.09E-05	1.10E-03	2.49E-07	8.00E-03	1.99E-09
SEMI-VOLATILE ORGANICS										
FLUORANTHENE	5.00E-03	3.07E-03	2.97E-01	4.56E-06	2.00E-02	2.28E-04	1.10E-03	1.63E-06	NA	
PYRENE	5.00E-03	3.07E-03	8.00E-04	1.23E-08	1.50E-02	8.18E-07	1.10E-03	4.38E-09	NA	
METALS										
ALUMINUM	4.75E+00	3.07E-03	8.00E-04	1.17E-05	NA		1.10E-03	4.17E-06	NA	
BERYLLIUM	2.50E-03	3.07E-03	2.16E-03	1.66E-08	1.00E-03	1.66E-05	1.10E-03	5.92E-09	2.10E+01	1.24E-07
CADMIUM	2.22E-02	3.07E-03	5.06E-04	3.44E-08	1.00E-04	3.44E-04	1.10E-03	1.23E-08	NA	
CHROMIUM	2.07E-01	3.07E-03	2.10E-03	1.33E-06	1.00E-03	1.33E-03	1.10E-03	4.77E-07	NA	
COBALT	2.13E-01	3.07E-03	5.50E-04	3.59E-07	NA		1.10E-03	1.28E-07	NA	
COPPER	6.22E-01	3.07E-03	1.01E-03	1.93E-06	NA		1.10E-03	6.88E-07	NA	
CYANIDE	1.15E-02	3.07E-03	1.70E-03	6.02E-08	4.00E-03	1.50E-05	1.10E-03	2.15E-08	NA	
IRON	5.56E+00	3.07E-03	8.00E-04	1.37E-05	NA		1.10E-03	4.88E-06	NA	
LEAD	1.10E-01	3.07E-03	1.34E-04	4.53E-08	NA		1.10E-03	1.62E-08	NA	
NICKEL	2.30E+00	3.07E-03	1.08E-03	7.62E-06	4.00E-03	1.90E-03	1.10E-03	2.72E-06	NA	
SELENIUM	5.90E-03	3.07E-03	8.10E-04	1.47E-08	NA		1.10E-03	5.24E-09	NA	
SILVER	1.01E-02	3.07E-03	5.39E-04	1.67E-08	6.00E-04	2.78E-05	1.10E-03	5.95E-09	NA	
VANADIUM	4.99E-02	3.07E-03	8.00E-04	1.22E-07	1.40E-03	8.75E-05	1.10E-03	4.37E-08	NA	
ZINC	1.54E+00	3.07E-03	9.80E-04	4.64E-06	4.00E-02	1.16E-04	1.10E-03	1.66E-06	NA	
						4.2E-03				1.3E-07

DERMAL CONTACT WITH SURFACE WATER
CW = Concentration of chemical in water (mg/L)
PC = Permeability Constant (Chemical Specific), (Table 4-1)

9.80E+03	SA = 9800 sq cm - Surface Area Available for Contact, (Adult), head, arms, hands, lowerlegs, (EPA, 1989a)
1.00E+00	EF = 1 day/yr - Exposure Frequency #
8.00E+00	ET = 8 hrs/day - Exposure Time #
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 = 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-03	CF = Conversion Factor (1 L/1000 sq.cm.), (EPA, 1989a)
3.07E-03	HIF = [(SA * ET * EF * ED) / (BW * ATN * 365)] * CF
1.10E-03	HIF = [(SA * ET * EF * ED) / (BW * ATC * 365)] * CF

HIF--(NON-CARCINOGENIC)---------->
HIF--(CARCINOGENIC)---------->

INTAKE = (CW * PC * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-66
RISK SEGMENT A
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS									
NOT ANALYZED									
METALS									
NOT ANALYZED									

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------> 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-67
RISK SEGMENT B
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NOT ANALYZED									
SEMI-VOLATILE ORGANICS									
NOT ANALYZED									
METALS									
NOT ANALYZED									

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------> 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))* CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))* CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-68
RISK SEGMENT M1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	4.87E-01	1.19E-07	5.78E-08	2.00E-02	2.89E-06	5.09E-08	2.48E-08	1.40E-02	3.47E-10
METALS									
ARSENIC	3.91E+00	1.19E-07	4.65E-07	1.00E-03	4.65E-04	5.09E-08	1.99E-07	NA	
BARIUM	3.25E+02	1.19E-07	3.86E-05	7.00E-02	5.51E-04	5.09E-08	1.65E-05	NA	
CADMIUM	1.58E+01	1.19E-07	1.87E-06	5.00E-04	3.75E-03	5.09E-08	8.03E-07	NA	
CHROMIUM	2.81E+02	1.19E-07	3.33E-05	5.00E-03	6.67E-03	5.09E-08	1.43E-05	NA	
MANGANESE	5.31E+02	1.19E-07	6.31E-05	1.00E-01	6.31E-04	5.09E-08	2.71E-05	NA	
NICKEL	4.88E+01	1.19E-07	5.80E-06	2.00E-02	2.90E-04	5.09E-08	2.49E-06	NA	
VANADIUM	2.64E+01	1.19E-07	3.14E-06	7.00E-03	4.48E-04	5.09E-08	1.35E-06	NA	
					1.3E-02				3.5E-10

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: DS3

TABLE C-69

RISK SEGMENT M2

INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)

TINKER AFB - SOLDIER CREEK RI/FS

RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
BENZENE	5.00E-03	1.19E-07	5.94E-10	NA		5.09E-08	2.55E-10	2.90E-02	7.38E-12
CHLOROFORM	5.22E-03	1.19E-07	6.21E-10	1.00E-02	6.21E-08	5.09E-08	2.66E-10	6.10E-03	1.62E-12
TETRACHLOROETHENE	5.00E-03	1.19E-07	5.94E-10	1.00E-02	5.94E-08	5.09E-08	2.55E-10	5.10E-02	1.30E-11
XYLENE (TOTAL)	5.21E-03	1.19E-07	6.19E-10	2.00E+00	3.10E-10	5.09E-08	2.65E-10	NA	
SEMI-VOLATILE ORGANICS									
BENZO(A)PYRENE	2.46E-01	1.19E-07	2.92E-08	NA		5.09E-08	1.25E-08	1.20E+01	1.50E-07
BIS(2-ETHYLHEXYL)PHTHALATE	5.53E-01	1.19E-07	6.58E-08	2.00E-02	3.28E-06	5.09E-08	2.81E-08	1.40E-02	3.94E-10
DI-N-BUTYLPHTHALATE	1.65E-01	1.19E-07	1.96E-08	1.00E-01	1.96E-07	5.09E-08	8.40E-09	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	1.19E-07	1.96E-08	2.00E-02	9.80E-07	5.09E-08	8.40E-09	NA	
FLUORANTHENE	1.65E-01	1.19E-07	1.96E-08	4.00E-02	4.90E-07	5.09E-08	8.40E-09	NA	
METALS									
BARIUM	4.12E+02	1.19E-07	4.90E-05	7.00E-02	7.00E-04	5.09E-08	2.10E-05	NA	
CADMIUM	5.69E+00	1.19E-07	6.76E-07	5.00E-04	1.35E-03	5.09E-08	2.90E-07	NA	
CALCIUM	2.16E+04	1.19E-07	2.57E-03	NA		5.09E-08	1.10E-0[illegible]	NA	
CHROMIUM	1.03E+02	1.19E-07	1.22E-05	5.00E-03	2.44E-03	5.09E-08	5.22E-[illegible]	NA	
MANGANESE	5.54E+02	1.19E-07	6.58E-05	1.00E-01	6.58E-04	5.09E-08	2.82E-[illegible]	NA	
MERCURY	1.66E-01	1.19E-07	1.97E-08	3.00E-04	6.56E-05	5.09E-08	8.43E-[illegible]	NA	
					5.2E-03				1.5E-07

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------> 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-70
RISK SEGMENT M3
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
CHLOROBENZENE	6.09E-03	1.19E-07	7.23E-10	2.00E-02	3.62E-08	5.09E-08	3.10E-10	NA	
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	6.84E-01	1.19E-07	8.12E-08	2.00E-02	4.06E-06	5.09E-08	3.48E-08	1.40E-02	4.87E-10
METALS									
BARIUM	4.17E+02	1.19E-07	4.96E-05	7.00E-02	7.09E-04	5.09E-08	2.13E-05	NA	
					7.1E-04				4.9E-10

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA))*CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-71
RISK SEGMENT E2
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
CHLOROFORM	9.36E-03	1.19E-07	1.11E-09	1.00E-02	1.11E-07	5.09E-08	4.77E-10	6.10E-03	2.91E-12
XYLENE (TOTAL)	5.00E-03	1.19E-07	5.94E-10	2.00E+00	2.97E-10	5.09E-08	2.55E-10	NA	0.00E+00
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	6.37E-01	1.19E-07	7.57E-08	2.00E-02	3.78E-06	5.09E-08	3.24E-08	1.40E-02	4.54E-10
DI-N-BUTYLPHTHALATE	1.65E-01	1.19E-07	1.96E-08	1.00E-01	1.96E-07	5.09E-08	8.40E-09	NA	
DI-N-OCTYL PHTHALATE	3.30E-02	1.19E-07	3.92E-09	2.00E-02	1.96E-07	5.09E-08	1.68E-09	NA	
FLUORANTHENE	1.65E-01	1.19E-07	1.96E-08	4.00E-02	4.90E-07	5.09E-08	8.40E-09	NA	
METALS									
BARIUM	9.13E+02	1.19E-07	1.08E-04	7.00E-02	1.55E-03	5.09E-08	4.65E-05	NA	
CADMIUM	4.21E+00	1.19E-07	5.00E-07	5.00E-04	1.00E-03	5.09E-08	2.14E-07	NA	
CHROMIUM	3.95E+01	1.19E-07	4.70E-06	5.00E-03	9.40E-04	5.09E-08	2.01E-06	NA	
					3.5E-03				4.6E-10

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------> 1.19E-07 HIF = {((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)} * CF/ (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = {((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF/ (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-72
RISK SEGMENT W2
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
ACENAPHTHENE	1.65E-01	1.19E-07	1.96E-08	6.00E-02	3.27E-07	5.09E-08	8.40E-09	NA	
ANTHRACENE	1.65E-01	1.19E-07	1.96E-08	3.00E-01	6.53E-08	5.09E-08	8.40E-09	NA	
BENZO(A)ANTHRACENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	1.20E+01	1.01E-07
BENZO(B)FLUORANTHENE	1.86E-01	1.19E-07	2.21E-08	NA		5.09E-08	9.47E-09	1.20E+01	1.14E-07
BENZO(K)FLUORANTHENE	1.78E-01	1.19E-07	2.11E-08	NA		5.09E-08	9.04E-09	1.20E+01	1.09E-07
BENZO(A)PYRENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	1.20E+01	1.01E-07
BIS(2-ETHYLHEXYL)PHTHALATE	4.20E+00	1.19E-07	4.99E-07	2.00E-02	2.49E-05	5.09E-08	2.14E-07	1.40E-02	2.99E-09
CHRYSENE	2.03E-01	1.19E-07	2.41E-08	NA		5.09E-08	1.03E-08	1.20E+01	1.24E-07
DI-N-OCTYL PHTHALATE	1.65E-01	1.19E-07	1.96E-08	2.00E-02	9.80E-07	5.09E-08	8.40E-09	NA	
FLUORANTHENE	3.79E-01	1.19E-07	4.51E-08	4.00E-02	1.13E-06	5.09E-08	1.93E-08	NA	
FLUORENE	1.65E-01	1.19E-07	1.96E-08	4.00E-02	4.90E-07	5.09E-08	8.40E-09	NA	
2-METHYLNAPHTHALENE	1.11E+00	1.19E-07	1.32E-07	NA		5.09E-08	5.67E-08	NA	
NAPHTHALENE	1.65E-01	1.19E-07	1.96E-08	4.00E-03	4.90E-06	5.09E-08	8.40E-09	NA	
PHENANTHRENE	2.59E-01	1.19E-07	3.08E-08	NA		5.09E-08	1.32E-08	NA	
PYRENE	4.71E-01	1.19E-07	5.59E-08	3.00E-02	1.86E-06	5.09E-08	2.40E-08	NA	
METALS									
BARIUM	4.26E+02	1.19E-07	5.06E-05	7.00E-02	7.23E-04	5.09E-08	2.17E-05	NA	
CADMIUM	8.42E+00	1.19E-07	1.00E-06	5.00E-04	2.00E-03	5.09E-08	4.29E-07	NA	
CALCIUM	4.33E+04	1.19E-07	5.14E-03	NA		5.09E-08	2.20E-03	NA	
CHROMIUM	3.37E+02	1.19E-07	4.00E-05	5.00E-03	8.01E-03	5.09E-08	1.72E-05	NA	
MAGNESIUM	1.34E+04	1.19E-07	1.59E-03	NA		5.09E-08	6.80E-04	NA	
MERCURY	2.19E+00	1.19E-07	2.60E-07	3.00E-04	8.66E-04	5.09E-08	1.11E-07	NA	
SILVER	4.26E+00	1.19E-07	5.06E-07	3.00E-03	1.69E-04	5.09E-08	2.17E-07	NA	
					1.2E-02				5.5E-07

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (a day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------> 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: DS7

TABLE C–73
RISK SEGMENT A
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF–BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB – SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON–CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg–day)	Absorbance Factor	Intake (mg/kg–day)	RfD (mg/kg–day)	Risk	Human Intake Factor (kg/kg–day)	Intake (mg/kg–day)	Slope Factor (kg–day/mg)	Risk
VOLATILE ORGANICS										
NOT ANALYZED										
SEMI–VOLATILE ORGANICS										
NOT ANALYZED										
METALS										
NOT ANALYZED										

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi–volatiles and 0.01 for metals) (Ryan, 1987)

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

7.20E+03 SAC = 7200 sq cm – Skin Surface Area Available for Contact, (Child: 0–6 yrs.),whole body, (EPA, 1989a)

8.62E+03 SAA = 8620 sq cm – Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)

1.70E+01 EFC = 17 days/yr – Exposure Frequency, (Child: 0–6 yrs.) (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr – Exposure Frequency, (Adult: 6–30 yrs.), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs – Duration for child (1–6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs – Exposure Duration for adult (6–30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg – Body Weight for a child (1–6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg – Body Weight for adult (6–30 yrs.), (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)

1.45E+00 AF = 1.45 mg/sq cm – Adherence Factor, (EPA, 1989a)

HIF––(NON–CARCINOGENIC)––––––––––––> 7.37E–06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF––(CARCINOGENIC)––––––––––––––––– 3.16E–06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

– Assumed Value
NA – Data Not Available

TABLE C-74
RISK SEGMENT B
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NOT ANALYZED										
SEMI-VOLATILE ORGANICS										
NOT ANALYZED										
METALS										
NOT ANALYZED										

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

1.00E-06	CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03	SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.),whole body, (EPA, 1989a)
8.62E+03	SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00	AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
7.37E-06	HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) *CF / (ATN)(365)]
3.16E-06	HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

HIF--(NON-CARCINOGENIC)---------->

HIF--(CARCINOGENIC)---------->

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-75
RISK SEGMENT M1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	4.87E-01	7.37E-06	1.00E-01	3.58E-07	1.00E-02	3.58E-05	3.16E-06	1.54E-07	2.80E-02	4.30E-09
METALS										
ARSENIC	3.91E+00	7.37E-06	1.00E-02	2.88E-07	2.00E-04	1.44E-03	3.16E-06	1.23E-07	NA	
BARIUM	3.25E+02	7.37E-06	1.00E-02	2.39E-05	1.40E-02	1.71E-03	3.16E-06	1.02E-05	NA	
CADMIUM	1.58E+01	7.37E-06	1.00E-02	1.16E-06	1.00E-04	1.16E-02	3.16E-06	4.98E-07	NA	
CHROMIUM	2.81E+02	7.37E-06	1.00E-02	2.07E-05	1.00E-03	2.07E-02	3.16E-06	8.86E-06	NA	
MANGANESE	5.31E+02	7.37E-06	1.00E-02	3.91E-05	2.00E-02	1.96E-03	3.16E-06	1.68E-05	NA	
NICKEL	4.88E+01	7.37E-06	1.00E-02	3.60E-06	4.00E-03	8.99E-04	3.16E-06	1.54E-06	NA	
VANADIUM	2.64E+01	7.37E-06	1.00E-02	1.95E-06	1.40E-03	1.39E-03	3.16E-06	8.34E-07	NA	
						4.0E-02				4.3E-09

DERMAL CONTACT WITH SEDIMENTS

	CS = Concentration of chemical in sediments (mg/kg)
	AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06	CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03	SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.),whole body, (EPA, 1989a)
8.62E+03	SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)
1.70E+01	EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (1 day/wk for 17 wks of summer) #
4.00E+00	EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00	EDC = 5 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01	EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01	BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01	BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00	AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
7.37E-06	HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
3.16E-06	HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
	INTAKE = (CS * AF * HIF)
	RISK (non-carcinogenic) = (INTAKE / RfD)
	RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

HIF--(NON-CARCINOGENIC)---------->
HIF--(CARCINOGENIC)---------->

- Assumed Value
NA - Data Not Available

TABLE C-76
RISK SEGMENT M2
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
BENZENE	5.00E-03	7.37E-06	2.50E-01	9.21E-09	NA		3.16E-06	3.95E-09	3.60E-02	1.42E-10
CHLOROFORM	5.22E-03	7.37E-06	2.50E-01	9.62E-09	8.00E-03	1.20E-06	3.16E-06	4.12E-09	7.60E-03	3.13E-11
TETRACHLOROETHENE	5.00E-03	7.37E-06	2.50E-01	9.21E-09	8.00E-03	1.15E-06	3.16E-06	3.95E-09	6.40E-02	2.53E-10
XYLENE (TOTAL)	5.21E-03	7.37E-06	2.50E-01	9.60E-09	1.60E+00	6.00E-09	3.16E-06	4.11E-09	NA	
SEMI-VOLATILE ORGANICS										
BENZO(A)PYRENE	2.46E-01	7.37E-06	1.00E-01	1.81E-07	NA		3.16E-06	7.77E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	5.53E-01	7.37E-06	1.00E-01	4.07E-07	1.00E-02	4.07E-05	3.16E-06	1.75E-07	2.80E-02	4.89E-09
DI-N-BUTYLPHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	5.00E-02	2.43E-06	3.16E-06	5.21E-08	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.00E-02	1.22E-05	3.16E-06	5.21E-08	NA	
FLUORANTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-02	6.08E-06	3.16E-06	5.21E-08	NA	
METALS										
BARIUM	4.12E+02	7.37E-06	1.00E-02	3.04E-05	1.40E-02	2.17E-03	3.16E-06	1.30E-05	NA	
CADMIUM	5.69E+00	7.37E-06	1.00E-02	4.19E-07	1.00E-04	4.19E-03	3.16E-06	1.80E-07	NA	
CALCIUM	2.16E+04	7.37E-06	1.00E-02	1.59E-03	NA		3.16E-06	6.82E-04	NA	
CHROMIUM	1.03E+02	7.37E-06	1.00E-02	7.55E-06	1.00E-03	7.55E-03	3.16E-06	3.24E-06	NA	
MANGANESE	5.54E+02	7.37E-06	1.00E-02	4.08E-05	2.00E-02	2.04E-03	3.16E-06	1.75E-05	NA	
MERCURY	1.66E-01	7.37E-06	1.00E-02	1.22E-08	6.00E-05	2.03E-04	3.16E-06	5.23E-09	NA	
						1.6E-02				5.3E-09

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

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

7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.),whole body, (EPA, 1989a)

8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)

1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)

1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)---------->

7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--(CARCINOGENIC)---------->

3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: DS11

TABLE C-77
RISK SEGMENT M3
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
CHLOROBENZENE	6.09E-03	7.37E-06	2.50E-01	1.12E-08	1.60E-02	7.00E-07	3.16E-06	4.80E-09	NA	
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	6.84E-01	7.37E-06	1.00E-01	5.04E-07	1.00E-02	5.04E-05	3.16E-06	2.16E-07	2.80E-02	6.04E-09
METALS										
BARIUM	4.17E+02	7.37E-06	1.00E-02	3.08E-05	1.40E-02	2.20E-03	3.16E-06	1.32E-05	NA	
						2.2E-03				6.0E-09

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

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

7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.),whole body, (EPA, 1989a)

8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)

1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)

1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)---------->

7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--(CARCINOGENIC)---------->

3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: DS12

TABLE C-78
RISK SEGMENT E2
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
CHLOROFORM	9.36E-03	7.37E-06	2.50E-01	1.72E-08	8.00E-03	2.15E-06	3.16E-06	7.39E-09	7.60E-03	5.61E-11
XYLENE (TOTAL)	5.00E-03	7.37E-06	2.50E-01	9.21E-09	1.60E+00	5.75E-09	3.16E-06	3.95E-09	NA	
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	6.37E-01	7.37E-06	1.00E-01	4.69E-07	1.00E-02	4.69E-05	3.16E-06	2.01E-07	2.80E-02	5.63E-09
DI-N-BUTYLPHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	5.00E-02	2.43E-06	3.16E-06	5.21E-08	NA	
DI-N-OCTYL PHTHALATE	3.30E-02	7.37E-06	1.00E-01	2.43E-08	1.00E-02	2.43E-06	3.16E-06	1.04E-08	NA	
FLUORANTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-02	6.08E-06	3.16E-06	5.21E-08	NA	
METALS										
BARIUM	9.13E+02	7.37E-06	1.00E-02	6.72E-05	1.40E-02	4.80E-03	3.16E-06	2.88E-05	NA	
CADMIUM	4.21E+00	7.37E-06	1.00E-02	3.10E-07	1.00E-04	3.10E-03	3.16E-06	1.33E-07	NA	
CHROMIUM	3.95E+01	7.37E-06	1.00E-02	2.91E-06	1.00E-03	2.91E-03	3.16E-06	1.25E-06	NA	
						1.1E-02				5.7E-09

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

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

7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.),whole body, (EPA, 1989a)

8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)

1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)

1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)---------->

7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--(CARCINOGENIC)---------->

3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-79
RISK SEGMENT W2
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
ACENAPHTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	3.00E-02	4.05E-06	3.16E-06	5.21E-08	NA	
ANTHRACENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.50E-01	8.10E-07	3.16E-06	5.21E-08	NA	
BENZO(A)ANTHRACENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06	5.21E-08	NA	
BENZO(B)FLUORANTHENE	1.86E-01	7.37E-06	1.00E-01	1.37E-07	NA		3.16E-06	5.87E-08	NA	
BENZO(K)FLUORANTHENE	1.78E-01	7.37E-06	1.00E-01	1.31E-07	NA		3.16E-06	5.61E-08	NA	
BENZO(A)PYRENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06	5.21E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	4.20E+00	7.37E-06	1.00E-01	3.09E-06	1.00E-02	3.09E-04	3.16E-06	1.33E-06	2.80E-02	3.71E-08
CHRYSENE	2.03E-01	7.37E-06	1.00E-01	1.49E-07	NA		3.16E-06	6.40E-08	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.00E-02	1.22E-05	3.16E-06	5.21E-08	NA	
FLUORANTHENE	3.79E-01	7.37E-06	1.00E-01	2.79E-07	2.00E-02	1.40E-05	3.16E-06	1.20E-07	NA	
FLUORENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-02	6.08E-06	3.16E-06	5.21E-08	NA	
2-METHYLNAPHTHALENE	1.11E+00	7.37E-06	1.00E-01	8.20E-07	NA		3.16E-06	3.51E-07	NA	
NAPHTHALENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-03	6.08E-05	3.16E-06	5.21E-08	NA	
PHENANTHRENE	2.59E-01	7.37E-06	1.00E-01	1.91E-07	NA		3.16E-06	8.17E-08	NA	
PYRENE	4.71E-01	7.37E-06	1.00E-01	3.47E-07	1.50E-02	2.31E-05	3.16E-06	1.49E-07	NA	
METALS										
BARIUM	4.26E+02	7.37E-06	1.00E-02	3.14E-05	1.40E-02	2.24E-03	3.16E-06	1.34E-05	NA	
CADMIUM	8.42E+00	7.37E-06	1.00E-02	6.20E-07	1.00E-04	6.20E-03	3.16E-06	2.66E-07	NA	
CALCIUM	4.33E+04	7.37E-06	1.00E-02	3.19E-03	NA		3.16E-06	1.37E-03	NA	
CHROMIUM	3.37E+02	7.37E-06	1.00E-02	2.48E-05	1.00E-03	2.48E-02	3.16E-06	1.06E-05	NA	
MAGNESIUM	1.34E+04	7.37E-06	1.00E-02	9.83E-04	NA		3.16E-06	4.21E-04	NA	
MERCURY	2.19E+00	7.37E-06	1.00E-02	1.61E-07	6.00E-05	2.69E-03	3.16E-06	6.91E-08	NA	
SILVER	4.26E+00	7.37E-06	1.00E-02	3.14E-07	6.00E-04	5.23E-04	3.16E-06	1.34E-07	NA	
						3.7E-02				3.7E-08

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult), hands, arms, lower legs, (EPA, 1989a)
1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.) (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
HIF-(NON-CARCINOGENIC)----------> 7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF-(CARCINOGENIC)----------> 3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
INTAKE = (CS * AF * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

FILE: DS14

TABLE C-80
RISK SEGMENT E1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
CHLOROBENZENE	7.91E+00	1.96E-09	1.55E-08	2.00E-02	7.74E-07	6.99E-10	5.53E-09	NA	
CHLOROETHANE	1.31E-02	1.96E-09	2.56E-11	NA		6.99E-10	9.16E-12	NA	
CHLOROFORM	1.06E+00	1.96E-09	2.07E-09	1.00E-02	2.07E-07	6.99E-10	7.41E-10	6.10E-03	4.52E-12
1,2-DICHLOROETHENE (TOTAL)	1.82E+01	1.96E-09	3.56E-08	1.00E-02	3.56E-06	6.99E-10	1.27E-08	NA	
METHYLENE CHLORIDE	1.43E+01	1.96E-09	2.80E-08	6.00E-02	4.66E-07	6.99E-10	9.99E-09	7.50E-03	7.50E-11
TETRACHLOROETHENE	8.42E+00	1.96E-09	1.65E-08	1.00E-02	1.65E-06	6.99E-10	5.88E-09	5.10E-02	3.00E-10
TOLUENE	1.03E-01	1.96E-09	2.02E-10	2.00E-01	1.01E-09	6.99E-10	7.20E-11	NA	
VINYL ACETATE	5.00E-03	1.96E-09	9.78E-12	1.00E+00	9.78E-12	6.99E-10	3.49E-12	NA	
TRICHLOROETHENE	4.15E-01	1.96E-09	8.12E-10	NA		6.99E-10	2.90E-10	1.10E-02	3.19E-12
XYLENE (TOTAL)	1.05E-01	1.96E-09	2.05E-10	2.00E+00	1.03E-10	6.99E-10	7.34E-11	NA	
SEMI-VOLATILE ORGANICS									
2-METHYLPHENOL	1.65E-01	1.96E-09	3.23E-10	5.00E-02	6.46E-09	6.99E-10	1.15E-10	NA	
4-METHYLPHENOL	1.65E-01	1.96E-09	3.23E-10	5.00E-02	6.46E-09	6.99E-10	1.15E-10	NA	
2,4-DIMETHYLPHENOL	1.65E-01	1.96E-09	3.23E-10	2.00E-02	1.61E-08	6.99E-10	1.15E-10	NA	
ACENAPHTHENE	1.62E-01	1.96E-09	3.17E-10	6.00E-02	5.28E-09	6.99E-10	1.13E-10	NA	
ANTHRACENE	3.60E-01	1.96E-09	7.05E-10	3.00E-01	2.35E-09	6.99E-10	2.52E-10	NA	
BENZO(A)ANTHRACENE	1.05E+00	1.96E-09	2.05E-09	NA		6.99E-10	7.33E-10	1.20E+01	8.79E-09
BENZO(B)FLUORANTHENE	1.04E+00	1.96E-09	2.04E-09	NA		6.99E-10	7.28E-10	1.20E+01	8.74E-09
BENZO(K)FLUORANTHENE	1.09E+00	1.96E-09	2.14E-09	NA		6.99E-10	7.63E-10	1.20E+01	9.16E-09
BENZO(G,H,I)PERYLENE	5.28E-01	1.96E-09	1.03E-09	NA		6.99E-10	3.69E-10	NA	
BENZO(A)PYRENE	9.53E-01	1.96E-09	1.87E-09	NA		6.99E-10	6.66E-10	1.20E+01	8.00E-09
BIS(2-ETHYLHEXYL)PHTHALATE	2.89E+00	1.96E-09	5.66E-09	2.00E-02	2.83E-07	6.99E-10	2.02E-09	1.40E-02	2.83E-11
BUTYLBENZYLPHTHALATE	1.65E-01	1.96E-09	3.23E-10	2.00E-01	1.61E-09	6.99E-10	1.15E-10	NA	
2-CHLORONAPHTHALENE	4.99E-01	1.96E-09	9.77E-10	NA		6.99E-10	3.49E-10	NA	
CHRYSENE	1.29E+00	1.96E-09	2.52E-09	NA		6.99E-10	9.01E-10	1.20E+01	1.08E-08
DIBENZ (A,H) ANTHRACENE	1.65E-01	1.96E-09	3.23E-10	NA		6.99E-10	1.15E-10	1.20E+01	1.38E-09
DIBENZOFURAN	1.90E-01	1.96E-09	3.72E-10	NA		6.99E-10	1.33E-10	NA	
1,3-DICHLOROBENZENE	1.79E-01	1.96E-09	3.49E-10	NA		6.99E-10	1.25E-10	NA	
1,4-DICHLOROBENZENE	7.13E-01	1.96E-09	1.39E-09	NA		6.99E-10	4.98E-10	2.40E-02	1.20E-11
1,2-DICHLOROBENZENE	5.44E-01	1.96E-09	1.07E-09	9.00E-02	1.18E-08	6.99E-10	3.80E-10	NA	
DI-N-BUTYLPHTHALATE	1.06E-01	1.96E-09	2.07E-10	1.00E-01	2.07E-09	6.99E-10	7.41E-11	NA	
DI-N-OCTYL PHTHALATE	1.58E-01	1.96E-09	3.09E-10	2.00E-02	1.54E-08	6.99E-10	1.10E-10	NA	
FLUORANTHENE	3.06E+00	1.96E-09	5.98E-09	4.00E-02	1.49E-07	6.99E-10	2.14E-09	NA	
FLUORENE	1.63E-01	1.96E-09	3.19E-10	4.00E-02	7.97E-09	6.99E-10	1.14E-10	NA	
INDENO(1,2,3-CD)PYRENE	5.30E-01	1.96E-09	1.04E-09	NA		6.99E-10	3.70E-10	1.20E+01	4.44E-09
NAPHTHALENE	3.05E-01	1.96E-09	5.98E-10	4.00E-03	1.49E-07	6.99E-10	2.13E-10	NA	
2-METHYLNAPHTHALENE	3.91E-01	1.96E-09	7.65E-10	NA		6.99E-10	2.73E-10	NA	
PHENANTHRENE	1.66E+00	1.96E-09	3.25E-09	NA		6.99E-10	1.16E-09	NA	
PYRENE	2.51E+00	1.96E-09	4.91E-09	3.00E-02	1.64E-07	6.99E-10	1.76E-09	NA	
METALS									
BARIUM	1.01E+03	1.96E-09	1.98E-06	7.00E-02	2.82E-05	6.99E-10	7.06E-07	NA	
CADMIUM	6.78E+01	1.96E-09	1.33E-07	5.00E-04	2.65E-04	6.99E-10	4.74E-08	NA	
CALCIUM	3.04E+04	1.96E-09	5.95E-05	NA		6.99E-10	2.13E-05	NA	
CHROMIUM	3.25E+02	1.96E-09	6.35E-07	5.00E-03	1.27E-04	6.99E-10	2.27E-07	NA	
COPPER	1.36E+02	1.96E-09	2.66E-07	NA		6.99E-10	9.50E-08	NA	
CYANIDE	1.81E+00	1.96E-09	3.54E-09	2.00E-02	1.77E-07	6.99E-10	1.26E-09	NA	
LEAD	1.33E+02	1.96E-09	2.60E-07	NA		6.99E-10	9.29E-08	NA	
MAGNESIUM	3.53E+03	1.96E-09	6.90E-06	NA		6.99E-10	2.46E-06	NA	
MANGANESE	4.99E+02	1.96E-09	9.76E-07	1.00E-01	9.76E-06	6.99E-10	3.49E-07	NA	
NICKEL	1.36E+02	1.96E-09	2.67E-07	2.00E-02	1.33E-05	6.99E-10	9.52E-08	NA	
SILVER	6.68E+00	1.96E-09	1.31E-08	3.00E-03	4.35E-06	6.99E-10	4.67E-09	NA	
ZINC	1.81E+02	1.96E-09	3.54E-07	2.00E-01	1.77E-06	6.99E-10	1.26E-07	NA	
					4.6E-04				5.2E-08

FILE: DS15

TABLE C-80 (CONTINUED)
RISK SEGMENT E1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

INCIDENTAL INGESTION OF SEDIMENTS

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

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)

2.50E+01 ED = 25 yrs - Exposure Duration for an adult worker, (OSWER, 1991)

1.00E+00 EF = 1 day/yr - Exposure Frequency for an adult worker #

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)----------> 1.96E-09 HIF = ((CF * IR * ED * EF / BW)) / (ATN)(365)

HIF--(CARCINOGENIC)---------- 6.99E-10 HIF = ((CF * IR * ED * EF / BW)) / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-81
RISK SEGMENT W1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
CARBON DISULFIDE	9.07E-03	1.96E-09	1.77E-11	1.00E-01	1.77E-10	6.99E-10	6.34E-12	NA	
CHLOROFORM	1.64E-02	1.96E-09	3.21E-11	1.00E-02	3.21E-09	6.99E-10	1.15E-11	6.10E-03	6.98E-14
ETHYLBENZENE	5.00E-03	1.96E-09	9.78E-12	1.00E-01	9.78E-11	6.99E-10	3.49E-12	NA	
TETRACHLOROETHENE	5.00E-03	1.96E-09	9.78E-12	1.00E-02	9.78E-10	6.99E-10	3.49E-12	5.10E-02	1.78E-13
TOLUENE	9.74E-02	1.96E-09	1.91E-10	2.00E-01	9.53E-10	6.99E-10	6.81E-11	NA	
XYLENE (TOTAL)	1.79E-02	1.96E-09	3.51E-11	2.00E+00	1.75E-11	6.99E-10	1.25E-11	NA	
SEMI-VOLATILE ORGANICS									
ACENAPHTHENE	3.68E-01	1.96E-09	7.20E-10	6.00E-02	1.20E-08	6.99E-10	2.57E-10	NA	
ANTHRACENE	3.93E-01	1.96E-09	7.69E-10	3.00E-01	2.56E-09	6.99E-10	2.74E-10	NA	
BENZO(A)ANTHRACENE	1.36E+00	1.96E-09	2.65E-09	NA		6.99E-10	9.47E-10	1.20E+01	1.14E-08
BENZO(B)FLUORANTHENE	2.44E+00	1.96E-09	4.78E-09	NA		6.99E-10	1.71E-09	1.20E+01	2.05E-08
BENZO(K)FLUORANTHENE	4.82E-01	1.96E-09	9.42E-10	NA		6.99E-10	3.37E-10	1.20E+01	4.04E-09
BENZO(A)PYRENE	1.47E+00	1.96E-09	2.87E-09	NA		6.99E-10	1.02E-09	1.20E+01	1.23E-08
BENZO(G,H,I)PERYLENE	1.17E+00	1.96E-09	2.30E-09	NA		6.99E-10	8.20E-10	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	1.22E+01	1.96E-09	2.39E-08	2.00E-02	1.20E-06	6.99E-10	8.54E-09	1.00E-02	8.54E-11
BUTYLBENZYLPHTHALATE	2.84E-01	1.96E-09	5.55E-10	2.00E-01	2.78E-09	6.99E-10	1.98E-10	NA	
CHRYSENE	2.18E+00	1.96E-09	4.27E-09	NA		6.99E-10	1.53E-09	1.20E+01	1.83E-08
DIBENZOFURAN	2.44E-01	1.96E-09	4.77E-10	NA		6.99E-10	1.71E-10	NA	
1,3-DICHLOROBENZENE	1.75E-01	1.96E-09	3.42E-10	NA		6.99E-10	1.22E-10	NA	
1,4-DICHLOROBENZENE	6.00E-01	1.96E-09	1.18E-09	NA		6.99E-10	4.20E-10	2.40E-02	1.01E-11
1,2-DICHLOROBENZENE	1.77E-01	1.96E-09	3.46E-10	9.00E-02	3.84E-09	6.99E-10	1.24E-10	NA	
3,3'-DICHLOROBENZIDINE	4.93E-01	1.96E-09	9.66E-10	NA		6.99E-10	3.45E-10	4.50E-01	1.55E-10
DI-N-BUTYLPHTHALATE	6.71E-01	1.96E-09	1.31E-09	1.00E-01	1.31E-08	6.99E-10	4.69E-10	NA	
DI-N-OCTYL PHTHALATE	1.94E-01	1.96E-09	3.79E-10	2.00E-02	1.90E-08	6.99E-10	1.35E-10	NA	
FLUORANTHENE	4.71E+00	1.96E-09	9.21E-09	4.00E-02	2.30E-07	6.99E-10	3.29E-09	NA	
FLUORENE	3.42E-01	1.96E-09	6.70E-10	4.00E-02	1.68E-08	6.99E-10	2.39E-10	NA	
INDENO(1,2,3-CD)PYRENE	1.15E+00	1.96E-09	2.24E-09	NA		6.99E-10	8.00E-10	1.20E+01	9.60E-09
2-METHYLNAPHTHALENE	3.27E-01	1.96E-09	6.40E-10	NA		6.99E-10	2.28E-10	NA	
NAPHTHALENE	2.87E-01	1.96E-09	5.62E-10	4.00E-03	1.40E-07	6.99E-10	2.01E-10	NA	
PHENANTHRENE	2.07E+00	1.96E-09	4.06E-09	NA		6.99E-10	1.45E-09	NA	
PYRENE	1.83E+00	1.96E-09	3.57E-09	3.00E-02	1.19E-07	6.99E-10	1.28E-09	NA	
METALS									
ALUMINUM	1.44E+04	1.96E-09	2.82E-05	NA		6.99E-10	1.01E-05	NA	
ARSENIC	3.20E+00	1.96E-09	6.27E-09	1.00E-03	6.27E-06	6.99E-10	2.24E-09	NA	
BARIUM	5.20E+02	1.96E-09	1.02E-06	7.00E-02	1.45E-05	6.99E-10	3.64E-07	NA	
CADMIUM	2.06E+01	1.96E-09	4.03E-08	5.00E-04	8.07E-05	6.99E-10	1.44E-08	NA	
CALCIUM	1.80E+04	1.96E-09	3.52E-05	NA		6.99E-10	1.26E-05	NA	
CHROMIUM	3.81E+02	1.96E-09	7.46E-07	5.00E-03	1.49E-04	6.99E-10	2.66E-07	NA	
COBALT	2.08E+01	1.96E-09	4.07E-08	NA		6.99E-10	1.45E-08	NA	
COPPER	1.02E+02	1.96E-09	2.00E-07	NA		6.99E-10	7.15E-08	NA	
LEAD	8.94E+01	1.96E-09	1.75E-07	NA		6.99E-10	6.25E-08	NA	
MAGNESIUM	6.40E+03	1.96E-09	1.25E-05	NA		6.99E-10	4.47E-06	NA	
MANGANESE	4.23E+02	1.96E-09	8.28E-07	1.00E-01	8.28E-06	6.99E-10	2.96E-07	NA	
MERCURY	4.35E-01	1.96E-09	8.52E-10	3.00E-04	2.84E-06	6.99E-10	3.04E-10	NA	
NICKEL	6.07E+02	1.96E-09	1.19E-06	2.00E-02	5.94E-05	6.99E-10	4.24E-07	NA	
POTASSIUM	1.26E+03	1.96E-09	2.46E-06	NA		6.99E-10	8.79E-07	NA	
SELENIUM	3.34E+00	1.96E-09	6.54E-09	NA		6.99E-10	2.33E-09	NA	
SILVER	3.03E+01	1.96E-09	5.94E-08	3.00E-03	1.98E-05	6.99E-10	2.12E-08	NA	
VANADIUM	2.67E+01	1.96E-09	5.22E-08	7.00E-03	7.46E-06	6.99E-10	1.86E-08	NA	
ZINC	2.44E+02	1.96E-09	4.77E-07	2.00E-01	2.38E-06	6.99E-10	1.70E-07	NA	
					3.5E-04				7.6E-08

FILE: DS16

TABLE C-81 (CONTINUED)
RISK SEGMENT W1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

	INCIDENTAL INGESTION OF SEDIMENTS
	CS = Concentration of chemical in sediment (mg/kg)
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)
2.50E+01	ED = 25 yrs - Exposure Duration for an adult worker, (OSWER, 1991)
1.00E+00	EF = 1 day/yr - Exposure Frequency for an adult worker #
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)---------->	1.96E-09 HIF = (CF * IR * ED * EF / BW) / (ATN)(365)
HIF--(CARCINOGENIC)----------	6.99E-10 HIF = (CF * IR * ED * EF / BW)) / (ATC)(365)
	INTAKE = (CS * HIF)
	RISK (non-carcinogenic) = (INTAKE / RfD)
	RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-82
RISK SEGMENT E1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
CHLOROBENZENE	7.91E+00	5.56E-07	2.50E-01	1.10E-06	1.60E-02	6.87E-05	1.99E-07	3.93E-07	NA	
CHLOROETHANE	1.31E-02	5.56E-07	2.50E-01	1.82E-09	NA		1.99E-07	6.51E-10	NA	
CHLOROFORM	1.06E+00	5.56E-07	2.50E-01	1.47E-07	8.00E-03	1.84E-05	1.99E-07	5.26E-08	7.60E-03	4.00E-10
1,2-DICHLOROETHENE (TOTAL)	1.82E+01	5.56E-07	2.50E-01	2.53E-06	8.00E-03	3.16E-04	1.99E-07	9.04E-07	NA	
METHYLENE CHLORIDE	1.43E+01	5.56E-07	2.50E-01	1.99E-06	4.80E-02	4.14E-05	1.99E-07	7.10E-07	9.40E-03	6.67E-09
TETRACHLOROETHENE	8.42E+00	5.56E-07	2.50E-01	1.17E-06	8.00E-03	1.46E-04	1.99E-07	4.18E-07	6.40E-02	2.68E-08
TOLUENE	1.03E-01	5.56E-07	2.50E-01	1.43E-08	1.60E-01	8.95E-08	1.99E-07	5.11E-09	NA	
VINYL ACETATE	5.00E-03	5.56E-07	2.50E-01	6.95E-10	8.00E-01	8.69E-10	1.99E-07	2.48E-10	NA	
TRICHLOROETHENE	4.15E-01	5.56E-07	2.50E-01	5.77E-08	NA		1.99E-07	2.06E-08	1.40E-02	2.89E-10
XYLENE (TOTAL)	1.05E-01	5.56E-07	2.50E-01	1.46E-08	1.60E+00	9.12E-09	1.99E-07	5.21E-09	NA	
SEMI-VOLATILE ORGANICS										
2-METHYLPHENOL	1.65E-01	5.56E-07	1.00E-01	9.18E-09	2.50E-02	3.67E-07	1.99E-07	3.28E-09	NA	
4-METHYLPHENOL	1.65E-01	5.56E-07	1.00E-01	9.18E-09	2.50E-02	3.67E-07	1.99E-07	3.28E-09	NA	
2,4-DIMETHYLPHENOL	1.65E-01	5.56E-07	1.00E-01	9.18E-09	1.00E-02	9.18E-07	1.99E-07	3.28E-09	NA	
ACENAPHTHENE	1.62E-01	5.56E-07	1.00E-01	9.00E-09	3.00E-02	3.00E-07	1.99E-07	3.21E-09	NA	
ANTHRACENE	3.60E-01	5.56E-07	1.00E-01	2.00E-08	1.50E-01	1.34E-07	1.99E-07	7.15E-09	NA	
BENZO(A)ANTHRACENE	1.05E+00	5.56E-07	1.00E-01	5.83E-08	NA		1.99E-07	2.08E-08	NA	
BENZO(B)FLUORANTHENE	1.04E+00	5.56E-07	1.00E-01	5.80E-08	NA		1.99E-07	2.07E-08	NA	
BENZO(K)FLUORANTHENE	1.09E+00	5.56E-07	1.00E-01	6.07E-08	NA		1.99E-07	2.17E-08	NA	
BENZO(G,H,I)PERYLENE	5.28E-01	5.56E-07	1.00E-01	2.94E-08	NA		1.99E-07	1.05E-08	NA	
BENZO(A)PYRENE	9.53E-01	5.56E-07	1.00E-01	5.30E-08	NA		1.99E-07	1.89E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	2.89E+00	5.56E-07	1.00E-01	1.61E-07	1.00E-02	1.61E-05	1.99E-07	5.75E-08	2.80E-02	1.61E-09
BUTYLBENZYLPHTHALATE	1.65E-01	5.56E-07	1.00E-01	9.18E-09	1.00E-01	9.18E-08	1.99E-07	3.28E-09	NA	
2-CHLORONAPHTHALENE	4.99E-01	5.56E-07	1.00E-01	2.78E-08	NA		1.99E-07	9.91E-09	NA	
CHRYSENE	1.29E+00	5.56E-07	1.00E-01	7.17E-08	NA		1.99E-07	2.56E-08	NA	
DIBENZ (A,H) ANTHRACENE	1.65E-01	5.56E-07	1.00E-01	9.18E-09	NA		1.99E-07	3.28E-09	NA	
DIBENZOFURAN	1.90E-01	5.56E-07	1.00E-01	1.06E-08	NA		1.99E-07	3.77E-09	NA	
1,3-DICHLOROBENZENE	1.79E-01	5.56E-07	1.00E-01	9.93E-09	NA		1.99E-07	3.55E-09	NA	
1,4-DICHLOROBENZENE	7.13E-01	5.56E-07	1.00E-01	3.96E-08	NA		1.99E-07	1.42E-08	4.80E-02	6.79E-10
1,2-DICHLOROBENZENE	5.44E-01	5.56E-07	1.00E-01	3.03E-08	4.50E-02	6.73E-07	1.99E-07	1.08E-08	NA	
DI-N-BUTYLPHTHALATE	1.06E-01	5.56E-07	1.00E-01	5.89E-09	5.00E-02	1.18E-07	1.99E-07	2.11E-09	NA	
DI-N-OCTYL PHTHALATE	1.58E-01	5.56E-07	1.00E-01	8.78E-09	1.00E-02	8.78E-07	1.99E-07	3.14E-09	NA	
FLUORANTHENE	3.06E+00	5.56E-07	1.00E-01	1.70E-07	2.00E-02	8.50E-06	1.99E-07	6.07E-08	NA	
FLUORENE	1.63E-01	5.56E-07	1.00E-01	9.06E-09	2.00E-02	4.53E-07	1.99E-07	3.23E-09	NA	
INDENO(1,2,3-CD)PYRENE	5.30E-01	5.56E-07	1.00E-01	2.95E-08	NA		1.99E-07	1.05E-08	NA	
NAPHTHALENE	3.05E-01	5.56E-07	1.00E-01	1.70E-08	2.00E-03	8.49E-06	1.99E-07	6.06E-09	NA	
2-METHYLNAPHTHALENE	3.91E-01	5.56E-07	1.00E-01	2.17E-08	NA		1.99E-07	7.76E-09	NA	
PHENANTHRENE	1.66E+00	5.56E-07	1.00E-01	9.23E-08	NA		1.99E-07	3.30E-08	NA	
PYRENE	2.51E+00	5.56E-07	1.00E-01	1.40E-07	1.50E-02	9.31E-06	1.99E-07	4.99E-08	NA	
METALS										
BARIUM	1.01E+03	5.56E-07	1.00E-02	5.61E-06	1.40E-02	4.01E-04	1.99E-07	2.01E-06	NA	
CADMIUM	6.78E+01	5.56E-07	1.00E-02	3.77E-07	1.00E-04	3.77E-03	1.99E-07	1.35E-07	NA	
CALCIUM	3.04E+04	5.56E-07	1.00E-02	1.69E-04	NA		1.99E-07	6.04E-05	NA	
CHROMIUM	3.25E+02	5.56E-07	1.00E-02	1.81E-06	1.00E-03	1.81E-03	1.99E-07	6.45E-07	NA	
COPPER	1.36E+02	5.56E-07	1.00E-02	7.56E-07	NA		1.99E-07	2.70E-07	NA	
CYANIDE	1.81E+00	5.56E-07	1.00E-02	1.01E-08	4.00E-03	2.51E-06	1.99E-07	3.59E-09	NA	
LEAD	1.33E+02	5.56E-07	1.00E-02	7.39E-07	NA		1.99E-07	2.64E-07	NA	
MAGNESIUM	3.53E+03	5.56E-07	1.00E-02	1.96E-05	NA		1.99E-07	7.00E-06	NA	
MANGANESE	4.99E+02	5.56E-07	1.00E-02	2.77E-06	2.00E-02	1.39E-04	1.99E-07	9.91E-07	NA	
NICKEL	1.36E+02	5.56E-07	1.00E-02	7.58E-07	4.00E-03	1.89E-04	1.99E-07	2.71E-07	NA	
SILVER	6.68E+00	5.56E-07	1.00E-02	3.71E-08	6.00E-04	6.19E-05	1.99E-07	1.33E-08	NA	
ZINC	1.81E+02	5.56E-07	1.00E-02	1.01E-06	4.00E-02	2.51E-05	1.99E-07	3.59E-07	NA	
						7.0E-03				3.6E-08

FILE: DS17

TABLE C-82 (CONTINUED)
RISK SEGMENT E1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

1.00E-06 CF = 0.000001 kg/mg - Conversion Facor, (EPA, 1989a)
9.80E+03 SA = 9800 sq cm - Skin Surface Area Available for Contact, head, hands, arms, lower legs, (EPA, 1989a)
1.00E+00 EF = 1 day/yr - Exposure Frequency #
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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)----------> 5.56E-07 HIF = (CF * SA * EF * ED * AF / BW)) / (ATN)(365)]
HIF--(CARCINOGENIC)----------> 1.99E-07 HIF = (CF * SA * EF * ED * AF / BW)) / (ATC)(365)]

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

- Assumed Value
NA - Data Not Available

TABLE C-83
RISK SEGMENT W1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Report (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
CARBON DISULFIDE	9.07E-03	5.56E-07	2.50E-01	1.26E-09	8.00E-02	1.58E-08	1.99E-07	4.50E-10	NA	
CHLOROFORM	1.64E-02	5.56E-07	2.50E-01	2.28E-09	8.00E-03	2.85E-07	1.99E-07	8.14E-10	7.60E-03	6.18E-12
ETHYLBENZENE	5.00E-03	5.56E-07	2.50E-01	6.95E-10	8.00E-02	8.69E-09	1.99E-07	2.48E-10	NA	
TETRACHLOROETHENE	5.00E-03	5.56E-07	2.50E-01	6.95E-10	8.00E-03	8.69E-08	1.99E-07	2.48E-10	6.40E-02	1.59E-11
TOLUENE	9.74E-02	5.56E-07	2.50E-01	1.35E-08	1.60E-01	8.46E-08	1.99E-07	4.84E-09	NA	
XYLENE (TOTAL)	1.79E-02	5.56E-07	2.50E-01	2.49E-09	1.60E+00	1.56E-09	1.99E-07	8.90E-10	NA	
SEMI-VOLATILE ORGANICS										
ACENAPHTHENE	3.68E-01	5.56E-07	1.00E-01	2.05E-08	3.00E-02	6.82E-07	1.99E-07	7.31E-09	NA	
ANTHRACENE	3.93E-01	5.56E-07	1.00E-01	2.18E-08	1.50E-01	1.46E-07	1.99E-07	7.80E-09	NA	
BENZO(A)ANTHRACENE	1.36E+00	5.56E-07	1.00E-01	7.54E-08	NA		1.99E-07	2.69E-08	NA	
BENZO(B)FLUORANTHENE	2.44E+00	5.56E-07	1.00E-01	1.36E-07	NA		1.99E-07	4.85E-08	NA	
BENZO(K)FLUORANTHENE	4.82E-01	5.56E-07	1.00E-01	2.68E-08	NA		1.99E-07	9.56E-09	NA	
BENZO(A)PYRENE	1.47E+00	5.56E-07	1.00E-01	8.16E-08	NA		1.99E-07	2.91E-08	NA	
BENZO(G,H,I)PERYLENE	1.17E+00	5.56E-07	1.00E-01	6.52E-08	NA		1.99E-07	2.33E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	1.22E+01	5.56E-07	1.00E-01	6.80E-07	1.00E-02	6.80E-05	1.99E-07	2.43E-07	2.80E-02	6.80E-09
BUTYLBENZYLPHTHALATE	2.84E-01	5.56E-07	1.00E-01	1.58E-08	1.00E-01	1.58E-07	1.99E-07	5.64E-09	NA	
CHRYSENE	2.18E+00	5.56E-07	1.00E-01	1.21E-07	NA		1.99E-07	4.34E-08	NA	
DIBENZOFURAN	2.44E-01	5.56E-07	1.00E-01	1.36E-08	NA		1.99E-07	4.85E-09	NA	
1,3-DICHLOROBENZENE	1.75E-01	5.56E-07	1.00E-01	9.71E-09	NA		1.99E-07	3.47E-09	NA	
1,4-DICHLOROBENZENE	6.00E-01	5.56E-07	1.00E-01	3.34E-08	NA		1.99E-07	1.19E-08	4.80E-02	5.73E-10
1,2-DICHLOROBENZENE	1.77E-01	5.56E-07	1.00E-01	9.83E-09	4.50E-02	2.18E-07	1.99E-07	3.51E-09	NA	
3,3'-DICHLOROBENZIDINE	4.93E-01	5.56E-07	1.00E-01	2.74E-08	NA		1.99E-07	9.80E-09	9.00E-01	8.82E-09
DI-N-BUTYLPHTHALATE	6.71E-01	5.56E-07	1.00E-01	3.73E-08	5.00E-02	7.46E-07	1.99E-07	1.33E-08	NA	
DI-N-OCTYL PHTHALATE	1.94E-01	5.56E-07	1.00E-01	1.08E-08	1.00E-02	1.08E-06	1.99E-07	3.85E-09	NA	
FLUORANTHENE	4.71E+00	5.56E-07	1.00E-01	2.62E-07	2.00E-02	1.31E-05	1.99E-07	9.35E-08	NA	
FLUORENE	3.42E-01	5.56E-07	1.00E-01	1.90E-08	2.00E-02	9.52E-07	1.99E-07	6.80E-09	NA	
INDENO(1,2,3-CD)PYRENE	1.15E+00	5.56E-07	1.00E-01	6.37E-08	NA		1.99E-07	2.27E-08	NA	
2-METHYLNAPHTHALENE	3.27E-01	5.56E-07	1.00E-01	1.82E-08	NA		1.99E-07	6.49E-09	NA	
NAPHTHALENE	2.87E-01	5.56E-07	1.00E-01	1.60E-08	2.00E-03	7.98E-06	1.99E-07	5.70E-09	NA	
PHENANTHRENE	2.07E+00	5.56E-07	1.00E-01	1.15E-07	NA		1.99E-07	4.12E-08	NA	
PYRENE	1.83E+00	5.56E-07	1.00E-01	1.02E-07	1.50E-02	6.77E-06	1.99E-07	3.63E-08	NA	
METALS										
ALUMINUM	1.44E+04	5.56E-07	1.00E-02	8.02E-05	NA		1.99E-07	2.86E-05	NA	
ARSENIC	3.20E+00	5.56E-07	1.00E-02	1.78E-08	2.00E-04	8.90E-05	1.99E-07	6.36E-09	NA	
BARIUM	5.20E+02	5.56E-07	1.00E-02	2.89E-06	1.40E-02	2.07E-04	1.99E-07	1.03E-06	NA	
CADMIUM	2.06E+01	5.56E-07	1.00E-02	1.15E-07	1.00E-04	1.15E-03	1.99E-07	4.09E-08	NA	
CALCIUM	1.80E+04	5.56E-07	1.00E-02	9.99E-05	NA		1.99E-07	3.57E-05	NA	
CHROMIUM	3.81E+02	5.56E-07	1.00E-02	2.12E-06	1.00E-03	2.12E-03	1.99E-07	7.57E-07	NA	
COBALT	2.08E+01	5.56E-07	1.00E-02	1.16E-07	NA		1.99E-07	4.13E-08	NA	
COPPER	1.02E+02	5.56E-07	1.00E-02	5.69E-07	NA		1.99E-07	2.03E-07	NA	
LEAD	8.94E+01	5.56E-07	1.00E-02	4.97E-07	NA		1.99E-07	1.78E-07	NA	
MAGNESIUM	6.40E+03	5.56E-07	1.00E-02	3.56E-05	NA		1.99E-07	1.27E-05	NA	
MANGANESE	4.23E+02	5.56E-07	1.00E-02	2.35E-06	2.00E-02	1.18E-04	1.99E-07	8.41E-07	NA	
MERCURY	4.35E-01	5.56E-07	1.00E-02	2.42E-09	6.00E-05	4.04E-05	1.99E-07	8.65E-10	NA	
NICKEL	6.07E+02	5.56E-07	1.00E-02	3.37E-06	4.00E-03	8.43E-04	1.99E-07	1.20E-06	NA	
POTASSIUM	1.26E+03	5.56E-07	1.00E-02	6.99E-06	NA		1.99E-07	2.50E-06	NA	
SELENIUM	3.34E+00	5.56E-07	1.00E-02	1.86E-08	NA		1.99E-07	6.64E-09	NA	
SILVER	3.03E+01	5.56E-07	1.00E-02	1.69E-07	6.00E-04	2.81E-04	1.99E-07	6.03E-08	NA	
VANADIUM	2.67E+01	5.56E-07	1.00E-02	1.48E-07	1.40E-03	1.06E-04	1.99E-07	5.30E-08	NA	
ZINC	2.44E+02	5.56E-07	1.00E-02	1.35E-06	4.00E-02	3.39E-05	1.99E-07	4.84E-07	NA	
						5.1E-03				1.6E-08

TABLE C-83 (CONTINUED)
RISK SEGMENT W1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (FUTURE SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

1.00E-06	CF = 0.000001 kg/mg - Conversion Facor, (EPA, 1989a)
9.80E+03	SA = 9800 sq cm - Skin Surface Area Available for Contact, head, hands, arms, lower legs, (EPA, 1989a)
1.00E+00	EF = 1 day/yr - Exposure Frequency #
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)
1.45E+00	AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
5.56E-07	HIF = (CF * SA * EF * ED * AF / BW) / (ATN)(365)
1.99E-07	HIF = (CF * SA * EF * ED * AF / BW) / (ATC)(365)

HIF--(NON-CARCINOGENIC)---------->
HIF--(CARCINOGENIC)---------->

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

- Assumed Value
NA - Data Not Available

TABLE C-84
RISK SEGMENT A
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BENZO(A)ANTHRACENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	1.20E+01	1.01E-07
BENZO(B)FLUORANTHENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	1.20E+01	1.01E-07
BENZO(K)FLUORANTHENE	2.30E-01	1.19E-07	2.73E-08	NA		5.09E-08	1.17E-08	1.20E+01	1.41E-07
BIS(2-ETHYLHEXYL)PHTHALATE	5.20E-01	1.19E-07	6.18E-08	2.00E-02	3.09E-06	5.09E-08	2.65E-08	1.40E-02	3.71E-10
CHRYSENE	1.90E-01	1.19E-07	2.26E-08	NA		5.09E-08	9.67E-09	1.20E+01	1.16E-07
DI-N-BUTYLPHTHALATE	1.65E-01	1.19E-07	1.96E-08	1.00E-01	1.96E-07	5.09E-08	8.40E-09	NA	
FLUORANTHENE	2.10E-01	1.19E-07	2.49E-08	4.00E-02	6.24E-07	5.09E-08	1.07E-08	NA	
PYRENE	1.90E-01	1.19E-07	2.26E-08	3.00E-02	7.52E-07	5.09E-08	9.67E-09	NA	
METALS									
BARIUM	3.86E+02	1.19E-07	4.59E-05	7.00E-02	6.55E-04	5.09E-08	1.97E-05	NA	
MANGANESE	4.44E+02	1.19E-07	5.28E-05	1.00E-01	5.28E-04	5.09E-08	2.26E-05	NA	
ZINC	5.19E+01	1.19E-07	6.17E-06	2.00E-01	3.08E-05	5.09E-08	2.64E-06	NA	
					1.2E-03				4.6E-07

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)----------: 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

TABLE C-85
RISK SEGMENT B
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
ACETONE	1.70E+00	1.19E-07	2.02E-07	1.00E-01	2.02E-06	5.09E-08	8.66E-08	NA	
CHLOROFORM	2.80E-02	1.19E-07	3.33E-09	1.00E-02	3.33E-07	5.09E-08	1.43E-09	6.10E-03	8.70E-12
METHYLENE CHLORIDE	1.00E-01	1.19E-07	1.19E-08	6.00E-02	1.98E-07	5.09E-08	5.09E-09	7.50E-03	3.82E-11
TOLUENE	5.00E-03	1.19E-07	5.94E-10	2.00E-01	2.97E-09	5.09E-08	2.55E-10	NA	
SEMI-VOLATILE ORGANICS									
ANTHRACENE	1.65E-01	1.19E-07	1.96E-08	3.00E-01	6.53E-08	5.09E-08	8.40E-09	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	6.70E-01	1.19E-07	7.96E-08	2.00E-02	3.98E-06	5.09E-08	3.41E-08	1.40E-02	4.78E-10
BUTYLBENZYLPHTHALATE	1.65E-01	1.19E-07	1.96E-08	2.00E-01	9.80E-08	5.09E-08	8.40E-09	NA	
DI-N-BUTYLPHTHALATE	1.65E-01	1.19E-07	1.96E-08	1.00E-01	1.96E-07	5.09E-08	8.40E-09	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	1.19E-07	1.96E-08	2.00E-02	9.80E-07	5.09E-08	8.40E-09	NA	
FLUORANTHENE	1.65E-01	1.19E-07	1.96E-08	4.00E-02	4.90E-07	5.09E-08	8.40E-09	NA	
PHENANTHRENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	NA	
PYRENE	1.65E-01	1.19E-07	1.96E-08	3.00E-02	6.53E-07	5.09E-08	8.40E-09	NA	
METALS									
BARIUM	9.73E+02	1.19E-07	1.16E-04	7.00E-02	1.65E-03	5.09E-08	4.95E-05	NA	
CHROMIUM	8.48E+01	1.19E-07	1.01E-05	5.00E-03	2.02E-03	5.09E-08	4.32E-06	NA	
LEAD	2.96E+01	1.19E-07	3.52E-06	NA		5.09E-08	1.51E-06	NA	
MANGANESE	3.88E+02	1.19E-07	4.61E-05	1.00E-01	4.61E-04	5.09E-08	1.98E-05	NA	
ZINC	1.30E+02	1.19E-07	1.54E-05	2.00E-01	7.72E-05	5.09E-08	6.62E-06	NA	
					4.2E-03				4.8E-10

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)
5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)
HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)

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

- Assumed Value
NA - Data Not Available

FILE: SS2

TABLE C-86
RISK SEGMENT M1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	5.03E-01	1.19E-07	5.98E-08	2.00E-02	2.99E-06	5.09E-08	2.56E-08	1.40E-02	3.59E-10
METALS									
ARSENIC	5.40E+00	1.19E-07	6.42E-07	1.00E-03	6.42E-04	5.09E-08	2.75E-07	NA	
BARIUM	3.66E+02	1.19E-07	4.35E-05	7.00E-02	6.22E-04	5.09E-08	1.86E-05	NA	
CADMIUM	2.75E+01	1.19E-07	3.26E-06	5.00E-04	6.52E-03	5.09E-08	1.40E-06	NA	
CHROMIUM	4.23E+02	1.19E-07	5.02E-05	5.00E-03	1.00E-02	5.09E-08	2.15E-05	NA	
LEAD	3.74E+01	1.19E-07	4.44E-06	NA		5.09E-08	1.90E-06	NA	
MANGANESE	7.09E+02	1.19E-07	8.43E-05	1.00E-01	8.43E-04	5.09E-08	3.61E-05	NA	
NICKEL	6.01E+01	1.19E-07	7.15E-06	2.00E-02	3.57E-04	5.09E-08	3.06E-06	NA	
SILVER	7.80E+00	1.19E-07	9.27E-07	3.00E-03	3.09E-04	5.09E-08	3.97E-07	NA	
VANADIUM	3.31E+01	1.19E-07	3.93E-06	7.00E-03	5.61E-04	5.09E-08	1.68E-06	NA	
					2.0E-02				3.6E-10

INCIDENTAL INGESTION OF SEDIMENTS
CS = Concentration of chemical in sediments (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)
5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)
HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)
INTAKE = (CS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-87

RISK SEGMENT M2

INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING

OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)

TINKER AFB - SOLDIER CREEK RI/FS

RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BENZO(A)PYRENE	3.30E-01	1.19E-07	3.92E-08	NA		5.09E-08	1.68E-08	1.20E+01	2.02E-07
BIS(2-ETHYLHEXYL)PHTHALATE	6.70E-01	1.19E-07	7.96E-08	2.00E-02	3.98E-06	5.09E-08	3.41E-08	1.40E-02	4.78E-10
DI-N-BUTYLPHTHALATE	1.65E-01	1.19E-07	1.96E-08	1.00E-01	1.96E-07	5.09E-08	8.40E-09	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	1.19E-07	1.96E-08	2.00E-02	9.80E-07	5.09E-08	8.40E-09	NA	
METALS									
BARIUM	4.88E+02	1.19E-07	5.80E-05	7.00E-02	8.28E-04	5.09E-08	2.48E-05	NA	
CALCIUM	2.26E+04	1.19E-07	2.69E-03	NA		5.09E-08	1.15E-03	NA	
CHROMIUM	3.85E+01	1.19E-07	4.57E-06	5.00E-03	9.15E-04	5.09E-08	1.96E-06	NA	
MANGANESE	8.40E+02	1.19E-07	9.98E-05	1.00E-01	9.98E-04	5.09E-08	4.28E-05	NA	
					2.7E-03				2.0E-07

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)

5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)

1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) *CF / (ATN)(365)

HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: SS4

TABLE C-88
RISK SEGMENT M3
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	3.80E-01	1.19E-07	4.51E-08	2.00E-02	2.26E-06	5.09E-08	1.93E-08	1.40E-02	2.71E-10
METALS									
BARIUM	6.51E+02	1.19E-07	7.73E-05	7.00E-02	1.10E-03	5.09E-08	3.31E-05	NA	
					1.1E-03				2.7E-10

INCIDENTAL INGESTION OF SEDIMENTS
CS = Concentration of chemical in sediments (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)
5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)
HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)
INTAKE = (CS * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Vlaue
NA - Data Not Available

TABLE C-89
RISK SEGMENT E2
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
BIS(2-ETHYLHEXYL)PHTHALATE	6.90E-01	1.19E-07	8.20E-08	2.00E-02	4.10E-06	5.09E-08	3.51E-08	1.40E-02	4.92E-10
FLUORANTHENE	1.65E-01	1.19E-07	1.96E-08	4.00E-02	4.90E-07	5.09E-08	8.40E-09	NA	
PYRENE	1.65E-01	1.19E-07	1.96E-08	3.00E-02	6.53E-07	5.09E-08	8.40E-09	NA	
METALS									
BARIUM	9.93E+02	1.19E-07	1.18E-04	7.00E-02	1.69E-03	5.09E-08	5.06E-05	NA	
CHROMIUM	5.93E+01	1.19E-07	7.05E-06	5.00E-03	1.41E-03	5.09E-08	3.02E-06	NA	
					3.1E-03				4.9E-10

INCIDENTAL INGESTION OF SEDIMENTS
CS = Concentration of chemical in sediments (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)
5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)
HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)

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

- Assumed Value
NA - Data Not Available

FILE: SS6

TABLE C-90
RISK SEGMENT W2
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS									
NONE DETECTED									
SEMI-VOLATILE ORGANICS									
ACENAPHTHENE	1.65E-01	1.19E-07	1.96E-08	6.00E-02	3.27E-07	5.09E-08	8.40E-09	NA	
ANTHRACENE	1.65E-01	1.19E-07	1.96E-08	3.00E-01	6.53E-08	5.09E-08	8.40E-09	NA	
BENZO(A)ANTHRACENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	1.20E+01	1.01E-07
BENZO(B)FLUORANTHENE	1.90E-01	1.19E-07	2.26E-08	NA		5.09E-08	9.67E-09	1.20E+01	1.16E-07
BENZO(K)FLUORANTHENE	1.80E-01	1.19E-07	2.14E-08	NA		5.09E-08	9.17E-09	1.20E+01	1.10E-07
BENZO(A)PYRENE	1.65E-01	1.19E-07	1.96E-08	NA		5.09E-08	8.40E-09	1.20E+01	1.01E-07
BIS(2-ETHYLHEXYL)PHTHALATE	4.20E+00	1.19E-07	4.99E-07	2.00E-02	2.49E-05	5.09E-08	2.14E-07	1.40E-02	2.99E-09
CHRYSENE	2.10E-01	1.19E-07	2.49E-08	NA		5.09E-08	1.07E-08	1.20E+01	1.28E-07
FLUORANTHENE	4.20E-01	1.19E-07	4.99E-08	4.00E-02	1.25E-06	5.09E-08	2.14E-08	NA	
FLUORENE	1.65E-01	1.19E-07	1.96E-08	4.00E-02	4.90E-07	5.09E-08	8.40E-09	NA	
2-METHYLNAPHTHALENE	1.30E+00	1.19E-07	1.54E-07	NA		5.09E-08	6.62E-08	NA	
NAPHTHALENE	1.65E-01	1.19E-07	1.96E-08	4.00E-03	4.90E-06	5.09E-08	8.40E-09	NA	
PHENANTHRENE	2.60E-01	1.19E-07	3.09E-08	NA		5.09E-08	1.32E-08	NA	
PYRENE	5.30E-01	1.19E-07	6.30E-08	3.00E-02	2.10E-06	5.09E-08	2.70E-08	NA	
METALS									
BARIUM	4.26E+02	1.19E-07	5.06E-05	7.00E-02	7.23E-04	5.09E-08	2.17E-05	NA	
CADMIUM	1.27E+01	1.19E-07	1.51E-06	5.00E-04	3.02E-03	5.09E-08	6.47E-07	NA	
CALCIUM	3.96E+04	1.19E-07	4.70E-03	NA		5.09E-08	2.02E-03	NA	
CHROMIUM	5.27E+02	1.19E-07	6.26E-05	5.00E-03	1.25E-02	5.09E-08	2.68E-05	NA	
LEAD	5.50E+01	1.19E-07	6.53E-06	NA		5.09E-08	2.80E-06	NA	
MAGNESIUM	6.94E+03	1.19E-07	8.25E-04	NA		5.09E-08	3.53E-04	NA	
MANGANESE	4.24E+02	1.19E-07	5.04E-05	1.00E-01	5.04E-04	5.09E-08	2.16E-05	NA	
NICKEL	3.60E+01	1.19E-07	4.28E-06	2.00E-02	2.14E-04	5.09E-08	1.83E-06	NA	
SILVER	4.60E+00	1.19E-07	5.47E-07	3.00E-03	1.82E-04	5.09E-08	2.34E-07	NA	
					1.7E-02				5.6E-07

INCIDENTAL INGESTION OF SEDIMENTS

CS = Concentration of chemical in sediments (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)
5.00E+00 EDC = 5 yrs - Exposure Duration for a child (0-6 yrs), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for an adult (6-30 yrs), (OSWER, 1991)
1.70E+01 EFC = 17 days/yr - Exposure Frequency for a child (0-6 yrs), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency for an adult (6-30 yrs), (1 day/mo for 4 months of summer) #
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs), (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)---------- 1.19E-07 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATN)(365)
HIF--(CARCINOGENIC)---------- 5.09E-08 HIF = ((IRC * EFC * EDC / BWC) + (IRA * EFA * EDA / BWA)) * CF / (ATC)(365)

INTAKE = (CS * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

FILE: SS7

TABLE C-91
RISK SEGMENT A
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BENZO(A)ANTHRACENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06		NA	
BENZO(B)FLUORANTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06		NA	
BENZO(K)FLUORANTHENE	2.30E-01	7.37E-06	1.00E-01	1.69E-07	NA		3.16E-06		NA	
BIS(2-ETHYLHEXYL)PHTHALATE	5.20E-01	7.37E-06	1.00E-01	3.83E-07	1.00E-02	3.83E-05	3.16E-06	1.64E-07	2.80E-02	4.60E-09
CHRYSENE	1.90E-01	7.37E-06	1.00E-01	1.40E-07	NA		3.16E-06		NA	
DI-N-BUTYLPHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	5.00E-02	2.43E-06	3.16E-06		NA	
FLUORANTHENE	2.10E-01	7.37E-06	1.00E-01	1.55E-07	2.00E-02	7.73E-06	3.16E-06		NA	
PYRENE	1.90E-01	7.37E-06	1.00E-01	1.40E-07	1.50E-02	9.33E-06	3.16E-06		NA	
METALS										
BARIUM	3.86E+02	7.37E-06	1.00E-02	2.84E-05	1.40E-02	2.03E-03	3.16E-06		NA	
MANGANESE	4.44E+02	7.37E-06	1.00E-02	3.27E-05	2.00E-02	1.64E-03	3.16E-06		NA	
ZINC	5.19E+01	7.37E-06	1.00E-02	3.82E-06	4.00E-02	9.56E-05	3.16E-06		NA	
						3.8E-03				4.6E-0[c]

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)
1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
HIF--(NON-CARCINOGENIC)----------> 7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF--(CARCINOGENIC)----------> 3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
INTAKE = (CS * AF * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

FILE: SS8

TABLE C-92
RISK SEGMENT B
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Report (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
ACETONE	1.70E+00	7.37E-06	2.50E-01	3.13E-06	8.00E-02	3.91E-05	3.16E-06	1.34E-06	NA	
CHLOROFORM	2.80E-02	7.37E-06	2.50E-01	5.16E-08	8.00E-03	6.45E-06	3.16E-06	2.21E-08	7.60E-03	1.68E-10
METHYLENE CHLORIDE	1.00E-01	7.37E-06	2.50E-01	1.84E-07	4.80E-02	3.84E-06	3.16E-06	7.89E-08	9.40E-03	7.42E-10
TOLUENE	5.00E-03	7.37E-06	2.50E-01	9.21E-09	1.60E-01	5.75E-08	3.16E-06	3.95E-09	NA	
SEMI-VOLATILE ORGANICS										
ANTHRACENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.50E-01	8.10E-07	3.16E-06	5.21E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	6.70E-01	7.37E-06	1.00E-01	4.94E-07	1.00E-02	4.94E-05	3.16E-06	2.12E-07	2.80E-02	5.92E-09
BUTYLBENZYLPHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.00E-01	1.22E-06	3.16E-06	5.21E-08	NA	
DI-N-BUTYLPHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	5.00E-02	2.43E-06	3.16E-06	5.21E-08	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.00E-02	1.22E-05	3.16E-06	5.21E-08	NA	
FLUORANTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-02	6.08E-06	3.16E-06	5.21E-08	NA	
PHENANTHRENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06	5.21E-08	NA	
PYRENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.50E-02	8.10E-06	3.16E-06	5.21E-08	NA	
METALS										
BARIUM	9.73E+02	7.37E-06	1.00E-02	7.17E-05	1.40E-02	5.12E-03	3.16E-06	3.07E-05	NA	
CHROMIUM	8.48E+01	7.37E-06	1.00E-02	6.25E-06	1.00E-03	6.25E-03	3.16E-06	2.68E-06	NA	
LEAD	2.96E+01	7.37E-06	1.00E-02	2.18E-06	NA		3.16E-06	9.34E-07	NA	
MANGANESE	3.68E+02	7.37E-06	1.00E-02	2.86E-05	2.00E-02	1.43E-03	3.16E-06	1.22E-05	NA	
ZINC	1.30E+02	7.37E-06	1.00E-02	9.58E-06	4.00E-02	2.39E-04	3.16E-06	4.10E-06	NA	
						1.3E-02				6.8E-09

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

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

7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)

8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)

1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)

1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)----------> 7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--(CARCINOGENIC)----------> 3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value

NA - Data Not Available

FILE: SS9

TABLE C-93
RISK SEGMENT M1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	5.03E-01	7.37E-06	1.00E-01	3.71E-07	1.00E-02	3.71E-05	3.16E-06	1.59E-07	2.80E-02	4.45E-09
METALS										
ARSENIC	5.40E+00	7.37E-06	1.00E-02	3.98E-07	2.00E-04	1.99E-03	3.16E-06	1.71E-07	NA	
BARIUM	3.66E+02	7.37E-06	1.00E-02	2.70E-05	1.40E-02	1.93E-03	3.16E-06	1.16E-05	NA	
CADMIUM	2.75E+01	7.37E-06	1.00E-02	2.02E-06	1.00E-04	2.02E-02	3.16E-06	8.67E-07	NA	
CHROMIUM	4.23E+02	7.37E-06	1.00E-02	3.11E-05	1.00E-03	3.11E-02	3.16E-06	1.33E-05	NA	
LEAD	3.74E+01	7.37E-06	1.00E-02	2.75E-06	NA		3.16E-06	1.18E-06	NA	
MANGANESE	7.09E+02	7.37E-06	1.00E-02	5.23E-05	2.00E-02	2.61E-03	3.16E-06	2.24E-05	NA	
NICKEL	6.01E+01	7.37E-06	1.00E-02	4.43E-06	4.00E-03	1.11E-03	3.16E-06	1.90E-06	NA	
SILVER	7.80E+00	7.37E-06	1.00E-02	5.75E-07	6.00E-04	9.58E-04	3.16E-06	2.46E-07	NA	
VANADIUM	3.31E+01	7.37E-06	1.00E-02	2.44E-06	1.40E-03	1.74E-03	3.16E-06	1.04E-06	NA	
						6.2E-02				4.4E-09

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)
1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)---------->
7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--(CARCINOGENIC)---------->
3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

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

- Assumed Value
NA - Data Not Available

TABLE C-94
RISK SEGMENT M2
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BENZO(A)PYRENE	3.30E-01	7.37E-06	1.00E-01	2.43E-07	NA		3.16E-06	1.04E-07	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	6.70E-01	7.37E-06	1.00E-01	4.94E-07	1.00E-02	4.94E-05	3.16E-06	2.12E-07	2.80E-02	5.92E-09
DI-N-BUTYLPHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	5.00E-02	2.43E-06	3.16E-06	5.21E-08	NA	
DI-N-OCTYL PHTHALATE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.00E-02	1.22E-05	3.16E-06	5.21E-08	NA	
METALS										
BARIUM	4.88E+02	7.37E-06	1.00E-02	3.59E-05	1.40E-02	2.57E-03	3.16E-06	1.54E-05	NA	
CALCIUM	2.26E+04	7.37E-06	1.00E-02	1.66E-03	NA		3.16E-06	7.13E-04	NA	
CHROMIUM	3.85E+01	7.37E-06	1.00E-02	2.84E-06	1.00E-03	2.84E-03	3.16E-06	1.22E-06	NA	
MANGANESE	8.40E+02	7.37E-06	1.00E-02	6.19E-05	2.00E-02	3.09E-03	3.16E-06	2.65E-05	NA	
						8.6E-03				5.9E-09

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)
1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
HIF--(NON-CARCINOGENIC)---------->
7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF--(CARCINOGENIC)---------->
3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
INTAKE = (CS * AF * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-95
RISK SEGMENT M3
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	3.80E-01	7.37E-06	1.00E-01	2.80E-07	1.00E-02	2.80E-05	3.16E-06	1.20E-07	2.80E-02	3.36E-09
METALS										
BARIUM	6.51E+02	7.37E-06	1.00E-02	4.79E-05	1.40E-02	3.42E-03	3.16E-06	2.05E-05	NA	
						3.5E-03				3.4E-09

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)
1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
HIF--(NON-CARCINOGENIC)----------> 7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF--(CARCINOGENIC)----------> 3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
INTAKE = (CS * AF * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-96
RISK SEGMENT E2
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (kg-day/mg)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
BIS(2-ETHYLHEXYL)PHTHALATE	6.90E-01	7.37E-06	1.00E-01	5.08E-07	1.00E-02	5.08E-05	3.16E-06	2.18E-07	2.80E-02	6.10E-09
FLUORANTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-02	6.08E-06	3.16E-06	5.21E-08	NA	
PYRENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.50E-02	8.10E-06	3.16E-06	5.21E-08	NA	
METALS										
BARIUM	9.93E+02	7.37E-06	1.00E-02	7.31E-05	1.40E-02	5.22E-03	3.16E-06	3.13E-05	NA	
CHROMIUM	5.93E+01	7.37E-06	1.00E-02	4.37E-06	1.00E-03	4.37E-03	3.16E-06	1.87E-06	NA	
						9.7E-03				6.1E-09

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)
8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)
1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #
4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #
5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)
2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)
1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)
5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)
HIF--(NON-CARCINOGENIC)---------->
7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]
HIF--(CARCINOGENIC)---------->
3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]
INTAKE = (CS * AF * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-97
RISK SEGMENT W2
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO SWIMMING AND WADING
OFF-BASE CHILD AND ADULT (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (mg/kg-day)	Risk
VOLATILE ORGANICS										
NONE DETECTED										
SEMI-VOLATILE ORGANICS										
ACENAPHTHENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	3.00E-02	4.05E-06	3.16E-06	5.21E-08	NA	
ANTHRACENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	1.50E-01	8.10E-07	3.16E-06	5.21E-08	NA	
BENZO(A)ANTHRACENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06	5.21E-08	NA	
BENZO(B)FLUORANTHENE	1.90E-01	7.37E-06	1.00E-01	1.40E-07	NA		3.16E-06	6.00E-08	NA	
BENZO(K)FLUORANTHENE	1.80E-01	7.37E-06	1.00E-01	1.33E-07	NA		3.16E-06	5.68E-08	NA	
BENZO(A)PYRENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	NA		3.16E-06	5.21E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	4.20E+00	7.37E-06	1.00E-01	3.09E-06	1.00E-02	3.09E-04	3.16E-06	1.33E-06	2.80E-02	3.71E-08
CHRYSENE	2.10E-01	7.37E-06	1.00E-01	1.55E-07	NA		3.16E-06	6.63E-08	NA	
FLUORANTHENE	4.20E-01	7.37E-06	1.00E-01	3.09E-07	2.00E-02	1.55E-05	3.16E-06	1.33E-07	NA	
FLUORENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-02	6.08E-06	3.16E-06	5.21E-08	NA	
2-METHYLNAPHTHALENE	1.30E+00	7.37E-06	1.00E-01	9.58E-07	NA		3.16E-06	4.10E-07	NA	
NAPHTHALENE	1.65E-01	7.37E-06	1.00E-01	1.22E-07	2.00E-03	6.08E-05	3.16E-06	5.21E-08	NA	
PHENANTHRENE	2.60E-01	7.37E-06	1.00E-01	1.92E-07	NA		3.16E-06	8.21E-08	NA	
PYRENE	5.30E-01	7.37E-06	1.00E-01	3.90E-07	1.50E-02	2.60E-05	3.16E-06	1.67E-07	NA	
METALS										
BARIUM	4.26E+02	7.37E-06	1.00E-02	3.14E-05	1.40E-02	2.24E-03	3.16E-06	1.34E-05	NA	
CADMIUM	1.27E+01	7.37E-06	1.00E-02	9.35E-07	1.00E-04	9.35E-03	3.16E-06	4.01E-07	NA	
CALCIUM	3.96E+04	7.37E-06	1.00E-02	2.92E-03	NA		3.16E-06	1.25E-03	NA	
CHROMIUM	5.27E+02	7.37E-06	1.00E-02	3.88E-05	1.00E-03	3.88E-02	3.16E-06	1.66E-05	NA	
LEAD	5.50E+01	7.37E-06	1.00E-02	4.05E-06	NA		3.16E-06	1.74E-06	NA	
MAGNESIUM	6.94E+03	7.37E-06	1.00E-02	5.11E-04	NA		3.16E-06	2.19E-04	NA	
MANGANESE	4.24E+02	7.37E-06	1.00E-02	3.12E-05	2.00E-02	1.56E-03	3.16E-06	1.34E-05	NA	
NICKEL	3.60E+01	7.37E-06	1.00E-02	2.65E-06	4.00E-03	6.63E-04	3.16E-06	1.14E-06	NA	
SILVER	4.60E+00	7.37E-06	1.00E-02	3.39E-07	6.00E-04	5.65E-04	3.16E-06	1.45E-07	NA	
						5.4E-02				3.7E-08

DERMAL CONTACT WITH SEDIMENTS

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

AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)

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

7.20E+03 SAC = 7200 sq cm - Skin Surface Area Available for Contact, (Child: 0-6 yrs.), whole body, (EPA, 1989a)

8.62E+03 SAA = 8620 sq cm - Skin Surface Area Available for Contact, (Adult),head,hands,arms,lower legs,(EPA, 1989a)

1.70E+01 EFC = 17 days/yr - Exposure Frequency, (Child: 0-6 yrs.), (1 day/wk for 17 wks of summer) #

4.00E+00 EFA = 4 days/yr - Exposure Frequency, (Adult: 6-30 yrs.), (1 day/mo for 4 months of summer) #

5.00E+00 EDC = 5 yrs - Exposure Duration for child (1-6 yrs.), (OSWER, 1991)

2.50E+01 EDA = 25 yrs - Exposure Duration for adult (6-30 yrs.), (OSWER, 1991)

1.51E+01 BWC = 15.1 kg - Body Weight for a child (1-6 yrs.), (OSWER, 1991)

5.71E+01 BWA = 57.1 kg - Body Weight for adult (6-30 yrs.), (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)

1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)----------> 7.37E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATN)(365)]

HIF--(CARCINOGENIC)----------> 3.16E-06 HIF = [((SAC * EFC * EDC * AF / BWC) + (SAA * EFA * EDA * AF / BWA)) * CF / (ATC)(365)]

INTAKE = (CS * AF * HIF)

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

RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

\# - Assumed Value

NA - Data Not Available

FILE: SS14

TABLE C-98
RISK SEGMENT E1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (mg/kg-day)	Risk
VOLATILE ORGANICS									
CHLOROBENZENE	1.99E+01	1.96E-09	3.90E-08	2.00E-02	1.95E-06	6.99E-10	1.39E-08	NA	
CHLOROETHANE	2.57E-02	1.96E-09	5.03E-11	NA		6.99E-10	1.80E-11	NA	
CHLOROFORM	2.47E+00	1.96E-09	4.83E-09	1.00E-02	4.83E-07	6.99E-10	1.72E-09	6.10E-03	1.05E-11
1,2-DICHLOROETHENE (TOTAL)	4.60E+01	1.96E-09	9.01E-08	1.00E-02	9.01E-06	6.99E-10	3.22E-08	NA	
METHYLENE CHLORIDE	3.58E+01	1.96E-09	7.01E-08	6.00E-02	1.17E-06	6.99E-10	2.50E-08	7.50E-03	1.88E-10
TRICHLOROETHENE	1.05E+00	1.96E-09	2.06E-09	NA		6.99E-10	7.35E-10	1.10E-02	8.09E-12
TETRACHLOROETHENE	2.12E+01	1.96E-09	4.15E-08	1.00E-02	4.15E-06	6.99E-10	1.48E-08	5.10E-02	7.56E-10
XYLENE (TOTAL)	2.59E-01	1.96E-09	5.07E-10	2.00E+00	2.54E-10	6.99E-10	1.81E-10	NA	
VINYL ACETATE	5.00E-03	1.96E-09	9.78E-12	1.00E+00	9.78E-12	6.99E-10	3.49E-12	NA	
SEMI-VOLATILE ORGANICS									
ACENAPHTHENE	1.71E-01	1.96E-09	3.35E-10	6.00E-02	5.59E-09	6.99E-10	1.20E-10	NA	
ANTHRACENE	5.14E-01	1.96E-09	1.01E-09	3.00E-01	3.35E-09	6.99E-10	3.59E-10	NA	
BENZO(A)ANTHRACENE	1.61E+00	1.96E-09	3.14E-09	NA		6.99E-10	1.12E-09	1.20E+01	1.35E-08
BENZO(B)FLUORANTHENE	1.56E+00	1.96E-09	3.06E-09	NA		6.99E-10	1.09E-09	1.20E+01	1.31E-08
BENZO(K)FLUORANTHENE	1.68E+00	1.96E-09	3.28E-09	NA		6.99E-10	1.17E-09	1.20E+01	1.41E-08
BENZO(G,H,I)PERYLENE	6.90E-01	1.96E-09	1.35E-09	NA		6.99E-10	4.82E-10	NA	
BENZO(A)PYRENE	1.43E+00	1.96E-09	2.81E-09	NA		6.99E-10	1.00E-09	1.20E+01	1.20E-08
BIS(2-ETHYLHEXYL)PHTHALATE	3.38E+00	1.96E-09	6.62E-09	2.00E-02	3.31E-07	6.99E-10	2.36E-09	1.40E-02	3.31E-11
BUTYLBENZYLPHTHALATE	1.65E-01	1.96E-09	3.23E-10	2.00E-01	1.61E-09	6.99E-10	1.15E-10	NA	
2-CHLORONAPHTHALENE	7.50E-01	1.96E-09	1.47E-09	NA		6.99E-10	5.24E-10	NA	
CHRYSENE	1.93E+00	1.96E-09	3.78E-09	NA		6.99E-10	1.35E-09	1.20E+01	1.62E-08
DIBENZOFURAN	2.14E-01	1.96E-09	4.19E-10	NA		6.99E-10	1.50E-10	NA	
1,3-DICHLOROBENZENE	1.65E-01	1.96E-09	3.23E-10	NA		6.99E-10	1.15E-10	NA	
1,4-DICHLOROBENZENE	1.65E-01	1.96E-09	3.23E-10	NA		6.99E-10	1.15E-10	2.40E-02	2.77E-12
1,2-DICHLOROBENZENE	1.65E-01	1.96E-09	3.23E-10	9.00E-02	3.59E-09	6.99E-10	1.15E-10	NA	
DI-N-BUTYLPHTHALATE	1.32E-01	1.96E-09	2.59E-10	1.00E-01	2.59E-09	6.99E-10	9.26E-11	NA	
DI-N-OCTYLPHTHALATE	2.10E-01	1.96E-09	4.10E-10	2.00E-02	2.05E-08	6.99E-10	1.47E-10	NA	
FLUORANTHENE	4.51E+00	1.96E-09	8.82E-09	4.00E-02	2.20E-07	6.99E-10	3.15E-09	NA	
FLUORENE	1.64E-01	1.96E-09	3.21E-10	4.00E-02	8.03E-09	6.99E-10	1.15E-10	NA	
INDENO(1,2,3-CD)PYRENE	7.19E-01	1.96E-09	1.41E-09	NA		6.99E-10	5.03E-10	1.20E+01	6.03E-09
2-METHYLNAPHTHALENE	2.72E-01	1.96E-09	5.32E-10	NA		6.99E-10	1.90E-10	NA	
NAPHTHALENE	3.16E-01	1.96E-09	6.18E-10	4.00E-03	1.54E-07	6.99E-10	2.21E-10	NA	
PHENANTHRENE	2.50E+00	1.96E-09	4.89E-09	NA		6.99E-10	1.75E-09	NA	
PYRENE	3.62E+00	1.96E-09	7.09E-09	3.00E-02	2.36E-07	6.99E-10	2.53E-09	NA	
METALS									
ARSENIC	3.84E-03	1.96E-09	7.51E-12	1.00E-03	7.51E-09	6.99E-10	2.68E-12	NA	
BARIUM	1.21E+00	1.96E-09	2.36E-09	7.00E-02	3.37E-08	6.99E-10	8.44E-10	NA	
CADMIUM	9.47E-02	1.96E-09	1.85E-10	5.00E-04	3.71E-07	6.99E-10	6.62E-11	NA	
CHROMIUM	4.35E-01	1.96E-09	8.51E-10	5.00E-03	1.70E-07	6.99E-10	3.04E-10	NA	
COBALT	8.57E-03	1.96E-09	1.68E-11	NA		6.99E-10	5.99E-12	NA	
COPPER	2.05E-01	1.96E-09	4.01E-10	NA		6.99E-10	1.43E-10	NA	
CYANIDE	2.59E-03	1.96E-09	5.07E-12	2.00E-02	2.54E-10	6.99E-10	1.81E-12	NA	
IRON	1.50E+01	1.96E-09	2.94E-08	NA		6.99E-10	1.05E-08	NA	
LEAD	2.05E-01	1.96E-09	4.02E-10	NA		6.99E-10	1.44E-10	NA	
MAGNESIUM	3.93E+00	1.96E-09	7.69E-09	NA		6.99E-10	2.75E-09	NA	
MANGANESE	5.19E-01	1.96E-09	1.02E-09	1.00E-01	1.02E-08	6.99E-10	3.63E-10	NA	
MERCURY	8.12E-04	1.96E-09	1.59E-12	3.00E-04	5.30E-09	6.99E-10	5.67E-13	NA	
NICKEL	1.26E-01	1.96E-09	2.46E-10	2.00E-02	1.23E-08	6.99E-10	8.78E-11	NA	
SELENIUM	2.55E-03	1.96E-09	4.98E-12	NA		6.99E-10	1.78E-12	NA	
SILVER	8.43E-03	1.96E-09	1.65E-11	3.00E-03	5.50E-09	6.99E-10	5.89E-12	NA	
VANADIUM	2.52E-02	1.96E-09	4.94E-11	7.00E-03	7.05E-09	6.99E-10	1.76E-11	NA	
ZINC	2.41E-01	1.96E-09	4.71E-10	2.00E-01	2.35E-09	6.99E-10	1.68E-10	NA	
					1.8E-05				7.6E-08

FILE: SS15

TABLE C-98 (CONTINUED)
RISK SEGMENT E1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

	INCIDENTAL INGESTION OF SEDIMENTS
	CS = Concentration of chemical in sediment (mg/kg)
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)
2.50E+01	ED = 25 yrs - Exposure Duration for an adult worker, (OSWER, 1991)
1.00E+00	EF = 1 day/yr - Exposure Frequency for an adult worker #
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)----------	1.96E-09 HIF = (CF * IR * ED * EF / BW) / (ATN)(365)
HIF--(CARCINOGENIC)----------	6.99E-10 HIF = (CF * IR * ED * EF / BW) / (ATC)(365)
	INTAKE = (CS * HIF)
	RISK (non-carcinogenic) = (INTAKE / RfD)
	RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-99
RISK SEGMENT W1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK				LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (mg/kg-day)	Risk
VOLATILE ORGANICS									
ACETONE	1.28E-01	1.96E-09	2.51E-10	1.00E-01	2.51E-09	6.99E-10	8.95E-11	NA	
CARBON DISULFIDE	2.06E-02	1.96E-09	4.03E-11	1.00E-01	4.03E-10	6.99E-10	1.44E-11	NA	
ETHYLBENZENE	5.00E-03	1.96E-09	9.78E-12	1.00E-01	9.78E-11	6.99E-10	3.49E-12	NA	
TOLUENE	7.81E-02	1.96E-09	1.53E-10	2.00E-01	7.64E-10	6.99E-10	5.46E-11	NA	
XYLENE (TOTAL)	3.26E-02	1.96E-09	6.39E-11	2.00E+00	3.19E-11	6.99E-10	2.28E-11	NA	
SEMI-VOLATILE ORGANICS									
ACENAPHTHENE	6.35E-01	1.96E-09	1.24E-09	6.00E-02	2.07E-08	6.99E-10	4.44E-10	NA	
ANTHRACENE	5.76E-01	1.96E-09	1.13E-09	3.00E-01	3.76E-09	6.99E-10	4.03E-10	NA	
BENZO(A)ANTHRACENE	2.20E+00	1.96E-09	4.30E-09	NA		6.99E-10	1.54E-09	1.20E+01	1.84E-08
BENZO(B)FLUORANTHENE	4.92E+00	1.96E-09	9.63E-09	NA		6.99E-10	3.44E-09	1.20E+01	4.13E-08
BENZO(K)FLUORANTHENE	7.88E-01	1.96E-09	1.54E-09	NA		6.99E-10	5.51E-10	1.20E+01	6.61E-09
BENZO(G,H,I)PERYLENE	2.23E+00	1.96E-09	4.36E-09	NA		6.99E-10	1.56E-09	NA	
BENZO(A)PYRENE	2.48E+00	1.96E-09	4.85E-09	NA		6.99E-10	1.73E-09	1.20E+01	2.08E-08
BIS(2-ETHYLHEXYL)PHTHALATE	2.56E+01	1.96E-09	5.01E-08	2.00E-02	2.50E-06	6.99E-10	1.79E-08	1.40E-02	2.50E-10
BUTYLBENZYLPHTHALATE	4.44E-01	1.96E-09	8.69E-10	2.00E-01	4.34E-09	6.99E-10	3.10E-10	NA	
CHRYSENE	3.92E+00	1.96E-09	7.67E-09	NA		6.99E-10	2.74E-09	1.20E+01	3.29E-08
DIBENZOFURAN	3.23E-01	1.96E-09	6.33E-10	NA		6.99E-10	2.26E-10	NA	
1,3-DICHLOROBENZENE	1.88E-01	1.96E-09	3.67E-10	NA		6.99E-10	1.31E-10	NA	
1,4-DICHLOROBENZENE	1.19E+00	1.96E-09	2.32E-09	NA		6.99E-10	8.30E-10	2.40E-02	1.99E-11
1,2-DICHLOROBENZENE	1.93E-01	1.96E-09	3.77E-10	9.00E-02	4.19E-09	6.99E-10	1.35E-10	NA	
3,3'-DICHLOROBENZIDINE	9.36E-01	1.96E-09	1.83E-09	NA		6.99E-10	6.54E-10	4.50E-01	2.94E-10
DI-N-BUTYLPHTHALATE	1.21E+00	1.96E-09	2.37E-09	1.00E-01	2.37E-08	6.99E-10	8.47E-10	NA	
DI-N-OCTYLPHTHALATE	2.08E-01	1.96E-09	4.06E-10	2.00E-02	2.03E-08	6.99E-10	1.45E-10	NA	
FLUORANTHENE	7.50E+00	1.96E-09	1.47E-08	4.00E-02	3.67E-07	6.99E-10	5.24E-09	NA	
FLUORENE	5.24E-01	1.96E-09	1.03E-09	4.00E-02	2.57E-08	6.99E-10	3.66E-10	NA	
INDENO(1,2,3-CD)PYRENE	2.09E+00	1.96E-09	4.10E-09	NA		6.99E-10	1.46E-09	1.20E+01	1.76E-08
2-METHYLNAPHTHALENE	4.84E-01	1.96E-09	9.47E-10	NA		6.99E-10	3.38E-10	NA	
NAPHTHALENE	4.29E-01	1.96E-09	8.39E-10	4.00E-03	2.10E-07	6.99E-10	3.00E-10	NA	
PHENANTHRENE	3.21E+00	1.96E-09	6.27E-09	NA		6.99E-10	2.24E-09	NA	
PYRENE	1.78E+00	1.96E-09	3.48E-09	3.00E-02	1.16E-07	6.99E-10	1.24E-09	NA	
METALS									
BARIUM	4.73E+02	1.96E-09	9.25E-07	7.00E-02	1.32E-05	6.99E-10	3.30E-07	NA	
CADMIUM	5.40E+01	1.96E-09	1.06E-07	5.00E-04	2.11E-04	6.99E-10	3.77E-08	NA	
CALCIUM	1.59E+04	1.96E-09	3.12E-05	NA		6.99E-10	1.11E-05	NA	
CHROMIUM	1.07E+03	1.96E-09	2.10E-06	5.00E-03	4.20E-04	6.99E-10	7.50E-07	NA	
COBALT	3.08E+01	1.96E-09	6.02E-08	NA		6.99E-10	2.15E-08	NA	
COPPER	1.71E+02	1.96E-09	3.34E-07	NA		6.99E-10	1.19E-07	NA	
LEAD	1.34E+02	1.96E-09	2.62E-07	NA		6.99E-10	9.36E-08	NA	
MAGNESIUM	9.12E+03	1.96E-09	1.79E-05	NA		6.99E-10	6.38E-06	NA	
MANGANESE	6.13E+02	1.96E-09	1.20E-06	1.00E-01	1.20E-05	6.99E-10	4.29E-07	NA	
MERCURY	2.10E+00	1.96E-09	4.11E-09	3.00E-04	1.37E-05	6.99E-10	1.47E-09	NA	
NICKEL	1.15E+03	1.96E-09	2.26E-06	2.00E-02	1.13E-04	6.99E-10	8.06E-07	NA	
POTASSIUM	1.65E+03	1.96E-09	3.22E-06	NA		6.99E-10	1.15E-06	NA	
SELENIUM	1.77E+00	1.96E-09	3.46E-09	NA		6.99E-10	1.24E-09	NA	
SILVER	5.81E+01	1.96E-09	1.14E-07	3.00E-03	3.79E-05	6.99E-10	4.06E-08	NA	
ZINC	2.88E+02	1.96E-09	5.63E-07	2.00E-01	2.81E-06	6.99E-10	2.01E-07	NA	
					8.3E-04				1.4E-07

FILE: SS16

TABLE C-99 (CONTINUED)
RISK SEGMENT W1
INCIDENTAL INGESTION OF CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

	INCIDENTAL INGESTION OF SEDIMENTS
	CS = Concentration of chemical in sediment (mg/kg)
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)
2.50E+01	ED = 25 yrs - Exposure Duration for an adult worker, (OSWER, 1991)
1.00E+00	EF = 1 day/yr - Exposure Frequency for an adult worker #
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)----------	1.96E-09 HIF = (CF * IR * ED * EF / BW) / (ATN)(365)
HIF--(CARCINOGENIC)----------	6.99E-10 HIF = (CF * IR * ED * EF / BW) / (ATC)(365)
	INTAKE = (CS * HIF)
	RISK (non-carcinogenic) = (INTAKE / RfD)
	RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

TABLE C-100
RISK SEGMENT E1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (mg/kg-day)	Risk
VOLATILE ORGANICS										
CHLOROBENZENE	1.99E+01	5.56E-07	2.50E-01	2.77E-06	1.60E-02	1.73E-04	1.99E-07	9.91E-07	NA	
CHLOROETHANE	2.57E-02	5.56E-07	2.50E-01	3.57E-09	NA		1.99E-07	1.28E-09	NA	
CHLOROFORM	2.47E+00	5.56E-07	2.50E-01	3.43E-07	8.00E-03	4.29E-05	1.99E-07	1.23E-07	7.60E-03	9.31E-10
1,2-DICHLOROETHENE (TOTAL)	4.60E+01	5.56E-07	2.50E-01	6.40E-06	1.60E-02	4.00E-04	1.99E-07	2.29E-06	NA	
METHYLENE CHLORIDE	3.58E+01	5.56E-07	2.50E-01	4.98E-06	4.80E-02	1.04E-04	1.99E-07	1.78E-06	9.40E-03	1.67E-08
TRICHLOROETHENE	1.05E+00	5.56E-07	2.50E-01	1.46E-07	NA		1.99E-07	5.22E-08	1.40E-02	7.31E-10
TETRACHLOROETHENE	2.12E+01	5.56E-07	2.50E-01	2.95E-06	8.00E-03	3.69E-04	1.99E-07	1.05E-06	6.40E-02	6.74E-08
XYLENE (TOTAL)	2.59E-01	5.56E-07	2.50E-01	3.61E-08	1.60E+00	2.25E-08	1.99E-07	1.29E-08	NA	
VINYL ACETATE	5.00E-03	5.56E-07	2.50E-01	6.95E-10	8.00E-01	8.69E-10	1.99E-07	2.48E-10	NA	
SEMI-VOLATILE ORGANICS										
ACENAPHTHENE	1.71E-01	5.56E-07	1.00E-01	9.53E-09	3.00E-02	3.18E-07	1.99E-07	3.40E-09	NA	
ANTHRACENE	5.14E-01	5.56E-07	1.00E-01	2.86E-08	1.50E-01	1.91E-07	1.99E-07	1.02E-08	NA	
BENZO(A)ANTHRACENE	1.61E+00	5.56E-07	1.00E-01	8.93E-08	NA		1.99E-07	3.19E-08	NA	
BENZO(B)FLUORANTHENE	1.56E+00	5.56E-07	1.00E-01	8.70E-08	NA		1.99E-07	3.11E-08	NA	
BENZO(K)FLUORANTHENE	1.68E+00	5.56E-07	1.00E-01	9.33E-08	NA		1.99E-07	3.33E-08	NA	
BENZO(G,H,I)PERYLENE	6.90E-01	5.56E-07	1.00E-01	3.84E-08	NA		1.99E-07	1.37E-08	NA	
BENZO(A)PYRENE	1.43E+00	5.56E-07	1.00E-01	7.98E-08	NA		1.99E-07	2.85E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	3.38E+00	5.56E-07	1.00E-01	1.88E-07	1.00E-02	1.88E-05	1.99E-07	6.72E-08	2.80E-02	1.88E-09
BUTYLBENZYLPHTHALATE	1.65E-01	5.56E-07	1.00E-01	9.18E-09	1.00E-01	9.18E-08	1.99E-07	3.28E-09	NA	
2-CHLORONAPHTHALENE	7.50E-01	5.56E-07	1.00E-01	4.17E-08	NA		1.99E-07	1.49E-08	NA	
CHRYSENE	1.93E+00	5.56E-07	1.00E-01	1.07E-07	NA		1.99E-07	3.84E-08	NA	
DIBENZOFURAN	2.14E-01	5.56E-07	1.00E-01	1.19E-08	NA		1.99E-07	4.25E-09	NA	
1,3-DICHLOROBENZENE	1.65E-01	5.56E-07	1.00E-01	9.18E-09	NA		1.99E-07	3.28E-09	NA	
1,4-DICHLOROBENZENE	1.65E-01	5.56E-07	1.00E-01	9.18E-09	NA		1.99E-07	3.28E-09	4.80E-02	1.57E-10
1,2-DICHLOROBENZENE	1.65E-01	5.56E-07	1.00E-01	9.18E-09	4.50E-02	2.04E-07	1.99E-07	3.28E-09	NA	
DI-N-BUTYLPHTHALATE	1.32E-01	5.56E-07	1.00E-01	7.37E-09	5.00E-02	1.47E-07	1.99E-07	2.63E-09	NA	
DI-N-OCTYLPHTHALATE	2.10E-01	5.56E-07	1.00E-01	1.17E-08	1.00E-02	1.17E-06	1.99E-07	4.16E-09	NA	
FLUORANTHENE	4.51E+00	5.56E-07	1.00E-01	2.51E-07	2.00E-02	1.25E-05	1.99E-07	8.95E-08	NA	
FLUORENE	1.64E-01	5.56E-07	1.00E-01	9.13E-09	2.00E-02	4.57E-07	1.99E-07	3.26E-09	NA	
INDENO(1,2,3-CD)PYRENE	7.19E-01	5.56E-07	1.00E-01	4.00E-08	NA		1.99E-07	1.43E-08	NA	
2-METHYLNAPHTHALENE	2.72E-01	5.56E-07	1.00E-01	1.51E-08	NA		1.99E-07	5.40E-09	NA	
NAPHTHALENE	3.16E-01	5.56E-07	1.00E-01	1.76E-08	2.00E-03	8.78E-06	1.99E-07	6.27E-09	NA	
PHENANTHRENE	2.50E+00	5.56E-07	1.00E-01	1.39E-07	NA		1.99E-07	4.96E-08	NA	
PYRENE	3.62E+00	5.56E-07	1.00E-01	2.01E-07	1.50E-02	1.34E-05	1.99E-07	7.20E-08	NA	
METALS										
ARSENIC	3.84E+00	5.56E-07	1.00E-02	2.13E-08	2.00E-04	1.07E-04	1.99E-07	7.62E-09	NA	
BARIUM	1.21E+03	5.56E-07	1.00E-02	6.71E-06	1.40E-02	4.79E-04	1.99E-07	2.40E-06	NA	
CADMIUM	9.47E+01	5.56E-07	1.00E-02	5.27E-07	1.00E-04	5.27E-03	1.99E-07	1.88E-07	NA	
CHROMIUM	4.35E+02	5.56E-07	1.00E-02	2.42E-06	1.00E-03	2.42E-03	1.99E-07	8.63E-07	NA	
COBALT	8.57E+00	5.56E-07	1.00E-02	4.76E-08	NA		1.99E-07	1.70E-08	NA	
COPPER	2.05E+02	5.56E-07	1.00E-02	1.14E-06	NA		1.99E-07	4.07E-07	NA	
CYANIDE	2.59E+00	5.56E-07	1.00E-02	1.44E-08	4.00E-03	3.60E-06	1.99E-07	5.15E-09	NA	
IRON	1.50E+04	5.56E-07	1.00E-02	8.36E-05	NA		1.99E-07	2.99E-05	NA	
LEAD	2.05E+02	5.56E-07	1.00E-02	1.14E-06	NA		1.99E-07	4.08E-07	NA	
MAGNESIUM	3.93E+03	5.56E-07	1.00E-02	2.19E-05	NA		1.99E-07	7.81E-06	NA	
MANGANESE	5.19E+02	5.56E-07	1.00E-02	2.88E-06	2.00E-02	1.44E-04	1.99E-07	1.03E-06	NA	
MERCURY	8.12E-01	5.56E-07	1.00E-02	4.52E-09	6.00E-05	7.53E-05	1.99E-07	1.61E-09	NA	
NICKEL	1.26E+02	5.56E-07	1.00E-02	6.98E-07	4.00E-03	1.75E-04	1.99E-07	2.49E-07	NA	
SELENIUM	2.55E+00	5.56E-07	1.00E-02	1.42E-08	NA		1.99E-07	5.06E-09	NA	
SILVER	8.43E+00	5.56E-07	1.00E-02	4.69E-08	6.00E-04	7.81E-05	1.99E-07	1.67E-08	NA	
VANADIUM	2.52E+01	5.56E-07	1.00E-02	1.40E-07	1.40E-03	1.00E-04	1.99E-07	5.01E-08	NA	
ZINC	2.41E+02	5.56E-07	1.00E-02	1.34E-06	4.00E-02	3.35E-05	1.99E-07	4.78E-07	NA	
						1.0E-02				8.8E-08

FILE: SS17

TABLE C-100 (CONTINUED)
RISK SEGMENT E1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = 0.000001 kg/mg - Conversion Factor, (EPA, 1989a)
9.80E+03 SA = 9800 sq cm - Skin Surface Area Available for Contact (Adult), head,hands,arms,lower legs, (EPA, 1989a)
1.00E+00 EF = 1 day/yr - Exposure Frequency #
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)
1.45E+00 AF = 1.45 mg/sq cm - Adherence Factor, (EPA, 1989a)

HIF--(NON-CARCINOGENIC)---------->
5.56E-07 HIF = (CF * SA * EF * ED * AF / BW) / (ATN)(365)]

HIF--(CARCINOGENIC)---------->
1.99E-07 HIF = (CF * SA * EF * ED * AF / BW) / (ATN)(365)]

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

- Assumed Value
NA - Data Not Available

TABLE C-101
RISK SEGMENT W1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

		CHRONIC / NON-CARCINOGENIC RISK					LIFETIME / CARCINOGENIC RISK			
ANALYTE	Risk Assessment Conc. (mg/kg)	Human Intake Factor (kg/kg-day)	Absorbance Factor	Intake (mg/kg-day)	RfD (mg/kg-day)	Risk	Human Intake Factor (kg/kg-day)	Intake (mg/kg-day)	Slope Factor (mg/kg-day)	Risk
VOLATILE ORGANICS										
ACETONE	1.28E-01	5.56E-07	2.50E-01	1.78E-08	8.00E-02	2.23E-07	1.99E-07	6.36E-09	NA	
CARBON DISULFIDE	2.06E-02	5.56E-07	2.50E-01	2.86E-09	8.00E-02	3.58E-08	1.99E-07	1.02E-09	NA	
ETHYLBENZENE	5.00E-03	5.56E-07	2.50E-01	6.95E-10	8.00E-02	8.69E-09	1.99E-07	2.48E-10	NA	
TOLUENE	7.81E-02	5.56E-07	2.50E-01	1.09E-08	1.60E-01	6.78E-08	1.99E-07	3.88E-09	NA	
XYLENE (TOTAL)	3.26E-02	5.56E-07	2.50E-01	4.54E-09	1.60E+00	2.84E-09	1.99E-07	1.62E-09	NA	
SEMI-VOLATILE ORGANICS										
ACENAPHTHENE	6.35E-01	5.56E-07	1.00E-01	3.53E-08	3.00E-02	1.18E-06	1.99E-07	1.26E-08	NA	
ANTHRACENE	5.76E-01	5.56E-07	1.00E-01	3.20E-08	1.50E-01	2.14E-07	1.99E-07	1.14E-08	NA	
BENZO(A)ANTHRACENE	2.20E+00	5.56E-07	1.00E-01	1.22E-07	NA		1.99E-07	4.37E-08	NA	
BENZO(B)FLUORANTHENE	4.92E+00	5.56E-07	1.00E-01	2.74E-07	NA		1.99E-07	9.77E-08	NA	
BENZO(K)FLUORANTHENE	7.88E-01	5.56E-07	1.00E-01	4.38E-08	NA		1.99E-07	1.57E-08	NA	
BENZO(G,H,I)PERYLENE	2.23E+00	5.56E-07	1.00E-01	1.24E-07	NA		1.99E-07	4.42E-08	NA	
BENZO(A)PYRENE	2.48E+00	5.56E-07	1.00E-01	1.38E-07	NA		1.99E-07	4.92E-08	NA	
BIS(2-ETHYLHEXYL)PHTHALATE	2.56E+01	5.56E-07	1.00E-01	1.42E-06	1.00E-02	1.42E-04	1.99E-07	5.08E-07	2.80E-02	1.42E-08
BUTYLBENZYLPHTHALATE	4.44E-01	5.56E-07	1.00E-01	2.47E-08	1.00E-01	2.47E-07	1.99E-07	8.82E-09	NA	
CHRYSENE	3.92E+00	5.56E-07	1.00E-01	2.18E-07	NA		1.99E-07	7.79E-08	NA	
DIBENZOFURAN	3.23E-01	5.56E-07	1.00E-01	1.80E-08	NA		1.99E-07	6.42E-09	NA	
1,3-DICHLOROBENZENE	1.88E-01	5.56E-07	1.00E-01	1.04E-08	NA		1.99E-07	3.73E-09	NA	
1,4-DICHLOROBENZENE	1.19E+00	5.56E-07	1.00E-01	6.60E-08	NA		1.99E-07	2.36E-08	4.80E-02	1.13E-09
1,2-DICHLOROBENZENE	1.93E-01	5.56E-07	1.00E-01	1.07E-08	4.50E-02	2.38E-07	1.99E-07	3.83E-09	NA	
3,3'-DICHLOROBENZIDINE	9.36E-01	5.56E-07	1.00E-01	5.21E-08	NA		1.99E-07	1.86E-08	9.00E-01	1.67E-08
DI-N-BUTYLPHTHALATE	1.21E+00	5.56E-07	1.00E-01	6.74E-08	5.00E-02	1.35E-06	1.99E-07	2.41E-08	NA	
DI-N-OCTYLPHTHALATE	2.08E-01	5.56E-07	1.00E-01	1.16E-08	1.00E-02	1.16E-06	1.99E-07	4.13E-09	NA	
FLUORANTHENE	7.50E+00	5.56E-07	1.00E-01	4.17E-07	2.00E-02	2.09E-05	1.99E-07	1.49E-07	NA	
FLUORENE	5.24E-01	5.56E-07	1.00E-01	2.92E-08	2.00E-02	1.46E-06	1.99E-07	1.04E-08	NA	
INDENO(1,2,3-CD)PYRENE	2.09E+00	5.56E-07	1.00E-01	1.16E-07	NA		1.99E-07	4.16E-08	NA	
2-METHYLNAPHTHALENE	4.84E-01	5.56E-07	1.00E-01	2.69E-08	NA		1.99E-07	9.62E-09	NA	
NAPHTHALENE	4.29E-01	5.56E-07	1.00E-01	2.38E-08	2.00E-03	1.19E-05	1.99E-07	8.52E-09	NA	
PHENANTHRENE	3.21E+00	5.56E-07	1.00E-01	1.78E-07	NA		1.99E-07	6.37E-08	NA	
PYRENE	1.78E+00	5.56E-07	1.00E-01	9.90E-08	1.50E-02	6.60E-06	1.99E-07	3.54E-08	NA	
METALS										
BARIUM	4.73E+02	5.56E-07	1.00E-02	2.63E-06	1.40E-02	1.88E-04	1.99E-07	9.39E-07	NA	
CADMIUM	5.40E+01	5.56E-07	1.00E-02	3.00E-07	1.00E-04	3.00E-03	1.99E-07	1.07E-07	NA	
CALCIUM	1.59E+04	5.56E-07	1.00E-02	8.86E-05	NA		1.99E-07	3.16E-05	NA	
CHROMIUM	1.07E+03	5.56E-07	1.00E-02	5.97E-06	1.00E-03	5.97E-03	1.99E-07	2.13E-06	NA	
COBALT	3.08E+01	5.56E-07	1.00E-02	1.71E-07	NA		1.99E-07	6.11E-08	NA	
COPPER	1.71E+02	5.56E-07	1.00E-02	9.50E-07	NA		1.99E-07	3.39E-07	NA	
LEAD	1.34E+02	5.56E-07	1.00E-02	7.45E-07	NA		1.99E-07	2.66E-07	NA	
MAGNESIUM	9.12E+03	5.56E-07	1.00E-02	5.07E-05	NA		1.99E-07	1.81E-05	NA	
MANGANESE	6.13E+02	5.56E-07	1.00E-02	3.41E-06	2.00E-02	1.71E-04	1.99E-07	1.22E-06	NA	
MERCURY	2.10E+00	5.56E-07	1.00E-02	1.17E-08	6.00E-05	1.95E-04	1.99E-07	4.17E-09	NA	
NICKEL	1.15E+03	5.56E-07	1.00E-02	6.41E-06	4.00E-03	1.60E-03	1.99E-07	2.29E-06	NA	
POTASSIUM	1.65E+03	5.56E-07	1.00E-02	9.16E-06	NA		1.99E-07	3.27E-06	NA	
SELENIUM	1.77E+00	5.56E-07	1.00E-02	9.84E-09	NA		1.99E-07	3.51E-09	NA	
SILVER	5.81E+01	5.56E-07	1.00E-02	3.23E-07	6.00E-04	5.38E-04	1.99E-07	1.15E-07	NA	
ZINC	2.88E+02	5.56E-07	1.00E-02	1.60E-06	4.00E-02	4.00E-05	1.99E-07	5.71E-07	NA	
						1.2E-02				3.2E-08

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TABLE C-101 (CONTINUED)
RISK SEGMENT W1
DERMAL CONTACT WITH CONTAMINANTS IN SEDIMENTS DUE TO CONSTRUCTION WORK
ON-BASE ADULT WORKER (CURRENT SCENARIO)
TINKER AFB - SOLDIER CREEK RI/FS
RISK ASSESSMENT REPORT

DERMAL CONTACT WITH SEDIMENTS
CS = Concentration of chemical in sediments (mg/kg)
AF = Absorbance Factor (assumed to be 0.25 for volatiles, 0.1 for semi-volatiles and 0.01 for metals) (Ryan, 1987)
1.00E-06 CF = Conversion Facor (10E-6kg/mg)
9.80E+03 SA = Skin Surface Area Available for Contact (sq.cm.)
1.00E+00 EF = Exposure Frequency (days/year)
2.50E+01 ED = Exposure Duration for adult (yrs.)
7.00E+01 BW = Body Weight for adult (kg)
2.50E+01 ATN = Averaging Time for non-carcinogenic compounds
7.00E+01 ATC = Averaging Time for carcinogenic compounds
1.45E+00 AF = Adherence Factor (mg/sq.cm.)

HIF--(NON-CARCINOGENIC)---------->
5.56E-07 HIF = (CF * SA * EF * ED * AF / BW) / (ATN)(365)

HIF--(CARCINOGENIC)---------->
1.99E-07 HIF = (CF * SA * EF * ED * AF / BW) / (ATC)(365)

INTAKE = (CW * AF * HIF)
RISK (non-carcinogenic) = (INTAKE / RfD)
RISK (carcinogenic) = (INTAKE * SLOPE FACTOR)

- Assumed Value
NA - Data Not Available

APPENDIX D

CHARACTERISTICS, ENVIRONMENTAL FATE, AND HEALTH EFFECTS OF THE CHEMICALS OF CONCERN

TINKER AFB - SOLDIER CREEK RI/FS
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D 1.0 AROMATIC HYDROCARBONS

D 1.1 Characteristics

Aromatic hydrocarbons, which include benzene, ethyl benzene, toluene, and xylenes are found in crude light oils. Aromatic hydrocarbons are recovered after distillation and used as fuels or blended with other petroleum stocks. Compared to polycyclic aromatic hydrocarbons that are discussed later, aromatic hydrocarbons have lower molecular weights, are less dense (lighter than water), have higher water solubilities, have higher vapor pressures, have a lower affinity for soil, and generally have shorter half-lives.

D 1.2 Environmental Fate

Aromatic hydrocarbons are primarily found as components of complex mixtures, particularly petroleum sources. Because benzene is one of the more toxic aromatic hydrocarbons, it has been studied more than the other compounds in this group. The discussion of environmental occurrence of aromatic hydrocarbons will focus on benzene because there is a relatively large amount of data available and because benzene's characteristics are representative of other aromatic hydrocarbons.

Environmental sources of benzene include gasoline filling stations, industrial facilities using benzene or producing it as a byproduct, vehicle exhaust emissions, cigarette smoke, leaking underground storage tanks, contaminated leachate from landfills, chemical spills, and foods that contain benzene as a natural constituent. Aromatic hydrocarbons are found in consumer products such as plastics, glues, and adhesives, household cleaning products, paint strippers, and art supplies (ATSDR, 1991).

D 1.2.1 Benzene

Benzene in surface water or groundwater tends to be mobile because of its relatively high solubility in water and relatively low affinity for soils and sediment. Because benzene has a relatively high volatility, it tends to evaporate into the air from soil and water, with a half-life of four to five hours for evaporation (ATSDR, 1991).

Benzene is degraded in air by reacting with hydroxyl radicals. The half-life in air ranges from several hours to several days, depending upon atmospheric conditions. Microbial degradation of benzene occurs in water and soil, with the rate and extent

of degradation depending upon specific conditions such as microbes present, pH, and oxygen level (ATSDR, 1991).

Although large amounts of benzene are released to the environment by both natural and manmade sources, environmental levels are relatively low due to efficient removal processes. Benzene concentrations in the air are normally higher in urban areas than in rural areas, primarily because of vehicle and industrial emissions. Benzene concentrations in air have been reported to range from 0.8 to 60 ppb in urban and industrial areas and from 0.02 to 1.4 ppb in rural areas (ATSDR, 1991).

Benzene has been detected in rainwater, surface water, sea water, drinking water, and groundwater samples collected throughout the United States, Canada, and the United Kingdom. Benzene levels detected range from 0.005 ppb in the Gulf of Mexico to 330 ppb in contaminated groundwater in New York, New Jersey, and Connecticut. Very high concentrations of benzene; up to 24,000 ppb, have been recorded in subsurface water samples collected near extensive gas and oil reserves (ATSDR, 1991).

Limited data are available for benzene concentrations in soils. However, one study found benzene levels ranging from less than 2 ppb to 191 ppb in samples collected near several industrial facilities that either used or produced benzene (ATSDR, 1991).

D 1.2.2 Ethylbenzene

Ethylbenzene has a strong tendency to partition into the atmosphere, as indicated by its physical and chemical properties and the magnitude of the Henry's Law constant for ethylbenzene. Migration occurs in most soils, although sorption and retardation by soil organic carbon may occur to a small extent. Ethylbenzene is transported in the atmosphere until it is removed by physical or chemical processes. It does not significantly bioaccumulate in aquatic food species.

D 1.2.3 Toluene

Most toluene that is released into the environment evaporates into the air because of its moderate volatility. Toluene is also moderately soluble in water, so it can be transported by surface or groundwater. Toluene is not usually persistent in the

environment. In air, toluene has a half-life of about thirteen hours. In water and soil, it is rapidly degraded by microbial processes with usual half-lives of one to seven days (ATSDR, 1988).

D 1.2.4 Xylenes

Most xylenes released to water or soil tend to evaporate into the air because of their moderate volatility. Volatilization half-lives range from several hours to several weeks, depending upon conditions. Xylenes degrade in air mainly by reacting with photochemically generated hydroxyl radicals, with usual half-lives of eight to 24 hours. Significant levels may exist in surface water or groundwater because of their moderate water solubility. Xylenes have only a moderate tendency to adsorb onto soil or sediment because of a fairly low octanol-water partition coefficient. In water, soil, and sediment, biodegradation occurs with usual half-lives of about ten days, but volatilization remains the primary fate in the environment (ATSDR, 1989).

D 1.3 Health Effects

D 1.3.1 Benzene

D 1.3.1.1 Noncarcinogenic Effects of Benzene. Acute inhalation exposure to benzene at concentrations from 50 to 3000 ppm results in a range of effects on the nervous system, depending on level and duration. Common signs include dizziness, nausea, headache, sleepiness, and loss of coordination. These effect are generally fully reversible, although exposure to a very high level (20,000 ppm) can induce coma and even cause death (ATSDR, 1991).

Long-term exposure to lower levels of benzene can injure the hematopoietic (blood-forming) system. Pancytopenia, aplastic anemia, and other abnormalities of blood cells have been reported to occur more frequently in groups of workers exposed to benzene in the workplace at level perhaps as low as 20 to 30 ppm. Similar blood dyscrasia have been reported in many animal studies of inhalation exposure to levels of around one hundred ppm or higher or oral doses of 50 to 500 mg/kg/day. Abnormalities in the immune system have also been detected in humans and animals exposed to benzene (ATSDR, 1991).

Because benzene is a potent carcinogen (see following section), the EPA has not yet derived inhalation or oral RfD values (IRIS, 1991). Based on studies in mice and

rats, a minimal risk level (MRL) of 0.01 ppm for short-term inhalation exposure and 0.0001 mg/kg/day for chronic oral exposure was estimated and assigned to benzene (ATSDR, 1991).

D 1.3.1.2 Carcinogenic Effects of Benzene. There is convincing data from both human and animal studies that chronic exposure to benzene leads to increased risk of leukemia (ATSDR, 1991), and EPA has ranked benzene as a Group A carcinogen for both inhalation and oral exposure (IRIS, 1991).

Several studies provide useful data for estimating the carcinogenic potency of benzene in humans. Based on epidemiological data the EPA has calculated a geometric mean inhalation slope factor. This assumes 100% absorption of inhaled benzene, so it is the same value taken as the oral slope factor (IRIS, 1991).

D 1.3.2 Ethylbenzene

D 1.3.2.1 Noncarcinogenic Effects of Ethylbenzene. No data are available on the effects of oral exposure of humans to ethylbenzene. The data base for oral exposure of ethylbenzene in experimental animals consists of one acute and one subchronic study in rats. Acute oral exposure caused death with an LD_{50} of 4,728 mg/kg (ATSDR, 1989). Subchronic oral exposure caused toxicity to liver and kidney with a no observable adverse effect level (NOAEL) of 97.1 mg/kg/day (IRIS, 1991).

Exposure of humans to ethylbenzene at concentrations of 230 ppm and above causes eye and throat irritation, dizziness and vertigo. A variety of acute and subchronic inhalation exposures in rats, mice and rabbits indicate that ethylbenzene causes toxicity to lungs, liver, kidney and hematological and reproductive systems (ATSDR, 1989). However, each of those studies has limitations (IRIS, 1991).

No data are available on the effects of dermal exposure of humans to ethylbenzene. A single study of dermal exposure to ethylbenzene in rabbits found irritation and blistering to the skin and eye (ATSDR, 1989).

D 1.3.2.2 Carcinogenic Effects of Ethylbenzene. No data are available on the carcinogenicity of ethylbenzene to humans. A single oral study of the carcinogenicity of ethylbenzene in rats was inconclusive. Ethylbenzene has been shown to be

nongenotoxic in many systems, but it does cause gene mutations in mouse lymphoma cells and sister chromatid exchanges in human lymphocytes (ATSDR, 1989). At present, the EPA has placed ethylbenzene in Group D (not classified as to carcinogenicity), and no quantitative estimate of carcinogenic risk is available. The National Toxicology Program has plans to evaluate the rodent carcinogenicity of ethylbenzene (IRIS, 1991).

D 1.3.3 Toluene.

D 1.3.3.1 Noncarcinogenic Effects of Toluene. The principal effect associated with exposure to toluene is depression of the central nervous system. In humans, inhalation of toluene in air at concentrations of 100 ppm can cause sleepiness and decreased dexterity. Exposure to levels of 200 to 800 ppm can lead to narcosis, characterized by impaired mental and motor functions. These effects appear to be fully reversible, although very high exposures can lead to permanent central nervous system damage and may produce such profound central nervous system depression that death ensues (EPA, 1985).

Inhalation exposure to toluene does not usually lead to significant effects on tissues other than the central nervous system, although lung irritation, decreased immunological function, and developmental effects have been noted in some studies of animals or humans exposed to levels of 200 ppm or higher. Based on a two-year inhalation study in rats, the EPA identified a dose of 300 ppm (1,130 mg/m^3) as a NOAEL, and calculated an inhalation RfD (HEAST, 1991). The EPA is currently reviewing this value (IRIS, 1991).

Humans are rarely exposed to toluene orally at doses high enough to cause measurable effects. Limited studies of animals indicate that doses of 590 mg/kg/day for six months do not significantly effect rats. Based on a chronic (2-year) inhalation study of rats, the EPA has calculated a chronic oral RfD (IRIS, 1991). This was based on absence of effects on the central nervous system, liver, or kidneys. Dermal or ocular contact with toluene can result in irritation and skin damage, but neurological or systemic effects have not been noted (ATSDR, 1988).

D 1.3.3.2 Carcinogenic Effects of Toluene. There are no studies of humans that indicate that toluene is carcinogenic, and cancer studies of animals exposed by

inhalation or dermal contact have been negative. However, due to limitations in these studies, the EPA does not consider the weight of evidence adequate to rank toluene as a noncarcinogen. Consequently, toluene has been placed in Group D-not classified (IRIS, 1991).

D 1.3.4 Xylenes

D 1.3.4.1 Noncarcinogenic Effects of Xylenes. Acute inhalation exposure of humans to xylenes at levels of 200 ppm or higher irritates the eyes, nose, and throat (ATSDR, 1989). Similar levels (100 to 400 ppm) can lead to central nervous system effects, including headache, nausea, and decreased performance on tests on mental and physical dexterity (ATSDR, 1989).

Acute oral doses of 2,000 mg/kg/day or more leads to shallow breathing, unsteadiness, tremors, and prostation in mice. These effects tend to appear within five to 10 minutes and last 15 to 60 minutes. Acute oral doses of 4,000 to 6,000 mg/kg/ can cause death.

Effects of longer-term exposure of humans to xylene are not well-documented, but studies of animals suggest the liver is subject to mild injury. Inhalation exposure of rats to concentrations of 3,500 ppm for six weeks caused liver enlargement (but no histologic abnormalities), but no effects were noted as 810 ppm. Based on this, information the EPA has calculated a chronic inhalation RfD (HEAST, 1991). The EPA is currently reviewing this value (IRIS, 1991).

Oral exposure of rats to 10 mg/kg/day for six months resulted only in increased vacuolation in hepatocytes. Chronic (2-year) oral dosing of rats with 500 mg/kg/day caused hyperactivity (a sign of CNS toxicity) in mice. No clinical signs of injury were detected in rats or mice at doses of 250 mg/kg/day. Based on this value, the EPA has calculated a chronic oral RfD for xylene (IRIS, 1991).

Another effect of concern is fetotoxicity. Epidemiological studies of women exposed to xylenes are not adequate to draw firm conclusions, but fetotoxicity has been reported in animals exposed to concentrations of 12 to 691 ppm in air during gestation (ATSDR, 1989). This has not been reported following oral exposure of animals.

Some earlier studies of xylene effects in animals have reported effects on the blood, but this is suspected to be because of traces of benzene concentration. No hematological abnormalities were detected in the recent subchronic or chronic oral studies.

Xylene has been found to have some developmental effects in animals exposed to relatively high doses, but the RfD values calculated are believed to be protective for these effects (IRIS, 1991).

D 1.3.4.2 Carcinogenic Effects of Xylenes. Xylenes have been tested for genotoxic potential in a variety of systems, and the results indicate that xylene is nonmutagenic (IRIS, 1991). Limited data suggest that oral exposure of rats to 500 mg/kg/day for one year might cause increased frequency of tumors. In a more thorough study, the National Toxicology Program (NTP) (1986) detected no evidence of tendency to develop tumors in rats exposed to 500 mg/kg/day or in mice exposed to 1,000 mg/kg/day for two years. Based on these data, the EPA has assigned xylene to Group D- not classified (IRIS, 1991).

D 1.4 Bibliography

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IRIS, 1991 — EPA, Integrated Risk Information System (IRIS), Xylene, on-line, Office of Health and Environmental Assessment, Cincinnati, OH.

D 2.0 CHLOROBENZENE

D 2.1 Characteristics

Chlorobenzene, Chemical Abstract Service Registry No. 108-90-7, is a colorless liquid with an almond-like odor. The compound does not occur widely in nature, but is manufactured for use as a solvent and is used in the production of other chemicals. 500 mg of chlorobenzene is soluble in 1 liter of water. The vapor pressure of chlorobenzene is 8.8 mm Hg (ATSDR, 1989).

D 2.2 Environmental Fate

Chlorobenzene will enter the atmosphere from fugitive emissions connected with its use as a solvent in pesticide formulations and as an industrial solvent. Once released it will decrease in concentration due to dilution and photooxidation. Releases into water and onto land will decrease in concentration due to vaporization into the atmosphere and slow biodegradation in the soil and water. Chlorobenzene has potential to percolate into the groundwater, particularly if soil is sandy and poor in organic matter. This will result in leaching into groundwater. Little bioconcentration is expected into fish and food products. Primary human exposure is expected to be from ambient air, especially near point and sources (Howard, 1989).

Chlorobenzene is lost from water primarily by evaporation. Biodegradation, another loss process, will occur during the warmer seasons and will proceed more rapidly in fresh water than in estuarine and marine systems. One reported half-life for an estuarine river with near natural conditions is 75 days. A moderate amount of adsorption will occur onto organic sediments (Howard, 1989).

If released to the atmosphere, chlorobenzene is expected to exist almost entirely in the vapor phase based upon the vapor pressure. Reaction with hydroxyl radicals is the dominant removal mechanism with an estimated half-life of 17 days with the formation of chlorophenols. Reaction in polluted air is faster, resulting in the formation of chloronitrobenzene and chloronitrophenols. Photolysis would proceed at a much slower rate, with monochlorobiphenyl being produced (Howard, 1989).

D 2.3 Health Effects

D 2.3.1 Noncarcinogenic Effects of Chlorobenzene

A subacute oral toxicity test using male and female beagles derived a NOAEL of 27.3 mg/kg/day. The chlorobenzene was administered orally by capsules at does of 27.3, 54.5 and 272.5 mg/kg/day, 5 day/week for 13 weeks. At the 54.5 mg/kg/day dose, adverse effects were detected. The histopathologic changes noted in the liver included slight bile proliferation, cytologic alternations, and leukocytic infiltration of the stroma.

Based on the above test, and other supportive studies, an RfD value has been assigned to chlorobenzene (IRIS, 1991).

D 2.3.2 Carcinogenic Effects of Chlorobenzene

The evaluation for this chemical is presently under review by the EPA and therefore a slope factor has not been assigned (IRIS, 1991).

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IRIS, 1991 — EPA, Integrated Risk Information System (IRIS), Assessment of Chlorobenzene, Office of Health and Environmental Assessment, Cincinnati, OH.

D 3.0 CHLOROFORM

D 3.1 Characteristics

Chloroform, Chemical Abstract Service Registry No. 67-66-3, is a chlorinated aliphatic hydrocarbon also known as trichloromethane or methyl trichloride (IRIS 1991). Chloroform is a non flammable, clear, colorless, volatile liquid at ordinary temperature and pressure. It has a pleasant ether-like non-irritating odor (NIOSH 1974). Five milliliters of chloroform dissolves in one liter of water, making it slightly soluble in water. It is miscible with alcohol, benzene, ether, carbon tetrachloride, carbon disulfide and oils (MERCK, 1976).

D 3.2 Environmental Fate

Prior to World War II, chloroform was used primarily as an anesthetic and a pharmaceutical. It is now seldom used as an anesthetic, but it is still used by many manufacturers for pharmaceutical purposes (NIOSH, 1974). Today, most of the chloroform is used to make Fluorocarbon-22. Much smaller amounts are used as a pesticide and solvent and in the manufacturing of pesticides and dyes (ATSDR, 1991).

Chloroform is likely to enter the environment associated with its use as an industrial solvent, extractant, and chemical intermediate as well as from its indirect production in the chlorination of drinking water, municipal sewage, and cooling water. The majority of the environmental releases from industrial uses are to the atmosphere; releases to water and land will be primarily lost by evaporation and will end up in the atmosphere. Release to the atmosphere may be transported long distances and will react in the gas-phase with photochemically produced hydroxyl radicals with a half-life for this reaction of a few months. Spills and other releases on land will also leach into the groundwater where they may reside for long periods of time. It will be expected to evaporate rapidly from near-surface soils based on its high vapor pressure. Chloroform released to water will evaporate rapidly with the half-life for evaporation determined in the laboratory to be several hours; modeling studies have estimated the half-life for evaporation to be 36 hours in a river, 40 hours in a pond, and 9-10 days in a lake. Chloroform may be subject to significant biodegradation based on laboratory experiments, although the reported data are somewhat conflicting. It will not significantly adsorb to sediment. Chloroform will not be

expected to bioconcentrate in aquatic organisms but contamination of food is likely due to its use as an extractant and its presence in drinking water. It will not significantly hydrolyze in water or soil under normal environmental conditions. Major human exposure is from ingestion of contaminated drinking water and inhalation of contaminated ambient air, the latter particularly in the vicinity of industrial sources. Exposure may also occur via ingestion of contaminated food and by cutaneous contact with contaminated water (Howard, 1990).

D 3.3 Health Effects

D 3.3.1 Noncarcinogenic Effects of Chloroform

A study where beagle dogs were orally administered chloroform in doses of 15 or 30 mg chloroform/kg/day for 6 day/week for 7.5 years resulted in liver damage being observed in both treatment groups. The lowest observable adverse effect level (LOAEL) was determined to be 12.9 mg/kg/day, and an oral RfD was set. Chloroform is considered to be highly fetotoxic, but not teratogenic by and demonstrated by a single gavage dose of chloroform at 60 mg/kg/day as a LOAEL for decreased weight gain, plasma cholinesterase and relative liver weight (IRIS, 1991).

D 3.3.2 Carcinogenic Effects of Chloroform

Data on human carcinogenicity is inadequate. Epidemiologic studies of chloroform itself does not exist. Several ecological and case-control studies of population consuming chlorinated drinking water, which form chloroform and other trihalomethanes from the interaction of chlorine with organic material, show small significant increases in risk of rectal, bladder, or colon cancer on an intermittent basis. Many other suspected carcinogens were present in these water supplies (IRIS, 1991).

Chloroform has been tested for carcinogenicity in eight strains of mice, two strains of rats and in beagle dogs.

A study to specifically measure the effects of low doses of chloroform was performed. Chloroform was administered in drinking water to male rats and female mice at concentrations of 19, 38, 81, and 160 mg/kg/day for rats and 34, 65, 130, 263

mg/kg/day for mice. A significant increase in renal tumor in rats was observed in the highest dose groups and was determined to be dose related. The liver tumor incidence in female mice was not significantly increased.

In a gavage bioassay (IRIS, 1991), rats and mice were treated with chloroform in corn oil 5 times/week for 78 weeks. At dose levels higher than in a 1985 study, a significant increase in kidney epithelial tumors were observed in male rats and highly significant increases in hepatocellular carcinomas in mice of both sexes. Liver nodular hyperplasia was observed in low-dose male mice not developing hepatocellular carcinoma. Hepatomas have also developed in mice gavaged with chloroform (IRIS, 1991).

Based on these principal studies and other supporting studies, U.S. EPA has classed chloroform B2, probable human carcinogen. The oral and inhalation slope factors for chloroform have been established (IRIS, 1991).

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D 4.0 1,1-DICHLOROETHENE

D 4.1 Characteristics

1,1-Dichloroethene, Chemical Abstract Registry Service No. 75-35-4, is also known as 1,1-dichloroethylene and vinylidine chloride, is an organic solvent which is a gas at room temperature. It has a mild, sweet odor, resembling chloroform. At temperatures above 0 C, especially in the presence of O_2, it polymerizes to a plastic. Uncontrolled polymerization may be explosive (Merck, 1983).

D 4.2 Environmental Fate

1,1-Dichloroethene is released into the environment as fugitive emissions and in wastewater during its production and use as a chemical intermediate and solvent. If released on land, it will be removed rapidly by volatilization, although it may also leach into groundwater where its fate is unknown. Bioconcentration in aquatic organisms will not be important. If released in water it will primarily be lost by evaporation into the atmosphere with a half-life of 1-6 days. Little of the chemical would be lost by adsorption onto the sediment. In the atmosphere, it will degrade (half-life 11 hours) by reaction with photochemically produced hydroxyl radicals. Human exposure will be by inhalation to workers and those living or working near source areas (Howard, 1989, 1990).

Volatilization appears to be the primary transport process for 1,1-dichloroethylene, and its subsequent photooxidation in the atmosphere by reaction with hydroxyl radicals is apparently the predominant fate process. Information on other transport and fate mechanisms was generally lacking for 1,1-dichloroethene. However, by inference from related compounds, hydrolysis, sorption, bioaccumulation, biotransformation, and biodegradation probably all occur but at rates too slowly to be of much significance (Clement, 1985).

D 4.3 Health Effects

D 4.3.1 Noncarcinogenic Effects of 1,1-Dichloroethene

Groups of 48 each male and female Sprague-Dawley rats were administered 50, 100 or 200 ppm 1,1-dichloroethene in drinking water for a period of 2 years. Control groups of 80 animals/sex were maintained for the same period. Daily intakes were calculated to be 7,10 or 20 mg/kg/day for males and 9,14, or 30 mg/kg/day for females

(IRIS, 1991). The only pathologic findings were of hepatic lesions, generally characterized by minimal mid-zonal hepatocellular fatty change and hepatocellular swelling. This trend was noted in all female rat treatment groups and males in the high-dose treatment group.

D 4.3.2 Carcinogenic Effects of 1,1-Dichloroethene

Data regarding the carcinogenic toxicity of 1,1-dichloroethene is lacking for humans and limited for animals. 18 animal studies have been reported (11 inhalation, 5 oral, 1 dermal, 1 subcutaneous injection), but only one inhalation study produced a response as a complete carcinogen. In the positive carcinogenicity study, Swiss mice demonstrated increased kidney adenocarcinoma in the males, mammary carcinoma in females, and pulmonary adenoma in both sexes (IRIS, 1991).

1,1-Dichloroethene is a class C carcinogen, possible human carcinogen. The oral slope factor has been set.

D 4.4 Bibliography

Clement, 1985 — Clement Associates, Inc., Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites, reproduced by US Dept. of Commerce, NTIS, Springfield, VA.

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

IRIS, 1991 — EPA, Integrated Risk Information System (IRIS), on-line, Office of Health and Environmental Assessment, Cincinnati, OH.

Merck, 1983 — Windholz, Martham ed., The Merck Index, An Encyclopedia of Chemical and Drugs, Ninth Edition, Merck and Co., Rahway, NJ.

D 5.0 1,2-DICHLOROETHENE

D 5.1 Characteristics

1,2-Dichloroethene, Chemical Abstract Service Registry Nos. 156-59-2 (cis) and 156-60-5 (trans) is also known as 1,2 dichloroethylene, acetylene dichloride and symdichloroethylene. At room temperature, it is a liquid with a slight acrid, ethereal odor. Gradual decomposition results in hydrochloric acid formation in the presence of ultra-violet light or upon contact with hot metal (Sittig, 1985). trans-1,2 Dichloroethene has a solubility in water of 6.3 g/L at 25 C, while cis-1,2 dichloroethene has a solubility in water of 3.5 g/L.

D 5.2 Environmental Fate

Trans-1,2-Dichloroethene may be released to the environment in air emissions and wastewater during its production and use. Under anaerobic conditions that may exist in landfills, aquifers, or sediment one is likely to find 1,2-dichloroethenes that are formed as breakdown products from the reductive dehalogenation of common industrial solvents trichloroethene, tetrachloroethene, and 1,1,2,2-tetrachloroethane. The cis-1,2-dichloroethene is apparently the more common isomer found although it is mistakenly reported as the trans-isomer. The trans-isomer, being a priority pollutant, is more commonly analyzed for and the analytical procedures generally used do not distinguish between isomers. If 1,2-dichloroethene is released on soil, it should evaporate and leach into the groundwater where very slow biodegradation should occur. If released into water, 1,2-dichloroethene will be lost mainly through volatilization (half-life 3 hr in model river). Biodegradation, adsorption to sediment, and bioconcentration in aquatic organisms should not be significant. In the atmosphere, 1,2-dichloroethene will be lost by reaction with photochemically produced hydroxyl radicals (half-life 3.6 and 8 days for trans and cis respectively) and scavenged by rain. Because it is relatively long-lived in the atmosphere, considerable dispersal from source areas should occur. The general population is exposed to 1,2-dichloroethene in urban air as well as in contaminated drinking water from groundwater sources. Occupational exposure will be via dermal contact with the vapor and liquid or via inhalation (Howard, 1989, 1990).

D 5.3 Health Effects

D 5.3.1 Noncarcinogenic Effects of 1,2-Dichloroethene

A study determined the lethality after a single exposure by inhalation of 1,2-dichloroethene in mice. The LC_{50} of 21,723 ppm trans-1,2-dichloroethene was for a single 6-hour exposure. The cause of death was not reported. Another study observed pathological changes in the heart of rats exposed to trans-1,2-dichloroethene. The changes are described as fibrous swelling of the myocardium and hyperemia. The effects were evident after an 8-hour exposure to 3000 ppm but not after an exposure to lower levels. A variety of miscellaneous effects on composition of the blood and plasma was observed in rats exposed to trans-1,2-dichloroethene. A reduction in the number of circulating leukocytes and erythrocytes was observed after an 8-hour exposure to 1000 ppm trans-1,2-dichloroethene, a decrease in leukocyte count was observed. Inhalation of high concentrations of vaporized 1,2-dichloroethene depress the central nervous system in humans. It has also been reported that neurological effects of low levels of trans-1,2-dichloroethene occur. Inhalation of 6.8-8.8 mg/L trans-1,2-dichloroethene for 5 minutes, or of 4.8 mg/L for 10 minutes, reportedly caused nausea, drowsiness, fatigue, vertigo and intracranial pressure in two human subjects, but it is uncertain whether the human subjects were exposed to a gas or an aerosol (ATSDR, 1990).

D 5.3.2 Carcinogenic Effects of 1,2-Dichloroethene

At this time no studies concerning the carcinogenic effects of 1,2-dichloroethene have been located (ATSDR, 1990).

D 5.4 Bibliography

ATSDR, 1990 — Draft Toxicological Profile for 1,2-dichloroethene, U.S. Public Health Service, Wash., D.C.

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

Sittig, 1985 — Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals and Carcinogens, Second Ed., Noyes Publications, Park Ridge, NJ.

D 6.0 1,2-DICHLOROPROPANE

D 6.1 Characteristics

1,2-Dichloropropane, Chemical Abstract Registry Service No. 78-87-5, is also known as propylene dichloride and propylenechloride. At room temperature it is a flammable, mobile liquid with a chloroform-like odor. It has a low flash point but does not catch fire readily. It is slightly soluble in water, miscible in organic solvents.

D 6.2 Environmental Fate

1,2-Dichloropropane is released into soil during its use as a soil fumigant and into air as fugitive emissions and in wastewater during its production and use as a chemical intermediate, solvent, scouring, spotting, and metal degreasing agent. If injected into soil 1,2-dichloropropane will be primarily lost by volatilization. Some may leach into the groundwater where its fate is unknown. If released into water, 1,2-dichloropropane will be lost by volatilization with half-lives ranging from approximately 6 hr for a river to 10 days for a lake. Adsorption to soil and bioconcentration in fish will not be significant. In air it will react with photochemically generated hydroxyl radicals (half-life >23 days) and be washed out by rain. Therefore, there will be ample time for dispersal as is evidenced by its presence in ambient air. Human exposure is primarily due to inhalation. Occupational exposure, both dermal and via inhalation, will occur during and after its application as a soil fumigant as well as during its production and other uses (Howard, 1989, 1990).

D 6.3 Health Effects

D 6.3.1 Noncarcinogenic Effects of 1,2-Dichloropropane

High concentrations of 1,2-dichloropropane cause central nervous system depression and narcosis in humans. Other human symptoms include headache, vertigo, lacrimation, and irritation of the mucous membranes. Studies indicate that exposure to high concentrations may affect the rate of growth in rats and guinea pigs, and cause fatty degeneration and multilobular or centrilobular necrosis of the liver. Histopathological changes were also observed in the kidneys, adrenals, and heart. 1,2-dichloropropane is a mild skin irritant. It is moderately irritating to the eye but does not cause permanent injury.

The EPA has not set an oral or inhalation reference dose for 1,2-dichloropropane.

D 6.3.2 Carcinogenic Effects of 1,2-Dichloropropane

1,2-Dichloropropane caused an increased incidence of combined adenomas and carcinomas of the liver in male and female mice and caused a slight increase in mammary adenocarcinomas in female rates. In an earlier study, 80 C3H mice were exposed to 1,850 mg/m^3 of 1,2-dichloropropane for 4 to 7 hours per day 37 times and were then observed for the next 7 months; only 3 mice survived, but all of these developed multiple hepatomas. 1,2-Dichloropropane was found to be mutagenic using the Ames assay both with and without metabolic activation. It also increased the frequency of 8 azaguanine-resistant mutants in the *Aspergillus nidulans* spot test. No information was available on the reproductive or teratogenic effects of this compound.

The EPA has not set an oral or inhalation slope factor for 1,2-dichloropropane.

D 6.4 Bibliography

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

Merck, 1983 — Windholz, Martham ed., The Merck Index, An Encyclopedia of Chemical and Drugs, Ninth Edition, Merck and Co., Rahway, NJ.

D 7.0 METHYLENE CHLORIDE

D 7.1 Characteristics

Methylene chloride, Chemical Abstract Service Registry No. 75-09-2, is also known as dichloromethane, methylene dichloride and methylene bichloride. It is a nonflammable, colorless liquid with a pleasant aromatic odor noticeable at 300 ppm. Methylene chloride has a solubility in water of 13,000 mg/L at 25 C.

D 7.2 Environmental Fate

Large quantities of methylene chloride are used each year, primarily in aerosols, paint removers, and chemical processing. Most of the methylene chloride will be released to the atmosphere where it will degrade by reaction with photochemically produced hydroxyl radicals with a half-life of a few months. It will not be subject to direct photolysis. Releases to water will primarily be removed by evaporation. Biodegradation is with evaporation. It will not be expected to significantly adsorb to sediment or to bioconcentrate in aquatic organisms. Releases to soil will evaporate rapidly from near-surface soil and partially leach into groundwater where its fate is unknown. Major route of human exposure is from air, which can be high near sources of emission, and contaminated drinking water (Howard, 1989, 1990).

D 7.3 Health Effects

D 7.3.1 Noncarcinogenic Effects of Methylene Chloride

Evidence for the noncarcinogenic toxicity of methylene chloride comes from a study of 85 rats/sex at each of four nominal dose groups (i.e. 5, 50, 125, and 250 mg/kg/day) for 2 years. A high-dose recovery group of 25 rats/sex, as well as two control groups of 85 and 50 rats/sex were also tested. Many effects were monitored. Treatment related histological alternations of the liver were evident at minimal doses of 50 mg/kg/day or higher. The nominal dose of 5 mg/kg/day was a NOAEL (IRIS, 1991).

An oral reference dose has been established for methylene chloride. The supporting data base is limited. A NOAEL of 87 mg/m^3 was reported in one inhalation study (IRIS, 1991).

In humans, direct contact with methylene chloride produces eye, respiratory passage, and skin irritation (Clement, 1985). Mild poisonings due to inhalation exposure produce somnolence, lassitude, numbness and tingling of the limbs, anorexia, and light headedness, followed by rapid and complete recovery. More severe poisonings generally involve correspondingly greater disturbances of the central and peripheral nervous systems. Methylene chloride also has acute toxic effects on the heart, including the induction of arrhythmia. Fatalities reportedly due to methylene chloride exposure have been attributed to cardiac injury and heart failure. Methylene chloride is metabolized to carbon monoxide in vivo, and levels of carboxyhemoglobin in the blood are elevated after acute exposures.

D 7.3.2 Carcinogenic Effects of Methylene Chloride

Several rodent studies have been performed to assess the carcinogenic toxicity of methylene chlorine. F344 rats and B6C3F1 mice received methylene chloride in their drinking water at doses between 0 and 250 mg/kg-day. Female rats and male mice responded with a significant increase in neoplastic modules or hepatocellular carcinomas. Methylene chloride is mutagenic for Salmonella typhimurium and produce mitotic recombination in yeast.

An oral slope factor has been set for methylene chloride (IRIS, 1991).

D 7.4 Bibliography

Clement, 1985 — Clement Associates, Inc., Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites, reproduced by US Dept. of Commerce, NTIS, Springfield, VA.

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

IRIS, 1991 — EPA, Integrated Risk Information System (IRIS), on-line, Office of Health and Environmental Assessment, Cincinnati, OH.

D 8.0 TETRACHLOROETHENE

D 8.1 Characteristics

Tetrachloroethene, Chemical Abstract Service Registry No. 127-18-4, is known as perchloroethylene, tetrachloroethylene, ethylene tetrachloride, PER, PCE, and PERC. It is a clear, water-white liquid at ordinary temperatures with an odor like ether or chloroform. It is completely miscible with most organic liquids. Tetrachloroethene has a solubility in water of 150 mg/l at 25 C (Howard, 1989, 1990).

D 8.2 Environmental Fate

Tetrachloroethene (PCE) is likely to enter the environment by fugitive air emissions from dry cleaning and metal degreasing industries and by spills or accidental releases to air, soil, or water. If PCE is released to soil, it will be subject to evaporation into the atmosphere and to leaching to the groundwater. Biodegradation may be an important process in anaerobic soils based on laboratory tests with methanogenic columns. Slow biodegradation may occur in groundwater where acclimated populations of microorganisms exist. If PCE is released to water, it will be subject to rapid volatilization with estimated half-lives ranging from <1 day to several weeks. It will not be expected to significantly biodegrade, bioconcentrate in aquatic organisms, or adsorb to sediment. PCE will not be expected to significantly hydrolyze in soil or water under normal environmental conditions. If PCE is released to the atmosphere, it will exist mainly in the gas-phase and it will be subject to photooxidation with estimates of degradation time scales ranging from an approximate half-life of 2 months to complete degradation in an hour. Some of the PCE in the atmosphere may be subject to washout in rain based on the solubility of PCE in water; PCE has been detected in rain. Major human exposure is from inhalation of contaminated urban air, especially near point sources such as dry cleaners, drinking contaminated water from contaminated aquifers and drinking water distributed in pipelines with vinyl liners, and inhalation of contaminated occupational atmospheres in metal degreasing and dry cleaning industries (Howard, 1989, 1990).

World-wide production of tetrachloroethylene in 1973 was estimated to be just over one million tons, and it is likely that over 80% of this was lost to the atmosphere by evaporation during subsequent use. There have been a number of reports of the detection of tetrachloroethene in air. In New York City, levels ranged between 0.1

and 8.7 ug/m^3, whereas concentrations in rural areas were much lower. This solvent was detected at concentrations as high as 20-300 mg/m^3 near dry-cleaning firms.

Tetrachloroethene is used to extract oil and fat from meat so contamination of food may result from this process. Levels of 1 ug/kg have been detected in beef, up to 2 ug/kg in fruit and vegetables, 3 ug/kg in tea and coffee, and ranging from 7 ug/kg in olive oil to 13 ug/kg in butter.

D 8.3 Health Effects

D 8.3.1 Noncarcinogenic Effects of Tetrachloroethene

Swiss-Cox mice were exposed to tetrachloroethene in corn oil by gavage at doses of 0, 20, 100, 200, 500, 1500, and 2000 mg/kg, 5 days/week for 6 weeks. Liver toxicity was evaluated by several parameters including liver weight/body weight ratio, hepatic triglyceride concentration, DNA content, histopathological evaluation, and serum enzyme levels. Increased liver triglycerides were first observed in mice treated with 100 mg/kg. Liver weight/body weight ratios were significantly higher than controls for animals treated with 100 mg/kg. At higher doses, hepatotoxic effects included decreased DNA content, increased serum glutamic pyruvic transaminase, decreased levels of G6P and hepatocellular necrosis, degeneration and polyploidy.

A NOEL of 14 mg/kg/day was established in a second study, as well. Groups of 20 Sprague-Dawley rats of both sexes were administered doses of 14,400, or 1400 mg/kg/day in drinking water. Males in the high-dose group and females in the two highest groups exhibited depressed body weights. Equivocal evidence of hepatotoxicity (increased liver and kidney weight/body weight ratios) were also observed at the higher doses (IRIS, 1991). Based on these studies, an oral RfD was derived under the IRIS system.

Most of the information on the chronic effects of tetrachloroethylene in humans is from occupations data on dry-cleaners. The common symptoms of toxicity are dizziness, sleepiness, and irritation to the eyes, nose and throat. Russian authors have reported other neurophysiological effects following occupational exposure, such as a reduced ability to perceive color.

Neurological, physiological and behavioral tests were carried out on ten male and nine female volunteers exposed for 1, 3 or 7.5 hours/day, 5 days/week (for an unspecified period of time) to 20, 100 or 150 ppm tetrachloroethylene. No effects were observed at exposure levels of 20 ppm. Males showed a decrease in coordination skills at 100 and 150 ppm.

Behavioral, renal, hepatic and pulmonary tests were carried out on two groups of subjects: those occupationally exposed to tetrachloroethene and a control group. The exposed group consisted of 26 subjects (24 female and 2 male) working in dry-cleaning establishments and occupationally exposed to 21 ppm tetrachloroethene (time-weighted average exposure) over a period of 6 years; the control group was composed of 33 subjects (31 female and 2 male) working in a chocolate factory and who had never been occupationally exposed to organic solvents. No differences were found between the two groups.

Chronically exposed individuals may develop a tolerance to the solvent. Single and repeated experimental exposures to 100 ppm tetrachloroethene vapor were carried out in subjects for either a single 7-hour period, or 7 hours/day for 5 days. Subjects repeatedly exposed had fewer subjective and objective complaints (headaches, speech difficulty, dizziness, nose and throat irritation) than those who were exposed for only a single, 7-hour period.

Both OSHA and ACGIH have set an occupational exposure limit of 50 ppm 8 hr TWA for tetrachloroethene (OSHA, 1989; ACGIH, 1989).

D 8.3.2 Carcinogenic Effects of Tetrachloroethene

In the National Cancer Institute study groups of 48 B6C3F1 mice and Osborne-Mendel rats of both sexes were given doses of 500 or 1000 mg/kg body weight of tetrachloroethylene in corn oil by gavage, 5 days/ week for 78 weeks. A significant increase in hepatocellular carcinomas was found in treated male and female B6C3F1 mice at both low and high dose levels. No other organs or tissues appeared to be affected.

Evidence that tetrachloroethene causes cancer in humans is unclear. A group of 330 dry-cleaning and laundry workers were investigated who had been exposed to

tetrachloroethylene for periods of up to 20 years. The frequency of specific causes of deaths for this group was compared with that for the general population, and the frequency of deaths from cancer was higher than the predicted frequency for the normal population (87 recorded; 68 expected), although the difference was only small. Lung, cervical and skin cancer were mainly responsible for the increased mortality rate, but there was also a slightly elevated occurrence of leukemia and liver cancer. Although tetrachloroethylene was the main constituent of the cleaning fluid, other solvents such as carbon tetrachloride and trichloroethene were also present, so any effects cannot be attributed to tetrachloroethene alone. Also, a high incidence of lung cancer is associated with low socio-economic class. Since laundry workers tend to belong to this social group, this could have been an important contributing factor to the elevated mortality rate from cancer, rather than the single effect of exposure to tetrachloroethene.

Another study reported an unspecified excess of bladder and kidney cancers among 1690 dry-cleaning workers exposed to tetrachloroethylene. However, since exposure cannot be attributed to this solvent alone, due to the presence of other solvent compounds, the significance of the results is unclear.

The EPA is currently evaluating tetrachloroethene under the IRIS system.

The World Health Organization set a tentative guideline value of 10 ug/l for tetrachloroethene in drinking water. This was based on data from the mouse carcinogenicity study, using corn oil as the solvent. However, it is possible that the use of corn oil as a vehicle may overestimate the toxicity that might be expected following exposure through water.

D 8.4 Bibliography

ACGIH, 1989 — Documentation of Threshold Limit Values and Biological Exposure Indices, Fifth Edition, Cincinnati, OH.

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

OSHA, 1989 — 29 CFR 1910.1000

D 9.0 1,1,1-TRICHLOROETHANE

D 9.1 Characteristics

1,1,1-Trichloroethane, Chemical Abstract Service Registry No. 71-55-6, is also known as methyl chloroform. It is a colorless, nonflammable liquid with an odor similar to chloroform (Sittig, 1985). It has a solubility in water of 347 mg/L at 25 C.

D 9.2 Environmental Fate

1,1,1-Trichloroethane is likely to enter the environment from air emissions, in wastewater from its production, or from use in vapor degreasing, metal cleaning, etc. Releases to surface water will decrease in concentration almost entirely due to evaporation. Spills on land will decrease in concentration almost entirely due to volatilization and percolation into groundwater. Releases to air will be transported long distances and partially returning to earth in rain. In the troposphere, 1,1,1-trichloroethane will degrade very slowly by photooxidation and also slowly diffuse to the stratosphere where photooxidation will be rapid. Major human exposure is from air and drinking water. Exposure can be high near sources of emission or where drinking water is contaminated (Howard, 1989, 1990).

D 9.3 Health Effects

D 9.3.1 Noncarcinogenic Effects of 1,1,1-Trichloroethane

Groups of rats, rabbits, guinea pigs and monkeys were exposed to 1,1,1-trichloroethane vapor at concentrations of 500, 1000, 2000, or 10,000 ppm. From these studies, it was determined that the female guinea pig was the most sensitive species of those tested. At 500 ppm, groups of eight male and eight female guinea pigs showed no evidence of adverse effects compared with unexposed and air-exposed controls after exposure of 7 hours/day, 5 days/week for 6 months. Group of five female guinea pigs exposed to 1000 ppm 1,1,1-trichloroethane vapor 3 hours/day, 5 day/week for 3 months had fatty changes in the liver and statistically significant increased liver weights. Thus, this study defined a NOAEL of 500 ppm (2730 mg/cu.m) in guinea pigs (IRIS,1991).

D 9.3.2 Carcinogenic Effects of 1,1,1-Trichloroethane

Available data is not adequate to assess the carcinogenic potential of 1,1,1-trichloroethane. The National Cancer Institute (NCI) treated 50 male and 50 female

Osborne-Mendel rats with 750 or 1500 mg/kg technical-grade 1,1,1-trichoroethane 5 times/week for 78 weeks by gavage. The rats were observed for an additional 32 weeks. Twenty rats of each sex served as untreated controls. Low survival of both male and female treated (3%) may have precluded significant development of tumors late in life. Although a variety of neoplasms was observed in both treated and matched control rats, they were common to aged rats and were not significantly related to dosage. Similar results were obtained when the NCI treated B6C3F1 hybrid mice with the time-weight average doses of 2807 or 5615 mg/kg 1,1,1-trichloroethane by gavage 5 days/week for 78 weeks. The mice were observed for an additional 12 weeks. The control and treated groups had 20 and 50 animals of each sex, respectively. Only 25 to 45% of those treated survived until the time of terminal sacrifice. A variety of neoplasms were observed in treated groups but with an incidence not statistically different from matched controls.

Exposure of 96 Sprague-Dawley rats of both sexes to 875 or 1750 ppm 1,1,1-trichloroethane vapor for 6 hours/day, 5 days/week for 12 months, followed by an additional 19-month observation period. The only significant sign of toxicity was an increased incidence of focal hepatocellular alterations in female rats at the highest dosage (IRIS, 1991).

D 9.4 Bibliography

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

IRIS, 1991 — EPA, Integrated Risk Information System (IRIS), on-line, Office of Health and Environmental Assessment, Cincinnati, OH.

Sittig, 1985 — Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals and Carcinogens, Second Ed., Noyes Publications, Park Ridge, NJ.

D 10.0 TRICHLOROETHENE

D 10.1 Characteristics

Trichloroethene is also known as TCE, acetylene trichloride, ethylene trichloride, and trilene. It is a colorless liquid with a sweet odor like chloroform (NIOSH/OSHA, 1988). One gram of trichloroethene can be dissolved in one liter of water at 20 C. Trichloroethene has an odor threshold of 10 mg/l in water.

D 10.2 Environmental Fate

Over 155 million pounds of TCE are used for vapor degreasing of metals which should result in releases to the environment through evaporation, spills, and leaks in storage tanks. TCE released to the atmosphere will exist primarily in the vapor phase based on its relatively high vapor pressure. It will react fairly rapidly, especially under smog conditions. An atmospheric residence time of 5 days has been reported with formation of phosgene, dichloroacetyl chloride, and formyl chloride. It is not subject to direct photolysis (Howard, 1990).

TCE is a common contaminant of air, and has been detected at levels normally in the range of 1-20 ug/m^3. Analyses of concentrations of TCE in air in Western Europe during the period 1972-1976 indicated that levels were between 0.5 and 10 ug/m^3. However, concentrations up to 90 ug/m^3 have been reported in an urban area containing many dry-cleaning establishments. Atmospheric contamination with TCE has been implicated as a possible factor in the depletion of the ozone layer.

If TCE is released to water, the primary removal process will be evaporation with a half-life of minutes to hours, depending upon turbulence. Biodegradation, hydrolysis, and photoxidation are extremely slow by comparison. Adsorption to sediment and bioconcentration in aquatic organisms are not important processes. Releases to soil will be partially evaporated and partially leached into groundwater, where it may remain for a long time. However, there is some monitoring data that suggests degradation to other chlorinated alkenes. High levels of exposure are expected for workers in degreasing plants due to inhalation of vapors or adsorption through the skin. Lower exposure by inhalation is expected in persons living near degreasing plants or at spill sites. Broad population exposure to low levels is expected from

inhalation of contaminated ambient air and ingestion of contaminated drinking water (Howard, 1990).

TCE was identified in 13 out of 14 drinking water samples examined in a survey. Concentrations between 0.02 and 5.4 ug/l have been detected in domestic drinking water supplies in the United States. In rainwater, TCE was detected at levels of up to 0.07 ug/l. This compound was found as a common contaminant in groundwater in Britain, the Netherlands, France, Italy and the United States. In general, levels are below 2 ug/l although 40,000 ug/l have been reported. Since TCE is virtually insoluble in water and has a specific gravity heavier than water, any pollution of groundwater is likely to persist. There is no indication that TCE is produced from chlorination of natural waters.

Although ingestion is the main route of exposure for most waterborne chemicals, inhalation may also be important for compounds such as TCE, which are particularly volatile. A study measured air concentrations of TCE in showers, using TCE-contaminated groundwater, and has shown that this can be a substantial source of exposure.

TCE is used as a solvent in food processing, this may account for its occurrence in food. It has been detected at levels of 10 ug/kg in butter, 16 ug/kg in steak, and 60 ug/kg in tea. A study found 920 ug/kg TCE in margarine, but concentrations in other foodstuffs were negligible. There have been proposals by the U.S. Food and Drug Administration to discontinue the use of TCE in food processing. At present, the level of TCE in coffee is limited to 10 mg/kg dry weight in decaffeinated instant coffee and 25 mg/kg in decaffeinated ground coffee. Some manufacturers now use methylene chloride as an alternative for decaffeinating coffee.

D 10.3 Health Effects

D 10.3.1 Noncarcinogenic Effects of Trichloroethene

TCE is of moderate to low acute toxicity via the oral route. The oral LD_{50} in female mice was 2,443 mg/kg body weight, and in male mice it was 2,402 mg/kg, when this compound was administered by gavage, in a 10% solution of Emulphor. The oral LD_{50} in the rat was 4,920 mg/kg (Fawell, 1988).

Male Swiss-Cox mice exposed to doses of 100-3,200 mg/kg/day TCE in corn oil, by gavage, for 6 weeks, showed an increase in relative liver weight in all dose groups, with an increase of 75% compared to controls in the highest dose group. Hepatic glucose-6-phosphatase activity was depressed at dose levels of 800 mg/kg/day and above, but the levels of liver triglycerides or serum glutamate-pyruvate transaminase were unaffected, even at the highest dose (Fawell, 1988).

Workers chronically exposed to TCE may suffer central nervous effects such as headaches, dizziness, and impaired sensitivity to touch and pain. The trigeminal nerve appears to be particularly affected from long-term exposure. Disturbance in heart muscle conduction was reported in dry-cleaning workers (Fawell, 1988).

Where work involves frequent skin contact with TCE, this solvent causes defatting of tissues, so hands and skin become rough and chapped. Dermatitis and secondary infections may develop as a consequence (Fawell, 1988).

Both OSHA and ACGIH have set an occupational exposure limit of 50 ppm for an 8-hr TWA for trichloroethene (IRIS, 1991).

D 10.3.2 Carcinogenic Effects of Trichloroethene

In the National Cancer Institute study (1976), groups of 50 male B6C3F1 mice were given doses of 1,200 or 2,400 mg/kg body weight and females were given 900 or 1,800 mg/kg body weight of TCE (99% purity, 0.19% epoxybutane stabilizer) in corn oil, by gavage, 5 days/week for 78 weeks. Twenty animals of each sex and species were given the vehicle alone, as controls. A significant increase in hepatocellular carcinomas was found in treated mice of both sexes compared with control animals. There was also a slightly increased incidence of lung tumors in both sexes. No evidence of liver tumors was observed in groups of 50 Osborne-Mendel rats of both sexes given doses of 500 or 1,000 mg/kg body weight of TCE (99% purity, 0.19% epoxybutane) in corn oil, by gavage, 5 days/week for 78 weeks.

Recent evidence from long-term gavage studies suggests that concentrations of 250 mg/kg body weight TCE produce a low incidence of renal adenocarcinomas in male rats. This type of tumor occurs very rarely in untreated control animals (Fawell, 1988).

The carcinogenicity of TCE, with or without two epoxide stabilizers, epichlorohydrin (0.8% w/w) and epoxybutane (0.8% w/w) was investigated in Swiss mice, a strain with a low frequency of spontaneous liver tumors. Males were dosed with 2.4 g/kg and females were dosed with 1.8 g/kg TCE in corn oil, or TCE with epichlorohydrin and/or epoxybutane, by gavage, 5 days/week, for 18 months. Gross and microscopic examination of liver, stomach, spleen, kidney, adrenal, lung and heart tissue indicated a statistically significant increase in the incidence of forestomach tumors in mice treated with TCE plus epichlorohydrin, and mice treated with TCE plus epichlorohydrin and epoxybutane. No effect was observed in mice treated with pure, epoxybutane-stabilized and amine-stabilized TCE.

At present, epidemiological studies are inadequate to evaluate the risk of cancer in man from exposure to TCE. Limitations include uncertain estimation of the degree and duration of exposure to the clinical, simultaneous exposure to other potentially carcinogenic chemicals, small cohort size, and follow-up period which may be shorter than the latency period for a cancer to develop. The risk of death from cancer due to exposure to dry-cleaning fluids, including TCE, was investigated from the mortality figures of 330 dry-cleaning and laundry workers recorded between 1957 and 1977. The frequency of deaths from cancer was compared with the predicted frequently of deaths from cancer in the normal population. There was an increased occurrence of lung cancer, cervical cancer, and leukemia in the exposed, although the difference was not significant. Lung cancer is often associated with low socio-economic status, and it is likely that this was a major contributing factor to the increased frequency observed. The results were also unclear because PCE, carbon tetrachloride, and petroleum solvents were also present in the dry-cleaning fluids. In Finland, no significant difference was observed in either total mortality or cancer mortality between a cohort of 1,148 men and 969 women, occupationally exposed to TCE between 1963 and 1976, and the national average mortality figures. However, the period of exposure to TCE was not specified. In a retrospective study, comparing two information sources, the Cancer Registry of liver cancer and a list of past employees at Imperial Chemical Industries, Runcorn, there was only one probable match, and one possible match between the occurrence of liver cancer and occupational exposure. However, on further investigation these two possibilities proved to be negative since the subjects diagnosed with liver cancer had never worked on the Runcorn site (Fawell, 1988).

Based on these two studies and two inhalation studies, EPA has classed TCE as B2, probable human carcinogen. The oral and inhalation slope factors for TCE have been established.

D 10.4 Bibliography

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D 11.0 VINYL CHLORIDE

D 11.1 Characteristics

Vinyl chloride, Chemical Abstract Service Registry No. 75-01-4, is also known as chloroethylene, chloroethene and monochloroethylene. It is a flammable gas at room temperature (boils at 14 C), and is usually encountered as a cooled liquid (Sittig, 1985). The colorless liquid forms a vapor which has a pleasant, ethereal odor. Vinyl chloride has a solubility in water of 2763 mg /L at 25 C (Howard, 1989, 1990).

D 11.2 Environmental Fate

Although vinyl chloride is produced in large quantities, almost all of it is used for the production of polyvinyl chloride (PVC) and other polymers. Therefore, its major release to the environment will be as emissions and wastewater at these production and manufacturing facilities. If vinyl chloride is released to soil, it will be subject to rapid volatilization with reported half-lives of 0.2 and 0.5 days for evaporation from soil at 1 and 10 cm incorporation, respectively. Any vinyl chloride which does not evaporate will be expected to be highly to very highly mobile in soil and it may leach to the groundwater. It may be subject to biodegradation under aerobic conditions such as exists in flooded soil and groundwater. If vinyl chloride is released to water, it will not be expected to hydrolyze, to bioconcentrate in aquatic organisms, or to adsorb to sediments. It will be subject to rapid evaporation from a river 1 m deep with a current of 3 m/sec and a wind velocity of 3 m/sec. In waters containing photosensitizers such as humic acid, photodegradation will occur fairly rapidly. Limited existing data indicated that vinyl chloride is resistant to biodegradation in aerobic soils and natural waters. It will not be expected to hydrolyze in soils or natural waters under normal environmental conditions. If vinyl chloride is released to the atmosphere, it can be expected to exist mainly in the vapor phase in the ambient atmosphere and to degrade rapidly in air by gas-phase reaction with photochemically produced hydroxyl radicals with an estimated half-life of 1.5 days. Products of reaction in the atmosphere include chloroacetaldehyde, chloroethylene epoxide, formaldehyde, formyl chloride, formic acid, and carbon monoxide. In the presence of nitrogen oxides, e.g., photochemical smog situations, the half-life would be reduced to approx a few hours. Since vinyl chloride is primarily used in limited number of locations, it is unlikely that contamination will be widespread. Major human exposure will be from inhalation of occupational atmospheres and from

ingestion of contaminated food and drinking water which has come into contact with PVC packaging material, or pipe which has not been treated adequately to remove residual monomer (Howard, 1989, 1990).

D 11.3 Health Effects

D 11.3.1 Noncarcinogenic Effects of Vinyl Chloride

Acute occupational exposure to high concentrations of vinyl chloride can produce symptoms of narcosis in humans. Respiratory tract irritation, bronchitis, headache, and irritability may occur. Chronic exposure to vinyl chloride is associated with multiple systemic disorders, including a sclerotic syndrome, acro-osteolysis, thrombocytopenia, and liver damage, consisting of damage to parenchymal cells, fibrosis of the liver capsule, periportal fibrosis associated with hepatomegaly, and splenomegaly. Concentrations encountered by workers in industries using or producing vinyl chloride are reportedly quite variable and may range from less than the limit of detection to several grams per cubic meter.

Acute inhalation exposure of experimental animals to high concentrations of vinyl chloride can result in narcosis and death. The 2-hour LC_{50} value for rate is 390 g/m^3. Chronic and histopathological and histochemical lesions in the liver, kidneys, spleen, and lungs.

The EPA has not developed chronic oral or inhalation reference doses for vinyl chloride.

D 11.3.2 Carcinogenic Effects of Vinyl Chloride

EPA considers vinyl chloride to be a Class A human carcinogen, causing angiosarcomas of the liver and tumors of the brain, lung, and hemolymphopoietic systems in humans. Vinyl chloride is carcinogenic in mice, rats, and hamsters, it produces tumors at several sites, including angiosarcomas of the liver, after oral or inhalation exposure. Vinyl chloride, both as a vapor and in solution, mutagenic in several biological assay systems. In addition, chromosome aberrations including fragments, dicentics and rings, breaks, and gaps have been found in workers occupationally exposed to vinyl chloride. The evidence on its teratogenic and reproductive effects is equivocal. Minor skeletal abnormalities and increased fetal death rates have been observed in the offspring of experimental animals exposed by

inhalation to vinyl chloride. In humans, a significant increase in fetal deaths was seen where the father was exposed to vinyl chloride. Also, an excess number of central nervous system disorders and deformities of the upper alimentary tract, genital organs, and feet were observed in stillborn and live children born in cities with vinyl chloride facilities. However, further research is necessary before the link between vinyl chloride and these observed effects can be positively established.

Experimental studies with laboratory rats have determined an oral slope factor for vinyl chloride at 1.9 $(mg/kg/day)^{-1}$ and an inhalation slope factor of 0.29 $(mg/kg/day)^{-1}$.

D 11.4 Bibliography

Howard, 1989 and 1990 — Howard, Philip H., et al., Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volumes I and II, Lewis Publishers, Chelsea, MI.

Sittig, 1985 — Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals and Carcinogens, Second Ed., Noyes Publications, Park Ridge, NJ.

D 12.0 BIS(2-ETHYLHEXYL)PHTHALATE

D 12.1 Characteristics

Bis(2-ethylhexyl)phthalate, Chemical Abstract Service Registry No. 117-81-7 is a phthalate ester also known as BEHP, dioctyl phthalate, di-n-butylphthalate and Octoil. Bis(2-ethylhexyl)phthalate is a non volatile, colorless liquid, only slightly soluble in water. It is widely used as a plasticizer. Bis(2-ethylhexyl)phthalate has been suggested as a possible natural product in animal and plants (Howard, 1989).

D 12.2 Environmental Fate

Plastics may contain up to 40% bis(2-ethylhexyl)phthalate by weight and are widely used in consumer products such as imitation leather, rain wear, footwear, upholstery, flooring, food packaging materials, and children's toys. They are also used for tubing and containers for blood transfusions and blood products. Bis(2-ethylhexyl)phthalate is also used as a hydraulic fluid and as a dielectric fluid for use in electrical capacitors (ATSDR, 1987).

Bis(2-ethylhexyl)phthalate is used as a plasticizer for polyvinyl chloride and other polymers in large quantities and is likely to be released to air and water during production and waste disposal of these plastic products. Bis(2-ethylhexyl)phthalate will be carried long distances and be removed by rain. Human exposure will occur in occupational settings and from air, consumption of drinking water, food (especially fish, etc., where bioaccumulation can occur), and food wrapped in PVC, as well as during blood transfusions from PVC blood bags (Howard, 1989).

D 12.3 Health Effects

D 12.3.1 Noncarcinogenic Effects of Bis(2-ethylhexyl)phthalate

Chronic oral toxicity studies were conducted on rats, guinea gigs and dogs. The guinea pigs were fed diets containing bis(2-ethylhexyl)phthalate for a period of one year at levels corresponding to 19 and 64 mg/kg/day. Significant increases were observed in relative liver weights in both treated groups.

Groups of rats were maintained for 2 years on diets containing bis(2-ethylhexyl)phthalate. The results of this study demonstrated that guinea pigs offer the more sensitive animal model for bis(2-ethylhexyl)phthalate toxicity. A lowest

observable adverse effect level (LOAEL) in the guinea pigs is determined to be 19 mg/kg/day. EPA has established an oral reference dose based on the above studies (IRIS, 1991).

D 12.3.2 Carcinogenic Effects of Bis(2-ethylhexyl)phthalate

There is inadequate human carcinogenicity data for bis(2-ethylhexyl)phthalate. A mortality study was limited by a short follow-up period and unquantified bis(2-ethylhexyl)phthalate worker exposure.

In a National Toxicology Program (NTP) study, rats and mice were fed diets containing bis(2-ethylhexyl)phthalate for 103 weeks. A statistically significant increase in the incidence of hepatocellular carcinomas and combined incidence of carcinomas and adenomas were observed in female rats and both sexes of the mice (IRIS, 1991).

Based on a significant oral dose related increase in liver tumor responses in rats and mice EPA classified bis(2-ethylhexyl)phthalate as B2; probable human carcinogen. The oral slope factor has been assigned for bis(2-ethylhexyl)phthalate. An inhalation slope factor is not available (IRIS, 1991).

D 12.4 Bibliography

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IRIS, 1991 — EPA, Integrated Risk Information System (IRIS), Bis(2-ethylhexyl)phthalate, on-line, Office of Health and Environmental Assessment, Cincinnati, OH.

NIOSH/OSHA, 1988 — NIOSH, NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards; Bis(2-ethylhexyl)phthalate, Supplement I, U.S.Department of Health and Human Services, DHHS NIOSH Publication No 88-118, 1988.

D 13.0 1,4-DICHLOROBENZENE

D 13.1 Characteristics

1,4-Dichlorobenzene, Chemical Abstract Service Registry No. 106-46-7 is a monoclyclic halogenated aromatic hydrocarbon also known as p-DCB or paradichlorobenzene. 1,4-Dichlorobenzene is a colorless solid with a mothball-like odor (NIOSH 1981). 1,4-Dichlorobenzene is practically insoluble in water; soluble in alcohol, ether, benzene, chloroform, and carbon disulfide, and sublimes at ordinary temperatures (Merck, 1976).

D 13.2 Environmental Fate

The major uses of 1,4-dichlorobenzene are as space deodorizers, moth repellant and an intermediate in the production of polyphenylene sulfide resins. These uses account for over 90% of the 1,4-dichlorobenzene used in the United States in recent years. About 95% of the environmental releases of 1,4-dichlorobenzene occur during its use rather than during manufacturing or processing (ATSDR, 1991). 1,4-dichlorobenzenes are not known to occur as such in nature (Howard, 1989).

1,4-dichlorobenzene can be moderately to tightly absorbed if released to soil. It is possible 1,4-dichlorobenzene can be biodegraded in soil under aerobic conditions. The detection of 1,4-dichlorobenzene in various groundwaters indicates leaching can occur (Howard, 1989).

When released to water, volatilization may be the dominant removal process. The volatilization half-life is estimated to be 4.3 hours. If released to air, 1,4-dichlorobenzene will exist predominantly in the vapor phase and will react with photochemically produced hydroxyl radicals at an estimated half-life rate of 31 days. Because of its ability to sublime at ambient temperatures, it is expected to volatilize from dry surfaces (Howard, 1989).

D 13.3 Health Effects

D 13.3.1 Noncarcinogenic Effects of 1,4-Dichlorobenzene

There is no evidence that brief low-level or moderate-level exposures to household products containing 1,4-dichlorobenzene cause human health problems. Higher 1,4-dichlorobenzene levels in air, such as the levels that are sometimes associated with

industrial exposure, can cause headaches and dizziness. Levels that would result in death would be associated with a odor so intense that it would be very unpleasant, if not intolerable, and would serve as a danger warning (ATSDR, 1991).

D 13.3.2 Carcinogenic Effects of 1,4-Dichlorobenzene

In laboratory animals, breathing or ingestion of 1,4-dichlorobenzene can cause toxic effects in the liver and kidney. Although there is no evidence that 1,4-dichlorobenzene can cause cancer in humans, laboratory animals administered with 1,4-dichlorobenzene by gavage in lifetime studies had increased rates of cancer of the liver and kidneys when compared with animals not treated to 1,4-dichlorobenzene. Based on the results of these animals studies, a potential exists that 1,4-dichlorobenzene may cause cancer in humans. Based on two animal studies, there is some evidence that 1,4-dichlorobenzene exposure can result in birth defects (ATSDR, 1991).

D 13.4 Bibliography

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D 14.0 ARSENIC

D 14.1 Characteristics

Arsenic, Chemical Abstract Service Registry No. 7440-38-2 is also known as gray arsenic or arsen. Arsenic is a naturally occurring metalloid element. Pure arsenic is not commonly found in the environment. It is usually found combined with one or more other elements, such as oxygen, chlorine, or sulphur. Arsenic combined with these elements is referred to as inorganic arsenic, while arsenic combined with carbon and hydrogen is referred to as organic arsenic. The organic arsenic forms are usually less toxic than the inorganic forms (ATSDR, 1991). These arsenic compounds were selected because their toxicity or presence in the environment identified them as compounds of concern. The inorganic compounds of arsenic are solids at normal temperatures and are not likely to volatilize. The solubility of these compounds in water ranges from quite soluble (sodium arsenite and arsenic acid) to practically insoluble (arsenic trisulfide). Some organic arsenic compounds are gases or low-boiling liquids at normal temperatures. Except the organic acid compounds, they are not readily soluble in water (ATSDR, 1991).

D 14.2 Environmental Fate

Arsenic released to the atmosphere as a gas, vapor, or adsorbed to particulate matter may be transported to other media by wet or dry deposition, making the atmosphere an important route of arsenic transfer to other media. Trivalent arsenic may undergo oxidation in the air, and arsenic in the atmosphere is usually a mixture of the trivalent and pentavalent forms. Most arsenic in air is adsorbed to particulate matter, especially small-diameter particles. The residence time of particulate-bound arsenic in the air depends on particle size, but a typical value is about nine days, although it may persist longer under conditions of limited atmospheric mixing or low precipitation. Photolysis is not considered an important fate process for arsenic compounds (ATSDR, 1991).

Arsenic in surface water can undergo a complex pattern of transformation, including oxidation-reduction reactions, ligand exchange, biotransformation, precipitation, and adsorption. This complexity results in extremely mobile behavior in aquatic systems, with much of the arsenic entering rivers and eventually traveling to oceans. Sorption onto clays, iron oxides, manganese compounds, and organic material is an important

fate of arsenic in surface water, and sediment serves as a reservoir for much of the arsenic. Sediment-bound arsenic (arsenate/ arsenite) that has been methylated by aerobic and anaerobic microorganisms may be released back to the water column (ATSDR, 1991).

Soluble forms of arsenic interact with soil and travel with the groundwater mass with which they are associated. Shifts in oxidation state may occur in either direction, depending upon the particular physical and chemical characteristics of the soil and groundwater. Volatilization of methylated forms from groundwater is possible. Nonporous soil and heavy vegetation cover are expected to impede volatilization, and oxidation may transform volatile forms into nonvolatile species or species that will adsorb to clay, organic matter, and iron and aluminum complexes (ATSDR, 1991).

Arsenic occurs in soil predominately in an insoluble, adsorbed form. Arsenic leaching is usually important only in the top 30 cm of soil. Leaching carries arsenic deeper in sandy soils than in clay or loam soils, although the EPA reported that no leached arsenic could be detected below 90 cm in any study. While arsenate dominates in aerobic soils, arsenite is the predominate form in slightly reduced soils (temporary flooded soil), and arsine, methylated arsenic, and elemental arsenic predominate in very reduced conditions (swamps and bogs) (ATSDR, 1991).

As noted previously arsenic in water and soil may be reduced and methylated by fungi, yeasts, algae, and bacteria, and these forms may volatilize and escape into the air with the volatilization rate varying considerably, depending upon soil conditions, the pH value of the soil, and microbes present. Bioconcentration of arsenic occurs in aquatic organisms, primarily in algae and lower invertebrates. Biomagnification in aquatic food chains does not appear to be significant, although some fish and invertebrates contain high levels of arsenic compounds that are relatively inert toxicologically. Plants may accumulate arsenic by root uptake from soil solution, and certain species may accumulate substantial levels. In addition to species differences, the amount of arsenic taken up depends upon soil arsenic concentration, soil characteristics, and other factors (ATSDR, 1991).

D 14.3 Health Effects

Investigation and analysis of the toxicity of arsenic is complicated by the finding that different chemical forms of arsenic are not equally toxic. Inorganic arsenic tends to be more toxic, and exposure for human studies must be expressed in terms of total inorganic arsenic. An additional difficulty is that most studies indicate that animals are less sensitive to the toxic effects of arsenic than humans are. Although there is good evidence that arsenic is carcinogenic in humans by both the oral and inhalation routes, evidence of arsenic-induced carcinogenicity in animals is mostly negative. For these reasons, dose-response data from animals are not judged to be reliable for determining levels of significant human exposure and will not be considered except in the absence of any human data.

D 14.3.1 Noncarcinogenic Effects of Arsenic

The results of human studies indicate that doses as low as 20 to 60 ug/kg/day may produce the characteristic signs of arsenic toxicity, including gastrointestinal irritation, anemia, neuropathy, skin lesions, vascular lesions, and lepatic or renal injury. There does not appear to be a strong trend toward cumulative toxicity because doses of about fifty ug/kg/day produce similar effects after both short and long-term exposure. In most cases of subchronic or chronic exposure, many or all of the signs of arsenic toxicity are detected together, indicating systemic end points are similar. Doses of around ten ug/kg/day do not generally cause measurable signs of arsenic intoxication (ATSDR, 1991).

Studies in animals have revealed that very high oral doses of sodium arsenate (more than one hundred mg/kg) may be teratogenic and fetotoxic, but doses of 60 to 100 mg/kg/day have no significant effect. Sodium arsenite appears to be somewhat more toxic, causing increased malformations and prenatal mortality in mice and hamsters dosed at levels of 25 to 40 mg/kg/day. These dose levels that may cause maternal lethality in exposed animals are considerably higher than levels which may cause lethality in humans (0.6 mg/kg/day). The effects of arsenic exposure on reproductive parameters have not been well studied. Limited data in mice suggest that ingestion of water containing 5 mg/L of arsenite for three generations does not significantly impair reproductive success. Arsenic appears to be either inactive or extremely weak to the induction of specific gene mutations in vi TSDR, 1991).

Many reports indicate that dermal exposure to inorganic arsenic compounds leads to dermatitis. However, none of these reports provides quantitative information on dose-duration relationships. No reports indicating that dermal exposure is associated with increased risk of cancer have been located (ATSDR, 1991).

The oral reference dose (RfD) for arsenic, both chronic and subchronic exposure, has been established (HEAST, 1991). No inhalation RfD has been developed. The current MCL (maximum contaminant level) for arsenic in drinking water 0.05 mg/l, which is an interim measure the EPA is using that was previously derived by the Public Health Service (IRIS, 1991).

D 14.3.2 Carcinogenic Effects of Arsenic

Studies have indicated that skin cancer prevalence are proportional to arsenic exposure level. Other studies show the same results, which increased frequency of skin cancer or internal cancer in individuals exposed to water containing 0.3 mg/l or more. Failure to detect significant increases at lower doses may be due to lack of statistical power in the studies, or it could suggest that arsenic-induced cancers have a threshold dose. Although toxicokinetic data regarding arsenic methylation provide some support for this concept, at present it is judged inadequate to conclude that arsenic-induced cancer has a nonzero threshold (ATSDR, 1991).

It was originally calculated that a dose of 1 ug/kg/day corresponded to a skin cancer risk of 1.58×10^{-2}. The EPA has more recently refined these calculations, having estimated that a dose of 1 ug/kg/day corresponds to a risk of 1×10^{-3}. As with any cancer risk calculation, there is a considerable amount of uncertainty in this value, especially when extrapolated to very low exposure levels. None of the available studies provide adequate dose-response data to calculate the risk of internal cancers following exposure to arsenic (ATSDR, 1991).

Many studies report above-average lung cancer rates in groups of people with above-average exposure to airborne arsenic. It has been concluded that arsenic is a more potent lung carcinogen than previously believed, with a dose-response relationship concaved downward at exposure levels below 10,000 ug/m^3/year. The relationship between lung cancer and urinary arsenic levels was linear, suggesting that

bioavailability and lung absorption of arsenic tend to be proportionately greater at low exposure levels than at high exposure levels (ATSDR, 1991).

An inhalation slope factor has been derived for arsenic. An oral slope factor of 1.75 was been developed for arsenic but later removed, indicating uncertainty associated with this value (IRIS, 1991).

D 14.4 Bibliography

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IRIS, 1991 EPA, Integrated Risk Information System (IRIS), Arsenic, on-line, Office of Health and Environmental Assessment, Cincinnati, OH, verification date September 1, 1989.

D 15.0 BARIUM

D 15.1 Characteristics

Barium, Chemical Abstract Service Registry No. 7440-39-3, is a silvery white metallic element which oxidizes very easily. It is one of the less expensive metals that have the distinctive properties of absorbing gases. It belongs to the alkaline earth group, resembling calcium chemically. The most important compounds are the peroxide, chloride, sulfate, carbonate, nitrate, and chlorate. Naturally occurring barium is a mixture of seven stable isotopes (CRC, 1984).

D 15.2 Environmental Fate

Traces of barium are very widely distributed. No data exist concerning its presence or its amount in dust; the content of barium will probably be proportionally related to the calcium content.

Barium is extremely reactive, decomposes in water, and readily forms insoluble carbonate and sulfate salts. Barium is generally present in solution in surface or groundwater only in trace amounts. Large amounts will not dissolve because natural waters usually contain sulfate, and the solubility of barium sulfate is generally low. Barium is not soluble at more than a few parts per million in water that contains sulfate at more than a few parts per million. However, barium sulfate may become considerably more soluble in the presence of chloride and other anions. Monitoring programs show that it is rare to find barium in drinking water at concentrations greater than 1 mg/liter. Atmospheric transport of barium, in the form of particulates, can occur. Bioaccumulation is not an important process for barium (Clement, 1985).

D 15.3 Health Effects

D 15.3.1 Noncarcinogenic Effects of Barium

Compounds of barium are highly toxic, unlike others in its chemical group. The fatal dose of $BaCl_2$ for man is reported to be between 0.8 and 0.9 g (0.55 to 0.6 g as Ba).

A benign pneumoconiosis, baritosis, in workers exposed to finely ground $BaSO_4$, first described in Italy, was later confirmed by Arrigoni. Baritosis was later reported in the United States in barium miners, in Germany, and in Czechoslovakia. Baritosis

also occurred among workers handling lithopone. Baritosis causes no specific symptoms and no changes in pulmonary function (Clayton and Clayton, 1981).

A study concluded that there was no statistically significant difference in blood pressure between human ingesting drinking water containing barium at 7.3 mg/L compared with 0.1 mg/L. A concentration of 7.3 mg/L corresponds to a dose of 0.20 mg/kg/day (assuming that a 70-kg adult drinks 2 L/day).

A study exposed weaning rats to barium at 1, 10, or 100 ppm in drinking water for up to 16 months (average daily barium doses of 0.051, 0.51, and 5.1 mg/kg, respectively). There were no signs of toxicity at any barium dose level. Systolic blood pressure measurements revealed no increase in pressure in animals exposed to 1 ppm barium for 16 months, an increase of 4 mm Hg ($p<0.01$) in animals exposed to 10 ppm barium for 16 months, and an increase of 16 mm Hg ($p<0.001$) in animals exposed to 100 ppm barium for 16 months. The animals in this study were maintained in a special contaminant-free environment and fed a diet designed to reduce exposure to trace metals. It is possible that the restricted intake of certain beneficial metals (e.g., calcium and potassium) may have predisposed the test animals to the hypertensive effects of barium.

The LOAEL identified in the study (5.1 mg/kg/day) has been used in the derivation of the oral RfD without an additional 10-fold uncertainty factor for the lack of a NOAEL. The oral reference dose has an uncertainty factor of 100 (IRIS, 1991).

D 15.3.2 Carcinogenic Effects of Barium

No evidence of the carcinogenicity of barium could be located in the literature.

D 15.4 Bibliography

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D 16.0 CHROMIUM

D 16.1 Characteristics

The ammonium and alkali metal salts of hexavalent chromium are generally water-soluble, but the alkaline metal salts (calcium, strontium) are sparingly soluble or insoluble in water. Hexavalent chromium rarely occurs in nature apart from man-made sources because it is readily reduced in the presence of oxidizable organic matter; however, hexavalent chromium compounds that occur most commonly in the form of chromate and dichromate are stable in many natural waters because of the low concentration of reducing matter. Except acetate and nitrate salts, the trivalent chromium compounds are generally insoluble in water. In most biological systems, chromium is present in the trivalent form. The physical or chemical forms and the mode by which chromium (III) compounds are incorporated into biological systems are poorly characterized (ATSDR, 1991).

D 16.2 Environmental Fate

Chromium occurs naturally in the earth's crust. Continental dust is the primary source of natural chromium present in the environment; however, chromium is released to the environment because of human activities in much larger amounts. Chromium is primarily removed from the atmosphere by fallout and precipitation. Atmospheric chromium removed by physical processes predominantly enters surface water or soil; however, before their removal, chromium particles of aerodynamic diameter less than 20 um may remain airborne for long periods and may be transported long distances (ATSDR, 1991).

Because there are no known chromium compounds that can volatilize from water, transport of chromium from water to the atmosphere is not likely other than by transport in windblown sea sprays. Most of the chromium (III) is eventually expected to precipitate in sediments. Small amounts of chromium (III) may remain in solution as soluble complexes. Chromium (VI) will be present predominantly in soluble form. These soluble forms of chromium may be stable enough to undergo intramedia transport; however, organic matters present in water will eventually reduce chromium (VI) to chromium (III). It has been estimated that the residence time of chromium in lake water is from 4.6 to 18 years (ATSDR, 1991).

Chromium probably occurs as insoluble $Cr_2O_3H_2O$ in soil because the organic matter in soil is expected to convert soluble chromate to insoluble Cr_2O_3. Chromium in soil may be transported to the atmosphere in the aerosol form, and runoff and leaching may transport chromium from soil to surface waters and groundwater. Runoff could remove both soluble and bulk precipitate with final deposition on either a different land area or a water body. Flooding of soils and the subsequent anaerobic decomposition of plant matter may increase mobilization of chromium in soils because of the formation of soluble complexes. The half-life of chromium in soils may be several years (ATSDR, 1991; MERCK, 1976).

D 16.3 Health Effects

D 16.3.1 Noncarcinogenic Effects of Chromium

The estimated safe and adequate daily dietary recommendations of chromium, considered to be an essential nutrient, is 50-200 ug/day for adults. Effects observed after chromium (VI), hexavalent chromium, and chromium (III), trivalent chromium, oral exposure have not been well defined.

Chronic oral studies of chromium compounds have not identified any adverse effects on toxicological end points including body and organ weights, clinical chemistry values, and histologic appearance of tissue (ATSDR, 1991).

Studies indicate that oral chromium (VI) may result in reproductive toxicity (ATSDR, 1991). Inhalation exposure has several key effects including respiratory tract effects, irritation of the nasal mucosa; transient decreases in lung function; and induction of cancer. Many cases of nasal mucosal ulceration and perforation have been reported in workers exposed to chromium (VI). Slight effects on lung function have also been observed in exposed workers (ATSDR, 1991).

Studies of chromosome effects in lymphocytes of workers exposed to chromium (VI) have given mixed results. In vitro assays for gene mutations, chromosome effects, and cell transformation have consistently given positive results for chromium (VI) and negative results for chromium (III). The positive dominant lethal study considered with positive results in human somatic cells raises concern that chromium (VI) may be a potentially human germ-cell mutagen (ATSDR, 1991).

An oral RfD for chromium (III) (insoluble salts) was calculated. The value includes an uncertainty factor of 100 for interspecies and intraspecies variability and 10 as a modifying factor to reflect uncertainty around the (NOAEL), which was the basis of the calculation. An oral RfD has been calculated for chromium (VI), with a modifying factor of 100 for interspecies and intraspecies extrapolation and a modifying factor of 5 for less-than-lifetime exposure duration (IRIS, 1991).

D 16.3.2 Carcinogenic Effects of Chromium

The limited chronic oral studies of chromium (VI) and chromium (III) compounds have not resulted in significant tumor incidence (ATSDR, 1991).

Case studies and epidemiological studies for the inhalation route of exposure indicate that occupational exposure to chromium compounds is associated with respiratory cancer. Although these studies do not clearly implicate specific compounds or the valence state of chromium involved, the results of animal testing implicate chromium (VI). The key epidemiological study used for quantitative risk assessment found a dose-related increase in lung cancer death rates in chromate production workers exposed to chromium at 1-8 mg/m^3/year. Chronic inhalation studies of chromium (VI) in animals provide sufficient evidence that certain chromium (VI) compounds are carcinogens (ATSDR, 1991).

D 16.4 Bibliography

ATSDR, 1991 ATSDR, Final Toxicological Profile for Chromium, prepared by Syracuse Research Corporation, Oak Ridge National Laboratory, Oak Ridge, 1991.

Merck, 1976 Windholz, Martha, ed., The Merck Index, An Encyclopedia of Chemical and Drugs,, Ninth Edition, Merck & Co., Inc., Rahway, New Jersey, 1976.

IRIS, 1991 EPA, Integrated Risk Information System (IRIS), on-line, Office of Health and Environmental Assessment, Cincinnati, OH.

D 17.0 LEAD

D 17.1 Characteristics

Metallic lead is stable in dry air; however, in moist air, it quickly forms lead monoxide, which in turn produces lead carbonate with carbon dioxide in air. In general, the chemical properties of inorganic lead compounds are similar to those of the alkaline earth metals. The nitrate, chlorate, and acetate salts are water soluble; chloride is slightly soluble; and sulfate, carbonate, chromate, phosphate, and sulfide are insoluble. Aromate, carbonate, nitrate, sulfide, and phosphate are soluble in acid, and chloride is slightly soluble in acid. Lead forms stable tetraalkyl compounds with organic ligands, such as tetramethyl, tetraethyl, tetrapropyl, and tetrabutyl compounds. They are soluble in many organic solvents but are insoluble in water. The tetraorganolead compounds decompose to lead metal and free organic radicals at elevated temperatures or in light. In the presence of oxygen, the thermal decomposition of tetraethyl lead produces lead oxide rather than the free metal. Lead also forms stable metal complexes with polydentate chelating agents, such as penicillamine or EDTA (ATSDR, 1991).

D 17.2 Environmental Fate

In the atmosphere, lead exists primarily in the particulate form. Upon release to the atmosphere, lead particles are dispersed, transformed by physical or chemical processes, and ultimately removed by wet or dry deposition. An important factor in determining the atmospheric transport of lead is particle size distribution. Large particles, particularly those with aerodynamic diameters greater than 2 um, settle out of the atmosphere fairly rapidly and are deposited relatively close to emission sources, but small particles may be transported thousands of kilometers. Wet deposition is expected to remove larger amounts of lead in areas with acid rain (northeastern United States), because aid rain has a tendency to make lead soluble. The average residence time of lead particles in the atmosphere is expected to be between 7 and 30 days (ATSDR, 1991).

The chemistry of lead in aqueous solution is highly complex because this element can be found in many forms. Lead has a tendency to form compounds of low solubility with the major anions of natural water. In the natural environment, the divalent form (Pb^{2+}) is the stable ionic species of lead. Hydroxide, carbonate, sulfide, and, more

rarely, sulfate may act as solubility controls in precipitating lead from water. Tetraalkyl leads may also form by a combination of chemical/biological alkylation of inorganic lead compounds under appropriate conditions. A significant fraction of lead carried by river water is expected to be in an undissolved form, which can consist of colloidal particles or larger undissolved particles of lead carbonate, lead oxide, lead hydroxide, or other lead compounds incorporated in other components of surface particulate matters from runoff. Lead may occur either as absorbed ions or surface coatings on sediment mineral particles, or it may be carried as a part of suspended living or nonliving organic matter in water (ATSDR, 1991).

Except in some shellfish, such as mussels, lead does not appear to bioaccumulate significantly in most fish (ATSDR, 1991).

The accumulation of lead in most soils is primarily a function of the rate of deposition from the atmosphere. Most lead is retained strongly in soil, and very little is transported into surface water or groundwater. The fate of lead in soil is affected by the specific or exchange adsorption at mineral interfaces, the precipitation of sparingly soluble solid phases, and the formation of relatively stable organic-metal complexes or chelates with soil organic matter. These processes are dependent upon factors such as soil pH, organic content of soil, the presence of inorganic colloids and iron oxides, ion-exchange characteristics, and the amount of lead in soil. There is evidence that atmospheric lead enters the soil as lead sulfate or it is converted rapidly to lead sulfate at the soil surface. Lead sulfate is relatively soluble and could leach through soil if it were not transformed. In soils with pH of 5 or greater and with at least 5 percent organic content, atmospheric lead is retained in the upper 2 to 5 cm of undisturbed soil. Because many plants commonly take up lead from soil, lead may eventually return to soil when these plants decay, unless they are harvested or removed (ATSDR, 1991).

D 17.3 Health Effects

Lead is a naturally occurring element which is dispersed throughout the environment primarily as the result of anthropogenic activities. Environmental fate processes may transform one lead compound to another, but lead itself is not degraded and is still available for human exposure. The general population is exposed to lead in ambient air, in many foods, in drinking water, and in dust. The average baseline intake of

lead in 1982-1983 by 2-year old children, adult females, and adult males was 46.6 ug/day, 37.5 ug/day, and 50.7 ug/day, respectively. These reflect minimum levels of exposure during normal daily living. The highest and most prolonged lead exposures are found among workers in the lead smelting, refining, and manufacturing industries (ATSDR, 1991).

The database for lead is unusual in that it contains a great deal of data concerning dose-effect relationships in humans. However, the dose data for humans are generally expressed in terms of internal exposure, usually measured as levels of lead in the blood. Human body burdens of lead result from a combination of inhalation and oral exposure primarily to inorganic lead. Dose-effect data in terms of external exposure levels by a single route of exposure are not generally available for humans, therefore, experimental studies of lead toxicity in animals provide support for observations in human studies, with some consistency in types of effects and blood-lead-effects relationships (ATSDR, 1991).

D 17.3.1 Noncarcinogenic Effects of Lead

For oral exposure, the end points of greatest concern for human health are heme synthesis and erythropoiesis, neurobehavioral toxicity, cardiovascular toxicity, and vitamin D metabolism and growth (ATSDR, 1991).

In humans, studies have shown ingestion of lead produces a decrease in erythrocyte aminolerulinic acid dehydrase (ALA-D) and an increase in erythrocyte protoporphyrin. Lead ingestion has also shown delays in reflex development in rats; poorer performance on a spatial discrimination task was reported in rats fed 1.25 µg/kg/day. Monkeys given 0.05 mg/kg/day from birth performed significantly poorer in learning discrimination-reversal and delayed alternation. Studies have also shown that rats given drinking water with lead at 7 mg/kg/day lead showed markedly increased blood pressures, but rats given water with 3.5 mg/kg/day of lead showed no effect on blood pressure. A review of 65 pertinent animal studies concluded that low-level exposure to lead during prenatal or early postnatal life results in retarded growth in the absence of overt signs of toxicity. Studies have shown reproductive toxicity at levels as low as 0.014 mg/kg/day (ATSDR, 1991).

The only pertinent dose-effect data found in the available literature on lead inhalation were from a study of hematological effects in humans and a study of the developmental toxicity to animals. In the human study, exposure to particulate lead at 3.2 or 10.9 ug/m^3 in air for three months showed a decrease of 85 percent and 56 percent decrease after four months in erythrocyte levels of ALA-D. Maternal and fetal ALA-D were inhibited in rats exposed to 1, 3, and 10 mg/m^3 lead throughout gestation (ATSDR, 1991).

The EPA has not derived a reference dose for oral or inhalation exposure to lead.

D 17.3.2 Carcinogenic Effects of Lead

In the most adequate study available, rats exposed to lead acetate at 25 mg/kg/day in the diet for two years showed statistically increased incidence of kidney tumors. No kidney tumors were seen at the next lower dietary level, 5 mg/kg/day (ATSDR, 1991).

No slope factor has been developed for lead.

D 17.4 Bibliography

ATSDR, 1991 ATSDR, Final Toxicological Profile for Lead, prepared by Syracuse Research Corporation, Oak Ridge National Laboratory, Oak Ridge, 1991.

Merck, 1976 Windholz, Martha, ed., The Merck Index, An Encyclopedia of Chemical and Drugs, Ninth Edition, Merck & Co., Inc., Rahway, New Jersey, 1976.