UNITED STATES AIR FORCE
JOINT BASE ELMENDORF-RICHARDSON
ALASKA

NIKE SITE SUMMIT

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT REPORT

Remedial Investigation Report – Volume 3 of 3

FINAL

MAY 2012

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HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT REPORT

NIKE SITE SUMMIT

JOINT BASE ELMENDORF-RICHARDSON, ALASKA

Prepared for:
673rd Civil Engineer Squadron, Asset Management Flight,
Natural Resources Element, Restoration Section

Prepared by:
MWH

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LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
Air Force	U.S. Air Force
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm^2	square centimeter(s)
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSF	cancer slope factor
CSM	conceptual site model
DL	detection limit
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
GRO	gasoline range organics
HHERA	human health and ecological risk assessment
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
J&E Model	Johnson and Ettinger Vapor Intrusion Model
JBER	Joint Base Elmendorf-Richardson
kg	kilogram(s)
LSS	Lower Site Summit
m^3	cubic meters
mg	milligrams
mg/Kg	milligrams per kilogram
mg/Kg-day	milligrams per kilogram per day
mg/L	milligrams per liter
MLE	maximum likelihood estimate
NAWQC	National Ambient Water Quality Criteria
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observable adverse effect level
NSS	Nike Site Summit
ORNL	Oak Ridge National Laboratories
PA/SI	Preliminary Assessment/Site Investigation
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PHC	petroleum hydrocarbon
PPE	personal protective equipment

LIST OF ACRONYMS AND ABBREVIATIONS (Cont.)

RAPM	Risk Assessment Procedures Manual
RBCL	risk-based cleanup level
RfC	reference concentration
RfD	reference dose
RFI	Remedial Field Investigation
RI Work Plan	Remedial Investigation/Feasibility Studies and Baseline Risk Assessment Work Plan
RI	remedial investigation
RRO	residual range organics
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SQuiRT	Screening Quick Reference Table
SVOC	semi-volatile organic compound
TEL	threshold effects level
TRV	toxicity reference values
UCL	upper confidence level
UPL	upper prediction limit
URF	upper risk factor
USS	Upper Site Summit
UST	underground storage tank
VOC	volatile organic compound

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EXECUTIVE SUMMARY

This Human Health and Ecological Risk Assessment (HHERA) Report was prepared by MWH Americas, Inc. (MWH) on behalf of the U.S. Air Force for four areas where contamination has been detected at Nike Site Summit (NSS), Joint Base Elmendorf-Richardson (JBER), Alaska, and potentially contaminated downgradient off-site drainages adjacent to the NSS. This HHERA Report includes a description of the methods used in, and the results of, a quantitative HHERA performed for NSS.

Site investigations at NSS began in 1995, when four potential source areas were defined: Upper Site Summit (USS), Lower Site Summit (LSS), Area A, and Area C. Data used in this HHERA were collected as part of the current Remedial Field Investigation for NSS, and include samples collected from the four potential source areas and downgradient, off-site drainages.

The HHERA consisted of two phases. A qualitative phase that included the development of human health and ecological conceptual site models involved an evaluation of potentially contaminated media, fate and transport pathways, selection of potentially exposed human receptors and ecological guilds, and the identification of potentially complete exposure pathways between contaminated media and human and ecological receptors. Human and ecological receptors are exposed to potentially contaminated surface soil, subsurface soil, surface water, sediment, and groundwater at the four NSS Areas and the downgradient, off-site drainages. Chemicals of potential concern for human and ecological receptors were identified by screening the maximum detected concentration of each analyte in each medium sampled at the four NSS Areas and downgradient, off-site drainages against protective screening criteria. Chemicals present in each of these media at concentrations exceeding protective human health or ecological screening criteria, were included in the quantitative phase of the HHERA.

The quantitative human health risk assessment (HHRA) included exposure dose modeling for selected human receptors, a toxicity assessment, and risk characterization. Human receptors evaluated in the HHRA included a current/future site worker, a current/future site visitor, and a hypothetical future resident. Cancer risk estimates for one or more human receptors exceeded the Alaska Department of Environmental Conservation’s (ADEC’s) acceptable risk criterion of 1×10^{-5} in:

- Surface soil (arsenic and benzo(a)pyrene) and subsurface soil (benzo(a)pyrene and dibenz(a,h)anthracene) at USS.
- Modeled indoor air (naphthalene), surface soil (arsenic, pentachlorophenol, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h,)anthracene), subsurface soil (1,2,3-trichloropropane and 1,2-dibromo-3-chloropropane), and groundwater (total and dissolved arsenic, naphthalene, total and dissolved total unspeciated chromium, when hexavalent chromium toxicity values are used, and trichloroethylene) at LSS.

- Subsurface soil (total unspeciated chromium, when hexavalent chromium toxicity values are used) at Area A.
- Surface soil (benzo(a)pyrene) at Area C.

Noncancer hazard estimates for one or more human receptors exceeded ADEC's acceptable hazard criterion of 1 in:

- Subsurface soil (1,1,2-trichloroethane and 1,2-dibromo-3-chloropropane), groundwater (total and dissolved arsenic, total and dissolved vanadium, 2-methylnaphthalene, naphthalene and diesel range organics [DRO]), and modeled indoor air (trichloroethylene) at LSS.
- Surface soil (DRO and residual range organics [RRO]) and subsurface soil (DRO) at Area A.

The ecological risk assessment (ERA) consisted of the selection of indicator receptors to represent applicable feeding guilds identified during the problem formulation phase of the ERA, modeling exposure doses for contaminated media using standard, default assumptions or values obtained from peer reviewed literature, an ecological effects assessment, and the characterization of ecological hazard estimates. Ecological Hazard estimates exceeded ADEC's acceptable hazard criterion of 1 for one or more ecological receptors in:

- Surface soil (RRO, benzo(b)fluoranthene, pyrene, cadmium, and lead) at USS.
- Surface soil (pentachlorophenol, pyrene, RRO, cadmium, bis(2-ethylhexyl) phthalate, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, chrysene, indeno(1,2,3-c,d)pyrene) at LSS.
- Surface soil (RRO) at Area A.

No ecological hazard estimates exceeded ADEC's criterion of 1 in surface soil at Area C, or in surface water in downgradient, offsite drainages. Cumulative hazard indices were also calculated for target effects for ecological receptors at the four NSS Areas and downgradient off-site drainages.

Chemical- and medium-specific risk-based cleanup levels (RBCLs) were calculated for applicable human and ecological risk drivers identified in NSS media.

1.0 INTRODUCTION

This Human Health and Ecological Risk Assessment (HHERA) Report describes the methods used in, and results of, HHERAs for areas where contamination has been detected at Nike Site Summit (NSS), Joint Base Elmendorf-Richardson (JBER), Alaska (**Figure 1-1**). This document was prepared by MWH Americas, Inc. (MWH) on behalf of the U.S. Air Force (Air Force) under Air Force Center for Engineering and the Environment (AFCEE) Contract FA8903-08-D-8777, Task Order 83.

The four Areas that are the subject of this HHERA Report are:

- Upper Site Summit (USS)
- Lower Site Summit (LSS)
- Area A – Former Opportunity Strikes Radio Relay Station
- Area C – Pump House

These four NSS Areas are being investigated in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S. Code 9601, Executive Order 12580 (52 Federal Register 2923), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. Because NSS is a CERCLA site, it will be remediated under U.S. Environmental Protection Agency (EPA) and/or Alaska Department of Environmental Conservation (ADEC) regulations, as appropriate, based on contaminants present.

In addition to the four potential source areas listed above, this HHERA includes an assessment of potential impacts of site related contamination on downgradient, off-site drainages. The general layout of the four NSS Areas is shown on **Figure 1-2**.

A Preliminary Assessment/Site Investigation (PA/SI) at multiple sites across Fort Richardson (now part of JBER) was performed in 1995-1996 (Dowl/Ogden, 1996). The PA/SI included NSS, and grouped potential contaminant source areas at NSS into six Areas. Two Areas, Area B and Area D, were determined to be not contaminated during the 1996 PA/SI. As a result, only four of the six potential source areas are evaluated in this HHERA. Media sampled at NSS during the PA/SI included soils and surface water. Results of the PA/SI sampling and a preliminary data screening indicated the presence of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons, and several inorganic compounds in site media. Additionally, a radiological survey and explosive chemical wipe surveys were performed. The survey results were within background limits. The PA/SI also identified other potential contaminant sources for further characterization (e.g., transformers). A comprehensive Remedial Investigation (RI) was planned in 2010 (U.S. Army, 2010) and fieldwork was conducted in 2010 and 2011. Results of the fieldwork portions of the RI are detailed in separate reports (USAF, 2012a, 2012b).

The PA/SI for NSS also presented a thorough site description that included history, land uses, and the physical setting in and around NSS. Much of this information is also included in the

Remedial Field Investigation (RFI) *Report* (USAF, 2012b). Detailed information regarding site history, environmental setting, and site characterization is presented in the *Remedial Investigation/Feasibility Studies and Baseline Risk Assessment Work Plan* (RI Work Plan – U.S. Army, 2010), *Analytical Data Report* (USAF, 2012a), and RFI Report.

1.1 PURPOSE AND SCOPE

The goal of the HHERA for NSS is to evaluate potential risks to human health and the environment from chemical contaminants present in media (i.e., soil, sediment, water, air, and biota [e.g., plants and animals]) associated with four of the six NSS Areas. A risk assessment is a scientific procedure used to estimate the potential for current and future adverse effects on human health and the environment from exposure to physical, chemical, and/or radiological hazards. The baseline risk assessment for NSS was used to evaluate potential risks to human and ecological receptors posed by contaminant releases from each of the four NSS Areas in the absence of remediation or institutional controls. The results of this baseline risk assessment were used to develop alternative, risk-based cleanup levels (RCBLs) for site contaminants where results of the risk assessment suggested that adverse effects to human or ecological receptors are likely (refer to Section 7.0).

The baseline risk assessment includes both current and future hypothetical land uses in order to support regulatory closure and potential future changes in land uses. Currently, the NSS area is used for military personnel training purposes. In addition to military uses, the USS is leased to telecommunications companies, and three towers are utilized and maintained there. Access to the NSS area for non-military personnel who are not working with the telecommunications companies is restricted to occasional guided tours, although recreational visitors also trespass onto NSS property. Area C, to the southeast of the military property, is not under military control. Access to this public area is not restricted and Area C is utilized by non-military personal visiting the area recreationally.

Consistent with the stated goal of the HHERA for NSS, the purpose of this Report is to present the results of human health and ecological risk evaluations for potential exposures to chemicals present in, or released from, contaminated media associated with the four NSS Areas. This HHERA Report documents the technical approach (i.e., data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis) and general assumptions used in, and the results of, the HHERA for NSS.

A preliminary environmental investigation was conducted for NSS as documented in the PA/SI Report (Dowl/Ogden, 1996). Subsequent to the PA/SI, a conceptual site model (CSM) was developed for NSS (Dowl/Ogden, 1998) and an HHERA Work Plan (E&E, 2000), which recommended further characterization of NSS before risks could be properly evaluated, was prepared. Soil, surface water, sediment, and groundwater samples were collected from the four NSS Areas during a RFI for NSS. Due to the limited nature of the PA/SI, this HHERA for NSS utilized data collected during the comprehensive RFI.

1.2 ORGANIZATION

This HHERA Report consists of eight sections and 11 appendices, as described below.

Section 1.0 – Introduction: Describes the purpose, scope, and organization of this HHERA Report.

Section 2.0 – 2010 and 2011 Sampling Investigation Summary: Describes the data usability requirements for environmental data used in risk calculations and presents a summary of data collected in support of the HHERA.

Section 3.0 – CSM: Presents sources of screening criteria for conducting Tier I human health and ecological screening assessments, medium-specific contaminant fate and transport pathways, and exposure pathways for the NSS.

Section 4.0 – Human Health Risk Assessment (HHRA): Describes the approach, methods, general assumptions used in, and the results of, the HHRA for the four NSS Areas.

Section 5.0 – Ecological Risk Assessment (ERA): Describes the approach, methods, general assumptions used in, and the results of, the ERA for the four NSS Areas.

Section 6.0 – Uncertainty Analysis: Presents an evaluation of the uncertainties in the available information and methods used in the HHERA.

Section 7.0 – RBCLs: Presents methods used to develop Alternative RBCLs for protection of human health and the environment at NSS, and calculated RBCLs for human and ecological receptors.

Section 8.0 – References: Lists the reference documents cited in this HHERA Report.

Appendix A – Human Health CSM Scoping Form

Appendix B – Ecoscoping Form

Appendix C – ProUCL Output – Upper Prediction Limit (UPL) Concentrations for Background Data

Appendix D – Chemical of Potential Concern (COPC) and Chemical of Potential Ecological Concern (COPEC) Selection Results

Appendix E – ProUCL Output – 95% Upper Confidence Levels (UCLs) for COPCs and COPECs

Appendix F – Summary Statistics and Exposure Point Concentrations (EPCs) for COPCs and COPECs

Appendix G – Human Health Exposure Dose Equations

Appendix H – Johnson and Ettinger Model Input and Output

Appendix I – Human Health Risk and Hazard Calculations

Appendix J – Ecological Exposure Dose Equations

Appendix K – Ecological Hazard Calculations

Tables and figures are presented at the end of the chapter in which they are called out.

JOB No. 1008300.83010402 TIME: 17-FEB-2012 10:14 FILE: D:\CAD\Proj\AFCEE\Ft Richardson-Nike Site Summit _ 1008300\HHERA\FIG 1-1 location map.dgn

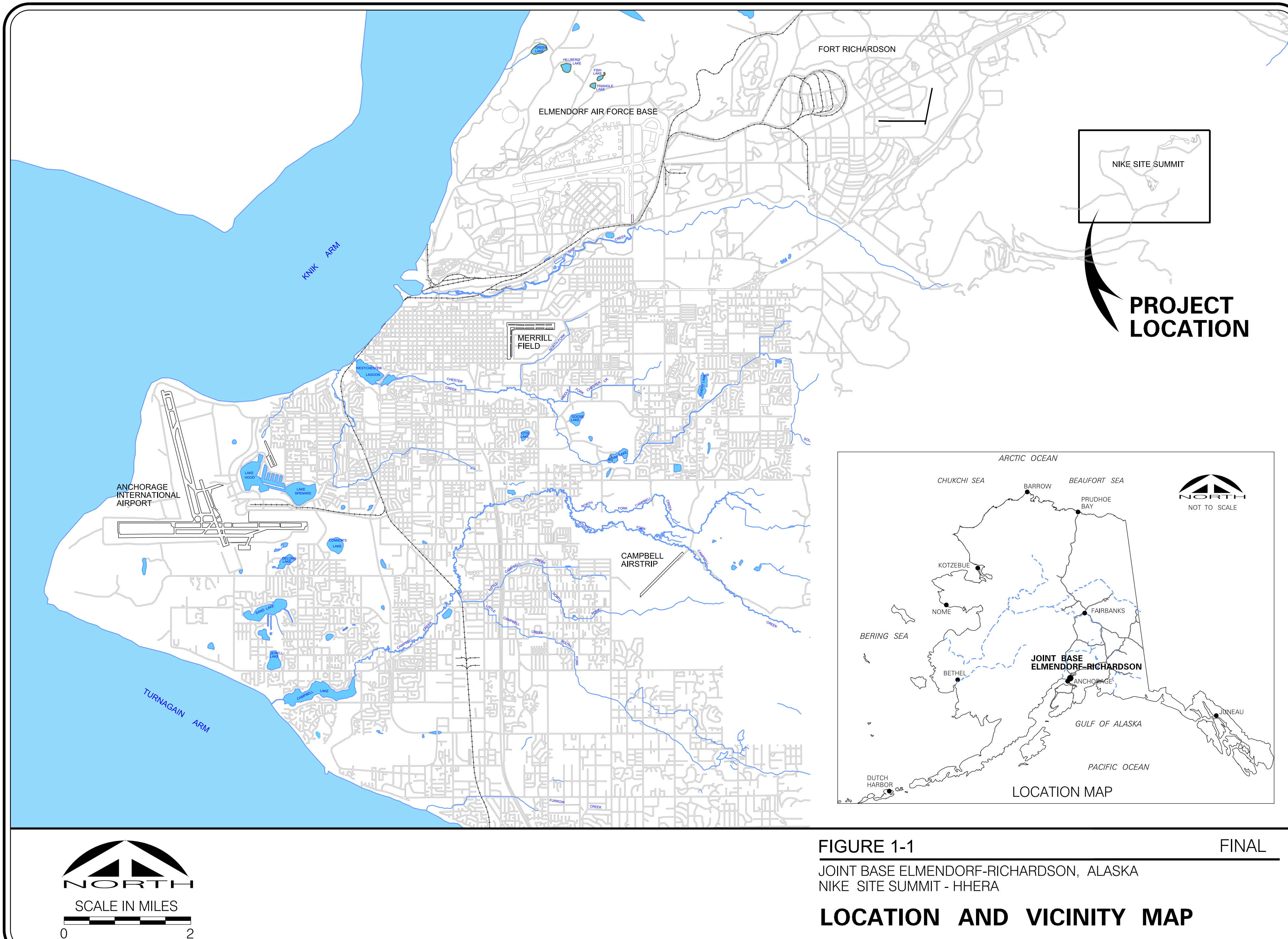

FIGURE 1-1

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JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT - HHERA

LOCATION AND VICINITY MAP

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JOB No. 1008300.83010402 TIME: 17-FEB-2012 10:16 FILE: D:\CAD\Proj\AFCEE\Ft Richardson-Nike Site Summit _ 1008300\HHERA\FIG 1-2 site map.dgn

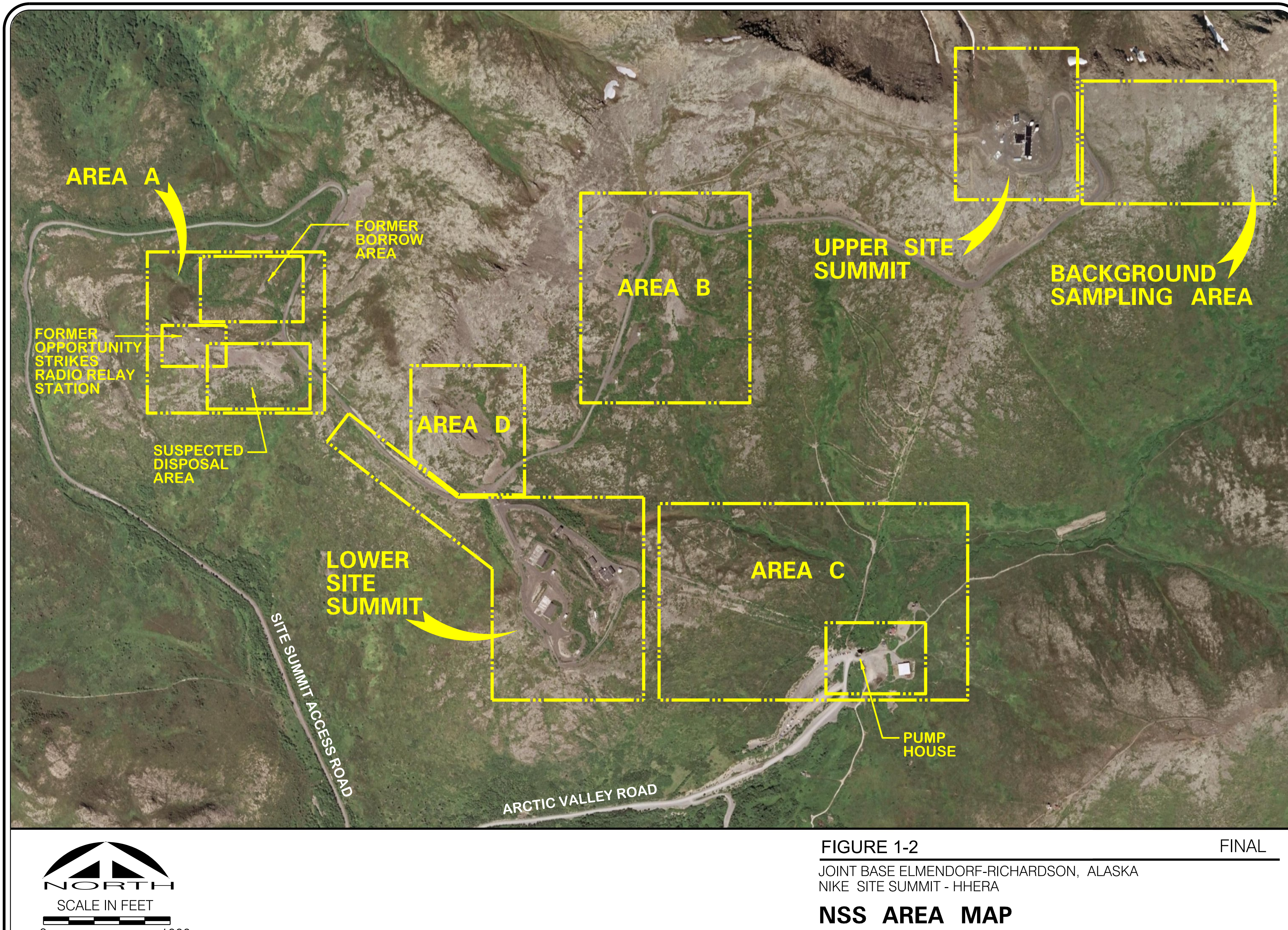

FIGURE 1-2

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JOINT BASE ELMENDORF-RICHARDSON, ALASKA
NIKE SITE SUMMIT - HHERA

NSS AREA MAP

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2.0 2010 AND 2011 SAMPLING INVESTIGATION SUMMARY

Data collected during the RFI followed procedures described in the RI Work Plan (U.S. Army, 2010). Investigation details and results are documented in detail in two separate reports: an *Analytical Data Report* (USAF, 2012a) and a RFI Report (USAF, 2012b). Analytical sample results were evaluated based on the criteria presented in Section 2.1. A summary of site characterization data used in the HHERA is presented in Section 2.2.

2.1 DATA EVALUATION

This section describes procedures for evaluating and selecting the data used in the HHERA for the four NSS Areas and downgradient off-site drainages. As part of the RFI, samples were collected from surface soil, subsurface soil, surface water, groundwater, and sediment within the four NSS Areas, as described in the Quality Assurance Project Plan (QAPP) presented in Attachment 2 of the RI Work Plan. Additional samples were collected from surface water in downgradient off-site drainages during the summer of 2011 to investigate the impacts of potentially-contaminated groundwater discharging to surface water. Media utilized in the HHERA included soil (surface and subsurface), surface water, groundwater, and sediment. Objectives and guidance for determining data quality is in accordance with ADEC's *Risk Assessment Procedures Manual* (RAPM) (ADEC, 2011a) and the EPA's *Guidance for Data Usability in Risk Assessment, Part A* (USEPA, 1992a).

For an analytical result to be usable for assessing risk, the sample collection, preparation, and analytical methods should appropriately identify the chemical form or species, and the specified sample detection limit should be at or below a concentration that is associated with toxicologically relevant levels (e.g., published risk-based screening levels or action levels).

According to the EPA (USEPA, 1989a), only field investigation analytical data that meet specific requirements are appropriate for use in a quantitative HHRA. Only data collected and analyzed at a quality control level equivalent to EPA Level III or higher (USEPA, 1988a), meets appropriate usability criteria for evaluation in a quantitative HHRA. EPA Level III data provide the following:

- Low detection limits.
- A wide range of calibrated analyses.
- Matrix recovery information.
- Laboratory process control information.
- Known precision and accuracy.

Data that meet EPA Contract Laboratory Program Level III or Level IV (or functionally equivalent) data validation criteria are not required for data used in quantitative ERAs. In some cases, Level II data may be used in a quantitative ERA, if the uncertainty in the data is known and is deemed to be acceptable.

The EPA's *Guidance for Data Usability in Risk Assessment, Part A* (USEPA, 1992a), further states:

- Data are almost always useable in the risk assessment process, as long as the uncertainty in the data and its impact on the risk assessment are thoroughly explained.
- The analytical data objective for baseline risk assessments is that uncertainty is known and acceptable, not that uncertainty be reduced to a particular level.
- Uncertainties in toxicological measures and exposure assessment are often assumed to be greater than uncertainties in environmental analytical data; thus, they are assumed to have a more significant effect on the uncertainty of the risk assessment.
- Sampling variability typically contributes much more to total error than analytical variability.
- Field methods can produce legally defensible data if appropriate method quality control is available, and if documentation is adequate.
- Qualified data can usually be used for quantitative risk assessment.
- Data qualified as U (not detected) or J (estimated concentration) can be used for risk assessment purposes.
- The primary planning objective is that uncertainty levels are acceptable, known, and quantifiable, not that uncertainty is eliminated.

All chemical data from the RFI sampling was evaluated for inclusion in the risk assessment, based on the following ADEC criteria (ADEC, 2011a):

- Analytical data sufficient for adequate site characterization is available.
- Data was collected consistent with ADEC and EPA guidance.
- Sampling and analytical procedures give accurate, chemical-specific concentrations.
- Analytical laboratory data was validated.
- Method detection limits and sample quantitation limits are below screening criteria.
- Qualified data are appropriately used and explained in the uncertainty section (i.e., discussion on potential bias from qualified data and how it might result in the over or under estimation of risk).
- Rejected data are not used for risk assessment purposes.

Additionally, in accordance with *Guidelines for Data Reporting, Data Reduction, and Treatment of Non-detect Values* (ADEC, 2008a), the following process was used to select either the field duplicate, or respective primary sample result, for use in the risk assessment:

- If both duplicate results are detected, the higher of the two detected concentrations was used.
- In the case of mixed detected and non-detect results, the detected concentration was selected.
- If all duplicate results are non-detect, then the lower detection limit (DL) was selected.

2.2 DATA SUMMARY

Data summaries for detected analytes in samples evaluated in the HHERA for the four NSS Areas are presented in **Tables 2-1** through **2-12**. Results for metals in background surface soil samples for NSS are presented in **Table 2-13**. Sample counts discussed below and presented in the tables are based on risk-assessment-specific sample classifications, and differ in some cases from totals presented in other project reports.

2.2.1 Upper Site Summit

Surface soil, subsurface soil, and groundwater samples were collected at USS in 2010 (Tables 2-1, 2-2, and 2-3, respectively). Surface water and sediment were not present during sampling. There were 23 surface soil samples collected from soil depths of 0 to 2 feet below ground surface (bgs) and analyzed for VOCs, SVOCs, diesel range organics (DRO), gasoline range organics (GRO) and residual range organics (RRO). A subset of the surface soil samples were also analyzed for inorganic compounds, energetic compounds, and polychlorinated biphenyls (PCBs). A total of 31 subsurface soil samples were collected at depths of 2 to 15 feet bgs and analyzed for VOCs, SVOCs, DRO, GRO, and RRO. A subset of the subsurface soil samples were also analyzed for inorganic compounds, energetic compounds, and PCBs. Three groundwater samples were collected at USS and analyzed for VOCs and GRO. A subset of the groundwater samples were also analyzed for SVOCs, DRO, RRO, and inorganic compounds. For inorganic analyses, both unfiltered and field-filtered groundwater samples were collected.

2.2.2 Lower Site Summit

Surface soil, subsurface soil, and groundwater samples were collected at LSS in 2010 (Tables 2-4, 2-5, and 2-6, respectively). Surface water and sediment were not present during sampling. A total of 37 surface soil samples were collected from depths of 0 to 2 feet bgs and analyzed for VOCs, SVOCs, DRO and RRO. A subset of the surface soil samples were also analyzed for GRO, inorganic compounds, energetic compounds, and Aroclors. A total of 29 subsurface soil samples were collected at depths of 2 to 15 feet bgs. Subsurface soil samples were analyzed for VOCs, SVOCs, DRO, GRO and RRO; a subset of these samples was also analyzed for inorganic compounds, energetic compounds, and PCBs. Seven groundwater samples were collected at LSS and analyzed for VOCs, SVOCs, DRO, GRO, RRO, and inorganic compounds. For inorganic analyses, both unfiltered and field-filtered groundwater samples were collected.

2.2.3 Area A

Surface soil and subsurface soil samples were collected at Area A in 2010 (Tables 2-7 and 2-8, respectively). Surface water and sediment were not present during sampling. Test pits advanced to refusal at bedrock, between 3.5 and 11 feet bgs, did not encounter groundwater. A total of 16 surface soil samples were collected from depths of 0 to 2 feet bgs and analyzed for VOCs, SVOCs, DRO, GRO, RRO, inorganic compounds, and Aroclors. A total of 15 subsurface soil samples were collected at depths of 2 to 15 feet bgs. Subsurface soil samples were analyzed for VOCs, SVOCs, DRO, GRO, RRO, inorganic compounds, and PCBs.

2.2.4 Area C

Surface soil and sediment samples were collected at Area C in 2010, and surface water samples were collected in 2010 and 2011 (Tables 2-9, 2-11, and 2-10, respectively). Subsurface soil and groundwater samples were not collected due to lack of suspected sources of contamination. Three surface soil samples were collected from depths of 0 to 2 feet bgs and analyzed for VOCs, SVOCs, DRO, GRO, RRO, inorganic compounds. Two surface water samples were collected from the Area C Pond and analyzed for VOCs, SVOCs, DRO, GRO, RRO, and inorganic compounds. For inorganic analyses, two unfiltered and two field-filtered surface water samples were collected. One sediment sample was collected from the Area C Pond from a depth of less than 6 inches and analyzed for VOCs, SVOCs, DRO, GRO, RRO, and inorganic compounds.

2.2.5 Downgradient Off-Site Drainages

Six surface water samples were collected from drainages downgradient of USS and LSS in 2011 (Table 2-12). Surface water samples collected included: two from an unnamed creek upstream of where it discharges to the Area C Pond, two from locations downstream of the weir, and two from downgradient of LSS in smaller drainages that discharge to the unnamed creek. These surface water samples were analyzed for VOCs, SVOCs, DRO, GRO, RRO, and inorganic compounds (both unfiltered and field-filtered samples).

2.2.6 Background Locations

Twelve surface soil samples collected in 2010 from locations upgradient of potential NSS sources of contamination were analyzed for Resource Conservation and Recovery Act (RCRA) 8 metals, with the addition of nickel and vanadium (Table 2-13). Background sample locations were distributed over areas of elevation and terrain similar to the NSS to determine ambient concentrations that potentially represent naturally-occurring geologic and depositional conditions for the area not attributable to site activities. Background data are provided in the *Analytical Data Report* (USAF, 2012a).

In addition to a data summary of the background data for the NSS, Table 2-13 includes 95 percent (%) UPLs for each metal. The 95% UPLs were calculated using the EPA's statistical software ProUCL Version 4.1.00 (USEPA, 2011a). The 95% UPLs are provided in Appendix C. ProUCL data distribution tests for background samples indicated that data for each analyte was normally distributed at a 5% significance level. Therefore, the 95% UPL (t) value was selected for each metal based on a normal distribution. Samples including non-detect results were assigned values based on maximum likelihood estimates (MLE), if available, and associated 95% UPLs were selected. When MLE-based values were "N/A", the ½-DL-based 95% UPL for a normal distribution was selected for use as the background value.

The ProUCL user's guide advises against the use of MLE- and DL-substituted values for datasets with less than 50 samples or 60% detection, because there is a higher degree of uncertainty in selecting a distribution for such data sets (USEPA, 2011b). Cadmium and mercury had detection frequencies of less than 50% in background data sets. Therefore, a nonparametric 95% UPL (t) value was selected for these metals. In both cases, the selected value was more conservative and closer to the maximum detected concentration.

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Table 2-1 Data Summary for Surface Soil - Detected Results at Upper Site Summit

Analyte	Surface Soil Data [a]					
	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
Inorganics						
Arsenic	14	14	100	2.12	19.1	2.16
Barium	14	14	100	0.636	1,240	72.2
Cadmium	14	14	100	0.424	23.9	0.115
Chromium, Hexavalent	4	3	75	1.40	0.890	0.160
Chromium, Total	14	14	100	0.848	63.2	16.0
Lead	14	14	100	0.424	950	8.85
Mercury	14	14	100	0.0902	0.815	0.0294
Nickel	14	14	100	0.424	47.6	14.1
Selenium	14	10	71	1.06	2.91	0.174
Silver	14	14	100	0.920	38.2	0.0434
Vanadium	14	14	100	6.36	134	18.1
Volatile Organic Compounds (VOCs)						
1,2,3-Trichlorobenzene	23	3	13	0.0407	0.0172	0.000570
1,2,4-Trichlorobenzene	23	2	8.7	0.114	0.00834	0.000610
1,2,4-Trimethylbenzene	23	8	35	0.114	0.0393	0.000430
1,3,5-Trimethylbenzene	23	3	13	0.114	0.0322	0.00617
2-Butanone (MEK)	23	2	8.7	1.14	0.00560	0.00330
4-Methyl-2-pentanone(MIBK)	23	2	8.7	1.14	0.00110	0.00100
Acetone	2	2	100	0.0150	0.0590	0.0360
Benzene	23	2	8.7	0.0178	0.000390	0.000370
Carbon disulfide	23	1	4.3	0.114	0.000170	0.000170
Dibenzofuran	23	3	13	2.26	0.424	0.144
Ethylbenzene	23	2	8.7	0.114	0.000210	0.000200
Isopropylbenzene	23	1	4.3	0.114	0.000130	0.000130
m,p-Xylene (Sum of isomers)	23	4	17	0.228	0.0302	0.000780
Methylene chloride	23	11	48	0.456	0.148	0.0267
n-Propylbenzene	23	1	4.3	0.114	0.0219	0.0219
o-Xylene	23	9	39	0.114	0.0472	0.000390
p-Isopropyltoluene	23	1	4.3	0.114	0.0137	0.0137
sec-Butylbenzene	23	1	4.3	0.114	0.000370	0.000370
Styrene	23	1	4.3	0.114	0.0144	0.0144
Toluene	23	7	30	0.114	0.0441	0.00100
Trichloroethylene (TCE)	23	3	13	0.0356	0.0173	0.00140
Xylenes, Total	21	2	10	0.342	0.0529	0.0422
Semi-Volatile Organic Compounds (SVOCs)						
4-Chloroaniline	23	2	8.7	2.26	7.80	5.52
bis(2-ethylhexyl) Phthalate	23	2	8.7	2.26	2.12	0.923

Table 2-1 Data Summary for Surface Soil - Detected Results at Upper Site Summit

Analyte	Surface Soil Data [a]					
	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	23	2	8.7	2.26	0.112	0.109
Acenaphthene	23	4	17	2.26	1.49	0.125
Acenaphthylene	23	1	4.3	2.26	0.783	0.783
Anthracene	23	8	35	2.26	2.30	0.108
Benzo(a)anthracene	23	10	43	2.26	8.61	0.0944
Benzo(a)pyrene	23	8	35	2.26	5.75	0.197
Benzo(b)fluoranthene	23	8	35	2.26	10.6	0.213
Benzo(g,h,i)perylene	23	7	30	2.26	1.96	0.103
Benzo(k)fluoranthene	23	7	30	2.26	4.48	0.0848
Chrysene	23	10	43	2.26	9.72	0.118
Dibenz(a,h)anthracene	23	5	22	1.33	2.42	0.160
Fluoranthene	23	11	48	2.26	16.0	0.105
Fluorene	23	4	17	2.26	1.14	0.138
Indeno(1,2,3-c,d)Pyrene	23	8	35	2.26	1.88	0.0957
Naphthalene	23	14	61	0.263	0.145	0.000810
Phenanthrene	23	10	43	2.26	8.93	0.124
Pyrene	23	11	48	2.26	16.6	0.145
Polychlorinated Biphenyls (PCBs)						
PCB-1260 (Aroclor 1260)	16	1	6.3	0.112	0.0214	0.0214
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	23	19	83	321	2,270	6.80
Gasoline Range Organics (GRO)	23	2	8.7	11.4	1.80	0.924
Residual Range Organics (RRO)	23	23	100	321	3,330	8.06

Notes:

[a] Surface soil samples were collected from 0 to 2 feet below ground surface.

mg/Kg - milligrams per kilogram

Table 2-2 Data Summary for Subsurface Soil - Detected Results at Upper Site Summit

Analyte	Subsurface Soil Data [a] Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
Inorganics						
Arsenic	21	21	100	1.07	6.20	1.32
Barium	21	21	100	0.321	358	21.7
Cadmium	21	21	100	0.214	0.335	0.0701
Chromium, Hexavalent	11	3	27	0.540	0.110	0.0900
Chromium, Total	21	21	100	0.428	46.8	13.2
Lead	21	21	100	0.214	50.0	2.07
Mercury	21	21	100	0.0440	0.102	0.0127
Nickel	21	21	100	0.214	29.7	13.0
Selenium	21	18	86	0.535	0.423	0.148
Silver	21	19	90	0.107	0.157	0.0314
Vanadium	21	21	100	3.21	102	34.4
Volatile Organic Compounds (VOCs)						
1,2,3-Trichlorobenzene	31	2	6.5	0.0402	0.0127	0.00888
1,2,3-Trichloropropane	31	1	3.2	0.0168	0.0247	0.0247
1,2,4-Trichlorobenzene	31	2	6.5	0.0292	0.00888	0.00646
1,2,4-Trimethylbenzene	31	12	39	0.0402	0.303	0.00845
1,2-Dibromoethane (EDB)	31	1	3.2	0.00904	0.000120	0.000120
1,2-Dichloroethane	31	2	6.5	0.00904	0.000190	0.000180
1,3,5-Trimethylbenzene	31	9	29	0.0311	0.106	0.0103
Benzene	31	5	16	0.0127	0.0291	0.00282
Ethylbenzene	31	2	6.5	0.0292	0.0309	0.00849
Isopropylbenzene	31	7	23	0.0311	0.0180	0.0102
m,p-Xylene (Sum of isomers)	31	8	26	0.0621	0.146	0.0105
Methylene chloride	31	6	19	0.116	0.0414	0.0273
n-Butylbenzene	31	3	10	0.0292	0.0696	0.0123
n-Propylbenzene	31	2	6.5	0.0292	0.0300	0.0220
o-Xylene	31	10	32	0.0402	0.0580	0.0120
p-Isopropyltoluene	31	5	16	0.0292	0.0805	0.0213
sec-Butylbenzene	31	5	16	0.0292	0.0194	0.00958
Toluene	31	11	35	0.0402	0.167	0.00551
Trichloroethylene (TCE)	31	15	48	0.0311	0.0790	0.00570
Xylenes, Total	31	9	29	0.0932	0.204	0.0178
Semi-Volatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	31	3	10	0.300	0.237	0.0994

Table 2-2 Data Summary for Subsurface Soil - Detected Results at Upper Site Summit

Analyte	Subsurface Soil Data [a]					
	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	31	4	13	0.300	0.762	0.104
Anthracene	31	2	6.5	0.300	0.865	0.181
Benzo(a)anthracene	31	3	10	0.300	3.43	0.268
Benzo(a)pyrene	31	3	10	0.276	3.71	0.231
Benzo(b)fluoranthene	31	4	13	0.300	1.53	0.111
Benzo(g,h,i)perylene	31	4	13	0.300	2.07	0.0865
Benzo(k)fluoranthene	31	3	10	0.300	5.63	0.135
Chrysene	31	5	16	1.38	8.77	0.0897
Dibenz(a,h)anthracene	31	2	6	0.276	0.846	0.273
Fluoranthene	31	5	16	0.300	3.97	0.138
Indeno(1,2,3-c,d)Pyrene	31	3	10	0.300	2.09	0.111
Naphthalene	31	11	35	0.0584	0.874	0.0140
Phenanthrene	31	5	16	0.300	1.18	0.137
Pyrene	31	6	19	0.300	3.77	0.099
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	31	19	61	222	3,690	6.45
Gasoline Range Organics (GRO)	31	14	45	2.92	12.7	0.650
Residual Range Organics (RRO)	31	24	77	211	3,340	14.2

Notes:

[a] Subsurface soil samples were collected from 2 to 15 feet below ground surface.

mg/Kg - milligrams per kilogram

Table 2-3 Data Summary for Groundwater - Detected Results at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/L)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)
	Groundwater Data					
Inorganics, Total						
Arsenic	2	2	100	0.00750	0.156	0.0730
Barium	2	2	100	0.0150	16.2	11.6
Cadmium	2	2	100	0.0100	0.00688	0.00495
Chromium, Total	2	2	100	0.0200	1.79	0.694
Lead	2	2	100	0.00500	0.653	0.189
Mercury	2	2	100	0.000200	0.000811	0.0000945
Nickel	2	2	100	0.0100	0.916	0.531
Selenium	2	1	50	0.00750	0.00343	0.00343
Silver	2	1	50	0.0100	0.00156	0.00156
Vanadium	2	2	100	0.100	2.45	1.61
Inorganics, Filtered						
Arsenic	2	1	50	0.00500	0.00480	0.00480
Barium	2	2	100	0.00300	0.136	0.0659
Chromium, Total	2	1	50	0.00400	0.00527	0.00527
Lead	2	1	50	0.00100	0.0435	0.0435
Nickel	2	2	100	0.00200	0.00489	0.00165
Vanadium	2	1	50	0.0200	0.0182	0.0182
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	3	3	100	0.00200	0.0247	0.00130
1,2-Dibromoethane (EDB)	3	1	33	0.000620	0.0000470	0.0000470
1,3,5-Trimethylbenzene	3	3	100	0.00200	0.0236	0.000660
2-Butanone (MEK)	3	1	33	0.0200	0.00709	0.00709
4-Methyl-2-pentanone(MIBK)	3	1	33	0.0200	0.00466	0.00466
Benzene	3	3	100	0.000800	0.00412	0.000940
Carbon disulfide	3	2	67	0.00400	0.00213	0.000900
Ethylbenzene	3	2	67	0.00200	0.00225	0.00182
Isopropylbenzene	3	3	100	0.00200	0.00108	0.000720
m,p-Xylene (Sum of isomers)	3	2	67	0.00400	0.0204	0.00862
n-Butylbenzene	3	1	33	0.00200	0.00134	0.00134
n-Propylbenzene	3	2	67	0.00200	0.000500	0.000340
o-Xylene	3	3	100	0.00200	0.00380	0.000910
p-Isopropyltoluene	3	3	100	0.00200	0.00229	0.00102
sec-Butylbenzene	3	1	33	0.00200	0.000820	0.000820
Toluene	3	3	100	0.00200	0.0187	0.000570
Trichloroethylene (TCE)	3	3	100	0.00200	0.00246	0.000640
Xylenes, Total	3	3	100	0.00600	0.0240	0.00127
Semi-Volatile Organic Compounds						
bis(2-ethylhexyl) Phthalate	1	1	100	0.0104	0.0115	0.0115

Table 2-3 Data Summary for Groundwater - Detected Results at Upper Site Summit

Analyte	Groundwater Data: Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/L)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	1	1	100	0.0104	0.0552	0.0552
Acenaphthene	1	1	100	0.0104	0.00500	0.00500
Anthracene	1	1	100	0.0104	0.00510	0.00510
Benzo(a)anthracene	1	1	100	0.0104	0.0168	0.0168
Benzo(a)pyrene	1	1	100	0.0104	0.0131	0.0131
Benzo(b)fluoranthene	1	1	100	0.0104	0.0142	0.0142
Benzo(g,h,i)perylene	1	1	100	0.0104	0.00540	0.00540
Benzo(k)fluoranthene	1	1	100	0.0104	0.00380	0.00380
Chrysene	1	1	100	0.0104	0.0177	0.0177
Fluoranthene	1	1	100	0.0104	0.0296	0.0296
Fluorene	1	1	100	0.0104	0.00480	0.00480
Indeno(1,2,3-c,d)Pyrene	1	1	100	0.0104	0.00510	0.00510
Naphthalene	3	3	100	0.00400	0.0112	0.00256
Phenanthrene	1	1	100	0.0104	0.0116	0.0116
Pyrene	1	1	100	0.0104	0.0329	0.0329
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	2	2	100	4.23	32.3	9.43
Gasoline Range Organics (GRO)	3	2	67	0.250	0.941	0.0888
Residual Range Organics (RRO)	2	2	100	2.65	31.0	4.14

Notes:

mg/L - milligrams per liter

Table 2-4 Data Summary for Surface Soil - Detected Results at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
	Surface Soil Data [a]					
Inorganics						
Arsenic	34	34	100	1.77	19.0	4.14
Barium	34	34	100	0.531	330	61.7
Cadmium	34	34	100	0.354	15.6	0.0789
Chromium, Hexavalent	9	5	56	12.0	6.80	0.120
Chromium, Total	34	34	100	0.707	65.0	15.6
Lead	34	34	100	0.354	208	6.14
Mercury	34	34	100	0.0742	1.92	0.0229
Nickel	34	34	100	0.354	49.1	15.9
Selenium	34	27	79	0.884	1.34	0.167
Silver	34	34	100	0.177	0.359	0.0452
Vanadium	34	34	100	5.31	59.9	31.4
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	37	1	2.7	0.127	0.0705	0.0705
1,1,2-Trichloroethane	37	1	2.7	0.0397	0.0149	0.0149
1,2,3-Trichlorobenzene	37	1	2.7	0.0763	0.000670	0.000670
1,2,4-Trichlorobenzene	37	5	14	0.127	0.000730	0.000610
1,2,4-Trimethylbenzene	37	5	14	0.254	0.0388	0.0103
1,3,5-Trimethylbenzene	37	2	5.4	0.127	0.0239	0.00853
2-Butanone (MEK)	37	5	14	1.27	0.110	0.00600
2-Hexanone	37	4	11	0.397	0.00840	0.00180
4-Methyl-2-pentanone(MIBK)	37	5	14	1.27	0.00270	0.00110
Acetone	5	5	100	0.0150	1.30	0.0670
Benzene	37	4	11	0.0198	0.000170	0.0000890
Carbon disulfide	37	4	11	0.509	0.000650	0.000140
Dibenzofuran	37	8	22	3.17	7.09	0.113
Ethylbenzene	37	2	5.4	0.127	0.0118	0.00742
Isopropylbenzene	37	1	2.7	0.127	0.0145	0.0145
m,p-Xylene (Sum of isomers)	37	5	14	0.254	0.0669	0.000190
Methylene chloride	37	10	27	0.158	0.0683	0.0261
n-Butylbenzene	37	1	2.7	0.127	0.0123	0.0123
n-Propylbenzene	37	2	5.4	0.127	0.0202	0.0156
o-Xylene	37	11	30	0.254	0.0322	0.0000700
p-Isopropyltoluene	37	1	2.7	0.127	0.0107	0.0107
sec-Butylbenzene	37	2	5.4	0.127	0.000390	0.000380
Toluene	37	9	24	0.254	0.0366	0.000120
trans-1,3-Dichloropropene	37	1	2.7	0.0397	0.000270	0.000270
Trichloroethylene (TCE)	37	11	30	0.0397	0.290	0.000380
Xylenes, Total	32	4	13	0.509	0.0992	0.0278
Semi-Volatile Organic Compounds (SVOCs)						
2,4-Dimethylphenol	37	1	2.7	3.17	0.210	0.210
Benzoic acid	37	2	5.4	19.0	1.39	1.16
Benzyl butyl phthalate	37	1	2.7	3.17	0.326	0.326
bis(2-ethylhexyl) Phthalate	37	3	8.1	3.17	5.44	0.128
Di-n-octylphthalate	37	1	2.7	3.17	0.205	0.205
Pentachlorophenol	37	1	2.7	25.4	46.5	46.5

Table 2-4 Data Summary for Surface Soil - Detected Results at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
	Surface Soil Data [a]					
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	37	5	14	2.66	2.44	0.0925
Acenaphthene	37	10	27	3.17	15.3	0.0855
Anthracene	37	12	32	3.17	26.0	0.0936
Benzo(a)anthracene	37	14	38	1.37	37.0	0.0860
Benzo(a)pyrene	37	14	38	3.17	35.7	0.0855
Benzo(b)fluoranthene	37	12	32	5.46	40.1	0.183
Benzo(g,h,i)perylene	37	13	35	3.17	17.1	0.109
Benzo(k)fluoranthene	37	11	30	5.46	10.8	0.182
Chrysene	37	12	32	5.43	43.4	0.182
Dibenz(a,h)anthracene	37	5	14	1.37	6.12	0.154
Fluoranthene	37	21	57	5.46	80.6	0.0851
Fluorene	37	9	24	3.17	15.1	0.192
Indeno(1,2,3-c,d)Pyrene	37	13	35	3.17	16.1	0.117
Naphthalene	37	16	43	1.37	2.91	0.000780
Phenanthrene	37	20	54	5.46	60.1	0.0884
Pyrene	37	21	57	5.46	78.0	0.0832
Polychlorinated Biphenyls (PCBs)						
PCB-1254 (Arocor 1254)	34	1	2.9	0.0940	0.0444	0.0444
PCB-1260 (Aroclor 1260)	34	4	12	0.0940	0.0309	0.0236
Energetics						
Perchlorate	8	3	38	0.000530	0.000430	0.000200
Total Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	37	29	78	6,200	7,360	7.81
Gasoline Range Organics (GRO)	29	10	34	12.7	14.5	0.454
Residual Range Organics (RRO)	37	36	97	6,200	24,400	11.0

Notes:

[a] Surface soil samples were collected from 0 to 2 feet below ground surface.

mg/Kg - milligrams per kilogram

Table 2-5 Data Summary for Subsurface Soil - Detected Results at Lower Site Summit

Analyte	Subsurface Soil Data [a] Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
Inorganics						
Arsenic	16	16	100	1.07	8.57	3.66
Barium	16	16	100	0.322	321	90.6
Cadmium	16	16	100	0.215	0.122	0.0828
Chromium, Hexavalent	2	2	100	0.530	0.300	0.220
Chromium, Total	16	16	100	0.429	171	15.7
Lead	16	16	100	0.215	9.87	3.49
Mercury	16	15	94	0.0440	0.211	0.0176
Nickel	16	16	100	0.215	143	14.3
Selenium	16	12	75	0.536	0.325	0.163
Silver	16	16	100	0.107	0.0945	0.0424
Vanadium	16	16	100	3.22	106	42.2
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	29	2	6.9	0.261	0.00858	0.00751
1,1,2,2-Tetrachloroethane	29	1	3.4	0.205	1.21	1.21
1,1,2-Trichloroethane	29	1	3.4	0.205	1.65	1.65
1,2,3-Trichlorobenzene	29	1	3.4	0.205	0.131	0.131
1,2,3-Trichloropropane	29	1	3.4	0.205	0.491	0.491
1,2,4-Trimethylbenzene	29	7	24	0.266	0.949	0.00732
1,2-Dibromo-3-chloropropane	29	1	3.4	0.821	3.04	3.04
1,3,5-Trimethylbenzene	29	7	24	0.266	0.407	0.00761
2-Hexanone	29	1	3.4	2.05	0.942	0.942
4-Chlorotoluene	29	1	3.4	0.261	0.501	0.501
Benzene	29	2	6.9	0.131	0.0497	0.0431
Ethylbenzene	29	4	14	0.261	0.0678	0.00731
Isopropylbenzene	29	3	10	0.261	0.0678	0.00994
m,p-Xylene (Sum of isomers)	29	5	17	0.532	0.213	0.0155
Methylene chloride	29	2	6.9	0.324	0.0354	0.0307
n-Butylbenzene	29	5	17	0.266	0.807	0.0105
n-Propylbenzene	29	1	3.4	0.261	0.0144	0.0144
o-Xylene	29	4	14	0.261	0.0189	0.0122
p-Isopropyltoluene	29	5	17	0.266	2.24	0.00837
sec-Butylbenzene	29	2	6.9	0.266	0.225	0.157
Styrene	29	2	6.9	0.261	0.119	0.0177
Toluene	29	9	31	0.261	0.437	0.0136
Trichloroethylene (TCE)	29	19	66	0.205	0.613	0.00952
Xylenes, Total	29	5	17	0.798	0.290	0.0342
Semi-Volatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	29	2	6.9	0.282	0.168	0.119

Table 2-5 Data Summary for Subsurface Soil - Detected Results at Lower Site Summit

Analyte	Subsurface Soil Data [a]					
	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	29	4	14	0.282	4.60	0.109
Acenaphthene	29	1	3.4	0.282	0.100	0.100
Anthracene	29	2	6.9	0.282	0.0923	0.0894
Benzo(a)anthracene	29	4	14	0.282	0.250	0.0907
Benzo(a)pyrene	29	3	10	0.282	0.347	0.112
Benzo(b)fluoranthene	29	3	10	0.282	0.449	0.124
Benzo(g,h,i)perylene	29	2	6.9	0.282	0.260	0.200
Benzo(k)fluoranthene	29	1	3.4	0.282	0.144	0.144
Chrysene	29	3	10	0.282	0.403	0.139
Fluoranthene	29	7	24	0.282	0.487	0.120
Fluorene	29	2	6.9	0.282	0.268	0.114
Indeno(1,2,3-c,d)Pyrene	29	2	6.9	0.282	0.233	0.192
Naphthalene	29	7	24	0.532	4.32	0.0238
Phenanthrene	29	7	24	0.282	0.453	0.0862
Pyrene	29	7	24	0.282	0.715	0.119
Polychlorinated Biphenyls (PCBs)						
PCB-1254 (Aroclor 1254)	17	1	5.9	0.0574	0.0551	0.0551
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	29	9	31	213	4,170	7.29
Gasoline Range Organics (GRO)	29	14	48	26.6	128	0.491
Residual Range Organics (RRO)	29	18	62	31.5	135	8.66

Notes:

[a] Subsurface soil samples were collected from 2 to 15 feet below ground surface.

mg/Kg - milligrams per kilogram

Table 2-6 Data Summary for Groundwater - Detected Results at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/L)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)
	Groundwater Data					
Inorganics, Total						
Arsenic	7	6	86	0.00500	0.0322	0.00874
Barium	7	7	100	0.00300	0.964	0.0372
Cadmium	7	1	14	0.00200	0.00107	0.00107
Chromium, Total	7	6	86	0.00400	0.0857	0.0170
Lead	7	6	86	0.00100	0.0333	0.00777
Mercury	7	3	43	0.000200	0.000299	0.0000744
Nickel	7	7	100	0.00200	0.0798	0.00108
Vanadium	7	6	86	0.0200	0.137	0.0329
Inorganics, Filtered						
Arsenic	7	4	57	0.00500	0.00681	0.00310
Barium	7	7	100	0.00300	0.141	0.0213
Chromium, Total	7	1	14	0.00400	0.0159	0.0159
Lead	7	1	14	0.00100	0.00608	0.00608
Nickel	7	7	100	0.00200	0.0142	0.00113
Vanadium	7	1	14	0.0200	0.0327	0.0327
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	7	1	14	0.00100	0.00686	0.00686
1,1-Dichloroethane	7	1	14	0.00100	0.000350	0.000350
1,2,4-Trimethylbenzene	7	2	29	0.0200	0.0356	0.00376
1,2-Dichloroethane	7	1	14	0.000500	0.000520	0.000520
1,3,5-Trimethylbenzene	7	2	29	0.00100	0.0164	0.00809
4-Methyl-2-pentanone(MIBK)	7	1	14	0.0100	0.00468	0.00468
Benzene	7	2	29	0.000400	0.00539	0.00111
Carbon disulfide	7	1	14	0.00200	0.000830	0.000830
Chloromethane	7	2	29	0.00100	0.000530	0.000330
Ethylbenzene	7	2	29	0.00100	0.00720	0.00713
Isopropylbenzene	7	2	29	0.00100	0.0099	0.00478
m,p-Xylene (Sum of isomers)	7	2	29	0.00200	0.0196	0.00192
Methylene chloride	7	4	57	0.00500	0.00121	0.00104
n-Butylbenzene	7	1	14	0.00100	0.00975	0.00975
n-Propylbenzene	7	2	29	0.00100	0.0117	0.00356
o-Xylene	7	2	29	0.00100	0.00313	0.000710
p-Isopropyltoluene	7	3	43	0.00100	0.00947	0.000520
sec-Butylbenzene	7	2	29	0.00100	0.0100	0.00287
t-Butylbenzene	7	2	29	0.00100	0.000770	0.000740
Toluene	7	2	29	0.00100	0.00128	0.000320
Trichloroethylene (TCE)	7	4	57	0.00100	0.0175	0.000620
Xylenes, Total	7	2	29	0.00300	0.0227	0.00263
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	7	2	29	0.0108	0.0735	0.0466
Acenaphthene	7	1	14	0.0108	0.00360	0.00360
Fluorene	7	1	14	0.0108	0.00390	0.00390
Naphthalene	7	3	43	0.0400	0.168	0.00176

Table 2-6 Data Summary for Groundwater - Detected Results at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/L)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)
	Groundwater Data					
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	7	5	71	3.37	29.4	0.403
Gasoline Range Organics (GRO)	7	2	29	0.100	0.383	0.252
Residual Range Organics (RRO)	7	5	71	0.549	1.03	0.267

Notes:

mg/L - milligrams per liter

Table 2-7 Data Summary for Surface Soil - Detected Results at Area A

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
	Surface Soil Data [a]					
Inorganics						
Arsenic	16	16	100	1.24	9.17	5.25
Barium	16	16	100	0.371	908	69.1
Cadmium	16	15	94	0.248	3.06	0.0739
Chromium, Hexavalent	10	7	70	0.630	1.98	0.130
Chromium, Total	16	16	100	0.495	57.4	29.3
Lead	16	16	100	0.248	116	5.37
Mercury	16	15	94	0.0524	0.110	0.0167
Nickel	16	16	100	0.248	52.2	27.7
Selenium	16	16	100	0.619	0.478	0.166
Silver	16	16	100	0.124	0.137	0.0339
Vanadium	16	16	100	3.71	63.3	49.1
Volatile Organic Compounds (VOCs)						
Methylene chloride	16	5	31	0.191	0.125	0.0481
Toluene	16	2	13	0.0954	0.0240	0.0115
Trichloroethylene (TCE)	16	1	6.3	0.0444	0.0818	0.0818
Semi-Volatile Organic Compounds (VOCs)						
Benzoic acid	16	5	31	48.1	1.52	1.24
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	16	15	94	3,920	19,200	22.3
Gasoline Range Organics (GRO)	16	6	38	4.77	1.71	1.09
Residual Range Organics (RRO)	16	16	100	9,350	161,000	17.0

Notes:

[a] Surface soil samples were collected from 0 to 2 feet below ground surface.

mg/Kg - milligrams per kilogram

Table 2-8 Data Summary for Subsurface Soil - Detected Results at Area A

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
	Subsurface Soil Data [a]					
Inorganics						
Arsenic	15	15	100	1.38	11.5	5.40
Barium	15	15	100	0.413	206	67.0
Cadmium	15	15	100	0.275	0.970	0.0752
Chromium, Total	15	15	100	0.550	45.1	22.3
Lead	15	15	100	0.275	15.5	4.58
Mercury	15	14	93	0.0561	0.238	0.0339
Nickel	15	15	100	0.275	39.6	25.6
Selenium	15	6	40	0.688	0.565	0.162
Silver	15	15	100	0.138	0.110	0.0390
Vanadium	15	15	100	4.13	56.6	38.1
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	15	3	20	0.0977	0.0338	0.0108
1,3,5-Trimethylbenzene	15	2	13	0.0489	0.00959	0.00830
Ethylbenzene	15	3	20	0.0489	0.0388	0.0116
m,p-Xylene (Sum of isomers)	15	3	20	0.0977	0.203	0.0373
Methylene chloride	15	4	27	0.112	0.0525	0.0268
n-Butylbenzene	15	1	6.7	0.0489	0.00789	0.00789
n-Propylbenzene	15	2	13	0.0489	0.0147	0.0119
o-Xylene	15	4	27	0.0977	0.0576	0.00962
Toluene	15	5	33	0.0977	0.0537	0.0122
Trichloroethylene (TCE)	15	5	33	0.0242	0.0866	0.0124
Xylenes, Total	15	4	27	0.195	0.261	0.0214
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	15	8	53	1,400	28,400	84.1
Gasoline Range Organics (GRO)	15	10	67	4.89	2.38	0.842
Residual Range Organics (RRO)	15	9	60	1,180	18,900	79.1

Notes:
[a] Subsurface soil samples were collected from 2 to 15 feet below ground surface.
mg/Kg - milligrams per kilogram

Table 2-9 Data Summary for Surface Soil - Detected Results at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
	Surface Soil Data [a]					
Inorganics						
Arsenic	3	3	100	1.37	7.27	4.12
Barium	3	3	100	0.405	88.9	60.8
Cadmium	3	3	100	0.270	0.168	0.108
Chromium, Total	3	3	100	0.540	35.6	28.0
Lead	3	3	100	0.275	18.5	8.44
Mercury	3	3	100	0.0582	0.119	0.0257
Nickel	3	3	100	0.270	37.7	31.9
Selenium	3	2	67	0.674	0.250	0.237
Silver	3	3	100	0.135	0.0827	0.0566
Vanadium	3	3	100	4.05	57.9	46.0
Volatile Organic Compounds (VOCs)						
Dibenzofuran	3	1	33	0.360	0.767	0.767
Toluene	3	1	33	0.0854	0.0165	0.0165
Semi-Volatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	3	1	33	0.360	0.126	0.126
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	3	1	33	0.360	0.231	0.231
Acenaphthene	3	1	33	0.360	1.14	1.14
Anthracene	3	1	33	0.360	1.24	1.24
Benzo(a)anthracene	3	1	33	0.360	1.80	1.80
Benzo(a)pyrene	3	1	33	0.360	1.62	1.62
Benzo(b)fluoranthene	3	1	33	0.360	2.08	2.08
Benzo(g,h,i)perylene	3	1	33	0.360	0.794	0.794
Benzo(k)fluoranthene	3	1	33	0.360	0.599	0.599
Chrysene	3	1	33	0.360	2.19	2.19
Fluoranthene	3	1	33	0.360	4.77	4.77
Fluorene	3	1	33	0.360	1.24	1.24
Indeno(1,2,3-c,d)Pyrene	3	1	33	0.360	0.818	0.818
Naphthalene	3	1	33	0.360	0.542	0.542
Phenanthrene	3	1	33	0.360	6.49	6.49
Pyrene	3	1	33	0.360	4.36	4.36
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	3	1	33	107	62.6	62.6
Residual Range Organics (RRO)	3	3	100	116	260	57.3

Notes:

[a] Surface soil samples were collected from 0 to 2 feet below ground surface.

mg/Kg - milligrams per kilogram

Table 2-10 Data Summary for Surface Water - Detected Results at Area C

Analyte	Surface Water Data Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/L)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)
Inorganics, Total						
Barium	2	2	100	0.00300	0.00963	0.00834
Nickel	2	1	50	0.00200	0.000889	0.000889
Inorganics, Dissolved						
Barium	2	2	100	0.00300	0.00956	0.00858
Chromium, Total	2	1	50	0.00400	0.00151	0.00151
Nickel	2	2	100	0.00200	0.00105	0.000906

Notes:
mg/L - milligrams per liter

Table 2-11 Data Summary for Sediment - Detected Results at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/Kg)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)
	Sediment Data [a]					
Inorganics						
Arsenic	1	1	100	1.07	5.77	5.77
Barium	1	1	100	0.326	53.1	53.1
Cadmium	1	1	100	0.214	0.120	0.120
Chromium, Total	1	1	100	0.427	29.7	29.7
Lead	1	1	100	0.214	11.8	11.8
Mercury	1	1	100	0.0455	0.0445	0.0445
Nickel	1	1	100	0.217	32.5	32.5
Selenium	1	1	100	0.543	0.284	0.284
Silver	1	1	100	0.107	0.0471	0.0471
Vanadium	1	1	100	3.21	50.8	50.8
Semi-Volatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	1	1	100	0.286	0.121	0.121
Di-n-octylphthalate	1	1	100	0.286	0.239	0.239
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	1	1	100	0.215	0.0707	0.0707
Chrysene	1	1	100	0.215	0.0772	0.0772
Fluoranthene	1	1	100	0.215	0.171	0.171
Phenanthrene	1	1	100	0.215	0.179	0.179
Pyrene	1	1	100	0.215	0.146	0.146
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	1	1	100	22.9	34.3	34.3
Residual Range Organics (RRO)	1	1	100	23.0	96.9	96.9

Notes:

[a] Sample collected the top 6 inches of sediment.
mg/Kg - milligrams per kilogram

Table 2-12 Data Summary for Surface Water - Detected Results at Downgradient Off-Site Drainages

Analyte	Surface Water Data: Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Reporting Limit (mg/L)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)
Inorganics, Total						
Barium	6	6	100	0.00959	0.0105	0.00585
Chromium, Total	6	5	83	0.00400	0.00206	0.00121
Nickel	6	6	100	0.00200	0.00101	0.000688
Inorganics, Dissolved						
Barium	6	6	100	0.0109	0.0123	0.00650
Chromium, Total	6	3	50	0.00100	0.000823	0.000322
Nickel	6	6	100	0.00200	0.00121	0.000753

Notes:
mg/L - milligrams per liter

Table 2-13 Metals in Background Surface Soil Samples

Analyte	Number of Samples[a]	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Mean Concentration [b, c] (mg/Kg)	Data Distribution [b]	95% UPL[b] (mg/Kg)	Background Concentration [d] (mg/Kg)
Arsenic	12	12	100	14.2	4.44	7.55	Normal	12.5 [e]	12.5
Barium	12	12	100	119	41.3	78.0	Normal	116.1 [e]	116
Cadmium	12	5	42	0.142	0.0712	0.0920	Normal	0.141 [f]	0.141
Chromium, Total	12	12	100	38.0	12.2	23.8	Normal	38.3 [e]	38.0
Lead	12	12	100	12.5	5.09	7.68	Normal	11.6 [e]	11.6
Mercury	12	6	50	0.0754	0.0243	0.0419	Normal	0.0737 [f]	0.0737
Nickel	12	12	100	28.6	8.67	20.7	Normal	31.3 [e]	28.6
Selenium	12	11	92	0.959	0.290	0.391	Normal	0.962 [g]	0.959
Silver	12	9	75	0.166	0.0337	0.0747	Normal	0.138 [h]	0.138
Vanadium	12	12	100	74.3	40.5	60.7	Normal	81.2 [e]	74.3

Notes:

% - percent

KM - Kaplan-Meier

mg/Kg - milligrams per kilogram

MLE - maximum likelihood estimate

UPL - upper prediction limit

USEPA - U.S. Environmental Protection Agency

[a] Background soil collected at 0.5 feet below ground surface from locations upgradient of potential site influences.
[b] Statistics including selection of 95% UPLs, data distributions, and mean concentrations were calculated by USEPA's ProUCL version 4.01.00 software (USEPA, 2011a)
[c] The mean corresponding to the chosen 95% UPL and associated handling of non-detects values was selected from USEPA's ProUCL version 4.01.00 software.
[d] The minimum of either the calculated 95% UPL or maximum detected concentration was selected as the background concentration for Nike Site Summit.
[e] The 95% UPL (t) for a normal distribution was selected.
[f] Although data were normally distributed according to ProUCL, a more conservative KM-based 95% UPL for nonparametric data was selected as recommended by ProUCL Technical Guide (USEPA, 2011a) for data with low detection frequency (less than 50%) and multiple reporting limits.
[g] Both an MLE-based 95% UPL and 1/2 Detection Limit 95% UPL were available for this analyte. The authors of ProUCL prefer the MLE method over the 1/2 Detection Limit for addressing non-detect values; therefore, the MLE-based value was selected.
[h] The 1/2 Detection Limit 95% UPL value was selected because no value was available for MLE-based statistics.

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3.0 CONCEPTUAL SITE MODEL

The risk assessment process begins with the development of a site-specific CSM. The CSM is a descriptive and graphical presentation of the physical, chemical, and biological relationships between sources of chemical contaminants and potentially exposed populations. As such, the CSM incorporates information on contaminant sources, migration and fate processes, complete and incomplete exposure pathways, and potentially exposed populations under current and future exposure scenarios (ADEC, 2010 and 2011a; USEPA, 1989a and 1989b).

CSMs identify and evaluate the following information:

- Contaminant sources, contaminated media, and COPC and COPEC selection criteria.
- Contaminant fate and transport pathways.
- Potentially exposed populations.
- Potentially complete exposure pathways between contaminated media and receptors.

The CSMs for the four NSS Areas and downgradient off-site drainages are described below.

3.1 CONTAMINATED MEDIA AND PRELIMINARY COPC/COPEC SELECTION

Potentially contaminated environmental media present at the four NSS Areas evaluated in this HHERA include surface and subsurface soils, limited surface water and sediment present in one small pond, surface water in downgradient off-site drainages, and groundwater. Concentrations of inorganic and organic contaminants detected in these media were compared with human health and ecological screening criteria, and lists of preliminary COPCs and COPECs were developed for evaluation in the HHERA.

Human health screening criteria include numeric criteria and standards published in State of Alaska regulations 18 Alaska Administrative Code (AAC) 75 (ADEC, 2011b) and 18 AAC 70 (ADEC, 2011c). Ecological screening criteria include numeric criteria and standards published in ADEC's *Ecoscoping Guidance* (ADEC, 2009a) and the National Oceanic and Atmospheric Administration's (NOAA's) Screening Quick Reference Table (SQuiRT) (Buchman, 2008). Detected chemicals without screening criteria were included as COPCs and COPECs.

3.1.1 Preliminary COPC Selection Methods – Human Health Screening

Medium-specific human health screening criteria are available for soil, surface water, and groundwater. Human health screening was conducted in accordance with State of Alaska regulations 18 AAC 75 (ADEC, 2011b), and the RAPM (ADEC, 2011a).

Surface and Subsurface Soil. Human health COPC screening for soil was based on comparisons of maximum concentrations of chemicals detected in surface soil (0 to 2 feet bgs) and subsurface soil (2 to 15 feet bgs) to:

- One-tenth of the ADEC Method Two Soil Cleanup Level (under 40-inch zone) for carcinogenic and noncarcinogenic chemicals compiled from Tables B1 and B2 in 18 AAC 75 (ADEC, 2011b), equivalent to a one-in-one million risk for carcinogenic chemicals and a noncancer hazard quotient of 0.1 to account for potential cumulative effects, OR
- EPA *Regional Screening Levels* (RSLs – USEPA, 2011c) for carcinogenic chemicals (equivalent to a one-in-one million risk) and one-tenth of the EPA RSLs for noncarcinogens (equivalent to a noncancer hazard quotient of 0.1), where ADEC Method Two Soil Cleanup Levels are not available.
- Site-specific background concentrations for metals at NSS.

ADEC Method Two Soil Cleanup Levels (ADEC, 2011b) are chemical-specific, applicable to surface and subsurface soils, and listed for direct contact and inhalation exposure pathways. For some chemicals, Method Two Soil Cleanup Levels are also listed for the ingestion pathway. For COPC screening, maximum concentrations of chemicals detected in soil were compared to values from the above sources. Chemicals exceeding both the COPC screening benchmarks and site-specific background levels established for the four NSS Areas (inorganics only) were identified as human health COPCs for soil. Soil screening benchmarks used in the HHRA are presented in **Table 3-1**, and results of COPC screening of detected chemicals in surface and subsurface soil are presented in Appendix D.

Surface Water. Human health COPC screening for surface water was based on comparison of maximum concentrations of chemicals detected in surface water to:

- *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (ADEC, 2008b), as referenced in 18 AAC 70 (ADEC, 2011c), OR
- One-tenth of the ADEC Method Two Groundwater Cleanup Levels for carcinogenic and noncarcinogenic chemicals compiled from Table C in 18 AAC 75.345 (ADEC, 2011b), equivalent to a one-in-one million risk for carcinogenic chemicals and a noncancer hazard quotient of 0.1 to account for potential cumulative effects, OR
- EPA RSLs for tap water (carcinogens), equivalent to a one-in-one million risk, and one-tenth of the EPA RSLs for tap water (noncarcinogens) equivalent to a noncancer hazard quotient of 0.1 to account for potential cumulative effects (USEPA, 2011c).

Chemicals exceeding either Alaska surface water criteria (ADEC, 2008b), one-tenth of the Table C Groundwater Cleanup Levels, EPA RSLs for tap water (carcinogens), or one-tenth EPA RSLs for tap water (noncarcinogens) were identified as human health COPCs for surface water. Surface water screening benchmarks used in the HHRA are presented in **Table 3-2**, and results of COPC screening of detected chemicals in surface water are presented in Appendix D.

Sediment. Numerical screening criteria are not published in 18 AAC 70 (ADEC, 2011c), 18 AAC 75 (ADEC, 2011b), or EPA RSLs (USEPA, 2011c) for evaluating potential human health impacts from exposure to chemicals in sediment. Therefore, human health COPC screening for sediment was based on comparisons of maximum concentrations of chemicals detected in sediments to:

- One-tenth of the ADEC Method Two Soil Cleanup Levels (under 40-inch zone) for carcinogenic and noncarcinogenic chemicals compiled from Tables B1 and B2 in 18 AAC 75 (ADEC, 2011b), equivalent to a one-in-one million risk for carcinogenic chemicals and a noncancer hazard quotient of 0.1 to account for potential cumulative effects, OR
- EPA RSLs (USEPA, 2011c) for carcinogenic chemicals (equivalent to a one-in-one million risk) and one-tenth of the EPA RSLs for noncarcinogens (equivalent to a noncancer hazard quotient of 0.1), where ADEC Method Two Soil Cleanup Levels are not available.

Chemicals exceeding COPC screening benchmarks from the above sources were identified as human health COPCs for sediment. Sediment screening benchmarks used in the HHRA are presented in **Table 3-3**, and results of COPC screening of detected chemicals in sediment are presented in Appendix D.

Groundwater. Human health COPC screening for groundwater was based on comparison of maximum concentrations of chemicals detected in groundwater to:

- One-tenth of the ADEC Method Two Groundwater Cleanup Levels compiled from Table C in 18 AAC 75.345 (ADEC, 2011b), equivalent to a one-in-one million risk for carcinogenic chemicals to account for potential cumulative effects, OR
- EPA RSLs for tap water (carcinogens) and one-tenth of the EPA RSLs for tap water (noncarcinogens) (USEPA, 2011c).

Chemicals one-tenth of the Table C Groundwater Cleanup Levels, the EPA RSLs for tap water (carcinogens), or one-tenth the EPA RSLs for tap water (noncarcinogens) were identified as human health COPCs for groundwater. Groundwater screening benchmarks used in the HHRA are presented in **Table 3-4**, and results of COPC screening of detected chemicals in groundwater are presented in Appendix D.

Groundwater Derived Vapor Migration to Indoor Air. Human health COPC screening for groundwater also included screening of maximum groundwater concentrations against vapor intrusion criteria:

- One-tenth of the Target Groundwater Concentrations from *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC, 2009b).

Chemicals exceeding ADEC vapor intrusion criteria (ADEC, 2009b) were identified as human health COPCs for the vapor intrusion from groundwater to indoor air pathway. Groundwater screening benchmarks for the protection of indoor air are presented in **Table 3-5**, and results of COPC screening for the vapor intrusion from groundwater pathway are presented in Appendix D.

3.1.2 Preliminary COPEC Selection Methods – Ecological Screening

Ecological COPEC screening was conducted in accordance with State of Alaska regulations (ADEC, 2008b and 2011c) and the RAPM (ADEC, 2011a), as described below.

Surface Soil. Ecological COPEC screening for soil was based on comparison of maximum concentrations of chemicals detected in surface soils to ecological benchmark criteria, based on the following hierarchy:

1. Soil Ecological Risk-Based Screening Concentration in *Ecoscoping Guidance* (ADEC, 2009a)
2. Ecological Screening Levels (ESLs) for soil (USEPA, 2005a)
3. The lower of Oak Ridge National Laboratories (ORNL) soil invertebrate benchmarks (ORNL, 1997a), or plant benchmarks (ORNL, 1997b)
4. The lower of ORNL mammalian or avian dietary wildlife benchmarks (ORNL, 1996a)

Chemicals exceeding the above ecological benchmarks AND background levels established for the four NSS Areas (inorganics only) were identified as preliminary COPECs for surface soil. Subsurface soil was not evaluated for ecological receptors, because they are unlikely to come into contact with subsurface soils for any significant length of time, as described in Section 3.4.2.1. Soil screening benchmarks for the ERA are presented in **Table 3-6**, and results of COPEC screening of detected chemicals in surface soil are presented in Appendix D.

Surface Water. Ecological COPEC screening for surface water was based on comparison of maximum concentrations of chemicals detected in surface water to ecological benchmark criteria, according to the following hierarchy:

1. Freshwater Ecological Risk-Based Screening Concentration in ADEC's *Ecoscoping Guidance* (ADEC, 2009a)
2. National Ambient Water Quality Criteria (NAWQC) – Freshwater Chronic Value (Buchman, 2008)
3. NAWQC – Marine Chronic Value (Buchman, 2008)
4. NAWQC – Freshwater Acute Value divided by 10 (Buchman, 2008)
5. NAWQC – Marine Acute Value divided by 10 (Buchman, 2008)
6. ORNL – Lowest Chronic Value observed in freshwater daphnids (ORNL, 1996b)

Chemicals exceeding the above aquatic screening benchmarks were identified as preliminary COPECs for surface water. Surface water screening benchmarks for the ERA are presented in **Table 3-7**, and results of COPEC screening of detected chemicals in surface water are presented in Appendix D.

Sediment. Ecological COPEC screening for sediment was based on comparison of maximum concentrations of chemicals detected in sediment to ecological benchmark criteria, based on the following hierarchy:

1. The lower value between the Threshold Effects Level (TEL), the Assessment and Remediation of Contaminated Sediments (ARCS) TEL, and the Probable Effects Level (PEL) in SQuiRT (Buchman, 2008)
2. Consensus-Based Freshwater Threshold Effects Concentrations (TECs) (MacDonald et al., 2000)
3. Benchmarks for sediment-associated biota (ORNL, 1997c):
    a. Ontario Ministry of Environment Lowest Effect Levels
    b. EPA Office of Solid Waste and Emergency Response Sediment Criteria
    c. NOAA Effects Range-Low Concentrations for Sediment
    d. Florida Department of Environmental Protection Threshold Effects Concentration Values

Chemicals exceeding the above sediment screening benchmarks were identified as preliminary COPECs for sediment. Sediment screening benchmarks for the ERA are presented in **Table 3-8**, and results of COPEC screening of detected chemicals in sediment are presented in Appendix D.

3.2 SCREENING RESULTS

Site- and medium-specific COPCs are presented in **Table 3-9**. Maximum detected concentrations of various metals, VOCs, polycyclic aromatic hydrocarbons (PAHs), and DRO in soil and groundwater, and SVOCs and RRO in soil, exceeded human health screening benchmarks for soil and potable water. Analytes selected as COPCs in these media were included in the quantitative HHRA, as described in Section 4. VOCs and volatile PAHs were selected as COPCs for the vapor intrusion from groundwater to indoor air pathway at LSS.

In surface water samples collected from the Area C Pond and off-site drainages, only barium, total chromium, and nickel were detected; however, none were identified as COPCs. In Area C Pond sediment, the maximum detected concentration of arsenic exceeded the soil screening benchmark for human health, and arsenic was, therefore, selected as a preliminary COPC in sediment. However, the maximum detected concentration of 5.77 milligrams per kilogram (mg/Kg) arsenic in sediment is less than the background concentration of 12.5 mg/Kg arsenic in soil developed for the NSS, and is only slightly greater than ADEC's Method Two Soil Cleanup Level of 4.5 mg/Kg for arsenic in soil. Use of ADEC's Method Two Soil Cleanup Level to evaluate potential human exposures to sediment is highly conservative. Contact between human receptors and potentially-contaminated sediment is expected to result in a lower dose than contact with potentially-contaminated soil due to the decreased potential for incidental ingestion and the absence of a dust inhalation pathway. Although exposure to potentially-contaminated sediment in the Area C Pond is a complete pathway for human health receptors, it is considered to be insignificant and was not quantitatively evaluated in the HHRA.

Site- and medium-specific COPECs are presented in **Table 3-10**. Maximum detected concentrations of various metals, VOCs, SVOCs, PAHs, total petroleum hydrocarbons, and perchlorate in surface soil exceeded ecological screening benchmarks for soil. Analytes selected as COPECs in surface soil were included in the quantitative ERA, as described in Section 5.

The maximum concentration of barium detected in the Area C Pond exceeded the surface water benchmark for water column aquatic receptors (e.g., fish, larval stage amphibians, and invertebrates). Detected concentrations of various metals, PAHs, di-n-octylphthalate, DRO, and RRO in sediment in the Area C Pond exceeded screening benchmarks for benthic ecological receptors (Table 3-10). The Area C Pond is a small, man-made impoundment. Pond features include a small concrete weir with a concrete apron, stone rip-rap upstream and downstream, and a stone-filled crib structure with stone abutments on the upstream side of the impoundment. The approximately 10-foot section of pond bottom between the concrete apron and crib abutments appears to have been formed from locally occurring in situ streambed materials. Because the impounded area is primarily man-made, spring run-off tends to flush sediment and other debris out of the pond so that sediment and gravel do not tend to collect in the bottom of it. Thus, the pond does not have the sediment characteristics of a normal aquatic habitat. No fish, amphibians, or water column invertebrates were observed in the Area C Pond during the RFI. The pond freezes completely or almost completely during the winter and does not provide sufficient refuge for aquatic receptors to overwinter, with the possible exception of some benthic invertebrates. So, the pond provides little in the way of an aquatic food source for higher trophic level receptors such as mink, kingfishers, or raptors. Therefore, potential dietary exposure pathways between the pond and upper trophic level receptors were assumed to be incomplete.

To address the concern that barium may pose a risk to terrestrial receptors using the Area C Pond as a drinking water source, the aquatic habitat goal for terrestrial receptors expressed as a drinking water level, developed by the California Regional Water Quality Control Board, was used as a secondary screening criterion for barium in surface water. The maximum concentration of barium detected in the Area C Pond, 0.00834 milligrams per liter (mg/L) in unfiltered water, is less than the 1 mg/L aquatic habitat goal for terrestrial receptors (CARWQCB, 2008). Because the maximum detected concentration of barium did not exceed this criterion, exposure to barium in surface water in the Area C Pond was not quantitatively evaluated for upper trophic level receptors in the ERA. However, because the Air Force has not performed a benthic survey on the small amount of sediment that does collect in the pond, benthic invertebrates were assumed to be potentially present. Chemicals selected as COPECs in sediment were evaluated for potential effects to benthic invertebrates, as described in Section 5.

In samples collected from downgradient off-site drainages, barium and total chromium concentrations exceeded surface water benchmarks for water column receptors (Table 3-10). The downgradient off-site drainages are seasonal. When they do have water in them, they are narrow (6 inches to 1-foot wide), high energy drainages with a steep incline and rocky bottom, and man-made barriers including culverts with significant drop-offs. In most cases, the drainages have no canopy to provide shade, cover, or shelter from predation.

Nevertheless, the drainages were assumed to provide habitat and/or foraging opportunities for benthic invertebrates, avian herbivores, avian invertivores, mammalian herbivores, and mammalian invertivores. However, the drainages were not assumed to provide habitat or foraging opportunities for avian or mammalian carnivores that prey on fish or amphibians (e.g., kingfishers or mink), because fish or amphibians are not likely to use these small, high energy, ephemeral drainages.

Photos of the Area C Pond and surrounding drainages are provided in an appendix of the RFI Report (USAF, 2012b).

3.3 CONTAMINANT FATE AND TRANSPORT PATHWAYS

3.3.1 Upper Site Summit

USS is characterized by limited vegetation and disturbed soils. Contaminants in surficial soils may be transported through surface runoff, weathering and erosion, infiltration and percolation of groundwater, and wind-blown particulates. Volatile chemicals in subsurface soils may diffuse into aboveground ambient and indoor air. There are no drainages immediately downgradient from USS, and infiltration capacity at USS typically exceeds rainfall. Thus, the extent of potentially affected surface water is limited to subsurface flow reemerging at downgradient off-site drainages. Groundwater at USS is also extremely limited. Thirteen boreholes were advanced during the RFI at USS until auger refusal at bedrock. Of these borings, only three encountered groundwater and were within former underground storage tank (UST) excavations. According to the as-builts for the site, the UST excavations extended below the surface of the bedrock in order to place the USTs at the proper depth, and the subsurface water encountered at USS appears to only exist within these bedrock depressions (i.e., a bathtub effect).

The limited groundwater present at USS within Monitoring Wells MW03USS, MW04USS, and MW12USS may potentially mobilize through fractures in bedrock or along the surface of the underlying bedrock, and emerge as surface water. Emerging surface water off the south slope of USS would be within the ADEC Drinking Water Protection Area for Surface Water, Zone C (watershed) for Upper Ship Creek. The unnamed creek present at the base of the valley represents the surface water divide, and presumed hydrologic groundwater divide between the east (NSS) and west (Arctic Valley Ski Area) ridgelines within Arctic Valley. This unnamed creek is a tributary of Upper Ship Creek, which is the basis for the Drinking Water Protection Area.

USS is approximately 1 mile upgradient from the Zone B Surface Water (1-mile buffer) Drinking Water Protection Area and 2.4 miles upgradient from the Zone A Surface Water (1,000-foot buffer) Drinking Water Protection Area, as drawn by the ADEC Drinking Water Program.

Given the topography, predominant drainages, and both vertical and horizontal distances between USS and the unnamed creek at the valley floor, it is likely that groundwater from

USS that emerges as surface water along the southern slope would be captured by the unnamed creek prior to the ponded area created by the weir at Area C.

Exposure to contaminants contained in surface water is likely to be concentrated at the Area C Pond, because it provides the largest surface area and the lowest flow conditions in immediate watershed. Surface Water Samples 10NSS001SW01ARC and 10NSS201SW01ARC were collected along the upgradient side of the weir during the RFI. Data from these samples should be considered as representative exposure concentrations for receptors that may utilize the Area C Pond.

Additionally, there are two active recreational areas adjacent to the Area C Pond and unnamed creek. To the west side of Arctic Valley Road is the Arctic Valley Trailhead and parking lot operated by the State of Alaska Department of Natural Resources, which is within Chugach State Park. On the east side of Arctic Valley Road, are the Arctic Valley Ski Area and Alpenglow Lodge operated by the Anchorage Ski Club, Inc. – also within Chugach State Park. The Arctic Valley Ski Area has a parking lot, as well as several ski lifts and generators. These facilities may also contribute contaminants from fuel and oil spills through surface water runoff within the Upper Ship Creek watershed.

3.3.2 Lower Site Summit, Area A, and Area C

Lower NSS Areas (LSS, Area A, and Area C) are characterized by disturbed soils around the facilities and crowberry/blueberry dwarf shrub tundra where soils are not disturbed. Contaminants in surficial soils may be transported through surface runoff, weathering and erosion, wind-blown particulates, infiltration and percolation of groundwater, and accumulation into the food chain via biota uptake. Volatile chemicals in surface soils, subsurface soils, and groundwater may diffuse into ambient air.

At the lower NSS Areas, surface water and sediment are seasonally present in small, ephemeral swales or gullies to the north and south of Area A, and to the south and east of LSS. Surface water to the south of Area A and LSS drains to Ship Creek far to the south. Surface water collecting on the east side of LSS drains towards a small tributary that also eventually discharges to Ship Creek. The drainages on the north side of Area A do not discharge to any major tributaries. The surface water runoff in gullies and drainages to the east of LSS and south of USS drains towards Area C and collects in a pond behind a small weir near the Pump House.

The groundwater present at LSS within Monitoring Wells MW02LSS, MW03LSS, MW04LSS, MW05LSS, MW06LSS, MW07LSS, and MW10LSS may potentially mobilize through fractures in bedrock or along the surface of the underlying bedrock, and emerge as surface water downgradient. Groundwater at LSS is expected to have limited mobility and groundwater leaving the site is likely to be captured by the three sentry wells – MW04LSS and MW05LSS to the east, and MW10LSS to the south. Emerging surface water from LSS would be within the ADEC Drinking Water Protection Area for Surface Water, Zone C (watershed) for Upper Ship Creek. The unnamed creek present at the base of the valley represents the surface water divide, and presumed hydrologic groundwater divide between the east (NSS) and west (Arctic Valley Ski Area) ridgelines within Arctic Valley. This unnamed creek is a tributary of Upper Ship Creek, which is the basis for the Drinking Water Protection Area.

LSS is approximately 0.4 miles upgradient from the Zone B Surface Water (1-mile buffer) Drinking Water Protection Area and 1.6 miles upgradient from the Zone A Surface Water (1,000-foot buffer) Drinking Water Protection Area, as drawn by the ADEC Drinking Water Program.

Given the topography, predominant drainages, and both vertical and horizontal distances between LSS and the unnamed creek at the valley floor, it is likely that groundwater that emerges as surface water along the eastern slope (Sentry Wells MW04LSS and MW05LSS) would be captured by the unnamed creek prior to the ponded area created by the weir at Area C. Groundwater that emerges as surface water along the southern slope (Sentry Well MW10LSS) would be captured by the unnamed creek downgradient of the ponded area and weir.

As mentioned previously, there are two active recreational areas adjacent to the Area C Pond and the unnamed creek. To the west side of Arctic Valley Road is the Arctic Valley Trailhead and parking lot operated by the State of Alaska Department of Natural Resources, which is within Chugach State Park. On the east side of Arctic Valley Road are the Arctic Valley Ski Area and Alpenglow Lodge operated by the Anchorage Ski Club, Inc. and also within Chugach State Park. The Arctic Valley Ski Area has a parking lot, as well as several ski lifts and generators. These facilities may contribute contaminants from fuel and oil spills through surface water runoff within the Upper Ship Creek watershed.

3.4 HUMAN HEALTH AND ECOLOGICAL CSMS

A CSM integrates available, site-specific information regarding contaminant sources, fate and transport pathways, land uses, current and future potentially exposed populations, and complete and incomplete exposure pathways. The process of CSM development is iterative and includes potential updates following additional site characterization and assessment. Preliminary human health and ecological CSMs for the four NSS Areas are described in the following subsections.

3.4.1 Human Health CSM

Human health CSMs for the four NSS Areas and downgradient off-site drainages were based, in part, on the site-specific Human Health Scoping Form prepared for NSS (Appendix A). The CSMs are graphically presented on **Figures 3-1** and **3-2** for the USS and LSS areas, respectively, and discussed below for surface and subsurface soil, sediment, surface water, and groundwater.

The four NSS Areas are owned by JBER, and operated for military personnel training. USS is currently leased to telecommunications companies, with three structures maintained at that location. Potential human receptors under current and presumed future land uses for the four

NSS Areas include site workers and site visitors. Site workers include current and future military personnel and maintenance workers for telecommunications equipment located at USS. Site visitors represent those individuals who pass through the four NSS Areas on guided tours, and trespassers who utilize NSS Areas for recreational activities. Site visitors are not permitted entrance into buildings, but are known to enter without permission. Site visitors typically come to the four NSS Areas to view historical features, hike, hunt ptarmigan, or pick berries. Any hunting or berry picking is limited to the lower sites (i.e., LSS, Area A, and Area C), because USS is very sparsely vegetated and would not support foraging activities for human receptors. While exposures from the consumption of contaminants in animal tissues and berries are potentially complete for recreators, it is unlikely that these exposures are significant. Additional potential receptors may be present at NSS in the future if land use changes. To be protective of future land use scenarios, a hypothetical future residential receptor was evaluated in addition to the current / future site worker and site visitor.

3.4.1.1 Surface and Subsurface Soils

Human receptors with a potential for exposure to soils at the four NSS Areas include current and future site workers and site visitors, and hypothetical future residents.

Current and future site workers/visitors and hypothetical future residents may be exposed to chemicals in soil via direct contact and inhalation pathways. Potentially complete direct exposure pathways include incidental ingestion of soil, dermal contact with soil, and inhalation of contaminants sorbed to dust particles (i.e., fugitive dust). Volatile chemicals are present in soil, and although NSS is located on top of a mountain where wind speeds are generally high, potential inhalation exposure to VOCs in outdoor ambient air is possible. Activities likely to result in surface and subsurface soil exposures vary by receptor. The greatest exposure to current and future site workers is likely to occur during installation, repair, or removal of telecommunications facilities. These activities may involve digging in surface and subsurface soil with hand tools or machinery. Current and future site visitors may be exposed to COPCs in surface soil as they hike and collect berries or hunt ptarmigan at the NSS. Although site visitors are unlikely to dig in to subsurface soil, it is possible that a site visitor could encounter subsurface soils brought to the surface by excavation; therefore, exposure to subsurface soil is conservatively included. Hypothetical future residents may be exposed to both surface and subsurface soils through gardening, construction, or maintenance activities. The standard definitions of surface and subsurface soil used in this HHRA are 0-2 feet bgs and 0-10 feet bgs, respectively. Although there is potential for a site worker to excavate to deeper soil, that scenario is unlikely, and would therefore not result in an extended exposure.

Current and future site workers and hypothetical future residents may also be exposed to VOCs in soil through inhalation of indoor air within current or future buildings. Volatile constituents in soil can migrate vertically to aboveground indoor air; however, modeling of indoor air VOC concentrations from soil VOC concentrations is imprecise, and soil data are not suitable for quantitative vapor intrusion assessment (ADEC, 2009b). Therefore, the soil to indoor air pathway was not quantitatively evaluated in the HHRA for NSS. Potential vapor intrusion to indoor air exposures was modeled from groundwater sampling results.

In addition to direct soil contact and inhalation pathways, current and future site visitors and hypothetical future residents may be exposed to chemicals through indirect exposure following contaminant uptake into biota and subsequent intake into human tissue through consumption of harvested plants or animals. Exposures due to plant consumption are potentially complete for receptors that forage along the borders of NSS. Blueberries and crowberries are present in sufficient quantities for foragers at the lower sites (LSS, Area A, and Area C). There is very little vegetation at USS and that which is present consists of mosses and lichens. Additionally, hunting and consumption of ptarmigan is a potentially complete exposure pathway. While consumption of contaminated plant and animal tissues is a potentially complete pathway, it is unlikely to occur frequently enough to result in significant exposures. Therefore, this pathway was not quantitatively evaluated in the HHRA for NSS.

3.4.1.2 Sediment

Current and future site visitors and hypothetical future residents may be exposed to sediment at NSS. Sediment at the four NSS Areas is limited to the Area C Pond, and small ephemeral drainages north and south of Area A, south of USS and LSS, and to the east of LSS. Potentially complete human exposures to sediment include accidental contact or hand washing in ephemeral drainages and the Area C pond, and potential wading or swimming in the Area C Pond. During the RFI conducted in the summer and fall of 2010, sediment was only encountered in the Area C Pond. As described in Section 3.2, no COPCs were identified in sediment in the Area C Pond. Therefore, sediment exposure pathways for Area C are considered to be potentially complete, but insignificant, while sediment exposure pathways for the remaining NSS Areas are considered incomplete.

3.4.1.3 Surface Water

Current and future site visitors may be exposed to chemicals in surface water at NSS via direct contact with, and inhalation of VOCs derived from, water in ephemeral drainages and in the Area C Pond. Surface water exposure pathways for ephemeral drainages at NSS are potentially complete for current and future site visitors, because small ephemeral drainages are located in close proximity to places where plant communities are established. However, no chemicals detected in samples collected from surface water of downgradient drainages were retained for evaluation in the risk assessment following screening. Therefore, surface water and sediment exposure pathways of downgradient drainages are considered to be potentially complete but insignificant (Figures 3-1 and 3-2).

The Area C Pond was created by damming, and water from the pond was historically pumped to LSS and USS where it was used as potable water. If land use changes at the four NSS Areas to allow for hypothetical future residents, it is possible that potable water would be collected from the Area C Pond. Complete exposure pathways for a hypothetical future resident exposed to surface water within the Area C Pond and downgradient off-site drainages include dermal contact and ingestion. Inhalation of VOCs is an incomplete pathway, because no VOCs were detected in surface water.

No COPCs were identified during screening of surface water samples from the Area C pond and downgradient off-site drainages (Table 3-9). Therefore, direct contact and potable use pathways for surface water in the Area C Pond and downgradient off-site drainages are considered to be potentially complete but insignificant.

3.4.1.4 Groundwater

There are no potentially complete direct exposure pathways between groundwater and current receptors at the four NSS Areas until groundwater re-emerges into small downgradient drainages. Exposure pathways to surface water in drainages are discussed in Section 3.4.1.3.

While current potable use groundwater pathways are incomplete, future potable use of groundwater is possible, and was evaluated for a hypothetical future residential scenario. Exposure to potable use groundwater occurs via ingestion, dermal contact, and inhalation of VOCs during showering. Hypothetical future exposure to groundwater was evaluated for LSS only. Groundwater was not found or was not contaminated at Area A or Area C, and was not present sufficiently at USS to support potable use wells. In February 2011, a determination of non-viable groundwater, under 18 AAC 75.350, was requested for the USS, only, based on the extremely limited amount of groundwater present. Of the 13 boreholes that were advanced to auger refusal at USS, only three encountered water. Three monitoring wells were constructed, but only two had viable amounts of water to sample and both of those had to be sampled directly using bailer with no development or purge due to the limited volume of water. The 350 determination was denied by ADEC based on uncertainties in off-site migration of groundwater emerging as surface water down slope of USS. However, although the 350 determination was denied, evaluation of potable use of groundwater at USS was not required for this HHRA.

Several buildings remain at NSS and, under residential land use, additional buildings could be constructed. Inhalation of volatile constituents in groundwater following volatilization and migration to aboveground indoor air is a potentially complete pathway for current and future site workers and hypothetical future residents at LSS. Although volatile chemicals were detected in groundwater at USS, the extent of affected subsurface water is limited, as described in Section 3.3.1. As a result, any contaminated groundwater is presumed to be insufficient to be a source of volatile contaminants for vapor intrusion to indoor air, and the inhalation of indoor air pathway is incomplete for current and future receptors at USS.

3.4.2 Ecological CSM

The CSM for ecological receptors is graphically presented in **Figure 3-3**, and is discussed below in regard to potential surface soil, sediment, and surface water exposure pathways. Ecological receptors are not likely to come in contact with subsurface soil or groundwater; therefore, exposure pathways associated with these media are not considered to be complete for ecological receptors associated with the four NSS Areas. The ecological CSM for NSS was based, in part, on the site-specific Ecoscoping Form prepared for the NSS (Appendix B).

A variety of herbivorous, carnivorous, or omnivorous birds and mammals occur in the vicinity of Mount Gordon Lyon, which is located on the western border of Chugach State Park. Ecological species include, but are not limited to: ptarmigan (*Lagopus* sp.), water pipit (*Anthus spinoletta*), golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), Dall sheep (*Ovis dalli*), brown bear (*Ursus arctos*), black bear (*Ursus americanus*), coyote (*Canis latrans*), wolf (*Canis lupus*), shrews (*Sorex* sp.), and voles (*Microtus* sp.). Plants and animals occurring or potentially occurring at NSS are listed in **Tables 3-11** through **3-15**. While most of these receptors would not use the four NSS Areas exclusively, some receptors may find the four NSS Areas to be within a range for foraging or migration activities. Small mammals and birds with limited foraging ranges may potentially use NSS exclusively. Larger home range species would likely use the higher quality habitat around the edges of the four NSS Areas preferentially, because it is less disturbed.

Receptors included in the ecological CSM (Figure 3-3) were based on receptor classes presented in the Default Endpoint Species User's Guide (ADEC, 1999a). Those ecological receptor classes that are applicable to the four NSS Areas included: freshwater aquatic and terrestrial invertebrates, terrestrial mammalian herbivores, terrestrial avian herbivores, terrestrial mammalian invertivores, terrestrial avian invertivores, terrestrial mammalian carnivores, terrestrial avian carnivores, benthic invertebrates, semi-aquatic avian herbivores, semi-aquatic mammalian herbivores, semi-aquatic avian invertivores, and freshwater avian invertivores. For other ecological niches presented in the User's Guide (ADEC, 1999a), sufficient habitat is not present at the four NSS Areas to be considered further (i.e., marine aquatic receptors and terrestrial amphibians).

Large portions of the four NSS Areas evaluated in this ERA are disturbed due to years of use as military facilities. However, open spaces in and around the developed areas are vegetated, and provide sufficient habitat for several ecological species during the months of the year that NSS is not snow-covered.

3.4.2.1 Surface Soils

Organisms foraging or living in the four NSS Areas may come into contact with contaminants in soil. As presented on Figure 3-3, terrestrial receptors at NSS have potentially complete direct contact and inhalation exposure pathways for contaminants in soil, including incidental ingestion, dermal absorption, and inhalation of soil particulates and soil-derived VOCs. However, the dermal contact pathway is considered insignificant for terrestrial receptors, with the exception of terrestrial invertebrates. Chemicals in soil are expected to accumulate on feathers or fur rather than skin, and accumulation is reduced during grooming; for this reason, the contribution of dermal exposure to overall exposure is considered to be minimal compared to ingestion pathways. In addition, while volatile chemicals are present in soils at NSS, inhalation of contaminants in ambient air is expected to be minor when compared to ingestion of soil due to dilution and wind dispersion. Therefore, the inhalation exposure pathway is considered to be insignificant for terrestrial receptors living and foraging above ground.

Inhalation of volatile contaminants in burrow air is also not likely at the four NSS Areas. No evidence of burrowing was found within the compacted gravel pads upon which all facilities were located at USS, LSS, and Area A. Similarly, limited area for burrowing is available at Area C, which consists mainly of the pump house and man-made Area C Pond. Burrowing rodents are more likely to burrow into the organic mat/tundra on the slopes rather than the flat surfaces of the gravel pads. Arctic ground squirrels (*spermophilus parryi*) were noted to be present along the slopes within the boundaries of NSS, and their burrows were evident across the faces of the slopes. However, as there is virtually no vegetation across the pads at USS, LSS, or Area A, it is unlikely that rodents would burrow in these areas.

Indirect uptake of contaminants from soil through bioaccumulation in prey species and subsequent food chain transfer is a potentially complete exposure pathway for organisms foraging within the four NSS Areas. In general, contaminants such as PAHs and several species of metals, have been identified as potentially bioaccumulative according to Appendix C of the Alaska *Ecoscoping Guidance* (ADEC, 2009a).

Exposure pathways between ecological receptors and subsurface soil at the NSS are considered to be incomplete. Invertivorous or omnivorous avian species at the NSS feed on insects primarily found on the surface or within the upper 6 inches of soil. Mammalian species living near the NSS generally forage and burrow within the upper 1 to 2 feet of soil. Voles and shrews live at the ground surface and in burrows through leaf litter or shallow soil, or under the snow during the winter. Arctic ground squirrels may construct deeper burrows; however, the depth to bedrock is shallow across much of the NSS, and most of the four NSS Areas are located on compacted gravel pads rather than soil, limiting opportunities for extensive deep burrow development at the site.

3.4.2.2 Groundwater

Groundwater is potentially in communication with surface water and sediment, but is not directly accessible to ecological receptors at NSS. Therefore, direct groundwater pathways are incomplete, and ecological exposures to potentially contaminated groundwater were assessed through the evaluation of downgradient surface water samples.

3.4.2.3 Surface Water and Sediment

Apparent ephemeral surface water drainages along the slopes of USS, LSS, and Area A are visible from aerial photographs. However, no surface water was noted running off from these areas immediately downgradient during the RFI.

USS has two visible drainages. The predominant drainage is toward the north and eventually drains into Eagle River, approximately 2.8 miles away. The secondary drainage is toward the south along the utility corridor that runs from USS to the Pump House at Area C. The secondary, southward drainage from USS joins the eastward drainage from LSS before draining into the unnamed creek that passes through Area C and eventually to Ship Creek.

LSS has four visible drainages. The predominant drainage is from the LSS pad toward the east where it drains into the unnamed creek prior to passing through the weir at Area C, eventually discharging into Ship Creek. There are two secondary drainages from the LSS pad that head south and west-southwest, and appear to drain into the unnamed creek prior to its drainage into Ship Creek. The fourth drainage from LSS occurs in the vicinity of the septic outfall and leads away from the LSS site in a west-northwesterly direction and does not appear to discharge to any major tributaries.

Area A has three visible drainages – north, east-southeast, and west-southwest – none appear to be predominant. The drainage to the north appears to follow the former switchback road that serviced Area A (Opportunity Strikes Radio Relay Station) prior to construction of the road that is now used to access Area A, LSS, and USS. The drainage to the east-southeast joins the LSS drainage in the vicinity of the LSS septic outfall. The drainage to the west-southwest splits into two directions (westerly and southerly) prior to reaching the NSS access road below. All of the drainages from Area A appear to drain northwesterly and do not discharge to any major tributaries.

Area C has a single drainage that is fed from runoff predominantly from the south slopes of Mount Gordon Lyon and Rendezvous Peak. A small weir retains runoff in a pond that is present year-round at Area C, which discharges to Ship Creek approximately 1.8 miles away. Although no aquatic organisms were observed in the Area C Pond during the RFI, there is a potential for benthic invertebrates to be present in the Area C Pond. Therefore, exposure of benthic invertebrates to contaminants in sediment at Area C is considered to be a complete pathway.

Terrestrial organisms at NSS have potential for direct contact with surface water and saturated soil in ephemeral drainages leaving the four NSS Areas. Direct contact exposure pathways include ingestion and dermal absorption of contaminants in surface water and saturated soil. Due to the ephemeral nature of drainages at NSS, and the fact that water was not available for sampling in any drainage during the early summer runoff or late summer rain, exposure to contaminants in surface water runoff from the four NSS Areas is considered to be incomplete. Indirect exposures via the uptake of contaminants through the food chain are also incomplete for the drainages due to their ephemeral nature, and the Area C Pond due to its limited size and the fact that it completely freezes over in the winter. Upper trophic level receptors may use the Area C Pond as a drinking water source; however, as described in Section 3.2, no chemicals were retained as COPECs following screening of analytes detected in surface water. Therefore, no exposure pathways associated with surface water in the Area C Pond was quantitatively evaluated in the ERA.

Drainages along the slopes below USS and LSS are too steep and small to support aquatic receptors. However, as groundwater begins to remerge in downslope areas near the unnamed creek, habitat increases sufficiently to potentially support aquatic-dependant receptors. Therefore, exposure pathways between aquatic receptors and surface water and sediment, including direct contact and food chain transfer, are potentially complete.

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Table 3-1 Human Health COPC Screening Criteria for Soil

Analyte	CAS Number	Regulatory Criterion[a] (mg/Kg)		Screening Benchmark[b] (mg/Kg)	Cancer / Noncancer	Source
Inorganics						
Arsenic	7440-38-2	4.5		0.45	cancer	ADEC, 2011b
Barium	7440-39-3	20,300		2,030	noncancer	ADEC, 2011b
Cadmium	7440-43-9	79		7.9	cancer	ADEC, 2011b
Chromium, Hexavalent	18540-29-9	300	c	30	noncancer	ADEC, 2011b
Chromium, Trivalent	16065-83-1	152,000	c	15,200	noncancer	ADEC, 2011b
Chromium, Total	7440-47-3	300	c	30	noncancer	ADEC, 2011b
Lead	7439-92-1	400	d	400	cancer	ADEC, 2011b
Mercury	7439-97-6	18		1.8	noncancer	ADEC, 2011b
Nickel	7440-02-0	2,000		200	noncancer	ADEC, 2011b
Selenium	7782-49-2	510		51	noncancer	ADEC, 2011b
Silver	7440-22-4	510		51	noncancer	ADEC, 2011b
Vanadium	7440-62-2	710		71	noncancer	ADEC, 2011b
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	71-55-6	360		36	noncancer	ADEC, 2011b
1,1,2,2-Tetrachloroethane	79-34-5	5.5		0.55	cancer	ADEC, 2011b
1,1,2-Trichloroethane	79-00-5	11		1.1	cancer	ADEC, 2011b
1,2,3-Trichlorobenzene	87-61-6	49		4.9	noncancer	USEPA, 2011c
1,2,3-Trichloropropane	96-18-4	0.17		0.017	cancer	ADEC, 2011b
1,2,4-Trichlorobenzene	120-82-1	41		4.1	noncancer	ADEC, 2011b
1,2,4-Trimethylbenzene	95-63-6	49		4.9	noncancer	ADEC, 2011b
1,2-Dibromo-3-chloropropane	96-12-8	0.0054		0.0054	cancer	USEPA, 2011c
1,2-Dibromoethane (EDB)	106-93-4	0.60		0.060	cancer	ADEC, 2011b
1,2-Dichloroethane	107-06-2	4.8		0.48	cancer	ADEC, 2011b
1,3,5-Trimethylbenzene	108-67-8	42		4.2	noncancer	ADEC, 2011b
2-Butanone (MEK)	78-93-3	23,300		2,330	noncancer	ADEC, 2011b
2-Hexanone	591-78-6	210		21	noncancer	USEPA, 2011c
4-Chlorotoluene	106-43-4	1,600		160	noncancer	USEPA, 2011c
4-Methyl-2-pentanone(MIBK)	108-10-1	2,100		210	noncancer	ADEC, 2011b
Acetone	67-64-1	68,600		6,860	noncancer	ADEC, 2011b
Benzene	71-43-2	11		1.1	cancer	ADEC, 2011b
Carbon Disulfide	75-15-0	250		25	noncancer	ADEC, 2011b
Dibenzofuran	132-64-9	200		20	noncancer	ADEC, 2011b
Ethylbenzene	100-41-4	110		11	cancer	ADEC, 2011b
Isopropylbenzene	98-82-8	62		6.2	noncancer	ADEC, 2011b
m,p-Xylene (Sum of isomers)	108-38-3/106-42-3	63	e	6.3	noncancer	ADEC, 2011b
Methylene chloride	75-09-2	160		16	cancer	ADEC, 2011b
n-Butylbenzene	104-51-8	42		4.2	noncancer	ADEC, 2011b
n-Propylbenzene	103-65-1	42		4.2	noncancer	ADEC, 2011b
o-Xylene	95-47-6	63	e	6.3	noncancer	ADEC, 2011b
p-Isopropyltoluene	99-87-6	62	f	6.2	noncancer	ADEC, 2011b
sec-Butylbenzene	135-98-8	41		4.1	noncancer	ADEC, 2011b
Styrene	100-42-5	200		20	noncancer	ADEC, 2011b
Toluene	108-88-3	220		22	noncancer	ADEC, 2011b
trans-1,3-Dichloropropene	542-75-6	83		8.3	cancer	ADEC, 2011b
Trichloroethylene (TCE)	79-01-6	0.57		0.057	cancer	ADEC, 2011b
Xylenes, Total	1330-20-7	63		6.3	noncancer	ADEC, 2011b

Table 3-1 Human Health COPC Screening Criteria for Soil

Analyte	CAS Number	Regulatory Criterion[a] (mg/Kg)	Screening Benchmark[b] (mg/Kg)	Cancer / Noncancer	Source
Semi-Volatile Organic Compounds (SVOCs)					
2,4-Dimethylphenol	105-67-9	1,300	130	noncancer	ADEC, 2011b
4-Chloroaniline	106-47-8	90	9.0	cancer	ADEC, 2011b
Benzoic Acid	65-85-0	317,000	31,700	noncancer	ADEC, 2011b
Benzyl butyl phthalate	85-68-7	2,900	290	cancer	ADEC, 2011b
bis(2-ethylhexyl) Phthalate	117-81-7	220	22	cancer	ADEC, 2011b
Di-n-octylphthalate	117-84-0	3,100	310	noncancer	ADEC, 2011b
Pentachlorophenol	87-86-5	39	3.9	cancer	ADEC, 2011b
Polycyclic Aromatic Hydrocarbons (PAHs)					
2-Methylnaphthalene	91-57-6	280	28	noncancer	ADEC, 2011b
Acenaphthene	83-32-9	2,800	280	noncancer	ADEC, 2011b
Acenaphthylene	208-96-8	2,800	280	noncancer	ADEC, 2011b
Anthracene	120-12-7	20,600	2,060	noncancer	ADEC, 2011b
Benzo(a)anthracene	56-55-3	4.9	0.49	cancer	ADEC, 2011b
Benzo(a)pyrene	50-32-8	0.49	0.049	cancer	ADEC, 2011b
Benzo(b)fluoranthene	205-99-2	4.9	0.49	cancer	ADEC, 2011b
Benzo(g,h,i)perylene	191-24-2	1,400	140	noncancer	ADEC, 2011b
Benzo(k)fluoranthene	207-08-9	49	4.9	cancer	ADEC, 2011b
Chrysene	218-01-9	490	49	cancer	ADEC, 2011b
Dibenz(a,h)anthracene	53-70-3	0.49	0.049	cancer	ADEC, 2011b
Fluoranthene	206-44-0	1,900	190	noncancer	ADEC, 2011b
Fluorene	86-73-7	2,300	230	noncancer	ADEC, 2011b
Indeno(1,2,3-c,d)Pyrene	193-39-5	4.9	0.49	cancer	ADEC, 2011b
Naphthalene	91-20-3	28	2.8	noncancer	ADEC, 2011b
Phenanthrene	85-01-8	20,600	2,060	noncancer	ADEC, 2011b
Pyrene	129-00-0	1,400	140	noncancer	ADEC, 2011b
Polychlorinated Biphenyls (PCBs)					
PCB-1254 (Aroclor 1254)	11097-69-1	1 [g]	0.1	cancer	ADEC, 2011b
PCB-1260 (Aroclor 1260)	11096-82-5	1 [g]	0.1	cancer	ADEC, 2011b
Energetics					
Perchlorate	7790-98-9	71	7.1	noncancer	ADEC, 2011b
Total Petroleum Hydrocarbons (TPHs)					
Diesel Range Organics (DRO)	na	10,250 [h]	10,250	noncancer	ADEC, 2011b
Gasoline Range Organics (GRO)	na	1,400 [h]	1,400	noncancer	ADEC, 2011b
Residual Range Organics (RRO)	na	10,000 [h]	10,000	noncancer	ADEC, 2011b

Table 3-1 Human Health COPC Screening Criteria for Soil

Analyte	CAS Number	Regulatory Criterion[a] (mg/Kg)	Screening Benchmark[b] (mg/Kg)	Cancer / Noncancer	Source

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - U.S. Environmental Protection Agency

[a] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[b] Benchmark Criteria are based on regulatory cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[c] Total chromium data will be compared to the soil screening benchmark for trivalent chromium at sites where hexavalent chromium data are available. For sites where hexavalent chromium data are unavailable, total chromium data will be compared to the soil screening benchmark for total chromium, which is equivalent to the soil screening benchmark for hexavalent chromium.

[d] Lead is not included in the cumulative hazard estimate (ADEC, 2008c); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008c).

[e] Total xylenes used as a surrogate.

[f] Isopropylbenzene used as a surrogate.

[g] PCBs used as a surrogate.

[h] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

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Table 3-2 Human Health COPC Screening Criteria for Surface Water

Analyte	CAS Number	Regulatory Criterion[a] (mg/L)	Screening Benchmark[b] (mg/L)	Cancer / Noncancer	Source
Inorganics					
Barium	7440-39-3	2.0	0.20	noncancer	ADEC, 2011b
Chromium, Total	7440-47-3	0.10	0.010	noncancer	ADEC, 2011b
Nickel	7440-02-0	0.30	0.030	noncancer	USEPA, 2011c

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/L - milligrams per liter
USEPA - U.S. Environmental Protection Agency

[a] Regulatory Criteria selected from the following sources, such that the lowest derived screening benchmark equal to:

1. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances (ADEC, 2008b) as referenced in 18 AAC 70 (ADEC, 2011c).
2. One-tenth of the 18 AAC 75, Table C Groundwater Cleanup Levels (ADEC, 2011b).
3. Regional Screening Levels for Chemical (RSLs) Contaminants at Superfund Sites - Tap Water for carcinogenic chemicals, and one-tenth of the Tap Water RSLs for noncarcinogenic chemicals (USEPA, 2011c).

was used for COPC screening.

[b] Benchmark Criteria are based on cancer risk of 1×10^{-6} or a hazard index of 0.1.

Table 3-3 Human Health COPC Screening Criteria for Sediment

Analyte	CAS Number	Regulatory Criterion[a] (mg/Kg)		Screening Benchmark[b] (mg/Kg)	Cancer/ Noncancer	Source
Inorganics						
Arsenic	7440-38-2	4.5		0.45	cancer	ADEC, 2011b
Barium	7440-39-3	20,300		2,030	noncancer	ADEC, 2011b
Cadmium	7440-43-9	79		7.9	cancer	ADEC, 2011b
Chromium, Total	7440-47-3	300		30	noncancer	ADEC, 2011b
Lead	7439-92-1	400	c	400	cancer	ADEC, 2011b
Mercury	7439-97-6	18		1.8	noncancer	ADEC, 2011b
Nickel	7440-02-0	2,000		200	noncancer	ADEC, 2011b
Selenium	7782-49-2	510		51	noncancer	ADEC, 2011b
Silver	7440-22-4	510		51	noncancer	ADEC, 2011b
Vanadium	7440-62-2	710		71	noncancer	ADEC, 2011b
Semi-Volatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	117-81-7	220		22	cancer	ADEC, 2011b
Di-n-octylphthalate	117-84-0	3,100		310	noncancer	ADEC, 2011b
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	56-55-3	4.9		0.49	cancer	ADEC, 2011b
Chrysene	218-01-9	490		49	cancer	ADEC, 2011b
Fluoranthene	206-44-0	1,900		190	noncancer	ADEC, 2011b
Phenanthrene	85-01-8	20,600		2,060	noncancer	ADEC, 2011b
Pyrene	129-00-0	1,400		140	noncancer	ADEC, 2011b
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	na	10,250	d	10,250	noncancer	ADEC, 2011b
Residual Range Organics (RRO)	na	10,000	d	10,000	noncancer	ADEC, 2011b

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - U.S. Environmental Protection Agency

[a] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[b] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[c] Lead is not included in the cumulative hazard estimate (ADEC, 2008c); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008c).

[d] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table 3-4 Human Health COPC Screening Criteria for Groundwater

Analyte	CAS Number	Regulatory Criterion[a] (mg/L)		Screening Benchmark[b] (mg/L)	Cancer / Noncancer	Source
Inorganics						
Arsenic	7440-38-2	0.010		0.0010	cancer	ADEC, 2011b
Barium	7440-39-3	2.0		0.20	noncancer	ADEC, 2011b
Cadmium	7440-43-9	0.005		0.0005	cancer	ADEC, 2011b
Chromium, Total	7440-47-3	0.10		0.010	noncancer	ADEC, 2011b
Lead	7439-92-1	0.015	c	0.015	cancer	ADEC, 2011b
Mercury	7439-97-6	0.002		0.0002	noncancer	ADEC, 2011b
Nickel	7440-02-0	0.10		0.010	noncancer	ADEC, 2011b
Vanadium	7440-62-2	0.26		0.026	noncancer	ADEC, 2011b
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	71-55-6	0.2		0.02	noncancer	ADEC, 2011b
1,1-Dichloroethane	75-34-3	7.3		0.73	cancer	ADEC, 2011b
1,2,4-Trimethylbenzene	95-63-6	1.8		0.18	noncancer	ADEC, 2011b
1,2-Dichloroethane	107-06-2	0.005		0.0005	cancer	ADEC, 2011b
1,3,5-Trimethylbenzene	108-67-8	1.8		0.18	noncancer	ADEC, 2011b
4-Methyl-2-pentanone(MIBK)	108-10-1	2.9		0.29	noncancer	ADEC, 2011b
Benzene	71-43-2	0.005		0.0005	cancer	ADEC, 2011b
Carbon Disulfide	75-15-0	3.7		0.37	noncancer	ADEC, 2011b
Chloromethane	74-87-3	0.066		0.0066	cancer	ADEC, 2011b
Ethylbenzene	100-41-4	0.7		0.07	cancer	ADEC, 2011b
Isopropylbenzene	98-82-8	3.7		0.37	noncancer	ADEC, 2011b
m,p-Xylene (Sum of isomers)	108-38-3/106-42-3	10	d	1.0	noncancer	ADEC, 2011b
Methylene Chloride	75-09-2	0.005		0.0005	cancer	ADEC, 2011b
n-Butylbenzene	104-51-8	0.37		0.037	noncancer	ADEC, 2011b
n-Propylbenzene	103-65-1	0.37		0.037	noncancer	ADEC, 2011b
o-Xylene	95-47-6	10	d	1.0	noncancer	ADEC, 2011b
p-Isopropyltoluene	99-87-6	3.7	e	0.37	noncancer	ADEC, 2011b
sec-Butylbenzene	135-98-8	0.37		0.037	noncancer	ADEC, 2011b
t-Butylbenzene	98-06-6	0.37		0.037	noncancer	ADEC, 2011b
Toluene	108-88-3	1.0		0.10	noncancer	ADEC, 2011b
Xylenes, Total	1330-20-7	10		1.0	noncancer	ADEC, 2011b
Trichloroethylene (TCE)	79-01-6	0.005		0.0005	cancer	ADEC, 2011b
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	91-57-6	0.15		0.015	noncancer	ADEC, 2011b
Acenaphthene	83-32-9	2.2		0.22	noncancer	ADEC, 2011b
Fluorene	86-73-7	1.5		0.15	noncancer	ADEC, 2011b
Naphthalene	91-20-3	0.73		0.073	noncancer	ADEC, 2011b
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	na	1.5	f	1.5	noncancer	ADEC, 2011b
Gasoline Range Organics (GRO)	na	2.2	f	2.2	noncancer	ADEC, 2011b
Residual Range Organics (RRO)	na	1.1	f	1.1	noncancer	ADEC, 2011b

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/L - milligrams per liter
na - not available
USEPA - U.S. Environmental Protection Agency

Table 3-4 Human Health COPC Screening Criteria for Groundwater

Analyte	CAS Number	Regulatory Criterion[a] (mg/L)	Screening Benchmark[b] (mg/L)	Cancer / Noncancer	Source

[a] Regulatory Criteria are derived from the following hierarchy:
1. Minimum of the Table C Groundwater Cleanup Levels listed in 18 AAC 75 (ADEC, 2011b).
2. Regional Screening Levels for Chemical Contaminants at Superfund Sites - Tap Water (USEPA, 2011c).

[b] Benchmark Criteria are based on a cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[c] Lead is not included in the cumulative hazard estimate (ADEC, 2008c); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008c).

[d] Total xylenes used as a surrogate.

[e] Isopropylbenzene used as a surrogate.

[f] Petroleum hydrocarbons are not included in the cumulative hazard calculations; therefore, the regulatory criteria were not divided by 10.

Table 3-5 Human Health COPC Screening Criteria for Groundwater for Protection of Indoor Air

Analyte	CAS Number	Regulatory Criterion[a] (mg/L)	Screening Benchmark[b] (mg/L)	Cancer / Noncancer	Source
Inorganics					
Arsenic	7440-38-2	NA [c]	NA	ADEC, 2011b	NA
Barium	7440-39-3	NA [c]	NA	ADEC, 2011b	NA
Cadmium	7440-43-9	NA [c]	NA	ADEC, 2011b	NA
Chromium, Total	7440-47-3	NA [c]	NA	ADEC, 2011b	NA
Fluoranthene	206-44-0	NA [c]	NA	ADEC, 2011b	NA
Lead	7439-92-1	NA [c]	NA	ADEC, 2011b	NA
Mercury	7439-97-6	NA [c]	NA	ADEC, 2011b	NA
Nickel	7440-02-0	NA [c]	NA	ADEC, 2011b	NA
Selenium	7782-49-2	NA [c]	NA	ADEC, 2011b	NA
Silver	7440-22-4	NA [c]	NA	ADEC, 2011b	NA
Vanadium	7440-62-2	NA [c]	NA	ADEC, 2011b	NA
Volatile Organic Compounds (VOCs)					
1,1,1-Trichloroethane	71-55-6	3.3	0.33	noncancer	ADEC, 2009c
1,1-Dichloroethane	75-34-3	2.3	0.23	noncancer	ADEC, 2009c
1,2,4-Trimethylbenzene	95-63-6	0.029	0.0029	noncancer	ADEC, 2009c
1,2-Dibromoethane (EDB)	106-93-4	0.0015	0.00015	cancer	ADEC, 2009c
1,2-Dichloroethane	107-06-2	0.019	0.0019	cancer	ADEC, 2009c
1,3,5-Trimethylbenzene	108-67-8	0.02	0.0020	noncancer	ADEC, 2009c
2-Butanone (MEK)	78-93-3	2,240	224	noncancer	ADEC, 2009c
4-Methyl-2-pentanone(MIBK)	108-10-1	555	55.5	noncancer	ADEC, 2009c
Benzene	71-43-2	0.014	0.0014	cancer	ADEC, 2009c
Carbon Disulfide	75-15-0	1.2	0.12	noncancer	ADEC, 2009c
Chloromethane	74-87-3	0.037	0.0037	cancer	ADEC, 2009c
Ethylbenzene	100-41-4	0.069	0.0069	cancer	ADEC, 2009c
Isopropylbenzene	98-82-8	0.89	0.089	noncancer	ADEC, 2009c
m,p-Xylene (Sum of isomers)	108-38-3/106-42-3	0.38 [d]	0.038	noncancer	ADEC, 2009c
Methylene Chloride	75-09-2	0.39	0.039	cancer	ADEC, 2009c
n-Butylbenzene	104-51-8	0.068	0.0068	noncancer	ADEC, 2009c
n-Propylbenzene	103-65-1	0.068	0.0068	noncancer	ADEC, 2009c
o-Xylene	95-47-6	0.38 [d]	0.038	noncancer	ADEC, 2009c
p-Isopropyltoluene	99-87-6	0.89 [e]	0.089	noncancer	ADEC, 2009c
sec-Butylbenzene	135-98-8	0.048	0.0048	noncancer	ADEC, 2009c
t-Butylbenzene	98-06-6	0.071	0.0071	noncancer	ADEC, 2009c
Toluene	108-88-3	19.2	1.92	noncancer	ADEC, 2009c
Xylenes, Total	1330-20-7	0.38	0.038	noncancer	ADEC, 2009c
Trichloroethylene (TCE)	79-01-6	0.00055	0.000055	cancer	ADEC, 2009c
Semi-Volatile Organic Compounds (SVOCs)					
bis(2-ethylhexyl) Phthalate	117-81-7	NA [c]	NA	cancer	NA

Table 3-5 Human Health COPC Screening Criteria for Groundwater for Protection of Indoor Air

Analyte	CAS Number	Regulatory Criterion[a] (mg/L)		Screening Benchmark[b] (mg/L)	Cancer / Noncancer	Source
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	91-57-6	0.69		0.069	noncancer	ADEC, 2009c
Acenaphthene	83-32-9	na		na	noncancer	na
Anthracene	120-12-7	na		na	noncancer	na
Benzo(a)anthracene	56-55-3	NA	c	NA	cancer	NA
Benzo(a)pyrene	50-32-8	NA	c	NA	cancer	NA
Benzo(b)fluoranthene	205-99-2	NA	c	NA	cancer	NA
Benzo(g,h,i)perylene	191-24-2	NA	c	NA	noncancer	NA
Benzo(k)fluoranthene	207-08-9	NA	c	NA	cancer	NA
Chrysene	218-01-9	NA	c	NA	cancer	NA
Fluorene	86-73-7	na		na	noncancer	na
Indeno(1,2,3-c,d)Pyrene	193-39-5	NA	c	NA	cancer	NA
Naphthalene	91-20-3	0.040		0.0040	noncancer	ADEC, 2009c
Phenanthrene	85-01-8	na		na	noncancer	na
Pyrene	129-00-0	na		na	noncancer	na
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	na	NA	f	NA	noncancer	NA
Gasoline Range Organics (GRO)	na	NA	f	NA	noncancer	NA
Residual Range Organics (RRO)	na	NA	c	NA	noncancer	NA

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern

mg/L - milligrams per liter
na - not available
NA - not applicable

[a] Regulatory Criteria are derived from Target Groundwater Concentrations from *Vapor Intrusion Guidance for Contaminated Sites. Draft.* (ADEC, 2009c).

[b] Benchmark Criteria are based on a cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[c] Vapor intrusion to indoor air pathway is incomplete because this chemical is not volatile.

[d] Total xylenes used as a surrogate.

[e] Isopropylbenzene used as a surrogate.

[f] Total petroleum hydrocarbons are not included because Individual petroleum hydrocarbon components were analyzed for and are included in the vapor intrusion assessment.

Table 3-6 Ecological COPEC Screening Criteria for Soil

Analyte	CAS Number	Regulatory Criterion [a] (mg/Kg)		Screening Benchmark [b] (mg/Kg)	Source
Inorganics					
Arsenic	7440-38-2	0.25	c	0.25	ADEC, 2009b
Barium	7440-39-3	5.0		5.0	ADEC, 2009b
Cadmium	7440-43-9	0.20		0.20	ADEC, 2009b
Chromium, Hexavalent	18540-29-9	0.018		0.018	ADEC, 2009b
Chromium, Total	7440-47-3	64		64	ADEC, 2009b
Lead	7439-92-1	9.36		9.36	ADEC, 2009b
Mercury	7439-97-6	0.30	d	0.30	ADEC, 2009b
Nickel	7440-02-0	25		25	ADEC, 2009b
Selenium	7782-49-2	0.02		0.02	ADEC, 2009b
Silver	7440-22-4	2.0		2.0	ADEC, 2009b
Vanadium	7440-62-2	2.0		2.0	ADEC, 2009b
Volatile Organic Compounds (VOCs)					
1,1,1-Trichloroethane	71-55-6	15		15	ADEC, 2009b
1,1,2,2-Tetrachloroethane	79-34-5	na		na	na
1,1,2-Trichloroethane	79-00-5	10		10	ADEC, 2009b
1,2,3-Trichlorobenzene	87-61-6	20		20	ADEC, 2009b
1,2,3-Trichloropropane	96-18-4	na		na	na
1,2,4-Trichlorobenzene	120-82-1	20		20	ORNL, 1997b
1,2,4-Trimethylbenzene	95-63-6	0.10	e	0.0068	ADEC, 2009b
1,2-Dibromo-3-chloropropane	96-12-8	na		na	na
1,2-Dibromoethane (EDB)	106-93-4	na		na	na
1,2-Dichloroethane	107-06-2	4.0		4.0	ADEC, 2009b
1,3,5-Trimethylbenzene	108-67-8	0.10	e	0.0068	ADEC, 2009b
2-Butanone (MEK)	78-93-3	35		35	ADEC, 2009b
2-Hexanone	591-78-6	na		na	na
4-Chlorotoluene	106-43-4	na		na	na
4-Methyl-2-pentanone(MIBK)	108-10-1	91.6		91.6	ADEC, 2009b
Acetone	67-64-1	20		20	ADEC, 2009b
Benzene	71-43-2	0.0068		0.0068	ADEC, 2009b
Carbon Disulfide	75-15-0	na		na	na
Dibenzofuran	132-64-9	1.6	f	1.6	ADEC, 2009b
Ethylbenzene	100-41-4	0.018		0.018	ADEC, 2009b
Isopropylbenzene	98-82-8	0.018	g	0.0068	ADEC, 2009b
m,p-Xylene (Sum of isomers)	108-38-3/106-42-3	0.10	e	0.10	ADEC, 2009b
Methylene chloride	75-09-2	183		183	ADEC, 2009b
n-Butylbenzene	104-51-8	0.018	g	0.0068	ADEC, 2009b
n-Propylbenzene	103-65-1	0.018	g	0.0068	ADEC, 2009b
o-Xylene	95-47-6	1.0		1.0	ADEC, 2009b
p-Isopropyltoluene	99-87-6	0.10	e	0.0068	ADEC, 2009b
sec-Butylbenzene	135-98-8	0.018	g	0.0068	ADEC, 2009b
Styrene	100-42-5	0.10		0.10	ADEC, 2009b
Toluene	108-88-3	0.08		0.08	ADEC, 2009b
trans-1,3-Dichloropropene	542-75-6	na		na	na
Trichloroethylene (TCE)	79-01-6	0.10		0.10	ADEC, 2009b
Xylenes, Total	1330-20-7	0.10		0.10	ADEC, 2009b
Semi-Volatile Organic Compounds (SVOCs)					
2,4-Dimethylphenol	105-67-9	20		20	ADEC, 2009b
4-Chloroaniline	106-47-8	40		40	ADEC, 2009b
Benzoic Acid	65-85-0	na		na	na
Benzyl butyl phthalate	85-68-7	48		48	ADEC, 2009b
bis(2-ethylhexyl) Phthalate	117-81-7	0.91		0.91	ADEC, 2009b
Di-n-octylphthalate	117-84-0	1,090	h	1,090	ADEC, 2009b
Pentachlorophenol	87-86-5	3.0		3.0	ADEC, 2009b

Table 3-6 Ecological COPEC Screening Criteria for Soil

Analyte	CAS Number	Regulatory Criterion [a] (mg/Kg)	Screening Benchmark [b] (mg/Kg)	Source
Polycyclic Aromatic Hydrocarbons (PAHs)				
2-Methylnaphthalene	91-57-6	29 [i]	29	USEPA, 2007a
Acenaphthene	83-32-9	29 [i]	29	USEPA, 2007a
Acenaphthylene	208-96-8	29 [i]	29	USEPA, 2007a
Anthracene	120-12-7	1.6	1.6	ADEC, 2009b
Benzo(a)anthracene	56-55-3	0.10	0.10	ADEC, 2009b
Benzo(a)pyrene	50-32-8	0.10	0.10	ADEC, 2009b
Benzo(b)fluoranthene	205-99-2	0.10	0.10	ADEC, 2009b
Benzo(g,h,i)perylene	191-24-2	33	33	ADEC, 2009b
Benzo(k)fluoranthene	207-08-9	0.10	0.10	ADEC, 2009b
Chrysene	218-01-9	35	35	ADEC, 2009b
Dibenz(a,h)anthracene	53-70-3	0.10	0.10	ADEC, 2009b
Fluoranthene	206-44-0	260	260	ADEC, 2009b
Fluorene	86-73-7	30	30	ADEC, 2009b
Indeno(1,2,3-c,d)Pyrene	193-39-5	0.10	0.10	ADEC, 2009b
Naphthalene	91-20-3	0.10	0.10	ADEC, 2009b
Phenanthrene	85-01-8	0.10	0.10	ADEC, 2009b
Pyrene	129-00-0	0.10	0.10	ADEC, 2009b
Polychlorinated Biphenyls (PCBs)				
PCB-1254 (Aroclor 1254)	11097-69-1	2,510	2,510	ADEC, 2009b
PCB-1260 (Aroclor 1260)	11096-82-5	2,510 [j]	2,510	ADEC, 2009b
Energetics				
Perchlorate	7790-98-9	na	na	na
Total Petroleum Hydrocarbons (TPHs)				
Diesel Range Organics (DRO)	na	na	na	na
Gasoline Range Organics (GRO)	na	na	na	na
Residual Range Organics (RRO)	na	na	na	na

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/Kg - milligrams per kilogram
na - not available
ORNL - Oak Ridge National Laboratory
USEPA - U.S. Environmental Protection Agency

[a] Regulatory criteria selected based on the following hierarchy:
1) ADEC Ecoscoping Guidance (ADEC, 2009b- Appendix D).
2) Eco-SSLs - Ecological Soil Screening Level Guidance. Office of Emergency and Remedial Response. (USEPA, 2005a).
3) The lower of ORNL plant (ONRL, 1997b - Table 1) or soil invertebrate (ORNL, 1997a - Table 1) benchmarks.
4) The lower of ORNL mammalian or avian dietary wildlife benchmarks, assuming diet consists of 100 percent soil (ORNL, 1996a - Appendix D, Table 12).

[b] Benchmark criteria is equal to the indicated regulatory criteria.
[c] Screening value is for Arsenic III.
[d] Screening value is for Inorganic Mercury.
[e] Total Xylenes used as a surrogate.
[f] Anthracene used as a surrogate.
[g] Ethylbenzene used as a surrogate.
[h] Di-n-hexylphthalate used as a surrogate.
[i] Low molecular weight PAHs used as a surrogate.
[j] Aroclor 1254 used as a surrogate.

Table 3-7 Ecological COPEC Screening Criteria for Surface Water

Analyte	CAS Number	Regulatory Criterion[a] (mg/L)	Screening Benchmark[b] (mg/L)	Source
Inorganics				
Barium	7440-39-3	0.00390	0.00390	ADEC, 2009b
Chromium, Total [c]	7440-47-3	0.000266	0.000266	ADEC, 2009b
Nickel	7440-02-0	0.00500	0.00500	ADEC, 2009b

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/L - milligrams per liter
NAWQC - National Ambient Water Quality Criteria
NOAA - National Oceanic and Atmospheric Adiministration
ORNL - Oak Ridge National Laboratory
SQuiRTs - Screening Quick Reference Tables

[a] Regulatory Criteria selected based on the following hierarchy:

1) Freshwater ecological screening values in ADEC's Ecoscoping Guidance (ADEC, 2009b- Appendix D).
2) NAWQC - Freshwater Chronic Value. NOAA SQuiRTs (Buchman, 2008).
3) NAWQC - Marine Chronic Value. NOAA SQuiRTs (Buchman, 2008).
4) NAWQC - Freshwater Acute Value divided by 10. NOAA SQuiRTs (Buchman, 2008).
5) NAWQC - Marine Acute Value divided by 10. NOAA SQuiRTs (Buchman, 2008).
6) Lowest Chronic Value observed in freshwater daphnids (ORNL, 1996b - Table 1).

[b] Benchmark criteria is based on the regulatory criteria and corresponds to a hazard quotient of 1.

[c] Criterion is for trivalent chromium. A screening value is not available for total chromium; however, hexavalent chromium was not detected and all chromium detected is assumed to be present in the trivalent form.

Table 3-8 Ecological COPEC Screening Criteria for Sediment

Analyte	CAS Number	Regulatory Criterion[a] (mg/Kg)	Screening Benchmark[b] (mg/Kg)	Source
Inorganics, Total				
Arsenic	7440-38-2	5.9	5.9	Buchman, 2008
Barium	7440-39-3	na	na	na
Cadmium	7440-43-9	0.583	0.583	Buchman, 2008
Chromium, Total	7440-47-3	36.286	36.286	Buchman, 2008
Lead	7439-92-1	35	35	Buchman, 2008
Mercury	7439-97-6	0.174	0.174	Buchman, 2008
Nickel	7440-02-0	18	18	Buchman, 2008
Selenium	7782-49-2	na	na	na
Silver	7440-22-4	1.0	1.0	NOAA ERL (ORNL, 1997c)
Vanadium	7440-62-2	na	na	na
Semi-Volatile Organic Compounds (SVOCs)				
bis(2-ethylhexyl) Phthalate	117-81-7	0.182	0.182	FDEP TEL (ORNL, 1997c)
Di-n-octylphthalate	117-84-0	na	na	na
Polycyclic Aromatic Hydrocarbons (PAHs)				
Benzo(a)anthracene	56-55-3	0.01572	0.01572	Buchman, 2008
Chrysene	218-01-9	0.02683	0.02683	Buchman, 2008
Fluoranthene	206-44-0	0.03146	0.03146	Buchman, 2008
Phenanthrene	85-01-8	0.01873	0.01873	Buchman, 2008
Pyrene	129-00-0	0.04427	0.04427	Buchman, 2008
Total Petroleum Hydrocarbons (TPHs)				
Diesel Range Organics (DRO)	na	na	na	na
Residual Range Organics (RRO)	na	na	na	na

Notes:

CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
ERL - effects range - low
FDEP - Florida Department of Environmental Protection threshold effects level
mg/Kg - milligrams per kilogram
na - not available
NOAA - National Oceanic and Atmospheric Administration
ORNL - Oak Ridge National Laboratory
TEL - threshold effects levels

[a] Regulatory Criteria selected based on the following hierarchy:
1) The lower of value between TEL and Assessment & Remediation of Contaminated Sediments (ARCS) TEL, and Probable Effects Level (PEL) in NOAA's Sediment Quality Guidelines in Screening Quick Reference Tables (SQuiRTs) (Buchman, 2008).
2) Consensus-based Freshwater Threshold Effects Concentrations (MacDonald et al., 2000 - Table 2).
3) Benchmarks for sediment-associated biota (ORNL, 1997c):
   - Ontario Ministry of Environment Lowest Effect Levels (Table 4).
   - U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response Sediment Criteria (Table 5).
   - NOAA ERL Concentrations for Sediment (Table 1).
   - FDEP TEL (Table 1).

[b] Benchmark criteria is equal to the indicated regulatory criteria.

Table 3-9 Summary of Chemicals of Potential Concern by NSS Area

Analyte	USS		LSS				Area A		Area C			Drainages
	SO	SX	SO	SX	GW	GW: VI	SO	SX	SO	SW	SD	SW
Inorganics, total												
Arsenic	X		X		X							
Barium					X							
Cadmium	X		X		X							
Chromium, Total					X			X				
Lead	X				X							
Mercury			X		X							
Nickel					X							
Vanadium	X	X		X	X							
Inorganics, filtered												
Arsenic					X							
Chromium, Total					X							
Nickel					X							
Vanadium					X							
Volatile Organic Compounds (VOCs)												
1,1,2,2-Tetrachloroethane				X								
1,1,2-Trichloroethane				X								
1,2,3-Trichloropropane		X		X								
1,2,4-Trimethylbenzene												
1,2-Dibromo-3-chloropropane				X								
1,2-Dichloroethane					X							
1,3,5-Trimethylbenzene												
Benzene					X	X						
Ethylbenzene						X						
Methylene Chloride					X							
n-Butylbenzene						X						
n-Propylbenzene						X						
sec-Butylbenzene						X						
Trichloroethylene (TCE)		X	X	X	X	X	X	X				
Semi-Volatile Organic Compounds (SVOCs)												
Pentachlorophenol			X									
Polycyclic Aromatic Hydrocarbons (PAHs)												
2-Methylnaphthalene					X	X						
Acenaphthene						X						
Anthracene												
Benzo(a)anthracene	X	X	X						X			
Benzo(a)pyrene	X	X	X	X					X			
Benzo(b)fluoranthene	X	X	X						X			
Benzo(k)fluoranthene		X	X									
Dibenz(a,h)anthracene	X	X	X									
Fluorene						X						
Indeno(1,2,3-c,d)Pyrene	X	X	X						X			
Naphthalene			X	X	X	X						
Phenanthrene												
Pyrene												

Table 3-9 Summary of Chemicals of Potential Concern by NSS Area

Analyte	USS		LSS				Area A		Area C			Drainages
	SO	SX	SO	SX	GW	GW: VI	SO	SX	SO	SW	SD	SW
Total Petroleum Hydrocarbons (TPHs)												
Diesel Range Organics (DRO)					X		X	X				
Residual Range Organics (RRO)			X				X	X				

Notes:
GW - groundwater
GW: VI - groundwater vapor intrusion to indoor air
LSS - Lower Site Summit
NSS - Nike Site Summit
SD - sediment
SO - surface soil
SW - surface water
SX - subsurface soil
USS - Upper Site Summit
X - analyte selected as a chemical of potential concern

Table 3-10 Summary of Chemicals of Potential Ecological Concern by NSS Area

Analyte	USS	LSS	Area A	Area C			Drainages
	SO	SO	SO	SO	SW	SD	SW
Inorganics							
Arsenic	X	X					
Barium	X	X	X			X	X
Cadmium	X	X	X				
Chromium, Hexavalent	X	X	X				
Chromium, Total		X					X
Lead	X	X	X	X			
Mercury	X	X					
Nickel	X	X	X	X		X	
Selenium	X	X				X	
Silver	X						
Vanadium	X					X	
Volatile Organic Compounds (VOCs)							
1,2,4-Trimethylbenzene	X	X					
1,3,5-Trimethylbenzene	X	X					
2-Hexanone		X					
Carbon disulfide	X	X					
Dibenzofuran		X					
Isopropylbenzene		X					
n-Butylbenzene		X					
n-Propylbenzene	X	X					
p-Isopropyltoluene	X	X					
trans-1,3-Dichloropropene		X					
Trichloroethylene (TCE)		X					
Semi-Volatile Organic Compounds (SVOCs)							
Benzoic acid		X	X				
bis(2-ethylhexyl) Phthalate	X	X					
Di-n-octylphthalate						X	
Pentachlorophenol		X					
Polycyclic Aromatic Hydrocarbons (PAHs)							
Anthracene	X	X					
Benzo(a)anthracene	X	X		X		X	
Benzo(a)pyrene	X	X		X			
Benzo(b)fluoranthene	X	X		X			
Benzo(k)fluoranthene	X	X		X			
Chrysene		X				X	
Dibenz(a,h)anthracene	X	X					
Fluoranthene						X	
Indeno(1,2,3-c,d)Pyrene	X	X		X			
Naphthalene	X	X		X			
Phenanthrene	X	X		X		X	
Pyrene	X	X		X		X	
Energetics							
Perchlorate		X					

Table 3-10 Summary of Chemicals of Potential Ecological Concern by NSS Area

Analyte	USS	LSS	Area A	Area C			Drainages
	SO	SO	SO	SO	SW	SD	SW
Total Petroleum Hydrocarbons (TPHs)							
Diesel Range Organics (DRO)	X	X	X	X		X	
Gasoline Range Organics (GRO)	X	X	X				
Residual range organics (RRO)	X	X	X	X		X	

Notes:
LSS - Lower Site Summit
NSS - Nike Site Summit
SD - sediment
SO - surface soil
SW - surface water
USS - Upper Site Summit
X - analyte selected as a chemical of potential ecological concern

Table 3-11 Flora Species Potentially Occurring At or Around Nike Site Summit

Common Name	Scientific Name	Reference
Trees and Shrubs		
Alpine bearberry	*Arctostaphylos alpina*	2
Red bearberry	*Arctostaphylos rubra*	2
Bearberry mananita	*Arctostaphylos uva-ursi*	1
Crowberry	*Empetrum nigrum*	2
Labrador tea	*Ledum palustre*	2
Sitka spruce	*Picea sitchensis*	1
Arctic willow	*Salix arctica*	2
Barclay's willow	*Salix barclayi*	1
Dwarf blueberry	*Vaccinium caespitosum*	2
Lowbush cranberry	*Vaccinium oxycoccos*	2
Blueberry	*Vaccinium uliginosum*	2
Bog blueberry	*Vaccinium uliginosum*	1,2
Low Shrubs		
White mountain heather	*Cassiope tetragona*	2
Alaska bellheather	*Harrimanella stelleriana*	1
Herbaceous Plants		
Anemone	*Anemone* sp.	2
Arnica	*Arnica* sp.	2
Wormwood	*Artemisia arctica*	2
Alpine bistort	*Bistorta vivipara*	2
Bluebells	*Campanula* sp.	2
Sedges	*Carex* sp.	2
Alpine fescue	*Festuca brachyphylla*	2
Alpine sweetgrass	*Hierochloe alpina*	2
Partridge foot	*Luetkea pectinata*	2
Wood rushes	*Luzula sp.*	2
Lousewort	*Pedicularis sp.*	2

Notes:

1– UAM, 2010. Searchable by geographic location online at: http://arctos.database.museum/home.cfm.
2 – E&E, 2000. Risk Assessment Work Plan Site Summit, Fort Richardson, Alaska. February.
sp – species

Table 3-12 Mammalian Species Potentially Occurring At or Around Nike Site Summit

Common Name	Scientific Name	Reference
Moose	*Alces alces*	3
Wolf	*Canis lupus Linnaeus*	1, 3
Coyote	*Canis latrans Say*	1, 2
Wolverine	*Gulo gulo*	1, 3
Snowshoe Hare	*Lepus americanus*	3
Lynx	*Lynx canadensis*	3
Hoary marmot	*Marmota caligata*	1
Tundra vole	*Microtus oeconomus*	1, 2
Pygmy shrew	*Microxorex hoyi*	1, 2
Singing vole	*Mircrotus miurus Osgood*	1, 2
Meadow vole	*Mircrotus pennsylvanicas*	1, 2
Ermine	*Mustela erminea Linnaeus*	1
Least weasel	*Mustela nivalis Linnaeus*	1
Pika	*Ochotona princeps*	2
Mountain goat	*Oreamnos americanus*	1
Dall sheep	*Ovis dalli*	1, 2, 3
Arctic shrew	*Sorex arcticus*	1
Masked shrew	*Sorex cinereus*	1
Dusky shrew	*Sorex monticolus*	1
Arctic ground squirrel	*Spermophilus parryii*	1, 3
Northern bog lemming	*Synaptomys borealis*	2
Brown bear	*Ursus arctos Linnaeus*	1, 3
Black bear	*Ursus americanus*	3
Red Fox	*Vulpes vulpes*	3

Notes:
1 – E&E, 2000. Risk Assessment Work Plan Site Summit, Fort Richardson, Alaska. February.
2 – ADEC, 1999b. Technical Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions. June.
3 – Dowl/Ogden, 1996. Final Site Assessment Report Two-Party Non-UST POL Preliminary Assessment/Site Investigation. Fort Richardson, Alaska.

Table 3-13 Avian Species Potentially Occurring At or Around Nike Site Summit

Common Name	Scientific Name	Reference
Anseriformes		
Mallard	*Anas platyrhynchos*	2
Charadiformes		
Surfbird	*Aphriza virgata*	1
Common snipe	*Gallinago gallinago*	
Wandering tattler	*Heteroscelus incanus*	1
Falconiformes		
Golden eagle	*Aquila chrysaetos*	1, 3
Rough-legged hawk	*Buteo lagopus*	1
Northern harrier	*Circus cyaneus*	1
Peregrine falcon	*Falco peregrinus anatum*	1
Gyrfalcon	*Falco rusticolus*	1
Galliformes		
Ruffed grouse	*Bonasa umbellus*	3
Spruce grouse	*Falcipennis canadensis*	3
Willow ptarmigan	*Lagopus lagopus*	1, 2
White-tailed ptarmigan	*Lagopus leucurus*	1, 2
Rock ptarmigan	*Lagopus muttus*	1, 2
Passeriformes		
Water pipit	*Anthus spinoletta*	1, 2
Hoary redpoll	*Carduelis hornemanni*	1
Hermit thrush	*Catharus guttatus*	1
American dipper	*Cinclus mexicanus*	2
Northwestern crow	*Corvus caurinus*	2
Common raven	*Corvus corax*	2, 3
Horned lark	*Eremophila alpestris*	1
Dark-eyed junco	*Junco hyemalis*	2
Northern shrike	*Lanius excubition*	2
Gray-crowned rosy finch	*Leucosticte tephrocotis*	1
Townsend's solitaire	*Myadestes townsendi*	1
Northern wheatear	*Oenanthe oenanthe*	1
Savannah Sparrow	*Passerculus sandwichensis*	1
Fox sparrow	*Passerella itiaca*	1
Black-billed magpie	*Pica pica*	1
Snow bunting	*Plectrophenax nivalis*	1
Say's phoebe	*Sayornis saya*	1
American robin	*Turdus migratorius*	2
Wilson's warbler	*Wilsonia pusilla*	1
Golden-crowned sparrow	*Zonotrichia atricapilla*	1

Table 3-13 (Cont.) Avian Species Potentially Occurring At or Around Nike Site Summit

Common Name	Scientific Name	Reference
Strigiformes		
Snowy owl	*Nyctea scandiaca*	1

Notes:

1 – E&E, 2000. Risk Assessment Work Plan Site Summit, Fort Richardson, Alaska. February

2 – ADEC, 1999b. Technical Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions. June.

3 – Dowl/Ogden, 1996. Final Site Assessment Report Two-Party Non-UST POL Preliminary Assessment/Site Investigation. Fort Richardson, Alaska.

Table 3-14 Amphibian and Reptile Species Potentially Occurring At or Around Nike Site Summit

Common Name	Scientific Name	Observed	Reference
Amphibians/Reptiles			
Western toad	*Bufo boreas*	No	1
Wood frog	*Rana sylvatica*	No	1

Note:
1 – MacDonald, 2003. Amphibians and Reptiles of Alaska: A Field Handbook. April.

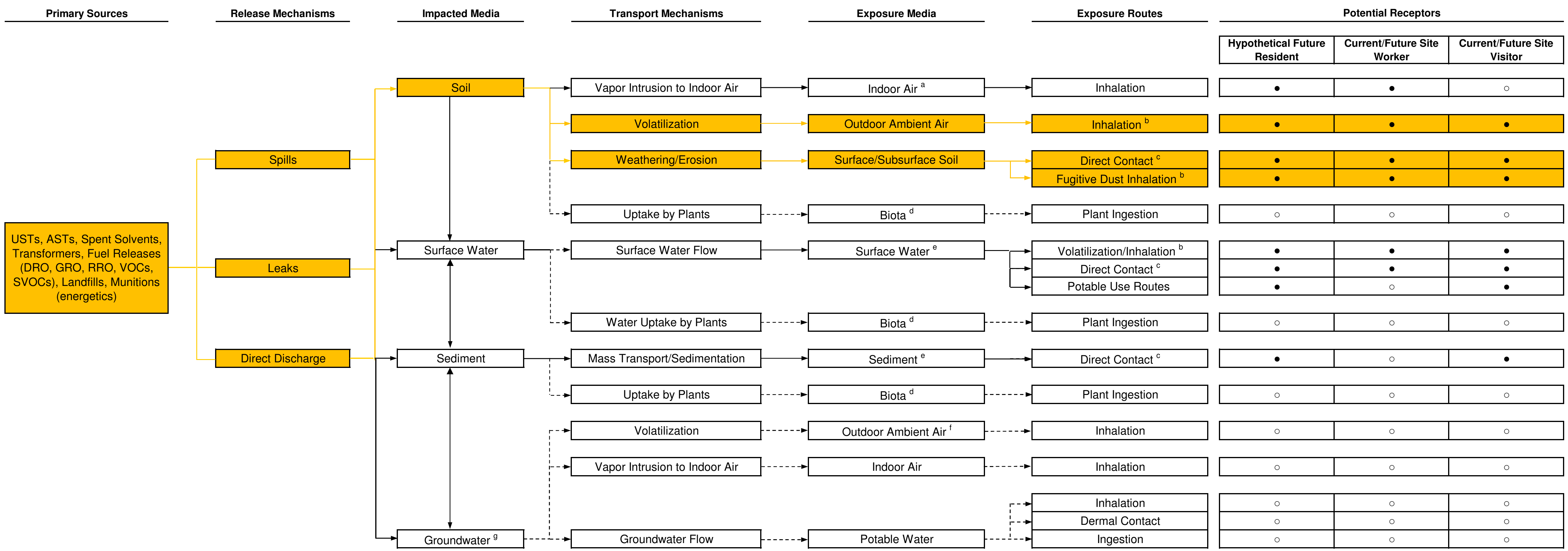
Table 3-15 Invertebrate Species Potentially Occurring At or Around Nike Site Summit

Scientific Name	Habitat / Community	Reference
Aquatic / Benthic		
Plecoptera	Freshwater	1
Ephemeroptera	Freshwater	1
Dipteral	Freshwater	1
Trichoptera	Freshwater	1
Collembola	Freshwater	1
Hymenoptera	Freshwater	1
Oligochaeta	Freshwater	1
Lepidoptera	Freshwater	1
Terrestrial		
Trichoptera	Soil	1
Coleopteran	Soil	1
Hemiptera	Soil	1
Arachnids	Soil	1
Dipterans	Soil	1

Note:

1 – ADEC, 1999b. Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions. June.

Figure 3-1 Human Health Conceptual Site Model - Upper Site Summit



Complete Exposure Pathway
Potentially Complete but Insignificant Pathway
Incomplete Pathway

Complete Exposure Pathway
Potentially Complete but Insignificant Pathway
Incomplete Exposure Pathway

Notes:

[a] Modeling of indoor air VOC concentrations from soil VOC concentrations is imprecise, and soil data are not suitable for quantitative vapor intrusion assessment (ADEC, 2009c). Therefore, the soil to indoor air pathway was not quantitatively evaluated.

[b] Nike Site Summit is located on the top of a mountain where wind speeds are consistently high, and it is likely that rapid dispersal in ambient air would prevent significant inhalation exposures. However, the inhalation of volatile contaminants and fugitive dust pathways were conservatively included in the risk and hazard calculations for soil.

[c] Direct Contact means exposure through both incidental ingestion and dermal absorption of soil, sediment, or surface water.

[d] There is little vegetation at Upper Site Summit and it is primarily dominated by mosses and lichens.

[e] No surface water or sediment is present at the Upper Site Summit. However, it is possible for contamination derived from the Upper Site Summit to impact surface water and sediment in off-site locations following transport with groundwater. No chemicals of potential concern were identified in surface water samples collected downgradient of the Upper Site Summit; therefore, surface water and sediment pathways are assumed to be potentially complete but insignificant.

[f] The groundwater to outdoor ambient air pathway is potentially complete, but insignificant compared to exposure to groundwater derived VOCs in indoor air.

[g] Groundwater at the Upper Site Summit is not present in sufficient quantities to supply a potable water well; however, there is potential for contaminated groundwater derived from the Upper Site Summit to impact surface water at off site locations. The groundwater to surface water pathway was evaluated through analysis of downgradient surface water samples (refer to footnote 'e').

ASTs - Aboveground Storage Tanks
DRO - diesel range organics
GRO - gasoline range organics
RRO - residual range organics
SVOCs - semi-volatile organic compounds
USTs - Underground Storage Tanks
VOCs - volatile organic compounds

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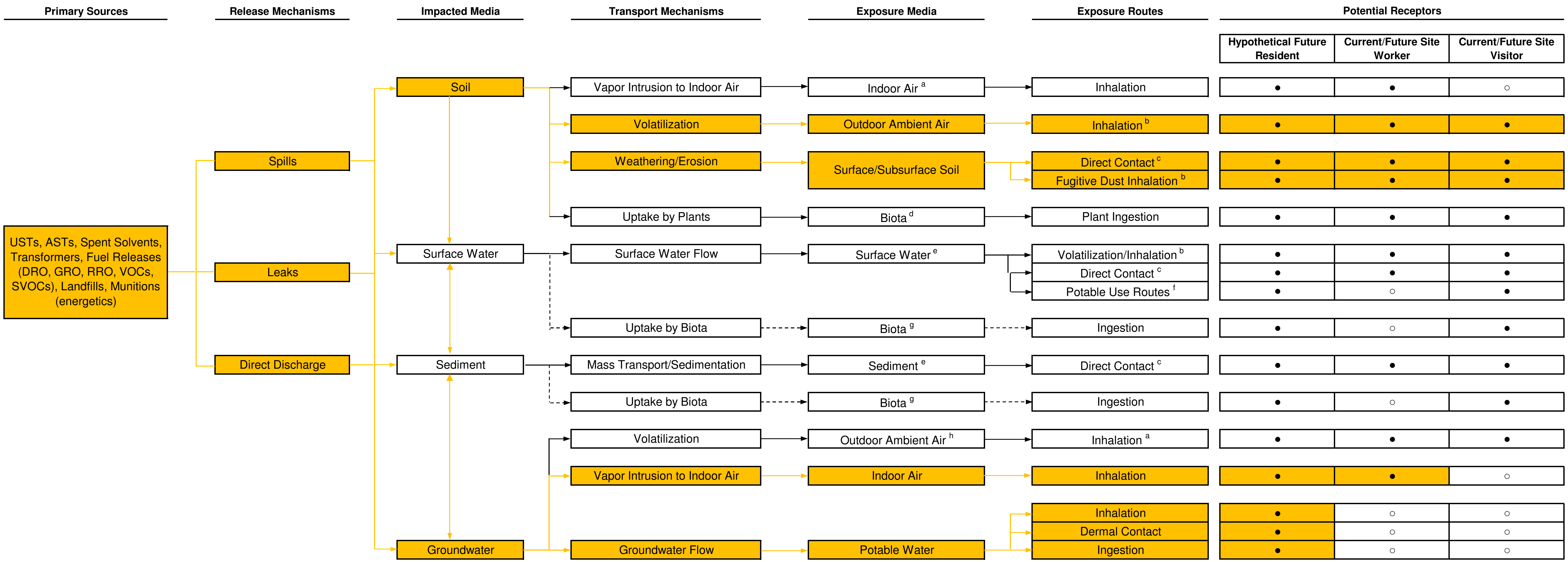
Figure 3-2 Human Health Conceptual Site Model - Lower Sites and Downgradient Off-Site Drainages



Complete Exposure Pathway
Potentially Complete but Insignificant Pathway
Incomplete Pathway

● Complete Exposure Pathway
● Potentially Complete but Insignificant Pathway
○ Incomplete Exposure Pathway

Notes:

[a] Modeling of indoor air VOC concentrations from soil VOC concentrations is imprecise, and soil data are not suitable for quantitative vapor intrusion assessment (ADEC, 2009c). Therefore, the soil to indoor air pathway was not quantitatively evaluated.

[b] Nike Site Summit is located on the top of a mountain where wind speeds are consistently high, and it is likely that rapid dispersal in ambient air would prevent significant exposures. However, the inhalation of volatile contaminants and fugitive dust pathways were conservatively included in the risk and hazard calculations for soil.

[c] Direct Contact means exposure through both incidental ingestion and dermal absorption of soil, sediment, or surface water.

[d] Recreational foraging is frequent at times when berries are growing on the slopes bordering Nike Site Summit, however, berry consumption is assumed to be only a small portion of the diet and this exposure pathway is considered to be complete but insignificant.

[e] Exposures to surface water and sediment is a potentially complete pathway for the Area C Pond and for off-site drainages downgradient of the Nike Site Summit. However, no chemicals detected in samples collected from surface water or sediment at the Area C Pond or downgradient drainages were retained for evaluation in the human health risk assessment following screening. Therefore, surface water and sediment exposure pathways are considered to be potentially complete but insignificant.

[f] Potable use routes for surface water in the Area C Pond and downgradient off-site drainages include direct consumption by current/future site visitors and hypothetical future residents, and potential pumping of water from the pond at Area C to hypothetical future homes.

[g] No biota were observed in the Area C Pond during visual assessments made as part of the Remedial Field Investigation. Therefore, consumption of biota from Area C Pond is an incomplete pathway. Consumption of biota from downgradient off-site drainages is possible. However, no chemicals of potential concern were identified in downgradient off-site surface water samples; therefore, biota consumption pathways are assumed to be potentially complete but insignificant.

[h] The groundwater to outdoor ambient air pathway is potentially complete but insignificant compared to exposure to groundwater derived VOCs in indoor air.

ASTs - Aboveground Storage Tanks
DRO - diesel range organics
GRO - gasoline range organics
RRO - residual range organics
SVOCs - semi-volatile organic compounds
USTs - Underground Storage Tanks
VOCs - volatile organic compounds

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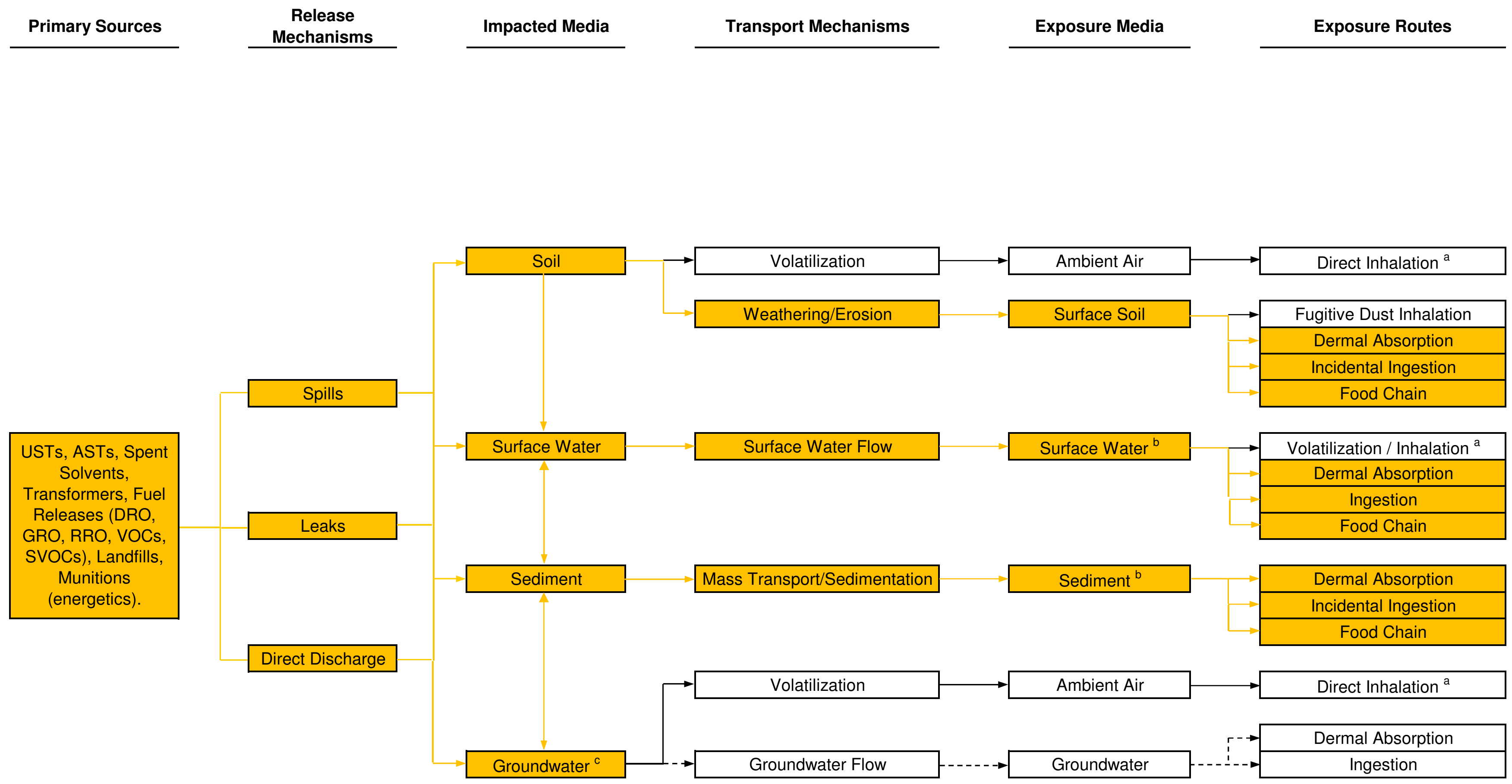
Figure 3-3 Ecological Conceptual Site Model - Nike Site Summit



Impacted Media	Transport Mechanisms	Exposure Media	Exposure Routes	Aquatic: Benthic Invertebrates	Aquatic: Aquatic Water Column Receptors	Aquatic: Semi-Aquatic Avian Herbivore	Aquatic: Semi-Aquatic Mammalian Herbivore	Aquatic: Freshwater Avian Invertivore	Aquatic: Semi-Aquatic Avian Invertivore	Terrestrial: Terrestrial Invertebrates	Terrestrial: Terrestrial Avian Herbivore	Terrestrial: Terrestrial Mammalian Herbivore	Terrestrial: Terrestrial Avian Insectivore	Terrestrial: Terrestrial Mammalian Insectivore	Terrestrial: Terrestrial Avian Carnivore	Terrestrial: Terrestrial Mammalian Carnivore
Soil	Volatilization	Ambient Air	Direct Inhalation [a]	○	○	○	○	○	○	•	•	•	•	•	•	•
Soil	Weathering/Erosion	Surface Soil	Fugitive Dust Inhalation	○	○	○	○	○	○	○	•	•	•	•	•	•
			Dermal Absorption	○	○	○	○	○	○	**•**	•	•	•	•	•	•
			Incidental Ingestion	○	○	○	○	○	○	**•**	**•**	**•**	**•**	**•**	**•**	**•**
			Food Chain	○	○	○	○	○	○	**•**	**•**	**•**	**•**	**•**	**•**	**•**
Surface Water	Surface Water Flow	Surface Water [b]	Volatilization / Inhalation [a]	○	○	•	•	•	•	○	•	•	•	•	•	•
			Dermal Absorption	**•**	**•**	•	•	•	•	○	•	•	•	•	•	•
			Ingestion	**•**	**•**	**•**	**•**	**•**	**•**	○	•	•	•	•	•	•
			Food Chain	**•**	**•**	**•**	**•**	**•**	**•**	○	○	○	○	○	○	○
Sediment	Mass Transport/Sedimentation	Sediment [b]	Dermal Absorption	**•**	○	•	•	•	•	○	•	•	•	•	•	•
			Incidental Ingestion	**•**	○	**•**	**•**	**•**	**•**	○	•	•	•	•	•	•
			Food Chain	**•**	○	**•**	**•**	**•**	**•**	○	○	○	○	○	•	•
Groundwater [c]	Volatilization	Ambient Air	Direct Inhalation [a]	○	○	○	○	○	○	•	•	•	•	•	•	•
Groundwater [c]	Groundwater Flow	Groundwater	Dermal Absorption	○	○	○	○	○	○	○	○	○	○	○	○	○
			Ingestion	○	○	○	○	○	○	○	○	○	○	○	○	○

Complete Exposure Pathway
Potentially Complete but Insignificant Pathway
Incomplete Pathway
• Complete Exposure Pathway
• Potentially Complete but Insignificant Pathway
○ Incomplete Exposure Pathway

Notes:

[a] Nike Site Summit is located on the top of a mountain where wind speeds are consistently high and it is not likely that significant exposures to outdoor air will occur due to rapid ambient air dispersal.

[b] Permanent surface water or semi-permanent surface water is present only in the Area C pond and the small drainages flowing in to and out of the pond. The Area C Pond is a small, man-made structure that does not support aquatic water column species and aquatic dependent terrestrial species; however, aquatic and semi-aquatic ecological receptors may utilize the downgradient off-site drainages.

[c] Direct exposure to groundwater is not a complete exposure pathway for ecological receptors. The potential for adverse impacts resulting from constituents detected in groundwater was evaluated through the groundwater-to-surface water pathway, using sampling results for surface water in downgradient off-site drainages under the conservative assumption that the Nike Site Summit is the only potential source area.

ASTs - Aboveground Storage Tanks
DRO - diesel range organics
GRO - gasoline range organics
RRO - residual range organics
SVOCs - semi-volatile organic compounds
USTs - Underground Storage Tanks
VOCs - volatile organic compounds

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4.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the methods and assumptions used in, and the results of, the HHRA that was prepared for the four NSS Areas. Risks to public health were evaluated in accordance with the CERCLA Remedial Response process, as amended by SARA, and Alaska *Oil and Other Hazardous Substances Pollution Control* (ADEC, 2011b) regulations. The HHRA evaluated potential public health risks associated with chemicals released from historic sources at the four NSS Areas. Potential threats to ecological habitats and receptors were evaluated as described in Section 5.0.

The HHRA for the four NSS Areas was performed in accordance with, or in consideration of, the following ADEC and EPA guidance documents or reference materials:

- *Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual, Part A* (USEPA, 1989a).
- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (USEPA, 1991a).
- *Final Exposure Assessment Guidelines* (USEPA, 1992b).
- *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons* (USEPA, 1993a).
- *Health Effects Assessment Summary Tables (HEAST)* (USEPA, 1997a).
- *Exposure Factors Handbook, Volume I: General Factors* (USEPA, 1997b).
- *Exposure Factors Handbook, Volume III: Activity Factors* (USEPA, 1997c).
- *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment* (USEPA, 2004a).
- *Cancer Guidelines and Supplemental Guidance* (USEPA, 2007b).
- *Child-Specific Exposure Factors Handbook, Final Report* (USEPA, 2008a).
- *Guidance for Cleanup of Petroleum Contaminated Sites* (ADEC, 2000).
- 18 AAC 75 – *Oil and Other Hazardous Substances Pollution Control* Regulations, as amended through October 1, 2011 (ADEC, 2011b).
- 18 AAC 70 – *Water Quality Standards*, amended through May 26, 2011 (ADEC, 2011c).
- *Cleanup Levels Guidance* (ADEC, 2008d).
- RAPM (ADEC, 2011a).
- *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC, 2009b).

As described above, the HHRA for the four NSS Areas and downgradient off-site drainages was conducted in accordance with 18 AAC 75. Site cleanup rules provided in 18 AAC 75 establish administrative processes and standards to determine the necessity for, and degree of, cleanup required to protect human health, safety, and welfare at a site where one or more hazardous substances are located.

The administrative processes and standards in 18 AAC 75 include generic soil and groundwater cleanup levels (i.e., Methods One and Two), and procedures for establishing site-specific cleanup levels (i.e., Methods Three and Four). The Air Force has elected to conduct a Method Four HHRA for NSS, consistent with 18 AAC 75 and the RAPM (ADEC, 2011a). Risk assessments conducted under Method Four may lead to development of media-specific cleanup levels for these four NSS Areas, depending on the findings of the RI.

The HHRA for the four NSS Areas and downgradient off-site drainages used a two-tiered approach. Conservative screening (Tier I) was performed to evaluate whether chemical concentrations measured in site media exceed protective screening criteria. Chemicals for which measured concentrations exceeded protective screening criteria were identified as COPCs and evaluated further in the Tier II baseline HHRA. The Tier II baseline HHRA was performed consistent with ADEC procedures and EPA risk assessment guidance, as applicable. Those areas and media for which Tier II HHRA criteria are exceeded will be proposed for further evaluation, or consideration of remedial alternatives. The methods and assumptions used in the Tier II baseline HHRA for the four NSS Areas and downgradient off-site drainages are described below.

The general framework for conducting baseline HHRAs is provided in *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual, Part A* (USEPA, 1989a) and the RAPM (ADEC, 2011a). Consistent with these guidance documents, the Tier II baseline HHRA consists of the following five steps:

1. Exposure Assessment
2. Exposure Quantification
3. Toxicity Assessment
4. Risk Characterization
5. Uncertainty Analysis

The first four steps are described in the following sections, as they relate to the baseline HHRA for the four NSS Areas. Step 5, a combined human health and ecological uncertainty analysis for the four NSS Areas, is presented and discussed in Section 6.0.

4.1 EXPOSURE ASSESSMENT

The exposure assessment begins with the development of a site-specific CSM. The human health CSMs for the four NSS Areas and downgradient off-site drainages were described in Section 3.4.1. Briefly, JBER owns NSS and operates it for military personnel training purposes. Historically, the four NSS Areas were used in support of NSS facilities and, specifically, the Hercules Missile Defense system. USS, LSS, and Area A are currently used for training military personnel and occasional guided tours. In addition to military uses, the USS is currently leased to telecommunications companies and three structures are utilized and maintained. Other current users of the NSS include recreational visitors who trespass onto the property. Area C, which is located to the southeast, is not under military control and is used only for recreational purposes.

Under current land uses at NSS, the only applicable receptors are a site worker and a recreational visitor. However, in the event that property ownership changes, a residential scenario may become applicable. In order to protect potential future receptors, the HHRA for the four NSS Areas included a hypothetical future residential receptor scenario. Future receptors could also include environmental investigators and remediation workers. However, these individuals are assumed to perform work activities according to approved health and safety policies and procedures, and with an appropriate level of personal protective equipment (PPE), as necessary. Based on the use of appropriate personal protective equipment and compliance with health and safety policies and procedures, and their lower frequency of exposure, environmental investigators and remediation workers are assumed to have lower exposures than hypothetical future residents and will be protected under the future residential scenario.

Consistent with the above, potential current and future human receptors for the four NSS Areas include:

- Current and future site workers
- Current and future site visitors
- Hypothetical future residents

A current and future trespasser scenario was not quantitatively evaluated for the four NSS Areas. Although there are complete exposure pathways between a site trespasser and potentially contaminated site media, the level of exposure for a trespasser is expected to be lower than for the receptors listed above. Therefore, risk results for receptors evaluated quantitatively are considered as protective of the trespasser scenario.

Relevant exposure pathways for the above receptors are graphically presented on Figures 3-1 and 3-2. Potentially complete and incomplete exposure pathways for human receptors that were evaluated further in the quantitative HHRA are described in more detail in the following sections.

4.1.1 Ambient Air Exposure Pathways

Historic spills and releases of fuels, solvents, and other volatile contaminants to soil can result in direct release of volatile COPCs to ambient air through volatilization. Surface runoff from rainfall or snowmelt can transport volatile COPCs in soil to surface water and sediment, from which they volatilize to ambient air. Percolation and leaching can transport volatile COPCs to groundwater, with subsequent volatilization to ambient air. Historic spills and releases of such contaminants at the four NSS Areas would have occurred years ago, and it is likely that the majority of volatile residues in environmental media have already migrated to ambient air and dissipated. Residual levels of volatile COPCs in these media may continue to volatilize. However, concentrations of volatile COPCs in ambient air at any given time are anticipated to be low because NSS is:

- Located on top of a mountain or close to the ridge of the mountain and wind speeds are consistently high, which would disperse most outdoor ambient air quickly.

- Covered by snow during winter months.

Based on the aforementioned conditions, ambient air concentrations of these VOCs are anticipated to be low. However, direct inhalation of VOCs from ambient air was conservatively included in this HHRA as a complete and significant pathway for soil and groundwater. Potential human exposure pathways associated with ambient air that were evaluated in this risk assessment include:

- Direct inhalation of soil derived volatile COPCs in outdoor ambient air by site workers, site visitors, and hypothetical future residents.
- Direct inhalation of groundwater derived volatile COPCs in indoor air by current/future site workers and hypothetical future residents.

The ADEC guidance document, *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC, 2009b), was used to evaluate the vapor intrusion to indoor air exposure pathway. Vapor intrusion from groundwater to indoor air was considered to be a potentially complete exposure pathway for current and future site workers and hypothetical future residents at the four NSS Areas; however, groundwater was only encountered at USS and LSS.

4.1.2 Soil Exposure Pathways

Contaminants have been released to surface and subsurface soil through historic spills, leaks, and disposal practices. Potential human exposure pathways for soil include:

- Uptake of soil COPCs by plants and food-chain transfer to animals that are subsequently consumed by site visitors.
- Incidental ingestion of soil particulates by site workers, visitors, and hypothetical future residents.
- Dermal absorption of COPCs adsorbed to soil particulates by site workers, visitors, and hypothetical future residents.
- Inhalation of COPCs adsorbed to soil particulates by site workers, visitors, and hypothetical future residents.

As described in Section 4.1.1, inhalation of soil-derived VOCs in outdoor ambient air by site workers is considered to be a potentially complete and significant exposure pathway. However, vapor intrusion from soil to indoor air was not quantitatively evaluated due to the lack of accurate models for calculating indoor air concentrations from soil concentrations. Potential vapor intrusion to indoor air exposures were modeled from groundwater sampling results.

Current and future site workers, site visitors and hypothetical future residents can potentially gather berries at LSS, Area A, and Area C. Additionally, current/future site visitors using the site recreationally can hunt ptarmigan. However, exposures due to consumption of gathered food are likely to be infrequent and insignificant compared to other direct contact pathways and will not be evaluated quantitatively.

4.1.3 Surface Water and Sediment Exposure Pathways

Contaminants may have been released to surface waters and sediment through runoff, historic spills, leaks, and disposal practices. Potential human exposure pathways for surface water and sediment include:

- Uptake of COPCs by plants and food-chain transfer to animals that are subsequently consumed by recreational site visitors.
- Ingestion of COPCs in water by recreational site visitors and hypothetical future residents using the Area C Pond as potable water.
- Direct contact with surface water and sediment by site visitors and hypothetical future residents recreationally wading in the Area C Pond.
- Dermal absorption and inhalation of COPCs in potable water during showering by hypothetical future residents using the Area C Pond as potable water.

Surface water at the four NSS Areas evaluated in this HHRA consists mainly of small drainages and gullies with only intermittent flow, where the potential for contact with surface water is minimal. However, at Area C there is a small pond where water collects below a weir. Recreational site visitors have been observed wading in this pond; therefore, direct contact pathways with surface water and sediment are potentially complete for the current/future visitor and hypothetical future resident. Surface water at the four NSS Areas is not currently used as a source of potable water. However, in the past, potable water has been obtained from the Area C Pond. Therefore, potable use of water from the Area C Pond is a potentially complete pathway for the hypothetical future resident scenario. As described in Section 3.2, no analytes detected in surface water or sediment from the Area C Pond were retained as COPCs for evaluation in the HHRA. Therefore, potentially complete pathways between human receptors and surface water/sediment associated with the Area C Pond are assumed to be insignificant and were not quantitatively evaluated.

Surface water in off-site drainages may be impacted by recharge from groundwater with potential site-related contamination following infiltration and percolation at the four NSS Areas. Current/future visitors and hypothetical future residents have unrestricted access to small off-site drainages; therefore, all direct contact pathways, including potable use, are potentially complete (Figures 3-1 and 3-2). However, no COPCs were identified in surface water following screening; therefore, this pathway is assumed to be insignificant.

Aquatic organisms were not observed in the Area C Pond during qualitative visual assessments during the RFI field activities; therefore, indirect exposures to COPCs in surface water through bioaccumulation in aquatic plants and animals and subsequent ingestion by recreational site visitors or hypothetical future residents is an incomplete exposure pathway.

4.1.4 Groundwater Exposure Pathways

Past spills or releases of fuels, solvents, and other soluble contaminants to soil, followed by percolation and leaching, can transport contaminants to groundwater. Potential human exposure pathways for groundwater at NSS include:

- Inhalation of volatile COPCs that volatize from groundwater to outdoor air by current/future site workers, current/future site visitors, and hypothetical future residents.
- Inhalation of volatile COPCs derived from groundwater following vapor intrusion into indoor air by current/future site workers and hypothetical future residents.
- Ingestion, dermal absorption, and inhalation of COPCs in groundwater used as potable water by hypothetical future residents.

Groundwater beneath the four NSS Areas evaluated in this HHRA is not currently used as a potable water supply, and it is unlikely that it would be used for such purposes in the future. However, consistent with State of Alaska regulations (18 AAC 75.345), all groundwater within the State should be evaluated as a potential drinking water supply unless a 350 Determination precludes potable uses. Groundwater was not encountered, or was not contaminated, at Area A or Area C, and was not present sufficiently at USS to support potable use wells. Therefore, groundwater was evaluated as a potable water source for a hypothetical future resident at LSS only. Potentially complete exposure pathways between COPCs in groundwater and future receptors at LSS include ingestion, dermal absorption, and inhalation of VOCs. The latter two pathways are assumed to occur primarily during showering (Figure 3-2).

Volatilization of COPCs in groundwater to aboveground ambient outdoor and indoor air is possible. Inhalation of volatile COPCs following vapor intrusion from groundwater to indoor air is a potentially complete and significant pathway for current and future site workers and hypothetical future residents at LSS (Figure 3-2). Exposure to volatile COPCs in outdoor ambient air is a potentially complete pathway for current and future site workers and site visitors and hypothetical future residents at LSS; however, this pathway is assumed to be insignificant compared with the inhalation of indoor air, due to dispersion and dilution in ambient air. Therefore, inhalation of volatile contaminants derived from groundwater in ambient air was not quantified in the HHRA. Contaminated groundwater was not encountered at Area A or Area C. Although VOCs were detected in subsurface water at USS, this subsurface water is very limited in extent, as described in Section 3.3.1, and is not considered a source of volatile contaminants in aboveground air.

4.2 EXPOSURE QUANTIFICATION

Potential exposures and risks associated with the complete exposure pathways identified in Section 4.1 were quantified in the HHRA. Each of the four NSS Areas was evaluated as an individual exposure area. Only data from the RFI was used to calculate EPCs and characterize potential risks for complete and potentially significant pathways, because these data are most representative of current site conditions. Methods to be used in the derivation of media EPCs, and procedures for quantifying exposure doses for current and future human receptors, are described in the following subsections.

4.2.1 Deriving Exposure Point Concentrations

An EPC describes the level of a chemical in soil, sediment, water, or food to which a receptor is exposed (USEPA, 1989a; ADEC, 2011a). As such, the EPC serves as the basis for quantifying pathway-specific exposure doses. For human health surface and subsurface soil exposures at the NSS, the EPC was assumed to be an average concentration over the exposure area, quantified by a 95% UCL on the mean concentration. Calculation of 95% UCLs on the mean concentration in site media was based on both measured concentrations and non-detect results. When the number of samples was insufficient to calculate a 95% UCL on the mean concentration, or data are deemed to be of inadequate quality (e.g., due to elevated sample quantitation limits), the maximum concentration was used as the soil EPC. The criteria used to determine sufficient sample size at the NSS was based on the number of detected results: for analytes with fewer than five detects, or if five or more detects, a detection frequency of less than 20%, the maximum detected concentration was used as the EPC. In addition, if the maximum detected concentration was less than the calculated 95% UCL on the mean concentration, then the maximum value was used as the soil EPC.

The 95% UCL on the mean concentrations were calculated using EPA's ProUCL software Version 4.10.00 (USEPA, 2011a) (Appendix E). Recommendations for appropriate distributions and 95% UCLs provided by the program were utilized. If a higher confidence than 95% (e.g. 97.5% or 99%) was recommended by ProUCL, the 95% UCL on the mean concentration from distribution recommended by ProUCL was used. In the case of non-detect results, the laboratory reporting limit value was entered as-is into the ProUCL input sheet; these values are indicated as non-detect to the program by a non-detect flag. The handling of non-detected results varies by statistical method used, but when data are entered with the non-detect flag, any statistics based on the ½ detection limit method would be indicated as such in the results. No statistics based on the ½ detection limit were selected for use in the HHERA. Selected 95% UCLs are presented in Appendix F.

The EPC used to quantify groundwater exposure doses at LSS was based on exposure at a single point rather than an average across the exposure area. The EPC for potable use of groundwater is based on the assumption that a hypothetical future resident obtains all of his or her water from a single well. To capture the highest cumulative cancer risk and noncancer hazard associated with potential potable use of groundwater, potable water risk and hazard calculations were performed as described below for all COPCs in every well (Appendix I, Table I-29 through I-31). By this analysis, it was determined that Monitoring Well MW03LSS had the highest cumulative incremental lifetime cancer risk (ILCR) and hazard index (HI) estimates for the potable water pathway of any monitoring well at LSS; therefore, COPC concentrations in MW03LSS were used as the groundwater EPC for potable use exposures at LSS. It should be noted that ILCR or HQ estimates for individual COPCs were sometimes higher in wells other than MW03LSS (refer to Table I-31). Although data from other wells were not included in the hypothetical future resident cumulative risk and hazard estimate, chemicals detected at elevated concentrations in wells other than MW03LSS are presented in the results (Section 4.5.2) and included in the derivation of RBCLs.

In a similarly fashion, the EPC for the vapor intrusion from groundwater to above ground indoor air pathway at LSS was based on the assumption that a hypothetical future building will be constructed over the area of highest vapor intrusion risk. A summary of risk and hazard estimates for all volatile COPCs detected in groundwater monitoring wells at LSS is presented in Appendix I, Table I-32. Based on this comparison, Monitoring Well MW07LSS was determined to have the highest potential risk and hazard for the vapor intrusion pathway.

4.2.2 Calculating Exposure Doses

This section describes HHRA methods for quantifying exposure doses for human receptors. As described in Section 4.1, complete and significant exposure pathways between human receptors and site-related COPCs include direct contact pathways (i.e., incidental ingestion and dermal contact) and inhalation of VOCs or particulates derived from soil, sediment, or groundwater. Potential exposures and risks related to other pathways and media were qualitatively evaluated in the HHRA. The dose equations to be used in the quantification of direct exposure pathways are consistent with ADEC and EPA guidance for conducting exposure assessments (ADEC, 2011a; USEPA, 1989a, 2007b, 2008a).

The general exposure dosage equations presented below are the basis of exposure modeling for current/future site workers and site visitors and hypothetical future residents. With the inclusion of carcinogenic modes of action (e.g. mutagenic and vinyl chloride-specific; USEPA, 2007b), exposures are averaged for different stages of development by applying age-adjusted factors, and more specific equations are needed. Where available and applicable, default ADEC or EPA exposure parameters were used in the HHRA for the four NSS Areas. Additional assumptions, equations, and age-adjusted factors used in quantifying exposures for human receptors are provided in **Table 4-1** and Appendix G of this HHERA Report.

4.2.2.1 Soil

Equations for quantifying potential exposures to human receptors through incidental ingestion, dermal contact, and inhalation of COPCs in soil are presented below.

Incidental Ingestion:

$$\text{Incidental Ingestion Intake}\left(\frac{\text{mg}}{\text{kg}\times\text{day}}\right)=\frac{C_s\times IR_s\times CF\times EF\times ED}{BW\times AT}$$

Where:

C_s = Concentration in soil (mg/Kg)
IR_s = Ingestion rate (milligrams [mg] soil/day)
CF = Conversion factor (10^{-6} kilograms [kg]/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged – days)

Dermal Contact:

$$\text{Dermal Absorption Intake}\left(\frac{\text{mg}}{\text{kg}\times\text{day}}\right)=\frac{C_s\times AF\times ABS\times SA\times CF\times EF\times ED}{BW\times AT}$$

Where:

C_s = Concentration in soil (mg/Kg)
AF = Adherence factor of soil (mg/square centimeter [cm^2]-day)
ABS = Skin absorption factor (unitless)
SA = Skin surface area exposed (cm^2)
CF = Conversion factor (10^{-6} kg/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged – days)

Inhalation of Volatiles and Fugitive Dust:

$$\text{Inhalation Concentration}\left(\frac{\text{mg}}{\text{kg}\times\text{dm}^3}\right)=\frac{C_s\times\left(\frac{1}{PEF}+\frac{1}{VF}\right)\times EF\times ED}{AT}$$

Where:

C_s = Concentration in soil (mg/Kg)
PEF = Particulate emission factor (m^3/kg)
VF = Volatilization factor (cubic meter [m^3]/kg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
AT = Averaging time (period over which exposure is averaged – days)

4.2.2.2 Potable water

Equations for quantifying potential exposure of human receptors through potable uses of groundwater or surface water are presented below.

Ingestion:

$$\text{Ingestion Intake}\left(\frac{\text{mg}}{\text{kg}\times\text{day}}\right)=\frac{C_w\times IR_w\times EF\times ED}{BW\times AT}$$

Where:

C_w = Concentration in water (mg/L)
IR_w = Water ingestion rate (liters groundwater/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)

Dermal Contact:

$$\text{Dermal Absorption Intake}\ \left(\frac{\text{mg}}{\text{kg} \times \text{day}}\right) = \frac{\text{EV} \times \text{SA} \times \text{DA}_e \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where:

EV	= Event frequency (events/day)
SA	= Skin surface area exposed (cm^2)
DA_e	= Absorbed dose per event (mg /cm^2 - event)
EF	= Exposure frequency (days/year)
ED	= Exposure duration (years)
BW	= Body weight (kg)
AT	= Averaging time (period over which exposure is averaged – days)

Inhalation:

$$\text{Concentration of VOCs in Air from Water}\ \left(\frac{\text{mg}}{\text{m}^3}\right) = \frac{\text{C}_w \times \text{CF} \times \frac{1}{24} \times \text{VF} \times \text{ET} \times \text{EF} \times \text{ED}}{\text{AT}}$$

Where:

C_w	= Concentration in groundwater (mg/liter)
CF	= Conversion factor (liters/m^3)
VF	= Volatility factor (unitless)
ET	= Exposure time (hours/day)
EF	= Exposure frequency (days/year)
ED	= Exposure duration (years)
AT	= Averaging time (period over which exposure is averaged – days)

The vapor intrusion to indoor air pathway was evaluated using EPA's version of the Johnson and Ettinger Vapor Intrusion Model (J&E Model) (Appendix H). Current versions of the J&E Model are available for evaluating detections of VOCs in soil vapor or groundwater. Because soil vapor data has not been collected at the four NSS Areas, quantitative evaluations of the vapor intrusion to indoor air pathway was limited to VOCs in groundwater. Modeling of indoor air concentrations and risk estimates for the vapor intrusion pathway was performed in accordance with EPA's *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (USEPA, 2004b) and ADEC's *Draft Vapor Intrusion Guidance for Contaminated Sites* (ADEC, 2009b).

4.3 TOXICITY ASSESSMENT

This section describes the toxicity assessment methodology used in the evaluation of human health risks for the four NSS Areas. Human health toxicity assessment methods were developed in accordance with ADEC and EPA guidance (ADEC, 2011a; USEPA, 1989a).

Toxicity assessment involves a critical review and interpretation of toxicology data from epidemiological, clinical, animal, and in vitro studies. A review of toxicology data ideally determines both the nature of health effects associated with a particular chemical and the probability that a given dose of a chemical could result in an adverse health effect. In accordance with the EPA's 2003 Directive (USEPA, 2003) and ADEC's RAPM (ADEC, 2011a), the following hierarchy of sources of toxicity values was used in the baseline HHRA for the four NSS Areas:

1. Integrated Risk Information System (IRIS) Database (USEPA, 2012a).
2. *Provisional Peer Reviewed Toxicity Values (PPRTVs)* (USEPA, 2012b)
3. Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (ATSDR, 2010).
4. California Environmental Protection Agency *Toxicity Criteria Database* (OEHHA, 2012).
5. Screening Toxicity Value Appendices to PPRTVs (USEPA, 2010a)
6. *Health Effects Assessment Summary Tables* (HEAST) (USEPA, 1997a).
7. *Cleanup Level Guidance*, Table 2 (ADEC, 2008d).
8. Other professionally peer reviewed documents, as needed and as approved by ADEC on a case-by-case basis.

Toxicology information important for quantitative risk assessment of long-term health effects is generally divided into the following two categories:

- Potential for carcinogenic health effects.
- Potential for chronic noncarcinogenic, adverse health effects.

4.3.1 Carcinogenic Effects of COPCs

Carcinogenic effects of COPCs were evaluated according to the EPA's *Cancer Guidelines and Supplemental Guidance* (USEPA, 2007b). The cancer slope factor (CSF) is the toxicity value used to quantitatively express the carcinogenic potential of cancer-causing constituents following oral and dermal exposures. The CSF is expressed as the inverse of milligrams per kilogram per day $(mg/Kg\text{-}day)^{-1}$ and represents the cancer risk per unit daily intake of a carcinogenic chemical. The CSF represents the 95% upper confidence interval of the slope of the dose response curve. The 95% upper confidence interval ensures a safety factor to protect the most sensitive receptors. For inhalation exposures, the carcinogenic potential is expressed as a unit risk factor (URF) in units of cubic meters per microgram ($m^3/\mu g$). The URF assumes a body weight of 70 kilograms, an inhalation rate of 20 cubic meters per day (m^3/day), and a continuous lifetime exposure. CSF and URF values for NSS are presented in **Table 4-2**.

4.3.2 Noncarcinogenic Effects of COPCs

The reference dose (RfD) is the toxicity value used to quantitatively express the potential for a chemical to produce chronic, noncarcinogenic effects following oral and dermal exposures. The RfD is expressed in units of mg/Kg-day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern for the contaminant. The potential for noncarcinogenic effects following inhalation exposure is expressed as a reference concentration (RfC) in units of milligrams per cubic meter (mg/m^3).

Exposure doses that are above the RfD or RfC, the threshold doses for noncarcinogens, could potentially cause adverse health effects. Confidence in the RfD and RfC is subjective, based on EPA review groups and the quality of the supporting database. Chemical-specific RfDs and RfCs do not account for the potential effects of chemical mixtures.

RfDs and RfCs are generally based on no observable adverse effect levels (NOAELs) derived from animal studies. When NOAEL values are unavailable, a lowest observable adverse effect level (LOAEL) is generally used. An uncertainty factor is typically incorporated into the RfD or RfC to reduce the numerical value, resulting in a more conservative toxicity value.

In addition to uncertainty factors, modifying factors are often used in calculating RfDs or RfCs. A modifying factor ranging from 0 to 10 can be included to reflect a qualitative, professional assessment of additional uncertainties in critical studies and available databases. RfDs and RfCs for NSS are presented in Table 4-2.

4.3.3 Chemical-Specific Assumptions

For several chemicals present at the four NSS Areas, additional interpretation of the toxicological literature is required. Some contaminants for which chemical-specific assumptions were employed include chromium, lead, and petroleum hydrocarbons (PHCs [DRO, GRO, and RRO]), as discussed below.

Chromium. Hexavalent chromium analysis was performed for a subset of soil samples at Areas where elevated total unspeciated chromium concentrations were detected. In instances where total chromium was detected at or above the NSS background concentration of 38.0 mg/Kg, additional analysis for hexavalent chromium was performed. Either an additional sample was collected from the same location, or, if the sample was still within hold time, the original sample was reanalyzed. Of the 192 metals samples for total chromium, there were a total of 19 sample locations with detections greater than 38.0 mg/Kg. A total of 22 samples (including three duplicates) were subsequently analyzed for hexavalent chromium, with 14 non-detect results. The remaining eight detections ranged from 0.09 to 0.89 mg/Kg hexavalent chromium. These results are sufficient to determine the presence of hexavalent chromium at NSS; however, there was no apparent correlation between total chromium to hexavalent chromium, so no ratio could be calculated.

Toxicity values are available for trivalent chromium and hexavalent chromium. At sites where chromium speciation data were available, total chromium was evaluated as trivalent chromium, and hexavalent chromium was evaluated as hexavalent chromium. Although there are no known sources of hexavalent chromium at the NSS, two scenarios were evaluated for total unspeciated chromium in groundwater at LSS and subsurface soil at Area A, where only total chromium data were available: one assuming all detected chromium was present as trivalent chromium, and a second assuming that all detected chromium was present as hexavalent chromium. Both results are presented in Section 4.5 for comparison.

Lead. Lead was selected as a COPC in soil at USS, and in groundwater at LSS. The quantification of lead exposure differs from other COPCs. Cause-and-effect relationships in humans have been correlated with blood concentrations of lead. Therefore, the preferred risk assessment approach for lead is the estimation of human blood lead concentrations associated with an exposure situation. The *Adult Lead Model* (USEPA, 2009) was used to predict blood lead levels for current/future site workers exposed to lead in soil at USS, as recommended by ADEC (2011a). Effects of exposure to lead in groundwater at LSS were not evaluated for the current/future site worker, because water exposures are not quantified in the *Adult Lead Model*. In addition to the *Adult Lead Model,* the *Integrated Exposure Uptake Biokinetic Model* (IEUBK; USEPA, 2010b) was used to evaluate potential impacts of exposure of a hypothetical future child residential receptor to lead in soil at USS and lead in groundwater at LSS. A summary of human blood lead estimates is presented in **Table 4-3**.

Petroleum Hydrocarbons. PHCs were selected as COPCs at LSS and Area A. Methods available for assessing risks from petroleum constituents include the following:

- Evaluating specific toxic indicator compounds of petroleum mixtures, such as PAHs and benzene, toluene, ethylbenzene, and xylenes (BTEX).
- Interpreting toxicity information developed for neat petroleum products, such as gasoline, diesel, or residual.
- Interpreting toxicity values developed for petroleum components that are chemically and toxicologically representative of other components.
- Interpreting toxicity values developed for surrogate mixtures toxicologically similar to PHC mixtures to which human or ecological receptors are potentially exposed.

Although no universally accepted method is currently available for evaluating human risks associated with exposures to petroleum mixtures, toxicity values have been developed for neat petroleum products and for surrogate petroleum fractions. ADEC has developed RfDs and RfCs for PHC ranges. The values published in *Guidance for Cleanup of Petroleum Contaminated Sites* (ADEC, 2000) were used to evaluate potential health hazards associated with human exposures to DRO, GRO, and RRO.

Potential dermal exposures to DRO, GRO, and RRO were not quantitatively evaluated in the baseline HHRA due to uncertainties in extrapolating oral RfDs to the dermal route of administration. Potential uncertainties in not quantifying this pathway are addressed in the uncertainty analysis (refer to Section 6.3).

Petroleum indicator compounds, including BTEX and PAHs, were analyzed during the RFI. Assessing risks for these indicator compounds and petroleum mixtures, as described above, could result in quantifying exposures for certain petroleum constituents twice. To avoid this potential overestimation, risks associated with indicator compounds were included in cumulative risk and hazard estimates for LSS and Area A, while health hazards associated with petroleum mixtures were evaluated and reported separately.

4.4 RISK CHARACTERIZATION

The Tier II baseline human health risk characterization for the four NSS Areas integrated the results of exposure and toxicity assessments described in Sections 4.1, 4.2, and 4.3 to derive a quantitative and qualitative evaluation of potential risks to current and potential future human receptors. Methods used in the characterization of Tier II baseline human health risks are described below.

Calculated exposure doses for each COPC identified for site media were used to estimate chemical-specific and cumulative cancer risks, as well as non-cancer HQs and HIs.

Risk of developing cancer from exposure to a carcinogenic chemical is estimated by multiplying the CSF by the exposure dose (USEPA, 1989a):

$$\text{ILCR (unitless)} = \text{Dose (or Concentration)} \times \text{CSF (or URF)}$$

Where:

ILCR = Incremental lifetime cancer risk (unitless)
Dose = Exposure dose (mg/Kg-day)
CSF = Cancer slope factor $(\text{mg/Kg-day})^{-1}$
URF = Unit Risk Factor $(\text{micrograms } [\mu g]/m^3)^{-1}$

Cancer risks from multiple COPCs identified for a site medium and through multiple modes of action are assumed to be additive and were summed to estimate a cumulative ILCR for all carcinogenic site contaminants in that medium. Additionally, cancer risks calculated for various site media were summed across media, as appropriate, to estimate cumulative ILCRs for each receptor.

The HQ describes the potential for site COPCs to produce noncarcinogenic effects. HQ is defined as the ratio of the exposure dose to the RfD (USEPA, 1989a):

$$\text{HQ (unitless)} = \frac{\text{Dose (or Concentration)}}{\text{RfD (or RfC)}}$$

Where:

Dose = Exposure dose (mg/Kg-day)
RfC = Reference concentration (mg/m^3)
RfD = Reference dose (mg/Kg-day)

An HQ greater than 1 indicates that the estimated exposure dose for that COPC may not be protective of noncarcinogenic health effects. An HQ of less than 1 suggests that noncarcinogenic health effects should not occur. Individual HQs for NSS COPCs were summed to produce a cumulative hazard estimate, termed the HI. In cases where the cumulative HI exceeds 1, the HI was re-evaluated based on target organ effects and a maximum target organ-specific HI was reported. This procedure is consistent with standard published risk assessment guidance (USEPA, 1989a; ADEC, 2011a).

ADEC currently considers a cumulative cancer risk of 1 x 10^{-5} and noncancer HI of 1 as the point of departure for making risk management decisions concerning a site. Sites with associated cumulative cancer risk and noncancer HI estimates that exceed these criteria are proposed for further evaluation, or consideration of remedial alternatives. It is worth noting that a cumulative Site ILCR of 1 x 10^{-5} represents the mid-point of the EPA's acceptable risk management range of 1 x 10^{-6} to 1 x 10^{-4} for carcinogenic chemicals, as per the National Contingency Plan (40 Code of Federal Regulations [CFR], Part 300) and EPA guidance (USEPA, 1991b). According to ADEC (18 AAC 75.325(h)) and the EPA (USEPA, 1991b), sites with a cumulative cancer risk estimate between 1 x 10^{-6} and 1 x 10^{-4}, and a noncancer HI of less than 1, may be appropriate for conditional closure. Conditional closure will be considered following an evaluation of site-specific issues related to future land uses, the technical feasibility of remediation, and related considerations.

4.5 RESULTS

4.5.1 Upper Site Summit

Risk characterization results expressed as cumulative carcinogenic ILCR and noncarcinogenic HI estimates for human receptors at USS are presented below and summarized in **Table 4-4**. Detailed carcinogenic ILCR and noncarcinogenic HI calculations are presented in Appendix I.

Environmental media sampled at USS during the RFI include surface soil, subsurface soil, and groundwater. As discussed in Sections 3.3.1 and 3.4.1.4, subsurface water encountered at USS was extremely limited, and does not represent an exposure media. Surface water and sediment were not encountered at USS during sampling, and evidence of surface water is limited to drainages that are occasionally wet when rainfall exceeds infiltration capacity. Therefore, risk and hazard estimates were calculated for surface and subsurface soil only. The cumulative site media risk and hazard estimates are equal to the risk and hazard estimates for surface or subsurface soil, whichever is greater. Results are presented below for non-PHC COPCs in surface and subsurface soil. PHCs were not selected as COPCs at USS.

Current and Future Site Worker

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site worker exposed to USS surface soil were 2 x 10^{-5} and 0.07, respectively, for non-PHC COPCs. The primary contributors to a carcinogenic risk estimate in excess of ADEC's acceptable risk criterion of 1 x 10^{-5} were arsenic (EPC = 9.84 mg/Kg) and benzo(a)pyrene (EPC = 1.37 mg/Kg). The noncarcinogenic HI estimate for surface soil is below ADEC's acceptable HI criterion of 1.

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site worker exposed to subsurface soil at USS were 3 x 10^{-5} and 0.02, respectively, for non-PHC COPCs. The primary contributor to a carcinogenic risk estimate in excess of ADEC's acceptable risk criterion of 1 x 10^{-5} was benzo(a)pyrene (EPC = 3.71 mg/Kg). The noncarcinogenic HI estimate for subsurface soil is less than ADEC's acceptable risk and HI criterion of 1.

Current and Future Site Visitor

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site visitor exposed to surface soil at USS were 2 x 10^{-6} and 0.006, respectively, for non-PHC COPCs. These cumulative carcinogenic risk and noncarcinogenic HI estimates are less than ADEC's acceptable risk and HI criteria of 1 x 10^{-5} and 1, respectively.

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site visitor exposed to subsurface soil at USS were 3 x 10^{-6} and 0.002, respectively, for non-PHC COPCs. These cumulative carcinogenic risk and noncarcinogenic HI estimates are less than ADEC's acceptable risk and HI criteria of 1 x 10^{-5} and 1, respectively.

Hypothetical Future Resident

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a hypothetical future resident exposed to surface soil at USS were 5 x 10^{-5} and 0.7, respectively, for non-PHC COPCs. The primary contributors to a carcinogenic risk estimate in excess of ADEC's acceptable risk criterion of 1 x 10^{-5} were arsenic (EPC = 9.84 mg/Kg) and benzo(a)pyrene (EPC = 1.37 mg/Kg). The noncarcinogenic HI estimate is below ADEC's acceptable HI criterion of 1.

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a hypothetical future resident exposed to subsurface soil at USS were 7 x 10^{-5} and 0.2, respectively, for non-PHC COPCs. The primary contributors to a carcinogenic risk estimate in excess of ADEC's acceptable risk criterion of 1 x 10^{-5} were benzo(a)pyrene (EPC = 3.71 mg/Kg) and dibenz(a,h)anthracene (EPC = 0.846 mg/Kg). The noncarcinogenic HI estimate is below ADEC's acceptable HI criterion of 1.

4.5.2 Lower Site Summit

Risk characterization results expressed as cumulative carcinogenic ILCR and noncarcinogenic HI estimates for human receptors at LSS are presented below and summarized in **Table 4-5**. Detailed carcinogenic ILCR and noncarcinogenic HI calculations are presented in Appendix I.

Media sampled at LSS during the RFI included surface soil, subsurface soil, and groundwater. Surface water and sediment were not encountered at LSS during sampling. Soil exposures were evaluated for all receptors. The vapor intrusion from groundwater to indoor air pathway was evaluated for current and future site workers and hypothetical future residents, while potable use of groundwater was evaluated for a hypothetical future resident only. As described in Section 4.2.1, the EPCs for groundwater constituents for the vapor intrusion and potable use pathways were equal to the detected concentration in the monitoring well with the highest cumulative cancer risk and noncancer hazard out of all monitoring wells at LSS. The highest risk wells were MW07LSS and MW03LSS for the vapor intrusion and potable use pathways, respectively (Appendix I, Table I-31 and Table I-32). Results for all chemical risk drivers identified for the vapor intrusion and potable use pathways are presented in Table 4-5 and described below. However, if a chemical risk driver was identified in a well that was not the highest risk well, the risk and hazard estimates for that chemical were not included in the cumulative risk and hazard for the site.

For the current and future site worker, the cumulative site media risk and hazard estimates are equal to the sum of the risk and hazard estimates for indoor air and the risk and hazard estimates for surface or subsurface soil, whichever is greater. For the current and future site visitor, the cumulative site media risk and hazard estimates are equal to the risk and hazard estimates for surface or subsurface soil, whichever is greater. For the hypothetical future resident, the cumulative site media risk and hazard estimates are equal to the sum of the risk and hazard estimates for indoor air, potable use of groundwater, and surface or subsurface soil, whichever is greater.

Current and Future Site Worker

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site worker exposed to soil and indoor air at LSS were 2 x 10^{-4} and 2, respectively, for non-PHC COPCs. ADEC's acceptable risk criterion of 1 x 10^{-5} was exceeded in surface soil and subsurface soil. The primary contributors to an ILCR in excess of 1 x 10^{-5} in surface soil were benzo(a)pyrene (EPC = 7.74 mg/Kg), dibenz(a,h)anthracene (EPC = 6.12 mg/Kg), and pentachlorophenol (EPC = 46.5 mg/Kg). The primary contributors to an ILCR in excess of 1 x 10^{-5} in subsurface soil were 1,2,3-trichloropropane (EPC = 0.491 mg/Kg) and 1,2-dibromo-3-chloropropane (EPC = 3.04 mg/Kg). PHCs were not selected as COPCs in subsurface soil at LSS.

ADEC's acceptable hazard criterion of 1 was not exceeded individually in indoor air, surface soil, or subsurface soil. The primary contributor to a cumulative site media noncarcinogenic HI for non-PHC-related COPCs in excess of 1 was 1,1,2-trichloroethane in subsurface soil (EPC = 1.65 mg/Kg). The cumulative noncarcinogenic HI estimate for current and future site workers exposed to PHC-related COPCs at LSS was 0.05. This noncarcinogenic HI estimate is less than ADEC's acceptable HI criterion of 1.

Current and Future Site Visitor

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site visitor exposed to subsurface soil at LSS were 2 x 10^{-5} and 0.1, respectively, for non-PHC COPCs. The primary contributor to an ILCR in excess of 1 x 10^{-5} in subsurface soil was 1,2-dibromo-3-chloropropane. The noncarcinogenic HI estimate is less than ADEC's acceptable HI criterion of 1. PHCs were not selected as COPCs in subsurface soil at LSS.

Cumulative carcinogenic risk and noncarcinogenic HI estimates for a current and future site visitor exposed to surface soil at LSS were 9 x 10^{-6} and 0.006, respectively, for non-PHC COPCs. These cumulative carcinogenic risk and noncarcinogenic HI estimates are less than ADEC's acceptable risk and HI criteria of 1 x 10^{-5} and 1, respectively.

The cumulative noncarcinogenic HI estimate for a current and future site visitor exposed to PHC-related COPCs in surface soil at LSS was 0.005. This noncarcinogenic HI estimate is less than ADEC's acceptable HI criterion of 1.

Hypothetical Future Resident

Risk and hazard estimates for a hypothetical future resident at LSS include exposure to groundwater as a potable water source. Groundwater samples collected at LSS included unfiltered samples collected for total metals analysis and filtered samples collected for dissolved metals analysis. It is assumed, given the poor quality of groundwater at NSS, that residents would filter groundwater before using it for potable applications. However, it is ADEC's policy to manage risk based on potable use of unfiltered water. In order to present a balanced HHRA, filtered and unfiltered groundwater data were both included in risk and hazard calculations for potable use pathways for comparison purposes. Risk and hazard calculations for field filtered and unfiltered groundwater were calculated using groundwater concentrations measured at the monitoring well with the highest cumulative ICLR and HI (MW03LSS), as described above.

COPCs identified for the potable use pathway included chromium, which was only reported as total unspeciated chromium. Although no suspected sources of hexavalent chromium are present at LSS, noncarcinogenic hazard assuming total unspeciated chromium as trivalent chromium, and carcinogenic risk and noncarcinogenic hazard assuming total unspeciated chromium as hexavalent chromium were both conservatively calculated. Total unspeciated chromium was not detected in filtered water samples from MW03LSS. As a consequence, cumulative site media risk and hazard estimates for exposure of a hypothetical future resident to non-PHC related COPCs are presented in Table 4-5 and described below in three scenarios:

- Unfiltered groundwater where all chromium is present as trivalent chromium.
- Unfiltered groundwater where all chromium is present as hexavalent chromium.
- Filtered groundwater.

Risk and hazard due to exposure to metals in groundwater is not incorporated into the PHC hazard estimate, and samples collected for PHC analysis were not filtered. Therefore, the above three scenarios do not affect the PHC hazard estimate.

Unfiltered Groundwater, Trivalent Chromium. Based on the assumptions that groundwater is not filtered prior to potable use, and all chromium detected in groundwater is present as trivalent chromium, the cumulative carcinogenic risk and noncarcinogenic HI estimates for a hypothetical future resident across all exposure media were 1 x 10^{-3} and 33, respectively, for non-PHC COPCs. ADEC's acceptable risk criterion of 1 x 10^{-5} was exceeded in indoor air, surface soil, subsurface soil, and groundwater. The primary contributors to a carcinogenic risk estimate in excess of 1 x 10^{-5} were:

- Naphthalene (EPC = 0.168 mg/L in groundwater) in modeled indoor air.
- Arsenic (EPC = 8.15 mg/Kg), pentachlorophenol (EPC = 46.5 mg/Kg), benzo(a)anthracene (EPC = 7.98 mg/Kg), benzo(a)pyrene (EPC = 7.74 mg/Kg), benzo(b)fluoranthene (EPC = 8.66 mg/Kg), and dibenz(a,h)anthreacene (EPC = 6.12 mg/Kg) in surface soil.
- 1,2,3-Trichloropropane (EPC = 0.491 mg/Kg) and 1,2-dibromo-3-chloropropane (EPC = 3.04) in subsurface soil.

- Total arsenic (EPC = 0.0322 mg/L) and naphthalene (EPC = 0.0685 mg/L) in groundwater.

ADEC's acceptable HI criterion of 1 was exceeded in groundwater and subsurface soil. Primary contributors to an HI greater than 1 in groundwater were: total arsenic (EPC = 0.0322 mg/L), naphthalene (EPC = 0.0685 mg/L), total vanadium (EPC = 0.109 mg/L), and 2-methylnaphthalene (EPC = 0.0735 mg/L). The primary contributor to an HI greater than 1 in subsurface soil was 1,1,2-trichloroethane (EPC = 1.65 mg/Kg). Because the chemical-specific HQs for total arsenic, total vanadium, 2-methylnaphthalene, and naphthalene in groundwater and 1,1,2-trichloroethane were greater than 1, target organ-specific HI estimates were not calculated.

Unfiltered Groundwater, Hexavalent Chromium. Based on the assumptions that groundwater is not filtered prior to potable use, and all chromium detected in groundwater is present as hexavalent chromium, the cumulative carcinogenic risk and noncarcinogenic HI estimates for a hypothetical future resident across all exposure media were 2 x 10^{-3} and 36, respectively, for non-PHC COPCs. ADEC's acceptable risk criterion of 1 x 10^{-5} was exceeded in indoor air, surface soil, subsurface soil, and groundwater; the acceptable HI criterion of 1 was exceeded in groundwater and subsurface soil. Primary contributors to a carcinogenic risk greater than 1 x 10^{-5} and a noncarcinogenic HI greater than 1 are as described above, with the addition of total unspeciated chromium assumed as total hexavalent chromium (EPC = 0.0525 mg/L) in groundwater. Because the chemical-specific HQs for total arsenic, total chromium assumed as hexavalent chromium, total vanadium, trichloroethylene, 2-methylnaphthalene, and naphthalene in groundwater were greater than 1, target organ-specific HI estimates were not calculated.

Unfiltered Groundwater. Based on the assumptions that groundwater is filtered prior to potable use, the cumulative carcinogenic risk and noncarcinogenic HI estimates for a hypothetical future resident across all exposure media were 5 x 10^{-4} and 14, respectively, for non-PHC COPCs. ADEC's acceptable risk criterion of 1 x 10^{-5} was exceeded in indoor air, surface soil, subsurface soil, and groundwater; the acceptable HI criterion of 1 was exceeded in groundwater and subsurface soil. The primary contributors to a carcinogenic risk estimate in excess of 1 x 10^{-5} in indoor air, surface soil, and subsurface soil are as described for unfiltered groundwater, above. The primary contributors to a carcinogenic risk estimate in excess of 1 x 10^{-5} in groundwater were dissolved arsenic (EPC = 0.00454 mg/L) and naphthalene (EPC = 0.0685 mg/L). The primary contributors to a noncarcinogenic hazard estimate greater than 1 were dissolved arsenic, naphthalene, and 2-methylnaphthalene (EPC = 0.0735 mg/L). Because the chemical-specific HQs for dissolved arsenic, 2-methylnaphthalene, and naphthalene in groundwater were greater than 1, target organ-specific HI estimates were not calculated.

The cumulative noncarcinogenic HI estimate for a hypothetical future resident exposed to PHC-related COPCs was 95. The acceptable noncarcinogenic HI criterion of 1 was exceeded in groundwater, and the primary contributor was DRO (EPC = 29.4 mg/L).

It should be noted that although cumulative risk and hazard estimates calculated based on exposure to COPCs at concentrations detected in MW03LSS and MW07LSS were the highest across all monitoring wells at LSS for the potable use and vapor intrusion pathways, respectively, some individual COPCs were detected at higher concentrations in other wells. For the potable use pathway (Table I-31), risk and hazard due to trichloroethylene exposure exceeded ADEC's acceptable risk criterion for carcinogenic chemicals in MW06LSS (EPC = 0.0175 mg/L) and ADEC's acceptable noncancer hazard criterion in MW04LSS (EPC = 0.00372 mg/L) and MW06LSS. In filtered groundwater samples, ADEC's acceptable risk criterion was exceeded by dissolved total chromium assumed as hexavalent chromium in MW10LSS (EPC = 0.0159 mg/L), and ADEC's acceptable noncancer hazard criterion was exceeded by dissolved vanadium in MW10LSS (EPC = 0.0327 mg/L). For the vapor intrusion from groundwater to indoor air pathway (Table I-32), ADEC's acceptable cancer risk criterion was exceeded by trichloroethylene in MW06LSS (EPC = 0.0175 mg/L).

4.5.3 Area A

Risk characterization results expressed as cumulative carcinogenic ILCR and noncarcinogenic HI estimates for human receptors at Area A are presented below and summarized in **Table 4-6**. Detailed carcinogenic ILCR and noncarcinogenic HI calculations are presented in Appendix I.

Media sampled at Area A during the RFI included surface soil and subsurface soil, and the cumulative site media risk and hazard estimates are equal to the risk and hazard estimates for surface or subsurface soil, whichever is greater. Subsurface soil samples collected at Area A were not analyzed for hexavalent chromium. Although no suspected sources of hexavalent chromium are present at Area A, noncarcinogenic hazard assuming total unspeciated chromium as trivalent chromium, and carcinogenic risks and noncarcinogenic hazard assuming total unspeciated chromium as hexavalent chromium, were calculated. Results for both scenarios are presented in Table 4-6 and described below. Risk due to exposure to metals is included in the cumulative non-PHC risk and hazard estimates; therefore, these two scenarios do not affect the PHC hazard.

Current and Future Site Worker

When total chromium detected in subsurface soil at Area A was assumed to be present as trivalent chromium, current/future site worker cumulative carcinogenic risk and noncarcinogenic HI estimates for non-PHC COPCs across all exposure media were 4×10^{-8} and 0.01, respectively. When total chromium detected in subsurface soil was assumed to be present as hexavalent chromium, cumulative carcinogenic risk and noncarcinogenic HI estimates for non-PHC COPCs across all exposure media were 6×10^{-6} and 0.02, respectively. These cumulative carcinogenic risk and noncarcinogenic HI estimates are less than ADEC's acceptable risk and HI criteria of 1×10^{-5} and 1, respectively. The cumulative noncarcinogenic HI estimate for a current and future site worker exposed to PHC-related COPCs was 1. This noncarcinogenic HI estimate is not greater than ADEC's acceptable HI criterion of 1.

Current and Future Site Visitor

When total chromium detected in subsurface soil at Area A was assumed to be present as trivalent chromium, current/future site visitor cumulative carcinogenic risk and noncarcinogenic HI estimates for non-PHC COPCs across all exposure media were 4 x 10^{-9} and 0.001, respectively. When total chromium detected in subsurface soil was assumed to be present as hexavalent chromium, cumulative carcinogenic risk and noncarcinogenic HI estimates for non-PHC COPCs across all exposure media were 6 x 10^{-7} and 0.002, respectively. These cumulative carcinogenic risk and noncarcinogenic HI estimates are less than ADEC's acceptable risk and HI criteria of 1 x 10^{-5} and 1, respectively. The cumulative noncarcinogenic HI estimate for the current and future site visitor exposed to PHC related COPCs was 0.08. This noncarcinogenic HI estimate is below ADEC's acceptable HI criterion of 1.

Hypothetical Future Resident

When total chromium detected in subsurface soil at Area A was assumed to be present as trivalent chromium, hypothetical future resident cumulative carcinogenic risk and noncarcinogenic HI estimates for non-PHC COPCs across all exposure media were 6 x 10^{-8} and 0.03, respectively. These cumulative carcinogenic risk and noncarcinogenic HI estimates are less than ADEC's acceptable risk and HI criteria of 1 x 10^{-5}, and 1, respectively. When total chromium detected in subsurface soil was assumed to be present as hexavalent chromium, cumulative carcinogenic risk and noncarcinogenic HI estimates for non-PHC COPCs across all exposure media were 2 x 10^{-5} and 0.1, respectively. ADEC's acceptable risk criterion of 1 x 10^{-5} was exceeded in subsurface soil, but not in surface soil. The primary contributor to a carcinogenic risk estimate in excess of ADEC's acceptable risk criterion of 1 x 10^{-5} was total chromium, assumed to be present as hexavalent chromium (EPC = 34.0 mg/Kg) in subsurface soil. The noncarcinogenic HI estimate for non-PHC related COPCS in this scenario is below ADEC's acceptable HI criterion of 1.

The cumulative noncarcinogenic HI estimate for a hypothetical future resident exposed to PHC-related COPCs was 10. ADEC's acceptable HI criterion of 1 was exceeded for PHC-related COPCs in surface and subsurface soil at Area A. The primary contributors to a noncarcinogenic HI in excess of ADEC's acceptable HI criterion of 1 in surface soil were DRO (EPC = 8,369 mg/Kg) and RRO (EPC = 63,887 mg/Kg). The primary contributor to a noncarcinogenic HI in excess of ADEC's acceptable HI criterion of 1 in subsurface soil was DRO (EPC = 8,583 mg/Kg).

4.5.4 Area C

Risk characterization results expressed as cumulative carcinogenic ILCR and noncarcinogenic HI estimates for human receptors at Area C are presented below and summarized in **Table 4-7**. Detailed carcinogenic ILCR and noncarcinogenic HI calculations are presented in Appendix I.

Media sampled at Area C during the RFI included surface soil, surface water, and sediment. COPCs were identified in surface soil only; therefore, the cumulative site media risk estimate is equal to the surface soil risk estimate for all receptors.

Current and Future Site Worker

The cumulative carcinogenic risk estimate for a current and future site worker exposed to surface soil at Area C was 1 x 10^{-5} for non-PHC COPCs. This carcinogenic risk estimate is not greater than ADEC's acceptable risk criterion of 1 x 10^{-5}. Non-carcinogenic chemicals and PHCs were not selected as COPCs at Area C, so a non-carcinogenic HI was not calculated for the site.

Current and Future Site Visitor

The cumulative carcinogenic risk estimate for a current and future site visitor exposed to surface soil at Area C was 1 x 10^{-6} for non-PHC COPCs. This carcinogenic risk estimate is less than ADEC's acceptable risk criterion of 1 x 10^{-5}. Non-carcinogenic chemicals and PHCs were not selected as COPCs at Area C, so a non-carcinogenic HI was not calculated for the site.

Hypothetical Future Resident

The cumulative carcinogenic risk estimate for a hypothetical future site resident exposed to surface soil at Area C was 3 x 10^{-5} for non-PHC COPCs. The primary contributor to a carcinogenic risk estimate in excess of ADEC's acceptable risk criterion of 1 x 10^{-5} was benzo(a)pyrene (EPC = 1.62 mg/Kg). Non-carcinogenic chemicals and PHCs were not selected as COPCs at Area C, so a non-carcinogenic HI was not calculated for the site.

Table 4-1 Exposure Assumptions for the Human Health Risk Assessment

Exposure Parameter	Units	Current/Future Site Worker [a]	Current/Future Site Visitor [b]	Hypothetical Future Resident[c]	
		Current	Current	Child	Adult
General					
CS = soil/sediment concentration [d]	mg/Kg	SS	SS	SS	SS
CW = surface/subsurface water concentration [d]	mg/L	SS	SS	SS	SS
BW = body weight [e]	Kg	70	70	70	15
ATc = averaging time for carcinogens [e]	years	70	70	70	70
ATn = averaging time for non-carcinogens [e]	years	25	25	6	24
Ingestion of Soil/Sediment					
IR = ingestion rate [e]	mg/day	100	100	200	100
CF = conversion factor [d]	Kg/mg	10^{-6}	10^{-6}	10^{-6}	10^{-6}
EF = exposure frequency for soil-related exposures [e]	days/yr	250	24	270	270
ED = exposure duration [e]	years	25	25	6	24
Dermal Contact with Soil/Sediment					
CF = conversion factor [d]	Kg/mg	10^{-6}	10^{-6}	10^{-6}	10^{-6}
SA = surface area [e]	cm^2	3,300	3,300	2,800	5,700
AF = soil-to-dermal adherence factor [e]	mg/cm^2	0.2	0.2	0.07	0.2
ABS = absorption fraction through skin for chemicals in soil [f]	unitless	CS	CS	CS	CS
EF = exposure frequency for soil-related exposures [e]	days/yr	250	24	270	270
ED = exposure duration [e]	years	25	25	6	24
Blood Lead from Ingestion of Soil/Sediment					
PbS = Soil lead concentration	µg/g or ppm	SS	SS	na	SS
$R_{fetal/maternal}$ = Fetal/metal PbB ratio [g]	--	0.9	0.9	na	0.9
BKSF = Biokinetic Slope Factor [g]	µg/dL per µg/day	0.4	0.4	na	0.4
$GSD_{i\,=}$ Geometric standard deviation PbB [g]	--	2.1	2.1	na	2.1
$PbB_{0\,=}$ Baseline concentration of lead in blood [g]	µg/dL	1.5	1.5	na	1.5
$IR_{S\,=}$ Soil ingestion rate (including soil-derived indoor dust) [g]	g/day	0.05	0.05	na	0.05
$AF_{S,\,D}$ = Absorption fraction (same for soil and dust) [g]	--	0.12	0.12	na	0.12
$EF_{S,\,D}$ = Exposure frequency (same for soil and dust) [e]	days/yr	250	24	na	270
$AT_{S,\,D}$ = Averaging time (same for soil and dust) [g]	days/yr	365	365	na	365
PbB_t = Target PbB level of concern (e.g., 10 ug/dL) [g]	µg/dL	10	10	na	10
$P(PbB_{fetal} > PbB_t)$ = Probability that fetal PbB > PbBt [g]	%	5	5	na	5
Inhalation of Soil Particulates					
VF = volatilization factor [h]	m^3/Kg	CS	CS	CS	CS
PEF = particulate emission factor [i]	m^3/Kg	1.36E+09	1.36E+09	1.36E+09	1.36E+09
EF = exposure frequency for soil-related exposures [e]	days/year	250	24	270	270
ED = exposure duration [e]	years	25	25	6	24
Volatilization Factor (m^3/kg)					
θ_a = air-filled soil porosity [h]	L_{air}/L_{soil}	0.284	0.284	0.284	0.284
θ_w = water-filled soil porosity [h]	L_{water}/L_{soil}	0.15	0.15	0.15	0.15
ρ_b = dry soil bulk density [h]	Kg/L	1.5	1.5	1.5	1.5
D_A = apparent diffusivity	cm^2/s	CS	CS	CS	CS
D_i = diffusivity in air	cm^2/s	CS	CS	CS	CS
D_w = diffusivity in water	cm^2/s	CS	CS	CS	CS
H' = dimensionless Henry's law constant	unitless	CS	CS	CS	CS
K_d = soil-water partition coefficient (K_{oc} x f_{oc})	L/Kg	CS	CS	CS	CS
n = total soil porosity [h]	L_{pore}/L_{soil}	0.434	0.434	0.434	0.434
Q/C_{vf} = inverse of the mean conc. at the center of a 0.5 acre^2 source [h]	g/m^2-s per Kg/m^3	90.80	90.80	90.80	90.80
T = exposure interval(s) [h]	seconds	9.5 x 10^8	9.5 x 10^8	9.5 x 10^8	9.5 x 10^8
Ingestion of Surface Water / Groundwater					
IR = ingestion rate [e]	L/day	na	2	2	2
EF = exposure frequency [e]	days/yr	na	24	350	350
ED = exposure duration [e]	yr	na	25	6	24

Table 4-1 Exposure Assumptions for the Human Health Risk Assessment

Exposure Parameter	Units	Current/Future Site Worker [a]	Current/Future Site Visitor [b]	Hypothetical Future Resident[c]	
		Current	Current	Child	Adult
Dermal Contact with Potable Water					
CF = conversion factor	L/cm^3	na	na	10^3	10^3
SA = surface area [f, j]	cm^2	na	na	6,600	18,000
DAevent = Absorbed dose per event [f]	mg/cm^2-event	na	na	CS	CS
ET = exposure time [f, j]	hr/day	na	na	0.33	0.25
EF = exposure frequency [f, j]	days/yr	na	na	350	350
ED = exposure duration [e]	yr	na	na	6	24
Inhalation of Constituents Volatilizing from Potable Water While Bathing					
VF = volatilization factor	m^3/Kg	na	na	CS	CS
ET = exposure time [f, j]	hr/day	na	na	0.33	0.25
EF = exposure frequency [f, j]	days/yr	na	na	350	350
ED = exposure duration [e]	yr	na	na	6	24
Inhalation of Constituents in Indoor Air					
EF = exposure frequency [e]	days/year	250	na	350	350
ED = exposure duration [e]	years	25	na	6	24
J&E Model and Soil Parameters					
Average groundwater temperature	^oC	SS	na	SS	SS
Depth to groundwater	cm	SS	na	SS	SS
Depth below grade to bottom of enclosed space floor [k]	cm	15	na	15	15
Soil type		SS	na	SS	SS
Dry soil bulk density	g/cm^3	SS	na	SS	SS
Total soil porosity	L_{pore}/L_{soil}	SS	na	SS	SS
Water-filled soil porosity	L_{water}/L_{soil}	SS	na	SS	SS
Air-filled soil porosity	L_{air}/L_{soil}	SS	na	SS	SS
Apparent diffusivity	cm^2/s	CS	na	CS	CS
Diffusivity in air	cm^2/s	CS	na	CS	CS
Diffusivity in water	cm^2/s	CS	na	CS	CS

Notes:

% - percent
°C - degrees Celsius
µg/dL - micrograms per deciliter
µg/dL per µg/day - micrograms per deciliter per micrograms per day
µg/g - micrograms per gram
ADEC - Alaska Department of Environmental Conservation
cm - centimeter
cm^2 - square centimeters
cm^2/s - square centimeters per second
CS - chemical-specific
days/yr - days per year
g/cm^3 - grams per cubic centimeter
g/day - grams per day
g/m^2-s per Kg/m^3 - grams per square meter per second per kilograms per cubic meter
hr/day - hours per day
Kg - kilogram
Kg/L - kilograms per liter
Kg/mg - kilograms per milligram
L/cm^3 - liters per cubic meter
L/day - liters per day
L/Kg - liters per kilogram
L_{air} - liters air
L_{pore} - liters pore
L_{soil} - liters soil
L_{water} - liters water
m^3/Kg - cubic meters per kilogram
mg/cm^2 - milligrams per square centimeter
mg/day - milligrams per day
mg/Kg - milligrams per kilogram
mg/L - milligrams p
na - not applicable
ppm - parts per million
SS - site-specific
USEPA - U.S. Environmental Protection Agency
yr - year

[a] Values listed are standard ADEC and USEPA default parameters for the Site Worker for "Under the 40-inch" climate zone. A soil ingestion rate of 100 g/day for an outdoor worker was selected to be protective of maintenance workers or military personnel training outside.

[b] Values presented are based on standard ADEC and USEPA default parameters for the "Under the 40-inch" climate zone. The site visitor is assumed to have access to outdoor areas only, and will be present at the Site for 1 day per weekend for the 24 weeks between May and September that the Site is snow-free.

Table 4-1 Exposure Assumptions for the Human Health Risk Assessment

		Current/Future Site Worker [a]	Current/Future Site Visitor [b]	Hypothetical Future Resident[c]	
Exposure Parameter	Units	Current	Current	Child	Adult

[c] Values presented are based on standard ADEC and USEPA default parameters for the Resident for "Under the 40-inch" climate zone.

[d] USEPA. 1989a. Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part A), Interim Final, USEPA/540/1-89/002. December.

[e] ADEC. 2011a. Risk Assessment Procedures Manual. ADEC, Division of Spill Prevention and Response. Contaminated Sites Program. July.

[f] USEPA. 2004a. Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). USEPA/540/R/99/005.

[g] USEPA. 2009. Adult Lead Methodology Spreadsheet Model, http://www.epa.gov/superfund/lead/products/ALM_2009.xls

[h] ADEC. 2008d. Cleanup Levels Guidance. June 9.

[i] USEPA. 2002. Supplemental Soil Screening Guidance. December.

[j] Standard default value for an adult showering/bathing from Exhibit 3-2 (USEPA 2004a).

[k] USEPA. 2004b. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings.

Table 4-2 Human Health Toxicity Criteria Values

Chemical of Potential Concern	CAS Number	Cancer Slope Factor (mg/Kg-d)-1				URF (µg/m^3)$^{-1}$		Chronic Reference Dose (mg/Kg-d)				RfC (mg/m^3)		ABS_{GI} [a] (%)	Critical Effect
		Oral		Dermal[b]		Inhalation		Oral		Dermal[b]		Inhalation			
Inorganics															
Arsenic	7440-38-2	1.5E+00	I	1.5E+00	I	4.3E-03	I	3.0E-04	I	3.0E-04	R	1.5E-05	C	95%	Dermal effects: Hyperpigmentation and keratosis
Barium	7440-39-3	na		na		na		2.0E-01	I	1.4E-02	R	5.0E-04	H	7%	Nephropathy
Cadmium, Soil	7440-43-9	na		na		1.8E-03	I	1.0E-03	I	2.5E-05	R	2.0E-05	C	2.5%	Hematologic: proteinuria
Cadmium, Water	7440-43-9	na		na		1.8E-03	I	5.0E-04	I	2.5E-05	R	2.0E-05	C	5%	Hematologic: proteinuria
Chromium, Trivalent	16065-83-1	na		na		na		1.5E+00	I	2.0E-02	R	na		1.3%	na
Chromium, Hexavalent	18540-29-9	5.0E-01	J	2.0E+01	R	8.4E-02	I[c]	3.0E-03	I	7.5E-05		1.0E-04	I	2.5%	Respiratory Effects
Lead	7439-92-1	na	[d]	na	[d]	na	[d]	na	[d]	na	[d]	na	[d]	na	na
Mercury	7487-94-7	na		na		na		3.0E-04	I	2.1E-05	R	3.0E-05	C	7%	Neurological, neuro-behavioral and immunological effects
Nickel	7440-02-0	na		na		2.6E-04	C	2.0E-02	I	8.0E-04	R	9.0E-05	AT	4%	Decreased body and organ weights
Vanadium	7440-62-2	na		na		na		5.0E-03	I[e]	1.3E-04	R	na		2.6%	Decreased hair cystine
Volatile Organic Compounds (VOCs)															
1,1,2,2-Tetrachloroethane	79-34-5	2.0E-01	I	2.0E-01	R	5.8E-05	C	2.0E-02	I	2.0E-02	R	na		100%	Hepatotoxicity
1,1,2-Trichloroethane	79-00-5	5.70E-02	I	5.70E-02	R	1.6E-05	I	4.0E-03	I	4.0E-03	R	2.0E-04	X	100%	Alterations in clinical chemistry
1,2,3-Trichloropropane	96-18-4	3.00E+01	I	3.00E+01	R	2.0E-03	A	4.0E-03	I	4.0E-03	R	3.0E-04	I	100%	Hepatotoxicity and respiratory effects.
1,2,4-Trimethylbenzene	95-63-6	na		na		na		5.0E-02	A	5.0E-02	R	7.0E-03	P	100%	na
1,2-Dibromo-3-chloropropane	96-12-8	8.0E-01	P	8.0E-01	R	6.0E-03	P	2.0E-04	P	2.0E-04	R	2.0E-04	I	100%	Testicular effects
1,2-Dichloroethane	107-06-2	9.1E-02	I	9.1E-02	R	2.6E-05	I	6.0E-03	X	2.0E-02	R	7.0E-03	P	100%	na
1,3,5-Trimethylbenzene	108-67-8	na		na		na		1.0E-02	X	1.0E-02	R	7.0E-03	A	100%	na
Benzene	71-43-2	5.5E-02	I	5.5E-02	R	7.8E-06	I	4.0E-03	I	4.0E-03	R	3.0E-02	I	100%	Decreased lymphocyte count
Ethylbenzene	100-41-4	1.1E-02	C	1.1E-02	R	2.5E-06	C	1.0E-01	I	1.0E-01	R	1.0E+00	I	100%	Hepatotoxicity, nephrotoxicity, and developmental effects
Methylene chloride	75-09-2	7.5E-03	I	7.5E-03	R	4.7E-07	I	6.0E-02	I	6.0E-02	R	1.0E+00	AT	100%	Hepatotoxicity
n-Butylbenzene	104-51-8	na		na		na		5.0E-02	P	1.0E-02	R	3.5E-02	A	na	na
n-Propylbenzene	103-65-1	na		na		na		1.0E-01	X	1.0E-01	R	1.0E+00	X	100%	Hepatotoxicity and nephrotoxicity
sec-Butylbenzene	135-98-8	na		na		na		1.0E-02	A	1.0E-02	R	3.5E-02	A	100%	Kidney Effects
Trichloroethylene (TCE)	79-01-6	4.6E-02	I	4.6E-02	R	4.1E-06	I	5.0E-04	I	5.0E-04	R	2.0E-03	I	100%	Hepatic, Renal and Neurotoxicity
Semi-Volatile Organic Compounds (SVOCs)															
Pentachlorophenol	87-86-5	4.0E-01	I	4.0E-01	R	5.1E-06	C	5.0E-03	I	5.0E-03	R	na		100%	Hepatotoxicity

Table 4-2 Human Health Toxicity Criteria Values

Chemical of Potential Concern	CAS Number	Cancer Slope Factor (mg/Kg-d)-1				URF ($\mu g/m^3$)$^{-1}$		Chronic Reference Dose (mg/Kg-d)				RfC (mg/m^3)		ABS_{GI} [a] (%)	Critical Effect
		Oral		Dermal[b]		Inhalation		Oral		Dermal[b]		Inhalation			
Polycyclic Aromatic Hydrocarbons (PAHs)															
2-Methylnaphthalene	91-57-6	na		na		na		4.0E-03	I	4.0E-03	R	na		89%	Respiratory effects
Acenaphthene	83-32-9	na		na		na		6.0E-02	I	6.0E-02	R	na		89%	Hepatotoxicity
Anthracene	120-12-7	na		na		na		3.0E-01	I	3.0E-01	R	na		89%	na
Benzo(a)anthracene	56-55-3	7.3E-01	T	7.3E-01	R	1.1E-04	C	na		na		na		89%	na
Benzo(a)pyrene	50-32-8	7.3E+00	I	7.3E+00	R	1.1E-03	C	na		na		na		89%	na
Benzo(b)fluoranthene	205-99-2	7.3E-01	T	7.3E-01	R	1.1E-04	C	na		na		na		89%	na
Benzo(k)fluoranthene	207-08-9	7.3E-02	T	7.3E-02	R	1.1E-04	C	na		na		na		89%	na
Dibenz(a,h)anthracene	53-70-3	7.3E+00	T	7.3E+00	R	1.2E-03	C	na		na		na		89%	na
Fluorene	86-73-7	na		na		na		4.0E-02	I	4.0E-02	R	na		89%	Hemotoxicity
Indeno(1,2,3-c,d)pyrene	193-39-5	7.3E-01	T	7.3E-01	R	1.1E-04	C	na		na		na		89%	na
Naphthalene	91-20-3	na		na		3.4E-05	C	2.0E-02	I	2.0E-02	R	3.0E-03	I	89%	Decreased body weight; Nasal, olfactory and respiratory effects
Phenanthrene	85-01-8	na		na		na		3.0E-01	A	3.0E-01	R	na		89%	na
Pyrene	129-00-0	na		na		na		3.0E-02	I	3.0E-02	R	na		89%	Nephrotoxicity
Petroleum Hydrocarbons															
Diesel Range Organics (DRO), Aliphatic	na	na		na		na		1.0E-01	AK	na		1.0E+00	AK	100%	Hepatotoxicity/ Hemtological Changes
Diesel Range Organics (DRO), Aromatic	na	na		na		na		4.0E-02	AK	na		2.0E-01	AK	100%	Decreased body weight
Residual Range Organics (RRO), Aliphatic	na	na		na		na		2.0E+00	AK	na		na		100%	Hepatic granuloma
Residual Range Organics (RRO), Aromatic	na	na		na		na		3.0E-02	AK	na		na		100%	Nephrotoxicity

Toxicity values were selected according to the following hierarchy of sources:

I - IRIS Database (USEPA, 2012a)
P - Provisional Peer Reviewed Toxicity Values (PPRTVs) (USEPA, 2012b)
AT - Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (ATSDR, 2010)
C - CalEPA Toxicity Values (OEHHA, 2012)
X - PPRTV Appendix (USEPA, 2010a)
H - Health Effects Assessment Summary Tables (USEPA, 1997a)
A - ADEC Cleanup Levels Guidance (ADEC, 2008d)
R - Route-to-Route Extrapolation.

As well as other professionally peer reviewed documents as needed, including:

AK - ADEC Petroleum Contaminated Site Guidance (ADEC, 2000)
J - New Jersey Department of Environment Protection (NJDEP, 2009)
T - Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (USEPA, 1993a)

Table 4-2 Human Health Toxicity Criteria Values

Chemical of Potential Concern	CAS Number	Cancer Slope Factor (mg/Kg-d)-1		URF ($\mu g/m^3)^{-1}$	Chronic Reference Dose (mg/Kg-d)		RfC (mg/m^3)	ABS_{GI} [a] (%)	Critical Effect
		Oral	Dermal[b]	Inhalation	Oral	Dermal[b]	Inhalation		

Notes:

$\mu g/m^3$ - Micrograms per cubic meter
% - Percent
ABS_{GI} - Oral absorption efficiencies
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
CSF - Cancer slope factor
IRIS - Integrated Risk Information System
mg/Kg-d - Milligrams per kilogram per day
mg/m^3 - Milligrams per cubic meter
na - Not available
RAGS - Risk Assessment Guidance for Superfund
RfC - Refernce Concentration
RfD - Reference Dose
SF - slope factor
USEPA - U. S. Environmental Protection Agency
URF - Unit Risk Factor

[a] Values are from Exhibit 4-1 USEPA RAGS Part E. Where no specific ABS_{GI} is available, the ABS_{GI} is assumed to be 100% (USEPA 2004a).

[b] The following equations are used as recommended by the USEPA (2004a) to estimate dermal CSF and RFDs from the ingestion toxicity values when ABS_{GI} is less than 50%: Dermal RfD = Oral RfD x ABS_{GI} and Dermal CSF = Oral SF/ABS_{GI}. When ABS_{GI} is greater than 50%, the dermal CSF and/or RfD is assumed to be equal to the oral CSF and/or RfD (USEPA, 2004a).

[c] Chromium VI oral toxicity value was muliplied by 7 as a health-protective assumption (USEPA, 2011c).

[d] Per ADEC (2011a) guidance, lead is evaluated using biokinetic models; refer to Section 4.3.3.

[e] Vanadium oral RfD is based on IRIS vanadium pentoxide value, with a factor applied to account for the weight of oxygen (USEPA, 2011c).

Table 4-3 Human Health Blood Lead Estimates Summary

Site / Receptor	Soil Lead EPC (mg/Kg)	Drinking Water Lead EPC (mg/L)	Target Blood Lead of Adult (µg/dL)	Adult Lead Model: Geometric Mean Blood Lead of Adult [f] (µg/dL)	Adult Lead Model: 95% Blood Lead for Fetus within Adult Female [f] (µg/dL)	Adult Lead Model: Probability of Fetal Blood Lead > Target [g] (%)	IEUBK: Highest Blood Lead in Children (µg/dL) [h]
Upper Site Summit (USS) [a]							
Current/Future Site Worker	386	--	10	2.1	6.5	1.3	--
Current/Future Site Visitor	386	--	10	1.6	4.8	0.40	--
Future Hypothetical Child Resident [b]	386	0.004	10	--	--	--	5.6
Lower Site Summit (LSS) [c]							
Future Hypothetical Child Resident [d,e]	75	0.0333	10	--	--	--	4.4

Notes:

-- not applicable
% - percent
> - greater than
µg/dL - microgram lead per deciliter of blood
ADEC - Alaska Department of Environmental Conservation
COPC - chemical of potential concern
EPC - exposure point concentration
IEUBK - Integrated Exposure Biokinetic Model for lead
LSS - Lower Site Summit
mg/Kg - milligrams per kilogram
mg/L - miligram per liter
NHANES - National Health and Nutrition Examination Survey
USEPA - United States Environmental Protection Agency
USS - Upper Site Summit

a At USS, lead was selected as a COPC in surface soil. Blood lead levels from exposure to USS surface soil were modeled for the current/future site worker, current/future site visitor, and future hypothetical child resident. Blood lead levels for the residential scenario were modeled for the future hypoethetical child resident as recommended in the Risk Assessment Procedures Manual (ADEC, 2011a).

b At USS, lead was not selected as a COPC in groundwater. A drinking water lead concentration of 0.004 mg/L, the default lead concentration in drinking water in the IEUBK model, was used to model the blood lead levels for the future hypothetical child resident exposed to USS surface soil.

c At LSS, lead was selected as a COPC in groundwater, but not in soil. Exposure to potable groundwater is a potentially complete pathway only for hypothetical future residents.

d At LSS, lead was not selected as a COPC in soil. A soil lead concentration of 75 mg/Kg, the calculated 95% upper confidence limit on the mean lead concentration measured in LSS surface soil, was conservatively used in the IEUBK model to estimate blood lead levels for future hypothetical child residents exposed to groundwater.

e The maximum detected lead concentration measured in LSS monitoring wells, 0.0333 mg/L, was used in the IEUBK model to estimate blood lead levels for future hypothetical child residents exposed to groundwater.

f Blood lead concentrations for adults and potential fetuses were calculated using the Adult Lead Model (USEPA, 2009) NHANES III column for all adult receptors.

g The probability of fetal blood lead concentrations exceeding a target blood lead concentration of 10 ug/dL was calculated using the Adult Lead Model (USEPA, 2009) and assuming a lognormal distribution. The target probability is compared to the ADEC standard value of 5% for the protection of human health (ADEC, 2011c).

h The current IEUBK model (USEPA, 2010b) was used to evaluate blood lead levels for the future hypothetical child resident. The blood lead level presented represents the highest value found at any of the age groups calculated by the IEUBK model (1-2 years old).

Table 4-4 Summary of Cumulative Risk Estimates for Human Receptors - Upper Site Summit

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[c]	ILCR	HI	ILCR	HI	ILCR	HI
Non-Petroleum hydrocarbons									
Surface Soil (mg/Kg)				**2E-05**	0.07	2E-06	0.006	**5E-05**	0.7
Arsenic	19.1	9.84	9.84	6.2E-06	0.039	5.9E-07	0.0037	**2.1E-05**	0.39
Benzo(a)pyrene	5.75	1.37	1.37	6.5E-06	NA	6.2E-07	NA	**1.8E-05**	NA
Subsurface Soil (mg/Kg)				**3E-05**	0.02	3E-06	0.002	**7E-05**	0.2
Benzo(a)pyrene	3.71	0.632	3.71	**1.8E-05**	NA	1.7E-06	NA	**5.0E-05**	NA
Dibenz(a,h)anthracene	0.846	0.335	0.846	4.0E-06	NA	3.8E-07	NA	**1.1E-05**	NA
Non-PHC Cumulative Media ILCR/HI [d] :				**3E-05**	0.07	3E-06	0.006	**7E-05**	0.7
ADEC Risk Criteria :				10^{-5}	1				
USEPA Risk Range :				10^{-6} - 10^{-4}	1				

Notes:

% - percent
ADEC - Alaska Department of Environmental Conservation
COPC - chemical of potential concern
EPC - exposure point concentration
HI - hazard index
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
PHC - petroleum hydrocarbon
UCL - upper confidence limit
USEPA - U.S. Environmental Protection Agency
USS - Upper Site Summit

[a] Summary of risk estimates for COPCs are presented if the COPC is a risk driver for at least one receptor. Risk estimates for all COPCs are presented in Appendix I.

[b] Maximum detected concentration and 95% UCL on the mean concentration measured in various media collected from USS sampling locations.

[c] The EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[d] Cumulative media ILCR/HI includes the higher of the surface soil or subsurface soil ILCR/HI.

Bold indicates exceedance of the ADEC acceptable risk criteria.

Table 4-5 Summary of Cumulative Risk Estimates for Human Receptors - Lower Site Summit

Medium/Risk Driver[a]	Concentration [b]			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC [c]	ILCR	HI	ILCR	HI	ILCR	HI
Non-Petroleum Hydrocarbons									
Indoor Air - Derived From Groundwater measured at MW07LSS [d] (mg/L)				1E-05	0.6	NA	NA	**2E-05**	0.8
Naphthalene	0.168	NA	0.168	8.0E-06	0.22	NA	NA	1.3E-05	0.31
Indoor Air - Derived From Groundwater measured at MW06LSS [d] (mg/L)				3E-06	1	NA	NA	5E-06	1
Trichloroethylene (TCE)	0.0175	NA	0.0175	2.9E-06	1.0	NA	NA	4.9E-06	**1.4**
Surface Soil (mg/Kg)				**1E-04**	0.07	9E-06	0.006	**3E-04**	0.6
Arsenic	19.0	8.15	8.15	5.1E-06	0.032	4.9E-07	0.0031	**1.7E-05**	0.32
Pentachlorophenol	46.5	NC	46.5	**1.7E-05**	0.024	1.7E-06	0.0023	**4.4E-05**	0.18
Benzo(a)anthracene	37.0	7.98	7.98	3.8E-06	NA	3.6E-07	NA	**1.1E-05**	NA
Benzo(a)pyrene	35.7	7.74	7.74	**3.7E-05**	NA	3.5E-06	NA	**1.0E-04**	NA
Benzo(b)fluoranthene	40.1	8.66	8.66	4.1E-06	NA	3.9E-07	NA	**1.2E-05**	NA
Dibenz(a,h)anthracene	6.12	0.786	6.12	**2.9E-05**	NA	2.8E-06	NA	**8.2E-05**	NA
Subsurface Soil (mg/Kg)				**2E-04**	1	**2E-05**	0.1	**4E-04**	**3**
1,1,2-Trichloroethane	1.65	NC	1.65	1E-06	0.92	1E-07	0.088	2E-06	**2.0**
1,2,3-Trichloropropane	0.491	NC	0.491	**2.6E-05**	0.095	2.4E-06	0.0091	**5.1E-05**	0.21
1,2-Dibromo-3-chloropropane	3.04	NC	3.04	**1.9E-04**	0.45	**1.8E-05**	0.043	**2.9E-04**	**1.1**
Groundwater from MW03LSS [e] - Potable Use (mg/L) - unfiltered, trivalent Cr [f,g]				NA	NA	NA	NA	**1E-03**	**29**
Arsenic, total	0.0322	NA	0.0322	NA	NA	NA	NA	**9.8E-04**	**17**
Vanadium, total	0.137	NA	0.109	NA	NA	NA	NA	NA	**3.6**
2-Methylnaphthalene	0.0735	NA	0.0735	NA	NA	NA	NA	NA	**2.9**
Naphthalene	0.168	NA	0.0685	NA	NA	NA	NA	**2.4E-05**	**4.2**
Groundwater from MW03LSS [e] - Potable Use (mg/L) - unfiltered, hexavalent Cr [f,g]				NA	NA	NA	NA	**2E-03**	**31**
Arsenic, total	0.0322	NA	0.0322	NA	NA	NA	NA	**9.8E-04**	**17**
Total chromium, total, assumed as hexavalent	0.0857	NA	0.0525	NA	NA	NA	NA	**5.9E-04**	**2.9**
Vanadium, total	0.137	NA	0.109	NA	NA	NA	NA	NA	**3.6**
2-Methylnaphthalene	0.0735	NA	0.0735	NA	NA	NA	NA	NA	**2.9**
Naphthalene	0.168	NA	0.0685	NA	NA	NA	NA	**2.4E-05**	**4.2**
Groundwater from MW03LSS [e] - Potable Use (mg/L) - filtered [f,g]				NA	NA	NA	NA	**2E-04**	**10**
Arsenic, dissolved	0.00681	NA	0.00454	NA	NA	NA	NA	**1.4E-04**	**2.4**
2-Methylnaphthalene	0.0735	NA	0.0735	NA	NA	NA	NA	NA	**2.9**
Naphthalene	0.168	NA	0.0685	NA	NA	NA	NA	**2.4E-05**	**4.2**

Table 4-5 Summary of Cumulative Risk Estimates for Human Receptors - Lower Site Summit

Medium/Risk Driver[a]	Concentration [b]			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC [c]	ILCR	HI	ILCR	HI	ILCR	HI
Groundwater from MW06LSS [h] - Potable Use (mg/L) [e]								**2E-05**	**7**
Trichloroethylene (TCE)	0.0175	NA	0.0175	NA	NA	NA	NA	**2.0E-05**	**6.8**
Non-PHC Cumulative Media ILCR/HI with no groundwater exposure [i] :				**2E-04**	**2**	**2E-05**	0.1	NA	NA
Non-PHC Cumulative Media ILCR/HI (Groundwater - unfiltered, trivalent Cr [f,g]) [i] :				NA	NA	NA	NA	**1E-03**	**33**
Non-PHC Cumulative Media ILCR/HI (Groundwater - unfiltered,hexavalent Cr [f,g]) [i] :				NA	NA	NA	NA	**2E-03**	**36**
Non-PHC Cumulative Media ILCR/HI (Groundwater - filtered [f,g]) [i] :				NA	NA	NA	NA	**5E-04**	**14**
Petroleum Hydrocarbons									
Indoor Air - Derived From Groundwater (mg/L)				NA	NA	NA	NA	NA	NA
Surface Soil (mg/Kg)				NA	0.05	NA	0.005	NA	0.5
Subsurface Soil (mg/Kg)				NA	NA	NA	NA	NA	NA
Groundwater - Potable Use (mg/L)				NA	NA	NA	NA	NA	**95**
Diesel Range Organics (DRO)	29.4	NA	29.4	NA	NA	NA	NA	NA	**95**
PHC Cumulative Media ILCR / HI [i] :				NA	0.05	NA	0.005	NA	**95**
ADEC Risk Criteria:								10^{-5}	1
USEPA Risk Range:								10^{-6} - 10^{-4}	1

Notes:

% - percent
ADEC - Alaska Department of Environmental Conservation
COPC - chemical of potential concern
Cr - chromium
EPC - exposure point concentration
HI - hazard index
ILCR - incremental lifetime cancer risk
LSS - Lower Site Summit
mg/Kg - milligrams per kilogram
mg/L - milligrams per liter
NA - not applicable
NC - not collected
PHC - petroleum hydrocarbon
UCL - upper confidence limit
USEPA - U.S. Environmental Protection Agency

[a] Summary of risk estimates for COPCs are presented if the COPC is a risk driver for at least one receptor. Risk estimates for all COPCs are presented in Appendix I.
[b] Maximum detected concentration, 95% UCL on the mean concentration, and EPC derived from measurements in various media collected from LSS sampling locations.

Table 4-5 Summary of Cumulative Risk Estimates for Human Receptors - Lower Site Summit

Medium/Risk Driver[a]	Concentration [b]			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC [c]	ILCR	HI	ILCR	HI	ILCR	HI

[c] The surface and subsurface soil EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the soil EPC is equal to the maximum detected concentration. The groundwater EPCs for the vapor intrusion and potable use pathways are equal to the concentrations detected in MW07LSS and MW03LSS, respectively. These wells had the highest cumulative ILCR and HI estimates for any groundwater monitoring well at LSS for these pathways.

[d] The vapor intrusion from groundwater to indoor air pathway EPC and corresponding ILCR and HI estimates for naphthalene are reported for Monitoring Well MW07LSS, which had the highest cumulative ILCR and HI estimates for the vapor intrusion pathway of any monitoring well at LSS. However, ILCR or HQ estimates for individual COPCs were sometimes higher in wells other than MW07LSS (refer to Table I-32). Only one other chemical, trichloroethylene, was identified as a vapor intrusion pathway risk driver for LSS. The well with the maximum ILCR and HQ estimates for trichloroethylene, as presented here, was MW06LSS.

[e] Detected concentrations of groundwater constituents, and corresponding ILCR and HI estimates, are reported for Monitoring Well MW03LSS, which had the highest cumulative ILCR and HI estimates for the potable water pathway of any monitoring well at LSS. However, ILCR or HQ estimates for individual COPCs were sometimes higher in wells other than MW03LSS (refer to Table I-31). Only one chemical that was identified as a risk driver for LSS, trichloroethylene, was not identified as a risk driver in MW03LSS. ILCR and HI estimates due to maximum trichloroethylene exposure at LSS are presented in this table following the MW03LSS results.

[f] Unfiltered and field filtered groundwater samples were collected for total and dissolved metals analyses at LSS. Given the low quality of groundwater at NSS, it is assumed that residents would filter groundwater before using it for potable applications. However, it is ADEC policy to manage risk based on potable use of unfiltered water. For a balanced Human Health Risk Assessment, risk and hazard results based on both dissolved and total metals data are presented here for comparison purposes.

[g] Groundwater samples at LSS were analyzed for total chromium only. No suspected sources of hexavalent chromium are present at LSS; however, to be conservative, both total chromium as trivalent chromium and total chromium as hexavalent chromium risks were calculated. Both sets of risk results are presented here for comparison purposes. Total chromium was not detected in filtered groundwater samples collected from the highest risk well, MW03LSS.

[h] All chemical risk drivers identified in any well at LSS were identified in Monitoring Well MW03LSS, with the exception of trichloroethylene, which was identified as a carcinogenic risk and non-cancer hazard driver based on groundwater data from MW06LSS and as a non-cancer hazard driver based on groundwater data from MW04LSS (Table I-31). Risk and hazard estimates resulting from potential exposure to trichloroethylene in groundwater at MW06LSS are presented here, and risk-based groundwater cleanup levels for trichloroethylene are presented in Table 7-2.

[i] Cumulative media ILCR / HI includes the higher of the surface soil or subsurface soil ILCR / HI.

Bold indicates exceedance of the ADEC acceptable risk criteria.

Table 4-6 Summary of Cumulative Risk Estimates for Human Receptors - Area A

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[c]	ILCR	HI	ILCR	HI	ILCR	HI
Non-Petroleum Hydrocarbons									
Surface Soil (mg/Kg)				4E-08	0.01	4E-09	0.001	6E-08	0.03
Subsurface Soil (mg/Kg) - trivalent Cr [d]				2E-08	0.006	2E-09	0.0005	3E-08	0.01
Subsurface Soil (mg/Kg) - hexavalent Cr [d]				6E-06	0.02	6E-07	0.002	**2E-05**	0.1
Total chromium, assumed as hexavalent Cr	45.1	34.0	34.0	6.5E-06	0.011	6.2E-07	0.0011	**2.3E-05**	0.12
Non-PHC Cumulative Media ILCR/HI (assuming trivalent Cr in subsurface soil) [d,e] :				4E-08	0.01	4E-09	0.001	6E-08	0.03
Non-PHC Cumulative Media ILCR/HI (assuming hexavalent Cr in subsurface soil) [d,e] :				6E-06	0.02	6E-07	0.002	**2E-05**	0.1
Petroleum Hydrocarbons									
Surface Soil (mg/Kg)				NA	1	NA	0.08	NA	**10**
Diesel Range Organics (DRO)	19,200	8,369	8,369	NA	0.68	NA	0.014	NA	**2.8**
Residual Range Organics (RRO)	161,000	63,887	63,887	NA	0.65	NA	0.063	NA	**7.3**
Subsurface Soil (mg/Kg)				NA	0.8	NA	0.02	NA	**4**
Diesel Range Organics (DRO)	28,400	8,583	8,583	NA	0.70	NA	0.015	NA	**2.9**
PHC Cumulative Media ILCR / HI [e]:				NA	1	NA	0.08	NA	**10**
ADEC Risk Criteria:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

% - percent

ADEC - Alaska Department of Environmental Conservation
COPC - contaminant of potential concern
Cr - chromium
EPC - exposure point concentration
HI - hazard index
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
PHC - petroleum hydrocarbon
UCL - upper confidence limit
USEPA - U.S. Environmental Protection Agency

[a] Summary of risk estimates for COPCs are presented if the COPC is a risk driver for at least one receptor. Risk estimates for all COPCs are presented in Appendix I.
[b] Maximum detected concentration and 95% UCL on the mean concentration measured in various media collected from Area A sampling locations.
[c] The EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.
[d] Subsurface soil samples at Area A were analyzed for total Cr only. No suspected sources of hexavalent Cr are present at Area A; however, to be conservative, both total Cr as trivalent Cr and total Cr as hexavalent Cr risks were calculated.
[e] Cumulative media ILCR/HI includes the higher of the usrface soil or subsurface soil ILCR/HI.

Bold indicates exceedance of the ADEC acceptable risk criteria.

Table 4-7 Summary of Cumulative Risk Estimates for Human Receptors - Area C

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[c]	ILCR	HI	ILCR	HI	ILCR	HI
Non-Petroleum hydrocarbons									
Surface Soil (mg/Kg)				1E-05	NA	1E-06	NA	**3E-05**	NA
Benzo(a)pyrene	1.62	NC	1.62	7.7E-06	NA	7.4E-07	NA	**2.2E-05**	NA
Non-PHC Cumulative Media ILCR/HI :				1E-05	NA	1E-06	NA	**3E-05**	NA
ADEC Risk Criteria:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

% - percent
ADEC - Alaska Department of Environmental Conservation
COPC - checmical of potential concern
EPC - exposure point concentration
HI - hazard index
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
UCL - upper confidence limit
USEPA - U.S. Environmental Protection Agency

a Summary of risk estimates for COPCs are presented if the COPC is a risk driver for at least one receptor. Risk estimates for all COPCs are presented in Appendix I.

b Maximum detected concentration and 95% UCL on the mean concentration measured in various media collected from Area C sampling locations.

c The EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of the USEPA's risk management range and/or ADEC's acceptable risk criteria.

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5.0 ECOLOGICAL RISK ASSESSMENT

This section presents the methods used in, and results of, an ERA that was prepared for the four NSS Areas. ERA methods were developed in accordance with the EPA's *Guidelines for Ecological Risk Assessment – Final* (USEPA, 1998), and *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final* (USEPA, 1997d). In accordance with 18 AAC 75 and the RAPM (ADEC, 2011a), the ERA included Tier I (screening) and Tier II (baseline) ecological assessments.

The ERA described herein was performed in accordance with, or in consideration of, the following ADEC and EPA guidance documents or reference materials:

- *Risk Assessment Guidance for Superfund. Volume II: Environmental Evaluation Manual.* Interim Final (USEPA, 1989b).
- *Wildlife Exposure Factors Handbook* (USEPA, 1993b).
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final* (USEPA, 1997d).
- *Guidelines for Ecological Risk Assessment* (USEPA, 1998)
- *User's Guide for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions* (ADEC, 1999a).
- *Guidance for Cleanup of Petroleum Contaminated Sites* (ADEC, 2000).
- 18 AAC 75 – *Oil and Other Hazardous Substance Control Regulations*, Revised as of October 1, 2011 (ADEC, 2011b).
- 18 AAC 70 – *Water Quality Standards*, amended as of May 26, 2011 (ADEC, 2011c).
- RAPM (ADEC, 2011a).
- *Ecoscoping Guidance* (ADEC, 2009a).

The ERA for the four NSS Areas and downgradient off-site drainages was conducted in accordance with 18 AAC 75. Site cleanup rules provided in 18 AAC 75 establish administrative processes and standards to determine the necessity for, and degree of, cleanup required, to protect the environment at a site where one or more hazardous substances are located.

The administrative processes and standards in 18 AAC 75 include generic soil and groundwater cleanup levels (i.e., Methods One and Two), and procedures for establishing site-specific cleanup levels (i.e., Methods Three and Four). The Air Force has elected to conduct a Method Four ERA for NSS, consistent with 18 AAC 75 and the RAPM (ADEC, 2011a). Risk assessments conducted under Method Four may lead to development of media-specific cleanup levels for the four NSS Areas, depending on the findings of the RI.

The ERA for the NSS used a two-tiered approach. Conservative screening (Tier I) was performed to evaluate whether chemical concentrations measured in site media exceed protective screening criteria. Tier I screening was conducted in accordance with State of

Alaska regulations (18 AAC 75), the RAPM (ADEC, 2011a), and ADEC's *Ecoscoping Guidance* (ADEC, 2009a), as described in Section 3.1.2. Chemicals for which the maximum detected concentration exceeded protective screening criteria were identified as preliminary COPECs and evaluated further in the Tier II ERA. The Tier II ERA was performed consistent with ADEC Method Four procedures. Those areas and media for which Tier II ERA criteria were exceeded were proposed for further evaluation or consideration of remedial alternatives.

The Tier I ERA included comparisons of maximum analyte concentrations against protective, media-specific screening benchmarks and resulted in the identification of COPECs for soil, surface water, and sediment (refer to Sections 3.1.2 and 3.2). The Tier II ERA involves a more detailed evaluation of ecological hazard, including: 1) a "problem formulation phase," wherein biological resources are evaluated and assessment and measurement endpoints are selected, and 2) an "analysis phase," wherein exposures are quantified for representative ecological receptors. Pending the outcome of the ecological problem formulation phase, an analysis phase may or may not be required.

The Tier II ERA consists of the following five steps:

1. Problem Formulation
2. Exposure Assessment
3. Ecological Effects Assessment
4. Risk Characterization
5. Uncertainty Analysis

If it is determined in the problem formulation phase that COPECs or receptors are absent, or exposure pathways are incomplete or would result in insignificant ecological hazards, then the exposure assessment, ecological effects assessment, and risk characterization steps are not required. The first four steps are described below, as they relate to the Tier II ERA for the NSS. The fifth step, a combined human health and ecological uncertainty analysis for the four NSS Areas, is presented and discussed in Section 6.0.

5.1 PROBLEM FORMULATION

Problem formulation is intended to facilitate a preliminary understanding of how stressors, such as chemical contaminants, may impact ecological habitats and receptors. Problem formulation provides the foundation for the remainder of the ERA. Consistent with ADEC guidance (ADEC, 1999a; 2011a), the initial steps involved in the Tier II ERA are as follows:

- Determine the Alaska ecoregion in which NSS falls.
- Identify the default assessment endpoints and indicator species for the applicable ecoregion.
- Evaluate the relevance of default assessment endpoints and indicator species, and modify as appropriate.

JBER, including NSS, falls within Alaska's Southcentral ecoregion (ADEC, 1999a). Consistent with ADEC (1999a; 1999b), default assessment endpoints and indicator species are identified for the applicable ecoregion to ensure that representative food guilds, trophic levels, and species are evaluated for all potentially impacted organisms. As defined in EPA guidelines (USEPA, 1998), an assessment endpoint is an explicit expression of the environmental value that is to be protected (for example, growth, survival, and reproduction of a specific species population). Default assessment endpoints and indicator species for the Southcentral ecoregion are presented in **Table 5-1**.

The relevance of default assessment and measurement endpoints to the ERA is determined based on the following:

- The site-specific ecological CSM.
- The COPECs identified for the site.
- Physical factors and known site ecology.
- The availability of assessment endpoints.

The default assessment endpoints and indicator species for the Southcentral ecoregion are evaluated and refined for the four NSS Areas and downgradient off-site drainages, based on the above criteria, in Section 5.2.1.4, and summarized in Table 5-1.

5.2 EXPOSURE ASSESSMENT

The exposure assessment step consists of two parts: a qualitative exposure analysis (Section 5.2.1) and a quantitative exposure dose analysis (Section 5.2.2), as described below.

5.2.1 Exposure Analysis

The ecological exposure analysis begins with development of a site-specific CSM. The CSM for the four NSS Areas was based on information provided in the Ecoscoping Form (Appendix B). The CSM is a descriptive and graphical presentation of relationships between chemical contaminants and potentially exposed receptors. The ecological CSM identifies chemical sources, ecological habitats and receptors, and complete exposure pathways between contaminant sources and ecological resources.

An ecological CSM for the four NSS Areas and downgradient off-site drainages was described in Section 3.4.2. Briefly, the NSS Areas are locations at NSS where inorganic compounds, VOCs, SVOCs, PAHs, and total PHCs were released. There is potential that transformers containing PCBs were present at all four NSS Areas due to the timeline of NSS activities; therefore, there is the potential for site-related releases of PCBs.

NSS is adjacent to the 495,000-acre Chugach State Park, and a variety of herbivorous, carnivorous, or omnivorous birds and mammals occur at or in the vicinity of the four NSS Areas and downgradient off-site drainages. Although NSS is moderately to highly disturbed, open spaces in and around the four NSS Areas consist of tundra and low shrub vegetation. These vegetated areas may provide habitat, breeding areas, or forage for various birds and mammals. Complete exposure pathways exist between terrestrial ecological receptors inhabiting the area and potentially contaminated media, including surface soil, sediment, and surface water. As described in Section 3.2 and summarized below, no aquatic receptors are present at the four NSS Areas; however, there is potential for lower tropic level aquatic receptors to utilize the off-site downgradient drainages.

As depicted in the ecological CSM for NSS (Figure 3-3), exposure pathways between surface soil COPECs and terrestrial birds and mammals are complete for all four NSS Areas. Potential surface soil exposure pathways for terrestrial receptors include direct contact and inhalation pathways (i.e., incidental surface soil ingestion, dermal contact with surface soil, and inhalation of dust), as well as uptake by biota (i.e., plants and animals) and food chain transfer (Figure 3-3).

Permanent surface water bodies are not present at USS, LSS, and Area A; therefore, surface water and sediment exposure pathways are incomplete for ecological receptors at these NSS Areas. Ephemeral surface water and sediment may be present at Area A, USS, and LSS, and would represent potentially complete exposure pathways for terrestrial receptors. However, due to the ephemeral nature of these surface waters, it is assumed that exposures would not be significant. Exposure to surface water potentially occurs at Area C, where a small pond collects overland runoff from Mount Gordon Lyon behind a weir, and within offsite downgradient drainages.

As described in Section 3.2, the Area C Pond is a small, man-made structure that does not support aquatic receptors or aquatic-dependent wildlife (e.g., aquatic invertebrates). However, as a conservative measure, surface water and sediment data from the Area C Pond were screened against ecological benchmarks (refer to Section 3.1.2 and Appendix D). COPECs identified for sediment based on results of this screening were evaluated as described in Section 5.2.1.4.2. In the Area C Pond surface water, barium exceeded screening benchmarks for water column receptors. Because water column receptors are not present in the Area C Pond, potential impacts associated with exposure of higher trophic level terrestrial receptors to surface water in the Area C Pond were evaluated by comparison of the maximum detected concentration of barium to a secondary screening criterion based on drinking water, as described in Section 3.2. Based on this secondary evaluation, surface water in the Area C Pond was not carried forward as a medium of concern in the ERA.

Surface water COPECs were identified for downgradient off-site drainages, and these drainages are expected to provide sufficient habitat for supporting aquatic and aquatic dependant wildlife. However, as described in Section 3.2, these drainages are small, high energy streams with natural and man-made barriers (such as culverts), significant drop-offs, and limited cover. Fish and amphibians are unlikely to use this low quality habitat, and if present would not be available in sufficient quantities to support foraging by piscivorous wildlife.

Sources of potential exposure identified in the ecological CSM include ambient air, surface soil, sediment, and surface water (Figure 3-3). Each of these sources, as they relate to potential ecological exposures at the areas, is discussed in the following subsections.

5.2.1.1 Ambient Air Exposure Pathways

Historic spills and releases of fuels, solvents, and other volatile contaminants to surface soil can result in direct release of volatile COPECs to ambient air through volatilization. Surface runoff from rainfall or snowmelt can transport volatile COPECs in soil to surface water and sediment, from which they volatilize to ambient air. Percolation and leaching can transport volatile COPECs to groundwater, with subsequent volatilization to ambient air. Historic spills and releases of such contaminants at NSS occurred more 30 years ago, and it is likely that the majority of volatile residues in surface soil, surface water, sediment, or groundwater have already migrated to ambient air and dissipated. Residual levels of volatile COPECs in these media may continue to volatilize. However, concentrations of volatile COPECs in ambient air at any given time are anticipated to be low because NSS is:

- Located on top of a mountain or close to the ridge of the mountain and wind speeds are consistently high, which would disperse COPECs in outdoor ambient air quickly.
- Covered by snow during winter months.

Potential ecological exposure pathways associated with ambient air include:

- Uptake of volatile COPECs by plants that are subsequently consumed by resident or migratory animals (e.g., terrestrial birds and mammals).
- Dermal absorption by resident or migratory animals.
- Direct inhalation by resident or migratory animals.

As described above, physical conditions at NSS are expected to substantially dilute and disperse any COPECs that volatize to ambient air. Avian and mammalian receptors that forage at the four NSS Areas may briefly come into contact with COPECs in ambient air. However, such exposures are anticipated to be minimal in comparison to ingestion pathways. Consequently, ambient air pathways are deemed to be potentially complete but insignificant for all ecological receptors (Figure 3-3).

5.2.1.2 Soil Exposure Pathways

Contaminants may be released to surface and subsurface soil through historic spills, leaks, and disposal practices. Potential ecological exposure pathways for soil include:

- Uptake of surface soil COPECs by plants and subsequent food chain transfer to resident or migratory animals.
- Incidental ingestion of surface soil particulates by resident or migratory animals.
- Dermal absorption of COPECs adsorbed to surface soil particulates by resident or migratory animals.
- Inhalation of surface soil particulates by resident or migratory animals.

As depicted in the ecological CSM for NSS (Figure 3-3), exposure pathways between surface soil COPECs and terrestrial birds and mammals are complete. The following exposure pathways will be quantitatively evaluated in the ERA for the four NSS Areas: uptake of surface soil COPECs by plants and subsequent food chain transfer to upper trophic level receptors, and incidental ingestion of soil while foraging.

Although dermal contact with surface soil COPECs is a potentially complete pathway, potentially contaminated soil is expected to accumulate on feathers or fur rather than skin, and will be removed during grooming. As a result of variable protection due to feathers and fur, dose modeling methods for evaluating the dermal pathway are currently not well developed for ecological receptors. Therefore, the dermal pathway will not be quantitatively evaluated for birds and mammals.

Although inhalation of COPECs adsorbed to dust is a potentially complete exposure pathway, this pathway is also typically minor in comparison to the ingestion pathway. Furthermore, methods for quantifying the inhalation pathway for ecological receptors are currently not well developed. Consequently, the inhalation pathway will not be evaluated quantitatively for ecological receptors.

Exposure to COPECs in subsurface soil is considered to be an incomplete pathway for ecological receptors at the NSS. As described in Section 3.4.2.1, most of the NSS is constructed on compacted gravel pads, and bedrock is close to the ground surface, limiting opportunities for burrow development.

5.2.1.3 Surface Water and Sediment Exposure Pathways

Water soluble COPECs (e.g., BTEX) or lipophilic COPECs (e.g., PAHs) sorbed to soil particles, or organic matter, can be transported to surface water bodies via snowmelt and rainfall runoff. As depicted in the ecological CSM (Figure 3-3), exposure pathways between surface water and sediment COPECs and ecological receptors at Area C are potentially complete, and surface water and sediment data were conservatively screened against ecological benchmarks (Section 3.1.2 and Appendix D). Because aquatic ecological receptors were not observed in the small pond at Area C in visual assessments made during the RFI, exposure to potentially-contaminated surface water is potentially complete for terrestrial avian and mammalian receptors using the pond as a drinking water source. As discussed in Section 3.2, no analytes detected in surface water were retained for quantitative assessment in the ERA; therefore, exposure pathways between ecological receptors and potentially contaminated surface water at the pond are considered potentially complete, but insignificant. Because visual assessments cannot conclusively rule out the presence of benthic invertebrates, exposure of benthic invertebrates to COPECs in sediment is a complete pathway.

Seasonally wet gullies are present at USS, LSS, and Area A; however, these drainages do not support aquatic-dependent receptors. Surface water and sediment were not present in these drainages during the RFI; therefore, exposure of terrestrial birds and mammals to ephemeral surface water and sediment within the four NSS Areas is potentially seasonally complete, but insignificant, and will not be quantitatively evaluated.

Drainages fed primarily by emerging groundwater were present in off-site areas downgradient from the NSS. Groundwater infiltration and percolation may transport COPECs from the NSS Areas to off-site downgradient drainages. Therefore, exposure of aquatic and benthic invertebrates and aquatic-dependent birds and mammals to surface water COPECs derived from groundwater is potentially complete.

5.2.1.4 Assessment and Measurement Endpoints

Assessment endpoints focus the ERA on the guild or community that might be adversely affected by exposure to a COPEC. As defined in EPA guidelines (USEPA, 1998), an assessment endpoint is an explicit expression of the environmental value that is to be protected (for example, growth, survival, and reproduction of a specific species population). A measurement endpoint is defined as a quantitative expression of an observed or measured effect of the hazard; that is, a measurable response to a stressor related to the ecological characteristic chosen as the assessment endpoint (USEPA, 1998). Assessment and measurement endpoints selected for ecological receptors at the four NSS Areas are described in the following subsections.

5.2.1.4.1 Assessment Endpoints

Consistent with ADEC guidance (ADEC, 1999a), and the ecological CSM for the NSS (Section 3.4.2 and Figure 3-3), appropriate assessment endpoints for the four NSS Areas and downgradient off-site drainages are summarized below, with additional details provided in Table 5-1:

- The potential for significant adverse effects on terrestrial soil plant species abundance, diversity, and primary production (i.e., plants that obtain nutrients primarily from soil).
- The potential for significant adverse effects on freshwater plant species abundance, diversity, and primary production (i.e., plants that obtain nutrients primarily from freshwater).
- The potential for significant adverse effects on freshwater semi-aquatic plant species abundance, diversity, and primary production (i.e., plants that obtain nutrients primarily from freshwater sediment).
- The potential for significant adverse effects on freshwater benthic invertebrate community abundance and diversity (i.e., all freshwater benthic invertebrates).
- The potential for significant adverse effects on freshwater aquatic invertebrate community abundance and diversity (i.e., all freshwater aquatic invertebrates).
- The potential for significant adverse effects on soil invertebrate community abundance and diversity (i.e., all terrestrial invertebrates).
- The potential for significant adverse effects on terrestrial avian herbivore abundance and diversity (e.g., dark-eyed junco).
- The potential for significant adverse effects on semi-aquatic avian herbivore abundance and diversity (e.g., mallard).

- The potential for significant adverse effects on terrestrial mammalian herbivore abundance and diversity (e.g., tundra vole).
- The potential for significant adverse effects on semi-aquatic mammalian herbivore abundance and diversity (e.g., northern bog lemming).
- The potential for significant adverse effects on terrestrial avian invertivore abundance and diversity (e.g., American robin).
- The potential for significant adverse effects on freshwater aquatic avian invertivore abundance and diversity (e.g., American dipper).
- The potential for significant adverse effects on freshwater semi-aquatic avian invertivore abundance and diversity (e.g., common snipe).
- The potential for significant adverse effects on terrestrial mammalian invertivore abundance and diversity (e.g., masked shrew).
- The potential for significant adverse effects on terrestrial avian carnivore abundance and diversity (e.g., northern shrike).
- The potential for significant adverse effects on terrestrial mammalian carnivore abundance and diversity (e.g., least weasel).

5.2.1.4.2 Measurement Endpoints

A measurement endpoint is defined as a quantitative expression of an observed or measured effect of the hazard; that is, a measurable response to a stressor related to the ecological characteristic chosen as the assessment endpoint (USEPA, 1998). To evaluate the potential for significant adverse effects of soil COPECs on terrestrial soil plant and invertebrate communities, these organisms were evaluated semi-quantitatively by comparison with phytotoxicity benchmarks and earthworm/soil organism benchmarks, respectively. This comparison was performed as part of the Tier I screening ERA process for the four NSS Areas and downgradient off-site drainages (Appendix D). Potential adverse effects of sediment COPECs on benthic invertebrates in the Area C pond were evaluated by screening against effects threshold-low and effects threshold-high values (Appendix K, Table K-25).

The potential for significant adverse effects of soil COPECs on the remaining, higher trophic level organisms was evaluated by using COPEC concentrations in abiotic media (i.e., soil) and biotic media (i.e., plant and animal tissues) to model exposure doses for comparison to toxicity reference values (TRVs). This process is described in Section 5.2.2.

The assessment and measurement endpoints evaluated for the four NSS Areas and downgradient off-site drainages are highlighted in Table 5-1 [Note: The measurement endpoint for each selected assessment endpoint is listed under the column heading ‘Typical Assessment Method’].

5.2.1.5 Indicator Receptors

Because an evaluation of all receptors inhabiting a given ecosystem, or even all receptors representing an assessment endpoint, is not possible, representative indicator species are typically selected for quantitative evaluation in the ERA. The general criteria that are used to select indicator receptors are described in Section 5.2.1.5.1, and the specific indicator receptors that were selected for four NSS Areas and downgradient off-site drainages are identified in Section 5.2.1.5.2.

5.2.1.5.1 Selection Criteria

Criteria used in the selection of indicator receptors for quantitative evaluation in the ERA are as follows (ADEC, 1999a; USEPA, 1998):

- Ecological Relevance – Highly relevant receptors provide an important functional or structural aspect in the ecosystem. Attributes of highly relevant receptors typically fall under the categories of food, habitat, production, seed dispersal, pollination, and decomposition. Critical attributes include those that affect or determine the function or survival of a population.
- Exposure Potential – Receptors with high exposure potentials are those that, due to their metabolism, feeding habits, and range, location, or reproductive strategy, tend to have higher potentials for exposure than other receptors.
- Sensitivity – Highly susceptible receptors include those with low tolerances to a COPEC, and receptors with enhanced COPEC susceptibility due to other contaminant stressors that may not be related to a COPEC, such as reduced habitat availability. For example, a species that forages entirely within a contaminated site will be more exposed to a COPEC and, therefore, more sensitive to COPEC impacts.
- Availability of Natural History Information – Natural history information is essential to quantitatively evaluate risk to measurement receptors. If information such as body weight; food, soil, and surface water ingestion rates; or reproductive and behavioral information, is unavailable for a potential receptor, then another species is chosen, or estimates are made from a taxonomically related species.
- Status – Species designated as "threatened and endangered" or "priority for conservation and management" are typically given preference in selection as indicator receptors to ensure that potential risk to the most sensitive species is evaluated.

5.2.1.5.2 Selected Indicator Receptors

Default indicator receptors recommended by ADEC (ADEC, 1999a) were selected for evaluation in the ERA for the four NSS Areas. Default assessment endpoints representative of the food guild to be protected by each of the assessment endpoints identified in Section 5.2.1.4.1 are as follows:

- Terrestrial plants – Terrestrial soil plant primary production.
- Freshwater aquatic plants – Aquatic plant primary production.

- Freshwater semi-aquatic plants – Semi-aquatic plant primary production.
- Terrestrial invertebrates – Soil invertebrate community.
- Freshwater aquatic invertebrates – Aquatic invertebrate community.
- Freshwater benthic invertebrates – Sediment invertebrate community.
- Dark-eyed junco (*Junco hyemalis*) – Terrestrial avian herbivore.
- Mallard (*Anas platyrhynchos*) – Semi-aquatic avian herbivore.
- Tundra vole (*Microtus oeconomus*) – Terrestrial mammalian herbivore.
- Northern bog lemming (*Synaptomys borealis*) – Semi-aquatic mammalian herbivore.
- American robin (*Turdus migratorius*) – Terrestrial avian invertivore.
- American dipper (*Cinclus mexicanus*) – Freshwater aquatic avian invertivore.
- Common snipe (*Gallinago gallinago*) – Freshwater semi-aquatic avian invertivore.
- Masked shrew (*Sorex cinereus*) – Terrestrial mammalian invertivore.
- Northern shrike (*Lanius excubitor*) – Terrestrial avian carnivore.
- Least weasel (*Mustela nivalis*) – Terrestrial mammalian carnivore.

The above mammalian and avian species are appropriate as indicator receptors because they have been observed at, or potentially occur on, NSS (Tables 3-12 and 3-13, respectively).

5.2.2 Exposure Dose Analysis

Exposure dose analysis uses statistical methods to determine or predict ecological responses to stressors under exposure conditions of interest (USEPA, 1998). The following information is used to estimate the relationship between chemical stressor(s) and ecological response(s):

- Exposure pathways and routes.
- Exposure point concentrations.
- Exposure dose calculations.

Each of these steps in the exposure analysis process is described in the following subsections.

5.2.2.1 Exposure Pathways and Routes

All potential exposure pathways for indicator receptors present or potentially occurring at NSS were evaluated, and the potentially complete exposure pathways were identified. Complete and significant exposure pathways for indicator receptors to be quantitatively evaluated in the ERA for the four NSS Areas and downgradient off-site drainages are shown on Figure 3-3, and are briefly summarized as follows:

- Direct exposure to contaminants in surface soil or sediment through incidental ingestion, and surface water through ingestion.
- Uptake through food chain transfer of chemicals in surface soil, surface water, or sediment.

Inhalation exposure estimates were not quantified in the Tier II ERA due to lack of toxicity data and exposure information for this pathway. In addition, dermal exposure estimates were not quantified for indicator receptors in the Tier II ERA. The lack of exposure models and toxicity information for quantifying dermal exposures and for estimating the probability of toxicological effects limits the reliability of such calculations. Potential uncertainties associated with not quantitatively evaluating the inhalation and dermal exposure pathways are described in Section 6.4.

5.2.2.2 Exposure Point Concentrations

Methods used in the statistical derivation of soil and surface water EPCs during the Tier II ERA are the same as those previously described for human health (refer to Section 4.2.1).

EPCs for sediment in downgradient off-site drainages were estimated by applying a partitioning coefficient to the EPCs calculated from measured concentrations in surface water samples from downgradient off-site drainages. EPCs in food items were estimated through application of abiotic to biotic media transfer factors.

5.2.2.3 Exposure Dose Calculations

Exposure dose calculation consolidates exposure pathways and routes, EPCs, and exposure parameters into an equation that provides an exposure dose estimate in units of mg/Kg-day (Appendix J).

Ingestion dose estimates were calculated using the following general equation derived from the EPA's *Wildlife Exposure Factors Handbook* (USEPA, 1993b):

$$\mathrm{Dose_{Ingestion}} = \frac{[(\mathrm{IR_{Biotic}} \times \mathrm{C_{Biotic}}) + (\mathrm{IR_{Abiotic}} \times \mathrm{EPC_{Abiotic}})] \times \mathrm{SUF} \times \mathrm{ED}}{\mathrm{BW}}$$

Where:

$\mathrm{Dose}_{\mathrm{Ingestion}}$	=	Estimated exposure dose from ingestion of food and ingestion of abiotic media (mg/Kg-day)
$\mathrm{IR}_{\mathrm{Biotic}}$	=	Food ingestion rate (kg[tissue dry weight]/day)
$\mathrm{C}_{\mathrm{Biotic}}$	=	Concentration of COPEC in food items (mg[COPEC]/kg[dry weight])
$\mathrm{IR}_{\mathrm{Abiotic}}$	=	Abiotic media ingestion rate (kg[soil dry weight]/day)
$\mathrm{EPC}_{\mathrm{Abiotic}}$	=	Concentration of COPEC in abiotic media (kg[COPEC]/kg[dry weight soil])
SUF	=	Site utilization factor (unitless)
ED	=	Exposure duration (unitless)
BW	=	Body weight (kg)

Exposure parameters required for calculating estimated exposure doses include the following:

- Biotic (i.e., plant and animal tissue) and abiotic (i.e., surface soil) media ingestion rates.
- Average concentrations of COPECs in food items and in abiotic media (i.e., surface soil).

- Exposure duration (time in a year that a receptor is exposed to NSS COPECs).
- Site utilization factor (the area of contamination in relation to the receptor's home range).
- Body weight.

Food ingestion rates for each indicator receptor were calculated using allometric equations provided in Nagy (2001) or in the EPA's *Wildlife Exposure Factors Handbook* (USEPA, 1993b). These equations are based on established relationships between body size and metabolic requirements, and are expressed in units of grams of food per day. Exposure parameters for NSS ecological indicator receptors are identified in **Table 5-2**, and were obtained from the following sources:

- *Field Guide to North American Mammals* (NAS, 1996).
- *Wildlife Exposure Factors Handbook* (USEPA, 1993b).
- *Estimates of Soil Ingestion by Wildlife* (Beyer et al., 1994).
- Alaska Department of Fish and Game *Wildlife Notebook Series* (ADF&G, 2008)
- California Wildlife Habitat Relationship System (CDF&G, 2009)
- Cornell Lab of Ornithology (Cornell, 2009)
- Idaho State University Natural History Digital Atlas (ISU, 2000)

Dose estimation for higher trophic level receptors requires abiotic-to-abiotic media uptake factors and bioconcentration factors. Uptake factors and bioconcentration factors for individual COPECs evaluated in the ERA are presented in **Table 5-3**. These bioconcentration factors were obtained from the following sources:

- *Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs* (USEPA, 2007c).
- *Uptake of Inorganic Chemicals from Soil by Plant Leaves: Regressions of Field Data* (Efroymson et al., 2001).
- *Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants* (Bechtel Jacobs, 1998a)
- *Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation* (Bechtel Jacobs, 1998b).
- *Soil Screening Guidance Technical Background Document* (USEPA, 1996)
- Literature-derived Bioaccumulation Models for Energetic Compounds in Plants and Soil Invertebrates Technical Memorandum (CH2M Hill, 2005).
- *A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture* (Baes et al., 1984).
- *Development and Validation of Bioaccumulation Models for Small Mammals,* Table 7 and Appendix B (Sample et al., 1998).

5.3 ECOLOGICAL EFFECTS ASSESSMENT

The Tier II ecological effects assessment describes how toxicity information was used in the characterization of potential ecological effects for indicator receptors. Ecological effects assessments for predictive ERAs require the use of ecological TRVs obtained from the literature. Two types of ecological TRVs were used in the ERA, consistent with the nature of the ecological indicator receptors:

- Media-based TRVs for lower trophic level receptors (e.g., sediment benthic invertebrates).
- Dietary-based TRVs for upper trophic level receptors (i.e., herbivorous, omnivorous, invertivorous, or carnivorous birds and mammals).

Sources of media-based TRVs include:

- *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald et al., 2000).

Sources of dietary exposure-based TRVs include:

- *Guidance for Developing Ecological Soil Screening Levels* (USEPA, 2005a).
- *Toxicological Benchmarks for Wildlife* (ORNL, 1996a).
- Integrated Risk Information System (IRIS) Database (USEPA, 2012a).
- *Wildlife Toxicity Assessment for Perchlorate* (USACHPPM, 2007).
- *Fluorescence of Chickens and Eggs Following the Feeding of Benzpyrene Crystals* (Rigdon and Neal, 1963).
- *The Acute Oral Toxicity, Repellency, and Hazard Potential of 998 Chemicals to One or More Species of Wild and Domestic Birds* (Schafer et al., 1983).

The TRVs developed as part of the ecological effects assessment for upper trophic level mammalian and avian receptors are presented in **Table 5-4** and **Table 5-5**, respectively.

Ecological hazards for PHCs were evaluated based on sampling results for specific indicator chemicals (e.g., BTEX and PAHs). Although ADEC has developed RfDs for individual PHC fractions, these toxicity values were developed based on protection of human health. Therefore, these values will not be used to evaluate ecological receptors. In addition to the evaluation of indicator chemicals, as described above, potential impacts of PHC mixtures (such as DRO) were evaluated through the use of TRVs for surrogate compounds (e.g., benzene, benzo(a)pyrene, and naphthalene).

5.4 RISK CHARACTERIZATION

Ecological risk characterization integrates results of the exposure dose analysis and the effects assessment described in Sections 5.2.2 and 5.3, respectively. For higher trophic level receptors, estimated exposure doses for each chemical and indicator receptor were compared to ecological TRVs to calculate a chemical-specific HQ. The equation for calculating the HQ is:

$$\mathrm{HQ} = \frac{\mathrm{Dose}}{\mathrm{TRV}}$$

Where:

HQ = Hazard quotient (unitless).
Dose = Modeled exposure dose for indicator species (mg/Kg-day).
TRV = Toxicity reference value for the indicator species (mg/Kg-day).

The HQ value scheme is derived from toxicity testing in an aquatic framework, and a high HQ may not necessarily mean that representative ecological receptors are experiencing adverse health effects. For example, TRVs used in predictive ERAs are typically NOAEL-based. Therefore, environmental exposures higher than the TRV may be without adverse effects.

HQ values exceeding 1 are generally considered to be indicative of potential biological or ecological effects on representative receptors. HQ values above 1 do not necessarily indicate that a biological or ecological effect will occur, only that a lower threshold has been exceeded (Menzie et al., 1992). Evaluating the significance of HQ values is conducted in a manner generally consistent with Menzie et al. (1992):

- HQ less than 1 – no adverse effects on representative receptors.
- HQ between 1 and 10 – limited potential for adverse effects on representative receptors.
- HQ between 10 and 100 – potentially adverse effects on representative receptors.
- HQ exceeds 100 – significant potential for adverse effects on representative receptors.

Note that these HQ ranges and anticipated outcomes are only guidelines. Site-specific factors such as spatial distribution and detection frequency of COPECs, uncertainty of assumptions used in exposure determination, and the study endpoint used to determine toxicity benchmarks will be considered when reviewing specific HQs.

The ADEC risk management level is set at an ecological HQ of 1. Consistent with ADEC guidance (ADEC, 2011a), chemicals and NSS Areas associated with ecological HQ estimates greater than 1 were retained for further evaluation. Options for further evaluation of NSS Areas with ecological HQ estimates in excess of 1 may include, but not be limited to: ecological field validation studies, additional investigations of ambient conditions, or remedial options. Areas where HQ values are less than 1 for all receptors, and uncertainties are acceptable, will be proposed for no further remedial action planned with regard to ecological concerns.

5.5 RESULTS

Results of the ERA for each of the four NSS Areas and downgradient off-site drainages are discussed in the following subsections. Detailed ecological hazard calculations are presented in Appendix K.

5.5.1 Upper Site Summit

Hazard estimates for ecological indicator receptors exposed to contaminants associated with USS are summarized in **Table 5-6**. Detailed ecological hazard calculations for USS are presented in Appendix K.

Mammalian Receptors

Ecological HQ and HI estimates were calculated for the following mammalian indicator receptors exposed to COPECs in surface soil at USS: tundra vole (terrestrial mammalian herbivore), masked shrew (terrestrial mammalian invertivore), and least weasel (terrestrial mammalian carnivore). Ecological HQ estimates in excess of 1.0 were calculated for the tundra vole, masked shrew, and least weasel. The highest HQ estimate (13) was calculated for the tundra vole and was attributable to RRO in soil (EPC = 1,505 mg/Kg). Other COPECs with HQ estimates in excess of 1.0 included lead, cadmium, benzo(b)fluoranthene, and pyrene.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for USS mammals were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the tundra vole, masked shrew, and least weasel at USS were 2, 7, and 0.5, respectively. Primary contributors to cumulative growth/body weight HI estimates in excess of the ADEC HI criterion of 1 were several metals in soil (in order of descending contribution): cadmium, lead, barium, nickel, selenium, silver, and vanadium.
- Cumulative kidney and liver HI estimates for the tundra vole, masked shrew, and least weasel at USS were 0.00008, 0.0004, and 0.0000006, respectively. Cumulative kidney and liver HI estimates are all less than ADEC's HI criterion of 1.
- Cumulative PAH HI estimates for the tundra vole, masked shrew, and least weasel at USS were 1, 5, and 0.04, respectively. Primary contributors to cumulative PAH HI estimates in excess of the ADEC HI criterion of 1 were benzo(b)fluoranthene and pyrene.
- Cumulative PHC HI estimates for the tundra vole, masked shrew, and least weasel at USS were 13, 7, and 6, respectively. The primary contributor to cumulative PHC HI estimates in excess of the ADEC HI criterion of 1 was RRO.
- Cumulative reproductive HI estimates for the tundra vole, masked shrew, and least weasel at USS were 0.7, 1, and 0.3, respectively. These cumulative reproductive HI estimates are not greater than ADEC's HI criterion of 1.

Avian Receptors

Ecological HQ and HI estimates were calculated for the following avian indicator receptors exposed to COPECs in surface soil at USS: American robin (terrestrial avian invertivore), dark-eyed junco (terrestrial avian herbivore), and northern shrike (terrestrial avian carnivore). Ecological HQ estimates were less than 1.0 for all avian receptors.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for avian receptors at USS were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the American robin, dark-eyed junco, and northern shrike at USS were 0.4, 0.1, and 0.09, respectively. These cumulative growth/body weight HI estimates are less than ADEC's HI criterion of 1.
- Cumulative mortality HI estimates for the American robin, dark-eyed junco, and northern shrike at USS were 0.07, 0.1, and 0.01, respectively. These cumulative mortality HI estimates are less than ADEC's HI criterion of 1.
- Cumulative PAH HI estimates for the American robin, dark-eyed junco, and northern shrike at USS were 0.1, 0.08, and 0.03, respectively. These cumulative PAH HI estimates are less than ADEC's HI criterion of 1.
- Cumulative PHC HI estimates for the American robin, dark-eyed junco, and northern shrike at USS were 0.05, 0.03, and 0.003, respectively. These cumulative PHC HI estimates are less than ADEC's HI criterion of 1.
- Cumulative reproductive HI estimates for the American robin, dark-eyed junco, and northern shrike at USS were 1, 0.1, and 0.4, respectively. These cumulative reproductive HI estimates are not greater than ADEC's HI criterion of 1.

5.5.2 Lower Site Summit

Hazard estimates for ecological indicator receptors exposed to contaminants associated with LSS are summarized in **Table 5-7**. Detailed ecological hazard calculations for LSS are presented in Appendix K.

Mammalian Receptors

Ecological HQ and HI estimates were calculated for the following mammalian indicator receptors exposed to COPECs in surface soil at LSS: tundra vole (terrestrial mammalian herbivore), masked shrew (terrestrial mammalian invertivore), and least weasel (terrestrial mammalian carnivore). Ecological HQ estimates in excess of 1.0 were calculated for the tundra vole, masked shrew, and least weasel. The highest HQ estimate (38) was calculated for the tundra vole and was attributable to RRO in soil (EPC = 4,601 mg/Kg). Other COPECs with HQ estimates in excess of 1.0 include cadmium, bis(2-ethylhexyl)phthalate, pentachlorophenol, and PAHs.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for LSS mammals were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative gastrointestinal HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 0.0000002, 0.00000009, and 0.00000007, respectively. These cumulative gastrointestinal HI estimates are all less than ADEC's HI criterion of 1.

- Cumulative growth/body weight HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 5, 9, and 0.3, respectively. Primary contributors to cumulative growth/body weight HI estimates in excess of the ADEC HI criterion of 1 were cadmium and pentachlorophenol.
- Cumulative kidney HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 0.0002, 0.0008, and 0.000001, respectively. These cumulative kidney HI estimates are all less than ADEC's HI criterion of 1.
- Cumulative liver HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 0.0004, 0.05, and 0.0002, respectively. These cumulative liver HI estimates are all less than ADEC's HI criterion of 1.
- Cumulative neurotoxicity HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 0.001, 0.000003, and 0.000002, respectively. These cumulative neurotoxicity HI estimates are all less than ADEC's HI criterion of 1.
- Cumulative no adverse effects HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 0.0002, 0.03, and 0.0001, respectively. These cumulative no adverse effects HI estimates are all less than ADEC's HI criterion of 1.
- Cumulative PAH HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 7, 25, and 0.2, respectively. Primary contributors to cumulative PAH HI estimates in excess of the ADEC HI criterion of 1 were: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and pyrene.
- Cumulative PHC HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 39, 22, and 17, respectively. The primary contributor to cumulative PHC HI estimates in excess of the ADEC HI criterion of 1 was RRO.
- Cumulative reproductive HI estimates for the tundra vole, masked shrew, and least weasel at LSS were 5, 9, and 0.3, respectively. The primary contributors to reproductive HI estimates in excess of the ADEC HI criterion of 1 were pentachlorophenol and bis(2-ethylhexyl)phthalate.

Avian Receptors

Ecological HQ and HI estimates were calculated for the following avian indicator receptors exposed to COPECs in surface soil at LSS: American robin (terrestrial avian invertivore), dark-eyed junco (terrestrial avian herbivore), and northern shrike (terrestrial avian carnivore). Ecological HQ estimates in excess of 1.0 were calculated for the American robin, dark-eyed junco, and northern shrike. The highest HQ estimate (9.9) was calculated for the American robin and was attributable to bis(2-ethylhexyl)phthalate in soil (EPC = 5.44 mg/Kg). Other COPECs with HQ estimates in excess of 1.0 were pentachlorophenol and pyrene.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for LSS avian receptors were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the American robin, dark-eyed junco, and northern shrike at LSS were 3, 2, and 0.8, respectively. The primary contributor to cumulative growth/body weight HI estimates in excess of the ADEC HI criterion of 1 was pentachlorophenol.
- Cumulative mortality HI estimates for the American robin, dark-eyed junco, and northern shrike at LSS were 1, 0.3, and 0.4, respectively. These cumulative mortality HI estimates do not exceed ADEC's HI criterion of 1.
- Cumulative PAH HI estimates for the American robin, dark-eyed junco, and northern shrike at LSS were 3, 2, and 0.8, respectively. The primary contributor to cumulative PAH HI estimates in excess of the ADEC HI criterion of 1 was pyrene.
- Cumulative PHC HI estimates for the American robin, dark-eyed junco, and northern shrike at LSS were 0.8, 0.4, and 0.1, respectively. These cumulative PHC HI estimates are less than ADEC's HI criterion of 1.
- Cumulative reproductive HI estimates for the American robin, dark-eyed junco, and northern shrike at LSS were 11, 0.3, and 3, respectively. The primary contributor to a cumulative reproductive HI estimate in excess of the ADEC HI criterion of 1 was bis(2-ethylhexyl) phthalate.

5.5.3 Area A

Hazard estimates for ecological indicator receptors exposed to contaminants associated with Area A are summarized in **Table 5-8**. Detailed ecological hazard calculations for Area A are presented in Appendix K.

Mammalian Receptors

Ecological HQ and HI estimates were calculated for the following mammalian indicator receptors exposed to COPECs in surface soil at Area A: tundra vole (terrestrial mammalian herbivore), masked shrew (terrestrial mammalian invertivore), and least weasel (terrestrial mammalian carnivore). Ecological HQ estimates in excess of ADEC's criterion of 1.0 were calculated for the tundra vole, masked shrew, and least weasel. The highest HQ estimate (533) was calculated for the tundra vole and was attributable to RRO in soil (EPC = 63,887 mg/Kg). RRO was the only COPEC having HQ estimates exceeding ADEC's criterion of 1.0.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for Area A mammals were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the tundra vole, masked shrew, and least weasel at Area A were 0.4, 1, and 0.06, respectively. These cumulative growth/body weight effects HI estimates do not exceed ADEC's HI criterion of 1.
- Cumulative no adverse effects HI estimates for the tundra vole, masked shrew, and least weasel at Area A were 0.0003, 0.03, and 0.00006, respectively. These cumulative no adverse effects HI estimates are all less than ADEC's HI criterion of 1.

- Cumulative PHC HI estimates for the tundra vole, masked shrew, and least weasel at Area A were 534, 309, and 129, respectively. The primary contributor to cumulative PHC HI estimates in excess of the ADEC HI criterion of 1 was RRO.
- Cumulative reproductive HI estimates for the tundra vole, masked shrew, and least weasel at Area A were 0.6, 0.2, and 0.2, respectively. These cumulative reproductive effects HI estimates are all less than ADEC's HI criterion of 1.

Avian Receptors

Ecological HQ and HI estimates were calculated for the following avian indicator receptors exposed to COPECs in surface soil at Area A: American robin (terrestrial avian invertivore), dark-eyed junco (terrestrial avian herbivore), and northern shrike (terrestrial avian carnivore). No COPECs had HQs in excess of 1.0.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for Area A avian receptors were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the American robin, dark-eyed junco, and northern shrike at Area A were 0.01, 0.004, and 0.004, respectively. These cumulative growth/body weight HI estimates are less than the ADEC's HI criterion of 1.
- Cumulative mortality HI estimates for the American robin, dark-eyed junco, and northern shrike at Area A were 0.04, 0.02, and 0.009, respectively. These cumulative mortality HI estimates are less than ADEC's HI criterion of 1.
- Cumulative PHC HI estimates for the American robin, dark-eyed junco, and northern shrike at Area A were 0.8, 0.4, and 0.05, respectively. These cumulative PHC HI estimates are less than ADEC's HI criterion of 1.
- Cumulative reproductive HI estimates for the American robin, dark-eyed junco, and northern shrike at Area A were 0.04, 0.01, and 0.009, respectively. These cumulative reproductive HI estimates do not exceed ADEC's HI criterion of 1.

5.5.4 Area C

Hazard estimates for ecological indicator receptors exposed to contaminants associated with Area C are summarized in **Table 5-9**. Detailed ecological hazard calculations for Area C are presented in Appendix K.

Mammalian Receptors

Ecological HQ and HI estimates were calculated for the following mammalian indicator receptors exposed to COPECs in surface soil at Area C: tundra vole (terrestrial mammalian herbivore), masked shrew (terrestrial mammalian invertivore), and least weasel (terrestrial mammalian carnivore). Ecological HQ estimates did not exceed 1.0 for any mammalian receptors.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for Area C mammals were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the tundra vole, masked shrew, and least weasel at Area C were 0.02, 0.004, and 0.0005, respectively. These cumulative growth/body weight HI estimates are all less than ADEC’s HI criterion of 1.
- Cumulative PAH HI estimates for the tundra vole, masked shrew, and least weasel at Area C were 0.7, 0.1, and 0.0005, respectively. These cumulative PAH HI estimates are all less than ADEC’s HI criterion of 1.
- Cumulative PHC HI estimates for the tundra vole, masked shrew, and least weasel at Area C were 1, 0.03, and 0.01, respectively. These cumulative PHC effects HI estimates do not exceed ADEC’s HI criterion of 1.
- Cumulative reproductive HI estimates for the tundra vole, masked shrew, and least weasel at Area C were 0.2, 0.002, and 0.004, respectively. These cumulative reproductive HI estimates are all less than ADEC’s HI criterion of 1.

Avian Receptors

Ecological HQ and HI estimates were calculated for the following avian indicator receptors exposed to COPECs in surface soil at Area C: American robin (terrestrial avian invertivore), dark-eyed junco (terrestrial avian herbivore), and northern shrike (terrestrial avian carnivore). Ecological HQ estimates were less than 1.0 for all avian receptors.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for Area C avian receptors were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the American robin, dark-eyed junco, and northern shrike at Area C were 0.00003, 0.00004, and 0.000002, respectively. These cumulative growth/body weight HI estimates are less than ADEC’s HI criterion of 1.
- Cumulative PAH HI estimates for the American robin, dark-eyed junco, and northern shrike at Area C were 0.001, 0.0009, and 0.0004, respectively. These cumulative PAH HI estimates are less than ADEC’s HI criterion of 1.
- Cumulative PHC HI estimates for the American robin, dark-eyed junco, and northern shrike at Area C were 0.00007, 0.00004, and 0.000004, respectively. These cumulative PHC HI estimates are less than ADEC’s HI criterion of 1.
- Cumulative reproductive HI estimates for the American robin, dark-eyed junco, and northern shrike at Area C were 0.0002, 0.0001, and 0.00005, respectively. These cumulative reproductive HI estimates are less than ADEC’s HI criterion of 1.

5.5.5 Downgradient Off-Site Drainages

Hazard estimates for ecological indicator receptors exposed to contaminants associated with downgradient off-site drainages are summarized in **Table 5-10**. Detailed ecological hazard calculations for downgradient off-site are presented in Appendix K.

Mammalian Receptors

Ecological HQ and HI estimates were calculated for a single herbivorous semi-aquatic mammalian indicator receptor, the northern bog lemming, exposed to COPECs in surface water in downgradient off-site drainages. All ecological HQ estimates were less than ADEC's criterion of 1.0.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for the northern bog lemming in downgradient, offsite drainages were calculated for the following mechanisms of action or specific chemical classes:

- The cumulative growth/body weight HI estimate for the northern bog lemming exposed at downgradient off-site drainages was 0.2. This growth/body weight HI is less than ADEC's HI criterion of 1.
- The cumulative reproductive HI estimate for the northern bog lemming exposed at downgradient off-site drainages was 0.00007. This reproductive HI estimate is less than ADEC's HI criterion of 1.

Avian Receptors

Ecological HQ and HI estimates were calculated for the following avian indicator receptors exposed to COPECs in surface water at downgradient off-site drainages: mallard (aquatic avian herbivore), American dipper (semi-aquatic avian invertivore), and common snipe (aquatic avian invertivore). Ecological HQ estimates were less than 1.0 for all avian receptors.

In order to evaluate potential cumulative effects, ecological HQ estimates were summed to HIs for COPECs having similar mechanisms of action or within specific chemical classes. Cumulative HI estimates for downgradient off-site drainage avian receptors were calculated for the following mechanisms of action or specific chemical classes:

- Cumulative growth/body weight HI estimates for the mallard, American dipper, and common snipe at downgradient off-site drainages were 0.0001, 0.6, and 0.03, respectively. These cumulative growth/body weight HI estimates are less than ADEC's HI criterion of 1.
- Cumulative mortality HI estimates for the mallard, American dipper, and common snipe at downgradient off-site drainages were 0.000001, 0.04, and 0.000004, respectively. These cumulative mortality HI estimates are less than ADEC's HI criterion of 1.
- Cumulative reproductive HI estimates for the mallard, American dipper, and common snipe at downgradient off-site drainages were 0.0001, 0.6, and 0.03, respectively. These cumulative reproductive HI estimates are less than ADEC's HI criterion of 1.

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Table 5-1 Summary of Default Assessment Endpoints and Indicator Species for the Southcentral Ecoregion

Default Assessment Endpoint	Default Indicator Species [1]	Typical Assessment Method	Primary (Bold) and Other Exposure Media
Primary Producers (Trophic Level 0)			
The potential for significant adverse effects on terrestrial soil plant species abundance, diversity, and primary production.	**all plants that obtain nutrients primarily from soil**	Compare soil concentrations with phytotoxicity benchmarks.	**Surface soil**
The potential for significant adverse effects on terrestrial air plant species abundance, diversity, and primary production.	all plants that obtain nutrients primarily from air	Not evaluated under normal circumstances.	**Air**
The potential for significant adverse effects on freshwater plant species abundance, diversity, and primary production.	**all plants that obtain nutrients primarily from freshwater**	Compare media concentrations with available WQC.	**Freshwater**
The potential for significant adverse effects on freshwater semi-aquatic plant species abundance, diversity, and primary production.	**all plants that obtain nutrients primarily from freshwater sediment** [2]	Compare media concentrations with available SQC.	**Freshwater sediment** Freshwater
Herbivores and Detritivores (Primary Consumers - Trophic Levels 1 and 2)			
The potential for significant adverse effects on freshwater aquatic invertebrate community abundance and diversity.	**all freshwater aquatic invertebrates** [2]	Compare media concentrations with available WQC.	**Freshwater**
The potential for significant adverse effects on freshwater benthic invertebrate community abundance and diversity.	**all freshwater benthic invertebrates** [2]	Compare media concentrations with available SQC.	**Freshwater sediment** Freshwater
The potential for significant adverse effects on soil invertebrate community abundance and diversity.	**all terrestrial invertebrates**	Compare media concentrations with earthworm/soil organism benchmarks.	**Surface Soil**
The potential for significant adverse effects on freshwater fish detritivore abundance and diversity.	all freshwater fish [3]	Compare media concentrations with available WQC.	**Freshwater**
The potential for significant adverse effects on semi-aquatic avian herbivore abundance and diversity.	**mallard** [2]	Model dose from sediment, surface water, aquatic plant, and aquatic invertebrate ingestion, compare with TRVs.	**Freshwater sediment** Freshwater
The potential for significant adverse effects on terrestrial avian herbivore abundance and diversity.	**dark-eyed junco**	Model dose from soil, surface water, and plant ingestion, compare to TRVs.	**Surface soil** Freshwater
The potential for significant adverse effects on semi-aquatic mammalian herbivore abundance and diversity.	**northern bog lemming** [2]	Model dose from sediment, surface water, and plant ingestion, compare to TRVs.	**Freshwater sediment** Freshwater
The potential for significant adverse effects on terrestrial mammalian herbivore abundance and diversity.	**tundra vole**	Model dose from soil, surface water, and plant ingestion, compare to TRVs.	**Surface soil** Freshwater

Table 5-1 Summary of Default Assessment Endpoints and Indicator Species for the Southcentral Ecoregion

Default Assessment Endpoint	Default Indicator Species [1]	Typical Assessment Method	Primary (Bold) and Other Exposure Media
Secondary Consumers (Trophic Level 3)			
The potential for significant adverse effects on freshwater aquatic avian invertivore abundance and diversity.	**American dipper [2]**	Model dose from sediment, surface water, and aquatic invertebrate ingestion, compare with TRVs.	**Freshwater**
The potential for significant adverse effects on freshwater semi-aquatic avian invertivore abundance and diversity.	**common snipe [2]**	Model dose from sediment, surface water, and benthic invertebrate ingestion, compare with TRVs.	**Freshwater sediment**
The potential for significant adverse effects on terrestrial avian invertivore abundance and diversity	**American robin**	Model dose associated with soil ingestion and ingestion of soil invertebrates and compare with applicable TRV.	**Surface soil**
The potential for significant adverse effects on freshwater fish invertivore abundance and diversity.	all freshwater fish [3]	Compare media concentrations with available WQC.	**Freshwater**
The potential for significant adverse effects on freshwater amphibian invertivore abundance and diversity	wood frog	Compare media concentrations with WQC or model dose associated with ingestion of freshwater aquatic invertebrates and sediment and compare with applicable TRV.	**Freshwater** Sediment
Terrestrial amphibian invertivore abundance and physical health	western toad	Model dose associated with ingestion of soil invertebrates and soil and compare with applicable TRV.	**Surface soil**
The potential for significant adverse effects on terrestrial mammalian invertivore abundance and diversity.	**masked shrew**	Model dose from soil and soil invertebrate ingestion, compare with TRVs.	**Surface soil** **F**reshwater
Tertiary Consumers (Trophic Level 4)			
The potential for significant adverse effects on freshwater avian piscivore abundance and diversity.	belted kingfisher [3]	Model dose from sediment, surface water, and fish ingestion, compare to TRVs.	**Freshwater**
The potential for significant adverse effects on terrestrial avian carnivore abundance and diversity.	**northern shrike**	Model dose from soil and soil invertebrate ingestion, compare with TRVs.	**Surface soil**
The potential for significant adverse effects on terrestrial mammalian carnivore abundance and diversity.	**least weasel**	Model dose from soil and terrestrial prey ingestion, compare with TRVs.	**Surface soil**
The potential for significant adverse effects on freshwater semi-aquatic mammalian carnivore abundance and diversity.	mink [3]	Model dose from sediment, surface water, and fish ingestion, compare to TRVs.	**Freshwater** Sediment Surface soil
The potential for significant adverse effects on freshwater mammalian piscivore abundance and diversity.	river otter [3]	Model dose from fresh surface water and fish ingestion, compare to TRVs.	**Freshwater**
The potential for significant adverse effects on freshwater fish piscivore abundance and diversity.	all freshwater fish [3]	Compare media concentrations with available WQC.	**Freshwater**

Table 5-1 Summary of Default Assessment Endpoints and Indicator Species for the Southcentral Ecoregion

Default Assessment Endpoint	Default Indicator Species [1]	Typical Assessment Method	Primary (Bold) and Other Exposure Media

Notes:

SQC - Sediment quality criteria.
TRV - Toxicity reference value.
WQC - Water quality criteria.

[1] Source: Technical Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions (ADEC, 1999).
[2] Due to the limited nature of the surface water habitat in drainages at NSS, aquatic dependent receptors are limited to aquatic plants, inverterates (aquatic and benthic), and organisms dependant on these receptors as a food source.
[3] Fish and larger associated piscivores have not been observed and are not expected to be present due to the limited nature of the surface water habitat in the NSS drainages.

Highlighted assessment endpoints and indicator species will be evaluated in the Ecological Risk Assessment for Nike Site Summit.

Table 5-2 Exposure Parameters for Ecological Receptors

Exposure Parameter [a]	American Robin *(Turdus migratorius)*	Dark-eyed Junco *(Funco hyemalis)*	Least Weasel *(Mustela nivalis)*	Masked Shrew *(Sorex cinereus)*	Northern Shrike *(Laninus excubitor)*	Tundra Vole *(Microtus oeconomus)*	Mallard *(Anas platyrhynchos)*	Northern Bog Lemming *(Synaptomys borealis)*	American Dipper *(Cinclus mexicanus)*	Common Snipe *(Gallinago gallinago)*
Body Mass average (grams) [b]	81 [c]	24 [d]	45 [c]	4.5 [c]	68 [d]	53 [e]	1171 [c]	33 [f]	55 [d]	113 [d]
Male Range	63.5-103	18-30	39-63	3-6	56-79	25-80	1,225-1,246	23-34 [g]	43 - 67 [d]	79-146
Female Range	63.5-103	18-30	38-40	3-6	56-79	25-80	1,043-1,197	23-34 [g]	43 - 67 [d]	79-146
Diet Composition (percent)										
Plant Matter	30	100	0	0	0	100	90 [h]	100	0	10 [d]
Animal Matter	70	0	100	100	100	0	10 [h]	0	100	90 [d]
Food Ingestion Rate (grams/day) [i]	11	5.5	3.7	0.95	14	10	56	7.7	9.1	15
Plant Matter	3.2	5.5	0	0	0	10	50	7.7	0	1.5
Animal Matter	7.4	0	3.7	0.95	14	0	5.6	0	9.1	14
Soil/Sediment Ingestion Rate (grams/day)										
Percent [j]	10	3.3	2.8	2.4	3.3	2.4	3.3	2.4	3.3	14.1
Intake Rate (grams/day) [k]	1.1	0.18	0.10	0.023	0.46	0.25	1.85	0.19	0.30	2.13
Water Ingestion Rate (liters/day) [l]	0.011	0.0048	0.0061	0.00076	0.0097	0.0070	0.066	0.0046	0.0085	0.014
Home Range (acres) [m]	22	17	2.9	1.1	320	0.067	560	1 [g]	0.1	24
Exposure Area (acres) [n]	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
Site Utilization Factor (unitless) [o]	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
Exposure Duration (percent of year) [p]	0.5	0.5	1	1	1	1	0.5	1	0.5	0.5

Notes:
SS – site-specific

[a] Exposure parameters are listed for the terrestrial birds and mammals selected as indicator receptors.
[b] Average body weight for males and females combined.
[c] *Wildlife Exposure Factors Handbook* (USEPA, 1993b).
[d] Cornell (2009).
[e] *Field Guide to North American Mammals* (NAS, 1996).
[f] ADF&G (2008)
[g] ISU (2000)
[h] CDF&G (2009)
[i] Calculated using Equations 25 (least weasel), 29 (tundra vole and northern bog lemming), 31 (masked shrew), 37 (dark-eyed junco), 59 (American dipper and common snipe), 61 (American robin and mallard), and 63 (northern shrike) from Nag (2001).
[j] Soil ingestion rates were derived from Beyer et al. (1994). Tundra vole, masked shrew, and northern bog lemming based on meadow vole soil ingestion rate. Dark-eyed junco and northern shrike based on mallard soil ingestion rate. Least weasel based on red fox soil ingestion rate. American robin and American dipper based on American woodcock soil ingestion rate. Common snipe sediment ingestion rate based on the average of the stilt, least sandpiper, and western sandpiper sediment ingestion rates.
[k] Calculated as percent soil ingestion rates derived from Beyer et al. (1994) multiplied by the food ingestion rate (grams per day).
[l] Calculated using Equation 3-15 (all birds) and Equation 3-17 (all mammals) from USEPA, 1993b.
[m] Home range is equal to the area necessary to support the dietary and reproductive needs of each animal. Home range for tundra vole based on similar species home range, meadow vole (*Microtus pennsylvanicus*), USEPA (1993b). Home range for masked shrew based on data from the University of Michigan (2006). Home range for dark-eyed junco, American robin, Northern shrike, mallard, American dipper, and common snipe based on data from the California Wildlife Habitat Relationship System (CDF&G, 2009). Home range for least weasel based on data from the Alaska Department of Fish and Game (2006).
[n] Exposure area based on the total area of each site.
[o] Site utilization factors are calculated as the exposure area divided by the home range. Instances where the home range less than exposure area are reported as 1.
[p] Exposure duration (percent of year exposed) for species based on the following facts: tundra vole, masked shrew, least weasel, and northern bog lemming do not migrate and are active year-round, so expsoure duration = 1.0. Nike Site Summit is within the year-round range of the northern shrike, mallard, and American dipper, and outside of the year-round range of the American robin, dark-eyed junco, and common snipe (Cornell, 2009). However, mallards and American dippers are not expected to utilize habitat at the site during winter months due to the fact that surface water is frozen.

Table 5-3 Bioconcentration Factors for Use in Modeling Food Chain Exposure for Ecological Receptors

Modeling Parameters for the Terrestrial Assessment								
Chemicals of Potential Ecological Concern	Chemical Information		BCF_{AM-W} [a]					
			BCF_{S-P} / Source		BCF_{S-I} / Source		BCF_{S-M} / Source	
	Log (K_{ow})/ Source		Kg dry soil/ Kg dry tissue		Kg dry soil/ Kg dry tissue		Kg dry soil/ Kg dry tissue	
Inorganics								
Arsenic	0.68	b	0.038	c	Regression	c	Regression	c
Barium	0.23	b	0.16	c	0.091	c	0.0075	c
Cadmium	-0.070	b	Regression	c	Regression	c	Regression	c
Chromium, Hexavalent	--		0.041	c	0.31	c	Regression	c
Chromium, Total	0.23	b	0.041	c	0.31	c	Regression	c
Lead	0.73	b	Regression	c	Regression	c	Regression	c
Mercury	0.62	b	Regression	d	Regression	c	0.192	e
Nickel	-0.57	b	Regression	c	Regression	c	Regression	c
Selenium	0.24	b	Regression	c	Regression	c	Regression	c
Silver	0.23	b	0.014	c	2.0	c	0.0040	c
Vanadium	2.0	b	0.0049	c	0.042	c	0.012	c
Volatile Organic Compounds (VOCs)								
1,2,4-Trimethylbenzene	3.6	b	1.6	c**	Log Kow model	c**	--	
1,3,5-Trimethylbenzene	3.4	b	1.7	c**	Log Kow model	c**	--	
2-Hexanone	1.4	b	--		--		--	
Carbon disulfide	1.9	b	--		Log Kow model	c**	--	
Dibenzofuran	4.1	b	1.2	c**	Log Kow model	c**	--	
Isopropylbenzene	3.7	b	1.5	c**	Log Kow model	c**	--	
n-Butylbenzene	4.4	b	1.0	c**	Log Kow model	c**	--	
n-Propylbenzene	3.7	b	1.5	c**	Log Kow model	c**	--	
p-Isopropyltoluene	4.1	b	1.2	c**	Log Kow model	c**	--	
trans-1,3-Dichloropropene	2.0		--		--		--	
Trichloroethylene (TCE)	2.4	b	--		Log Kow model	c**	--	
Semi-Volatile Organic Compounds (SVOCs)								
Benzoic acid	1.9	b	--		Log Kow model	c**	--	
bis(2-ethylhexyl) Phthalate	7.6	b	--		Log Kow model	c**	--	
Pentachlorophenol	5.1	b	5.9	c	15	c	Regression	c
Polynuclear Aromatic Hydrocarbons (PAHs)								
Anthracene	4.5	b	Regression	c	2.4	c	0	c
Benzo(a)anthracene	5.8	b	Regression	c	1.6	c	0	c
Benzo(a)pyrene	6.1	b	Regression	c	1.3	c	0	c
Benzo(b)fluoranthene	5.8	b	0.31	c	2.6	c	0	c
Benzo(k)fluoranthene	6.1	b	Regression	c	2.6	c	0	c
Chrysene	5.8	b	Regression	c	2.3	c	0	c
Dibenz(a,h)anthracene	6.8	b	0.13	c	2.3	c	0	c
Indeno(1,2,3-c,d)Pyrene	6.7	b	0.31	c**	2.9	c	0	c
Naphthalene	3.3	b	12	c	4.4	c	0	c
Phenanthrene	4.5	b	Regression	c	1.7	c	0	c
Pyrene	4.9	b	0.72	c	1.8	c	0	c
Energetics								
Perchlorate	--		Regression	f	0.28	f	--	

Table 5-3 Bioconcentration Factors for Use in Modeling Food Chain Exposure for Ecological Receptors

Modeling Parameters for the Terrestrial Assessment									
Chemicals of Potential Ecological Concern	Chemical Information			BCF_{AM-W} [a]					
				BCF_{S-P} / Source		BCF_{S-I} / Source		BCF_{S-M} / Source	
	Log (K_{ow})/ Source			Kg dry soil/ Kg dry tissue		Kg dry soil/ Kg dry tissue		Kg dry soil/ Kg dry tissue	
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	--			--		--		--	
Gasoline Range Organics (GRO)	--			--		--		--	
Residual Range organics (RRO)	--			--		--		--	
Modeling Parameters for the Aquatic Assessment									
Chemicals of Potential Ecological Concern	Chemical Information			BCF_{AM-W} [a]					
				BCF_{Sd-P} / Source		BCF_{Sd-I} / Source		BCF_{W-I} / Source	
	K_d/ Source (L/Kg)			Kg dry sediment/ Kg dry tissue		Kg dry sediment/ Kg dry tissue		L water/ Kg dry tissue	
Inorganics									
Barium	41	g		0.156	c	0.091	c	1,198	h
Chromium, Total	150,000	i		0.041	c	0.588	j	17,970	h

Notes:
-- not available
BCF_{AM-W} - Bioconcentration Factor - Abiotic Media to Wildlife.
BCF_{S-I} - Bioconcentration Factor - Soil to Invertebrate.
BCF_{S-P} - Bioconcentration Factor - Soil to Plant.
BCF_{S-M} - Bioconcentration Factor - Soil to Mammal.
BCF_{Sd-I} - Bioconcentration Factor - Sediment to Invertebrate.
BCF_{Sd-P} - Bioconcentration Factor - Sediment to Plant.
BCF_{W-I} - Bioconcentration Factor - Water to Invertebrate.
K_d - soil to water partition coefficient L/Kg
Kg - kilogram(s)
L - liter(s)
Log (K_{ow}) - Log of octanol water partition coefficient

[a] Bioconcentration factors between abiotic media and wildlife (BCF_{AM-W}) were derived from various published sources, and were used to calculate exposure point concentrations in biotic media.
[b] USEPA (2008b). As recommended by this software, estimated values were only used when experimental (measured) values were unavailable within the database.
[c] USEPA (2007c).
[d] Efroymson (2001).
[e] Sample, et al. (1998)
[f] CH2M HILL (2005).
[g] ORNL, 2011.
[h] USEPA, 1999
[i] USEPA, 1996.
[j] Bechtel Jacobs (1998b).

** Used log Kow model as follows:

Soil to plant: BAF for organics with log Kows between 3 and 8 were derived using log BAF = -0.229*(logKow)+1.0237 (unrinsed plants, USEPA, 2007c)

Soil to invetebrate : Concentration in worm calculated from log Kow between 2 and 8 using model from USEPA, 2007c. An Foc (0.001) as listed in the Cleanup Level Guidance was used (ADEC, 2008d).

Cworm=10^((0.87*logKow)-2)*Csoil/(foc*10^((0.679*logKow)+0.663).

Table 5-4 Ecological Toxicity Reference Values for Mammalian Indicator Receptors

Chemicals of Potential Ecological Concern	Benchmark Dose (mg/Kg-day)		Effect	Benchmark Species		Benchmark Species Body Weight (Kg)		Allometric TRV (mg/Kg-day) Masked Shrew *(Sorex cinereus)*	Tundra Vole *(Microtus oeconomus)*	Least Weasel *(Mustela rixosa)*	Northern Bog Lemming *(Synaptomys borealis)*
Inorganics											
Arsenic	1.0E+00	a	Growth	Dog	a	1.0E+01	a	7.2E+00	3.9E+00	4.0E+00	NA
Barium	5.2E+01	b	Reproduction and Growth	rat/mouse	b	1.5E-01	b	1.2E+02	6.7E+01	7.0E+01	7.5E+01
Cadmium	7.7E-01	c	Growth	rat	c	4.3E-01	c	2.4E+00	1.3E+00	1.4E+00	NA
Chromium, Hexavalent	9.2E+00	d	Reproduction and Growth	rat/mouse	d	8.5E-02	d	1.9E+01	1.0E+01	1.1E+01	NA
Chromium, Total	2.4E+00	d	Growth	/mouse/pig/ca	d	2.0E+00	d	1.1E+01	6.0E+00	6.2E+00	6.7E+00
Lead	4.7E+00	e	Growth	Rat	e	3.0E-01	e	1.3E+01	7.2E+00	7.6E+00	NA
Mercury	1.0E+00	f	Reproduction	mink	f	1.0E+00	f	3.9E+00	2.1E+00	2.2E+00	NA
Nickel	1.7E+00	g	Reproduction	Mouse	g	2.5E-02	g	2.6E+00	1.4E+00	1.5E+00	NA
Selenium	1.4E-01	h	Growth	pig	h	1.8E+01	h	1.1E+00	6.1E-01	6.4E-01	NA
Silver	6.0E+00	i,j,k	Growth	pig	k	8.9E+00	k	4.0E+01	2.2E+01	2.3E+01	NA
Vanadium	4.2E+00	l	Reproduction and Growth	mouse	l	4.7E-02	l	7.5E+00	4.0E+00	4.2E+00	NA
Volatile Organic Compounds (VOCs)											
1,2,4-Trimethylbenzene	2.1E+00	f,m	Reproduction	mouse	f	3.0E-02	f	3.3E+00	1.8E+00	1.9E+00	NA
1,3,5-Trimethylbenzene	2.1E+00	f,m	Reproduction	mouse	f	3.0E-02	f	3.3E+00	1.8E+00	1.9E+00	NA
2-Hexanone	5.0E+00	n	Neurotoxicity	rat	n	7.1E-01	n	1.8E+01	9.6E+00	1.0E+01	NA
Carbon Disulfide	1.1E+01	n	Reproduction	rabbit	n	1.1E+00	n	4.4E+01	2.4E+01	2.5E+01	NA
Dibenzofuran	6.6E+01	o	Growth	rat		2.5E-01		1.8E+02	9.6E+01	1.0E+02	NA
Isopropylbenzene	5.5E+01	i,n	Kidney Toxicity	rat	n	3.5E-01	f	1.6E+02	8.8E+01	9.2E+01	NA
n-Butylbenzene	4.9E+01	i,n,p	Liver and Kidney Toxicity	rat	n	3.5E-01	f	1.4E+02	7.8E+01	8.1E+01	NA
n-Propylbenzene	4.9E+01	i,n,p	Liver and Kidney Toxicity	rat	n	3.5E-01	f	1.4E+02	7.8E+01	8.1E+01	NA
p-Isopropyltoluene	2.1E+00	f,m	Reproduction	mouse	f	3.0E-02	f	3.3E+00	1.8E+00	1.9E+00	NA
trans-1,3-Dichloropropene	5.1E+00	n	Gastrointestinal	rat	n	3.5E-01	n	1.5E+01	8.2E+00	8.5E+00	NA
Trichloroethylene (TCE)	7.0E-01	f	Liver Toxicity	mouse	f	3.0E-02	f	1.1E+00	6.1E-01	6.3E-01	NA
Semi-Volatile Organic Compounds (SVOCs)											
Benzoic Acid	4.4E+00	n	No Adeverse Effects	human	n	7.0E+01	n	4.9E+01	2.7E+01	2.8E+01	NA
bis(2-ethylhexyl) Phthalate	1.8E+01	f	Reproduction	mouse	f	3.0E-02	f	2.9E+01	1.6E+01	1.7E+01	NA
Pentachlorophenol	8.4E+00	q	Reproduction and Growth	Various	q	2.9E-01	q	2.4E+01	1.3E+01	1.3E+01	NA
Polynuclear Aromatic Hydrocarbons (PAHs)											
Anthracene	6.6E+01	r,s	NA	rat	r	2.5E-01	r	1.8E+02	9.6E+01	1.0E+02	NA
Benzo(a)anthracene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Benzo(a)pyrene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Benzo(b)fluoranthene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Benzo(k)fluoranthene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Chrysene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Dibenz(a,h)anthracene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Indeno(1,2,3-c,d)Pyrene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA

Table 5-4 Ecological Toxicity Reference Values for Mammalian Indicator Receptors

Chemicals of Potential Ecological Concern	Benchmark Dose (mg/Kg-day)		Effect	Benchmark Species		Benchmark Species Body Weight (Kg)		Allometric TRV (mg/Kg-day) Masked Shrew *(Sorex cinereus)*	Tundra Vole *(Microtus oeconomus)*	Least Weasel *(Mustela rixosa)*	Northern Bog Lemming *(Synaptomys borealis)*
Naphthalene	6.6E+01	r,s	NA	rat	r	2.5E-01	r	1.8E+02	9.6E+01	1.0E+02	NA
Phenanthrene	6.6E+01	r,s	NA	rat	r	2.5E-01	r	1.8E+02	9.6E+01	1.0E+02	NA
Pyrene	6.2E-01	r,t	NA	mouse	r	3.8E-02	r	1.0E+00	5.7E-01	5.9E-01	NA
Energetics											
Perchlorate	6.4E+00	u	Neurotoxicity	rabbit	u	3.8E+00	g	3.5E+01	1.9E+01	1.9E+01	NA
Total Petroleum Hydrocarbons (TPHs)											
Diesel Range Organics (DRO)	6.6E+01	r,v	NA	rat	r,v	2.5E-01	r,v	1.8E+02	9.6E+01	1.0E+02	NA
Gasoline Range Organics (GRO)	2.6E+01	f,w	NA	mouse	f	3.0E-02	f	4.2E+01	2.3E+01	2.4E+01	NA
Residual Range Organics (RRO)	6.2E-01	r,x	NA	mouse	r,x	3.8E-02	r,x	1.0E+00	5.7E-01	5.9E-01	NA

Notes:
Eco-SSL - Ecological Soil Screening Levels
Kg - kilograms
mg/Kg-day - milligrams per kilogram per day (dry weight)
NA - not applicable
TRV - Toxicity Reference Value
USEPA - U.S. Environmental Protection Agency

Receptor-specific TRVs are derived from body weight based allometric conversion of the toxicity benchmark value (ORNL, 1996a). Ecological toxicity values were selected according to the following hierarchy of sources:
1- Guidance for Developing Ecological Soil Screening Levels (USEPA, 2005a).
2 - Toxicological Benchmarks for Wildlife (ORNL, 1996a; 1996b).
3 - Integrated Risk Information System (IRIS) Database (USEPA, 2011c).
4 - Wildlife Toxicity Assessment for Perchlorate (USACHPPM, 2007).

[a] USEPA Eco-SSL for Arsenic (USEPA, 2005b).
[b] USEPA Eco-SSL for Barium (USEPA, 2005c).
[c] USEPA Eco-SSL for Cadmium (USEPA, 2005d).
[d] USEPA Eco-SSL for Chromium (USEPA, 2008c).
[e] USEPA Eco-SSL for Lead (USEPA, 2005e).
[f] Toxicological Benchmarks for Wildlife (ORNL, 1996a)
[g] USEPA Eco-SSL for Nickel (USEPA, 2007d).
[h] USEPA Eco-SSL for Selenium (USEPA, 2007e).
[i] A subchronic-to-chronic uncertainty factor of 2 was applied to the study dose.
[j] A low observable adverse effect level (LOAEL) to no observable adverse effect level (NOAEL) uncertainty factor of 5 was applied to the study dose.
[k] USEPA Eco-SSL for Silver (USEPA, 2006a).
[l] USEPA Eco-SSL for Vanadium (USEPA, 2005f).
[m] Xylenes used as a surrogate.
[n] USEPA IRIS database (USEPA, 2011c).

Table 5-4 Ecological Toxicity Reference Values for Mammalian Indicator Receptors

Chemicals of Potential Ecological Concern	Benchmark Dose (mg/Kg-day)	Effect	Benchmark Species	Benchmark Species Body Weight (Kg)	Allometric TRV (mg/Kg-day) Masked Shrew *(Sorex cinereus)*	Tundra Vole *(Microtus oeconomus)*	Least Weasel *(Mustela rixosa)*	Northern Bog Lemming *(Synaptomys borealis)*

[o] Anthracene used as a surrogate.
[p] Ethylbenzene used as a surrogate.
[q] USEPA Eco-SSL for Pentachlorophenol (USEPA, 2007f).
[r] USEPA Eco-SSL for Polycyclic Aromatic Hydrocarbons (USEPA, 2007a).
[s] Low molecular weight-PAH used as a surrogate.
[t] High molecular weight-PAH used as a surrogate.
[u] Wildlife Toxicity Assessment for Perchlorate. 87-MA02T6-05D. (USACHPPM, 2007).
[v] Naphthalene used as a surrogate for DRO.
[w] Benzene used as a surrogate for GRO.
[x] Benzo(a)pyrene used as a surrogate for RRO.

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Table 5-5 Ecological Toxicity Reference Values for Avian Indicator Receptors

Chemicals of Potential Ecological Concern	Benchmark Dose (mg/Kg-day)		Effect	Benchmark Species		Benchmark Species Body Weight (Kg)		Allometric TRV (mg/kg-day) Dark-eyed Junco *(Junco hyemalis)*	American Robin *(Turdus migratorius)*	Northern Shrike *(Laninus excubitor)*	Mallard *(Anas platyrhynchos)*	American Dipper *(Cinclus mexicanus)*	Common Snipe *(Gallinago gallinago)*
Inorganics													
Arsenic	2.2E+00	a	Reproduction, Growth and Mortality	Chicken	a	1.6E+00	a	6.4E+00	4.7E+00	4.9E+00	NA	NA	NA
Barium	2.1E+01	b	Mortality	Chicken	b	1.2E-01	b	3.1E+01	2.3E+01	2.4E+01	1.2E+01	2.5E+01	2.1E+01
Cadmium	1.5E+00	c	Reproduction and Growth	Various	c	5.8E-01	c	3.3E+00	2.4E+00	2.5E+00	NA	NA	NA
Chromium, Hexavalent	--		--	--		--		--	--	--	NA	NA	NA
Chromium, Total	2.7E+00	d	Reproduction and Growth	Chicken, duck, turkey	d	1.1E+00	d	6.9E+00	5.1E+00	5.3E+00	2.6E+00	5.6E+00	4.7E+00
Lead	1.6E+00	e	Reproduction	Chicken	e	1.8E+00	e	4.8E+00	3.5E+00	3.7E+00	NA	NA	NA
Mercury	4.5E-01	b	Reproduction	Japanese Quail	b	1.5E-01	b	7.1E-01	5.2E-01	5.5E-01	NA	NA	NA
Nickel	6.7E+00	f	Reproduction and Growth	Chicken, duck	f	9.0E-01	f	1.7E+01	1.2E+01	1.3E+01	NA	NA	NA
Selenium	2.9E-01	g	Mortality	Chicken	g	3.3E-01	g	5.6E-01	4.1E-01	4.3E-01	NA	NA	NA
Silver	2.0E+00	h, i	Growth	Turkey	i	6.6E-01	i	4.6E+00	3.4E+00	3.6E+00	NA	NA	NA
Vanadium	3.4E-01	j	Growth	Chicken	j	1.0E+00	j	8.8E-01	6.5E-01	6.8E-01	NA	NA	NA
Volatile Organic Compounds (VOCs)													
1,2,4-Trimethylbenzene	--		--	--		--		--	--	--	NA	NA	NA
1,3,5-Trimethylbenzene	--		--	--		--		--	--	--	NA	NA	NA
2-Hexanone	--		--	--		--		--	--	--	NA	NA	NA
Carbon Disulfide	--		--	--		--		--	--	--	NA	NA	NA
Dibenzofuran	1.0E+00	k,l	Mortality	Red-Winged Blackbird	l	5.5E-02	m	1.3E+00	9.2E-01	9.7E-01	NA	NA	NA
Isopropylbenzene	9.8E-01	k,l	Mortality	Red-Winged Blackbird	l	5.5E-02	m	1.2E+00	8.9E-01	9.3E-01	NA	NA	NA
n-Butylbenzene	--		--	--		--		--	--	--	NA	NA	NA
n-Propylbenzene	--		--	--		--		--	--	--	NA	NA	NA
p-Isopropyltoluene	3.2E+00	k,l	Mortality	Red-Winged Blackbird	l	5.5E-02	m	3.9E+00	2.9E+00	3.0E+00	NA	NA	NA
trans-1,3-Dichloropropene	--		--	--		--		--	--	--	NA	NA	NA
Trichloroethylene (TCE)	--		--	--		--		--	--	--	NA	NA	NA
Semi-Volatile Organic Compounds (SVOCs)													
Benzoic Acid	1.0E+00	k,l	Mortality	Red-Winged Blackbird	l	5.5E-02	m	1.2E+00	9.1E-01	9.5E-01	NA	NA	NA
bis(2-ethylhexyl) Phthalate	1.1E+00	b	Reproductive	Ringed dove	b	1.6E-01	b	1.8E+00	1.3E+00	1.4E+00	NA	NA	NA
Pentachlorophenol	6.7E+00	n	Growth	Chicken	n	6.6E-01	n	7.7E+00	5.7E+00	5.9E+00	NA	NA	NA
Polynuclear Aromatic Hydrocarbons (PAHs)													
Anthracene	1.1E+00	k,l	NA	Red-Winged Blackbird	l	5.5E-02	m	1.4E+00	1.0E+00	1.1E+00	NA	NA	NA
Benzo(a)anthracene	2.0E+01	h,o,p	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA
Benzo(a)pyrene	2.0E+01	h,o	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA
Benzo(b)fluoranthene	2.0E+01	h,o,p	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA
Benzo(k)fluoranthene	2.0E+01	h,o,p	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA
Chrysene	2.0E+01	h,o,p	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA
Dibenz(a,h)anthracene	2.0E+01	h,o,p	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA
Indeno(1,2,3-c,d)Pyrene	--		NA	--		--		--	--	--	NA	NA	NA
Naphthalene	4.2E+01	r,s	NA	Mallard Duck	s	1.0E+00	s	1.1E+02	7.8E+01	8.1E+01	NA	NA	NA
Phenanthrene	1.1E+00	k,l	NA	Red-Winged Blackbird	l	5.5E-02	m	1.4E+00	1.0E+00	1.1E+00	NA	NA	NA
Pyrene	1.1E+00	k,l,t	NA	Red-Winged Blackbird	l	5.5E-02	m	1.4E+00	1.0E+00	1.1E+00	NA	NA	NA

Table 5-5 Ecological Toxicity Reference Values for Avian Indicator Receptors

Chemicals of Potential Ecological Concern	Benchmark Dose (mg/Kg-day)		Effect	Benchmark Species		Benchmark Species Body Weight (Kg)		Allometric TRV (mg/kg-day) Dark-eyed Junco *(Junco hyemalis)*	American Robin *(Turdus migratorius)*	Northern Shrike *(Laninus excubitor)*	Mallard *(Anas platyrhynchos)*	American Dipper *(Cinclus mexicanus)*	Common Snipe *(Gallinago gallinago)*
Energetics													
Perchlorate	1.3E+01	u	Growth	Bob White Quail	u	1.7E-01	u	2.1E+01	1.6E+01	1.6E+01	NA	NA	NA
Petroleum Hydrocarbons													
Diesel Range Organics (DRO)	4.2E+01	r,s,v	NA	Mallard Duck	s	1.0E+00	s	1.1E+02	7.8E+01	8.1E+01	NA	NA	NA
Gasoline Range Organics (GRO)	--		NA	--		--		--	--	--	NA	NA	NA
Residual Range Organics (RRO)	2.0E+01	h,o,w	NA	Chicken	o	1.5E+00	q	5.5E+01	4.1E+01	4.3E+01	NA	NA	NA

Notes:

-- not available
Eco-SSL - Ecological Soil Screening Levels
Kg - kilograms
mg/Kg-day - milligrams per kilogram per day (dry weight)
NA - not applicable
NOAEL - no observble adverse effect level
TRV - Toxicity Reference Value
USEPA - U.S. Environmental Protection Agency

Receptor-specific TRVs are derived from body weight based allometric conversion of the toxicity benchmark value (ORNL, 1996a). Ecological toxicity values were selected according to the following hierarchy of sources:

1 - Guidance for Developing Ecological Soil Screening Levels (USEPA, 2005a).
2 - Toxicological Benchmarks for Wildlife (ORNL, 1996a; 1996b).
3 - Integrated Risk Information System (IRIS) Database (USEPA, 2011c).
4 - Wildlife Toxicity Assessment for Perchlorate (USACHPPM, 2007).
5 - Fluorescence of Chickens and Eggs Following the Feeding of Benzpyrene Crystals (Rigdon and Neal, 1963).
6 - The Acute Oral Toxicity, Repellency, and Hazard Potential of 998 Chemicals to One or More Species of Wild and Domestic Birds (Schafer et al., 1983).

[a] USEPA Eco-SSL for Arsenic (USEPA, 2005b).
[b] Toxicological Benchmarks for Wildlife: 1996 Revision (ORNL, 1996a)
[c] USEPA Eco-SSL for Cadmium (USEPA, 2005d).
[d] USEPA Eco-SSL for Chromium (USEPA, 2008c).
[e] USEPA Eco-SSL for Lead (USEPA, 2005e).
[f] USEPA Eco-SSL for Nickel (USEPA, 2007d).
[g] USEPA Eco-SSL for Selenium (USEPA, 2007e).
[h] A subchronic-to-chronic uncertainty factor of 2 was applied to the study dose.
[i] USEPA Eco-SSL for Silver (USEPA, 2006a).
[j] USEPA Eco-SSL for Vanadium (USEPA, 2005f).
[k] A LD50-to-chronic NOAEL uncertainty factor of 100 was applied to the study dose.
[l] The Acute Oral Toxicity, Repellency, and Hazard Potential of 998 Chemicals to Birds. (Schaefer et.al., 1983).
[m] The Cornell Lab of Ornithology (http://www.allaboutbirds.org/guide/Red-winged_Blackbird/lifehistory).
[n] USEPA Eco-SSL for Pentachlorophenol (USEPA, 2007f).
[o] Feeding of Benzpyrene Crystals (Rigdon and Neal, 1963).
[p] Benzo(a)pyrene used as a surrogate.
[q] Mean body weight of adults at 140 days (USEPA, 1988b).
[r] A low observable adverse effect level (LOAEL) to NOAEL uncertainty factor of 5 was applied to the study dose.
[s] Effects of petroleum hydrocarbons on hepatic function (Patton and Dieter, 1980).
[t] Phenanthrene used as a surrogate.
[u] Wildlife Toxicity Assessment for Perchlorate. 87-MA02T6-05D (USACHPPM, 2007).
[v] Naphthalene used as a surrogate for DRO.
[w] Benzo(a)pyrene used as a surrogate for RRO.

Table 5-6 Sumary of Ecological Hazard Estimates - Upper Site Summit

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike
Inorganics							
Arsenic	9.84	0.062	0.086	0.013	0.0047	0.0028	0.00075
Barium	592	0.31	0.12	0.025	0.061	0.093	0.0074
Cadmium	9.62	0.36	**4.4**	0.066	0.17	0.019	0.048
Chromium, Hexavalent	0.890	0.0011	0.0032	0.0018	--	--	--
Lead	386	0.45	**1.7**	0.28	0.35	0.11	0.072
Mercury	0.398	0.022	0.025	0.0033	0.0090	0.0086	0.0020
Nickel	29.9	0.29	0.058	0.26	0.0032	0.0037	0.00019
Selenium	1.57	0.28	0.25	0.11	0.035	0.041	0.0075
Silver	14.8	0.0051	0.16	0.0017	0.074	0.0039	0.021
Vanadium	75.6	0.11	0.14	0.059	0.17	0.08	0.020
Volatile Organic Compounds (VOCs)							
1,2,4-Trimethylbenzene	0.0156	0.0027	0.011	0.000019	--	--	--
1,3,5-Trimethylbenzene	0.0322	0.0063	0.020	0.000039	--	--	--
Carbon disulfide	0.000170	0.000000034	0.0000042	0.000000016	--	--	--
n-Propylbenzene	0.0219	0.000085	0.00035	0.0000006	--	--	--
p-Isopropyltoluene	0.0137	0.0019	0.012	0.000017	0.00051	0.00011	0.00015
Semi-Volatile Organic Compounds (SVOCs)							
bis(2-ethylhexyl) Phthalate	2.12	0.00063	0.94	0.00029	0.78	0.0010	0.23
Polycyclic Aromatic Hydrocarbons (PAHs)							
Anthracene	0.646	0.00057	0.0019	0.000015	0.014	0.0054	0.0036
Benzo(a)anthracene	1.78	0.048	0.58	0.0069	0.00060	0.000071	0.00016
Benzo(a)pyrene	1.37	0.071	0.37	0.0053	0.00040	0.00010	0.00011
Benzo(b)fluoranthene	2.37	0.27	**1.3**	0.0091	0.0013	0.00038	0.00035
Benzo(k)fluoranthene	0.956	0.047	0.51	0.0037	0.00051	0.000067	0.00014
Dibenz(a,h)anthracene	0.493	0.026	0.23	0.0019	0.00024	0.000038	0.000065
Indeno(1,2,3-c,d)Pyrene	0.664	0.077	0.39	0.0026	--	--	--
Naphthalene	0.0719	0.0018	0.00038	0.0000016	0.000070	0.00021	0.0000094
Phenanthrene	1.70	0.0025	0.0035	0.000038	0.028	0.023	0.0067
Pyrene	3.55	0.92	**1.3**	0.014	0.059	0.050	0.014

Table 5-6 Sumary of Ecological Hazard Estimates - Upper Site Summit

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike
Total Petroleum Hydrocarbons (TPHs)							
Diesel Range Organics (DRO)	651	0.032	0.018	0.015	0.010	0.0052	0.00063
Gasoline Range Organics (GRO)	1.80	0.00037	0.00022	0.00017	--	--	--
Residual Range Organics (RRO)	1,505	**13**	**7.3**	**5.8**	0.042	0.023	0.0028
Cumulative Growth/Body Weight HI [b]		**2**	**7**	0.5	0.4	0.1	0.09
Cumulative Kidney HI [c]		0.00008	0.0004	0.0000006	--	--	--
Cumulative Liver HI [d]		0.00008	0.0004	0.0000006	--	--	--
Cumulative Mortality HI [e]		--	--	--	0.07	0.1	0.01
Cumulative PAH HI [f]		1	**5**	0.04	0.1	0.08	0.03
Cumulative PHC HI [g]		**13**	**7**	**6**	0.05	0.03	0.003
Cumulative Reproductive HI [h]		0.7	1	0.3	1	0.1	0.4

Notes:

% - percent
-- not available
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
mg/Kg - milograms per kilogram
PHC - petroleum hydrocarbon

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable hazard criterion.

[a] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[b] The cumulative growth/body weight HI is equal to the sum of the growth/body weight-related HQs for arsenic, barium, cadmium, chromium (hexavalent and total), lead, selenium, silver, and vanadium for mammalian receptors; and arsenic, cadmium, chromium (total), nickel, silver, and vanadium for avian receptors.

[c] The cumulative kidney HI is equal to the kidney-related HQ for n-propylbenzene for mammalian receptors.

[d] The cumulative liver HI is equal to the liver-related HQ for n-propylbenzene for mammalian receptors.

[e] The cumulative mortality HI is equal to the sum of the mortality-related HQs for arsenic, barium, selenium, and p-isopropyltoluene for avian receptors.

[f] The cumulative PAH HI is equal to the sum of the PAH-related HQs for: anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, naphthalene, phenanthrene, and pyrene for mammalian and avian receptors, as well as indeno(1,2,3-c,d)pyrene for mammalian receptors.

[g] The cumulative PHC HI is equal to the sum of the PHC-related HQs for: DRO, GRO and RRO for mammalian receptors; and DRO and RRO for avian receptors.

[h] The cumulative reproductive/developmental HI is equal to the sum of the reproductive/developmental-related HQs for: arsenic, cadmium, lead, mercury, nickel, and bis(2-ethylhexyl) phthalate for avian receptors; and barium, chromium (hexavalent), mercury, nickel, vanadium, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, carbon disulfide, p-isopropyltoluene, and bis(2-ethylhexyl) phthalate for mammalian receptors.

Table 5-7 Summary of Ecological Hazard Estimates - Lower Site Summit

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike
Inorganics							
Arsenic	8.15	0.051	0.074	0.011	0.019	0.010	0.0032
Barium	135	0.072	0.027	0.0056	0.069	0.09	0.0083
Cadmium	2.82	0.18	**1.7**	0.033	0.31	0.042	0.089
Chromium, Hexavalent	4.79	0.0059	0.017	0.0065	--	--	--
Chromium, Total	31.9	0.068	0.20	0.050	0.11	0.039	0.024
Lead	75.0	0.13	0.44	0.10	0.42	0.13	0.092
Mercury	0.383	0.022	0.025	0.0032	0.044	0.037	0.010
Nickel	30.9	0.30	0.060	0.26	0.016	0.017	0.00094
Selenium	0.365	0.056	0.084	0.059	0.053	0.037	0.013
Volatile Organic Compounds (VOCs)							
1,2,4-Trimethylbenzene	0.0388	0.0068	0.027	0.000047	--	--	--
1,3,5-Trimethylbenzene	0.0239	0.0046	0.015	0.000029	--	--	--
2-Hexanone	0.00840	0.0000041	0.0000024	0.0000019	--	--	--
Carbon disulfide	0.000650	0.00000013	0.000016	0.000000060	--	--	--
Dibenzofuran	1.67	0.0042	0.026	0.000038	0.97	0.19	0.27
Isopropylbenzene	0.0145	0.000050	0.00020	0.00000036	0.0073	0.0022	0.0020
n-Butylbenzene	0.0123	0.000033	0.00027	0.00000035	--	--	--
n-Propylbenzene	0.0202	0.000078	0.00033	0.00000057	--	--	--
p-Isopropyltoluene	0.0107	0.0015	0.0090	0.000013	0.0020	0.00040	0.00056
trans-1,3-Dichloropropene	0.000270	0.00000016	0.000000090	0.000000072	--	--	--
Trichloroethylene (TCE)	0.0416	0.00032	0.049	0.00015	--	--	--
Semi-Volatile Organic Compounds (SVOCs)							
Benzoic acid	1.39	0.00025	0.030	0.00011	0.30	0.0043	0.087
bis(2-ethylhexyl) Phthalate	5.44	0.0016	**2.4**	0.00075	**9.9**	0.012	**2.9**
Pentachlorophenol	46.5	**4.2**	**6.1**	0.015	**2.7**	**2.1**	0.68
Polycyclic Aromatic Hydrocarbons (PAHs)							
Anthracene	5.82	0.0033	0.017	0.00013	0.59	0.14	0.16
Benzo(a)anthracene	7.98	0.15	**2.6**	0.031	0.013	0.0010	0.0036
Benzo(a)pyrene	7.74	0.39	**2.1**	0.030	0.011	0.0025	0.0029
Benzo(b)fluoranthene	8.66	**1.0**	**4.6**	0.033	0.023	0.0062	0.0063
Benzo(k)fluoranthene	1.86	0.084	1.0	0.0072	0.0049	0.00054	0.0014
Chrysene	9.55	0.17	**4.5**	0.037	0.022	0.0012	0.0062
Dibenz(a,h)anthracene	6.12	0.33	**2.9**	0.024	0.014	0.0021	0.0040
Indeno(1,2,3-c,d)Pyrene	2.42	0.28	**1.4**	0.0093	--	--	--
Naphthalene	0.595	0.015	0.0031	0.000013	0.0029	0.0079	0.00038
Phenanthrene	13.0	0.0091	0.027	0.00030	0.98	0.38	0.25
Pyrene	17.1	**4.4**	**6.1**	0.066	**1.4**	**1.1**	0.34

Table 5-7 Summary of Ecological Hazard Estimates - Lower Site Summit

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike
Energetics							
Perchlorate	0.000423	0.0012	0.00000079	0.000000050	0.00012	0.00063	0.00000010
Total Petroleum Hydrocarbons (TPHs)							
Diesel Range Organics (DRO)	2123	0.10	0.060	0.048	0.15	0.076	0.010
Gasoline Range Organics (GRO)	2.66	0.00055	0.00032	0.00025	--	--	--
Residual range organics (RRO)	4,601	**38**	**22**	**17**	0.64	0.32	0.042
Cumulative Gastrointestinal HI [b]		0.0000002	0.00000009	0.00000007	--	--	--
Cumulative Growth/Body Weight HI [c]		**5**	**9**	0.3	**3**	**2**	0.8
Cumulative Kidney HI [d]		0.0002	0.0008	0.000001	--	--	--
Cumulative Liver HI [e]		0.0004	0.05	0.0002	--	--	--
Cumulative Mortality HI [f]		--	--	--	1	0.3	0.4
Cumulative Neurotoxicity HI [g]		0.001	0.000003	0.000002	--	--	--
Cumulative No Adverse Effects HI [h]		0.0002	0.03	0.0001	--	--	--
Cumulative PAH HI [i]		**7**	**25**	0.2	**3**	**2**	0.8
Cumulative PHC HI [j]		**39**	**22**	**17**	0.8	0.4	0.1
Cumulative Reproductive HI [k]		**5**	**9**	0.3	**11**	0.3	**3**

Notes:

-- not available
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
mg/Kg - milograms per kilogram
PHC - petroleum hydrocarbon

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable hazard criterion.

[a] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[b] The cumulative gastrointestinal HI is equal to the gastrointestinal-related HQ for trans-1,3-dichloropropene for mammalian receptors.

[c] The cumulative growth/body weight HI is equal to the sum of the growth/body weight-related HQs for: arsenic, barium, cadmium, chromium (hexavalent and total), lead, selenium, dibenzofuran, and pentachlorophenol for mammalian receptors; and arsenic, cadmium, chromium (total), nickel, pentachlorophenol, and perchlorate for avian receptors.

[d] The cumulative kidney HI is equal to the sum of the kidney related HQs for isopropylbenzene, n-butylbenzene, and n-propylbenzene for mammalian receptors.

[e] The cumulative liver HI is equal to the sum of the liver-related HQs for n-butylbenzene, n-propylbenzene, and TCE for mammalian receptors.

[f] The cumulative mortality HI is equal to the sum of the mortality-related HQs for arsenic, barium, selenium, dibenzofuran, isopropylbenzene, p-isopropyltoluene, and benzoic acid for avian receptors.

[g] The cumulative neurotoxicity HI is equal to the sum of the neurotoxicity-related HQs for 2-hexanone and perchlorate for mammalian receptors.

[h] The cumulative 'no adverse effects' HI is equal to the 'no adverse effects'-related HQs for benzoic acid for mammalian receptors.

Table 5-7 Summary of Ecological Hazard Estimates - Lower Site Summit

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike

[i] The cumulative PAH HI is equal to the sum of the PAH-related HQs for anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, naphthalene, phenanthrene, and pyrene for mammalian and avian receptors, as well as indeno(1,2,3-c,d)pyrene for mammalian receptors.

[j] The cumulative PHC HI is equal to the sum of the PHC-related HQs for DRO, GRO, and RRO for mammalian and avian receptors.

[k] The cumulative reproductive/developmental HI is equal to the sum of the reproductive/developmental-related HQs for: arsenic, cadmium, chromium (total), lead, mercury, nickel, and bis(2-ethylhexyl) phthalate for avian receptors; and barium, chromium (hexavalent), mercury, nickel, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, carbon disulfide, p-isopropyltoluene, bis(2-ethylhexyl) phthalate, and pentachlorophenol for mammalian receptors.

Table 5-8 Summary of Ecological Hazard Estimates - Area A

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike
Inorganics							
Barium	373	0.20	0.073	0.008	0.015	0.023	0.0019
Cadmium	1.23	0.11	0.86	0.011	0.013	0.0023	0.0038
Chromium, Hexavalent	0.897	0.0011	0.0032	0.00094	--	--	--
Lead	50.9	0.10	0.32	0.042	0.024	0.0088	0.0054
Nickel	41.1	0.38	0.080	0.16	0.0017	0.0019	0.00010
Semi-Volatile Organic Compounds (SVOCs)							
Benzoic acid	1.42	0.00025	0.030	0.000061	0.025	0.00039	0.0072
Total Petroleum Hydrocarbons (TPHs)							
Diesel Range Organics (DRO)	8,369	0.41	0.24	0.10	0.049	0.027	0.0033
Gasoline Range Organics (GRO)	1.62	0.00033	0.00019	0.000081	--	--	--
Residual Range Organics (RRO)	63,887	**533**	**309**	**129**	0.72	0.39	0.048
Cumulative Growth/Body Weight HI [b]		0.4	1	0.1	0.01	0.004	0.004
Cumulative Mortality HI [c]		--	--	--	0.04	0.02	0.009
Cumulative No Adverse Effects HI [d]		0.0003	0.03	0.00006	--	--	--
Cumulative PHC HI [e]		**534**	**309**	**129**	0.8	0.4	0.05
Cumulative Reproductive HI [f]		0.6	0.2	0.2	0.04	0.01	0.009

Notes:

-- not available

EPC - exposure point concentration

HI - hazard index

HQ - hazard quotient

mg/Kg - miligrams per kilogram

PHC - petroleum hydrocarbon

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable hazard criterion.

[a] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[b] The cumulative growth/body weight HI is equal to the sum of the growth/body weight-related HQs for: barium, cadmium, chromium (hexavalent), and lead for mammalian receptors; and cadmium and nickel for avian receptors.

[c] The cumulative mortality HI is equal to the sum of the mortality-related HQs for barium and benzoic acid for avian receptors.

[d] The cumulative 'no adverse effects' HI is equal to the 'no adverse effects'-related HQ for benzoic acid for mammalian receptors.

[e] The cumulative PHC HI is equal to the sum of the PHC-related HQs for DRO, GRO, and RRO for mammalian receptors and DRO and RRO for avian receptors.

[f] The cumulative reproductive/developmental HI is equal to the sum of the reproductive/developmental-related HQs for: cadmium, lead, and nickel for avian receptors; and barium, chromium (hexavalent), and nickel for mammalian receptors.

Table 5-9 Summary of Ecological Hazard Estimates - Area C

Chemical of Potential Ecological Concern	EPC[a] Soil (mg/Kg)	Ecological Hazard Estimates (HQ) Tundra Vole	Masked Shrew	Least Weasel	American Robin	Dark-eyed Junco	Northern Shrike
Inorganics							
Lead	386	0.022	0.0038	0.00050	0.00021	0.000085	0.000047
Nickel	29.9	0.16	0.0020	0.0031	0.000032	0.000036	0.0000019
Polycyclic Aromatic Hydrocarbons (PAHs)							
Benzo(a)anthracene	1.78	0.021	0.016	0.000073	0.0000048	0.00000057	0.0000013
Benzo(a)pyrene	1.37	0.038	0.012	0.000065	0.0000038	0.00000096	0.0000010
Benzo(b)fluoranthene	2.37	0.11	0.030	0.000084	0.0000091	0.0000027	0.0000025
Benzo(k)fluoranthene	0.956	0.014	0.0086	0.000024	0.0000026	0.00000035	0.00000071
Indeno(1,2,3-c,d)Pyrene	0.664	0.042	0.013	0.000033	--	--	--
Naphthalene	0.0719	0.0061	0.000077	0.00000013	0.0000042	0.000013	0.00000057
Phenanthrene	1.70	0.0026	0.00037	0.0000015	0.00081	0.00043	0.00020
Pyrene	3.55	0.51	0.043	0.00018	0.00058	0.00049	0.00014
Total Petroleum Hydrocarbons (TPHs)							
Diesel Range Organics (DRO)	651	0.0014	0.000048	0.000015	0.0000074	0.0000040	0.00000049
Residual Range Organics (RRO)	1,505	0.97	0.034	0.010	0.000059	0.000032	0.0000039
Cumulative Growth/Body Weight HI [b]		0.02	0.004	0.0005	0.00003	0.00004	0.000002
Cumulative PAH HI [c]		0.7	0.1	0.0005	0.001	0.0009	0.0004
Cumulative PHC HI [d]		1	0.03	0.01	0.00007	0.00004	0.000004
Cumulative Reproductive HI [e]		0.2	0.002	0.004	0.0002	0.0001	0.00005

Notes:

-- not available
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
mg/Kg - milograms per kilogram
PHC - petroleum hydrocarbon

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable hazard criterion.

[a] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[b] The cumulative growth/body weight HI is equal to the growth/body weight-related HQs for lead for mammalian receptors, and nickel for avian receptors.

[c] The cumulative PAH HI is equal to the sum of the PAH-related HQs for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene for mammalian and avian receptors.

[d] The cumulative PHC HI is equal to the sum of the PHC-related HQs for DRO and RRO for mammalian and avian receptors.

[e] The cumulative reproductive/developmental HI is equal to the sum of the reproductive/developmental-related HQs for lead and nickel for avian receptors and nickel for mammalian receptors.

Table 5-10 Summary of Ecological Hazard Estimates - Downgradient Off-Site Drainages

Chemical of Potential Ecological Concern	EPC[a] Water (mg/L)	Ecological Hazard Estimates (HQ)			
		Northern Bog Lemming	Mallard	American Dipper	Common Snipe
Inorganics					
Barium	0.0105	0.000072	0.0000013	0.041	0.0000041
Chromium, Total	0.00178	0.2	0.000099	0.60	0.030
Cumulative Growth/Body Weight HI [b]		0.2	0.0001	0.6	0.03
Cumulative Mortality HI [c]		--	0.000001	0.04	0.000004
Cumulative Reproductive HI [d]		0.00007	0.0001	0.6	0.03

Notes:
-- not available
EPC - exposure point concentration
HQ - hazard quotient
HI - hazard index
mg/L - milligrams per liter

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable hazard criterion.

[a] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface water samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[b] The cumulative growth/body weight HI is equal to the sum of the growth/body weight-related HQs for barium and total chromium for mammalian receptors; and total chromium for avian receptors.

[c] The cumulative mortality HI is equal to the mortality-related HQ for barium for avian receptors.

[d] The cumulative reproductive/developmental HI is equal to the reproductive/developmental-related HQ for barium for mammalian receptors, and total chromium for avian receptors.

6.0 UNCERTAINTY ANALYSIS

Following is a discussion of potential uncertainties associated with the HHERA conducted for the four NSS Areas. Uncertainties are inherent in risk assessment and arise from limitations in the available information, methods, or assumptions that are included in the HHERA. Potential uncertainties in the HHERA are described in the following subsections.

6.1 CONTAMINANT SOURCE CHARACTERIZATION

Environmental investigations conducted at the four NSS Areas are based on area histories, known or suspected contaminant releases, and physical characteristics (i.e., the presence of waste materials) identified during preliminary site investigation activities (Dowl/Ogden, 1996). These investigations focused on known or suspected sources of contamination, and included collecting and analyzing field screening and fixed laboratory samples of surface soil, subsurface soil, and surface water between 1995 and 1996. Due to the biased nature of sampling known sources, the contaminant characterization is expected to result in a protective assessment of potential risks. Nevertheless, a degree of uncertainty remained in the characterization of contamination associated with the four NSS Areas. Surface soil, subsurface soil, surface water, groundwater, and sediment were sampled, where present, during the RFI. However, surface water may occasionally be present in gullies and drainages that were dry at the time of sampling, representing additional exposure media.

A degree of uncertainty is also associated with additional surface water samples collected in 2011 from Area C and downgradient off-site drainages. These samples were collected during a one-time summer sampling event, and reflect conditions of the time of the sampling, including the amount of recent precipitation, snow melt, and total runoff volume. As runoff conditions may cause variation in concentrations seasonally, there is some associated uncertainty in sample results. The downgradient off-site drainages also have other potential contaminant sources (ski lifts, parking lots, roads, etc.) besides NSS.

Surface water and groundwater samples for metals were collected during the RFI and analyzed for both total and dissolved phase metals. Samples for dissolved metals were filtered in the field with a 0.45 micron in-line filter. Data from filtered surface water samples were not included in the HHERA because there is no mechanism by which ecological receptors would be exposed to filtered surface water, and no constituents detected in surface water were selected as COPCs. However, data from both unfiltered and field-filtered groundwater samples were included in the HHRA. Due to the low quantity and quality of groundwater at the NSS, it is expected that filtering would be used to remove sediment prior to any hypothetical future potable water uses. However, it is ADEC policy to manage risk based on potable use of unfiltered water. For a balanced HHRA, risk and hazard results based on both dissolved and total metals data are presented for comparison purposes. However, the quality of groundwater in any hypothetical future potable wells developed at the NSS is not a significant source of uncertainty in the HHRA, because any potable water use is unlikely.

In addition to field sample collection, there is contaminant characterization uncertainty associated with laboratory sample analysis. Several VOCs and some SVOCs and PAHs were detected at concentrations greater than the analytical method detection limit, but less than the laboratory reporting limit. The analytical method detection limit is the theoretical minimum concentration of an analyte that can be detected by a specific method, while the laboratory reporting limit is a sample-specific estimate of the minimum concentration of the analyte that can be reported with confidence. Laboratory reporting limits are always equal to or greater than method detection limits; factors which may result in a large difference between the analytical detection limit and the reporting limit include sample dilution and matrix interference. Results between the method detection limit and reporting limit are flagged as "estimated" in a dataset due to the uncertainty associated with the actual detected value.

Estimated results at NSS were associated with: NSS Areas and chemicals with low detection frequencies; low maximum detected concentrations of VOCs, SVOCs, and PAHs; and elevated concentrations of RRO. All results greater than the analytical detection limit, but less than the laboratory reporting limit, were counted as detected results, and the actual detected concentration was included in human health and ecological risk and hazard estimate calculations. The uncertainty associated with the use of an estimated value in the risk assessment is assumed to be insignificant due to the low detection frequency and low maximum detected concentration of constituents with elevated reporting limits.

Chemical analyses included in contaminant characterization at NSS were planned based on site history and suspected sources of contamination; there is uncertainty associated with the fact that it is not feasible to analyze every sample for every possible constituent. Chromium may be present in environmental media as several species, with the most common oxidation states being elemental, trivalent, and hexavalent chromium. Because no suspected sources of hexavalent chromium are present at NSS, sample analysis initially included total unspeciated chromium only.

At sites where total chromium in soil was detected at or above the NSS background concentration of 38 mg/Kg, additional analysis for hexavalent chromium was performed. Either an additional sample was collected from the same location or, if the sample was still within hold time, it was reanalyzed. Of the 192 metals samples, there were a total of 19 sample locations where total chromium was detected at greater than 38 mg/Kg. A total of 22 samples (including three duplicates) were subsequently analyzed for hexavalent chromium; 14 of these samples were non-detect for hexavalent chromium. The remaining eight detections ranged from 0.09 to 0.89 mg/Kg hexavalent chromium. These results are sufficient to determine the presence of hexavalent chromium at the NSS. However, there was no apparent correlation between total chromium to hexavalent, so no ratio could be calculated. Although a ratio of total to hexavalent chromium in soil at the NSS could not be established, the relatively small hexavalent chromium dataset is not considered to be a significant source of uncertainty in the HHERA.

At sites where only total chromium data were available, total chromium was conservatively screened against hexavalent chromium screening criteria. If total chromium was selected as a COPC or COPEC based on hexavalent chromium screening criteria, it was analyzed as a both trivalent and hexavalent chromium for comparison purposes, even though the lower detection frequency of hexavalent chromium indicates that chromium is not likely to be present in that form. At sites where speciated chromium data were available for screening, hexavalent chromium was not selected as a COPC at any site, and was not associated with a HQ greater than 1 at any site where it was selected as a COPEC.

6.2 BACKGROUND SAMPLES

Background data was historically collected at Fort Richardson (North) – now part of JBER – for both groundwater and soils. However, NSS is located at Fort Richardson (South) – also now part of JBER – and has a very different physical setting and elevation. For these reasons, additional background samples that are more representative of conditions at NSS were collected in 2010.

There is a degree of uncertainty introduced into any risk assessment when background data is incorporated. No two datasets are exactly equivalent and, as such, when two datasets are compared in order to determine if datasets come from the same population, there is a possibility of error within that statistical comparison. The likelihood of being able to correctly identify a difference between datasets also depends on the size and variability of the sample and population.

6.3 HUMAN HEALTH RISK ASSESSMENT

6.3.1 COPC Identification

The process used in selecting COPCs may introduce a degree of uncertainty in the HHRA. Protective methods and assumptions were used in selecting preliminary COPCs, in accordance with State of Alaska regulations (18 AAC 75). Protective assumptions used in the COPC screening procedure include comparing maximum detected chemical concentrations to one-tenth of the most protective screening criteria for the ingestion or inhalation exposure pathways listed in 18 AAC 70 and 18 AAC 75. Chemicals without risk-based screening benchmarks were screened based on toxicity information for surrogate chemicals to the extent appropriate. Chemicals that exceed criteria and benchmarks, and chemicals without screening benchmarks or appropriate surrogates, were proposed for further evaluation in the baseline HHRA.

There is some degree of uncertainty associated with the use of standardized screening criteria for COPC selection. Screening criteria are created to conservatively protect human health. These criteria do not reflect site-specific exposures and likely overestimate exposures to site-specific receptors. However, the associated uncertainty is low, because chemicals retained in this conservative process were evaluated with more site-specific methods in Tier II baseline HHRA calculations.

6.3.2 Exposure Assessment

Exposure assessment describes the processes used to identify potentially important receptors, exposure media, exposure pathways, and methods to quantify exposure of human health receptors to site contaminants. Potential uncertainties in the exposure assessment phase of the

HHRA for the four NSS Areas and down-gradient off-site drainages include, but are not limited to: the selection of receptors, exposure pathways and assumptions, EPCs, available contaminant characterization data, and toxicity values (Section 6.3.3).

Selection of Receptors

Receptors quantitatively evaluated in the HHRA for the four NSS Areas included site workers, site visitors, and hypothetical future residents. A potential trespasser was not quantitatively evaluated. This is not expected to result in significant uncertainty in the risk results, because exposure to potentially contaminated media would be lower for a trespasser than for the other receptors that were quantitatively evaluated.

Exposure Pathways and Assumptions

Exposure pathways used in the HHRA included ingestion, dermal contact, and inhalation of dust and VOCs. Standard assumptions associated with these pathways are designed to capture the reasonable maximum exposure scenarios; therefore, uncertainty associated with exposure modeling is expected to lead to over estimates of risk and hazard.

Biological investigations of plants and animals that may be directly exposed to contaminants present at NSS have not been conducted. The lower NSS Areas may be used by trespassers gathering berries or hunting for ptarmigan. Such gathering does not represent a subsistence source of food, and would occur over a broad area in Chugach State Park and nearby open land, not just at NSS. Therefore, the potential for exposure of trespassers to COPCs through berry or meat consumption is deemed to be potentially complete, but insignificant, and lack of chemical monitoring data for such species is believed to represent a low uncertainty.

EPCs

The media-specific EPCs used to quantify exposures for human health receptors may result in uncertainty in the exposure dose estimates. To address this potential uncertainty, maximum, or 95% UCL on the mean, concentrations were generally used to estimate exposure doses, consistent with ADEC (2011a) and EPA (USEPA, 1989a; 1992a) guidelines. Where the number of samples or detection frequency was insufficient to calculate 95% UCL on the mean concentration, the maximum detected concentrations was used to quantify exposure doses and risk estimates. EPCs for groundwater-derived VOC concentrations in indoor air and for potable use of groundwater were equal to the COPC concentration detected in the monitoring well with the highest cumulative cancer risk and non-cancer hazard. If a chemical was a risk driver based on sample results from a well that that was different than the highest risk well, separate results were presented for that chemical. Based on the above considerations, the exposure doses used in the HHRA for the four NSS Areas are believed to represent protective, upper bound estimates of exposure.

Available Contaminant Characterization Data

The RFI was designed to provide as comprehensive a characterization as possible, given the limited nature of the PA/SI.

6.3.3 Toxicity Assessment

The Tier I screening assessments used to identify preliminary COPCs for the NSS included the use of surrogate toxicity benchmarks for chemicals without benchmarks. Identification of surrogate toxicity benchmarks was based on similarities in chemical structure and/or toxicological mechanism between surrogate chemicals and site chemicals.

The toxicity values (CSFs and RfDs) that were used for estimating carcinogenic risks and noncarcinogenic hazards for human receptors represent a potential source of uncertainty. The toxicity values used in the HHRA were derived from EPA or ADEC sources, as described in Section 4.3. Toxicity values that are developed by the EPA generally represent upper bound estimates of toxicity, and incorporate uncertainty factors for extrapolation from animal data to humans, differences in individual sensitivity within populations, and the overall confidence in the data set. Because the toxicity values established by the EPA are based on NOAEL concentrations and incorporate uncertainty factors, the values are generally considered to be protective. The use of conservative toxicity values in the risk estimate tends to overestimate actual risks.

Dermal toxicity criteria are not available from the EPA. Typically, a simple route-to-route (i.e., oral-to-dermal) extrapolation is assumed, such that the available oral toxicity criteria (e.g., RfD or CSF) are used to quantify potential systemic effects associated with dermal exposure. However, as noted in the EPA's *Risk Assessment Guidance for Superfund, Part E Supplemental Guidance for Dermal Risk Assessment* (USEPA, 2004a), there is uncertainty associated with this approach because the oral toxicity criteria are based on an administered dose and not an absorbed dose. In general, EPA guidance recommends an adjustment to the oral toxicity criteria to convert an administered dose into an absorbed dose (USEPA, 2004a). The adjustment accounts for the absorption efficiency of the constituent in the "critical study" that is the basis of the oral toxicity criterion. If the oral absorption in the critical study is 100%, then the absorbed dose is equivalent to the administered dose and no adjustment is necessary. If the oral absorption of a constituent in the critical study is poor (i.e., less than 50%), then the absorbed dose is much smaller than the administered dose. In this situation, an adjustment to the oral toxicity criteria is recommended.

As described in Section 4.3.3, potential dermal exposures to DRO, GRO, and RRO were not quantitatively evaluated in the baseline HHRA due to uncertainties in extrapolating oral RfDs for PHCs to the dermal route of administration. Not quantifying dermal exposures associated with DRO, GRO, and RRO results in some uncertainty in the human health risk estimates for the four NSS Areas, because PHCs have relatively high dermal absorption coefficients. However, similar to other organic chemicals, the majority of the exposure dose and risk estimate for higher molecular weight PHCs is received through the oral route of exposure. So, not quantifying the dermal pathway for DRO, GRO, and RRO is not anticipated to result in significant underestimation of risks for these constituents. It should also be noted that individual PHCs (e.g., BTEX and PAHs) were detected in site media and were quantitatively evaluated in the HHRA.

Where speciated chromium data were not available (i.e., groundwater at LSS and subsurface soil at Area A), risk to human receptors due to exposure to total chromium was conservatively evaluated using both hexavalent chromium and trivalent toxicity values. There is no known historic use of, or activities relating to, hexavalent chromium at LSS and Area A. Additionally, hexavalent chromium is very unstable in soil and, without a high concentration of total chromium, there are not likely to be high concentrations of hexavalent chromium at LSS or Area A.

6.3.4 Risk Characterization

The different sources of uncertainty described above are incorporated in the risk estimate. Because the majority of these uncertainties err on the conservative side, the estimated risks presented in this HHRA for the NSS most likely represent upper bound estimates of risk.

ADEC currently considers a cumulative cancer risk estimate of 1×10^{-5} and a noncancer HI of 1 as the point of departure for making risk management decisions concerning a site. It should be noted, however, that according to State of Alaska (18 AAC 75.325(h)) and EPA (USEPA, 1991a) guidance, sites with a cumulative cancer risk estimate between 1×10^{-6} and 1×10^{-4}, and a noncancer HI of less than 1, may be appropriate for conditional closure following an evaluation of site-specific issues related to future land uses, the technical feasibility of remediation, and related considerations.

6.4 ECOLOGICAL RISK ASSESSMENT

6.4.1 COPEC Identification

The process used in selecting COPECs may introduce a degree of uncertainty in the ERA. Protective methods and assumptions were used in selecting preliminary COPCs, in accordance with State of Alaska regulations (18 AAC 75). Protective assumptions used in COPEC screening include comparing the maximum detected concentration for each chemical against conservative, media-specific criteria, and automatic inclusion of chemicals without screening criteria in the Tier II ERA. Chemicals without risk-based screening benchmarks were screened based on toxicity information for surrogate chemicals to the extent appropriate. Chemicals that exceed criteria and benchmarks, and chemicals without screening benchmarks or appropriate surrogates, were proposed for further evaluation in the Tier II baseline ERA.

There is some degree of uncertainty associated with the use of standardized screening criteria for COPEC selection. Screening criteria are created to conservatively protect ecological beneficial uses. These criteria do not reflect site-specific exposures and likely overestimate exposures to site-specific receptors. However, the associated uncertainty is low because chemicals retained in this conservative process were evaluated with more site-specific methods in Tier II baseline ERA calculations.

6.4.2 Problem Formulation and Exposure Assessment

Problem formulation and exposure assessment describe the processes used to identify potentially important receptors, exposure media, exposure pathways, and methods to quantify exposure of ecological receptors to site contaminants. Potential uncertainties in the problem formulation and exposure assessment phases for the four NSS Areas and down-gradient off-site drainages evaluated in this ERA include, but are not limited to: the selection of receptors, exposure pathways and assumptions, EPCs, available contaminant characterization data, bioaccumulation factors, partitioning coefficients, and toxicity values.

Selection of Receptors

Receptors quantitatively evaluated in the ERA for NSS were selected based on a review of ecosystems and organisms occurring in the area. It is possible that ecological species not identified in the ERA biological characterization may occur at NSS. However, the indicator species for the Southcentral ecoregion that were evaluated in the ERA were selected by ADEC to be representative of all guilds in the region. This group of indicator receptors can, therefore, be considered protective of the ecosystem.

There is no aquatic habitat present at the majority of NSS due to the ephemeral nature of surface drainages. The only potential habitat for aquatic receptors at NSS is the small pond located in Area C, and in small off-site drainages. The off-site drainages contained potential habitat and were evaluated in the Tier II ERA. However, the Area C Pond is not expected to provide habitat except for potential benthic invertebrates. This assumption is supported by the small size and man-made nature of the Area C Pond, as well as the observed absence of aquatic receptors during visual assessments made as part of the RFI. Based on the small size of the pond and limited potential for habitat, if any exists, omission of aquatic receptors in Area C Pond from the Tier II ERA is not believed to be a significant source of uncertainty.

Exposure Pathways and Assumptions

Ecological receptors are in direct contact with potentially contaminated media. Although inhalation and dermal exposure pathways were identified for ecological receptors, these pathways were not quantitatively evaluated in the ERA due to uncertainties in available exposure modeling methods. Inhalation is not expected to be a significant route of exposure due to the high winds and exposed nature of NSS, which will readily disperse contaminants in the air. Dermal exposure is similarly expected to be minimal due to the protection provided by feathers and fur.

EPCs

The media-specific EPCs used to quantify exposures for ecological receptors may result in uncertainty in the exposure dose estimates. To address this potential uncertainty, maximum, or 95% UCL on the mean, concentrations were used to estimate exposure doses, consistent with ADEC (2011a) and EPA (USEPA, 1989a; 1992a) guidelines. Where the number of samples or frequency of detection were insufficient to calculate 95% UCL on the mean concentrations, maximum concentrations of COPCs were used to quantify exposure doses and risk estimates. Based on the above considerations, the exposure doses used in the HHERA for the four NSS Areas and downgradient off-site drainages are believed to represent protective, upper bound estimates of exposure.

Available Contaminant Characterization Data

The RFI was designed to provide as comprehensive a characterization as possible, given the limited nature of the PA/SI.

Bioaccumulation Factors

The quantitative estimation of doses and hazards for ecological receptors through food chain transfer of chemicals relied upon the use of abiotic-to-biotic media uptake factors or regressions obtained from the literature, as presented in Section 5.2.2.3. Uptake factors provided in literature were derived from results of both field and laboratory studies, where exposure conditions were different than site-specific conditions at the four NSS Areas. The use of literature-derived biota uptake factors obtained from locations that may have little similarity to the NSS results in uncertainties in modeled exposure dose and hazard estimates based on these uptake factors.

Partitioning Coefficients

The quantitative estimation of chemical concentrations partitioning between two abiotic media introduces some uncertainty. Site-specific factors such as surrounding chemistry physical processes may affect or alter the assumptions of equilibrium. Partitioning coefficients used to estimate COPEC concentrations in sediment in downgradient off-site drainages were selected at the conservative end of the range of available applicable values. Therefore, modeled sediment concentrations are expected to provide an upper bound estimate of actual sediment concentrations.

6.4.3 Ecological Effects Assessment

The Tier I screening assessments used to identify preliminary COPECs for the four NSS Areas and downgradient off-site drainages included the use of surrogate screening benchmarks for chemicals without benchmarks. Identification of surrogate toxicity benchmarks was based on similarities in chemical structure and/or toxicological mechanism between surrogate chemicals and site chemicals. Selected surrogate chemicals were used in the ecological effects assessments if the analyte was identified as a COPEC and toxicity reference values were not available. The use of surrogate toxicity information results in some uncertainty in the ecological effects assessment processes.

Fewer published TRVs are generally available for avian receptors than are available for mammalian receptors. As a result, ecological hazards for avians could not be quantified for a number of COPECs due to a lack of avian TRVs for these constituents. The constituents for which ecological hazards to avians could not be calculated due to a lack of available TRVs include PAHs and PHCs. As a result, there is a potential that hazards to avian receptors may be underestimated at sites where PAHs and PHCs were identified as COPECs.

6.4.4 Risk Characterization

The different sources of uncertainty described above are incorporated in the risk estimate. Because the majority of these uncertainties err on the conservative side, the estimated risks presented in this ERA for the four NSS Areas and downgradient off-site drainages most likely represent upper bound estimates of risk.

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7.0 RISK-BASED CLEANUP LEVELS

Chemical-specific and medium-specific risk-based cleanup levels (RBCLs) were developed for chemical risk drivers identified during this HHERA. Human health risk drivers are those constituents with a calculated ILCR or HI greater than 1 x 10^{-5} or 1, respectively, or those constituents that contributed greater than 90% to the cumulative ILCR or an HI greater than 1 x 10^{-5} or 1. Ecological risk drivers are those constituents that contributed to an ecological HI in excess of 1.

Methods used in the development of RBCLs are described in Section 7.1, and results of RBCL development for the four NSS Areas are presented in Section 7.2

7.1 METHODS

Chemical- and medium-specific RBCLs were developed for risk drivers identified during this HHERA in accordance with ADEC Method Four procedures described in 18 AAC 75.340, 18 AAC 75.345, and ADEC's *Cleanup Levels Guidance* (ADEC, 2008d). Briefly, chemical- and medium-specific RBCLs for the protection of human health were derived by back-calculating concentrations of chemical risk drivers in site media equivalent to a chemical-specific ILCR of 1 x 10^{-5}, or an HQ of 1. Similarly, chemical- and medium-specific RBCLs for the protection of ecological receptors (ERBCLs) were derived by back-calculating concentrations of chemical risk drivers in site media equivalent to a chemical-specific HQ of 1.

7.1.1 Human Health RBCL Calculation Methods

Human health RBCLs were calculated for each of the media where risk drivers were identified for the current/future site worker and site visitor, and hypothetical future resident, according to the following general equation:

$$\text{RBCL} = \frac{\text{C x TR}}{\text{Chemical-specific risks or HQ}}$$

Where:

RBCL = Risk-based concentration
C = EPC used to calculate chemical-specific risks or HQ
TR = Target Risk: either 1 x 10^{-5} cancer risk or a noncancer HQ of 1.0.

Human health RBCLs were calculated using the exposure assumptions listed in Table 4-1 and the toxicity values listed in Table 4-2. Human health RBCLs are presented in **Tables 7-1** through **7-4** for the four NSS Areas.

7.1.2 Ecological RBCL Calculation Methods

Ecological RBCLs were calculated according to the general equation shown below for ecological receptors, and chemical risk drivers for which there is a linear relationship between the chemical concentration in environmental media and the concentration in prey items:

$$\text{ERBCL} = \frac{C \times TR}{\text{Chemical-specific risks or HQ}}$$

Where:

ERBCL	= Ecological risk-based cleanup level
C	= EPC used to calculate chemical-specific risks or HQ
TR	= Target Risk: 1.

For constituents for which the chemical concentration in prey items was based on a regression with the chemical concentration in environmental media, the Solver function in Microsoft Excel® was used to back-calculate the ecological RBCL.

Ecological RBCLs were calculated using the exposure parameters listed in Table 5-2, bioconcentration factors listed in Table 5-3, mammalian TRVs listed in Table 5-4, and avian TRVs listed in Table 5-5. Ecological RBCLs are summarized in **Tables 7-5** through **7-7**.

7.2 RESULTS

Chemical- and medium-specific RBCLs for the protection of human health are presented in Section 7.2.1, and chemical- and medium-specific RBCLs for the protection of ecological receptors are presented in Section 7.2.2.

The RBCLs presented below are equivalent to a chemical- and medium-specific ILCR of 1 x 10^{-5} or an HQ of 1. These RBCLs should be adjusted downward at sites with multiple risk drivers and exposure pathways to ensure that the total cumulative site ILCR and HI do not exceed 1 x 10^{-5} and 1, respectively. In addition, it is worth noting that a cumulative site ILCR of 1 x 10^{-5} represents the mid-point of the EPA's acceptable risk management range of 1 x 10^{-6} to 1 x 10^{-4} for carcinogenic chemicals, as per the National Contingency Plan (40 CFR, Part 300) and USEPA (1991b) guidance.

7.2.1 RBCLs for Human Receptors

Human health RBCLs were calculated for the current and future site worker, current and future site visitors, and hypothetical future resident for each of the media where risk drivers were identified. RBCLs for these receptors are presented in Tables 7-1 through 7-4; text below describes the risk drivers for the most protective human heath scenario, the hypothetical future resident.

Upper Site Summit

At USS, cumulative ILCR estimates for the hypothetical future resident exposed to surface soil was greater than ADEC's acceptable risk of 1 x 10^{-5} (Table 7-1). Cumulative HI estimates for surface soil at USS did not exceed ADEC's acceptable criteria of 1. Arsenic and benzo(a)pyrene were identified as carcinogenic risk drivers in surface soil.

The cumulative ILCR estimate for the current / future site worker and the hypothetical future resident exposed to subsurface soil was greater than ADEC's acceptable risk of $^{-5}$ (Table 7-1).

Cumulative HI estimates for the subsurface soil at USS did not exceed ADEC's acceptable criteria of 1. Benzo(a)pyrene and dibenz(a,h)anthracene were identified as carcinogenic risk drivers in subsurface soil.

Lower Site Summit

At LSS, cumulative ILCR estimates for the hypothetical future resident exposed to modeled indoor air, surface soil, subsurface soil, and groundwater were greater than ADEC's acceptable risk criterion of 1 x 10-5, and the cumulative HI estimates for the hypothetical future resident exposed to modeled indoor air, subsurface soil, and groundwater were greater than ADEC's acceptable noncancer hazard criterion of 1 (Table 7-2).

The carcinogenic risk drivers for a hypothetical future resident at LSS included:

- Naphthalene in groundwater for modeled indoor air.
- Arsenic, pentachlorophenol, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h,)anthracene in surface soil.
- 1,2,3-trichloropropane and 1,2-dibromo-3-chloropropane in subsurface soil.
- Total arsenic and naphthalene were identified as carcinogenic risk drivers in groundwater for risk estimates assuming no groundwater filtration and total chromium as trivalent chromium. When total chromium was assumed to be present as total hexavalent chromium, total hexavalent chromium was also identified as a risk driver for unfiltered groundwater.
- Dissolved arsenic and naphthalene in groundwater for risk estimates assuming groundwater filtration and dissolved chromium as trivalent chromium. When total chromium was assumed to be present as dissolved hexavalent chromium, dissolved hexavalent chromium was also identified as a risk driver for filtered groundwater.
- Trichloroethylene in groundwater was identified as a risk driver for the hypothetical future resident, but was not detected at an elevated concentration in the groundwater well with the highest risk and hazard estimates for the potable use pathway (refer to Section 4.5.2). Although the risk due to exposure to trichloroethylene in potable groundwater was not included in the cumulative site ILCR for LSS, an RBCLs trichloroethylene is presented in Table 7-2.

The noncarcinogenic risk drivers for a hypothetical future resident at LSS included:

- 1,1,2-trichloroethane and 1,2-dibromo-3-chloropropane in subsurface soil.
- Total arsenic, total vanadium, 2-methylnaphthalene, naphthalene and DRO in groundwater for risk estimates assuming no groundwater filtration and total chromium as trivalent chromium.
- Total arsenic, total chromium as hexavalent chromium, total vanadium, 2-methylnaphthalene, naphthalene, and DRO in groundwater for risk estimates assuming no groundwater filtration and total chromium as hexavalent chromium.

- Dissolved arsenic, 2-methylnaphthalene, naphthalene, and DRO in groundwater for risk estimates assuming groundwater filtration
- Dissolved vanadium was identified as a risk driver for the hypothetical future resident, but was not detected in the groundwater monitoring well with the highest cumulative hazard estimate for the potable use pathway (refer to Section 4.5.2). Although risk due to exposure to dissolved vanadium in potable use groundwater was not included in the cumulative site HI for LSS, an RBCL for vanadium is presented in Table 7-2.
- Trichloroethylene in modeled indoor air was identified as a risk driver for the hypothetical future resident, but was not detected at an elevated concentration in the groundwater well with the highest cumulative hazard estimate for the vapor intrusion pathway (refer to Section 4.5.2). Although risk due to exposure to trichloroethylene in modeled indoor air was not included in the cumulative site HI for LSS, an RBCL for trichloroethylene is presented in Table 7-2.

At LSS, cumulative ILCR estimates for the current/future site worker were greater than ADEC's acceptable risk criterion of 1 x 10-5 for pentachlorophenol and benzo(a)pyrene in surface soil and 1,2,3-trichloropropane and 1,2-dibromo-3-chloropropane in subsurface soil (Table 7-2). ADEC's acceptable noncancer hazard criterion of 1 was not exceeded in any media at LSS for the current/future site worker.

Cumulative ILCR estimates for the current/future site visitor at LSS were greater than ADEC's acceptable risk criterion of 1 x 10-5 for 1,2-dibromo-3-chloropropane in subsurface soil (Table 7-2). ADEC's acceptable noncancer hazard criterion of 1 was not exceeded in any media at LSS for the current/future site visitor.

Derived RBCLs for risk driers at LSS are presented in Table 7-2. It should be noted that, in some cases, RBCLs for groundwater are lower than screening levels or standards for groundwater (e.g., Table C Groundwater Cleanup Levels or Maximum Contaminant Levels). This is because RBCLs are risk-based, while Table C Groundwater Cleanup Levels and Maximum Contaminant Levels are frequently set to higher levels based on cost or technical feasibility of meeting risk-based levels.

Area A

At Area A, cumulative HI and ILCR estimates for the hypothetical future resident exposed to surface soil and subsurface soil was above ADEC's acceptable risk and HI criteria of 1×10^{-5} and 1, respectively. DRO and RRO were identified as noncarcinogenic risk drivers in surface soil. Total chromium, assumed as hexavalent chromium, was identified as a carcinogenic risk driver in subsurface soil. DRO was identified as a noncarcinogenic risk driver in subsurface soil. Derived RBCLs for risk drivers at Area A are presented in Table 7-3.

Area C

At Area C, the cumulative ILCR estimate for the hypothetical future resident exposed to surface soil was above ADEC's acceptable risk criterion of 1×10^{-5}. Benzo(a)pyrene was identified as a carcinogenic risk driver in surface soil. The derived RBCL for the risk driver at Area C is presented in Table 7-4.

7.2.2 RBCLs for Ecological Receptors

Ecological RBCLs were calculated for constituents in surface soil at NSS. Exposure pathways between ecological receptors and subsurface soil at NSS are incomplete, and risk drivers were not identified in surface water and sediment. Any constituent in surface soil associated with an HQ in excess of 1.0 for any receptor was identified as a risk driver.

Upper Site Summit

RRO in surface soil was identified as a risk driver for the tundra vole, masked shrew, and least weasel (Table 7-5). Benzo(b)fluoranthene, pyrene, cadmium, and lead in surface soil were also identified as risk drivers for the masked shrew.

Lower Site Summit

Pentachlorophenol, pyrene, and RRO in surface soil were identified as risk drivers for the tundra vole (Table 7-6). Cadmium, bis(2-ethylhexyl) phthalate, pentachlorophenol, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, pyrene, and RRO in surface soil were identified as risk drivers for the masked shrew. RRO in surface soil was identified as a risk driver for the least weasel. Pentachlorophenol and pyrene in surface soil were identified as risk drivers for the American robin and dark-eyed junco. For the American robin and northern shrike, bis(2-ethylhexyl) phthalate was also a risk driver.

Area A

RRO in surface soil was identified as a risk driver for the tundra vole, masked shrew, and least weasel (Table 7-7).

Area C

No risk drivers were identified for surface soil at Area C and, as a result, no ecological RBCLs were calculated for this site.

Downgradient Off-site Drainages

No risk drivers were identified in off-site drainages and, as a result, no ecological RBCLs were calculated for surface water in these drainages.

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Table 7-1 Summary of Risk-Based Cleanup Levels for Human Receptors - Upper Site Summit

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker				Current/Future Site Visitor				Hypothetical Future Resident			
				Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]	
	Maximum	95% UCL	EPC[c]	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer
Non-Petroleum Hydrocarbons (TPHs)															
Surface Soil (mg/Kg)															
Arsenic	19.1	9.84	9.84	6.2E-06	0.039	NC	NC	5.9E-07	0.0037	NC	NC	**2.1E-05**	0.39	4.68	NC
Benzo(a)pyrene	5.75	1.37	1.37	6.5E-06	NA	NC	NA	6.2E-07	NA	NC	NA	**1.8E-05**	NA	0.744	NA
Subsurface Soil (mg/Kg)															
Benzo(a)pyrene	3.71	0.632	3.71	**1.8E-05**	NA	2.11	NA	1.7E-06	NA	NC	NA	**5.0E-05**	NA	0.744	NA
Dibenz(a,h)anthracene	0.846	0.335	0.846	4.0E-06	NA	NC	NA	3.8E-07	NA	NC	NA	**1.1E-05**	NA	0.744	NA

Notes:

% - percent
EPC - exposure point concentration
HQ - hazard quotient
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
RBCL - risk-based cleanup level
UCL - upper confidence limit

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable risk criteria.

[a] Summary of risk estimates and RBCLs are only presented for chemicals of potential concern (COPCs) that are risk drivers for at least one receptor.

[b] Maximum detected concentration and 95% UCL on the mean concentration measured in various media collected from Upper Site Summit sampling locations.

[c] The EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[d] RBCLs are based on a chemical- and medium-specific target risk of 1 x 10^{-5} for carcinogenic risk drivers or a target HQ of 1 for noncarcinogenic risk drivers. It should be noted that chemical- and medium- specific RBCLs presented in this table should be adjusted downward where multiple risk drivers and exposure pathways are present to ensure that the total cumulative site incremental lifetime cancer risk and hazard index do not exceed 1 x 10^{-5} and 1, respectively

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Table 7-2 Summary of Risk-Based Cleanup Levels for Human Receptors - Lower Site Summit

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker				Current/Future Site Visitor				Hypothetical Future Resident			
				Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]	
	Maximum	95% UCL	EPC[c]	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer
Non-Petroleum Hydrocarbons															
Indoor Air - Derived From Groundwater from MW07LSS [e] (mg/L)															
Naphthalene	0.168	NA	0.168	8.0E-06	0.22	NC	NC	NA	NA	NA	NA	**1.3E-05**	0.31	0.125	NC
Indoor Air - Derived From Groundwater from MW06LSS [e] (mg/L)															
Trichloroethylene (TCE)	0.0175	NA	0.0175	2.9E-06	1.0	NC	NC	NA	NA	NA	NA	4.9E-06	**1.4**	NC	0.0125
Surface Soil (mg/Kg)															
Arsenic	19.0	8.15	8.15	5.1E-06	0.032	NC	NC	4.9E-07	0.0031	NC	NC	**1.7E-05**	0.32	4.68	NC
Pentachlorophenol	46.5	NC	46.5	**1.7E-05**	0.024	27	NC	1.7E-06	0.0023	NC	NC	**4.4E-05**	0.18	10.7	NA
Benzo(a)anthracene	37.0	7.98	7.98	3.8E-06	NA	NC	NA	3.6E-07	NA	NC	NA	**1.1E-05**	NA	7.44	NA
Benzo(a)pyrene	35.7	7.74	7.74	**3.7E-05**	NA	2.11	NA	3.5E-06	NA	NC	NA	**1.0E-04**	NA	0.744	NA
Benzo(b)fluoranthene	40.1	8.66	8.66	4.1E-06	NA	NC	NA	3.9E-07	NA	NC	NA	**1.2E-05**	NA	7.44	NA
Dibenz(a,h)anthracene	6.12	0.786	6.12	3.7E-06	NA	NC	NA	3.6E-07	NA	NC	NA	**1.1E-05**	NA	0.744	NA
Subsurface Soil (mg/Kg)															
1,1,2-Trichloroethane	1.65	NC	1.65	1.1E-06	0.92	NC	1.8	1.0E-07	0.088	NC	NC	1.8E-06	**2.0**	NC	0.831
1,2,3-Trichloropropane	0.491	NC	0.491	**2.6E-05**	0.095	0.192	NC	2.4E-06	0.0091	NC	NC	**5.1E-05**	0.21	0.0967	NC
1,2-Dibromo-3-chloropropane	3.04	NC	3.04	**1.9E-04**	0.45	0.163	NC	**1.8E-05**	0.043	1.69	NC	**2.9E-04**	**1.1**	0.104	NC
Groundwater from MW03LSS [f] - Potable Use (mg/L) - unfiltered, trivalent chromium [g,h]															
Arsenic, total	0.0322	NA	0.0322	NA	NA	NA	NA	NA	NA	NA	NA	**9.8E-04**	**17**	0.000327	0.00193
Vanadium, total	0.137	NA	0.109	NA	NA	NA	NA	NA	NA	NA	NA	NA	**3.6**	NA	0.0307
2-Methylnaphthalene	0.0735	NA	0.0735	NA	NA	NA	NA	NA	NA	NA	NA	NA	**2.9**	NA	0.0257
Naphthalene	0.168	NA	0.0685	NA	NA	NA	NA	NA	NA	NA	NA	**2.4E-05**	**4.2**	0.0289	0.0163
Groundwater from MW03LSS [f] - Potable Use (mg/L) - unfiltered,hexavalent chromium [g,h]															
Arsenic, total	0.0322	NA	0.0322	NA	NA	NA	NA	NA	NA	NA	NA	**9.8E-04**	**17**	0.000327	0.00193
Total chromium, total, assumed as hexavalent	0.0857	NA	0.0525	NA	NA	NA	NA	NA	NA	NA	NA	**5.9E-04**	**2.9**	0.000888	0.0184
Vanadium, total	0.137	NA	0.109	NA	NA	NA	NA	NA	NA	NA	NA	NA	**3.6**	NA	0.0307
2-Methylnaphthalene	0.0735	NA	0.0735	NA	NA	NA	NA	NA	NA	NA	NA	NA	**2.9**	NA	0.0257
Naphthalene	0.168	NA	0.0685	NA	NA	NA	NA	NA	NA	NA	NA	**2.4E-05**	**4.2**	0.0289	0.0163
Groundwater from MW03LSS [f] - Potable Use (mg/L) - filtered [g,h]															
Arsenic, dissolved	0.00681	NA	0.00454	NA	NA	NA	NA	NA	NA	NA	NA	**1.4E-04**	**2.4**	0.000327	0.00193
2-Methylnaphthalene	0.0735	NA	0.0735	NA	NA	NA	NA	NA	NA	NA	NA	NA	**2.9**	NA	0.0257
Naphthalene	0.168	NA	0.0685	NA	NA	NA	NA	NA	NA	NA	NA	**2.4E-05**	**4.2**	0.0289	0.0163
Groundwater from MW06LSS [i] - Potable Use (mg/L)															
Trichloroethylene (TCE)	0.0175	NA	0.0175	NA	NA	NA	NA	NA	NA	NA	NA	**2.0E-05**	**6.8**	0.00868	0.00256
Petroleum Hydrocarbons															
Groundwater from MW03LSS [f] - Potable Use (mg/L)															
Diesel Range Organics (DRO)	29.4	NA	29.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	**95**	NA	0.308

Table 7-2 Summary of Risk-Based Cleanup Levels for Human Receptors - Lower Site Summit

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker				Current/Future Site Visitor				Hypothetical Future Resident			
				Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]	
	Maximum	95% UCL	EPC[c]	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer

Notes:

% - percent
COPC - chemical of potential concern
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
LSS - Lower Site Summit
mg/Kg - milligrams per kilogram
mg/L - milligrams per liter
NA - not applicable
NC - not calculated
RBCL - risk-based cleanup level
UCL - upper confidence limit

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable risk criteria.

[a] Summary of risk estimates and RBCLs are only presented for COPCs that are risk drivers for at least one receptor.

[b] Maximum detected concentration, 95% UCL on the mean concentration, and EPC measured in various media collected from LSS sampling locations.

[c] The surface and subsurface soil EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the soil EPC is equal to the maximum detected concentration. The groundwater EPCs for the vapor intrusion and potable use pathways are equal to the concentrations detected in MW07LSS and MW03LSS, respectively. These wells had the highest cumulative ILCR and HI estimates for any groundwater monitoring well at LSS for these pathways.

[d] RBCLs are based on a chemical- and medium-specific target risk of 1 x 10^{-5} for carcinogenic risk drivers or a target HQ of 1 for noncarcinogenic risk drivers. It should be noted that chemical- and medium- specific RBCLs presented in this table should be adjusted downward where multiple risk drivers and exposure pathways are present to ensure that the total cumulative site ILCR and HI do not exceed 1 x 10^{-5} and 1, respectively

[e] The vapor intrusion from groundwater to indoor air pathway EPC and corresponding ILCR and HI estimates for naphthalene are reported for Monitoring Well MW07LSS, which had the highest cumulative ILCR and HI estimates for the vapor intrusion pathway of any monitoring well at LSS. However, ILCR or HQ estimates for individual COPCs were sometimes higher in wells other than MW07LSS (refer to Table I-32). Only one other chemical, trichloroethylene, was identified as a vapor intrusion pathway risk driver for LSS. The well with the maximum ILCR and HQ estimates for trichloroethylene, as presented here, was MW06LSS. RBCLs for both naphthalene and trichloroethylene are presented here.

[f] Detected concentrations of groundwater constituents, and corresponding ILCR and HI estimates, are reported for Monitoring Well MW03LSS, which had the highest cumulative ILCR and HI estimates for any groundwater monitoring well at LSS. However, ILCR or HQ estimates for individual COPCs were sometimes higher in wells other than MW03LSS (refer to Table I-31). Only one chemical that was identified as a risk driver for LSS, trichloroethylene, was not identified as a risk driver in MW03LSS. ILCR and HI estimates due to maximum trichloroethylene exposure at LSS and RBCLs for trichloroethylene are presented in this table following the MW03LSS results and RBCLs.

[g] Unfiltered and field-filtered groundwater samples were collected for total and dissolved metals analyses at the LSS. It is assumed that residents would filter groundwater before using it for potable applications; however, to be conservative, both dissolved and total metals data were included in risk and hazard calculations. Both sets of risk results are presented here for comparison purposes.

[h] Groundwater samples at LSS were analyzed for total chromium only. No suspected sources of hexavalent chromium are present at LSS; however, to be conservative, both total chromium as trivalent chromium and total chromium as hexavalent chromium risks were calculated. Both sets of risk results are presented here for comparison purposes. Total chromium was not detected in filtered groundwater samples collected from the highest risk well, MW03LSS.

[i] All chemical risk drivers identified in any well at LSS were identifed in MW03LSS, with the exception of trichloroethylene, which was identified as a carcinogenic and risk and non-cancer hazard driver based on groundwater data from MW06LSS and as a non-cancer hazard driver based on groundwater data from MW04LSS (Table 1-31). Risk and hazard estimates resulting from potential exposure to trichloroethylene in groundwater at MW06LSS and the groundwater RBCL for trichloroethylene are presented here for completeness.

Table 7-3 Summary of Risk-Based Cleanup Levels for Human Receptors - Area A

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker Risk / Hazard		Current/Future Site Worker RBCL[d]		Current/Future Site Visitor Risk / Hazard		Current/Future Site Visitor RBCL[d]		Hypothetical Future Resident Risk / Hazard		Hypothetical Future Resident RBCL[d]	
	Maximum	95% UCL	EPC[c]	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer
Non-Petroleum Hydrocarbons															
Subsurface Soil (mg/Kg) - hexavalent chromium[e]															
Total chromium, assumed as hexalent chromium	45.1	34.0	34.0	6.5E-06	0.011	NC	NC	6.2E-07	0.0011	NC	NC	**2.3E-05**	0.12	14.9	NC
Petroleum Hydrocarbons															
Surface Soil (mg/Kg)															
Diesel Range Organics (DRO)	19,200	8,369	8,369	NA	0.68	NA	NC	NA	0.014	NA	NC	NA	**2.8**	NA	2,998
Residual Range Organics (RRO)	161,000	63,887	63,887	NA	0.65	NA	NC	NA	0.063	NA	NC	NA	**7.3**	NA	8,763
Subsurface Soil (mg/Kg)															
Diesel Range Organics (DRO)	28,400	8,583	8,583	NA	0.70	NA	NC	NA	0.015	NA	NC	NA	**2.9**	NA	2,998

Notes:

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HQ - hazard quotient
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
RBCL - risk-based cleanup level
UCL - upper confidence limit

Bold indicates exceedance of the ADEC's acceptable risk criteria.

[a] Summary of risk estimates and RBCLs are only presented for chemicals of potential concern (COPCs) that are risk drivers for at least one receptor.

[b] Maximum detected concentration and 95% UCL on the mean concentration measured in various media collected from Area A sampling locations.

[c] The EPC is based on the lower of the 95% UCL or the maximum detected concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[d] RBCLs are based on a chemical- and medium-specific target risk of 1 x 10^{-5} for carcinogenic risk drivers or a target HQ of 1 for noncarcinogenic risk drivers. It should be noted that chemical- and medium- specific RBCLs presented in this table should be adjusted downward where multiple risk drivers and exposure pathways are present to ensure that the total cumulative site incremental lifetime cancer risk and hazard index do not exceed 1 x 10^{-5} and 1, respectively.

[e] Subsurface soil samples at Area A were analyzed for total chromium only. No suspected sources of hexavalent chromium are present at Area A; however, to be conservative, both total chromium as trivalent chromium and total chromium as hexavalent chromium risks were calculated. ADEC's acceptable risk criterion was exceeded only when total chromium was assumed to be present as hexavalent chromium.

Table 7-4 Summary of Risk-Based Cleanup Levels for Human Receptors - Area C

Medium/Risk Driver[a]	Concentration[b]			Current/Future Site Worker				Current/Future Site Visitor				Hypothetical Future Resident			
				Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]		Risk / Hazard		RBCL [d]	
	Maximum	95% UCL	EPC[c]	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer	Risk	HQ	Cancer	Noncancer
Non-Petroleum Hydrocarbons															
Surface Soil (mg/Kg)															
Benzo(a)pyrene	1.62	NC	1.62	7.7E-06	NA	NC	NA	7.4E-07	NA	NC	NA	**2.2E-05**	NA	0.744	NA

Notes:

% - percent
EPC - exposure point concentration
HQ - hazard quotient
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
RBCL - risk-based cleanup level
UCL - upper confidence limit

Bold indicates exceedance of the Alaska Department of Environmental Conservation's acceptable risk criteria.

[a] Summary of risk estimates and RBCLs are only presented for chemicals of potential concern (COPCs) that are risk drivers for at least one receptor.
[b] Maximum detected concentration and 95% UCL on the mean concentration measured in various media collected from Area C sampling locations.
[c] The EPC is based on the lower of the 95% UCL or the maximum detected concentration.
[d] RBCLs are based on a chemical- and medium-specific target risk of 1 x 10^{-5} for carcinogenic risk drivers or a target HQ of 1 for noncarcinogenic risk drivers. It should be noted that chemical- and medium- specific RBCLs presented in this table should be adjusted downward where multiple risk drivers and exposure pathways are present to ensure that the total cumulative site incremental lifetime cancer risk and hazard index do not exceed 1 x 10^{-5} and 1, respectively.

Table 7-5 Summary of ERBCLs for Ecological Receptors - Upper Site Summit

Risk Driver [a]	EPC[b] Surface Soil (mg/Kg)	Ecological Hazard Estimates and Risk-Based Cleanup Levels											
		Tundra Vole		Masked Shrew		Least Weasel		American Robin		Dark-eyed Junco		Northern Shrike	
		HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]
Inorganics													
Cadmium	9.62	0.36	NC	**4.4**	1.49	0.066	NC	0.17	NC	0.019	NC	0.048	NC
Lead	386	0.45	NC	**1.7**	204	0.28	NC	0.35	NC	0.11	NC	0.072	NC
Polycyclic Aromatic Hydrocarbons (PAHs)													
Benzo(b)fluoranthene	2.37	0.27	NC	**1.3**	1.89	0.0091	NC	0.0013	NC	0.00038	NC	0.00035	NC
Pyrene	3.55	0.92	NC	**1.3**	2.80	0.014	NC	0.059	NC	0.050	NC	0.014	NC
Total Petroleum Hydrocarbons (TPHs)													
Residual Range Organics (RRO)	1,505	**13**	120	**7.3**	207	**5.8**	259	0.042	NC	0.023	NC	0.0028	NC

Notes:

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
ERBCL - ecological risk-based cleanup level
HQ - hazard quotient
mg/Kg - milligrams per kilogram
NC - Not calculated

Bold indicates exceedance of the ADEC's acceptable risk criteria.

[a] Risk drivers are those chemicals for which the chemical-specific HQ exceeds the ADEC and U.S. Environmental Protection Agency hazard criterion of 1, or contribı significantly to a cumulative hazard index greater than 1.

[b] The EPC is the lower of the maximum detected concentration or 95 percent upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[c] Chemical-specific ERBCLs for soil are calculated with a target HQ of 1. It should be noted that these chemical-specific soil ERBCLs presented in this table should be adjus downward where multiple risk drivers and exposure media are present to ensure that the total cumulative site hazard does not exceed 1 for individual target effects.

Table 7-6 Summary of ERBCLs for Ecological Receptors - Lower Site Summit

Risk Driver [a]	EPC[b] Surface Soil (mg/Kg)	Ecological Hazard Estimates and Risk-Based Cleanup Levels											
		Tundra Vole		Masked Shrew		Least Weasel		American Robin		Dark-eyed Junco		Northern Shrike	
		HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]
Inorganics													
Cadmium	2.82	0.18	NC	**1.7**	1.49	0.033	NC	0.31	NC	0.042	NC	0.089	NC
Semi-Volatile Organic Compounds (SVOCs)													
bis(2-ethylhexyl) Phthalate	5.44	0.0016	NC	**2.4**	2.26	0.00075	NC	**9.9**	0.549	0.012	NC	**2.9**	1.85
Pentachlorophenol	46.5	**4.2**	10.9	**6.1**	7.67	0.015	NC	**2.7**	17.1	**2.1**	22.5	0.68	NC
Polycyclic Aromatic Hydrocarbons (PAHs)													
Benzo(a)anthracene	7.98	0.15	NC	**2.6**	3.07	0.031	NC	0.013	NC	0.0010	NC	0.0036	NC
Benzo(a)pyrene	7.74	0.39	NC	**2.1**	3.67	0.030	NC	0.011	NC	0.0025	NC	0.0029	NC
Benzo(b)fluoranthene	8.66	1.0	NC	**4.6**	1.89	0.033	NC	0.023	NC	0.0062	NC	0.0063	NC
Chrysene	9.55	0.17	NC	**4.5**	2.14	0.037	NC	0.022	NC	0.0012	NC	0.0062	NC
Dibenz(a,h)anthracene	6.12	0.33	NC	**2.9**	2.13	0.024	NC	0.014	NC	0.0021	NC	0.0040	NC
Indeno(1,2,3-c,d)Pyrene	2.42	0.28	NC	**1.4**	1.72	0.0093	NC	--	NC	--	NC	--	NC
Pyrene	17.1	**4.4**	3.86	**6.1**	2.80	0.066	NC	**1.4**	12.1	**1.1**	16.0	0.34	NC
Total Petroleum Hydrocarbons (TPHs)													
Residual range organics (RRO)	4,601	**38**	120	**22**	207	**17**	270	0.64	NC	0.32	NC	0.042	NC

Notes:

% - percent
-- not available
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
ERBCL - ecological risk-based cleanup levels
HQ - hazard quotient
mg/Kg - milograms per kilogram
NC - Not calculated

Bold indicates exceedance of the ADEC's acceptable risk criteria.

[a] Risk drivers are those chemicals for which the chemical specific HQ exceeds the ADEC and U.S. Environmental Protection Agency hazard criterion of 1, or contribute significa to a cumulative hazard index greater than 1.

[b] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[c] Chemical-specific ERBCLs for soil are calculated with a target HQ of 1. It should be noted that these chemical-specific soil ERBCLs presented in this table should be adjus downward where multiple risk drivers and exposure media are present to ensure that the total cumulative site hazard does not exceed 1 for individual target effects.

Table 7-7 Summary of ERBCLs for Ecological Receptors - Area A

Risk Driver [a]	EPC[b] Surface Soil (mg/Kg)	Ecological Hazard Estimates and Risk-Based Cleanup Levels											
		Tundra Vole		Masked Shrew		Least Weasel		American Robin		Dark-eyed Junco		Northern Shrike	
		HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]	HQ	ERBCL [c]
Total Petroleum Hydrocarbons (TPHs)													
Residual range organics (RRO)	63,887	**533**	NC	**309**	NC	**129**	496	0.72	NC	0.39	NC	0.048	NC

Notes:
% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
ERBCL - ecological risk-based cleanup level
HQ - hazard quotient
mg/Kg - milograms per kilogram
NC - Not calculated

Bold indicates exceedance of the ADEC's acceptable risk criteria.

[a] Risk drivers are those chemicals for which the chemical specific HQ exceeds the ADEC and U.S. Environmental Protection Agency hazard criterion of 1, or contribute significantly to a cumulative hazard index greater than 1.

[b] The EPC is the lower of the maximum detected concentration or 95% upper confidence limit on the mean concentration measured in soil samples. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[c] Chemical-specific ERBCLs for soil are calculated with a target HQ of 1. It should be noted that these chemical-specific soil ERBCLs presented in this table should be adjus downward where multiple risk drivers and exposure media are present to ensure that the total cumulative site hazard does not exceed 1 for individual target effects.

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8.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 1999a. User's Guide for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions. Contaminated Sites Remediation Program. June.

ADEC. 1999b. Technical Background Document for Selection and Application of Default Assessment Endpoints and Indicator Species in Alaskan Ecoregions. Contaminated Sites Remediation Program. June.

ADEC. 2000. Guidance for Cleanup of Petroleum Contaminated Sites. ADEC, Division of Spill Prevention and Response, Contaminated Sites Remediation Program.

ADEC. 2008a. Guidelines for Data Reporting, Data Reduction, and Treatment of Non-detect Values. Contaminated Sites Program. Technical Memorandum – 08-001. August 12.

ADEC. 2008b. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. December.

ADEC. 2008c. Cumulative Risk Guidance. June.

ADEC. 2008d. Cleanup Levels Guidance. Division of Spill Prevention and Response. Contaminated Sites Program. June 9.

ADEC. 2009a. Ecoscoping Guidance. Division of Spill Prevention and Response. Contaminated Site Program. March.

ADEC. 2009b. Draft Vapor Intrusion Guidance for Contaminated Sites. Division of Spill Prevention and Response. Contaminated Site Program. July.

ADEC. 2010. Policy Guidance on Developing Conceptual Site Models. ADEC. Division of Spill Prevention and Response. Contaminated Sites Program. October.

ADEC. 2011a. Risk Assessment Procedures Manual. ADEC, Division of Spill Prevention and Response. Contaminated Sites Program. November.

ADEC. 2011b. Oil and Other Hazardous Substances Pollution Control – 18 AAC 75. Revised as of October 1.

ADEC. 2011c. Water Quality Standards – 18 AAC 70. Amended as of May 26.

Alaska Department of Fish and Game (ADF&G). 2006. Wildlife Notebook Series. http://www.adfg.state.ak.us/pubs/nortebook/furber/weasels.php.

ADF&G. 2008. Wildlife Notebook Series: Small Game. Accessed July 2011 at http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries.

Agency for Toxic Substances and Disease Registry (ATSDR). 2010. Minimal Risk Levels (MRLs) for Hazardous Substances. http://www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_december_2010.pdf

Baes, C. F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor (Baes et al.). 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. ORNL-5786. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Bechtel Jacobs Company LLC (Bechtel Jacobs). 1998a. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. September 1998.

Bechtel Jacobs. 1998b. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. 1998.

Beyer, W.N., E. Connor, and S. Gerould (Beyer et al.). 1994. Estimates of Soil Ingestion by Wildlife. J. Wildl. Manage. 58:375-382.

Buchman, M.F. 2008. NOAA Screening Quick Reference Tables. NOAA OR&R Report 08-1, Seattle, WA. Office of Response and Restoration Division. National Oceanic and Atmospheric Administration. 34 pages.

California Department of Fish & Game (CDF&G). 2009. California Wildlife Habitat Relationship System. http://www.dfg.ca.gov/biogeodata/swhr/cawildlife.aspx.

California Regional Water Quality Control Board (CARWQCB). 2008. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/available_documents/ESL_May_2008.pdf

CH2M Hill. 2005. Technical Memorandum Literature-derived Bioaccumulation Models for Energetic Compounds in Plants and Soil Invertebrates. June.

Cornell Lab of Ornithology (Cornell). 2009. http://www.birds.cornell.edu.

Dowl/Ogden Joint Venture (Dowl/Ogden). 1996. Final Site Assessment Report Two-Party Non-UST POL Preliminary Assessment/Site Investigation. Fort Richardson, Alaska.

Dowl/Ogden. 1998. Former Nike Hercules Missile Site and Former Radio Relay Station "Opportunity Strikes" Site Summit.

Ecology and Environment Inc. (E&E). 2000. Risk Assessment Work Plan Site Summit Fort Richardson, Alaska.

Efroymson, R.A., B.E. Sample, G.W. Suter (Efroymson et al.). 2001. Uptake of Inorganic Chemicals from Soil by Plant Leaves: Regression of Field Data. April. Environmental Toxicology and Chemistry 20(11):2561-2571.

Idaho State University (ISU). 2000. Idaho Museum of Natural History Digital Atlas. Accessed July 2011 at http://imnh.isu.edu/digitalatlas/bio/mammal/Rod/Mice/nble/nble.htm.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger (MacDonald et al.). 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology. January.

MacDonald, S.O. 2003. Amphibians and Reptiles of Alaska: A Field Handbook. April.

Menzie, C., J. Cuira, J. Freshman, and S. Svirshy (Menzie et al.). 1992. Evaluating Ecological Risks and Developing Remedial Objectives at Forested Wetland Systems in New England. In: Application of Ecological Risk Assessment to Hazardous Waste Site Remediation, Water Environment Federation, Alexandria, VA. Pp. 89-100.

Nagy, K.A. 2001. Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles and Birds. Nutrition Abstracts and Reviews, Series B 71, 21R-31R.

National Audubon Society (NAS). 1996. Field Guide to North American Mammals. Chanticleer Press Inc., New York.

New Jersey Department of Environmental Protection (NJDEP). 2009. Derivation of Ingestion-Based Soil Remediation Criterion for Cr+6 based on the NTP Chronic Bioassay Data for Sodium Dichromate Dihydrate. http://www.state.nj.us/dep/dsr/chromium/soil-cleanup-derivation.pdf

Office of Environmental Health Hazard Assessment (OEHHA). 2012. Toxicity Criteria Database. California Environmental Protection Agency.

Oak Ridge National Laboratory (ORNL). 1996a. Toxicological Benchmarks for Wildlife: 1996 Revision. U.S. Department of Energy, Oak Ridge National Laboratory (ORNL). Oak Ridge, Tennessee. June.

ORNL. 1996b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Aquatic Biota: 1996 Revision. U.S. Department of Energy, Oak Ridge National Laboratory (ORNL). Oak Ridge, Tennessee. November.

ORNL. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision. U.S. Department of Energy, Oak Ridge National Laboratory (ORNL). Oak Ridge, Tennessee.

ORNL. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. U.S. Department of Energy, Oak Ridge National Laboratory (ORNL). Oak Ridge, Tennessee.

ORNL. 1997c. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997. U.S. Department of Energy, Oak Ridge National Laboratory (ORNL). Oak Ridge, Tennessee. November. Office of Environmental Health Hazard Assessment (OEHHA). 2011. Toxicity Criteria Database, online at http://www.oehha.ca.gov/risk/ChemicalDB/index.asp.

ORNL. 2011. Risk Assessment Information System, online at http://rais.ornl.gov/.

Patton, J. F. and M. P. Dieter. 1980. Effects of Petroleum Hydrocarbons on Hepatic Function in the Duck. Comparative Biochemistry and Physiology Part C: Comparative Pharmacology 65(1):33-36.

Rigdon, R.H. and Neal, J. 1963. Fluorescence of Chickens and Eggs Following the Feeding of Benzpyrene Crystals. Texas Reports on Biology and Medicine. 21(4):558-566.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, and T.L. Ashwood (Sample et al.). 1998. Development and Validation of Bioaccumulation Models for Small Mammals.

Schafer, E.W., W.A. Bowles, J. Hurlbut (Schafer et al.). 1983. The Acute Oral Toxicity, Repellency, and Hazard Potential of 998 Chemicals to One or More Species of Wild and Domestic Birds. Archives of Environmental Contamination and Toxicology 12:355-382.

University of Alaska Museum of the North Herbarium Collection (UAM). 2010. Searchable by geographic location online at: http://arctos.database.museum/home.cfm.

University of Michigan (UM). 2006. Museum of Zoology. http://animaldiversity.ummz.umich.edu/index.html.

U.S. Air Force (USAF). 2012a. Nike Site Summit – Remedial Investigation Report – Volume 1 of 3 – Analytical Data Report, Final. May.

USAF. 2012b. Nike Site Summit – Remedial Investigation Report – Volume 2 of 3 – Remedial Field Investigation Report, Final. May.

U.S. Army. 2010. Nike Site Summit – Remedial Investigation/Feasibility Studies and Baseline Risk Assessment Work Plan – Final. August.

U.S. Army Center for Health, Promotion and Preventive Medicine (USACHPPM). 2007. Wildlife Toxicity Assessment for Perchlorate. 87-MA02T6-05D. February.

U.S. Environmental Protection Agency (USEPA). 1988a. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, USEPA/540/G-089/004. October.

USEPA. 1988b. Recommendations for and Documentation of Biological Values for Use in Risk Assessment. Environmental Criteria and Assessment Office, Cincinnati, OH. EPA/600/6-87/008.

USEPA. 1989a. Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part A), Interim Final, USEPA/540/1-89/002. December.

USEPA. 1989b. Risk Assessment Guidance for Superfund (RAGS). Volume II: Environmental Evaluation Manual. Interim Final. USEPA/540/1-89/001A.

USEPA. 1991a. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors.

USEPA. 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Office of Solid Waste and Emergency Response. OSWER Directive 9355.0-30. April 22.

USEPA. 1992a. Guidance for Data Usability in Risk Assessment, Part A. USEPA/540/R-92/003. December.

USEPA. 1992b. Final Exposure Assessment Guidelines. USEPA/600/Z-92/001. May.

USEPA. 1993a. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. USEPA/600/R-93/089. July.

USEPA. 1993b. Wildlife Exposure Factors Handbook. USEPA/600/R-93/187a. December.

USEPA. 1996. Soil Screening Guidance Technical Background Document. EPA/540/R-96/018. July.

USEPA. 1997a. Annual Health Effects Assessment Summary Tables (HEAST) FY 1997. Office of Solid Waste and Emergency Response, Washington DC. USEPA 540/R-94/036.

USEPA. 1997b. Exposure Factors Handbook, Volume I: General Factors. Office of Emergency and Remedial Response. USEPA/600/P-95/002 Fa. August.

USEPA. 1997c. Exposure Factors Handbook, Volume III: Activity Factors. Office of Emergency and Remedial Response. USEPA/600/P-95/002 Fa. August.

USEPA. 1997d. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final. Office of Solid Waste and Emergency Response. USEPA/540-R-97-006; OSWER 9285.7-25; PB97-963211. June.

USEPA. 1998. Guidelines for Ecological Risk Assessment – Final. U.S. Environmental Protection Agency, Risk Assessment Forum. USEPA/630/R-95/002F. April.

USEPA. 1999. Screening Level Ecological Risk Assessment Protocol: Appendix C – Media to Receptor BCF Values. Region 9. August.

USEPA. 2002. Supplemental Soil Screening Guidance. Office of Solid Waste and Emergency Response 9355.4-24. December.

USEPA. 2003. Human Health Toxicity Values in Superfund Risk Assessments. Office of Solid Waste and Emergency Response 9285.7-53. December.

USEPA. 2004a. Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). USEPA/540/R/99/005.

USEPA. 2004b. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February.

USEPA. 2005a. Guidance for Developing Ecological Soil Screening Levels. OSWER Directive 9285.7-55. November 2003. Revised February 2005.

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic. Interim Final. OSWER Directive-9285.7-62. March 2005.

USEPA. 2005c. Ecological Soil Screening Levels for Barium. Interim Final. OSWER Directive-9285.7-63. February 2005.

USEPA. 2005d. Ecological Soil Screening Levels for Cadmium. Interim Final. OSWER Directive-9285.7-65. March 2005.

USEPA. 2005e. Ecological Soil Screening Levels for Lead. Interim Final. OSWER Directive-9285.7-70. March 2005.

USEPA. 2005f. Ecological Soil Screening Levels for Vanadium. Interim Final. OSWER Directive-9285.7-75. March 2005.

USEPA. 2006a. Ecological Soil Screening Levels for Silver. Interim Final. OSWER Directive-9285.7-77. September 2006.

USEPA. 2007a. Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAHs). Interim Final. June.

USEPA. 2007b. Cancer Guidelines and Supplemental Guidance.

USEPA. 2007c. Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. August.

USEPA. 2007d. Ecological Soil Screening Levels for Nickel. Interim Final. OSWER Directive-9285.7-76. March 2007

USEPA. 2007e. Ecological Soil Screening Levels for Selenium. Interim Final. OSWER Directive-9285.7-72. July 2007

USEPA. 2007f. Ecological Soil Screening Levels for Pentachlorophenol. Interim Final. OSWER Directive-9285.7-58. March 2005. Revised April 2007.

USEPA. 2008a. Child-Specific Exposure Factors Handbook, Final Report. October, 2008.

USEPA. 2008b. Estimation Program Interface (EPI) Suite Software (EPI Kow v1.67). http://www.epa.gov/oppt/exposure/pubs/episuite.htm.

USEPA. 2008c. Ecological Soil Screening Levels for Chromium Interim Final. OSWER Directive-9285.7-66. March 2005. Revised April 2008.

USEPA. 2009. Adult Lead Model Spreadsheet. Online: http://www.epa.gov/superfund/lead/products/ALM_2009.xls.

USEPA. 2010a. Screening Toxicity Value Appendices to PPRTVs.

USEPA. 2010b. Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children. Version 1.1 build 11. February, 2010.

USEPA. 2011a. ProUCL Version 4.1.00 Statistical Software Package for Calculating Upper Confidence Limits (UCLs).

USEPA. 2011b. ProUCL Version 4.1 User Guide (Draft): Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041. May.

USEPA. 2011c. Regional Screening Levels. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

USEPA. 2012a. Integrated Risk Information System (IRIS) Database. http://cfpub.epa.gov/ncea/iris/index.cfm.

USEPA. 2012b. Provisional Peer-Reviewed Toxicity Values (PPRTVs). Office of Superfund Remediation and Technology Innovation. http://hhpprtv.ornl.gov/index.shtml

Van Derveer, W.D., and S.P. Canton. 1997. Selenium sediment toxicity thresholds and derivation of water quality criteria for freshwater biota of western streams. Environmental Toxicology and Chemistry. 16(6): 1260-1268.

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APPENDIX A

Human Health Scoping Form

Human Health Conceptual Site Model
Scoping Form

Site Name: Nike Site Summit, Fort Richardson

File Number: __________

Completed by: MWH

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, a CSM graphic and text must be submitted with the site characterization work plan.

General Instructions: Follow the italicized instructions in each section below.

1. *General Information:*

Sources *(check potential sources at the site)*

- ☑ USTs
- ☑ ASTs
- ☑ Dispensers/fuel loading racks
- ☑ Drums
- ☑ Vehicles
- ☑ Landfills
- ☑ Transformers
- ☐ Other: __________

Release Mechanisms *(check potential release mechanisms at the site)*

- ☑ Spills
- ☑ Leaks
- ☑ Direct discharge
- ☑ Burning
- ☐ Other: __________

Impacted Media *(check potentially-impacted media at the site)*

- ☑ Surface soil (0-2 feet bgs*)
- ☑ Subsurface Soil (>2 feet bgs)
- ☑ Air
- ☑ Groundwater
- ☑ Surface water
- ☐ Other: __________

Receptors (*check receptors that could be affected by contamination at the site)*

- ☑ Residents (adult or child)
- ☑ Commercial or industrial worker
- ☐ Construction worker
- ☐ Subsistence harvester (i.e., gathers wild foods)
- ☐ Subsistence consumer (i.e., eats wild foods)
- ☑ Site visitor
- ☑ Trespasser
- ☑ Recreational user
- ☐ Farmer
- ☑ Other: Military Personnel

* bgs – below ground surface

2. *Exposure Pathways:* *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact –

1 Incidental Soil Ingestion

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

If both boxes are checked, label this pathway complete: Complete

2 Dermal Absorption of Contaminants from Soil

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Can the soil contaminants permeate the skin? (Contaminants listed below, or within the groups listed below, should be evaluated for dermal absorption). ☑

Arsenic	Lindane
Cadmium	PAHs
Chlordane	Pentachlorophenol
2,4-dichlorophenoxyacetic acid	PCBs
Dioxins	SVOCs
DDT	

If all of the boxes are checked, label this pathway complete: Complete

b) Ingestion –

1 Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, OR are contaminants expected to migrate to groundwater in the future? ☑

Could the potentially affected groundwater be used as a current or future drinking water source? *Please note, only leave the box unchecked if ADEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350.* ☑

If both the boxes are checked, label this pathway complete: Complete

2 Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water OR are contaminants expected to migrate to surface water in the future? ☑

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? *Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities).* ☑

If both boxes are checked, label this pathway complete: Complete

3 Ingestion of Wild Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild food? ☑

Do the site contaminants have the potential to bioaccumulate (*see* Appendix A)? ☑

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. the top 6 feet of soil, in groundwater that **could be** connected to surface water, etc.) ☑

If all of the boxes are checked, label this pathway complete: Complete

c) Inhalation

1 Inhalation of Outdoor Air

Is soil contaminated anywhere between 0 and 15 feet bgs? ☑

Do people use the site or is there a chance they will use the site in the future? ☑

Are the contaminants in soil volatile (*See Appendix B*)? ☑

If all of the boxes are checked, label this pathway complete: Complete

2 Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be placed on the site in an area that could be affected by contaminant vapors? (i.e., within 100 feet, horizontally or vertically, of the contaminated soil or groundwater, or subject to "preferential pathways" that promote easy airflow, like utility conduits or rock fractures) ☑

Are volatile compounds present in soil or groundwater (*See Appendix C*)? ☑

If both boxes are checked, label this pathway complete: Complete

3. Additional Exposure Pathways: *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- Climate permits recreational use of waters for swimming,
- Climate permits exposure to groundwater during activities, such as construction, without protective clothing, or
- Groundwater or surface water is used for household purposes.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

There is likely some current/future dermal contact with surface water migrating off-site. However, this pathway is expected to be minimal (i.e., related to hand washing and accidental contact). There is also the possibility for future receptors to potentially use collected surface water for potable site uses as it was historically. However, this pathway would be limited to Investigation Area C. The potential for groundwater use as potable water will require further analysis, but remains potentially complete.

Inhalation of Volatile Compounds in Household Water

Exposure from this pathway may need to be assessed only in cases where DEC water-quality or drinking-water standards are not being applied as cleanup levels. Examples of conditions that may warrant further investigation include:

- The contaminated water is used for household purposes such as showering, laundering, and dish washing, <u>and</u>
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix B)

Check the box if further evaluation of this pathway is needed: ☑

Comments:

VOC's have been detected in both surface water and soils, and there is the potential for future potable use at Investigation Area C if surface water is collected for potable use as it was historically. The potential for groundwater use as potable water will require further analysis, but remains potentially complete.

Inhalation of Fugitive Dust

Generally DEC soil ingestion cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway, although this is not true in the case of chromium. Examples of conditions that may warrant further investigation include:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers. This size can be inhaled and would be of concern for determining if this pathway is complete.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

In the listing of preliminary COPCs based on the historical soil data (Ecology and Environment, Inc., 2000), soil exceedances of ADEC Method Two Cleanup Levels were present at the Site, including arsenic, cadmium, chromium, lead, trichloroethylene, benzene, ethylbenzene, total xylenes, diesel range organics (DRO), and gasoline range organics (GRO). Additionally, there were several locations with transformers indicating the possibility of bioaccumulative PCBs presence in media.

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during recreational or some types of subsistence activities. People then incidentally **ingest** sediment from normal hand-to-mouth activities. In addition, **dermal absorption of contaminants** may be of concern if people come in contact with sediment and the contaminants are able to permeate the skin (see dermal exposure to soil section). This type of exposure is rare but it should be investigated if:

- Climate permits recreational activities around sediment, and/or
- Community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

ADEC soil ingestion cleanup levels are protective of direct contact with sediment. If they are determined to be over-protective for sediment exposure at a particular site, other screening levels could be adopted or developed.

Check the box if further evaluation of this pathway is needed: ☑

Comments:

There are drainages at the southern portion of the Site where individuals gather berries. However, sediment pathways are likely to be minimal as individuals only contact surface water and sediments as a means of washing hands or accidental contact. Plant uptake would also likely be minimal as an indirect pathways as there are no subsistence harvesters.

4. Other Comments (*Provide other comments as necessary to support the information provided in this form.)*

APPENDIX A

BIOACCUMULATIVE COMPOUNDS

Table A-1: List of Compounds of Potential Concern for Bioaccumulation

Organic compounds are identified as bioaccumulative if they have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5. Inorganic compounds are identified as bioaccumulative if they are listed as such by EPA (2000). Those compounds in Table X of 18 AAC 75.345 that are bioaccumulative, based on the definition above, are listed below.

Aldrin	DDT	Lead
Arsenic	Dibenzo(a,h)anthracene	Mercury
Benzo(a)anthracene	Dieldrin	Methoxychlor
Benzo(a)pyrene	Dioxin	Nickel
Benzo(b)fluoranthene	Endrin	PCBs
Benzo(k)fluoranthene	Fluoranthene	
Cadmium	Heptachlor	Pyrene
Chlordane	Heptachlor epoxide	Selenium
Chrysene	Hexachlorobenzene	Silver
Copper	Hexachlorocyclopentadiene	Toxaphene
DDD	Indeno(1,2,3-c,d)pyrene	Zinc
DDE		

Because BCF values can relatively easily be measured or estimated, the BCF is frequently used to determine the potential for a chemical to bioaccumulate. A compound with a BCF greater than 1,000 is considered to bioaccumulate in tissue (EPA 2004b).

For inorganic compounds, the BCF approach has not been shown to be effective in estimating the compound's ability to bioaccumulate. Information available, either through scientific literature or site-specific data, regarding the bioaccumulative potential of an inorganic site contaminant should be used to determine if the pathway is complete.

The list was developed by including organic compounds that either have a BCF equal to or greater than 1,000 or a log K_{ow} greater than 3.5 and inorganic compounds that are listed by the United States Environmental Protection Agency (EPA) as being bioaccumulative (EPA 2000). The BCF can also be estimated from a chemical's physical and chemical properties. A chemical's octanol-water partitioning coefficient (K_{ow}) along with defined regression equations can be used to estimate the BCF. EPA's Persistent, Bioaccumulative, and Toxic (PBT) Profiler (EPA 2004) can be used to estimate the BCF using the K_{ow} and linear regressions presented by Meylan et al. (1996). The PBT Profiler is located at http://www.pbtprofiler.net/. For compounds not found in the PBT Profiler, DEC recommends using a log K_{ow} greater than 3.5 to determine if a compound is bioaccumulative.

APPENDIX B

VOLATILE COMPOUNDS

Table B-1: List of Volatile Compounds of Potential Concern
Common volatile contaminants of concern at contaminated sites. A chemical is defined as volatile if the Henry's Law constant is 1×10^{-5} atm-m^3/mol or greater and the molecular weight less than 200 g/mole (g/mole; EPA 2004a). Those compounds in Table X of 18 AAC 75.345 that are volatile, based on the definition above, are listed below.

Acenaphthene	1,4-dichlorobenzene	Pyrene
Acetone	1,1-dichloroethane	Styrene
Anthracene	1,2-dichloroethane	1,1,2,2-tetrachloroethane
Benzene	1,1-dichloroethylene	Tetrachloroethylene
Bis(2-chlorethyl)ether	Cis-1,2-dichloroethylene	Toluene
Bromodichloromethane	Trans-1,2-dichloroethylene	1,2,4-trichlorobenzene
Carbon disulfide	1,2-dichloropropane	1,1,1-trichloroethane
Carbon tetrachloride	1,3-dichloropropane	1,1,2-trichloroethane
Chlorobenzene	Ethylbenzene	Trichloroethylene
Chlorodibromomethane	Fluorene	Vinyl acetate
Chloroform	Methyl bromide	Vinyl chloride
2-chlorophenol	Methylene chloride	Xylenes
Cyanide	Naphthalene	GRO
1,2-dichlorobenzene	Nitrobenzene	DRO

APPENDIX C

COMPOUNDS OF CONCERN FOR VAPOR MIGRATION

Table C-1: List of Compounds of Potential Concern for the Vapor Migration

A chemical is considered sufficiently toxic if the vapor concentration of the pure component poses an incremental lifetime cancer risk greater than 10-6 or a non-cancer hazard index greater than 1. A chemical is considered sufficiently volatile if it's Henry's Law constant is 1 x 10^{-5} atm-m^3/mol or greater.

Acenaphthene	Dibenzofuran	Hexachlorobenzene
Acetaldehyde	1,2-Dibromo-3-chloropropane	Hexachlorocyclopentadiene
Acetone	1,2-Dibromoethane (EDB)	Hexachloroethane
Acetonitrile	1,3-Dichlorobenzene	Hexane
Acetophenone	1,2-Dichlorobenzene	Hydrogen cyanide
Acrolein	1,4-Dichlorobenzene	Isobutanol
Acrylonitrile	2-Nitropropane	Mercury (elemental)
Aldrin	N-Nitroso-di-n-butylamine	Methacrylonitrile
alpha-HCH (alpha-BHC)	n-Propylbenzene	Methoxychlor
Benzaldehyde	o-Nitrotoluene	Methyl acetate
Benzene	o-Xylene	Methyl acrylate
Benzo(b)fluoranthene	p-Xylene	Methyl bromide
Benzylchloride	Pyrene	Methyl chloride chloromethane)
beta-Chloronaphthalene	sec-Butylbenzene	Methylcyclohexane
Biphenyl	Styrene	Methylene bromide
Bis(2-chloroethyl)ether	tert-Butylbenzene	Methylene chloride
Bis(2-chloroisopropyl)ether	1,1,1,2-Tetrachloroethane	Methylethylketone (2-butanone)
Bis(chloromethyl)ether	1,1,2,2-Tetrachloroethane	Methylisobutylketone
Bromodichloromethane	Tetrachloroethylene	Methylmethacrylate
Bromoform	Dichlorodifluoromethane	2-Methylnaphthalene
1,3-Butadiene	1,1-Dichloroethane	MTBE
Carbon disulfide	1,2-Dichloroethane	m-Xylene
Carbon tetrachloride	1,1-Dichloroethylene	Naphthalene
Chlordane	1,2-Dichloropropane	n-Butylbenzene
2-Chloro-1,3-butadiene (chloroprene)	1,3-Dichloropropene	Nitrobenzene
Chlorobenzene	Dieldrin	Toluene
1-Chlorobutane	Endosulfan	trans-1,2-Dichloroethylene
Chlorodibromomethane	Epichlorohydrin	1,1,2-Trichloro-1,2,2-trifluoroethane
Chlorodifluoromethane	Ethyl ether	1,2,4-Trichlorobenzene
Chloroethane (ethyl chloride)	Ethylacetate	1,1,2-Trichloroethane
Chloroform	Ethylbenzene	1,1,1-Trichloroethane
2-Chlorophenol	Ethylene oxide	Trichloroethylene
2-Chloropropane	Ethylmethacrylate	Trichlorofluoromethane
Chrysene	Fluorene	1,2,3-Trichloropropane
cis-1,2-Dichloroethylene	Furan	1,2,4-Trimethylbenzene
Crotonaldehyde (2-butenal)	Gamma-HCH (Lindane)	1,3,5-Trimethylbenzene
Cumene	Heptachlor	Vinyl acetate
DDE	Hexachloro-1,3-butadiene	Vinyl chloride (chloroethene)

Source: EPA 2002.

APPENDIX B

Ecoscoping Form

Attachment B: Ecoscoping Form

Site Name: Nike Site Summit, Fort Richardson
Completed by: MWH
Date: 5-03-10

Instructions: Follow the italicized instructions in each section below. "Off-ramps," where the evaluation ends before completing all of the sections, can be taken when indicated by the instructions. Comment boxes should be used to help support your answers.

1. Direct Visual Impacts and Acute Toxicity

Are direct impacts that may result from the site contaminants evident, or is acute toxicity from high contaminant concentrations suspected? C*heck the appropriate box.*

- ☑ Yes – *describe observations below and evaluate all of the remaining sections without taking any off-ramps.*
- ☐ No – *go to next section.*

Comments:
There appear to be direct impacts at the Site. Both visible staining of soil and disturbed vegetation are present at the Site as indicated in the Draft Conceptual Site Model (DOWL/Ogden, 1998) and Preliminary Assessment/Site Investigation (DOWL/Ogden, 1996).

2. Receptor-Pathway Interactions

Check each terrestrial and aquatic pathways that could occur at the site.

<u>Terrestrial Pathway Interactions</u>

- ☑ Exposure to water-borne contaminants as a result of wading or swimming in contaminated waters or ingesting contaminated water
- ☑ Contaminant uptake in terrestrial plants whose roots are in contact with contaminated surface water
- ☐ Contaminant migration via saturated or unsaturated groundwater zones and discharge at upland "seep" locations (not associated with a wetland or water body)
- ☐ Contaminant uptake by terrestrial plants whose roots are in contact with groundwater present within the root zone
- ☑ Particulates deposited on plants directly or from rain splash
- ☑ Contaminants dissolved into moisture in the soil, making them available to roots
- ☑ Incidental ingestion and/or exposure while animals grub for food, burrow or groom
- ☑ Inhalation of fugitive dust or vapors disturbed by foraging or burrowing activities
- ☑ Bioaccumulatives (see Appendix C) taken up by soil invertebrates, which are in turn eaten by higher food chain organisms
- ☐ Other site-specific exposure pathways

Aquatic Pathway Interactions

- ☑ Contaminated surface runoff migration to water bodies through swales, drainage ditches, or overland flow
- ☑ Aquatic receptors exposed through osmotic exchange, respiration, or ventilation of surface waters
- ☑ Contaminant migration via saturated or unsaturated groundwater zones and discharge at "seep" locations along banks or directly to surface water
- ☐ Deposition into sediments from upwelling of contaminated groundwater
- ☑ Aquatic receptors may be exposed directly to contaminated sediments through foraging or burrowing, or indirectly exposed due to osmotic exchange, respiration, or ventilation of sediment pore water.
- ☐ Aquatic plants rooted in contaminated sediments
- ☑ Bioaccumulatives (see Appendix C) taken up by sediment invertebrates, which are in turn eaten by higher food chain organisms
- ☐ Other site-specific exposure pathways

If any of the above boxes are checked go on to the next section. If none are checked, end the evaluation and check the box below.

- ☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

Ephemeral drainages on the slopes of the Site do not present a large aquatic habitat, and they are too steep for fish. However, there are likely some invertebrates in the sediments or soils near the drainage. Vegetation present in the drainages would probably be terrestrial vegetation with roots in the water and sediments, rather than aquatic vegetation. Surface water and sediments present in the pond at Investigation Area C are the most likely location for aquatic receptors, but this is likely to be limited to invertebrates.

3. Habitat

Check all that may apply. See Ecoscoping Guidance for additional help.

- ☑ Habitat that could be affected by the contamination supports valued species (i.e., species that are regulated, used for subsistence, have ceremonial importance, have commercial value, or provide recreational opportunity)
- ☐ Critical habitat or anadromous stream in an area that could be affected by the contamination
- ☑ Habitat that is important to the region that could be affected by the contamination
- ☑ Contamination is in a park, preserve, or wildlife refuge

If any of the above boxes are checked go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

- ☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:
The slopes surrounding the lower sites have crowberry and blueberry plants, and are used both by potential human recreational receptors and ecological receptors (i.e., brown and black bears, birds, and small mammals) during parts of the year that berries are present.

Drainages from the Site eventually lead to Ship Creek, which is named as anadromous stream 247-50-10060 (ADFG, 2009). However, the downhill drainage extends over a mile and 3,000 ft in elevation before reaching Ship Creek or to a closer tributary which also eventually leads to ship creek. No additional locations are located within several miles which would be considered critical habitat according to the ADFG critical habitat listings (2010).

Additionally, the Site borders the Chugach State Park on three sides. On the northern side of the Site is an alpine marsh, which does not appear to receive drainage from the Site. On the eastern slopes is where the Alpenglow Ski Area is located and where drainages from the Site appear to flow. To the south is Ship Creek where drainages from the eastern slopes eventually reach either directly or via a small stream over 0.5 miles east of the Site.

4. Contaminant Quantity

Check all that may apply. See Ecoscoping Guidance for additional help.

- ☐ Endangered-, threatened-, or species of special concern are present
- ☑ The aquatic environment is or could be affected
- ☑ Non-petroleum contaminants may be present, or the total area of petroleum contaminated surface soil exceeds one-half acre

If any of the above boxes are checked go on to the next scoping factor. If none are checked, end the evaluation and check the box below.

- ☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:
Aquatic habitat at the Site is limited, but may still be affected by Site-related contaminants. Metals, VOCs and petroleum related contaminants (DRO, GRO, PAHs and BTEX) have been detected in soils at the Site.

5. Toxicity Determination

Check all that apply.

- ☑ Bioaccumulative chemicals are present (see Appendix C)
- ☑ Contaminants exceed benchmark levels (see Appendix D)

If either box is checked complete a detailed Ecological Conceptual Site Model (see DEC's Conceptual Site Model Guidance) and submit it with the form to you DEC Project Manager.

If neither box is checked, check the box below and submit this form to your DEC Project Manager.

☐ OFF-RAMP: NO FURTHER ECOLOGICAL EVALUATION NECESSARY

Comments:

In the listing of preliminary COPCs based on historical soil data (Ecology and Environment, Inc., 2000), soil exceedances of ADEC Method Two Cleanup Levels were present at the Site, including: arsenic, cadmium, chromium, lead, trichloroethylene, benzene, ethylbenzene, total xylenes, diesel range organics (DRO) and gasoline range organics (GRO). Although, there were several locations with transformers, bioaccumulative PCBs were not detected infrequently in Site media, and did not exceed Cleanup Levels where detected.

APPENDIX C

ProUCL Output - UPL Concentrations for Background Data

	A–E	F	G–K	L
1		General Background Statistics for Data Sets with Non-Detects		
2	**User Selected Options**			
3	From File	Input.wst		
4	Full Precision	ON		
5	Confidence Coefficient	95%		
6	Coverage	90%		
7	Different or Future K Values	1		
8	Number of Bootstrap Operations	2000		
9				
10				
11	**Arsenic**			
12				
13		**General Statistics**		
14	Total Number of Observations	12	Number of Distinct Observations	12
15	Tolerance Factor	2.21		
16				
17	**Raw Statistics**		**Log-Transformed Statistics**	
18	Minimum	4.44	Minimum	1.4906544
19	Maximum	14.2	Maximum	2.653242
20	Second Largest	10.3	Second Largest	2.3321439
21	First Quartile	6.365	First Quartile	1.8468624
22	Median	6.99	Median	1.9444437
23	Third Quartile	8.17	Third Quartile	2.1004132
24	Mean	7.5525	Mean	1.9737236
25	SD	2.6258163	SD	0.3160019
26	Coefficient of Variation	0.3476751		
27	Skewness	1.5378034		
28				
29		**Background Statistics**		
30	**Normal Distribution Test**		**Lognormal Distribution Test**	
31	Shapiro Wilk Test Statistic	0.8663785	Shapiro Wilk Test Statistic	0.9531746
32	Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
33	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
34				
35	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
36	95% UTL with 90% Coverage	13.355554	95% UTL with 90% Coverage	14.470148
37	95% UPL (t)	12.460718	95% UPL (t)	12.992853
38	90% Percentile (z)	10.917619	90% Percentile (z)	10.790826
39	95% Percentile (z)	11.871584	95% Percentile (z)	12.10357
40	99% Percentile (z)	13.661062	99% Percentile (z)	15.01206
41				
42	**Gamma Distribution Test**		**Data Distribution Test**	
43	k star	7.9658433	**Data appear Normal at 5% Significance Level**	
44	Theta Star	0.9481105		
45	MLE of Mean	7.5525		
46	MLE of Standard Deviation	2.6759307		
47	nu star	191.18024		
48				
49	A-D Test Statistic	0.3853356	**Nonparametric Statistics**	
50	5% A-D Critical Value	0.7303853	90% Percentile	10.102
51	K-S Test Statistic	0.170029	95% Percentile	12.055
52	5% K-S Critical Value	0.2453702	99% Percentile	13.771

Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 90% Coverage	14.2
90% Percentile	11.12026	95% Percentile Bootstrap UTL with 90% Coverage	14.2
95% Percentile	12.423901	95% BCA Bootstrap UTL with 90% Coverage	14.2
99% Percentile	15.12389	95% UPL	14.2
		95% Chebyshev UPL	19.465529
95% WH Approx. Gamma UPL	12.711501	Upper Threshold Limit Based upon IQR	10.8775
95% HW Approx. Gamma UPL	12.76904		
95% WH Approx. Gamma UTL with 90% Coverage	13.918709		
95% HW Approx. Gamma UTL with 90% Coverage	14.033428		

Barium

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.21		
Raw Statistics		**Log-Transformed Statistics**	
Minimum	41.3	Minimum	3.7208625
Maximum	119	Maximum	4.7791235
Second Largest	92.3	Second Largest	4.5250441
First Quartile	65.75	First Quartile	4.1840151
Median	80.35	Median	4.3863361
Third Quartile	90.5	Third Quartile	4.5053207
Mean	77.991667	Mean	4.3228179
SD	20.384462	SD	0.278841
Coefficient of Variation	0.2613672		
Skewness	0.1305701		
Background Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9743105	Shapiro Wilk Test Statistic	0.9550725
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 90% Coverage	123.04133	95% UTL with 90% Coverage	139.63845
95% UPL (t)	116.09463	95% UPL (t)	126.98031
90% Percentile (z)	104.11541	90% Percentile (z)	107.78808
95% Percentile (z)	111.52112	95% Percentile (z)	119.27963
99% Percentile (z)	125.41302	99% Percentile (z)	144.24297
Gamma Distribution Test		**Data Distribution Test**	
k star	11.279025	**Data appear Normal at 5% Significance Level**	
Theta Star	6.9147524		
MLE of Mean	77.991667		
MLE of Standard Deviation	23.222684		
nu star	270.6966		

	A–E	F	G–K	L
105	A-D Test Statistic	0.2600657	**Nonparametric Statistics**	
106	5% A-D Critical Value	0.7310745	90% Percentile	92.24
107	K-S Test Statistic	0.1470905	95% Percentile	104.315
108	5% K-S Critical Value	0.2452906	99% Percentile	116.063
109	**Data appear Gamma Distributed at 5% Significance Level**			
110				
111	**Assuming Gamma Distribution**		95% UTL with 90% Coverage	119
112	90% Percentile	108.83794	95% Percentile Bootstrap UTL with 90% Coverage	119
113	95% Percentile	119.69987	95% BCA Bootstrap UTL with 90% Coverage	116.33
114	99% Percentile	141.90165	95% UPL	119
115			95% Chebyshev UPL	170.47364
116	95% WH Approx. Gamma UPL	122.00698	Upper Threshold Limit Based upon IQR	127.625
117	95% HW Approx. Gamma UPL	123.08036		
118	95% WH Approx. Gamma UTL with 90% Coverage	131.93355		
119	95% HW Approx. Gamma UTL with 90% Coverage	133.57424		
120				
121				
122				
123	**Cadmium**			
124				
125	**General Statistics**			
126	Number of Valid Data	12	Number of Detected Data	5
127	Number of Distinct Detected Data	5	Number of Non-Detect Data	7
128	Tolerance Factor	2.21	Percent Non-Detects	58.33%
129				
130	**Raw Statistics**		**Log-transformed Statistics**	
131	Minimum Detected	0.0712	Minimum Detected	-2.642262
132	Maximum Detected	0.142	Maximum Detected	-1.951928
133	Mean of Detected	0.09204	Mean of Detected	-2.419281
134	SD of Detected	0.029024	SD of Detected	0.2785346
135	Minimum Non-Detect	0.214	Minimum Non-Detect	-1.541779
136	Maximum Non-Detect	0.42	Maximum Non-Detect	-0.867501
137				
138	**Data with Multiple Detection Limits**		**Single Detection Limit Scenario**	
139	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	12
140	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	0
141	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
142				
143				
144	**Warning: There are only 5 Detected Values in this data**			
145	**Note: It should be noted that even though bootstrap may be performed on this data set**			
146	**the resulting calculations may not be reliable enough to draw conclusions**			
147				
148	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
149				
150	**Background Statistics**			
151	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
152	Shapiro Wilk Test Statistic	0.7773638	Shapiro Wilk Test Statistic	0.8325603
153	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
154	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
155				
156	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	

	A	B	C	D	E	F	G	H	I	J	K	L
157					DL/2 Substitution Method						DL/2 Substitution Method	
158					Mean	0.12435					Mean (Log Scale)	-2.135759
159					SD	0.0409765					SD (Log Scale)	0.3378526
160					95% UTL 90% Coverage	0.2149081					95% UTL 90% Coverage	0.2492983
161					95% UPL (t)	0.2009439					95% UPL (t)	0.2221861
162					90% Percentile (z)	0.1768635					90% Percentile (z)	0.1821757
163					95% Percentile (z)	0.1917503					95% Percentile (z)	0.2059666
164					99% Percentile (z)	0.2196756					99% Percentile (z)	0.259293
165												
166					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
167											Mean in Original Scale	0.0902582
168											SD in Original Scale	0.0175727
169											Mean in Log Scale	-2.419281
170											SD in Log Scale	0.1679627
171											95% UTL 90% Coverage	0.1289818
172											95% UPL (t)	0.1218064
173											90% Percentile (z)	0.1103577
174											95% Percentile (z)	0.1173016
175											99% Percentile (z)	0.1315272
176												
177	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
178					k star (bias corrected)	6.1252977	Data appear Normal at 5% Significance Level					
179					Theta Star	0.0150262						
180					nu star	61.252977						
181												
182					A-D Test Statistic	0.5609756	**Nonparametric Statistics**					
183					5% A-D Critical Value	0.6787854					Kaplan-Meier (KM) Method	
184					K-S Test Statistic	0.2761103					Mean	0.09204
185					5% K-S Critical Value	0.3573759					SD	0.0259599
186	**Data appear Gamma Distributed at 5% Significance Level**										SE of Mean	0.0129799
187											95% KM UTL with 90% Coverage	0.1494113
188	**Assuming Gamma Distribution**										95% KM Chebyshev UPL	0.2098169
189					Gamma ROS Statistics with Extrapolated Data						95% KM UPL (t)	0.1405646
190					Mean	0.0940048					90% Percentile (z)	0.1253089
191					Median	0.0954081					95% Percentile (z)	0.1347402
192					SD	0.0175879					99% Percentile (z)	0.1524317
193					k star	26.553415						
194					Theta star	0.0035402	**Gamma ROS Limits with Extrapolated Data**					
195					Nu star	637.28197					95% Wilson Hilferty (WH) Approx. Gamma UPL	0.1272584
196					95% Percentile of Chisquare (2k)	71.117423					95% Hawkins Wixley (HW) Approx. Gamma UPL	0.1273614
197											95% WH Approx. Gamma UTL with 90% Coverage	0.1342691
198					90% Percentile	0.1180102					95% HW Approx. Gamma UTL with 90% Coverage	0.1345305
199					95% Percentile	0.1258854						
200					99% Percentile	0.1415631						
201												
202	**Note: DL/2 is not a recommended method.**											
203												
204												
205	**Chromium, Total**											
206												
207	**General Statistics**											
208					Total Number of Observations	12					Number of Distinct Observations	11

	A–E	F	G–K	L
209	Tolerance Factor	2.21		
210				
211	**Raw Statistics**		**Log-Transformed Statistics**	
212	Minimum	12.2	Minimum	2.501436
213	Maximum	38	Maximum	3.6375862
214	Second Largest	34.3	Second Largest	3.5351454
215	First Quartile	18.8	First Quartile	2.9334664
216	Median	20.5	Median	3.0204249
217	Third Quartile	28.4	Third Quartile	3.345506
218	Mean	23.75	Mean	3.1179723
219	SD	7.7764797	SD	0.331519
220	Coefficient of Variation	0.3274307		
221	Skewness	0.4975684		
222				
223	**Background Statistics**			
224	**Normal Distribution Test**		**Lognormal Distribution Test**	
225	Shapiro Wilk Test Statistic	0.9435446	Shapiro Wilk Test Statistic	0.9629337
226	Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
227	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
228				
229	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
230	95% UTL with 90% Coverage	40.93602	95% UTL with 90% Coverage	47.022642
231	95% UPL (t)	38.285922	95% UPL (t)	41.999299
232	90% Percentile (z)	33.71596	90% Percentile (z)	34.564632
233	95% Percentile (z)	36.541171	95% Percentile (z)	38.988724
234	99% Percentile (z)	41.840797	99% Percentile (z)	48.87181
235				
236	**Gamma Distribution Test**		**Data Distribution Test**	
237	k star	7.7373643	**Data appear Normal at 5% Significance Level**	
238	Theta Star	3.0695207		
239	MLE of Mean	23.75		
240	MLE of Standard Deviation	8.5382151		
241	nu star	185.69674		
242				
243	A-D Test Statistic	0.3197033	**Nonparametric Statistics**	
244	5% A-D Critical Value	0.7303378	90% Percentile	33.92
245	K-S Test Statistic	0.221691	95% Percentile	35.965
246	5% K-S Critical Value	0.2453756	99% Percentile	37.593
247	**Data appear Gamma Distributed at 5% Significance Level**			
248				
249	**Assuming Gamma Distribution**		95% UTL with 90% Coverage	38
250	90% Percentile	35.1372	95% Percentile Bootstrap UTL with 90% Coverage	38
251	95% Percentile	39.31196	95% BCA Bootstrap UTL with 90% Coverage	37.63
252	99% Percentile	47.968509	95% UPL	38
253			95% Chebyshev UPL	59.031001
254	95% WH Approx. Gamma UPL	40.281456	Upper Threshold Limit Based upon IQR	42.8
255	95% HW Approx. Gamma UPL	40.648773		
256	95% WH Approx. Gamma UTL with 90% Coverage	44.15836		
257	95% HW Approx. Gamma UTL with 90% Coverage	44.761709		
258				
259				
260				

	A–E	F	G–K	L
261	**Lead**			
262				
263	**General Statistics**			
264	Total Number of Observations	12	Number of Distinct Observations	12
265	Tolerance Factor	2.21		
266				
267	**Raw Statistics**		**Log-Transformed Statistics**	
268	Minimum	5.09	Minimum	1.6272778
269	Maximum	12.5	Maximum	2.5257286
270	Second Largest	9.39	Second Largest	2.2396453
271	First Quartile	6.0175	First Quartile	1.7945963
272	Median	7.705	Median	2.0416115
273	Third Quartile	8.5225	Third Quartile	2.1424528
274	Mean	7.6783333	Mean	2.0063694
275	SD	2.0840731	SD	0.2622698
276	Coefficient of Variation	0.2714226		
277	Skewness	0.930979		
278				
279	**Background Statistics**			
280	**Normal Distribution Test**		**Lognormal Distribution Test**	
281	Shapiro Wilk Test Statistic	0.9273982	Shapiro Wilk Test Statistic	0.9623195
282	Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
283	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
284				
285	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
286	95% UTL with 90% Coverage	12.284135	95% UTL with 90% Coverage	13.276369
287	95% UPL (t)	11.573916	95% UPL (t)	12.141245
288	90% Percentile (z)	10.34918	90% Percentile (z)	10.407031
289	95% Percentile (z)	11.106329	95% Percentile (z)	11.447425
290	99% Percentile (z)	12.526612	99% Percentile (z)	13.687735
291				
292	**Gamma Distribution Test**		**Data Distribution Test**	
293	k star	11.885844	**Data appear Normal at 5% Significance Level**	
294	Theta Star	0.6460066		
295	MLE of Mean	7.6783333		
296	MLE of Standard Deviation	2.2271627		
297	nu star	285.26026		
298				
299	A-D Test Statistic	0.242184	**Nonparametric Statistics**	
300	5% A-D Critical Value	0.7312007	90% Percentile	9.337
301	K-S Test Statistic	0.1268729	95% Percentile	10.7895
302	5% K-S Critical Value	0.2452761	99% Percentile	12.1579
303	**Data appear Gamma Distributed at 5% Significance Level**			
304				
305	**Assuming Gamma Distribution**		95% UTL with 90% Coverage	12.5
306	90% Percentile	10.634904	95% Percentile Bootstrap UTL with 90% Coverage	12.5
307	95% Percentile	11.670689	95% BCA Bootstrap UTL with 90% Coverage	12.5
308	99% Percentile	13.783908	95% UPL	12.5
309			95% Chebyshev UPL	17.133535
310	95% WH Approx. Gamma UPL	11.884986	Upper Threshold Limit Based upon IQR	12.28
311	95% HW Approx. Gamma UPL	11.941147		
312	95% WH Approx. Gamma UTL with 90% Coverage	12.829954		

	A–E	F	G–K	L
313	95% HW Approx. Gamma UTL with 90% Coverage	12.927356		
314				
315				
316				
317	**Mercury**			
318				
319		**General Statistics**		
320	Number of Valid Data	12	Number of Detected Data	6
321	Number of Distinct Detected Data	6	Number of Non-Detect Data	6
322	Tolerance Factor	2.21	Percent Non-Detects	50.00%
323				
324	**Raw Statistics**		**Log-transformed Statistics**	
325	Minimum Detected	0.0243	Minimum Detected	-3.717279
326	Maximum Detected	0.0754	Maximum Detected	-2.584948
327	Mean of Detected	0.0525167	Mean of Detected	-3.013641
328	SD of Detected	0.0191839	SD of Detected	0.4218964
329	Minimum Non-Detect	0.0439	Minimum Non-Detect	-3.125841
330	Maximum Non-Detect	0.0473	Maximum Non-Detect	-3.051245
331				
332	**Data with Multiple Detection Limits**		**Single Detection Limit Scenario**	
333	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	8
334	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	4
335	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	66.67%
336				
337				
338		**Warning: There are only 6 Detected Values in this data**		
339		**Note: It should be noted that even though bootstrap may be performed on this data set**		
340		**the resulting calculations may not be reliable enough to draw conclusions**		
341				
342		**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**		
343				
344		**Background Statistics**		
345	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
346	Shapiro Wilk Test Statistic	0.9709794	Shapiro Wilk Test Statistic	0.9281676
347	5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
348	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
349				
350	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
351	DL/2 Substitution Method		DL/2 Substitution Method	
352	Mean	0.037625	Mean (Log Scale)	-3.398906
353	SD	0.0202323	SD (Log Scale)	0.4930526
354	95% UTL 90% Coverage	0.0823383	95% UTL 90% Coverage	0.0993347
355	95% UPL (t)	0.0754435	95% UPL (t)	0.0839709
356	90% Percentile (z)	0.0635537	90% Percentile (z)	0.0628481
357	95% Percentile (z)	0.0709041	95% Percentile (z)	0.0751772
358	99% Percentile (z)	0.0846923	99% Percentile (z)	0.1051997
359				
360	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
361	Mean	0.0383957	Mean in Original Scale	0.0414929
362	SD	0.0221087	SD in Original Scale	0.0175478
363	95% UTL with 90% Coverage	0.0872559	95% UTL with 90% Coverage	0.0917175
364			95% BCA UTL with 90% Coverage	0.07472

	A–F	F	G–K	L
365			95% Bootstrap (%) UTL with 90% Coverage	0.0754
366	95% UPL (t)	0.0797216	95% UPL (t)	0.0802359
367	90% Percentile (z)	0.0667291	90% Percentile (z)	0.0637098
368	95% Percentile (z)	0.0747612	95% Percentile (z)	0.073473
369	99% Percentile (z)	0.0898282	99% Percentile (z)	0.0960026
370				
371	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
372	k star (bias corrected)	3.9229516	Data appear Normal at 5% Significance Level	
373	Theta Star	0.013387		
374	nu star	47.07542		
375				
376	A-D Test Statistic	0.2476694	**Nonparametric Statistics**	
377	5% A-D Critical Value	0.6981969	Kaplan-Meier (KM) Method	
378	K-S Test Statistic	0.1762938	Mean	0.0418583
379	5% K-S Critical Value	0.3326273	SD	0.0170513
380	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0062126
381			95% KM UTL with 90% Coverage	0.0795417
382	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	0.1192182
383	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.0737309
384	Mean	0.0417386	90% Percentile (z)	0.0637105
385	Median	0.0391997	95% Percentile (z)	0.0699053
386	SD	0.0181135	99% Percentile (z)	0.0815256
387	k star	4.5605232		
388	Theta star	0.0091522	**Gamma ROS Limits with Extrapolated Data**	
389	Nu star	109.45256	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.0809536
390	95% Percentile of Chisquare (2k)	17.088171	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.082021
391			95% WH Approx. Gamma UTL with 90% Coverage	0.0907641
392	90% Percentile	0.0679198	95% HW Approx. Gamma UTL with 90% Coverage	0.0925934
393	95% Percentile	0.0781968		
394	99% Percentile	0.1000075		
395				
396	**Note: DL/2 is not a recommended method.**			
397				
398				
399	**Nickel**			
400				
401	**General Statistics**			
402	Total Number of Observations	12	Number of Distinct Observations	11
403	Tolerance Factor	2.21		
404				
405	**Raw Statistics**		**Log-Transformed Statistics**	
406	Minimum	8.67	Minimum	2.1598688
407	Maximum	28.6	Maximum	3.3534067
408	Second Largest	27.9	Second Largest	3.3286267
409	First Quartile	17.7	First Quartile	2.8731235
410	Median	20.4	Median	3.0149458
411	Third Quartile	24.4	Third Quartile	3.1926337
412	Mean	20.739167	Mean	2.9901501
413	SD	5.654222	SD	0.3222655
414	Coefficient of Variation	0.272635		
415	Skewness	-0.468501		
416				

	A–E	F	G–K	L
417	**Background Statistics**			
418	**Normal Distribution Test**		**Lognormal Distribution Test**	
419	Shapiro Wilk Test Statistic	0.9440092	Shapiro Wilk Test Statistic	0.8627602
420	Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
421	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
422				
423	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
424	95% UTL with 90% Coverage	33.234997	95% UTL with 90% Coverage	40.542741
425	95% UPL (t)	31.30813	95% UPL (t)	36.326006
426	90% Percentile (z)	27.985344	90% Percentile (z)	30.058632
427	95% Percentile (z)	30.039534	95% Percentile (z)	33.792186
428	99% Percentile (z)	33.892854	99% Percentile (z)	42.091745
429				
430	**Gamma Distribution Test**		**Data Distribution Test**	
431	k star	9.1342271	**Data appear Normal at 5% Significance Level**	
432	Theta Star	2.2704895		
433	MLE of Mean	20.739167		
434	MLE of Standard Deviation	6.862074		
435	nu star	219.22145		
436				
437	A-D Test Statistic	0.4148713	**Nonparametric Statistics**	
438	5% A-D Critical Value	0.7306284	90% Percentile	27.82
439	K-S Test Statistic	0.187452	95% Percentile	28.215
440	5% K-S Critical Value	0.2453421	99% Percentile	28.523
441	**Data appear Gamma Distributed at 5% Significance Level**			
442				
443	**Assuming Gamma Distribution**		95% UTL with 90% Coverage	28.6
444	90% Percentile	29.875052	95% Percentile Bootstrap UTL with 90% Coverage	28.6
445	95% Percentile	33.162911	95% BCA Bootstrap UTL with 90% Coverage	28.53
446	99% Percentile	39.935997	95% UPL	28.6
447			95% Chebyshev UPL	46.391727
448	95% WH Approx. Gamma UPL	33.893699	Upper Threshold Limit Based upon IQR	34.45
449	95% HW Approx. Gamma UPL	34.397238		
450	95% WH Approx. Gamma UTL with 90% Coverage	36.918726		
451	95% HW Approx. Gamma UTL with 90% Coverage	37.654463		
452				
453				
454				
455	**Selenium**			
456				
457	**General Statistics**			
458	Number of Valid Data	12	Number of Detected Data	11
459	Number of Distinct Detected Data	11	Number of Non-Detect Data	1
460	Tolerance Factor	2.21	Percent Non-Detects	8.33%
461				
462	**Raw Statistics**		**Log-transformed Statistics**	
463	Minimum Detected	0.29	Minimum Detected	-1.237874
464	Maximum Detected	0.959	Maximum Detected	-0.041864
465	Mean of Detected	0.4972727	Mean of Detected	-0.769105
466	SD of Detected	0.2093715	SD of Detected	0.3817241
467	Minimum Non-Detect	0.516	Minimum Non-Detect	-0.661649
468	Maximum Non-Detect	0.516	Maximum Non-Detect	-0.661649

	A	B	C	D	E	F	G	H	I	J	K	L
469												
470												
471						Background Statistics						
472	Normal Distribution Test with Detected Values Only						Lognormal Distribution Test with Detected Values Only					
473					Shapiro Wilk Test Statistic	0.8549468					Shapiro Wilk Test Statistic	0.9161153
474					5% Shapiro Wilk Critical Value	0.85					5% Shapiro Wilk Critical Value	0.85
475	Data appear Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level					
476												
477	Assuming Normal Distribution						Assuming Lognormal Distribution					
478					DL/2 Substitution Method						DL/2 Substitution Method	
479					Mean	0.4773333					Mean (Log Scale)	-0.817913
480					SD	0.2112398					SD (Log Scale)	0.4013137
481					95% UTL 90% Coverage	0.9441732					95% UTL 90% Coverage	1.0714263
482					95% UPL (t)	0.8721861					95% UPL (t)	0.9344749
483					90% Percentile (z)	0.748048					90% Percentile (z)	0.7381499
484					95% Percentile (z)	0.8247918					95% Percentile (z)	0.8540118
485					99% Percentile (z)	0.9687505					99% Percentile (z)	1.1226397
486												
487					Maximum Likelihood Estimate(MLE) Method						Log ROS Method	
488					Mean	0.3912633					Mean in Original Scale	0.4874423
489					SD	0.3052831					SD in Original Scale	0.2025116
490					95% UTL with 90% Coverage	1.0659389					95% UTL with 90% Coverage	1.0290555
491											95% BCA UTL with 90% Coverage	0.959
492											95% Bootstrap (%) UTL with 90% Coverage	0.959
493					95% UPL (t)	0.9619034					95% UPL (t)	0.9076053
494					90% Percentile (z)	0.7824993					90% Percentile (z)	0.7308739
495					95% Percentile (z)	0.8934093					95% Percentile (z)	0.8355804
496					99% Percentile (z)	1.1014579					99% Percentile (z)	1.0741379
497												
498	Gamma Distribution Test with Detected Values Only						Data Distribution Test with Detected Values Only					
499					k star (bias corrected)	5.3376884	Data appear Normal at 5% Significance Level					
500					Theta Star	0.0931626						
501					nu star	117.42914						
502												
503					A-D Test Statistic	0.5512416	Nonparametric Statistics					
504					5% A-D Critical Value	0.7304896					Kaplan-Meier (KM) Method	
505					K-S Test Statistic	0.2514429					Mean	0.486119
506					5% K-S Critical Value	0.2557203					SD	0.195104
507	Data appear Gamma Distributed at 5% Significance Level										SE of Mean	0.0592183
508											95% KM UTL with 90% Coverage	0.9172988
509	Assuming Gamma Distribution										95% KM Chebyshev UPL	1.3712835
510					Gamma ROS Statistics with Extrapolated Data						95% KM UPL (t)	0.8508105
511					Mean	0.4909287					90% Percentile (z)	0.7361548
512					Median	0.4165723					95% Percentile (z)	0.8070365
513					SD	0.2008339					99% Percentile (z)	0.9399987
514					k star	5.8923234						
515					Theta star	0.0833167	Gamma ROS Limits with Extrapolated Data					
516					Nu star	141.41576					95% Wilson Hilferty (WH) Approx. Gamma UPL	0.8884106
517					95% Percentile of Chisquare (2k)	20.736475					95% Hawkins Wixley (HW) Approx. Gamma UPL	0.8928652
518											95% WH Approx. Gamma UTL with 90% Coverage	0.9847665
519					90% Percentile	0.7613461					95% HW Approx. Gamma UTL with 90% Coverage	0.9943296
520					95% Percentile	0.8638469						

99% Percentile	1.0788468		
Note: DL/2 is not a recommended method.			
Silver			
General Statistics			
Number of Valid Data	12	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	3
Tolerance Factor	2.21	Percent Non-Detects	25.00%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0337	Minimum Detected	-3.390257
Maximum Detected	0.166	Maximum Detected	-1.795767
Mean of Detected	0.0815333	Mean of Detected	-2.588511
SD of Detected	0.0369494	SD of Detected	0.4268354
Minimum Non-Detect	0.107	Minimum Non-Detect	-2.234926
Maximum Non-Detect	0.112	Maximum Non-Detect	-2.189256
Data with Multiple Detection Limits		**Single Detection Limit Scenario**	
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	11
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	91.67%
Warning: There are only 9 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
Background Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.83423	Shapiro Wilk Test Statistic	0.9169111
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0747333	Mean (Log Scale)	-2.669596
SD	0.0338323	SD (Log Scale)	0.3926124
95% UTL 90% Coverage	0.1495028	95% UTL 90% Coverage	0.1649814
95% UPL (t)	0.1379733	95% UPL (t)	0.1443205
90% Percentile (z)	0.1180912	90% Percentile (z)	0.1145845
95% Percentile (z)	0.1303826	95% Percentile (z)	0.1321515
99% Percentile (z)	0.1534391	99% Percentile (z)	0.1726925
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
		Mean in Original Scale	0.077803
		SD in Original Scale	0.0325146
		Mean in Log Scale	-2.620616

	A–E	F	G–K	L
573			SD in Log Scale	0.3746447
574			95% UTL 90% Coverage	0.1665181
575			95% UPL (t)	0.1465595
576			90% Percentile (z)	0.1175973
577			95% Percentile (z)	0.1347438
578			99% Percentile (z)	0.173937
579				
580	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
581	k star (bias corrected)	4.2586399	Data appear Normal at 5% Significance Level	
582	Theta Star	0.0191454		
583	nu star	76.655518		
584				
585	A-D Test Statistic	0.5425219	**Nonparametric Statistics**	
586	5% A-D Critical Value	0.7225021	Kaplan-Meier (KM) Method	
587	K-S Test Statistic	0.2645128	Mean	0.0779502
588	5% K-S Critical Value	0.2797072	SD	0.0317979
589	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0101276
590			95% KM UTL with 90% Coverage	0.1482236
591	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	0.2222137
592	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.1373874
593	Mean	0.0801634	90% Percentile (z)	0.1187009
594	Median	0.0761	95% Percentile (z)	0.1302531
595	SD	0.0322708	99% Percentile (z)	0.1519232
596	k star	5.9138399		
597	Theta star	0.0135552	**Gamma ROS Limits with Extrapolated Data**	
598	Nu star	141.93216	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.1448414
599	95% Percentile of Chisquare (2k)	20.794399	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.1460752
600			95% WH Approx. Gamma UTL with 90% Coverage	0.1604949
601	90% Percentile	0.124238	95% HW Approx. Gamma UTL with 90% Coverage	0.1627023
602	95% Percentile	0.1409364		
603	99% Percentile	0.1759565		
604				
605	**Note: DL/2 is not a recommended method.**			
606				
607				
608	**Vanadium**			
609				
610	**General Statistics**			
611	Total Number of Observations	12	Number of Distinct Observations	11
612	Tolerance Factor	2.21		
613				
614	**Raw Statistics**		**Log-Transformed Statistics**	
615	Minimum	40.5	Minimum	3.701302
616	Maximum	74.3	Maximum	4.308111
617	Second Largest	72.3	Second Largest	4.2808241
618	First Quartile	52.95	First Quartile	3.9678257
619	Median	61.85	Median	4.1247039
620	Third Quartile	69.275	Third Quartile	4.2378991
621	Mean	60.7	Mean	4.0896502
622	SD	10.965815	SD	0.1928271
623	Coefficient of Variation	0.1806559		
624	Skewness	-0.526409		

	A–E	F	G–K	L
625				
626	**Background Statistics**			
627	**Normal Distribution Test**		**Lognormal Distribution Test**	
628	Shapiro Wilk Test Statistic	0.9338504	Shapiro Wilk Test Statistic	0.9132323
629	Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
630	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
631				
632	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
633	95% UTL with 90% Coverage	84.93445	95% UTL with 90% Coverage	91.45052
634	95% UPL (t)	81.197478	95% UPL (t)	85.634284
635	90% Percentile (z)	74.753257	90% Percentile (z)	76.460026
636	95% Percentile (z)	78.73716	95% Percentile (z)	82.008471
637	99% Percentile (z)	86.2103	99% Percentile (z)	93.525402
638				
639	**Gamma Distribution Test**		**Data Distribution Test**	
640	k star	23.195229	**Data appear Normal at 5% Significance Level**	
641	Theta Star	2.6169175		
642	MLE of Mean	60.7		
643	MLE of Standard Deviation	12.603448		
644	nu star	556.68549		
645				
646	A-D Test Statistic	0.4153583	**Nonparametric Statistics**	
647	5% A-D Critical Value	0.7310533	90% Percentile	72.23
648	K-S Test Statistic	0.1701426	95% Percentile	73.2
649	5% K-S Critical Value	0.2451096	99% Percentile	74.08
650	**Data appear Gamma Distributed at 5% Significance Level**			
651				
652	**Assuming Gamma Distribution**		95% UTL with 90% Coverage	74.3
653	90% Percentile	77.308182	95% Percentile Bootstrap UTL with 90% Coverage	74.3
654	95% Percentile	82.80877	95% BCA Bootstrap UTL with 90% Coverage	74.3
655	99% Percentile	93.798991	95% UPL	74.3
656			95% Chebyshev UPL	110.45065
657	95% WH Approx. Gamma UPL	83.830693	Upper Threshold Limit Based upon IQR	93.7625
658	95% HW Approx. Gamma UPL	84.243884		
659	95% WH Approx. Gamma UTL with 90% Coverage	88.748466		
660	95% HW Approx. Gamma UTL with 90% Coverage	89.360577		
661				
662				

APPENDIX D

COPC and COPEC Selection

Table D-1 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration[a] (mg/Kg)	Regulatory Criteria[b] (mg/Kg)	Screening Benchmark[c] (mg/Kg)	COPC?
Inorganics									
Arsenic	14	14	100	19.1	2.16	12.5	4.5	0.45	**Yes**
Barium	14	14	100	1,240	72.2	116	20,300	2,030	No
Cadmium	14	14	100	23.9	0.115	0.141	79	7.9	**Yes**
Chromium, Hexavalent	4	3	75	0.890	0.160	na	300	30	No
Chromium, Total	14	14	100	63.2	16.0	38.0	152,000 [d]	15,200	No
Lead	14	14	100	950	8.85	11.6	400 [e]	400	**Yes**
Mercury	14	14	100	0.815	0.0294	0.0737	18	1.8	No
Nickel	14	14	100	47.6	14.1	28.6	2,000	200	No
Selenium	14	10	71	2.91	0.174	0.959	510	51	No
Silver	14	14	100	38.2	0.0434	0.138	510	51	No
Vanadium	14	14	100	134	18.1	74.3	710	71	**Yes**
Volatile Organic Compounds (VOCs)									
1,2,3-Trichlorobenzene	23	3	13	0.0172	0.000570	na	49	4.9	No
1,2,4-Trichlorobenzene	23	2	9	0.00834	0.000610	na	41	4.1	No
1,2,4-Trimethylbenzene	23	8	35	0.0393	0.000430	na	49	4.9	No
1,3,5-Trimethylbenzene	23	3	13	0.0322	0.00617	na	42	4.2	No
2-Butanone (MEK)	23	2	9	0.00560	0.00330	na	23,300	2,330	No
4-Methyl-2-pentanone(MIBK)	23	2	9	0.00110	0.00100	na	2,100	210	No
Acetone	2	2	100	0.0590	0.0360	na	68,600	6,860	No
Benzene	23	2	9	0.000390	0.000370	na	11	1.1	No
Carbon Disulfide	23	1	4	0.000170	0.000170	na	250	25	No
Dibenzofuran	23	3	13	0.424	0.144	na	200	20	No
Ethylbenzene	23	2	9	0.000210	0.000200	na	110	11	No
Isopropylbenzene	23	1	4	0.000130	0.000130	na	62	6.2	No
m,p-Xylene (Sum of isomers)	23	4	17	0.0302	0.000780	na	63 [f]	6.3	No
Methylene chloride	23	11	48	0.148	0.0267	na	160	16	No
n-Propylbenzene	23	1	4	0.0219	0.0219	na	42	4.2	No
o-Xylene	23	9	39	0.0472	0.000390	na	63 [f]	6.3	No
p-Isopropyltoluene	23	1	4	0.0137	0.0137	na	62 [g]	6.2	No
sec-Butylbenzene	23	1	4	0.000370	0.000370	na	41	4.1	No
Styrene	23	1	4	0.0144	0.0144	na	200	20	No
Toluene	23	7	30	0.0441	0.00100	na	220	22	No
Trichloroethylene (TCE)	23	3	13	0.0173	0.00140	na	0.57	0.057	No
Xylenes, Total	21	2	10	0.0529	0.0422	na	63	6.3	No
Semi-Volatile Organic Compounds (SVOCs)									
4-Chloroaniline	23	2	9	7.80	5.52	na	90	9.0	No
bis(2-ethylhexyl) Phthalate	23	2	9	2.12	0.923	na	220	22	No

Table D-1 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration[a] (mg/Kg)	Regulatory Criteria[b] (mg/Kg)		Screening Benchmark[c] (mg/Kg)	COPC?
Polycyclic Aromatic Hydrocarbons (PAHs)										
2-Methylnaphthalene	23	2	9	0.112	0.109	na	280		28	No
Acenaphthene	23	4	17	1.49	0.125	na	2,800		280	No
Acenaphthylene	23	1	4	0.783	0.783	na	2,800		280	No
Anthracene	23	8	35	2.30	0.108	na	20,600		2,060	No
Benzo(a)anthracene	23	10	43	8.61	0.0944	na	4.9		0.49	**Yes**
Benzo(a)pyrene	23	8	35	5.75	0.197	na	0.49		0.049	**Yes**
Benzo(b)fluoranthene	23	8	35	10.6	0.213	na	4.9		0.49	**Yes**
Benzo(g,h,i)perylene	23	7	30	1.96	0.103	na	1,400		140	No
Benzo(k)fluoranthene	23	7	30	4.48	0.0848	na	49		4.9	No
Chrysene	23	10	43	9.72	0.118	na	490		49	No
Dibenz(a,h)anthracene	23	5	22	2.42	0.160	na	0.49		0.049	**Yes**
Fluoranthene	23	11	48	16.0	0.105	na	1,900		190	No
Fluorene	23	4	17	1.14	0.138	na	2,300		230	No
Indeno(1,2,3-c,d)Pyrene	23	8	35	1.88	0.0957	na	4.9		0.49	**Yes**
Naphthalene	23	14	61	0.145	0.000810	na	28		2.8	No
Phenanthrene	23	10	43	8.93	0.124	na	20,600		2,060	No
Pyrene	23	11	48	16.6	0.145	na	1,400		140	No
Polychlorinated Biphenyls (PCBs)										
PCB-1260 (Aroclor 1260)	16	1	6	0.0214	0.0214	na	1	h	0.1	No
Total Petroleum Hydrocarbons										
Diesel Range Organics (DRO)	23	19	83	2,270	6.80	na	10,250	i	10,250	No
Gasoline Range Organics (GRO)	23	2	9	1.80	0.924	na	1,400	i	1,400	No
Residual Range Organics (RRO)	23	23	100	3,330	8.06	na	10,000	i	10,000	No

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background value is equal to the lower of the 95% upper prediction limit or the maximum detected value.

[b] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[d] Total chromium data were compared to the soil screening benchmark for trivalent chromium because hexavalent chromium data are available for soil at the Upper Site Summit.

[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).

[f] Total xylenes used as a surrogate.

[g] Isopropylbenzene used as a surrogate.

[h] PCBs used as a surrogate.

[i] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-2 Selection of Chemicals of Potential Concern for Human Health - Subsurface Soil at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPC?
Inorganics									
Arsenic	21	21	100	6.20	1.32	12.5	4.5	0.45	No
Barium	21	21	100	358	21.7	116	20,300	2,030	No
Cadmium	21	21	100	0.335	0.0701	0.141	79	7.9	No
Chromium, Hexavalent	11	3	27	0.110	0.0900	na	300	30	No
Chromium, Total	21	21	100	46.8	13.2	38.0	152,000 [d]	15,200	No
Lead	21	21	100	50.0	2.07	11.6	400 [e]	400	No
Mercury	21	21	100	0.102	0.0127	0.0737	18	1.8	No
Nickel	21	21	100	29.7	13.0	28.6	2,000	200	No
Selenium	21	18	86	0.423	0.148	0.959	510	51	No
Silver	21	19	90	0.157	0.0314	0.138	510	51	No
Vanadium	21	21	100	102	34.4	74.3	710	71	**Yes**
Volatile Organic Compounds (VOCs)									
1,2,3-Trichlorobenzene	31	2	6	0.0127	0.00888	na	49	4.9	No
1,2,3-Trichloropropane	31	1	3	0.0247	0.0247	na	0.17	0.017	**Yes**
1,2,4-Trichlorobenzene	31	2	6	0.00888	0.00646	na	41	4.1	No
1,2,4-Trimethylbenzene	31	12	39	0.303	0.00845	na	49	4.9	No
1,2-Dibromoethane (EDB)	31	1	3	0.000120	0.000120	na	0.60	0.060	No
1,2-Dichloroethane	31	2	6	0.000190	0.000180	na	4.8	0.48	No
1,3,5-Trimethylbenzene	31	9	29	0.106	0.0103	na	42	4.2	No
Benzene	31	5	16	0.0291	0.00282	na	11	1.1	No
Ethylbenzene	31	2	6	0.0309	0.00849	na	110	11	No
Isopropylbenzene	31	7	23	0.0180	0.0102	na	62	6.2	No
m,p-Xylene (Sum of isomers)	31	8	26	0.146	0.0105	na	63 [f]	6.3	No
Methylene chloride	31	6	19	0.0414	0.0273	na	160	16	No
n-Butylbenzene	31	3	10	0.0696	0.0123	na	42	4.2	No
n-Propylbenzene	31	2	6	0.0300	0.0220	na	42	4.2	No
o-Xylene	31	10	32	0.0580	0.0120	na	63 [f]	6.3	No
p-Isopropyltoluene	31	5	16	0.0805	0.0213	na	62 [g]	6.2	No
sec-Butylbenzene	31	5	16	0.0194	0.00958	na	41	4.1	No
Toluene	31	11	35	0.167	0.00551	na	220	22	No
Trichloroethylene (TCE)	31	15	48	0.0790	0.00570	na	0.57	0.057	**Yes**
Xylenes, Total	31	9	29	0.204	0.0178	na	63	6.3	No
Semi-Volatile Organic Compounds (SVOCs)									
bis(2-ethylhexyl) Phthalate	31	3	10	0.237	0.0994	na	220	22	No

Table D-2 Selection of Chemicals of Potential Concern for Human Health - Subsurface Soil at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPC?
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	31	4	13	0.762	0.104	na	280	28	No
Anthracene	31	2	6	0.865	0.181	na	20,600	2,060	No
Benzo(a)anthracene	31	3	10	3.43	0.268	na	4.9	0.49	**Yes**
Benzo(a)pyrene	31	3	10	3.71	0.231	na	0.49	0.049	**Yes**
Benzo(b)fluoranthene	31	4	13	1.53	0.111	na	4.9	0.49	**Yes**
Benzo(g,h,i)perylene	31	4	13	2.07	0.0865	na	1,400	140	No
Benzo(k)fluoranthene	31	3	10	5.63	0.135	na	49	4.9	**Yes**
Chrysene	31	5	16	8.77	0.0897	na	490	49	No
Dibenz(a,h)anthracene	31	2	6	0.846	0.273	na	0.49	0.049	**Yes**
Fluoranthene	31	5	16	3.97	0.138	na	1,900	190	No
Indeno(1,2,3-c,d)Pyrene	31	3	10	2.09	0.111	na	4.9	0.49	**Yes**
Naphthalene	31	11	35	0.874	0.0140	na	28	2.8	No
Phenanthrene	31	5	16	1.18	0.137	na	20,600	2,060	No
Pyrene	31	6	19	3.77	0.099	na	1,400	140	No
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	31	19	61	3,690	6.45	na	10,250 [h]	10,250	No
Gasoline Range Organics (GRO)	31	14	45	12.7	0.650	na	1,400 [h]	1,400	No
Residual Range Organics (RRO)	31	24	77	3,340	14.2	na	10,000 [h]	10,000	No

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background value is equal to the lower of the 95% upper prediction limit or the maximum detected value.

[b] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1×10^{-6} or a hazard index of 0.1.

[d] Total chromium data were compared to the soil screening benchmark for trivalent chromium because hexavalent chromium data are available for soil at the Upper Site Summit.

[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).

[f] Total xylenes used as a surrogate.

[g] Isopropylbenzene used as a surrogate.

[h] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-3 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration[a] (mg/Kg)	Regulatory Criteria [b] (mg/Kg)	Screening Benchmark [c] (mg/Kg)	COPC?
Inorganics									
Arsenic	34	34	100	19.0	4.14	12.5	4.5	0.45	**Yes**
Barium	34	34	100	330	61.7	116	20,300	2,030	No
Cadmium	34	34	100	15.6	0.0789	0.141	79	7.9	**Yes**
Chromium, Hexavalent	9	5	56	6.80	0.120	na	300	30	No
Chromium, Total	34	34	100	65.0	15.6	38.0	152,000 [d]	15,200	No
Lead	34	34	100	208	6.14	11.6	400 [e]	400	No
Mercury	34	34	100	1.92	0.0229	0.0737	18	1.8	**Yes**
Nickel	34	34	100	49.1	15.9	28.6	2,000	200	No
Selenium	34	27	79	1.34	0.167	0.959	510	51	No
Silver	34	34	100	0.359	0.0452	0.138	510	51	No
Vanadium	34	34	100	59.9	31.4	74.3	710	71	No
Volatile Organic Compounds (VOCs)									
1,1,1-Trichloroethane	37	1	2.7	0.0705	0.0705	na	360	36	No
1,1,2-Trichloroethane	37	1	2.7	0.0149	0.0149	na	11	1.1	No
1,2,3-Trichlorobenzene	37	1	2.7	0.000670	0.000670	na	49	4.9	No
1,2,4-Trichlorobenzene	37	5	14	0.000730	0.000610	na	41	4.1	No
1,2,4-Trimethylbenzene	37	5	14	0.0388	0.0103	na	49	4.9	No
1,3,5-Trimethylbenzene	37	2	5.4	0.0239	0.00853	na	42	4.2	No
2-Butanone (MEK)	37	5	14	0.110	0.00600	na	23,300	2,330	No
2-Hexanone	37	4	11	0.00840	0.00180	na	210	21	No
4-Methyl-2-pentanone(MIBK)	37	5	14	0.00270	0.00110	na	2,100	210	No
Acetone	5	5	100	1.30	0.0670	na	68,600	6,860	No
Benzene	37	4	11	0.000170	0.0000890	na	11	1.1	No
Carbon Disulfide	37	4	11	0.000650	0.000140	na	250	25	No
Dibenzofuran	37	8	22	7.09	0.113	na	200	20	No
Ethylbenzene	37	2	5.4	0.0118	0.00742	na	110	11	No
Isopropylbenzene	37	1	2.7	0.0145	0.0145	na	62	6.2	No
m,p-Xylene (Sum of isomers)	37	5	14	0.0669	0.000190	na	63 [f]	6.3	No
Methylene chloride	37	10	27	0.0683	0.0261	na	160	16	No
n-Butylbenzene	37	1	2.7	0.0123	0.0123	na	42	4.2	No
n-Propylbenzene	37	2	5.4	0.0202	0.0156	na	42	4.2	No
o-Xylene	37	11	30	0.0322	0.0000700	na	63 [f]	6.3	No
p-Isopropyltoluene	37	1	2.7	0.0107	0.0107	na	62 [g]	6.2	No
sec-Butylbenzene	37	2	5.4	0.000390	0.000380	na	41	4.1	No
Toluene	37	9	24	0.0366	0.000120	na	220	22	No
trans-1,3-Dichloropropene	37	1	2.7	0.000270	0.000270	na	83	8.3	No
Trichloroethylene (TCE)	37	11	30	0.290	0.000380	na	0.57	0.057	**Yes**
Xylenes, Total	32	4	13	0.0992	0.0278	na	63	6.3	No
Semi-Volatile Organic Compounds (SVOCs)									
2,4-Dimethylphenol	37	1	2.7	0.210	0.210	na	1,300	130	No
Benzoic Acid	37	2	5.4	1.39	1.16	na	317,000	31,700	No
Benzyl butyl phthalate	37	1	2.7	0.326	0.326	na	2,900	290	No
bis(2-ethylhexyl) Phthalate	37	3	8.1	5.44	0.128	na	220	22	No
Di-n-octylphthalate	37	1	2.7	0.205	0.205	na	3,100	310	No
Pentachlorophenol	37	1	2.7	46.5	46.5	na	39	3.9	**Yes**

Table D-3 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentrationa (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPC?
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	37	5	14	2.44	0.0925	na	280	28	No
Acenaphthene	37	10	27	15.3	0.0855	na	2,800	280	No
Anthracene	37	12	32	26.0	0.0936	na	20,600	2,060	No
Benzo(a)anthracene	37	14	38	37.0	0.0860	na	4.9	0.49	**Yes**
Benzo(a)pyrene	37	14	38	35.7	0.0855	na	0.49	0.049	**Yes**
Benzo(b)fluoranthene	37	12	32	40.1	0.183	na	4.9	0.49	**Yes**
Benzo(g,h,i)perylene	37	13	35	17.1	0.109	na	1,400	140	No
Benzo(k)fluoranthene	37	11	30	10.8	0.182	na	49	4.9	**Yes**
Chrysene	37	12	32	43.4	0.182	na	490	49	No
Dibenz(a,h)anthracene	37	5	14	6.12	0.154	na	0.49	0.049	**Yes**
Fluoranthene	37	21	57	80.6	0.0851	na	1,900	190	No
Fluorene	37	9	24	15.1	0.192	na	2,300	230	No
Indeno(1,2,3-c,d)Pyrene	37	13	35	16.1	0.117	na	4.9	0.49	**Yes**
Naphthalene	37	16	43	2.91	0.000780	na	28	2.8	**Yes**
Phenanthrene	37	20	54	60.1	0.0884	na	20,600	2,060	No
Pyrene	37	21	57	78.0	0.0832	na	1,400	140	No
Polychlorinated Biphenyls (PCBs)									
PCB-1254 (Aroclor 1254)	34	1	2.9	0.0444	0.0444	na	1 [h]	0.1	No
PCB-1260 (Aroclor 1260)	34	4	12	0.0309	0.0236	na	1 [h]	0.1	No
Energetics									
Perchlorate	8	3	38	0.000430	0.000200	na	71	7.1	No
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	37	29	78	7,360	7.81	na	10,250 [i]	10,250	No
Gasoline Range Organics (GRO)	29	10	34	14.5	0.454	na	1,400 [i]	1,400	No
Residual Range Organics (RRO)	37	36	97	24,400	11.0	na	10,000 [i]	10,000	**Yes**

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.
[b] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.
[d] Total chromium data were compared to the soil screening benchmark for trivalent chromium because hexavalent chromium data are available for soil at Lower Site Summit.
[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).
[f] Total xylenes used as a surrogate.
[g] Isopropylbenzene used as a surrogate
[h] PCBs used as a surrogate.
[i] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-4 Selection of Chemicals of Potential Concern for Human Health - Surbsurface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPC?
Inorganics									
Arsenic	16	16	100	8.57	3.66	12	4.5	0.45	No
Barium	16	16	100	321	90.6	116	20,300	2,030	No
Cadmium	16	16	100	0.122	0.0828	0.14	79	7.9	No
Chromium, Hexavalent	2	2	100	0.300	0.220	na	300	30	No
Chromium, Total	16	16	100	171	15.7	38	152,000 [d]	15,200	No
Lead	16	16	100	9.9	3.49	12	400 [e]	400	No
Mercury	16	15	94	0.211	0.0176	0.074	18	1.8	No
Nickel	16	16	100	143	14.3	29	2,000	200	No
Selenium	16	12	75	0.325	0.163	0.96	510	51	No
Silver	16	16	100	0.0945	0.0424	0.14	510	51	No
Vanadium	16	16	100	106	42.2	74	710	71	**Yes**
Volatile Organic Compounds (VOCs)									
1,1,1-Trichloroethane	29	2	6.9	0.00858	0.00751	na	360	36	No
1,1,2,2-Tetrachloroethane	29	1	3.4	1.21	1.21	na	5.5	0.55	**Yes**
1,1,2-Trichloroethane	29	1	3.4	1.65	1.65	na	11	1.1	**Yes**
1,2,3-Trichlorobenzene	29	1	3.4	0.131	0.131	na	49	4.9	No
1,2,3-Trichloropropane	29	1	3.4	0.491	0.491	na	0.17	0.017	**Yes**
1,2,4-Trimethylbenzene	29	7	24	0.949	0.00732	na	49	4.9	No
1,2-Dibromo-3-chloropropane	29	1	3.4	3.04	3.04	na	0.0054	0.0054	**Yes**
1,3,5-Trimethylbenzene	29	7	24	0.407	0.00761	na	42	4.2	No
2-Hexanone	29	1	3.4	0.942	0.942	na	210	21	No
4-Chlorotoluene	29	1	3.4	0.501	0.501	na	1,600	160	No
Benzene	29	2	6.9	0.0497	0.0431	na	11	1.1	No
Ethylbenzene	29	4	14	0.0678	0.00731	na	110	11	No
Isopropylbenzene	29	3	10	0.0678	0.00994	na	62	6.2	No
m,p-Xylene (Sum of isomers)	29	5	17	0.213	0.0155	na	63 [f]	6.3	No
Methylene chloride	29	2	6.9	0.0354	0.0307	na	160	16	No
n-Butylbenzene	29	5	17	0.807	0.0105	na	42	4.2	No
n-Propylbenzene	29	1	3.4	0.0144	0.0144	na	42	4.2	No
o-Xylene	29	4	14	0.0189	0.0122	na	63 [f]	6.3	No
p-Isopropyltoluene	29	5	17	2.24	0.00837	na	62 [g]	6.2	No
sec-Butylbenzene	29	2	6.9	0.225	0.157	na	41	4.1	No
Styrene	29	2	6.9	0.119	0.0177	na	200	20	No
Toluene	29	9	31	0.437	0.0136	na	220	22	No
Trichloroethylene (TCE)	29	19	66	0.613	0.00952	na	0.57	0.057	**Yes**
Xylenes, Total	29	5	17	0.290	0.0342	na	63	6.3	No
Semi-Volatile Organic Compounds (SVOCs)									
bis(2-ethylhexyl) Phthalate	29	2	6.9	0.168	0.119	na	220	22	No

Table D-4 Selection of Chemicals of Potential Concern for Human Health - Surbsurface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPC?
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	29	4	14	4.60	0.109	na	280	28	No
Acenaphthene	29	1	3.4	0.100	0.100	na	2,800	280	No
Anthracene	29	2	6.9	0.0923	0.0894	na	20,600	2,060	No
Benzo(a)anthracene	29	4	14	0.250	0.0907	na	4.9	0.49	No
Benzo(a)pyrene	29	3	10	0.347	0.112	na	0.49	0.049	**Yes**
Benzo(b)fluoranthene	29	3	10	0.449	0.124	na	4.9	0.49	No
Benzo(g,h,i)perylene	29	2	6.9	0.260	0.200	na	1,400	140	No
Benzo(k)fluoranthene	29	1	3.4	0.144	0.144	na	49	4.9	No
Chrysene	29	3	10	0.403	0.139	na	490	49	No
Fluoranthene	29	7	24	0.487	0.120	na	1,900	190	No
Fluorene	29	2	6.9	0.268	0.114	na	2,300	230	No
Indeno(1,2,3-c,d)Pyrene	29	2	6.9	0.233	0.192	na	4.9	0.49	No
Naphthalene	29	7	24	4.32	0.0238	na	28	2.8	**Yes**
Phenanthrene	29	7	24	0.453	0.0862	na	20,600	2,060	No
Pyrene	29	7	24	0.715	0.119	na	1,400	140	No
Polychlorinated Biphenyls (PCBs)									
PCB-1254 (Aroclor 1254)	17	1	5.9	0.0551	0.0551	na	1 [h]	0.1	No
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	29	9	31	4,170	7.29	na	10,250 [i]	10,250	No
Gasoline Range Organics (GRO)	29	14	48	128	0.491	na	1,400 [i]	1,400	No
Residual Range Organics (RRO)	29	18	62	135	8.66	na	10,000 [i]	10,000	No

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.

[b] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[d] Total chromium data were compared to the soil screening benchmark for trivalent chromium because hexavalent chromium data are available for soil at Lower Site Summit.

[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).

[f] Total xylenes used as a surrogate.

[g] Isopropylbenzene used as a surrogate.

[h] PCBs used as a surrogate.

[i] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-5 Selection of Chemicals of Potential Concern for Human Health - Groundwater at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Regulatory Criteria [a] (mg/L)	Screening Benchmark [b] (mg/L)	COPC?
Inorganics, Total								
Arsenic	7	6	86	0.0322	0.00874	0.010	0.0010	**Yes**
Barium	7	7	100	0.964	0.0372	2.0	0.20	**Yes**
Cadmium	7	1	14	0.00107	0.00107	0.005	0.0005	**Yes**
Chromium, Total	7	6	86	0.0857	0.0170	0.10	0.010	**Yes**
Lead	7	6	86	0.0333	0.00777	0.015 [c]	0.015	**Yes**
Mercury	7	3	43	0.000299	0.0000744	0.002	0.0002	**Yes**
Nickel	7	7	100	0.0798	0.00108	0.10	0.010	**Yes**
Vanadium	7	6	86	0.137	0.0329	0.26	0.026	**Yes**
Inorganics, Filtered								
Arsenic	7	4	57	0.00681	0.00310	0.010	0.0010	**Yes**
Barium	7	7	100	0.141	0.0213	2.0	0.20	No
Chromium, Total	7	1	14	0.0159	0.0159	0.10	0.010	**Yes**
Lead	7	1	14	0.00608	0.00608	0.015 [c]	0.015	No
Nickel	7	7	100	0.0142	0.00113	0.10	0.010	**Yes**
Vanadium	7	1	14	0.0327	0.0327	0.26	0.026	**Yes**
Volatile Organic Compounds (VOCs)								
1,1,1-Trichloroethane	7	1	14	0.00686	0.00686	0.2	0.02	No
1,1-Dichloroethane	7	1	14	0.000350	0.000350	7.3	0.73	No
1,2,4-Trimethylbenzene	7	2	29	0.0356	0.00376	1.8	0.18	No
1,2-Dichloroethane	7	1	14	0.000520	0.000520	0.005	0.0005	**Yes**
1,3,5-Trimethylbenzene	7	2	29	0.0164	0.00809	1.8	0.18	No
4-Methyl-2-pentanone(MIBK)	7	1	14	0.00468	0.00468	2.9	0.29	No
Benzene	7	2	29	0.00539	0.00111	0.005	0.0005	**Yes**
Carbon Disulfide	7	1	14	0.000830	0.000830	3.7	0.37	No
Chloromethane	7	2	29	0.000530	0.000330	0.066	0.0066	No
Ethylbenzene	7	2	29	0.00720	0.00713	0.7	0.07	No
Isopropylbenzene	7	2	29	0.00990	0.00478	3.7	0.37	No
m,p-Xylene (Sum of isomers)	7	2	29	0.0196	0.00192	10 [d]	1.0	No
Methylene Chloride	7	4	57	0.00121	0.00104	0.005	0.0005	**Yes**
n-Butylbenzene	7	1	14	0.00975	0.00975	0.37	0.037	No
n-Propylbenzene	7	2	29	0.0117	0.00356	0.37	0.037	No
o-Xylene	7	2	29	0.00313	0.000710	10 [d]	1.0	No
p-Isopropyltoluene	7	3	43	0.00947	0.000520	3.7 [e]	0.37	No

Table D-5 Selection of Chemicals of Potential Concern for Human Health - Groundwater at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Regulatory Criteria [a] (mg/L)	Screening Benchmark [b] (mg/L)	COPC?
Volatile Organic Compounds (VOCs - Cont.)								
sec-Butylbenzene	7	2	29	0.0100	0.00287	0.37	0.037	No
t-Butylbenzene	7	2	29	0.000770	0.000740	0.37	0.037	No
Toluene	7	2	29	0.00128	0.000320	1.0	0.10	No
Trichloroethylene (TCE)	7	4	57	0.0175	0.000620	0.005	0.0005	**Yes**
Xylenes, Total	7	2	29	0.0227	0.00263	10	1.0	No
Polycyclic Aromatic Hydrocarbons (PAHs)								
2-Methylnaphthalene	7	2	29	0.0735	0.0466	0.15	0.015	**Yes**
Acenaphthene	7	1	14	0.00360	0.00360	2.2	0.22	No
Fluorene	7	1	14	0.00390	0.00390	1.5	0.15	No
Naphthalene	7	3	43	0.168	0.00176	0.73	0.073	**Yes**
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	7	5	71	29.4	0.403	1.5 [f]	1.5	**Yes**
Gasoline Range Organics (GRO)	7	2	29	0.383	0.252	2.2 [f]	2.2	No
Residual Range Organics (RRO)	7	5	71	1.03	0.267	1.1 [f]	1.1	No

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/L - milligrams per liter
na - not available
USEPA - United States Environmental Protection Agency

[a] Regulatory Criteria are derived from the following hierarchy:
1. Minimum of the Table C Groundwater Cleanup Levels listed in 18 AAC 75 (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Tap Water (USEPA, 2011c).

[b] Benchmark Criteria are based on a cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[c] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).

[d] Total xylenes used as a surrogate.

[e] Isopropylbenzene used as a surrogate.

[f] Petroleum hydrocarbons are not included in the cumulative hazard calculations. Therefore, the regulatory criteria were not divided by 10.

Table D-6 Selection of Chemicals of Potential Concern for Human Health - Protection of Indoor Air from Vapor Intrusion from Groundwater at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Regulatory Criteria [a] (mg/L)	Screening Benchmark [b] (mg/L)	COPC?
Inorganics, Total								
Arsenic	7	6	86	0.0322	0.00874	NA [c]	NA	No
Barium	7	7	100	0.964	0.0372	NA [c]	NA	No
Cadmium	7	1	14	0.00107	0.00107	NA [c]	NA	No
Chromium, Total	7	6	86	0.0857	0.0170	NA [c]	NA	No
Lead	7	6	86	0.0333	0.00777	NA [c]	NA	No
Mercury	7	3	43	0.000299	0.0000744	NA [c]	NA	No
Nickel	7	7	100	0.0798	0.00108	NA [c]	NA	No
Vanadium	7	6	86	0.137	0.0329	NA [c]	NA	No
Inorganics, Filtered								
Arsenic	7	4	57	0.00681	0.00310	NA [c]	NA	No
Barium	7	7	100	0.141	0.0213	NA [c]	NA	No
Chromium, Total	7	1	14	0.0159	0.0159	NA [c]	NA	No
Lead	7	1	14	0.00608	0.00608	NA [c]	NA	No
Nickel	7	7	100	0.0142	0.00113	NA [c]	NA	No
Vanadium	7	1	14	0.0327	0.0327	NA [c]	NA	No
Volatile Organic Compounds (VOCs)								
1,1,1-Trichloroethane	7	1	14	0.00686	0.00686	3.3	0.33	No
1,1-Dichloroethane	7	1	14	0.000350	0.000350	2.3	0.23	No
1,2,4-Trimethylbenzene	7	2	29	0.0356	0.00376	0.029	0.0029	**Yes**
1,2-Dichloroethane	7	1	14	0.000520	0.000520	0.019	0.0019	No
1,3,5-Trimethylbenzene	7	2	29	0.0164	0.00809	0.02	0.0020	**Yes**
4-Methyl-2-pentanone(MIBK)	7	1	14	0.00468	0.00468	555	55.5	No
Benzene	7	2	29	0.00539	0.00111	0.014	0.0014	**Yes**
Carbon Disulfide	7	1	14	0.000830	0.000830	1.2	0.12	No
Chloromethane	7	2	29	0.000530	0.000330	0.037	0.0037	No
Ethylbenzene	7	2	29	0.00720	0.00713	0.069	0.0069	**Yes**
Isopropylbenzene	7	2	29	0.00990	0.00478	0.89	0.089	No
m,p-Xylene (Sum of isomers)	7	2	29	0.0196	0.00192	0.38 [d]	0.038	No
Methylene Chloride	7	4	57	0.00121	0.00104	0.39	0.039	No
n-Butylbenzene	7	1	14	0.00975	0.00975	0.068	0.0068	**Yes**
n-Propylbenzene	7	2	29	0.0117	0.00356	0.068	0.0068	**Yes**
o-Xylene	7	2	29	0.00313	0.000710	0.38 [d]	0.038	No
p-Isopropyltoluene	7	3	43	0.00947	0.000520	0.89 [e]	0.089	No
sec-Butylbenzene	7	2	29	0.0100	0.00287	0.048	0.0048	**Yes**
t-Butylbenzene	7	2	29	0.000770	0.000740	0.071	0.0071	No
Toluene	7	2	29	0.00128	0.000320	19.2	1.92	No
Trichloroethylene (TCE)	7	4	57	0.0175	0.000620	0.00055	0.000055	**Yes**
Xylenes, Total	7	2	29	0.0227	0.00263	0.38	0.038	No

Table D-6 Selection of Chemicals of Potential Concern for Human Health - Protection of Indoor Air from Vapor Intrusion from Groundwater at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Regulatory Criteria [a] (mg/L)	Screening Benchmark [b] (mg/L)	COPC?
Polycyclic Aromatic Hydrocarbons (PAHs)								
2-Methylnaphthalene	7	2	29	0.0735	0.0466	0.69	0.069	**Yes**
Acenaphthene	7	1	14	0.00360	0.00360	na	na	**Yes**
Fluorene	7	1	14	0.00390	0.00390	na	na	**Yes**
Naphthalene	7	3	43	0.168	0.00176	0.040	0.0040	**Yes**
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	7	5	71	29.4	0.403	NA [f]	NA	No
Gasoline Range Organics (GRO)	7	2	29	0.383	0.252	NA [f]	NA	No
Residual range organics (RRO)	7	5	71	1.03	0.267	NA [c]	NA	No

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
MEK - Methyl ethyl ketone
mg/L - milligrams per liter
na - not available
NA - not applicable
USEPA - United States Environmental Protection Agency

[a] Regulatory Criteria are derived from Target Groundwater Concentrations from Vapor Intrusion Guidance for *Contaminated Sites. Draft.* (ADEC, 2009d).
[b] Benchmark Criteria are based on a cancer risk of 1×10^{-6} or a hazard index of 0.1.
[c] Vapor intrusion to indoor air pathway is incomplete because this chemical is not volatile.
[d] Total xylenes used as a surrogate.
[e] Isopropylbenzene used as a surrogate.
[f] Total petroleum hydrocarbons are not included because Individual petroleum hydrocarbon components were analyzed for and are included in the vapor intrusion assessment.

Table D-7 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Area A

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration[a] (mg/Kg)	Regulatory Criteria[b] (mg/Kg)	Screening Benchmark[c] (mg/Kg)	COPC?
Inorganics									
Arsenic	16	16	100	9.17	5.25	12.5	4.5	0.45	No
Barium	16	16	100	908	69.1	116	20,300	2,030	No
Cadmium	16	15	94	3.06	0.0739	0.141	79	7.9	No
Chromium, Hexavalent	10	7	70	1.98	0.130	na	300 [d]	30	No
Chromium, Total	16	16	100	57.4	29.3	38.0	152,000 [d]	15,200	No
Lead	16	16	100	116	5.37	11.6	400 [e]	400	No
Mercury	16	15	94	0.110	0.0167	0.0737	18	1.8	No
Nickel	16	16	100	52.2	27.7	28.6	2,000	200	No
Selenium	16	16	100	0.478	0.166	0.959	510	51	No
Silver	16	16	100	0.137	0.0339	0.138	510	51	No
Vanadium	16	16	100	63.3	49.1	74.3	710	71	No
Volatile Organic Compounds (VOCs)									
Methylene chloride	16	5	31	0.125	0.0481	na	160	16	No
Toluene	16	2	13	0.0240	0.0115	na	220	22	No
Trichloroethylene (TCE)	16	1	6.3	0.0818	0.0818	na	0.57	0.057	**Yes**
Semi-Volatile Organic Compounds (SVOCs)									
Benzoic Acid	16	5	31	1.52	1.24	na	317,000	31,700	No
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	16	15	94	19,200	22.3	na	10,250 [f]	10,250	**Yes**
Gasoline Range Organics (GRO)	16	6	38	1.71	1.09	na	1,400 [f]	1,400	No
Residual Range Organics (RRO)	16	16	100	161,000	17.0	na	10,000 [f]	10,000	**Yes**

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.

[b] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1×10^{-6} or a hazard index of 0.1.

[d] Total chromium data were compared to the soil screening benchmark for trivalent chromium because hexavalent chromium data are also available for Area A.

[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).

[f] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-8 Selection of Chemicals of Potential Concern for Human Health - Surbsurface Soil at Area A

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPC?
Inorganics									
Arsenic	15	15	100	11.5	5.40	12.5	4.5	0.45	No
Barium	15	15	100	206	67.0	116	20,300	2,030	No
Cadmium	15	15	100	0.970	0.0752	0.141	79	7.9	No
Chromium, Total	15	15	100	45.1	22.3	38.0	300 [d]	30	**Yes**
Lead	15	15	100	15.5	4.58	11.6	400 [e]	400	No
Mercury	15	14	93	0.238	0.0339	0.0737	18	1.8	No
Nickel	15	15	100	39.6	25.6	28.6	2,000	200	No
Selenium	15	6	40	0.565	0.162	0.959	510	51	No
Silver	15	15	100	0.110	0.0390	0.138	510	51	No
Vanadium	15	15	100	56.6	38.1	74.3	710	71	No
Volatile Organic Compounds (VOCs)									
1,2,4-Trimethylbenzene	15	3	20	0.0338	0.0108	na	49	4.9	No
1,3,5-Trimethylbenzene	15	2	13	0.00959	0.00830	na	42	4.2	No
Ethylbenzene	15	3	20	0.0388	0.0116	na	110	11	No
m,p-Xylene (Sum of isomers)	15	3	20	0.203	0.0373	na	63 [f]	6.3	No
Methylene chloride	15	4	27	0.0525	0.0268	na	160	16	No
n-Butylbenzene	15	1	6.7	0.00789	0.00789	na	42	4.2	No
n-Propylbenzene	15	2	13	0.0147	0.0119	na	42	4.2	No
o-Xylene	15	4	27	0.0576	0.00962	na	63 [f]	6.3	No
Toluene	15	5	33	0.0537	0.0122	na	220	22	No
Trichloroethylene (TCE)	15	5	33	0.0866	0.0124	na	0.57	0.057	**Yes**
Xylenes, Total	15	4	27	0.261	0.0214	na	63	6.3	No
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	15	8	53	28,400	84.1	na	10,250 [g]	10,250	**Yes**
Gasoline Range Organics (GRO)	15	10	67	2.38	0.842	na	1,400 [g]	1,400	No
Residual Range Organics (RRO)	15	9	60	18,900	79.1	na	10,000 [g]	10,000	**Yes**

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.
[b] Regulatory Criteria are derived from the following hierarchy:
1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.
[d] Total chromium data were compared to the soil screening benchmark for total chromium, which is equivalent to the soil screening benchmark for hexavalent chromium, because hexavalent chromium data are unavailable.
[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential
[f] Total xylenes used as a surrogate.
[g] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-9 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration[a] (mg/Kg)	Regulatory Criteria[b] (mg/Kg)	Screening Benchmark[c] (mg/Kg)	COPC?
Inorganics									
Arsenic	3	3	100	7.27	4.12	12.5	4.5	0.45	No
Barium	3	3	100	88.9	60.8	116	20,300	2,030	No
Cadmium	3	3	100	0.168	0.108	0.141	79	7.9	No
Chromium, Total	3	3	100	35.6	28.0	38.0	300 [d]	30	No
Lead	3	3	100	18.5	8.44	11.6	400 [e]	400	No
Mercury	3	3	100	0.119	0.0257	0.0737	18	1.8	No
Nickel	3	3	100	37.7	31.9	28.6	2,000	200	No
Selenium	3	2	67	0.250	0.237	0.959	510	51	No
Silver	3	3	100	0.0827	0.0566	0.138	510	51	No
Vanadium	3	3	100	57.9	46.0	74.3	710	71	No
Volatile Organic Compounds (VOCs)									
Dibenzofuran	3	1	33	0.767	0.767	na	200	20	No
Toluene	3	1	33	0.0165	0.0165	na	220	22	No
Semi-Volatile Organic Compounds (SVOCs)									
bis(2-ethylhexyl) Phthalate	3	1	33	0.126	0.126	na	220	22	No
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	3	1	33	0.231	0.231	na	280	28	No
Acenaphthene	3	1	33	1.14	1.14	na	2,800	280	No
Anthracene	3	1	33	1.24	1.24	na	20,600	2,060	No
Benzo(a)anthracene	3	1	33	1.80	1.80	na	4.9	0.49	**Yes**
Benzo(a)pyrene	3	1	33	1.62	1.62	na	0.49	0.049	**Yes**
Benzo(b)fluoranthene	3	1	33	2.08	2.08	na	4.9	0.49	**Yes**
Benzo(g,h,i)perylene	3	1	33	0.794	0.794	na	1,400	140	No
Benzo(k)fluoranthene	3	1	33	0.599	0.599	na	49	4.9	No
Chrysene	3	1	33	2.19	2.19	na	490	49	No
Fluoranthene	3	1	33	4.77	4.77	na	1,900	190	No
Fluorene	3	1	33	1.24	1.24	na	2,300	230	No
Indeno(1,2,3-c,d)Pyrene	3	1	33	0.818	0.818	na	4.9	0.49	**Yes**
Naphthalene	3	1	33	0.542	0.542	na	28	2.8	No
Phenanthrene	3	1	33	6.49	6.49	na	20,600	2,060	No
Pyrene	3	1	33	4.36	4.36	na	1,400	140	No

Table D-9 Selection of Chemicals of Potential Concern for Human Health - Surface Soil at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration[a] (mg/Kg)	Regulatory Criteria[b] (mg/Kg)	Screening Benchmark[c] (mg/Kg)	COPC?
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	3	1	33	62.6	62.6	na	10,250 [f]	10,250	No
Residual Range Organics (RRO)	3	3	100	260	57.3	na	10,000 [f]	10,000	No

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.

[b] Regulatory Criteria are derived from the following hierarchy:

1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[c] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.

[d] Total chromium data were compared to the soil screening benchmark for total chromium, which is equivalent to the soil screening benchmark for hexavalent chromium, because hexavalent chromium data are unavailable for Area C soil.

[e] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).

[f] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-10 Selection of Chemicals of Potential Concern for Human Health - Surface Water at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Regulatory Criteria [a] (mg/L)	Screening Benchmark [b] (mg/L)	COPC?
Inorganics, Total								
Barium	2	2	100	0.00963	0.00834	2.0	0.20	No
Nickel	2	1	50	0.000889	0.000889	0.30	0.030	No
Inorganics, Dissolved								
Barium	2	2	100	0.00956	0.00858	2.0	0.20	No
Chromium, Total	2	1	50	0.00151	0.00151	0.10	0.010	No
Nickel	2	2	100	0.00105	0.000906	0.30	0.030	No

Notes:

ADEC - Alaska Department of Environmental Conservation
AAC - Alaska Administrative Code
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/L - milligrams per liter
USEPA - United States Environmental Protection Agency

[a] Regulatory Criteria selected from the following sources, such that the lowest derived screening benchmark equal to:

1. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances (ADEC, 2008b) as referenced in 18 AAC 70 (ADEC, 2011c).
2. One-tenth of the 18 AAC 75, Table C Groundwater Cleanup Levels (ADEC, 2011b).
3. Regional Screening Levels for Chemical (RSLs) Contaminants at Superfund Sites - Tap Water for carcinogenic chemicals, and one-tenth of the Tap Water RSLs for noncarcinogenic chemicals (USEPA, 2011c).

was used for COPC screening.

[b] Benchmark Criteria are based on cancer risk of 1×10^{-6} or a hazard index of 0.1.

Table D-11 Selection of Chemicals of Potential Concern for Human Health - Sediment at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detecteded Concentration (mg/Kg)	Regulatory Criteria a (mg/Kg)		Screening Benchmark b (mg/Kg)	COPC?
Inorganics									
Arsenic	1	1	100	5.77	5.77	4.5		0.45	**Yes**
Barium	1	1	100	53.1	53.1	20,300		2,030	No
Cadmium	1	1	100	0.120	0.120	79		7.9	No
Chromium, Total	1	1	100	29.7	29.7	300		30	No
Lead	1	1	100	11.8	11.8	400	c	400	No
Mercury	1	1	100	0.0445	0.0445	18		1.8	No
Nickel	1	1	100	32.5	32.5	2,000		200	No
Selenium	1	1	100	0.284	0.284	510		51	No
Silver	1	1	100	0.0471	0.0471	510		51	No
Vanadium	1	1	100	50.8	50.8	710		71	No
Semi-Volatile Organic Compounds (SVOCs)									
bis(2-ethylhexyl) Phthalate	1	1	100	0.121	0.121	220		22	No
Di-n-octylphthalate	1	1	100	0.239	0.239	3,100		310	No
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a)anthracene	1	1	100	0.0707	0.0707	4.9		0.49	No
Chrysene	1	1	100	0.0772	0.0772	490		49	No
Fluoranthene	1	1	100	0.171	0.171	1,900		190	No
Phenanthrene	1	1	100	0.179	0.179	20,600		2,060	No
Pyrene	1	1	100	0.146	0.146	1,400		140	No
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	1	1	100	34.3	34.3	10,250	d	10,250	No
Residual Range Organics (RRO)	1	1	100	96.9	96.9	10,000	d	10,000	No

Notes:

AAC - Alaska Administrative Code
ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstract Service
COPC - chemical of potential concern
mg/Kg - milligrams per kilogram
na - not available
USEPA - United States Environmental Protection Agency

[a] Regulatory Criteria are derived from the following hierarchy:
1. Minimum of the Direct Contact and Inhalation pathways listed in 18 AAC 75, Tables B1 and B2, Under 40 inch Zone (ADEC, 2011b).
2. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites - Residential Soil (USEPA, 2011c).

[b] Benchmark Criteria are based on cancer risk of 1 x 10^{-6} or a hazard index of 0.1.
[c] Lead is not included in the cumulative hazard estimate (ADEC, 2008e); therefore, the regulatory criterion was not divided by 10. The regulatory criteria is based on the residential cleanup value calculated according to the *Cumulative Risk Guidance* (ADEC, 2008e).
[d] Because petroleum hydrocarbons are not included in the cumulative hazard estimate, the regulatory criteria were not divided by 10.

Table D-12 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?
Inorganics									
Arsenic	14	14	100	19.1	2.16	12.5	0.25 [d]	0.25	**Yes**
Barium	14	14	100	1,240	72.2	116	5.0	5.0	**Yes**
Cadmium	14	14	100	23.9	0.115	0.141	0.20	0.20	**Yes**
Chromium, Hexavalent	4	3	75	0.890	0.160	na	0.018	0.018	**Yes**
Chromium, Total	14	14	100	63.2	16.0	38	64	64	No
Lead	14	14	100	950	8.85	11.6	9.36	9.36	**Yes**
Mercury	14	14	100	0.815	0.0294	0.0737	0.30 [e]	0.30	**Yes**
Nickel	14	14	100	47.6	14.1	28.6	25	25	**Yes**
Selenium	14	10	71	2.91	0.174	0.959	0.02	0.02	**Yes**
Silver	14	14	100	38.2	0.0434	0.138	2.0	2.0	**Yes**
Vanadium	14	14	100	134	18.1	74.3	2.0	2.0	**Yes**
Volatile Organic Compounds (VOCs)									
1,2,3-Trichlorobenzene	23	3	13	0.0172	0.000570	na	20	20	No
1,2,4-Trichlorobenzene	23	2	8.7	0.00834	0.000610	na	20	20	No
1,2,4-Trimethylbenzene	23	8	35	0.0393	0.000430	na	0.10 [f]	0.0068	**Yes**
1,3,5-Trimethylbenzene	23	3	13	0.0322	0.00617	na	0.10 [f]	0.0068	**Yes**
2-Butanone (MEK)	23	2	8.7	0.00560	0.00330	na	35	35	No
4-Methyl-2-pentanone(MIBK)	23	2	8.7	0.00110	0.00100	na	91.6	91.6	No
Acetone	2	2	100	0.0590	0.0360	na	20	20	No
Benzene	23	2	8.7	0.000390	0.000370	na	0.0068	0.0068	No
Carbon disulfide	23	1	4.3	0.000170	0.000170	na	na	na	**Yes**
Dibenzofuran	23	3	13	0.424	0.144	na	1.6 [g]	1.6	No
Ethylbenzene	23	2	8.7	0.000210	0.000200	na	0.018	0.018	No
Isopropylbenzene	23	1	4.3	0.000130	0.000130	na	0.018 [h]	0.0068	No
m,p-Xylene (Sum of isomers)	23	4	17	0.0302	0.000780	na	0.10 [f]	0.10	No
Methylene chloride	23	11	48	0.148	0.0267	na	183	183	No
n-Propylbenzene	23	1	4.3	0.0219	0.0219	na	0.018 [h]	0.0068	**Yes**
o-Xylene	23	9	39	0.0472	0.000390	na	1.0	1.0	No
p-Isopropyltoluene	23	1	4.3	0.0137	0.0137	na	0.10 [f]	0.0068	**Yes**
sec-Butylbenzene	23	1	4.3	0.000370	0.000370	na	0.018 [h]	0.0068	No
Styrene	23	1	4.3	0.0144	0.0144	na	0.10	0.10	No
Toluene	23	7	30	0.0441	0.00100	na	0.08	0.08	No
Trichloroethylene (TCE)	23	3	13	0.0173	0.00140	na	0.10	0.10	No
Xylenes, Total	21	2	10	0.0529	0.0422	na	0.10	0.10	No
Semi-Volatile Organic Compounds (SVOCs)									
4-Chloroaniline	23	2	8.7	7.80	5.52	na	40	40	No
bis(2-ethylhexyl) Phthalate	23	2	8.7	2.12	0.923	na	0.91	0.91	**Yes**

Table D-12 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Upper Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)		Screening Benchmark c (mg/Kg)	COPEC?
Polycyclic Aromatic Hydrocarbons (PAHs)										
2-Methylnaphthalene	23	2	8.7	0.112	0.109	na	29	i	29	No
Acenaphthene	23	4	17	1.49	0.125	na	29	i	29	No
Acenaphthylene	23	1	4.3	0.783	0.783	na	29	i	29	No
Anthracene	23	8	35	2.30	0.108	na	1.6		1.6	**Yes**
Benzo(a)anthracene	23	10	43	8.61	0.0944	na	0.10		0.10	**Yes**
Benzo(a)pyrene	23	8	35	5.75	0.197	na	0.10		0.10	**Yes**
Benzo(b)fluoranthene	23	8	35	10.6	0.213	na	0.10		0.10	**Yes**
Benzo(g,h,i)perylene	23	7	30	1.96	0.103	na	33		33	No
Benzo(k)fluoranthene	23	7	30	4.48	0.0848	na	0.10		0.10	**Yes**
Chrysene	23	10	43	9.72	0.118	na	35		35	No
Dibenz(a,h)anthracene	23	5	22	2.42	0.160	na	0.10		0.10	**Yes**
Fluoranthene	23	11	48	16.0	0.105	na	260		260	No
Fluorene	23	4	17	1.14	0.138	na	30		30	No
Indeno(1,2,3-c,d)Pyrene	23	8	35	1.88	0.0957	na	0.10		0.10	**Yes**
Naphthalene	23	14	61	0.145	0.000810	na	0.10		0.10	**Yes**
Phenanthrene	23	10	43	8.93	0.124	na	0.10		0.10	**Yes**
Pyrene	23	11	48	16.6	0.145	na	0.10		0.10	**Yes**
Polychlorinated Biphenyls (PCBs)										
PCB-1260 (Arochlor 1260)	16	1	6.3	0.0214	0.0214	na	2,510	j	2,510	No
Total Petroleum Hydrocarbons (TPHs)										
Diesel Range Organics (DRO)	23	19	83	2,270	6.80	na	na		na	**Yes**
Gasoline Range Organics (GRO)	23	2	8.7	1.80	0.924	na	na		na	**Yes**
Residual range organics (RRO)	23	23	100	3,330	8.06	na	na		na	**Yes**

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/Kg - milligrams per kilogram
na - not available
ORNL - Oak Ridge National Laboratory
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.
[b] Regulatory criteria selected based on the following hierarchy:
1) ADEC Ecoscoping Guidance (ADEC, 2009c- Appendix D).
2) Eco-SSLs - Ecological Soil Screening Level Guidance. Office of Emergency and Remedial Response. (USEPA, 2005c).
3) The lower of ORNL plant (ONRL, 1997c - Table 1) or soil invertebrate (ORNL, 1997b - Table 1) benchmarks.
4) The lower of ORNL mammalian or avian dietary wildlife benchmarks, assuming diet consists of 100 percent soil (ORNL, 1996b - Appendix D, Table 12).

[c] Benchmark criteria is equal to the indicated regulatory criteria.
[d] Screening value is for arsenic III.
[e] Screening value is for inorganic mercury.
[f] Total xylenes used as a surrogate.
[g] Anthracene used as a surrogate.
[h] Ethylbenzene used as a surrogate.
[i] Low molecular weight polycyclic aromatic hydrocarbons used as a surrogate.
[j] Aroclor 1254 used as a surrogate.

Table D-13 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?
Inorganics									
Arsenic	34	34	100	19.0	4.14	12.5	0.25 [d]	0.25	**Yes**
Barium	34	34	100	330	61.7	116	5.0	5.0	**Yes**
Cadmium	34	34	100	15.6	0.0789	0.141	0.20	0.20	**Yes**
Chromium, Hexavalent	9	5	56	6.80	0.120	na	0.018	0.018	**Yes**
Chromium, Total	34	34	100	65.0	15.6	38.0	64	64	**Yes**
Lead	34	34	100	208	6.14	11.6	9.36	9.36	**Yes**
Mercury	34	34	100	1.92	0.0229	0.0737	0.30 [e]	0.30	**Yes**
Nickel	34	34	100	49.1	15.9	28.6	25	25	**Yes**
Selenium	34	27	79	1.34	0.167	0.959	0.02	0.02	**Yes**
Silver	34	34	100	0.359	0.0452	0.138	2.0	2.0	No
Vanadium	34	34	100	59.9	31.4	74.3	2.0	2.0	No
Volatile Organic Compounds (VOCs)									
1,1,1-Trichloroethane	37	1	3	0.0705	0.0705	na	15	15	No
1,1,2-Trichloroethane	37	1	3	0.0149	0.0149	na	10	10	No
1,2,3-Trichlorobenzene	37	1	3	0.000670	0.000670	na	20	20	No
1,2,4-Trichlorobenzene	37	5	14	0.000730	0.000610	na	20	20	No
1,2,4-Trimethylbenzene	37	5	14	0.0388	0.0103	na	0.10 [f]	0.0068	**Yes**
1,3,5-Trimethylbenzene	37	2	5	0.0239	0.00853	na	0.10 [f]	0.0068	**Yes**
2-Butanone (MEK)	37	5	14	0.110	0.00600	na	35	35	No
2-Hexanone	37	4	11	0.00840	0.00180	na	na	na	**Yes**
4-Methyl-2-pentanone(MIBK)	37	5	14	0.00270	0.00110	na	91.6	91.6	No
Acetone	5	5	100	1.30	0.0670	na	20	20	No
Benzene	37	4	11	0.000170	0.0000890	na	0.0068	0.0068	No
Carbon disulfide	37	4	11	0.000650	0.000140	na	na	na	**Yes**
Dibenzofuran	37	8	22	7.09	0.113	na	1.6 [g]	1.6	**Yes**
Ethylbenzene	37	2	5	0.0118	0.00742	na	0.018	0.018	No
Isopropylbenzene	37	1	3	0.0145	0.0145	na	0.018 [h]	0.0068	**Yes**
m,p-Xylene (Sum of isomers)	37	5	14	0.0669	0.000190	na	0.10 [f]	0.10	No
Methylene chloride	37	10	27	0.0683	0.0261	na	183	183	No
n-Butylbenzene	37	1	3	0.0123	0.0123	na	0.018 [h]	0.0068	**Yes**
n-Propylbenzene	37	2	5	0.0202	0.0156	na	0.018 [h]	0.0068	**Yes**
o-Xylene	37	11	30	0.0322	0.0000700	na	1.0	1.0	No
p-Isopropyltoluene	37	1	3	0.0107	0.0107	na	0.10 [f]	0.0068	**Yes**
sec-Butylbenzene	37	2	5	0.000390	0.000380	na	0.018 [h]	0.0068	No
Toluene	37	9	24	0.0366	0.000120	na	0.08	0.08	No
trans-1,3-Dichloropropene	37	1	3	0.000270	0.000270	na	na	na	**Yes**
Trichloroethylene (TCE)	37	11	30	0.290	0.000380	na	0.10	0.10	**Yes**
Xylenes, Total	32	4	13	0.0992	0.0278	na	0.10	0.10	No

Table D-13 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?
Semi-Volatile Organic Compounds (SVOCs)									
2,4-Dimethylphenol	37	1	3	0.210	0.210	na	20	20	No
Benzoic acid	37	2	5	1.39	1.16	na	na	na	**Yes**
Benzyl butyl phthalate	37	1	3	0.326	0.326	na	48	48	No
bis(2-ethylhexyl) Phthalate	37	3	8	5.44	0.128	na	0.91	0.91	**Yes**
Di-n-octylphthalate	37	1	3	0.205	0.205	na	1,090 [i]	1,090	No
Pentachlorophenol	37	1	3	46.5	46.5	na	3.0	3.0	**Yes**
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	37	5	14	2.44	0.0925	na	29 [j]	29	No
Acenaphthene	37	10	27	15.3	0.0855	na	29 [j]	29	No
Anthracene	37	12	32	26.0	0.0936	na	1.6	1.6	**Yes**
Benzo(a)anthracene	37	14	38	37.0	0.0860	na	0.10	0.10	**Yes**
Benzo(a)pyrene	37	14	38	35.7	0.0855	na	0.10	0.10	**Yes**
Benzo(b)fluoranthene	37	12	32	40.1	0.183	na	0.10	0.10	**Yes**
Benzo(g,h,i)perylene	37	13	35	17.1	0.109	na	33	33	No
Benzo(k)fluoranthene	37	11	30	10.8	0.182	na	0.10	0.10	**Yes**
Chrysene	37	12	32	43.4	0.182	na	35	35	**Yes**
Dibenz(a,h)anthracene	37	5	14	6.12	0.154	na	0.10	0.10	**Yes**
Fluoranthene	37	21	57	80.6	0.0851	na	260	260	No
Fluorene	37	9	24	15.1	0.192	na	30	30	No
Indeno(1,2,3-c,d)Pyrene	37	13	35	16.1	0.117	na	0.10	0.10	**Yes**
Naphthalene	37	16	43	2.91	0.000780	na	0.10	0.10	**Yes**
Phenanthrene	37	20	54	60.1	0.0884	na	0.10	0.10	**Yes**
Pyrene	37	21	57	78.0	0.0832	na	0.10	0.10	**Yes**
Polychlorinated Biphenyls (PCBs)									
PCB-1254 (Arochlor 1254)	34	1	3	0.0444	0.0444	na	2,510	2,510	No
PCB-1260 (Arochlor 1260)	34	4	12	0.0309	0.0236	na	2,510 [k]	2,510	No
Energetics									
Perchlorate	8	3	38	0.000430	0.000200	na	na	na	**Yes**
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	37	29	78	7,360	7.81	na	na	na	**Yes**
Gasoline Range Organics (GRO)	29	10	34	14.5	0.454	na	na	na	**Yes**
Residual range organics (RRO)	37	36	97	24,400	11.0	na	na	na	**Yes**

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/Kg - milligrams per kilogram
na - not available
ORNL - Oak Ridge National Laboratory
USEPA - United States Environmental Protection Agency

Table D-13 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.
[b] Regulatory criteria selected based on the following hierarchy:
1) ADEC Ecoscoping Guidance (ADEC, 2009c- Appendix D).
2) Eco-SSLs - Ecological Soil Screening Level Guidance. Office of Emergency and Remedial Response. (USEPA, 2005c).
3) The lower of ORNL plant (ONRL, 1997c - Table 1) or soil invertebrate (ORNL, 1997b - Table 1) benchmarks.
4) The lower of ORNL mammalian or avian dietary wildlife benchmarks, assuming diet consists of 100 percent soil (ORNL, 1996b - Appendix D, Table 12).

[c] Benchmark criteria is equal to the indicated regulatory criteria.
[d] Screening value is for arsenic III.
[e] Screening value is for inorganic mercury.
[f] Total xylenes used as a surrogate.
[g] Anthracene used as a surrogate.
[h] Ethylbenzene used as a surrogate.
[i] Di-n-hexylphthalate used as a surrogate.
[j] Low molecular weight polycyclic aromatic hydrocarbons used as a surrogate.
[k] Aroclor 1254 used as a surrogate.

Table D-14 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Area A

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?
Inorganics									
Arsenic	16	16	100	9.17	5.25	12.5	0.25 [d]	0.25	No
Barium	16	16	100	908	69.1	116	5.0	5.0	**Yes**
Cadmium	16	15	94	3.06	0.0739	0.141	0.20	0.20	**Yes**
Chromium, Hexavalent	10	7	70	1.98	0.130	na	0.018	0.018	**Yes**
Chromium, Total	16	16	100	57.4	29.3	38.0	64	64	No
Lead	16	16	100	116	5.37	11.6	9.36	9.36	**Yes**
Mercury	16	15	94	0.110	0.0167	0.0737	0.30 [e]	0.30	No
Nickel	16	16	100	52.2	27.7	28.6	25	25	**Yes**
Selenium	16	16	100	0.478	0.166	0.959	0.02	0.02	No
Silver	16	16	100	0.137	0.0339	0.138	2.0	2.0	No
Vanadium	16	16	100	63.3	49.1	74.3	2.0	2.0	No
Volatile Organic Compounds (VOCs)									
Methylene chloride	16	5	31	0.125	0.0481	na	183	183	No
Toluene	16	2	13	0.0240	0.0115	na	0.08	0.08	No
Trichloroethylene (TCE)	16	1	6.3	0.0818	0.0818	na	0.10	0.10	No
Semi-Volatile Organic Compounds (SVOCs)									
Benzoic acid	16	5	31	1.52	1.24	na	na	na	**Yes**
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	16	15	94	19,200	22.3	na	na	na	**Yes**
Gasoline Range Organics (GRO)	16	6	38	1.71	1.09	na	na	na	**Yes**
Residual range organics (RRO)	16	16	100	161,000	17.0	na	na	na	**Yes**

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
EDB - Ethylene dibromide
MEK - Methyl ethyl ketone
mg/Kg - milligrams per kilogram
MIBK - Methyl isobutyl ketone
na - not available
ORNL - Oak Ridge National Laboratory
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.
[b] Regulatory criteria selected based on the following hierarchy:
1) ADEC Ecoscoping Guidance (ADEC, 2009c- Appendix D).
2) Eco-SSLs - Ecological Soil Screening Level Guidance. Office of Emergency and Remedial Response. (USEPA, 2005c).
3) The lower of ORNL plant (ONRL, 1997c - Table 1) or soil invertebrate (ORNL, 1997b - Table 1) benchmarks.
4) The lower of ORNL mammalian or avian dietary wildlife benchmarks, assuming diet consists of 100 percent soil (ORNL, 1996b - Appendix D, Table 12).

[c] Benchmark criteria is equal to the indicated regulatory criteria.
[d] Screening value is for arsenic III.
[e] Screening value is for inorganic mercury.

Table D-15 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?
Inorganics									
Arsenic	3	3	100	7.27	4.12	12.5	0.25 [d]	0.25	No
Barium	3	3	100	88.9	60.8	116	5.0	5.0	No
Cadmium	3	3	100	0.168	0.108	0.141	0.20	0.20	No
Chromium, Total	3	3	100	35.6	28.0	38.0	64	64	No
Lead	3	3	100	18.5	8.44	11.6	9.36	9.36	**Yes**
Mercury	3	3	100	0.119	0.0257	0.0737	0.30 [e]	0.30	No
Nickel	3	3	100	37.7	31.9	28.6	25	25	**Yes**
Selenium	3	2	67	0.250	0.237	0.959	0.02	0.02	No
Silver	3	3	100	0.0827	0.0566	0.138	2.0	2.0	No
Vanadium	3	3	100	57.9	46.0	74.3	2.0	2.0	No
Volatile Organic Compounds (VOCs)									
Dibenzofuran	3	1	33	0.767	0.767	na	1.6 [f]	1.6	No
Toluene	3	1	33	0.0165	0.0165	na	0.08	0.08	No
Semi-Volatile Organic Compounds (SVOCs)									
bis(2-ethylhexyl) Phthalate	3	1	33	0.126	0.126	na	0.91	0.91	No
Polycyclic Aromatic Hydrocarbons (PAHs)									
2-Methylnaphthalene	3	1	33	0.231	0.231	na	29 [g]	29	No
Acenaphthene	3	1	33	1.14	1.14	na	29 [g]	29	No
Anthracene	3	1	33	1.24	1.24	na	1.6	1.6	No
Benzo(a)anthracene	3	1	33	1.80	1.80	na	0.10	0.10	**Yes**
Benzo(a)pyrene	3	1	33	1.62	1.62	na	0.10	0.10	**Yes**
Benzo(b)fluoranthene	3	1	33	2.08	2.08	na	0.10	0.10	**Yes**
Benzo(g,h,i)perylene	3	1	33	0.794	0.794	na	33	33	No
Benzo(k)fluoranthene	3	1	33	0.599	0.599	na	0.10	0.10	**Yes**
Chrysene	3	1	33	2.19	2.19	na	35	35	No
Fluoranthene	3	1	33	4.77	4.77	na	260	260	No
Fluorene	3	1	33	1.24	1.24	na	30	30	No
Indeno(1,2,3-c,d)Pyrene	3	1	33	0.818	0.818	na	0.10	0.10	**Yes**
Naphthalene	3	1	33	0.542	0.542	na	0.10	0.10	**Yes**
Phenanthrene	3	1	33	6.49	6.49	na	0.10	0.10	**Yes**
Pyrene	3	1	33	4.36	4.36	na	0.10	0.10	**Yes**

Table D-15 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Soil at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Background Concentration a (mg/Kg)	Regulatory Criteria b (mg/Kg)	Screening Benchmark c (mg/Kg)	COPEC?
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	3	1	33	62.6	62.6	na	na	na	**Yes**
Residual range organics (RRO)	3	3	100	260	57.3	na	na	na	**Yes**

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/Kg - milligrams per kilogram
na - not available
ORNL - Oak Ridge National Laboratory
USEPA - United States Environmental Protection Agency

[a] Background concentration is equal to the lower of the 95% upper prediction limit or the maximum detected value.
[b] Regulatory criteria selected based on the following hierarchy:
1) ADEC Ecoscoping Guidance (ADEC, 2009c- Appendix D).
2) Eco-SSLs - Ecological Soil Screening Level Guidance. Office of Emergency and Remedial Response. (USEPA, 2005c).
3) The lower of ORNL plant (ONRL, 1997c - Table 1) or soil invertebrate (ORNL, 1997b - Table 1) benchmarks.
4) The lower of ORNL mammalian or avian dietary wildlife benchmarks, assuming diet consists of 100 percent soil (ORNL, 1996b - Appendix D, Table 12).

[c] Benchmark criteria is equal to the indicated regulatory criteria.
[d] Screening value is for Arsenic III.
[e] Screening value is for Inorganic Mercury.
[f] Anthracene used as a surrogate.
[g] Low molecular weight polycyclic aromatic hydrocarbons used as a surrogate.

Table D-16 Selection of Chemicals of Potential Concern for Ecological Receptors - Surface Water at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Regulatory Criteria [a] (mg/L)	COPEC Screening Benchmark [b] (mg/L)	COPEC?
Inorganics, Total								
Barium	2	2	100	0.00963	0.00834	0.00390	0.00390	**Yes**
Nickel	2	1	50	0.000889	0.000889	0.00500	0.00500	No

Notes:

ADEC - Alaska Department of Environmental Conservation
CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/L - milligrams per liter
NAWQC - National Ambient Water Quality Criteria
NOAA - National Oceanic and Atmospheric Adiministration
ORNL - Oak Ridge National Laboratory
SQuiRTs - Screening Quick Reference Tables

[a] Regulatory Criteria selected based on the following hierarchy:
1) Freshwater ecological screening values in ADEC's Ecoscoping Guidance (ADEC, 2009b- Appendix D).
2) NAWQC - Freshwater Chronic Value. NOAA SQuiRTs (Buchman, 2008).
3) NAWQC - Marine Chronic Value. NOAA SQuiRTs (Buchman, 2008).
4) NAWQC - Freshwater Acute Value divided by 10. NOAA SQuiRTs (Buchman, 2008).
5) NAWQC - Marine Acute Value divided by 10. NOAA SQuiRTs (Buchman, 2008).
6) Lowest Chronic Value observed in freshwater daphnids (ORNL, 1996a - Table 1).

[b] Benchmark criteria is based on the regulatory criteria and corresponds to a hazard quotient of 1.

Table D-17 Selection of Chemicals of Potential Concern for Ecological Receptors - Sediment at Area C

Analyte	Number of Samples	Number of Detects	Frequency of Detection (%)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Regulatory Criteria a (mg/Kg)	COPEC Screening Benchmark b (mg/Kg)	COPEC?
Inorganics								
Arsenic	1	1	100	5.8	5.8	5.9	5.9	No
Barium	1	1	100	53	53	na	na	**Yes**
Cadmium	1	1	100	0.12	0.12	0.583	0.583	No
Chromium, Total	1	1	100	30	30	36.286	36.286	No
Lead	1	1	100	12	12	35	35	No
Mercury	1	1	100	0.045	0.045	0.174	0.174	No
Nickel	1	1	100	33	33	18	18	**Yes**
Selenium	1	1	100	0.28	0.28	na	na	**Yes**
Silver	1	1	100	0.047	0.047	1.0	1.0	No
Vanadium	1	1	100	51	51	na	na	**Yes**
Semi-Volatile Organic Compounds (SVOCs)								
bis(2-ethylhexyl) Phthalate	1	1	100	0.121	0.121	0.182	0.182	No
Di-n-octylphthalate	1	1	100	0.239	0.239	na	na	**Yes**
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	1	1	100	0.0707	0.0707	0.01572	0.01572	**Yes**
Chrysene	1	1	100	0.0772	0.0772	0.02683	0.02683	**Yes**
Fluoranthene	1	1	100	0.171	0.171	0.03146	0.03146	**Yes**
Phenanthrene	1	1	100	0.179	0.179	0.01873	0.01873	**Yes**
Pyrene	1	1	100	0.146	0.146	0.04427	0.04427	**Yes**
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	1	1	100	34.3	34.3	na	na	**Yes**
Residual Range Organics (RRO)	1	1	100	96.9	96.9	na	na	**Yes**

Notes:

CAS - Chemical Abstracts Service
COPEC - chemical of potential ecological concern
mg/Kg - milligrams per kilogram
na - not available
ORNL - Oak Ridge National Laboratory

[a] Regulatory Criteria selected based on the following hierarchy:

1) The lower of value between Threshold Effects Level (TEL) and Assessment & Remediation of Contaminated Sediments (ARCS) TEL, and Probable Effects Level (PEL) in National Oceanic and Atmospheric Administration's (NOAA) Sediment Quality Guidelines in Screening Quick Reference Tables (SQuiRTs) (Buchman, 2008).
2) Consensus-based Freshwater Threshold Effect Concentrations (TECs) per MacDonald et al. (2000 - Table 2).
3) Benchmarks for sediment-associated biota (ORNL, 1997a):
- Ontario Ministry of Environment Lowest Effect Levels (Table 4).
- United States Environmental Protection Agency Office of Solid Waste and Emergency Response Sediment Criteria (Table 5).
- NOAA Effects Range-Low (ERL) Concentrations for Sediment (Table 1).
- Florida Department of Environmental Protection (FDEP) TEL (Table 1).

[b] Benchmark criteria is equal to the indicated regulatory criteria.

APPENDIX E

ProUCL Output - 95% UCLs for COPCs and COPECs

APPENDIX E - 1

Upper Site Summit Surface Soil ProUCL Output - 95% UCLs for COPCs and COPECs

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	USS_SO.wst
Full Precision	ON
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2,4-Trimethylbenzene

General Statistics

Number of Valid Data	23	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	15
		Percent Non-Detects	65.22%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.00043	Minimum Detected	-7.751725
Maximum Detected	0.0393	Maximum Detected	-3.236531
Mean of Detected	0.014685	Mean of Detected	-5.022862
SD of Detected	0.0139486	SD of Detected	1.7496315
Minimum Non-Detect	0.0183	Minimum Non-Detect	-4.000854
Maximum Non-Detect	0.114	Maximum Non-Detect	-2.171557
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	23
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 8 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.904267	Shapiro Wilk Test Statistic	0.8358865
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0171643	Mean	-4.482958
SD	0.0149509	SD	1.1621533
95% DL/2 (t) UCL	0.0225175	95% H-Stat (DL/2) UCL	0.0438399
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-5.474085
		SD in Log Scale	1.0474249
		Mean in Original Scale	0.0072728
		SD in Original Scale	0.0096249
		95% t UCL	0.010719
		95% Percentile Bootstrap UCL	0.0109846

	A	B	C	D	E	F	G	H	I	J	K	L
54							95% BCA Bootstrap UCL					0.0116749
55							95% H-UCL					0.0129395
56												
57	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
58	k star (bias corrected)					0.5501505	**Data appear Normal at 5% Significance Level**					
59	Theta Star					0.0266927						
60	nu star					8.8024073						
61												
62	A-D Test Statistic					0.3801935	**Nonparametric Statistics**					
63	5% A-D Critical Value					0.7453433	Kaplan-Meier (KM) Method					
64	K-S Test Statistic					0.7453433	Mean					0.0103326
65	5% K-S Critical Value					0.304121	SD					0.0102218
66	**Data appear Gamma Distributed at 5% Significance Level**						SE of Mean					0.0030726
67							95% KM (t) UCL					0.0156086
68	**Assuming Gamma Distribution**						95% KM (z) UCL					0.0153865
69	Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL					0.0157777
70	Minimum					0.00043	95% KM (bootstrap t) UCL					0.016024
71	Maximum					0.0393	95% KM (BCA) UCL					0.0154206
72	Mean					0.0095307	95% KM (Percentile Bootstrap) UCL					0.0151444
73	Median					0.0064801	95% KM (Chebyshev) UCL					0.0237255
74	SD					0.0088055	97.5% KM (Chebyshev) UCL					0.0295207
75	k star					1.3639049	99% KM (Chebyshev) UCL					0.0409041
76	Theta star					0.0069878						
77	Nu star					62.739623	**Potential UCLs to Use**					
78	AppChi2					45.519359	95% KM (t) UCL					0.0156086
79	95% Gamma Approximate UCL					0.0131362	95% KM (Percentile Bootstrap) UCL					0.0151444
80	95% Adjusted Gamma UCL					0.0134504						
81	**Note: DL/2 is not a recommended method.**											
82												
83	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
84	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
85	**For additional insight, the user may want to consult a statistician.**											
86												
87												
88	**1,3,5-Trimethylbenzene**											
89												
90	**General Statistics**											
91	Number of Valid Data					23	Number of Detected Data					3
92	Number of Distinct Detected Data					3	Number of Non-Detect Data					20
93							Percent Non-Detects					86.96%
94												
95	**Raw Statistics**						**Log-transformed Statistics**					
96	Minimum Detected					0.00617	Minimum Detected					-5.088056
97	Maximum Detected					0.0322	Maximum Detected					-3.435789
98	Mean of Detected					0.01799	Mean of Detected					-4.22811
99	SD of Detected					0.0131786	SD of Detected					0.8282071
100	Minimum Non-Detect					0.0044	Minimum Non-Detect					-5.426151
101	Maximum Non-Detect					0.114	Maximum Non-Detect					-2.171557
102												
103	Note: Data have multiple DLs - Use of KM Method is recommended						Number treated as Non-Detect					23
104	For all methods (except KM, DL/2, and ROS Methods),						Number treated as Detected					0
105	Observations < Largest ND are treated as NDs						Single DL Non-Detect Percentage					100.00%
106												

	A	B	C	D	E	F	G	H	I	J	K	L
107	**Warning: There are only 3 Distinct Detected Values in this data set**											
108	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
109	**Those methods will return a 'N/A' value on your output display!**											
110												
111	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
112	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
113	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
114												
115												
116	**UCL Statistics**											
117	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
118					Shapiro Wilk Test Statistic	0.975314					Shapiro Wilk Test Statistic	0.9949805
119					5% Shapiro Wilk Critical Value	0.767					5% Shapiro Wilk Critical Value	0.767
120	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
121												
122	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
123					DL/2 Substitution Method						DL/2 Substitution Method	
124					Mean	0.0155943					Mean	-4.441876
125					SD	0.0142404					SD	0.7538355
126					95% DL/2 (t) UCL	0.0206931					95% H-Stat (DL/2) UCL	0.0223713
127												
128					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
129	**MLE method failed to converge properly**										Mean in Log Scale	-5.18187
130											SD in Log Scale	0.5146305
131											Mean in Original Scale	0.0067127
132											SD in Original Scale	0.0060841
133											95% t UCL	0.0088911
134											95% Percentile Bootstrap UCL	0.008903
135											95% BCA Bootstrap UCL	0.0102133
136											95% H-UCL	0.007974
137												
138	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
139					k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**					
140					Theta Star	N/A						
141					nu star	N/A						
142												
143					A-D Test Statistic	N/A	**Nonparametric Statistics**					
144					5% A-D Critical Value	N/A					Kaplan-Meier (KM) Method	
145					K-S Test Statistic	N/A					Mean	0.0097111
146					5% K-S Critical Value	N/A					SD	0.006516
147	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.0027639
148											95% KM (t) UCL	0.0144572
149	**Assuming Gamma Distribution**										95% KM (z) UCL	0.0142574
150					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.0160855
151					Minimum	N/A					95% KM (bootstrap t) UCL	0.0139218
152					Maximum	N/A					95% KM (BCA) UCL	0.0322
153					Mean	N/A					95% KM (Percentile Bootstrap) UCL	0.0322
154					Median	N/A					95% KM (Chebyshev) UCL	0.0217588
155					SD	N/A					97.5% KM (Chebyshev) UCL	0.0269718
156					k star	N/A					99% KM (Chebyshev) UCL	0.0372118
157					Theta star	N/A						
158					Nu star	N/A	**Potential UCLs to Use**					
159					AppChi2	N/A					95% KM (t) UCL	0.0144572

95% Gamma Approximate UCL	N/A	95% KM (Percentile Bootstrap) UCL	0.0322
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Anthracene

General Statistics

Number of Valid Data	23	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	15
		Percent Non-Detects	65.22%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.108	Minimum Detected	-2.225624
Maximum Detected	2.3	Maximum Detected	0.8329091
Mean of Detected	0.959875	Mean of Detected	-0.489536
SD of Detected	0.8075753	SD of Detected	1.1426392
Minimum Non-Detect	0.252	Minimum Non-Detect	-1.378326
Maximum Non-Detect	1.32	Maximum Non-Detect	0.2776317

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	3
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	86.96%

Warning: There are only 8 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.915803	Shapiro Wilk Test Statistic	0.916034
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.4444348	Mean	-1.409976
SD	0.6061197	SD	0.9981194
95% DL/2 (t) UCL	0.6614556	95% H-Stat (DL/2) UCL	0.6873961
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.200871	Mean in Log Scale	-1.503124
SD	0.9996583	SD in Log Scale	1.0228144
95% MLE (t) UCL	0.558798	Mean in Original Scale	0.4219063
95% MLE (Tiku) UCL	1.4180987	SD in Original Scale	0.6081628
		95% t UCL	0.6396586

	A	B	C	D	E	F	G	H	I	J	K	L
213											95% Percentile Bootstrap UCL	0.6430715
214											95% BCA Bootstrap UCL	0.6930573
215											95% H UCL	0.6552794
216												
217	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
218					k star (bias corrected)	0.8677645	**Data appear Normal at 5% Significance Level**					
219					Theta Star	1.1061469						
220					nu star	13.884232						
221												
222					A-D Test Statistic	0.2381406	**Nonparametric Statistics**					
223					5% A-D Critical Value	0.7318879					Kaplan-Meier (KM) Method	
224					K-S Test Statistic	0.7318879					Mean	0.4163616
225					5% K-S Critical Value	0.3001539					SD	0.5984913
226	**Data appear Gamma Distributed at 5% Significance Level**										SE of Mean	0.1339272
227											95% KM (t) UCL	0.6463338
228	**Assuming Gamma Distribution**										95% KM (z) UCL	0.6366521
229					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.637182
230					Minimum	0.000001					95% KM (bootstrap t) UCL	0.7488056
231					Maximum	2.3					95% KM (BCA) UCL	0.9166522
232					Mean	0.3747668					95% KM (Percentile Bootstrap) UCL	0.7569794
233					Median	0.108					95% KM (Chebyshev) UCL	1.0001366
234					SD	0.6374849					97.5% KM (Chebyshev) UCL	1.2527365
235					k star	0.1416807					99% KM (Chebyshev) UCL	1.7489201
236					Theta star	2.6451499						
237					Nu star	6.517314	**Potential UCLs to Use**					
238					AppChi2	1.9096895					95% KM (t) UCL	0.6463338
239					95% Gamma Approximate UCL	1.2789895					95% KM (Percentile Bootstrap) UCL	0.7569794
240					95% Adjusted Gamma UCL	1.4079497						
241	**Note: DL/2 is not a recommended method.**											
242												
243	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
244	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
245	**For additional insight, the user may want to consult a statistician.**											
246												
247												
248	**Arsenic**											
249												
250	**General Statistics**											
251					Number of Valid Observations	14					Number of Distinct Observations	14
252					Number of Missing Values	10						
253												
254	**Raw Statistics**						**Log-transformed Statistics**					
255					Minimum	2.16					Minimum of Log Data	0.7701082
256					Maximum	19.1					Maximum of Log Data	2.9496883
257					Mean	7.5714286					Mean of log Data	1.8530709
258					Median	5.955					SD of log Data	0.6075627
259					SD	4.7978839						
260					Std. Error of Mean	1.2822884						
261					Coefficient of Variation	0.6336828						
262					Skewness	1.3362561						
263												
264	**Relevant UCL Statistics**											
265	**Normal Distribution Test**						**Lognormal Distribution Test**					

266	Shapiro Wilk Test Statistic	0.8780122	Shapiro Wilk Test Statistic	0.9877143
267	Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
268	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
269				
270	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
271	95% Student's-t UCL	9.842276	95% H-UCL	11.149805
272	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	13.118947
273	95% Adjusted-CLT UCL (Chen-1995)	10.169924	97.5% Chebyshev (MVUE) UCL	15.525369
274	95% Modified-t UCL (Johnson-1978)	9.9185998	99% Chebyshev (MVUE) UCL	20.25232
275				
276	**Gamma Distribution Test**		**Data Distribution**	
277	k star (bias corrected)	2.4638908	**Data appear Normal at 5% Significance Level**	
278	Theta Star	3.0729563		
279	MLE of Mean	7.5714286		
280	MLE of Standard Deviation	4.8235535		
281	nu star	68.988942		
282	Approximate Chi Square Value (.05)	50.869763	**Nonparametric Statistics**	
283	Adjusted Level of Significance	0.03122	95% CLT UCL	9.6806053
284	Adjusted Chi Square Value	48.809854	95% Jackknife UCL	9.842276
285			95% Standard Bootstrap UCL	9.5445054
286	Anderson-Darling Test Statistic	0.2186052	95% Bootstrap-t UCL	10.643419
287	Anderson-Darling 5% Critical Value	0.7423401	95% Hall's Bootstrap UCL	11.563281
288	Kolmogorov-Smirnov Test Statistic	0.127391	95% Percentile Bootstrap UCL	9.7578571
289	Kolmogorov-Smirnov 5% Critical Value	0.2304443	95% BCA Bootstrap UCL	10.208571
290	**Data appear Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	13.160794
291			97.5% Chebyshev(Mean, Sd) UCL	15.579317
292	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	20.330037
293	95% Approximate Gamma UCL	10.268278		
294	95% Adjusted Gamma UCL	10.701627		
295				
296	**Potential UCL to Use**		Use 95% Student's-t UCL	9.842276
297				
298	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
299	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
300	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
301				
302				
303	**Barium**			
304				
305	**General Statistics**			
306	Number of Valid Observations	14	Number of Distinct Observations	13
307	Number of Missing Values	9		
308				
309	**Raw Statistics**		**Log-transformed Statistics**	
310	Minimum	72.2	Minimum of Log Data	4.27944
311	Maximum	1240	Maximum of Log Data	7.1228667
312	Mean	240.45	Mean of log Data	5.1255988
313	Median	129	SD of log Data	0.7477406
314	SD	301.63035		
315	Std. Error of Mean	80.614101		
316	Coefficient of Variation	1.254441		
317	Skewness	3.2077731		
318				

319	**Relevant UCL Statistics**			
320	**Normal Distribution Test**		**Lognormal Distribution Test**	
321	Shapiro Wilk Test Statistic	0.5405244	Shapiro Wilk Test Statistic	0.8517504
322	Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
323	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
324				
325	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
326	95% Student's-t UCL	383.2122	95% H-UCL	366.29246
327	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	417.02586
328	95% Adjusted-CLT UCL (Chen-1995)	446.89509	97.5% Chebyshev (MVUE) UCL	503.48585
329	95% Modified-t UCL (Johnson-1978)	394.7308	99% Chebyshev (MVUE) UCL	673.31978
330				
331	**Gamma Distribution Test**		**Data Distribution**	
332	k star (bias corrected)	1.2627128	**Data do not follow a Discernable Distribution (0.05)**	
333	Theta Star	190.42335		
334	MLE of Mean	240.45		
335	MLE of Standard Deviation	213.97966		
336	nu star	35.355958		
337	Approximate Chi Square Value (.05)	22.750838	**Nonparametric Statistics**	
338	Adjusted Level of Significance	0.03122	95% CLT UCL	373.0484
339	Adjusted Chi Square Value	21.416096	95% Jackknife UCL	383.2122
340			95% Standard Bootstrap UCL	369.50364
341	Anderson-Darling Test Statistic	1.3173084	95% Bootstrap-t UCL	693.82217
342	Anderson-Darling 5% Critical Value	0.7502112	95% Hall's Bootstrap UCL	807.92299
343	Kolmogorov-Smirnov Test Statistic	0.2341519	95% Percentile Bootstrap UCL	384.22143
344	Kolmogorov-Smirnov 5% Critical Value	0.2326287	95% BCA Bootstrap UCL	479.06429
345	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	591.83872
346			97.5% Chebyshev(Mean, Sd) UCL	743.8849
347	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	1042.5502
348	95% Approximate Gamma UCL	373.67151		
349	95% Adjusted Gamma UCL	396.96031		
350				
351	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	591.83872
352				
353	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
354	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
355	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
356				
357				
358	**Benzo(a)anthracene**			
359				
360	**General Statistics**			
361	Number of Valid Data	23	Number of Detected Data	10
362	Number of Distinct Detected Data	10	Number of Non-Detect Data	13
363			Percent Non-Detects	56.52%
364				
365	**Raw Statistics**		**Log-transformed Statistics**	
366	Minimum Detected	0.0944	Minimum Detected	-2.360214
367	Maximum Detected	8.61	Maximum Detected	2.1529243
368	Mean of Detected	2.17514	Mean of Detected	-0.164623
369	SD of Detected	2.698739	SD of Detected	1.6427962
370	Minimum Non-Detect	0.252	Minimum Non-Detect	-1.378326
371	Maximum Non-Detect	1.32	Maximum Non-Detect	0.2776317

	A B C D E	F	G H I J K	L
372				
373	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
374	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
375	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	82.61%
376				
377			**UCL Statistics**	
378	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
379	Shapiro Wilk Test Statistic	0.7932823	Shapiro Wilk Test Statistic	0.9109975
380	5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
381	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
382				
383	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
384	DL/2 Substitution Method		DL/2 Substitution Method	
385	Mean	1.0441261	Mean	-1.140055
386	SD	2.0049553	SD	1.4060384
387	95% DL/2 (t) UCL	1.761999	95% H-Stat (DL/2) UCL	2.1789225
388				
389	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
390	Mean	5.1988367	Mean in Log Scale	-1.04849
391	SD	2.3276705	SD in Log Scale	1.3396939
392	95% MLE (t) UCL	6.0322576	Mean in Original Scale	1.0513374
393	95% MLE (Tiku) UCL	7.1558396	SD in Original Scale	1.9993017
394			95% t UCL	1.7671861
395			95% Percentile Bootstrap UCL	1.7828182
396			95% BCA Bootstrap UCL	2.0436678
397			95% H UCL	2.0279079
398				
399	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
400	k star (bias corrected)	0.5207583	**Data appear Gamma Distributed at 5% Significance Level**	
401	Theta Star	4.1768703		
402	nu star	10.415167		
403				
404	A-D Test Statistic	0.3673098	**Nonparametric Statistics**	
405	5% A-D Critical Value	0.7650819	Kaplan-Meier (KM) Method	
406	K-S Test Statistic	0.7650819	Mean	1.0383971
407	5% K-S Critical Value	0.2779533	SD	1.962266
408	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.4319445
409			95% KM (t) UCL	1.7801081
410	**Assuming Gamma Distribution**		95% KM (z) UCL	1.7488825
411	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.7583998
412	Minimum	0.000001	95% KM (bootstrap t) UCL	2.4163713
413	Maximum	8.61	95% KM (BCA) UCL	1.7878261
414	Mean	0.979997	95% KM (Percentile Bootstrap) UCL	1.8133696
415	Median	0.0944	95% KM (Chebyshev) UCL	2.9211994
416	SD	2.0347312	97.5% KM (Chebyshev) UCL	3.7358895
417	k star	0.131541	99% KM (Chebyshev) UCL	5.3361903
418	Theta star	7.4501256		
419	Nu star	6.0508859	**Potential UCLs to Use**	
420	AppChi2	1.665925	95% KM (t) UCL	1.7801081
421	95% Gamma Approximate UCL	3.5594938		
422	95% Adjusted Gamma UCL	3.9386553		
423	**Note: DL/2 is not a recommended method.**			
424				

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Benzo(a)pyrene

General Statistics

Number of Valid Data	23	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	15
		Percent Non-Detects	65.22%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.197	Minimum Detected	-1.624552
Maximum Detected	5.75	Maximum Detected	1.7491999
Mean of Detected	2.043125	Mean of Detected	0.1827138
SD of Detected	1.9196516	SD of Detected	1.2540414
Minimum Non-Detect	0.0787	Minimum Non-Detect	-2.542112
Maximum Non-Detect	0.411	Maximum Non-Detect	-0.889162
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	17
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	73.91%

Warning: There are only 8 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.885726	Shapiro Wilk Test Statistic	0.903107
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.7451217	Mean	-1.936068
SD	1.4536392	SD	1.7639963
95% DL/2 (t) UCL	1.2655963	95% H-Stat (DL/2) UCL	2.7137305
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-2.342857
		SD in Log Scale	2.0301077
		Mean in Original Scale	0.7277043
		SD in Original Scale	1.4619702
		95% t UCL	1.2511618
		95% Percentile Bootstrap UCL	1.2507038
		95% BCA Bootstrap UCL	1.4975738
		95% H-UCL	4.45128

	A–E	F	G–K	L
478	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
479	k star (bias corrected)	0.7560432	**Data appear Normal at 5% Significance Level**	
480	Theta Star	2.7023917		
481	nu star	12.096692		
482				
483	A-D Test Statistic	0.2600074	**Nonparametric Statistics**	
484	5% A-D Critical Value	0.7344191	Kaplan-Meier (KM) Method	
485	K-S Test Statistic	0.7344191	Mean	0.8391332
486	5% K-S Critical Value	0.3010692	SD	1.376466
487	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.3068298
488			95% KM (t) UCL	1.3660042
489	**Assuming Gamma Distribution**		95% KM (z) UCL	1.3438233
490	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.3425152
491	Minimum	0.000001	95% KM (bootstrap t) UCL	1.6940507
492	Maximum	5.75	95% KM (BCA) UCL	2.1708696
493	Mean	0.7106528	95% KM (Percentile Bootstrap) UCL	1.5626087
494	Median	0.000001	95% KM (Chebyshev) UCL	2.1765733
495	SD	1.4705392	97.5% KM (Chebyshev) UCL	2.7552847
496	k star	0.1115804	99% KM (Chebyshev) UCL	3.8920512
497	Theta star	6.3689728		
498	Nu star	5.1327005	**Potential UCLs to Use**	
499	AppChi2	1.2139847	95% KM (t) UCL	1.3660042
500	95% Gamma Approximate UCL	3.0046244	95% KM (Percentile Bootstrap) UCL	1.5626087
501	95% Adjusted Gamma UCL	3.3663745		
502	**Note: DL/2 is not a recommended method.**			
503				
504	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
505	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
506	**For additional insight, the user may want to consult a statistician.**			
507				
508				
509	**Benzo(b)fluoranthene**			
510				
511	**General Statistics**			
512	Number of Valid Data	23	Number of Detected Data	8
513	Number of Distinct Detected Data	8	Number of Non-Detect Data	15
514			Percent Non-Detects	65.22%
515				
516	**Raw Statistics**		**Log-transformed Statistics**	
517	Minimum Detected	0.213	Minimum Detected	-1.546463
518	Maximum Detected	10.6	Maximum Detected	2.360854
519	Mean of Detected	3.571875	Mean of Detected	0.6016721
520	SD of Detected	3.5977454	SD of Detected	1.4558559
521	Minimum Non-Detect	0.252	Minimum Non-Detect	-1.378326
522	Maximum Non-Detect	1.32	Maximum Non-Detect	0.2776317
523				
524	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	18
525	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
526	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	78.26%
527				
528	**Warning: There are only 8 Detected Values in this data**			
529	**Note: It should be noted that even though bootstrap may be performed on this data set**			
530	**the resulting calculations may not be reliable enough to draw conclusions**			

	A	B	C	D	E	F	G	H	I	J	K	L
531												
532	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
533												
534												
535	**UCL Statistics**											
536	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
537					Shapiro Wilk Test Statistic	0.8769927					Shapiro Wilk Test Statistic	0.9037644
538					5% Shapiro Wilk Critical Value	0.818					5% Shapiro Wilk Critical Value	0.818
539	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
540												
541	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
542					DL/2 Substitution Method						DL/2 Substitution Method	
543					Mean	1.3529565					Mean	-1.030425
544					SD	2.6221149					SD	1.5060087
545					95% DL/2 (t) UCL	2.291803					95% H-Stat (DL/2) UCL	3.1564672
546												
547					Maximum Likelihood Estimate(MLE) Method						Log ROS Method	
548					Mean	6.0547263					Mean in Log Scale	-0.707035
549					SD	2.9969758					SD in Log Scale	1.3125825
550					95% MLE (t) UCL	7.1277916					Mean in Original Scale	1.4133993
551					95% MLE (Tiku) UCL	8.2995969					SD in Original Scale	2.5927448
552											95% t UCL	2.3417299
553											95% Percentile Bootstrap UCL	2.4055826
554											95% BCA Bootstrap UCL	2.6633551
555											95% H UCL	2.6749398
556												
557	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
558					k star (bias corrected)	0.6295335	**Data appear Normal at 5% Significance Level**					
559					Theta Star	5.6738442						
560					nu star	10.072536						
561												
562					A-D Test Statistic	0.2533866	**Nonparametric Statistics**					
563					5% A-D Critical Value	0.7403566					Kaplan-Meier (KM) Method	
564					K-S Test Statistic	0.7403566					Mean	1.3928645
565					5% K-S Critical Value	0.3027712					SD	2.5443235
566	**Data appear Gamma Distributed at 5% Significance Level**										SE of Mean	0.5672846
567											95% KM (t) UCL	2.366974
568	**Assuming Gamma Distribution**										95% KM (z) UCL	2.3259646
569					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	2.3247945
570					Minimum	0.000001					95% KM (bootstrap t) UCL	3.0876055
571					Maximum	10.6					95% KM (BCA) UCL	3.3519565
572					Mean	1.2959258					95% KM (Percentile Bootstrap) UCL	2.755
573					Median	0.000001					95% KM (Chebyshev) UCL	3.8656007
574					SD	2.6504831					97.5% KM (Chebyshev) UCL	4.9355557
575					k star	0.1237071					99% KM (Chebyshev) UCL	7.0372751
576					Theta star	10.47576						
577					Nu star	5.6905264	**Potential UCLs to Use**					
578					AppChi2	1.483811					95% KM (t) UCL	2.366974
579					95% Gamma Approximate UCL	4.9699725					95% KM (Percentile Bootstrap) UCL	2.755
580					95% Adjusted Gamma UCL	5.5240997						
581	**Note: DL/2 is not a recommended method.**											
582												
583	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Benzo(k)fluoranthene

General Statistics

Number of Valid Data	23	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	16
		Percent Non-Detects	69.57%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0848	Minimum Detected	-2.46746
Maximum Detected	4.48	Maximum Detected	1.499623
Mean of Detected	1.6002571	Mean of Detected	-0.07304
SD of Detected	1.5306991	SD of Detected	1.3154245
Minimum Non-Detect	0.252	Minimum Non-Detect	-1.378326
Maximum Non-Detect	1.32	Maximum Non-Detect	0.2776317
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	86.96%

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.8917031	Shapiro Wilk Test Statistic	0.9475812
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.6033609	Mean	-1.349809
SD	1.0513586	SD	1.1517657
95% DL/2 (t) UCL	0.9797991	95% H-Stat (DL/2) UCL	0.9843664
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	3.2302051	Mean in Log Scale	-1.780456
SD	1.1153774	SD in Log Scale	1.3961169
95% MLE (t) UCL	3.6295652	Mean in Original Scale	0.5480697
95% MLE (Tiku) UCL	4.3150857	SD in Original Scale	1.0706821
		95% t UCL	0.9314267
		95% Percentile Bootstrap UCL	0.9239409
		95% BCA Bootstrap UCL	1.0584522
		95% H UCL	1.1201901
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	

k star (bias corrected)	0.6986389	**Data appear Normal at 5% Significance Level**	
Theta Star	2.2905354		
nu star	9.7809447		
A-D Test Statistic	0.1512053	**Nonparametric Statistics**	
5% A-D Critical Value	0.7267995	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7267995	Mean	0.5504943
5% K-S Critical Value	0.3193102	SD	1.0471845
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.2361663
		95% KM (t) UCL	0.9560258
Assuming Gamma Distribution		95% KM (z) UCL	0.9389532
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.896325
Minimum	0.000001	95% KM (bootstrap t) UCL	1.1493123
Maximum	4.48	95% KM (BCA) UCL	1.432087
Mean	0.4870355	95% KM (Percentile Bootstrap) UCL	1.2512815
Median	0.000001	95% KM (Chebyshev) UCL	1.5799192
SD	1.0981041	97.5% KM (Chebyshev) UCL	2.0253521
k star	0.1090277	99% KM (Chebyshev) UCL	2.900319
Theta star	4.4670783		
Nu star	5.0152763	**Potential UCLs to Use**	
AppChi2	1.1592462	95% KM (t) UCL	0.9560258
95% Gamma Approximate UCL	2.107074	95% KM (Percentile Bootstrap) UCL	1.2512815
95% Adjusted Gamma UCL	2.3651606		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			
bis(2-ethylhexyl) Phthalate			
General Statistics			
Number of Valid Data	23	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	21
		Percent Non-Detects	91.30%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.923	Minimum Detected	-0.080126
Maximum Detected	2.12	Maximum Detected	0.7514161
Mean of Detected	1.5215	Mean of Detected	0.335645
SD of Detected	0.8464068	SD of Detected	0.5879891
Minimum Non-Detect	0.252	Minimum Non-Detect	-1.378326
Maximum Non-Detect	1.33	Maximum Non-Detect	0.2851789
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	22
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	95.65%
Warning: Data set has only 2 Distinct Detected Values.			
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.			
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).			

	A–E	F	G–K	L
690	Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.			
691				
692	The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.			
693	Those methods will return a 'N/A' value on your output display!			
694				
695	It is necessary to have 4 or more Distinct Values for bootstrap methods.			
696	However, results obtained using 4 to 9 distinct values may not be reliable.			
697	It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.			
698				
699				
700	**UCL Statistics**			
701	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
702	Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
703	5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
704	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
705				
706	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
707	DL/2 Substitution Method		DL/2 Substitution Method	
708	Mean	0.2776087	Mean	-1.737783
709	SD	0.4459296	SD	0.7457413
710	95% DL/2 (t) UCL	0.4372735	95% H-Stat (DL/2) UCL	0.3304721
711				
712	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
713	**MLE method failed to converge properly**		Mean in Log Scale	N/A
714			SD in Log Scale	N/A
715			Mean in Original Scale	N/A
716			SD in Original Scale	N/A
717			95% t UCL	N/A
718			95% Percentile Bootstrap UCL	N/A
719			95% BCA Bootstrap UCL	N/A
720			95% H-UCL	N/A
721				
722	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
723	k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**	
724	Theta Star	N/A		
725	nu star	N/A		
726				
727	A-D Test Statistic	N/A	**Nonparametric Statistics**	
728	5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
729	K-S Test Statistic	N/A	Mean	0.9750435
730	5% K-S Critical Value	N/A	SD	0.2441056
731	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0719828
732			95% KM (t) UCL	1.0986483
733	**Assuming Gamma Distribution**		95% KM (z) UCL	1.0934446
734	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.7649996
735	Minimum	N/A	95% KM (bootstrap t) UCL	N/A
736	Maximum	N/A	95% KM (BCA) UCL	2.12
737	Mean	N/A	95% KM (Percentile Bootstrap) UCL	2.12
738	Median	N/A	95% KM (Chebyshev) UCL	1.2888092
739	SD	N/A	97.5% KM (Chebyshev) UCL	1.4245759
740	k star	N/A	99% KM (Chebyshev) UCL	1.6912633
741	Theta star	N/A		
742	Nu star	N/A	**Potential UCLs to Use**	

AppChi2	N/A	95% KM (t) UCL	1.0986483
95% Gamma Approximate UCL	N/A	95% KM (% Bootstrap) UCL	2.12
95% Adjusted Gamma UCL	N/A		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			
Cadmium			
General Statistics			
Number of Valid Observations	14	Number of Distinct Observations	14
Number of Missing Values	9		
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.115	Minimum of Log Data	-2.162823
Maximum	23.9	Maximum of Log Data	3.1738785
Mean	2.2789286	Mean of log Data	-0.95054
Median	0.206	SD of log Data	1.5756559
SD	6.302285		
Std. Error of Mean	1.6843565		
Coefficient of Variation	2.7654596		
Skewness	3.5878705		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.3883453	Shapiro Wilk Test Statistic	0.7070361
Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	5.2618118	95% H-UCL	7.1493561
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.4896926
95% Adjusted-CLT UCL (Chen-1995)	6.7752354	97.5% Chebyshev (MVUE) UCL	4.5085839
95% Modified-t UCL (Johnson-1978)	5.5309997	99% Chebyshev (MVUE) UCL	6.5099985
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.3421083	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	6.6614253		
MLE of Mean	2.2789286		
MLE of Standard Deviation	3.896269		
nu star	9.5790311		
Approximate Chi Square Value (.05)	3.6804	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03122	95% CLT UCL	5.0494485
Adjusted Chi Square Value	3.2103937	95% Jackknife UCL	5.2618118
		95% Standard Bootstrap UCL	4.9714675
Anderson-Darling Test Statistic	2.6425321	95% Bootstrap-t UCL	18.589096
Anderson-Darling 5% Critical Value	0.8175329	95% Hall's Bootstrap UCL	18.999211
Kolmogorov-Smirnov Test Statistic	0.4311709	95% Percentile Bootstrap UCL	5.4790714
Kolmogorov-Smirnov 5% Critical Value	0.2454923	95% BCA Bootstrap UCL	7.3413571
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	9.6208684

	A	B	C	D	E	F	G	H	I	J	K	L
796									97.5% Chebyshev(Mean, Sd) UCL			12.797732
797			**Assuming Gamma Distribution**						99% Chebyshev(Mean, Sd) UCL			19.038064
798				95% Approximate Gamma UCL		5.9314008						
799				95% Adjusted Gamma UCL		6.7997665						
800												
801			**Potential UCL to Use**						Use 99% Chebyshev (Mean, Sd) UCL			19.038064
802												
803	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
804	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
805	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
806												
807												
808	**Carbon disulfide**											
809												
810						**General Statistics**						
811				Number of Valid Data		23			Number of Detected Data			1
812				Number of Distinct Detected Data		1			Number of Non-Detect Data			22
813									Percent Non-Detects			95.65%
814												
815	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
816	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**											
817												
818	**The data set for variable Carbon disulfide was not processed!**											
819												
820												
821												
822	**Chromium, Hexavalent**											
823												
824						**General Statistics**						
825				Number of Valid Data		4			Number of Detected Data			3
826				Number of Distinct Detected Data		3			Number of Non-Detect Data			1
827				Number of Missing Values		8			Percent Non-Detects			25.00%
828												
829	**Warning: This data set only has 4 observations!**											
830	**Data set is too small to compute reliable and meaningful statistics and estimates!**											
831	**The data set for variable Chromium, Hexavalent was not processed!**											
832												
833	**It is suggested to collect at least 8 to 10 observations before using these statistical methods!**											
834	**If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.**											
835												
836												
837												
838	**Dibenz(a,h)anthracene**											
839												
840						**General Statistics**						
841				Number of Valid Data		23			Number of Detected Data			5
842				Number of Distinct Detected Data		5			Number of Non-Detect Data			18
843									Percent Non-Detects			78.26%
844												
845			**Raw Statistics**						**Log-transformed Statistics**			
846				Minimum Detected		0.16			Minimum Detected			-1.832581
847				Maximum Detected		2.42			Maximum Detected			0.8837675
848				Mean of Detected		0.8182			Mean of Detected			-0.614452

	A	B	C	D	E	F	G	H	I	J	K	L
849					SD of Detected	0.9123016					SD of Detected	0.9857227
850					Minimum Non-Detect	0.0787					Minimum Non-Detect	-2.542112
851					Maximum Non-Detect	0.706					Maximum Non-Detect	-0.34814
852												
853	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	22
854	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	1
855	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	95.65%
856												
857	**Warning: There are only 5 Detected Values in this data**											
858	**Note: It should be noted that even though bootstrap may be performed on this data set**											
859	**the resulting calculations may not be reliable enough to draw conclusions**											
860												
861	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
862												
863												
864	**UCL Statistics**											
865	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
866					Shapiro Wilk Test Statistic	0.7347545					Shapiro Wilk Test Statistic	0.957579
867					5% Shapiro Wilk Critical Value	0.762					5% Shapiro Wilk Critical Value	0.762
868	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
869												
870	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
871					DL/2 Substitution Method						DL/2 Substitution Method	
872					Mean	0.2312957					Mean	-2.455172
873					SD	0.5063662					SD	1.2034534
874					95% DL/2 (t) UCL	0.4125997					95% H-Stat (DL/2) UCL	0.3637561
875												
876					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
877	**MLE method failed to converge properly**										Mean in Log Scale	-3.185945
878											SD in Log Scale	1.4995217
879											Mean in Original Scale	0.1951604
880											SD in Original Scale	0.5139279
881											95% t UCL	0.3791719
882											95% Percentile Bootstrap UCL	0.3883321
883											95% BCA Bootstrap UCL	0.4881664
884											95% H-UCL	0.3593289
885												
886	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
887					k star (bias corrected)	0.6736055	**Data appear Gamma Distributed at 5% Significance Level**					
888					Theta Star	1.2146575						
889					nu star	6.7360554						
890												
891					A-D Test Statistic	0.4070832	**Nonparametric Statistics**					
892					5% A-D Critical Value	0.6878683					Kaplan-Meier (KM) Method	
893					K-S Test Statistic	0.6878683					Mean	0.3057858
894					5% K-S Critical Value	0.3624883					SD	0.4675486
895	**Data appear Gamma Distributed at 5% Significance Level**										SE of Mean	0.1092135
896											95% KM (t) UCL	0.4933212
897	**Assuming Gamma Distribution**										95% KM (z) UCL	0.485426
898					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.4854868
899					Minimum	0.000001					95% KM (bootstrap t) UCL	0.7053116
900					Maximum	2.42					95% KM (BCA) UCL	0.7525678
901					Mean	0.1778703					95% KM (Percentile Bootstrap) UCL	0.6710435

	A	B	C	D	E	F	G	H	I	J	K	L
902					Median	0.000001					95% KM (Chebyshev) UCL	0.7818364
903					SD	0.5199983					97.5% KM (Chebyshev) UCL	0.9878239
904					k star	0.1066575					99% KM (Chebyshev) UCL	1.3924464
905					Theta star	1.6676775						
906					Nu star	4.9062461			**Potential UCLs to Use**			
907					AppChi2	1.1091137					95% KM (t) UCL	0.4933212
908					95% Gamma Approximate UCL	0.7868226						
909					95% Adjusted Gamma UCL	0.8847803						
910	**Note: DL/2 is not a recommended method.**											
911												
912	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
913	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
914	**For additional insight, the user may want to consult a statistician.**											
915												
916												
917	**Diesel Range Organics (DRO)**											
918												
919						**General Statistics**						
920					Number of Valid Data	23					Number of Detected Data	19
921					Number of Distinct Detected Data	19					Number of Non-Detect Data	4
922											Percent Non-Detects	17.39%
923												
924			**Raw Statistics**						**Log-transformed Statistics**			
925					Minimum Detected	6.8					Minimum Detected	1.9169226
926					Maximum Detected	2270					Maximum Detected	7.7275351
927					Mean of Detected	246.19579					Mean of Detected	4.0168811
928					SD of Detected	530.41868					SD of Detected	1.716857
929					Minimum Non-Detect	20.3					Minimum Non-Detect	3.0106209
930					Maximum Non-Detect	21.4					Maximum Non-Detect	3.0633909
931												
932	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	11
933	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	12
934	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	47.83%
935												
936						**UCL Statistics**						
937			**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**			
938					Shapiro Wilk Test Statistic	0.4972933					Shapiro Wilk Test Statistic	0.9158024
939					5% Shapiro Wilk Critical Value	0.901					5% Shapiro Wilk Critical Value	0.901
940			**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**			
941												
942			**Assuming Normal Distribution**						**Assuming Lognormal Distribution**			
943					DL/2 Substitution Method						DL/2 Substitution Method	
944					Mean	205.20957					Mean	3.7276012
945					SD	488.39802					SD	1.6814628
946					95% DL/2 (t) UCL	380.08016					95% H-Stat (DL/2) UCL	606.4982
947												
948					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
949			**MLE yields a negative mean**								Mean in Log Scale	3.7337305
950											SD in Log Scale	1.6825047
951											Mean in Original Scale	205.38395
952											SD in Original Scale	488.32813
953											95% t UCL	380.22952
954											95% Percentile Bootstrap UCL	387.61808

		95% BCA Bootstrap UCL	518.08978
		95% H-UCL	612.14287
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.4021005	**Data appear Lognormal at 5% Significance Level**	
Theta Star	612.27425		
nu star	15.279819		
A-D Test Statistic	1.3587803	**Nonparametric Statistics**	
5% A-D Critical Value	0.8156377	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.8156377	Mean	205.27776
5% K-S Critical Value	0.2116392	SD	477.63602
Data not Gamma Distributed at 5% Significance Level		SE of Mean	102.32348
		95% KM (t) UCL	380.98195
Assuming Gamma Distribution		95% KM (z) UCL	373.58491
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	380.13946
Minimum	0.000001	95% KM (bootstrap t) UCL	690.87025
Maximum	2270	95% KM (BCA) UCL	392.51739
Mean	203.37913	95% KM (Percentile Bootstrap) UCL	394.64957
Median	23	95% KM (Chebyshev) UCL	651.29546
SD	489.17723	97.5% KM (Chebyshev) UCL	844.28768
k star	0.17794	99% KM (Chebyshev) UCL	1223.3835
Theta star	1142.9645		
Nu star	8.1852411	**Potential UCLs to Use**	
AppChi2	2.842752	99% KM (Chebyshev) UCL	1223.3835
95% Gamma Approximate UCL	585.59705		
95% Adjusted Gamma UCL	635.63719		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Gasoline Range Organics (GRO)

General Statistics

Number of Valid Data	23	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	21
		Percent Non-Detects	91.30%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.924	Minimum Detected	-0.079043
Maximum Detected	1.8	Maximum Detected	0.5877867
Mean of Detected	1.362	Mean of Detected	0.2543717
SD of Detected	0.6194255	SD of Detected	0.4715199
Minimum Non-Detect	1.47	Minimum Non-Detect	0.3852624
Maximum Non-Detect	11.4	Maximum Non-Detect	2.4336134
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	23
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

	A–E	F	G–K	L
1008	**Warning: Data set has only 2 Distinct Detected Values.**			
1009	**This may not be adequate enough to compute meaningful and reliable test statistics and estimates.**			
1010	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**			
1011				
1012	**Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.**			
1013				
1014	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**			
1015	**Those methods will return a 'N/A' value on your output display!**			
1016				
1017	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**			
1018	**However, results obtained using 4 to 9 distinct values may not be reliable.**			
1019	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**			
1020				
1021				
1022	**UCL Statistics**			
1023	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1024	Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
1025	5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
1026	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1027				
1028	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1029	DL/2 Substitution Method		DL/2 Substitution Method	
1030	Mean	1.613	Mean	0.3111686
1031	SD	1.3127732	SD	0.5069151
1032	95% DL/2 (t) UCL	2.0830376	95% H-Stat (DL/2) UCL	1.9223159
1033				
1034	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
1035	**MLE method failed to converge properly**		Mean in Log Scale	N/A
1036			SD in Log Scale	N/A
1037			Mean in Original Scale	N/A
1038			SD in Original Scale	N/A
1039			95% t UCL	N/A
1040			95% Percentile Bootstrap UCL	N/A
1041			95% BCA Bootstrap UCL	N/A
1042			95% H-UCL	N/A
1043				
1044	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1045	k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**	
1046	Theta Star	N/A		
1047	nu star	N/A		
1048				
1049	A-D Test Statistic	N/A	**Nonparametric Statistics**	
1050	5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
1051	K-S Test Statistic	N/A	Mean	1.216
1052	5% K-S Critical Value	N/A	SD	0.4129504
1053	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.3371726
1054			95% KM (t) UCL	1.7949739
1055	**Assuming Gamma Distribution**		95% KM (z) UCL	1.7705995
1056	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.9101387
1057	Minimum	N/A	95% KM (bootstrap t) UCL	1.753331
1058	Maximum	N/A	95% KM (BCA) UCL	N/A
1059	Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
1060	Median	N/A	95% KM (Chebyshev) UCL	2.6857011

	A	B	C	D	E	F	G	H	I	J	K	L
1061					SD	N/A					97.5% KM (Chebyshev) UCL	3.3216419
1062					k star	N/A					99% KM (Chebyshev) UCL	4.5708246
1063					Theta star	N/A						
1064					Nu star	N/A	**Potential UCLs to Use**					
1065					AppChi2	N/A					95% KM (t) UCL	1.7949739
1066					95% Gamma Approximate UCL	N/A					95% KM (% Bootstrap) UCL	N/A
1067					95% Adjusted Gamma UCL	N/A						
1068	**Note: DL/2 is not a recommended method.**											
1069												
1070	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1071	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1072	**For additional insight, the user may want to consult a statistician.**											
1073												
1074												
1075	**Indeno(1,2,3-c,d)Pyrene**											
1076												
1077	**General Statistics**											
1078					Number of Valid Data	23					Number of Detected Data	8
1079					Number of Distinct Detected Data	7					Number of Non-Detect Data	15
1080											Percent Non-Detects	65.22%
1081												
1082	**Raw Statistics**						**Log-transformed Statistics**					
1083					Minimum Detected	0.0957					Minimum Detected	-2.346537
1084					Maximum Detected	1.88					Maximum Detected	0.6312718
1085					Mean of Detected	1.0129625					Mean of Detected	-0.534526
1086					SD of Detected	0.8405529					SD of Detected	1.2946103
1087					Minimum Non-Detect	0.252					Minimum Non-Detect	-1.378326
1088					Maximum Non-Detect	1.32					Maximum Non-Detect	0.2776317
1089												
1090	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	19
1091	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	4
1092	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	82.61%
1093												
1094	**Warning: There are only 8 Detected Values in this data**											
1095	**Note: It should be noted that even though bootstrap may be performed on this data set**											
1096	**the resulting calculations may not be reliable enough to draw conclusions**											
1097												
1098	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
1099												
1100												
1101	**UCL Statistics**											
1102	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
1103					Shapiro Wilk Test Statistic	0.7881071					Shapiro Wilk Test Statistic	0.8217138
1104					5% Shapiro Wilk Critical Value	0.818					5% Shapiro Wilk Critical Value	0.818
1105	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
1106												
1107	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1108					DL/2 Substitution Method						DL/2 Substitution Method	
1109					Mean	0.4629					Mean	-1.425625
1110					SD	0.6365876					SD	1.0413729
1111					95% DL/2 (t) UCL	0.6908298					95% H-Stat (DL/2) UCL	0.7331052
1112												
1113					Maximum Likelihood Estimate(MLE) Method						Log ROS Method	

	A–E	F	G–K	L
1114	Mean	0.6434331	Mean in Log Scale	-1.634535
1115	SD	0.7439326	SD in Log Scale	1.1301352
1116	95% MLE (t) UCL	0.9097977	Mean in Original Scale	0.4267316
1117	95% MLE (Tiku) UCL	1.3517303	SD in Original Scale	0.6460111
1118			95% t UCL	0.6580354
1119			95% Percentile Bootstrap UCL	0.6460909
1120			95% BCA Bootstrap UCL	0.7063758
1121			95% H UCL	0.7081855
1122				
1123	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1124	k star (bias corrected)	0.7387551	**Data appear Gamma Distributed at 5% Significance Level**	
1125	Theta Star	1.371175		
1126	nu star	11.820082		
1127				
1128	A-D Test Statistic	0.6930489	**Nonparametric Statistics**	
1129	5% A-D Critical Value	0.7348108	Kaplan-Meier (KM) Method	
1130	K-S Test Statistic	0.7348108	Mean	0.4203049
1131	5% K-S Critical Value	0.3012108	SD	0.6348393
1132	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.1416503
1133			95% KM (t) UCL	0.663539
1134	**Assuming Gamma Distribution**		95% KM (z) UCL	0.653299
1135	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.653064
1136	Minimum	0.000001	95% KM (bootstrap t) UCL	0.7467309
1137	Maximum	1.88	95% KM (BCA) UCL	0.7922451
1138	Mean	0.3903872	95% KM (Percentile Bootstrap) UCL	0.7114783
1139	Median	0.0587758	95% KM (Chebyshev) UCL	1.0377444
1140	SD	0.6701555	97.5% KM (Chebyshev) UCL	1.3049109
1141	k star	0.1401925	99% KM (Chebyshev) UCL	1.8297078
1142	Theta star	2.7846514		
1143	Nu star	6.4488549	**Potential UCLs to Use**	
1144	AppChi2	1.8733781	95% KM (t) UCL	0.663539
1145	95% Gamma Approximate UCL	1.3438562		
1146	95% Adjusted Gamma UCL	1.4804158		
1147	**Note: DL/2 is not a recommended method.**			
1148				
1149	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1150	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1151	**For additional insight, the user may want to consult a statistician.**			
1152				
1153				
1154	**Lead**			
1155				
1156	**General Statistics**			
1157	Number of Valid Observations	14	Number of Distinct Observations	13
1158	Number of Missing Values	10		
1159				
1160	**Raw Statistics**		**Log-transformed Statistics**	
1161	Minimum	8.85	Minimum of Log Data	2.1804175
1162	Maximum	950	Maximum of Log Data	6.856462
1163	Mean	97.737857	Mean of log Data	3.3491692
1164	Median	19.5	SD of log Data	1.3027432
1165	SD	247.48958		
1166	Std. Error of Mean	66.144373		

	A	B	C	D	E	F	G	H	I	J	K	L
1167					Coefficient of Variation	2.5321773						
1168					Skewness	3.6310574						
1169												
1170						**Relevant UCL Statistics**						
1171			**Normal Distribution Test**						**Lognormal Distribution Test**			
1172					Shapiro Wilk Test Statistic	0.3929502					Shapiro Wilk Test Statistic	0.8152726
1173					Shapiro Wilk Critical Value	0.874					Shapiro Wilk Critical Value	0.874
1174			**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**			
1175												
1176			**Assuming Normal Distribution**						**Assuming Lognormal Distribution**			
1177					95% Student's-t UCL	214.87514					95% H-UCL	220.93267
1178			**95% UCLs (Adjusted for Skewness)**								95% Chebyshev (MVUE) UCL	162.46537
1179					95% Adjusted-CLT UCL (Chen-1995)	275.12276					97.5% Chebyshev (MVUE) UCL	206.65087
1180					95% Modified-t UCL (Johnson-1978)	225.57334					99% Chebyshev (MVUE) UCL	293.44472
1181												
1182			**Gamma Distribution Test**						**Data Distribution**			
1183					k star (bias corrected)	0.4507317			**Data do not follow a Discernable Distribution (0.05)**			
1184					Theta Star	216.84264						
1185					MLE of Mean	97.737857						
1186					MLE of Standard Deviation	145.58068						
1187					nu star	12.620488						
1188					Approximate Chi Square Value (.05)	5.638448			**Nonparametric Statistics**			
1189					Adjusted Level of Significance	0.03122					95% CLT UCL	206.53567
1190					Adjusted Chi Square Value	5.0320744					95% Jackknife UCL	214.87514
1191											95% Standard Bootstrap UCL	200.20812
1192					Anderson-Darling Test Statistic	1.9947371					95% Bootstrap-t UCL	949.72234
1193					Anderson-Darling 5% Critical Value	0.7920874					95% Hall's Bootstrap UCL	719.83108
1194					Kolmogorov-Smirnov Test Statistic	0.3208481					95% Percentile Bootstrap UCL	226.08429
1195					Kolmogorov-Smirnov 5% Critical Value	0.2414191					95% BCA Bootstrap UCL	294.93857
1196			**Data not Gamma Distributed at 5% Significance Level**								95% Chebyshev(Mean, Sd) UCL	386.05449
1197											97.5% Chebyshev(Mean, Sd) UCL	510.80933
1198			**Assuming Gamma Distribution**								99% Chebyshev(Mean, Sd) UCL	755.86605
1199					95% Approximate Gamma UCL	218.76578						
1200					95% Adjusted Gamma UCL	245.12743						
1201												
1202			**Potential UCL to Use**								Use 95% Chebyshev (Mean, Sd) UCL	386.05449
1203												
1204	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1205	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
1206	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
1207												
1208												
1209	**Mercury**											
1210												
1211						**General Statistics**						
1212					Number of Valid Observations	14					Number of Distinct Observations	14
1213					Number of Missing Values	10						
1214												
1215			**Raw Statistics**						**Log-transformed Statistics**			
1216					Minimum	0.0294					Minimum of Log Data	-3.526761
1217					Maximum	0.815					Maximum of Log Data	-0.204567
1218					Mean	0.1441929					Mean of log Data	-2.469141
1219					Median	0.0664					SD of log Data	0.8847763

	A	B	C	D	E	F	G	H	I	J	K	L
1220					SD	0.2181152						
1221					Std. Error of Mean	0.0582937						
1222					Coefficient of Variation	1.5126631						
1223					Skewness	2.7703576						
1224												
1225	**Relevant UCL Statistics**											
1226	**Normal Distribution Test**						**Lognormal Distribution Test**					
1227					Shapiro Wilk Test Statistic	0.5109787					Shapiro Wilk Test Statistic	0.744753
1228					Shapiro Wilk Critical Value	0.874					Shapiro Wilk Critical Value	0.874
1229	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
1230												
1231	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1232					95% Student's-t UCL	0.2474272					95% H-UCL	0.2374213
1233	**95% UCLs (Adjusted for Skewness)**										95% Chebyshev (MVUE) UCL	0.2542258
1234					95% Adjusted-CLT UCL (Chen-1995)	0.2861959					97.5% Chebyshev (MVUE) UCL	0.3119804
1235					95% Modified-t UCL (Johnson-1978)	0.2546207					99% Chebyshev (MVUE) UCL	0.4254281
1236												
1237	**Gamma Distribution Test**						**Data Distribution**					
1238					k star (bias corrected)	0.8922111	**Data do not follow a Discernable Distribution (0.05)**					
1239					Theta Star	0.1616129						
1240					MLE of Mean	0.1441929						
1241					MLE of Standard Deviation	0.1526546						
1242					nu star	24.981911						
1243					Approximate Chi Square Value (.05)	14.597767	**Nonparametric Statistics**					
1244					Adjusted Level of Significance	0.03122					95% CLT UCL	0.2400775
1245					Adjusted Chi Square Value	13.553065					95% Jackknife UCL	0.2474272
1246											95% Standard Bootstrap UCL	0.235928
1247					Anderson-Darling Test Statistic	2.3527764					95% Bootstrap-t UCL	1.1510525
1248					Anderson-Darling 5% Critical Value	0.7585647					95% Hall's Bootstrap UCL	0.8355611
1249					Kolmogorov-Smirnov Test Statistic	0.3840143					95% Percentile Bootstrap UCL	0.2501071
1250					Kolmogorov-Smirnov 5% Critical Value	0.2347703					95% BCA Bootstrap UCL	0.2820857
1251	**Data not Gamma Distributed at 5% Significance Level**										95% Chebyshev(Mean, Sd) UCL	0.3982894
1252											97.5% Chebyshev(Mean, Sd) UCL	0.5082372
1253	**Assuming Gamma Distribution**										99% Chebyshev(Mean, Sd) UCL	0.7242083
1254					95% Approximate Gamma UCL	0.2467647						
1255					95% Adjusted Gamma UCL	0.2657859						
1256												
1257	**Potential UCL to Use**										Use 95% Chebyshev (Mean, Sd) UCL	0.3982894
1258												
1259	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1260	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
1261	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
1262												
1263												
1264	**Naphthalene**											
1265												
1266	**General Statistics**											
1267					Number of Valid Data	23					Number of Detected Data	14
1268					Number of Distinct Detected Data	14					Number of Non-Detect Data	9
1269					Number of Missing Values	1					Percent Non-Detects	39.13%
1270												
1271	**Raw Statistics**						**Log-transformed Statistics**					
1272					Minimum Detected	0.00081					Minimum Detected	-7.118476

	A–E	F	G–K	L
1273	Maximum Detected	0.145	Maximum Detected	-1.931022
1274	Mean of Detected	0.0436693	Mean of Detected	-3.724331
1275	SD of Detected	0.0389904	SD of Detected	1.5251485
1276	Minimum Non-Detect	0.0294	Minimum Non-Detect	-3.526761
1277	Maximum Non-Detect	0.228	Maximum Non-Detect	-1.47841
1278				
1279	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	23
1280	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
1281	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
1282				
1283	**UCL Statistics**			
1284	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1285	Shapiro Wilk Test Statistic	0.8243271	Shapiro Wilk Test Statistic	0.7592824
1286	5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
1287	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1288				
1289	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1290	DL/2 Substitution Method		DL/2 Substitution Method	
1291	Mean	0.0454922	Mean	-3.568988
1292	SD	0.0387908	SD	1.2833211
1293	95% DL/2 (t) UCL	0.0593812	95% H-Stat (DL/2) UCL	0.1428112
1294				
1295	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
1296	**MLE method failed to converge properly**		Mean in Log Scale	-3.953452
1297			SD in Log Scale	1.2223858
1298			Mean in Original Scale	0.0320481
1299			SD in Original Scale	0.033517
1300			95% t UCL	0.0440488
1301			95% Percentile Bootstrap UCL	0.0443548
1302			95% BCA Bootstrap UCL	0.0473618
1303			95% H-UCL	0.0847437
1304				
1305	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1306	k star (bias corrected)	0.8143474	**Data do not follow a Discernable Distribution (0.05)**	
1307	Theta Star	0.0536249		
1308	nu star	22.801728		
1309				
1310	A-D Test Statistic	0.8047358	**Nonparametric Statistics**	
1311	5% A-D Critical Value	0.7609903	Kaplan-Meier (KM) Method	
1312	K-S Test Statistic	0.7609903	Mean	0.0371353
1313	5% K-S Critical Value	0.2353678	SD	0.0334183
1314	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0079662
1315			95% KM (t) UCL	0.0508145
1316	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0502386
1317	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0508263
1318	Minimum	0.00081	95% KM (bootstrap t) UCL	0.0567157
1319	Maximum	0.145	95% KM (BCA) UCL	0.0513647
1320	Mean	0.0365869	95% KM (Percentile Bootstrap) UCL	0.0506525
1321	Median	0.0296659	95% KM (Chebyshev) UCL	0.0718593
1322	SD	0.0317765	97.5% KM (Chebyshev) UCL	0.0868844
1323	k star	1.1826739	99% KM (Chebyshev) UCL	0.1163983
1324	Theta star	0.0309358		
1325	Nu star	54.403001	**Potential UCLs to Use**	

	A	B	C	D	E	F	G	H	I	J	K	L
1326	AppChi2					38.455332	99% KM (Chebyshev) UCL					0.1163983
1327	95% Gamma Approximate UCL					0.0517598						
1328	95% Adjusted Gamma UCL					0.0531019						
1329	**Note: DL/2 is not a recommended method.**											
1330												
1331	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1332	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1333	**For additional insight, the user may want to consult a statistician.**											
1334												
1335												
1336	**Nickel**											
1337												
1338	**General Statistics**											
1339	Number of Valid Observations					14	Number of Distinct Observations					14
1340	Number of Missing Values					10						
1341												
1342	**Raw Statistics**						**Log-transformed Statistics**					
1343	Minimum					14.1	Minimum of Log Data					2.6461748
1344	Maximum					47.6	Maximum of Log Data					3.8628328
1345	Mean					26.071429	Mean of log Data					3.224256
1346	Median					24	SD of log Data					0.2754643
1347	SD					7.8014228						
1348	Std. Error of Mean					2.0850179						
1349	Coefficient of Variation					0.2992327						
1350	Skewness					1.6185329						
1351												
1352	**Relevant UCL Statistics**											
1353	**Normal Distribution Test**						**Lognormal Distribution Test**					
1354	Shapiro Wilk Test Statistic					0.8412718	Shapiro Wilk Test Statistic					0.9169388
1355	Shapiro Wilk Critical Value					0.874	Shapiro Wilk Critical Value					0.874
1356	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
1357												
1358	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1359	95% Student's-t UCL					29.763856	95% H-UCL					30.125569
1360	**95% UCLs (Adjusted for Skewness)**						95% Chebyshev (MVUE) UCL					34.464681
1361	95% Adjusted-CLT UCL (Chen-1995)					30.464691	97.5% Chebyshev (MVUE) UCL					38.112637
1362	95% Modified-t UCL (Johnson-1978)					29.914176	99% Chebyshev (MVUE) UCL					45.27834
1363												
1364	**Gamma Distribution Test**						**Data Distribution**					
1365	k star (bias corrected)					10.915428	**Data appear Gamma Distributed at 5% Significance Level**					
1366	Theta Star					2.3884935						
1367	MLE of Mean					26.071429						
1368	MLE of Standard Deviation					7.8912254						
1369	nu star					305.63198						
1370	Approximate Chi Square Value (.05)					266.13338	**Nonparametric Statistics**					
1371	Adjusted Level of Significance					0.03122	95% CLT UCL					29.500978
1372	Adjusted Chi Square Value					261.24409	95% Jackknife UCL					29.763856
1373							95% Standard Bootstrap UCL					29.502366
1374	Anderson-Darling Test Statistic					0.6812519	95% Bootstrap-t UCL					31.610352
1375	Anderson-Darling 5% Critical Value					0.7343231	95% Hall's Bootstrap UCL					48.190685
1376	Kolmogorov-Smirnov Test Statistic					0.20391	95% Percentile Bootstrap UCL					29.521429
1377	Kolmogorov-Smirnov 5% Critical Value					0.2285106	95% BCA Bootstrap UCL					30.378571
1378	**Data appear Gamma Distributed at 5% Significance Level**						95% Chebyshev(Mean, Sd) UCL					35.159811

	A	B	C	D	E	F	G	H	I	J	K	L
1379											97.5% Chebyshev(Mean, Sd) UCL	39.092361
1380	**Assuming Gamma Distribution**										99% Chebyshev(Mean, Sd) UCL	46.817095
1381					95% Approximate Gamma UCL	29.94086						
1382					95% Adjusted Gamma UCL	30.501216						
1383												
1384	**Potential UCL to Use**										Use 95% Approximate Gamma UCL	29.94086
1385												
1386	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1387	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
1388	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
1389												
1390												
1391	**n-Propylbenzene**											
1392												
1393	**General Statistics**											
1394					Number of Valid Data	23					Number of Detected Data	1
1395					Number of Distinct Detected Data	1					Number of Non-Detect Data	22
1396											Percent Non-Detects	95.65%
1397												
1398	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
1399	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**											
1400												
1401	**The data set for variable n-Propylbenzene was not processed!**											
1402												
1403												
1404												
1405	**Phenanthrene**											
1406												
1407	**General Statistics**											
1408					Number of Valid Data	23					Number of Detected Data	10
1409					Number of Distinct Detected Data	10					Number of Non-Detect Data	13
1410											Percent Non-Detects	56.52%
1411												
1412	**Raw Statistics**						**Log-transformed Statistics**					
1413					Minimum Detected	0.124					Minimum Detected	-2.087474
1414					Maximum Detected	8.93					Maximum Detected	2.1894164
1415					Mean of Detected	1.9877					Mean of Detected	-0.206661
1416					SD of Detected	2.7542041					SD of Detected	1.4928216
1417					Minimum Non-Detect	0.252					Minimum Non-Detect	-1.378326
1418					Maximum Non-Detect	2.26					Maximum Non-Detect	0.8153648
1419												
1420	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	20
1421	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	3
1422	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	86.96%
1423												
1424	**UCL Statistics**											
1425	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
1426					Shapiro Wilk Test Statistic	0.7241856					Shapiro Wilk Test Statistic	0.940445
1427					5% Shapiro Wilk Critical Value	0.842					5% Shapiro Wilk Critical Value	0.842
1428	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
1429												
1430	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1431					DL/2 Substitution Method						DL/2 Substitution Method	

	A	B	C	D	E	F	G	H	I	J	K	L
1432					Mean	1.0053913					Mean	-1.069508
1433					SD	1.9821609					SD	1.3370147
1434					95% DL/2 (t) UCL	1.7151027					95% H-Stat (DL/2) UCL	1.9729936
1435												
1436					Maximum Likelihood Estimate(MLE) Method						Log ROS Method	
1437					Mean	6.1603245					Mean in Log Scale	-1.156351
1438					SD	2.6232973					SD in Log Scale	1.3027031
1439					95% MLE (t) UCL	7.0995944					Mean in Original Scale	0.9541065
1440					95% MLE (Tiku) UCL	8.6848783					SD in Original Scale	1.9909023
1441											95% t UCL	1.6669477
1442											95% Percentile Bootstrap UCL	1.7047682
1443											95% BCA Bootstrap UCL	2.0440256
1444											95% H UCL	1.6676492
1445												
1446	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1447					k star (bias corrected)	0.5420717	**Data appear Gamma Distributed at 5% Significance Level**					
1448					Theta Star	3.6668581						
1449					nu star	10.841434						
1450												
1451					A-D Test Statistic	0.3610291	**Nonparametric Statistics**					
1452					5% A-D Critical Value	0.7626437					Kaplan-Meier (KM) Method	
1453					K-S Test Statistic	0.7626437					Mean	0.9602463
1454					5% K-S Critical Value	0.2773602					SD	1.9473315
1455	**Data appear Gamma Distributed at 5% Significance Level**										SE of Mean	0.4288003
1456											95% KM (t) UCL	1.6965584
1457	**Assuming Gamma Distribution**										95% KM (z) UCL	1.6655601
1458					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	1.6749738
1459					Minimum	0.000001					95% KM (bootstrap t) UCL	2.8030432
1460					Maximum	8.93					95% KM (BCA) UCL	1.7429391
1461					Mean	0.864218					95% KM (Percentile Bootstrap) UCL	1.6967367
1462					Median	0.000001					95% KM (Chebyshev) UCL	2.8293436
1463					SD	2.029355					97.5% KM (Chebyshev) UCL	3.6381035
1464					k star	0.1195999					99% KM (Chebyshev) UCL	5.2267558
1465					Theta star	7.2259098						
1466					Nu star	5.5015946	**Potential UCLs to Use**					
1467					AppChi2	1.3906949					95% KM (t) UCL	1.6965584
1468					95% Gamma Approximate UCL	3.4188496						
1469					95% Adjusted Gamma UCL	3.8097405						
1470	**Note: DL/2 is not a recommended method.**											
1471												
1472	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1473	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1474	**For additional insight, the user may want to consult a statistician.**											
1475												
1476												
1477	**p-Isopropyltoluene**											
1478												
1479	**General Statistics**											
1480					Number of Valid Data	23					Number of Detected Data	1
1481					Number of Distinct Detected Data	1					Number of Non-Detect Data	22
1482											Percent Non-Detects	95.65%
1483												
1484	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											

	A–E	F	G–K	L
1485	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**			
1486				
1487	**The data set for variable p-Isopropyltoluene was not processed!**			
1488				
1489				
1490				
1491	**Pyrene**			
1492				
1493	**General Statistics**			
1494	Number of Valid Data	23	Number of Detected Data	11
1495	Number of Distinct Detected Data	11	Number of Non-Detect Data	12
1496			Percent Non-Detects	52.17%
1497				
1498	**Raw Statistics**		**Log-transformed Statistics**	
1499	Minimum Detected	0.145	Minimum Detected	-1.931022
1500	Maximum Detected	16.6	Maximum Detected	2.8094027
1501	Mean of Detected	4.1086364	Mean of Detected	0.3681589
1502	SD of Detected	5.2098147	SD of Detected	1.7278929
1503	Minimum Non-Detect	0.252	Minimum Non-Detect	-1.378326
1504	Maximum Non-Detect	1.32	Maximum Non-Detect	0.2776317
1505				
1506	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	17
1507	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
1508	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	73.91%
1509				
1510	**UCL Statistics**			
1511	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1512	Shapiro Wilk Test Statistic	0.7930203	Shapiro Wilk Test Statistic	0.9051802
1513	5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
1514	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
1515				
1516	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1517	DL/2 Substitution Method		DL/2 Substitution Method	
1518	Mean	2.0570435	Mean	-0.808893
1519	SD	4.0475432	SD	1.6710803
1520	95% DL/2 (t) UCL	3.5062637	95% H-Stat (DL/2) UCL	6.2970304
1521				
1522	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
1523	**MLE yields a negative mean**		Mean in Log Scale	-0.71962
1524			SD in Log Scale	1.6000902
1525			Mean in Original Scale	2.0645888
1526			SD in Original Scale	4.0427356
1527			95% t UCL	3.5120877
1528			95% Percentile Bootstrap UCL	3.5422614
1529			95% BCA Bootstrap UCL	4.006428
1530			95% H-UCL	5.5939064
1531				
1532	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1533	k star (bias corrected)	0.4914568	**Data appear Gamma Distributed at 5% Significance Level**	
1534	Theta Star	8.3601162		
1535	nu star	10.812051		
1536				
1537	A-D Test Statistic	0.4328022	**Nonparametric Statistics**	

1538	5% A-D Critical Value	0.7742251	Kaplan-Meier (KM) Method	
1539	K-S Test Statistic	0.7742251	Mean	2.0648795
1540	5% K-S Critical Value	0.2675369	SD	3.953582
1541	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.8647112
1542			95% KM (t) UCL	3.5497134
1543	**Assuming Gamma Distribution**		95% KM (z) UCL	3.4872028
1544	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.5126047
1545	Minimum	0.000001	95% KM (bootstrap t) UCL	4.8804871
1546	Maximum	16.6	95% KM (BCA) UCL	3.7130435
1547	Mean	1.9650005	95% KM (Percentile Bootstrap) UCL	3.5715652
1548	Median	0.000001	95% KM (Chebyshev) UCL	5.8340681
1549	SD	4.0915839	97.5% KM (Chebyshev) UCL	7.4649991
1550	k star	0.1200706	99% KM (Chebyshev) UCL	10.668647
1551	Theta star	16.36538		
1552	Nu star	5.5232463	**Potential UCLs to Use**	
1553	AppChi2	1.4012796	95% KM (t) UCL	3.5497134
1554	95% Gamma Approximate UCL	7.7451937		
1555	95% Adjusted Gamma UCL	8.6281459		
1556	**Note: DL/2 is not a recommended method.**			
1557				
1558	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1559	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1560	**For additional insight, the user may want to consult a statistician.**			
1561				
1562				
1563	**Residual range organics (RRO)**			
1564				
1565	**General Statistics**			
1566	Number of Valid Observations	23	Number of Distinct Observations	23
1567				
1568	**Raw Statistics**		**Log-transformed Statistics**	
1569	Minimum	8.06	Minimum of Log Data	2.0869136
1570	Maximum	3330	Maximum of Log Data	8.1107276
1571	Mean	549.28087	Mean of log Data	4.9885593
1572	Median	88.9	SD of log Data	1.5523002
1573	SD	1051.0443		
1574	Std. Error of Mean	219.15789		
1575	Coefficient of Variation	1.9134916		
1576	Skewness	2.2275481		
1577				
1578	**Relevant UCL Statistics**			
1579	**Normal Distribution Test**		**Lognormal Distribution Test**	
1580	Shapiro Wilk Test Statistic	0.5271892	Shapiro Wilk Test Statistic	0.9027383
1581	Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
1582	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1583				
1584	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1585	95% Student's-t UCL	925.6066	95% H-UCL	1473.0764
1586	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	1207.5128
1587	95% Adjusted-CLT UCL (Chen-1995)	1018.5314	97.5% Chebyshev (MVUE) UCL	1538.7478
1588	95% Modified-t UCL (Johnson-1978)	942.57219	99% Chebyshev (MVUE) UCL	2189.3949
1589				
1590	**Gamma Distribution Test**		**Data Distribution**	

	A–E	F	G–K	L
1591	k star (bias corrected)	0.4495707	**Data do not follow a Discernable Distribution (0.05)**	
1592	Theta Star	1221.7898		
1593	MLE of Mean	549.28087		
1594	MLE of Standard Deviation	819.21046		
1595	nu star	20.680251		
1596	Approximate Chi Square Value (.05)	11.354141	**Nonparametric Statistics**	
1597	Adjusted Level of Significance	0.0389	95% CLT UCL	909.76351
1598	Adjusted Chi Square Value	10.854017	95% Jackknife UCL	925.6066
1599			95% Standard Bootstrap UCL	909.86616
1600	Anderson-Darling Test Statistic	2.3428518	95% Bootstrap-t UCL	1562.3095
1601	Anderson-Darling 5% Critical Value	0.8086248	95% Hall's Bootstrap UCL	828.92339
1602	Kolmogorov-Smirnov Test Statistic	0.2821746	95% Percentile Bootstrap UCL	936.68957
1603	Kolmogorov-Smirnov 5% Critical Value	0.1922865	95% BCA Bootstrap UCL	1041.0113
1604	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	1504.568
1605			97.5% Chebyshev(Mean, Sd) UCL	1917.9214
1606	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	2729.8743
1607	95% Approximate Gamma UCL	1000.4514		
1608	95% Adjusted Gamma UCL	1046.5495		
1609				
1610	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	1504.568
1611				
1612	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1613	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
1614	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
1615				
1616				
1617	**Selenium**			
1618				
1619	**General Statistics**			
1620	Number of Valid Data	14	Number of Detected Data	10
1621	Number of Distinct Detected Data	10	Number of Non-Detect Data	4
1622	Number of Missing Values	9	Percent Non-Detects	28.57%
1623				
1624	**Raw Statistics**		**Log-transformed Statistics**	
1625	Minimum Detected	0.174	Minimum Detected	-1.7487
1626	Maximum Detected	2.91	Maximum Detected	1.0681531
1627	Mean of Detected	0.6784	Mean of Detected	-1.077498
1628	SD of Detected	1.0037604	SD of Detected	1.070777
1629	Minimum Non-Detect	0.492	Minimum Non-Detect	-0.709277
1630	Maximum Non-Detect	0.523	Maximum Non-Detect	-0.648174
1631				
1632	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	12
1633	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
1634	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	85.71%
1635				
1636	**UCL Statistics**			
1637	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1638	Shapiro Wilk Test Statistic	0.5659551	Shapiro Wilk Test Statistic	0.6418395
1639	5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
1640	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1641				
1642	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1643	DL/2 Substitution Method		DL/2 Substitution Method	

	A	B	C	D	E	F	G	H	I	J	K	L
1644					Mean	0.5571429					Mean	-1.161266
1645					SD	0.8585572					SD	0.9015701
1646					95% DL/2 (t) UCL	0.9634996					95% H-Stat (DL/2) UCL	0.9081427
1647												
1648					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
1649	**MLE method failed to converge properly**										Mean in Log Scale	-1.159639
1650											SD in Log Scale	0.9010771
1651											Mean in Original Scale	0.557538
1652											SD in Original Scale	0.8584011
1653											95% t UCL	0.9638209
1654											95% Percentile Bootstrap UCL	0.9726535
1655											95% BCA Bootstrap UCL	1.1405928
1656											95% H-UCL	0.9087144
1657												
1658	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1659					k star (bias corrected)	0.6641692	**Data do not follow a Discernable Distribution (0.05)**					
1660					Theta Star	1.0214264						
1661					nu star	13.283384						
1662												
1663					A-D Test Statistic	2.0403099	**Nonparametric Statistics**					
1664					5% A-D Critical Value	0.7533656					Kaplan-Meier (KM) Method	
1665					K-S Test Statistic	0.7533656					Mean	0.5443571
1666					5% K-S Critical Value	0.2750561					SD	0.8324887
1667	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.2346331
1668											95% KM (t) UCL	0.9598768
1669	**Assuming Gamma Distribution**										95% KM (z) UCL	0.9302943
1670					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.9534882
1671					Minimum	0.174					95% KM (bootstrap t) UCL	7.0648217
1672					Maximum	2.91					95% KM (BCA) UCL	0.9630714
1673					Mean	0.5730827					95% KM (Percentile Bootstrap) UCL	0.9390179
1674					Median	0.2615					95% KM (Chebyshev) UCL	1.5670992
1675					SD	0.8528696					97.5% KM (Chebyshev) UCL	2.0096405
1676					k star	0.8711328					99% KM (Chebyshev) UCL	2.8789271
1677					Theta star	0.6578591						
1678					Nu star	24.391719	**Potential UCLs to Use**					
1679					AppChi2	14.146928					97.5% KM (Chebyshev) UCL	2.0096405
1680					95% Gamma Approximate UCL	0.9880923						
1681					95% Adjusted Gamma UCL	1.0654035						
1682	**Note: DL/2 is not a recommended method.**											
1683												
1684	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1685	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1686	**For additional insight, the user may want to consult a statistician.**											
1687												
1688												
1689	**Silver**											
1690												
1691	**General Statistics**											
1692					Number of Valid Observations	14					Number of Distinct Observations	14
1693					Number of Missing Values	9						
1694												
1695	**Raw Statistics**						**Log-transformed Statistics**					
1696					Minimum	0.0434					Minimum of Log Data	-3.137296

	A–E	F	G–K	L
1697	Maximum	38.2	Maximum of Log Data	3.6428355
1698	Mean	2.9759857	Mean of log Data	-1.975216
1699	Median	0.0731	SD of log Data	1.9030871
1700	SD	10.160925		
1701	Std. Error of Mean	2.7156215		
1702	Coefficient of Variation	3.4143057		
1703	Skewness	3.7135057		
1704				
1705	**Relevant UCL Statistics**			
1706	**Normal Distribution Test**		**Lognormal Distribution Test**	
1707	Shapiro Wilk Test Statistic	0.3258031	Shapiro Wilk Test Statistic	0.5658656
1708	Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
1709	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1710				
1711	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1712	95% Student's-t UCL	7.7851704	95% H-UCL	9.0271963
1713	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	2.2498726
1714	95% Adjusted-CLT UCL (Chen-1995)	10.322635	97.5% Chebyshev (MVUE) UCL	2.9460516
1715	95% Modified-t UCL (Johnson-1978)	8.2343687	99% Chebyshev (MVUE) UCL	4.3135605
1716				
1717	**Gamma Distribution Test**		**Data Distribution**	
1718	k star (bias corrected)	0.2315828	**Data do not follow a Discernable Distribution (0.05)**	
1719	Theta Star	12.850635		
1720	MLE of Mean	2.9759857		
1721	MLE of Standard Deviation	6.1841172		
1722	nu star	6.4843179		
1723	Approximate Chi Square Value (.05)	1.8921659	**Nonparametric Statistics**	
1724	Adjusted Level of Significance	0.03122	95% CLT UCL	7.4427855
1725	Adjusted Chi Square Value	1.5820192	95% Jackknife UCL	7.7851704
1726			95% Standard Bootstrap UCL	7.2582755
1727	Anderson-Darling Test Statistic	3.7363265	95% Bootstrap-t UCL	1716.7234
1728	Anderson-Darling 5% Critical Value	0.8593374	95% Hall's Bootstrap UCL	693.71163
1729	Kolmogorov-Smirnov Test Statistic	0.4888876	95% Percentile Bootstrap UCL	8.4140143
1730	Kolmogorov-Smirnov 5% Critical Value	0.2511986	95% BCA Bootstrap UCL	11.324364
1731	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	14.813105
1732			97.5% Chebyshev(Mean, Sd) UCL	19.935036
1733	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	29.996078
1734	95% Approximate Gamma UCL	10.198491		
1735	95% Adjusted Gamma UCL	12.197853		
1736				
1737	**Potential UCL to Use**		Use 99% Chebyshev (Mean, Sd) UCL	29.996078
1738				
1739	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1740	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
1741	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
1742				
1743				
1744	**Vanadium**			
1745				
1746	**General Statistics**			
1747	Number of Valid Observations	14	Number of Distinct Observations	14
1748	Number of Missing Values	9		
1749				

	A–E	F	G–K	L
1750	**Raw Statistics**		**Log-transformed Statistics**	
1751	Minimum	18.1	Minimum of Log Data	2.8959119
1752	Maximum	134	Maximum of Log Data	4.8978398
1753	Mean	62.007143	Mean of log Data	4.0189007
1754	Median	59.2	SD of log Data	0.5086415
1755	SD	28.805487		
1756	Std. Error of Mean	7.6985903		
1757	Coefficient of Variation	0.4645511		
1758	Skewness	0.9835351		
1759				
1760	**Relevant UCL Statistics**			
1761	**Normal Distribution Test**		**Lognormal Distribution Test**	
1762	Shapiro Wilk Test Statistic	0.9249807	Shapiro Wilk Test Statistic	0.9339505
1763	Shapiro Wilk Critical Value	0.874	Shapiro Wilk Critical Value	0.874
1764	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
1765				
1766	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1767	95% Student's-t UCL	75.640834	95% H-UCL	84.181539
1768	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	100.90087
1769	95% Adjusted-CLT UCL (Chen-1995)	76.832505	97.5% Chebyshev (MVUE) UCL	117.4382
1770	95% Modified-t UCL (Johnson-1978)	75.97811	99% Chebyshev (MVUE) UCL	149.92257
1771				
1772	**Gamma Distribution Test**		**Data Distribution**	
1773	k star (bias corrected)	3.799481	**Data appear Normal at 5% Significance Level**	
1774	Theta Star	16.319898		
1775	MLE of Mean	62.007143		
1776	MLE of Standard Deviation	31.811166		
1777	nu star	106.38547		
1778	Approximate Chi Square Value (.05)	83.58214	**Nonparametric Statistics**	
1779	Adjusted Level of Significance	0.03122	95% CLT UCL	74.670197
1780	Adjusted Chi Square Value	80.903642	95% Jackknife UCL	75.640834
1781			95% Standard Bootstrap UCL	74.31268
1782	Anderson-Darling Test Statistic	0.3819146	95% Bootstrap-t UCL	80.335842
1783	Anderson-Darling 5% Critical Value	0.7384713	95% Hall's Bootstrap UCL	86.746119
1784	Kolmogorov-Smirnov Test Statistic	0.1584436	95% Percentile Bootstrap UCL	74.828571
1785	Kolmogorov-Smirnov 5% Critical Value	0.2294112	95% BCA Bootstrap UCL	75.778571
1786	**Data appear Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	95.56452
1787			97.5% Chebyshev(Mean, Sd) UCL	110.08482
1788	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	138.60715
1789	95% Approximate Gamma UCL	78.924264		
1790	95% Adjusted Gamma UCL	81.53723		
1791				
1792	**Potential UCL to Use**		Use 95% Student's-t UCL	75.640834
1793				
1794	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1795	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
1796	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
1797				

APPENDIX E - 2

Upper Site Summit Subsurface Soil ProUCL Output - 95% UCLs for COPCs

	A	B	C	D	E	F	G	H	I	J	K	L
1				General UCL Statistics for Data Sets with Non-Detects								
2		User Selected Options										
3			From File	USS_SX.wst								
4			Full Precision	ON								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												
9	1,2,3-Trichloropropane											
10												
11						General Statistics						
12					Number of Valid Data	31					Number of Detected Data	1
13					Number of Distinct Detected Data	1					Number of Non-Detect Data	30
14					Number of Missing Values	4					Percent Non-Detects	96.77%
15												
16		Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!										
17	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).											
18												
19				The data set for variable 1,2,3-Trichloropropane was not processed!								
20												
21												
22												
23	Benzo(a)anthracene											
24												
25						General Statistics						
26					Number of Valid Data	31					Number of Detected Data	3
27					Number of Distinct Detected Data	3					Number of Non-Detect Data	28
28					Number of Missing Values	4					Percent Non-Detects	90.32%
29												
30			Raw Statistics						Log-transformed Statistics			
31					Minimum Detected	0.268					Minimum Detected	-1.316768
32					Maximum Detected	3.43					Maximum Detected	1.2325603
33					Mean of Detected	1.6026667					Mean of Detected	0.0067173
34					SD of Detected	1.6375596					SD of Detected	1.2774661
35					Minimum Non-Detect	0.253					Minimum Non-Detect	-1.374366
36					Maximum Non-Detect	0.3					Maximum Non-Detect	-1.203973
37												
38	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	29
39	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	2
40	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	93.55%
41												
42				Warning: There are only 3 Distinct Detected Values in this data set								
43			The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.									
44				Those methods will return a 'N/A' value on your output display!								
45												
46				It is necessary to have 4 or more Distinct Values for bootstrap methods.								
47				However, results obtained using 4 to 9 distinct values may not be reliable.								
48			It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.									
49												
50												
51						UCL Statistics						
52		Normal Distribution Test with Detected Values Only						Lognormal Distribution Test with Detected Values Only				
53					Shapiro Wilk Test Statistic	0.9320972					Shapiro Wilk Test Statistic	0.9955992

	A–E	F	G–K	L
54	5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
55	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
56				
57	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
58	DL/2 Substitution Method		DL/2 Substitution Method	
59	Mean	0.2738387	Mean	-1.832687
60	SD	0.6117973	SD	0.6962405
61	95% DL/2 (t) UCL	0.4603372	95% H-Stat (DL/2) UCL	0.2661814
62				
63	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
64	**MLE method failed to converge properly**		Mean in Log Scale	-6.515798
65			SD in Log Scale	2.8060524
66			Mean in Original Scale	0.1575768
67			SD in Original Scale	0.6403088
68			95% t UCL	0.3527667
69			95% Percentile Bootstrap UCL	0.3632308
70			95% BCA Bootstrap UCL	0.4896094
71			95% H-UCL	1.0212929
72				
73	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
74	k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**	
75	Theta Star	N/A		
76	nu star	N/A		
77				
78	A-D Test Statistic	N/A	**Nonparametric Statistics**	
79	5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
80	K-S Test Statistic	N/A	Mean	0.3971613
81	5% K-S Critical Value	N/A	SD	0.5733334
82	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.1261165
83			95% KM (t) UCL	0.611214
84	**Assuming Gamma Distribution**		95% KM (z) UCL	0.6046045
85	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.9468278
86	Minimum	N/A	95% KM (bootstrap t) UCL	0.6243882
87	Maximum	N/A	95% KM (BCA) UCL	3.43
88	Mean	N/A	95% KM (Percentile Bootstrap) UCL	3.43
89	Median	N/A	95% KM (Chebyshev) UCL	0.9468905
90	SD	N/A	97.5% KM (Chebyshev) UCL	1.1847588
91	k star	N/A	99% KM (Chebyshev) UCL	1.6520049
92	Theta star	N/A		
93	Nu star	N/A	**Potential UCLs to Use**	
94	AppChi2	N/A	95% KM (t) UCL	0.611214
95	95% Gamma Approximate UCL	N/A	95% KM (Percentile Bootstrap) UCL	3.43
96	95% Adjusted Gamma UCL	N/A		
97	**Note: DL/2 is not a recommended method.**			
98				
99	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
100	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
101	**For additional insight, the user may want to consult a statistician.**			
102				
103				
104	**Benzo(a)pyrene**			
105				
106	**General Statistics**			

	A	B	C	D	E	F	G	H	I	J	K	L
107					Number of Valid Data	31					Number of Detected Data	3
108					Number of Distinct Detected Data	3					Number of Non-Detect Data	28
109					Number of Missing Values	4					Percent Non-Detects	90.32%
110												
111	**Raw Statistics**						**Log-transformed Statistics**					
112					Minimum Detected	0.231					Minimum Detected	-1.465338
113					Maximum Detected	3.71					Maximum Detected	1.3110319
114					Mean of Detected	1.8536667					Mean of Detected	0.1093735
115					SD of Detected	1.7512311					SD of Detected	1.4252835
116					Minimum Non-Detect	0.0788					Minimum Non-Detect	-2.540842
117					Maximum Non-Detect	0.0936					Maximum Non-Detect	-2.368725
118												
119	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	28
120	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	3
121	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	90.32%
122												
123	**Warning: There are only 3 Distinct Detected Values in this data set**											
124	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
125	**Those methods will return a 'N/A' value on your output display!**											
126												
127	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
128	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
129	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
130												
131												
132	**UCL Statistics**											
133	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
134					Shapiro Wilk Test Statistic	0.9866284					Shapiro Wilk Test Statistic	0.9486012
135					5% Shapiro Wilk Critical Value	0.767					5% Shapiro Wilk Critical Value	0.767
136	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
137												
138	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
139					DL/2 Substitution Method						DL/2 Substitution Method	
140					Mean	0.216429					Mean	-2.874923
141					SD	0.7079769					SD	1.0596318
142					95% DL/2 (t) UCL	0.4322466					95% H-Stat (DL/2) UCL	0.1602441
143												
144					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
145	**MLE yields a negative mean**										Mean in Log Scale	-8.362788
146											SD in Log Scale	3.2329825
147											Mean in Original Scale	0.1796528
148											SD in Original Scale	0.7174339
149											95% t UCL	0.3983532
150											95% Percentile Bootstrap UCL	0.4115281
151											95% BCA Bootstrap UCL	0.5834404
152											95% H-UCL	1.305086
153												
154	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
155					k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**					
156					Theta Star	N/A						
157					nu star	N/A						
158												
159					A-D Test Statistic	N/A	**Nonparametric Statistics**					

160	5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
161	K-S Test Statistic	N/A	Mean	0.3880323
162	5% K-S Critical Value	N/A	SD	0.6542252
163	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.1439104
164			95% KM (t) UCL	0.6322857
165	**Assuming Gamma Distribution**		95% KM (z) UCL	0.6247437
166	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.2812571
167	Minimum	N/A	95% KM (bootstrap t) UCL	0.5296273
168	Maximum	N/A	95% KM (BCA) UCL	N/A
169	Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
170	Median	N/A	95% KM (Chebyshev) UCL	1.015323
171	SD	N/A	97.5% KM (Chebyshev) UCL	1.2867522
172	k star	N/A	99% KM (Chebyshev) UCL	1.8199222
173	Theta star	N/A		
174	Nu star	N/A	**Potential UCLs to Use**	
175	AppChi2	N/A	95% KM (t) UCL	0.6322857
176	95% Gamma Approximate UCL	N/A	95% KM (Percentile Bootstrap) UCL	N/A
177	95% Adjusted Gamma UCL	N/A		
178	**Note: DL/2 is not a recommended method.**			
179				
180	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
181	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
182	**For additional insight, the user may want to consult a statistician.**			
183				
184				
185	**Benzo(b)fluoranthene**			
186				
187	**General Statistics**			
188	Number of Valid Data	31	Number of Detected Data	4
189	Number of Distinct Detected Data	4	Number of Non-Detect Data	27
190	Number of Missing Values	4	Percent Non-Detects	87.10%
191				
192	**Raw Statistics**		**Log-transformed Statistics**	
193	Minimum Detected	0.111	Minimum Detected	-2.198225
194	Maximum Detected	1.53	Maximum Detected	0.4252677
195	Mean of Detected	0.5075	Mean of Detected	-1.265577
196	SD of Detected	0.6830717	SD of Detected	1.1612786
197	Minimum Non-Detect	0.253	Minimum Non-Detect	-1.374366
198	Maximum Non-Detect	0.3	Maximum Non-Detect	-1.203973
199				
200	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	30
201	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
202	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	96.77%
203				
204	**Warning: There are only 4 Distinct Detected Values in this data**			
205	**Note: It should be noted that even though bootstrap may be performed on this data set**			
206	**the resulting calculations may not be reliable enough to draw conclusions**			
207				
208	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
209				
210				
211	**UCL Statistics**			
212	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	

	A–E	F	G–K	L
213	Shapiro Wilk Test Statistic	0.6903505	Shapiro Wilk Test Statistic	0.8401043
214	5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
215	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
216				
217	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
218	DL/2 Substitution Method		DL/2 Substitution Method	
219	Mean	0.1802097	Mean	-1.929514
220	SD	0.2511644	SD	0.4514214
221	95% DL/2 (t) UCL	0.2567739	95% H-Stat (DL/2) UCL	0.1879278
222				
223	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
224	**MLE method failed to converge properly**		Mean in Log Scale	-1.70959
225			SD in Log Scale	0.5951114
226			Mean in Original Scale	0.2290999
227			SD in Original Scale	0.2555099
228			95% t UCL	0.3069888
229			95% Percentile Bootstrap UCL	0.3172345
230			95% BCA Bootstrap UCL	0.372001
231			95% H-UCL	0.2685868
232				
233	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
234	k star (bias corrected)	0.412816	**Data appear Gamma Distributed at 5% Significance Level**	
235	Theta Star	1.2293613		
236	nu star	3.3025279		
237				
238	A-D Test Statistic	0.6185668	**Nonparametric Statistics**	
239	5% A-D Critical Value	0.6668373	Kaplan-Meier (KM) Method	
240	K-S Test Statistic	0.6668373	Mean	0.2106452
241	5% K-S Critical Value	0.4026065	SD	0.2447017
242	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0573914
243			95% KM (t) UCL	0.3080534
244	**Assuming Gamma Distribution**		95% KM (z) UCL	0.3050456
245	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.3071751
246	Minimum	0.000001	95% KM (bootstrap t) UCL	0.3898246
247	Maximum	1.53	95% KM (BCA) UCL	0.3449677
248	Mean	0.2604298	95% KM (Percentile Bootstrap) UCL	0.3449677
249	Median	0.146753	95% KM (Chebyshev) UCL	0.4608085
250	SD	0.3273381	97.5% KM (Chebyshev) UCL	0.5690544
251	k star	0.2238616	99% KM (Chebyshev) UCL	0.7816824
252	Theta star	1.1633519		
253	Nu star	13.87942	**Potential UCLs to Use**	
254	AppChi2	6.4888673	95% KM (t) UCL	0.3080534
255	95% Gamma Approximate UCL	0.5570487		
256	95% Adjusted Gamma UCL	N/A		
257	**Note: DL/2 is not a recommended method.**			
258				
259	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
260	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
261	**For additional insight, the user may want to consult a statistician.**			
262				
263				
264	**Benzo(k)fluoranthene**			
265				

266	**General Statistics**			
267	Number of Valid Data	31	Number of Detected Data	3
268	Number of Distinct Detected Data	3	Number of Non-Detect Data	28
269	Number of Missing Values	4	Percent Non-Detects	90.32%
270				
271	**Raw Statistics**		**Log-transformed Statistics**	
272	Minimum Detected	0.135	Minimum Detected	-2.002481
273	Maximum Detected	5.63	Maximum Detected	1.7281094
274	Mean of Detected	2.0516667	Mean of Detected	-0.405327
275	SD of Detected	3.1015493	SD of Detected	1.9222446
276	Minimum Non-Detect	0.253	Minimum Non-Detect	-1.374366
277	Maximum Non-Detect	0.3	Maximum Non-Detect	-1.203973
278				
279	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	29
280	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
281	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	93.55%
282				
283	**Warning: There are only 3 Distinct Detected Values in this data set**			
284	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**			
285	**Those methods will return a 'N/A' value on your output display!**			
286				
287	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**			
288	**However, results obtained using 4 to 9 distinct values may not be reliable.**			
289	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**			
290				
291				
292	**UCL Statistics**			
293	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
294	Shapiro Wilk Test Statistic	0.7847109	Shapiro Wilk Test Statistic	0.9416065
295	5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
296	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
297				
298	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
299	DL/2 Substitution Method		DL/2 Substitution Method	
300	Mean	0.3172903	Mean	-1.872562
301	SD	0.9871006	SD	0.6971679
302	95% DL/2 (t) UCL	0.6181952	95% H-Stat (DL/2) UCL	0.2560617
303				
304	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
305	**MLE method failed to converge properly**		Mean in Log Scale	-2.02084
306			SD in Log Scale	0.9648273
307			Mean in Original Scale	0.3219317
308			SD in Original Scale	0.9898537
309			95% t UCL	0.6236758
310			95% Percentile Bootstrap UCL	0.6724324
311			95% BCA Bootstrap UCL	0.8628908
312			95% H-UCL	0.3212041
313				
314	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
315	k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**	
316	Theta Star	N/A		
317	nu star	N/A		
318				

	A	B	C	D	E	F	G	H	I	J	K	L
319					A-D Test Statistic	N/A	**Nonparametric Statistics**					
320					5% A-D Critical Value	N/A					Kaplan-Meier (KM) Method	
321					K-S Test Statistic	N/A					Mean	0.3204839
322					5% K-S Critical Value	N/A					SD	0.9704259
323	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.2134652
324											95% KM (t) UCL	0.6827901
325	**Assuming Gamma Distribution**										95% KM (z) UCL	0.6716029
326					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.5916077
327					Minimum	N/A					95% KM (bootstrap t) UCL	3.1888204
328					Maximum	N/A					95% KM (BCA) UCL	5.63
329					Mean	N/A					95% KM (Percentile Bootstrap) UCL	5.63
330					Median	N/A					95% KM (Chebyshev) UCL	1.2509572
331					SD	N/A					97.5% KM (Chebyshev) UCL	1.6535738
332					k star	N/A					99% KM (Chebyshev) UCL	2.4444361
333					Theta star	N/A						
334					Nu star	N/A	**Potential UCLs to Use**					
335					AppChi2	N/A					95% KM (t) UCL	0.6827901
336					95% Gamma Approximate UCL	N/A					95% KM (Percentile Bootstrap) UCL	5.63
337					95% Adjusted Gamma UCL	N/A						
338	**Note: DL/2 is not a recommended method.**											
339												
340	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
341	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
342	**For additional insight, the user may want to consult a statistician.**											
343												
344												
345	**Dibenz(a,h)anthracene**											
346												
347	**General Statistics**											
348					Number of Valid Data	31					Number of Detected Data	2
349					Number of Distinct Detected Data	2					Number of Non-Detect Data	29
350					Number of Missing Values	4					Percent Non-Detects	93.55%
351												
352	**Raw Statistics**						**Log-transformed Statistics**					
353					Minimum Detected	0.273					Minimum Detected	-1.298283
354					Maximum Detected	0.846					Maximum Detected	-0.167236
355					Mean of Detected	0.5595					Mean of Detected	-0.73276
356					SD of Detected	0.4051722					SD of Detected	0.7997714
357					Minimum Non-Detect	0.0788					Minimum Non-Detect	-2.540842
358					Maximum Non-Detect	0.0936					Maximum Non-Detect	-2.368725
359												
360	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	29
361	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	2
362	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	93.55%
363												
364	**Warning: Data set has only 2 Distinct Detected Values.**											
365	**This may not be adequate enough to compute meaningful and reliable test statistics and estimates.**											
366	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
367												
368	**Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.**											
369												
370	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
371	**Those methods will return a 'N/A' value on your output display!**											

	A	B	C	D	E	F	G	H	I	J	K	L
372												
373	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
374	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
375	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
376												
377												
378	**UCL Statistics**											
379	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
380					Shapiro Wilk Test Statistic	N/A					Shapiro Wilk Test Statistic	N/A
381					5% Shapiro Wilk Critical Value	N/A					5% Shapiro Wilk Critical Value	N/A
382	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
383												
384	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
385					DL/2 Substitution Method						DL/2 Substitution Method	
386					Mean	0.0744258					Mean	-3.036698
387					SD	0.1491406					SD	0.6332387
388					95% DL/2 (t) UCL	0.1198894					95% H-Stat (DL/2) UCL	0.0742429
389												
390					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
391	**MLE method failed to converge properly**										Mean in Log Scale	N/A
392											SD in Log Scale	N/A
393											Mean in Original Scale	N/A
394											SD in Original Scale	N/A
395											95% t UCL	N/A
396											95% Percentile Bootstrap UCL	N/A
397											95% BCA Bootstrap UCL	N/A
398											95% H-UCL	N/A
399												
400	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
401					k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**					
402					Theta Star	N/A						
403					nu star	N/A						
404												
405					A-D Test Statistic	N/A	**Nonparametric Statistics**					
406					5% A-D Critical Value	N/A					Kaplan-Meier (KM) Method	
407					K-S Test Statistic	N/A					Mean	0.2914839
408					5% K-S Critical Value	N/A					SD	0.1012403
409	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.0257151
410											95% KM (t) UCL	0.3351291
411	**Assuming Gamma Distribution**										95% KM (z) UCL	0.3337814
412					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.6668235
413					Minimum	N/A					95% KM (bootstrap t) UCL	0.2914839
414					Maximum	N/A					95% KM (BCA) UCL	N/A
415					Mean	N/A					95% KM (Percentile Bootstrap) UCL	0.846
416					Median	N/A					95% KM (Chebyshev) UCL	0.4035733
417					SD	N/A					97.5% KM (Chebyshev) UCL	0.4520744
418					k star	N/A					99% KM (Chebyshev) UCL	0.5473456
419					Theta star	N/A						
420					Nu star	N/A	**Potential UCLs to Use**					
421					AppChi2	N/A					95% KM (t) UCL	0.3351291
422					95% Gamma Approximate UCL	N/A					95% KM (% Bootstrap) UCL	0.846
423					95% Adjusted Gamma UCL	N/A						
424	**Note: DL/2 is not a recommended method.**											

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

Indeno(1,2,3-c,d)Pyrene

General Statistics

Number of Valid Data	31	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	28
Number of Missing Values	4	Percent Non-Detects	90.32%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.111	Minimum Detected	-2.198225
Maximum Detected	2.09	Maximum Detected	0.7371641
Mean of Detected	1.018	Mean of Detected	-0.540019
SD of Detected	0.9997645	SD of Detected	1.5043309
Minimum Non-Detect	0.253	Minimum Non-Detect	-1.374366
Maximum Non-Detect	0.3	Maximum Non-Detect	-1.203973
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	93.55%

Warning: There are only 3 Distinct Detected Values in this data set

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.9795528	Shapiro Wilk Test Statistic	0.9518671
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.2172581	Mean	-1.885597
SD	0.3710107	SD	0.5938763
95% DL/2 (t) UCL	0.3303559	95% H-Stat (DL/2) UCL	0.224947
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.08544
		SD in Log Scale	0.8816525
		Mean in Original Scale	0.2131148
		SD in Original Scale	0.3795786
		95% t UCL	0.3288244
		95% Percentile Bootstrap UCL	0.3390745

		95% BCA Bootstrap UCL	0.4198101
		95% H-UCL	0.2649439
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.1987742
5% K-S Critical Value	N/A	SD	0.3693137
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0812382
		95% KM (t) UCL	0.3366566
Assuming Gamma Distribution		95% KM (z) UCL	0.3323991
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.6767467
Minimum	N/A	95% KM (bootstrap t) UCL	0.2873342
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	2.09
Median	N/A	95% KM (Chebyshev) UCL	0.5528832
SD	N/A	97.5% KM (Chebyshev) UCL	0.7061065
k star	N/A	99% KM (Chebyshev) UCL	1.007084
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	95% KM (t) UCL	0.3366566
95% Gamma Approximate UCL	N/A	95% KM (Percentile Bootstrap) UCL	2.09
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Trichloroethylene (TCE)

General Statistics

Number of Valid Data	31	Number of Detected Data	15
Number of Distinct Detected Data	15	Number of Non-Detect Data	16
		Percent Non-Detects	51.61%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0057	Minimum Detected	-5.167289
Maximum Detected	0.079	Maximum Detected	-2.538307
Mean of Detected	0.03675	Mean of Detected	-3.657628
SD of Detected	0.0272508	SD of Detected	0.9598942
Minimum Non-Detect	0.00525	Minimum Non-Detect	-5.249527
Maximum Non-Detect	0.0091	Maximum Non-Detect	-4.699481
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	20
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	11
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	64.52%

	A–E	F	G–K	L
531	UCL Statistics			
532	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
533	Shapiro Wilk Test Statistic	0.8891348	Shapiro Wilk Test Statistic	0.8951366
534	5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
535	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
536				
537	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
538	DL/2 Substitution Method		DL/2 Substitution Method	
539	Mean	0.0194263	Mean	-4.745429
540	SD	0.0252483	SD	1.2619263
541	95% DL/2 (t) UCL	0.0271229	95% H-Stat (DL/2) UCL	0.0363338
542				
543	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
544	**MLE yields a negative mean**		Mean in Log Scale	-4.866955
545			SD in Log Scale	1.3697236
546			Mean in Original Scale	0.0190939
547			SD in Original Scale	0.0254696
548			95% t UCL	0.026858
549			95% Percentile Bootstrap UCL	0.026712
550			95% BCA Bootstrap UCL	0.0274995
551			95% H-UCL	0.0405785
552				
553	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
554	k star (bias corrected)	1.2909529	**Data appear Normal at 5% Significance Level**	
555	Theta Star	0.0284673		
556	nu star	38.728588		
557				
558	A-D Test Statistic	0.4343569	**Nonparametric Statistics**	
559	5% A-D Critical Value	0.7529819	Kaplan-Meier (KM) Method	
560	K-S Test Statistic	0.7529819	Mean	0.0207414
561	5% K-S Critical Value	0.2253763	SD	0.0239931
562	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0044607
563			95% KM (t) UCL	0.0283124
564	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0280786
565	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0281727
566	Minimum	0.000001	95% KM (bootstrap t) UCL	0.0296696
567	Maximum	0.079	95% KM (BCA) UCL	0.0300517
568	Mean	0.0177828	95% KM (Percentile Bootstrap) UCL	0.0286394
569	Median	0.000001	95% KM (Chebyshev) UCL	0.0401851
570	SD	0.026364	97.5% KM (Chebyshev) UCL	0.0485984
571	k star	0.1631084	99% KM (Chebyshev) UCL	0.0651247
572	Theta star	0.1090243		
573	Nu star	10.11272	**Potential UCLs to Use**	
574	AppChi2	4.0123365	95% KM (t) UCL	0.0283124
575	95% Gamma Approximate UCL	0.0448198	95% KM (Percentile Bootstrap) UCL	0.0286394
576	95% Adjusted Gamma UCL	0.0473209		
577	**Note: DL/2 is not a recommended method.**			
578				
579	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
580	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
581	**For additional insight, the user may want to consult a statistician.**			
582				
583				

	A–E	F	G–K	L
584	**Vanadium**			
585				
586	**General Statistics**			
587	Number of Valid Data	22	Number of Detected Data	21
588	Number of Distinct Detected Data	21	Number of Non-Detect Data	1
589	Number of Missing Values	10	Percent Non-Detects	4.55%
590				
591	**Raw Statistics**		**Log-transformed Statistics**	
592	Minimum Detected	34.4	Log Statistics Not Avaliable	
593	Maximum Detected	102		
594	Mean of Detected	69.904762		
595	Mean of Detected	69.904762		
596	Mean of Detected	69.904762		
597	Maximum Non-Detect	0		
598				
599	**UCL Statistics**			
600	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
601	Shapiro Wilk Test Statistic	0.9713841	Not Available	
602	5% Shapiro Wilk Critical Value	0.908		
603	**Data appear Normal at 5% Significance Level**			
604				
605	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
606	DL/2 Substitution Method		DL/2 Substitution Method	N/A
607	Mean	66.727273		
608	SD	24.10278		
609	95% DL/2 (t) UCL	75.569706		
610				
611	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	N/A
612	Mean	66.38539		
613	SD	24.593561		
614	95% MLE (t) UCL	75.407872		
615	95% MLE (Tiku) UCL	75.605443		
616				
617	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
618	Gamma Statistics Not Available		Data appear Normal at 5% Significance Level	
619				
620				
621	**Potential UCLs to Use**		**Nonparametric Statistics**	
622	95% KM (t) UCL	75.783083	Kaplan-Meier (KM) Method	
623	95% KM (Percentile Bootstrap) UCL	75.595455	Mean	68.290909
624			SD	19.930057
625			SE of Mean	4.3540344
626			95% KM (t) UCL	75.783083
627			95% KM (z) UCL	75.452658
628			95% KM (jackknife) UCL	75.653207
629			95% KM (bootstrap t) UCL	75.627442
630			95% KM (BCA) UCL	76.045455
631			95% KM (Percentile Bootstrap) UCL	75.595455
632			95% KM (Chebyshev) UCL	87.269705
633			97.5% KM (Chebyshev) UCL	95.481845
634			99% KM (Chebyshev) UCL	111.613
635	**Note: DL/2 is not a recommended method.**			
636				

	A	B	C	D	E	F	G	H	I	J	K	L
637	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
638	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
639	For additional insight, the user may want to consult a statistician.											
640												

APPENDIX E - 3

Lower Site Summit Surface Soil ProUCL Output - 95% UCLs for COPCs and COPECs

1	General UCL Statistics for Data Sets with Non-Detects			
2	**User Selected Options**			
3	From File	LSS_SO.wst		
4	Full Precision	ON		
5	Confidence Coefficient	95%		
6	Number of Bootstrap Operations	2000		
7				
8				
9	**1,2,4-Trimethylbenzene**			
10				
11	**General Statistics**			
12	Number of Valid Data	37	Number of Detected Data	5
13	Number of Distinct Detected Data	5	Number of Non-Detect Data	32
14	Number of Missing Values	5	Percent Non-Detects	86.49%
15				
16	**Raw Statistics**		**Log-transformed Statistics**	
17	Minimum Detected	0.0103	Minimum Detected	-4.575611
18	Maximum Detected	0.0388	Maximum Detected	-3.249335
19	Mean of Detected	0.01826	Mean of Detected	-4.134804
20	SD of Detected	0.0118302	SD of Detected	0.5387291
21	Minimum Non-Detect	0.0018	Minimum Non-Detect	-6.319969
22	Maximum Non-Detect	0.254	Maximum Non-Detect	-1.370421
23				
24	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	37
25	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
26	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
27				
28	**Warning: There are only 5 Detected Values in this data**			
29	**Note: It should be noted that even though bootstrap may be performed on this data set**			
30	**the resulting calculations may not be reliable enough to draw conclusions**			
31				
32	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
33				
34				
35	**UCL Statistics**			
36	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
37	Shapiro Wilk Test Statistic	0.7531672	Shapiro Wilk Test Statistic	0.8568792
38	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
39	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
40				
41	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
42	DL/2 Substitution Method		DL/2 Substitution Method	
43	Mean	0.0172743	Mean	-4.512902
44	SD	0.0205483	SD	1.0990432
45	95% DL/2 (t) UCL	0.0229776	95% H-Stat (DL/2) UCL	0.0317386
46				
47	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
48	**MLE method failed to converge properly**		Mean in Log Scale	-4.86285
49			SD in Log Scale	0.3811767
50			Mean in Original Scale	0.0085141
51			SD in Original Scale	0.0056287
52			95% t UCL	0.0100764
53			95% Percentile Bootstrap UCL	0.0101981

	A–E	F	G–K	L
54			95% BCA Bootstrap UCL	0.0112389
55			95% H-UCL	0.0093363
56				
57	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
58	k star (bias corrected)	1.7148147	**Data appear Gamma Distributed at 5% Significance Level**	
59	Theta Star	0.0106484		
60	nu star	17.148147		
61				
62	A-D Test Statistic	0.5285861	**Nonparametric Statistics**	
63	5% A-D Critical Value	0.6813044	Kaplan-Meier (KM) Method	
64	K-S Test Statistic	0.6813044	Mean	0.0124257
65	5% K-S Critical Value	0.3584949	SD	0.0054672
66	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0013044
67			95% KM (t) UCL	0.0146279
68	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0145712
69	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0143505
70	Minimum	0.000001	95% KM (bootstrap t) UCL	0.0156088
71	Maximum	0.0388	95% KM (BCA) UCL	0.0180963
72	Mean	0.0024684	95% KM (Percentile Bootstrap) UCL	0.0170385
73	Median	0.000001	95% KM (Chebyshev) UCL	0.0181114
74	SD	0.0074564	97.5% KM (Chebyshev) UCL	0.0205715
75	k star	0.1298607	99% KM (Chebyshev) UCL	0.0254041
76	Theta star	0.0190083		
77	Nu star	9.6096938	**Potential UCLs to Use**	
78	AppChi2	3.6993162	95% KM (t) UCL	0.0146279
79	95% Gamma Approximate UCL	0.0064122		
80	95% Adjusted Gamma UCL	0.006699		
81	**Note: DL/2 is not a recommended method.**			
82				
83	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
84	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
85	**For additional insight, the user may want to consult a statistician.**			
86				
87				
88	**1,3,5-Trimethylbenzene**			
89				
90	**General Statistics**			
91	Number of Valid Data	37	Number of Detected Data	2
92	Number of Distinct Detected Data	2	Number of Non-Detect Data	35
93	Number of Missing Values	1	Percent Non-Detects	94.59%
94				
95	**Raw Statistics**		**Log-transformed Statistics**	
96	Minimum Detected	0.00853	Minimum Detected	-4.764166
97	Maximum Detected	0.0239	Maximum Detected	-3.733877
98	Mean of Detected	0.016215	Mean of Detected	-4.249021
99	SD of Detected	0.0108682	SD of Detected	0.7285244
100	Minimum Non-Detect	0.0046	Minimum Non-Detect	-5.381699
101	Maximum Non-Detect	0.127	Maximum Non-Detect	-2.063568
102				
103	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	37
104	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
105	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
106				

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0124995	Mean	-4.587753
SD	0.0097942	SD	0.676715
95% DL/2 (t) UCL	0.0152179	95% H-Stat (DL/2) UCL	0.0161362
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.0092286
5% K-S Critical Value	N/A	SD	0.0032016
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0009653
		95% KM (t) UCL	0.0108584
Assuming Gamma Distribution		95% KM (z) UCL	0.0108164
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0191172
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	0.0239
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	0.0134363

	A	B	C	D	E	F	G	H	I	J	K	L
160					SD	N/A					97.5% KM (Chebyshev) UCL	0.015257
161					k star	N/A					99% KM (Chebyshev) UCL	0.0188333
162					Theta star	N/A						
163					Nu star	N/A	**Potential UCLs to Use**					
164					AppChi2	N/A					95% KM (t) UCL	0.0108584
165					95% Gamma Approximate UCL	N/A					95% KM (% Bootstrap) UCL	N/A
166					95% Adjusted Gamma UCL	N/A						
167	**Note: DL/2 is not a recommended method.**											
168												
169	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
170	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
171	**For additional insight, the user may want to consult a statistician.**											
172												
173												
174	**2-Hexanone**											
175												
176	**General Statistics**											
177					Number of Valid Data	37					Number of Detected Data	4
178					Number of Distinct Detected Data	4					Number of Non-Detect Data	33
179					Number of Missing Values	1					Percent Non-Detects	89.19%
180												
181	**Raw Statistics**						**Log-transformed Statistics**					
182					Minimum Detected	0.0018					Minimum Detected	-6.319969
183					Maximum Detected	0.0084					Maximum Detected	-4.779524
184					Mean of Detected	0.004475					Mean of Detected	-5.561944
185					SD of Detected	0.0028395					SD of Detected	0.6442557
186					Minimum Non-Detect	0.0049					Minimum Non-Detect	-5.31852
187					Maximum Non-Detect	0.397					Maximum Non-Detect	-0.923819
188												
189	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	37
190	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	0
191	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	100.00%
192												
193	**Warning: There are only 4 Distinct Detected Values in this data**											
194	**Note: It should be noted that even though bootstrap may be performed on this data set**											
195	**the resulting calculations may not be reliable enough to draw conclusions**											
196												
197	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
198												
199												
200	**UCL Statistics**											
201	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
202					Shapiro Wilk Test Statistic	0.9342035					Shapiro Wilk Test Statistic	0.9997916
203					5% Shapiro Wilk Critical Value	0.748					5% Shapiro Wilk Critical Value	0.748
204	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
205												
206	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
207					DL/2 Substitution Method						DL/2 Substitution Method	
208					Mean	0.0375757					Mean	-3.569544
209					SD	0.0305059					SD	0.9201704
210					95% DL/2 (t) UCL	0.0460427					95% H-Stat (DL/2) UCL	0.06121
211												
212					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	

	A–E	F	G–K	L
213	**MLE method failed to converge properly**		Mean in Log Scale	-5.636506
214			SD in Log Scale	0.2033656
215			Mean in Original Scale	0.0036455
216			SD in Original Scale	0.0009145
217			95% t UCL	0.0038994
218			95% Percentile Bootstrap UCL	0.0039234
219			95% BCA Bootstrap UCL	0.004039
220			95% H-UCL	0.0038605
221				
222	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
223	k star (bias corrected)	1.0247208	**Data appear Normal at 5% Significance Level**	
224	Theta Star	0.004367		
225	nu star	8.1977666		
226				
227	A-D Test Statistic	0.2112853	**Nonparametric Statistics**	
228	5% A-D Critical Value	0.6591809	Kaplan-Meier (KM) Method	
229	K-S Test Statistic	0.6591809	Mean	0.0042133
230	5% K-S Critical Value	0.3963871	SD	0.002314
231	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0012306
232			95% KM (t) UCL	0.0062909
233	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0062374
234	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0064981
235	Minimum	0.0018	95% KM (bootstrap t) UCL	0.0078479
236	Maximum	0.0084	95% KM (BCA) UCL	0.00675
237	Mean	0.0042463	95% KM (Percentile Bootstrap) UCL	0.0071
238	Median	0.004247	95% KM (Chebyshev) UCL	0.0095773
239	SD	0.0009148	97.5% KM (Chebyshev) UCL	0.0118982
240	k star	21.698901	99% KM (Chebyshev) UCL	0.0164574
241	Theta star	0.0001957		
242	Nu star	1605.7187	**Potential UCLs to Use**	
243	AppChi2	1513.6564	95% KM (t) UCL	0.0062909
244	95% Gamma Approximate UCL	0.0045045	95% KM (Percentile Bootstrap) UCL	0.0071
245	95% Adjusted Gamma UCL	N/A		
246	**Note: DL/2 is not a recommended method.**			
247				
248	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
249	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
250	**For additional insight, the user may want to consult a statistician.**			
251				
252				
253	**Anthracene**			
254				
255	**General Statistics**			
256	Number of Valid Data	37	Number of Detected Data	12
257	Number of Distinct Detected Data	12	Number of Non-Detect Data	25
258	Number of Missing Values	1	Percent Non-Detects	67.57%
259				
260	**Raw Statistics**		**Log-transformed Statistics**	
261	Minimum Detected	0.0936	Minimum Detected	-2.368725
262	Maximum Detected	26	Maximum Detected	3.2580965
263	Mean of Detected	4.6966333	Mean of Detected	-0.192571
264	SD of Detected	9.5311512	SD of Detected	1.8275997
265	Minimum Non-Detect	0.255	Minimum Non-Detect	-1.366492

	A	B	C	D	E	F	G	H	I	J	K	L
266					Maximum Non-Detect	2.66					Maximum Non-Detect	0.9783261
267												
268	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	35
269	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	2
270	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	94.59%
271												
272	**UCL Statistics**											
273	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
274					Shapiro Wilk Test Statistic	0.5187513					Shapiro Wilk Test Statistic	0.8776138
275					5% Shapiro Wilk Critical Value	0.859					5% Shapiro Wilk Critical Value	0.859
276	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
277												
278	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
279					DL/2 Substitution Method						DL/2 Substitution Method	
280					Mean	1.6769351					Mean	-1.285533
281					SD	5.6851845					SD	1.3655782
282					95% DL/2 (t) UCL	3.2548832					95% H-Stat (DL/2) UCL	1.3403257
283												
284					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
285	**MLE method failed to converge properly**										Mean in Log Scale	-1.863233
286											SD in Log Scale	1.5895713
287											Mean in Original Scale	1.5747182
288											SD in Original Scale	5.7067032
289											95% t UCL	3.1586389
290											95% Percentile Bootstrap UCL	3.1415914
291											95% BCA Bootstrap UCL	4.2070732
292											95% H-UCL	1.2615012
293												
294	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
295					k star (bias corrected)	0.3414959	**Data appear Lognormal at 5% Significance Level**					
296					Theta Star	13.753118						
297					nu star	8.1959013						
298												
299					A-D Test Statistic	1.4637231	**Nonparametric Statistics**					
300					5% A-D Critical Value	0.808054					Kaplan-Meier (KM) Method	
301					K-S Test Statistic	0.808054					Mean	1.61425
302					5% K-S Critical Value	0.2626342					SD	5.6195605
303	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.9652153
304											95% KM (t) UCL	3.2438206
305	**Assuming Gamma Distribution**										95% KM (z) UCL	3.2018878
306					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	3.1960943
307					Minimum	0.000001					95% KM (bootstrap t) UCL	21.92294
308					Maximum	26					95% KM (BCA) UCL	3.6335881
309					Mean	1.5232331					95% KM (Percentile Bootstrap) UCL	3.5004532
310					Median	0.000001					95% KM (Chebyshev) UCL	5.8215258
311					SD	5.7206322					97.5% KM (Chebyshev) UCL	7.6420174
312					k star	0.0956059					99% KM (Chebyshev) UCL	11.218021
313					Theta star	15.932416						
314					Nu star	7.074837	**Potential UCLs to Use**					
315					AppChi2	2.2117077					97.5% KM (Chebyshev) UCL	7.6420174
316					95% Gamma Approximate UCL	4.8725364						
317					95% Adjusted Gamma UCL	5.1425528						
318	**Note: DL/2 is not a recommended method.**											

319				
320	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
321	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
322	**For additional insight, the user may want to consult a statistician.**			
323				
324				
325	**Arsenic**			
326				
327	**General Statistics**			
328	Number of Valid Observations	34	Number of Distinct Observations	34
329	Number of Missing Values	3		
330				
331	**Raw Statistics**		**Log-transformed Statistics**	
332	Minimum	4.14	Minimum of Log Data	1.4206958
333	Maximum	19	Maximum of Log Data	2.944439
334	Mean	7.3876471	Mean of log Data	1.9611657
335	Median	7.015	SD of log Data	0.264817
336	SD	2.4750538		
337	Std. Error of Mean	0.4244682		
338	Coefficient of Variation	0.335026		
339	Skewness	3.240657		
340				
341	**Relevant UCL Statistics**			
342	**Normal Distribution Test**		**Lognormal Distribution Test**	
343	Shapiro Wilk Test Statistic	0.7148323	Shapiro Wilk Test Statistic	0.9134397
344	Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
345	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
346				
347	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
348	95% Student's-t UCL	8.1060003	95% H-UCL	7.99057
349	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	8.8286144
350	95% Adjusted-CLT UCL (Chen-1995)	8.337904	97.5% Chebyshev (MVUE) UCL	9.4669326
351	95% Modified-t UCL (Johnson-1978)	8.1453179	99% Chebyshev (MVUE) UCL	10.720785
352				
353	**Gamma Distribution Test**		**Data Distribution**	
354	k star (bias corrected)	11.966671	**Data do not follow a Discernable Distribution (0.05)**	
355	Theta Star	0.6173519		
356	MLE of Mean	7.3876471		
357	MLE of Standard Deviation	2.1355978		
358	nu star	813.73362		
359	Approximate Chi Square Value (.05)	748.53347	**Nonparametric Statistics**	
360	Adjusted Level of Significance	0.0422	95% CLT UCL	8.0858352
361	Adjusted Chi Square Value	745.45296	95% Jackknife UCL	8.1060003
362			95% Standard Bootstrap UCL	8.1132878
363	Anderson-Darling Test Statistic	1.0757751	95% Bootstrap-t UCL	8.5594537
364	Anderson-Darling 5% Critical Value	0.7472566	95% Hall's Bootstrap UCL	11.58727
365	Kolmogorov-Smirnov Test Statistic	0.1781336	95% Percentile Bootstrap UCL	8.1238235
366	Kolmogorov-Smirnov 5% Critical Value	0.150819	95% BCA Bootstrap UCL	8.4729412
367	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	9.2378611
368			97.5% Chebyshev(Mean, Sd) UCL	10.03845
369	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	11.611053
370	95% Approximate Gamma UCL	8.0311397		
371	95% Adjusted Gamma UCL	8.0643275		

Potential UCL to Use		Use 95% Student's-t UCL	8.1060003
		or 95% Modified-t UCL	8.1453179

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Barium

General Statistics

Number of Valid Observations	34	Number of Distinct Observations	25
Number of Missing Values	8		
Raw Statistics		**Log-transformed Statistics**	
Minimum	61.7	Minimum of Log Data	4.1222839
Maximum	330	Maximum of Log Data	5.7990927
Mean	118.14706	Mean of log Data	4.7077379
Median	106	SD of log Data	0.327867
SD	54.864468		
Std. Error of Mean	9.4091786		
Coefficient of Variation	0.4643744		
Skewness	3.202718		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.570985	Shapiro Wilk Test Statistic	0.7779663
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	134.07078	95% H-UCL	129.68826
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	145.917
95% Adjusted-CLT UCL (Chen-1995)	139.14597	97.5% Chebyshev (MVUE) UCL	158.54803
95% Modified-t UCL (Johnson-1978)	134.93213	99% Chebyshev (MVUE) UCL	183.35925
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	7.270052	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	16.251199		
MLE of Mean	118.14706		
MLE of Standard Deviation	43.818162		
nu star	494.36353		
Approximate Chi Square Value (.05)	443.80444	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	133.62378
Adjusted Chi Square Value	441.44324	95% Jackknife UCL	134.07078
		95% Standard Bootstrap UCL	133.14495
Anderson-Darling Test Statistic	3.5295066	95% Bootstrap-t UCL	158.77178
Anderson-Darling 5% Critical Value	0.748271	95% Hall's Bootstrap UCL	226.67537
Kolmogorov-Smirnov Test Statistic	0.2977528	95% Percentile Bootstrap UCL	134.6
Kolmogorov-Smirnov 5% Critical Value	0.1510557	95% BCA Bootstrap UCL	139.82059
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	159.16072
		97.5% Chebyshev(Mean, Sd) UCL	176.90736

Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	211.7672
95% Approximate Gamma UCL	131.60661		
95% Adjusted Gamma UCL	132.31055		
Potential UCL to Use		Use 95% Student's-t UCL	134.07078
		or 95% Modified-t UCL	134.93213

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Benzo(a)anthracene

General Statistics

Number of Valid Data	37	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	23
Number of Missing Values	4	Percent Non-Detects	62.16%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.086	Minimum Detected	-2.453408
Maximum Detected	37	Maximum Detected	3.6109179
Mean of Detected	5.5988571	Mean of Detected	-0.11702
SD of Detected	12.304663	SD of Detected	1.8466439
Minimum Non-Detect	0.255	Minimum Non-Detect	-1.366492
Maximum Non-Detect	0.989	Maximum Non-Detect	-0.011061
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	32
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	86.49%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.4876323	Shapiro Wilk Test Statistic	0.897206
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.2279459	Mean	-1.184227
SD	7.8606005	SD	1.4280075
95% DL/2 (t) UCL	4.4096903	95% H-Stat (DL/2) UCL	1.6999535
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-1.395741
		SD in Log Scale	1.5253446
		Mean in Original Scale	2.1930864
		SD in Original Scale	7.8696531
		95% t UCL	4.3773434
		95% Percentile Bootstrap UCL	4.3828254
		95% BCA Bootstrap UCL	5.8285856
		95% H-UCL	1.7223751

	A–E	F	G–K	L
478	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
479	k star (bias corrected)	0.3330869	**Data appear Lognormal at 5% Significance Level**	
480	Theta Star	16.809		
481	nu star	9.3264324		
482				
483	A-D Test Statistic	1.6536724	**Nonparametric Statistics**	
484	5% A-D Critical Value	0.8197581	Kaplan-Meier (KM) Method	
485	K-S Test Statistic	0.8197581	Mean	2.2135707
486	5% K-S Critical Value	0.2458465	SD	7.7573625
487	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	1.3236284
488			95% KM (t) UCL	4.4482494
489	**Assuming Gamma Distribution**		95% KM (z) UCL	4.3907456
490	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	4.3968656
491	Minimum	0.000001	95% KM (bootstrap t) UCL	30.765155
492	Maximum	37	95% KM (BCA) UCL	4.9481171
493	Mean	2.1184871	95% KM (Percentile Bootstrap) UCL	4.2976238
494	Median	0.000001	95% KM (Chebyshev) UCL	7.9831331
495	SD	7.8899845	97.5% KM (Chebyshev) UCL	10.479627
496	k star	0.0988159	99% KM (Chebyshev) UCL	15.383507
497	Theta star	21.438718		
498	Nu star	7.3123798	**Potential UCLs to Use**	
499	AppChi2	2.3435843	97.5% KM (Chebyshev) UCL	10.479627
500	95% Gamma Approximate UCL	6.6100386		
501	95% Adjusted Gamma UCL	6.9678145		
502	**Note: DL/2 is not a recommended method.**			
503				
504	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
505	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
506	**For additional insight, the user may want to consult a statistician.**			
507				
508				
509	**Benzo(a)pyrene**			
510				
511	**General Statistics**			
512	Number of Valid Data	37	Number of Detected Data	14
513	Number of Distinct Detected Data	14	Number of Non-Detect Data	23
514	Number of Missing Values	5	Percent Non-Detects	62.16%
515				
516	**Raw Statistics**		**Log-transformed Statistics**	
517	Minimum Detected	0.0855	Minimum Detected	-2.459239
518	Maximum Detected	35.7	Maximum Detected	3.5751507
519	Mean of Detected	5.6948214	Mean of Detected	0.18924
520	SD of Detected	11.671573	SD of Detected	1.765407
521	Minimum Non-Detect	0.0795	Minimum Non-Detect	-2.531998
522	Maximum Non-Detect	0.83	Maximum Non-Detect	-0.18633
523				
524	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	29
525	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	8
526	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	78.38%
527				
528	**UCL Statistics**			
529	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
530	Shapiro Wilk Test Statistic	0.5102778	Shapiro Wilk Test Statistic	0.9349931

	A	B	C	D	E	F	G	H	I	J	K	L
531					5% Shapiro Wilk Critical Value	0.874					5% Shapiro Wilk Critical Value	0.874
532	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
533												
534	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
535					DL/2 Substitution Method						DL/2 Substitution Method	
536					Mean	2.2006068					Mean	-1.764563
537					SD	7.5390466					SD	1.9404558
538					95% DL/2 (t) UCL	4.2931025					95% H-Stat (DL/2) UCL	3.6551458
539												
540					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
541	**MLE yields a negative mean**										Mean in Log Scale	-2.922649
542											SD in Log Scale	2.7086963
543											Mean in Original Scale	2.1604166
544											SD in Original Scale	7.5503409
545											95% t UCL	4.2560471
546											95% Percentile Bootstrap UCL	4.214877
547											95% BCA Bootstrap UCL	5.0164448
548											95% H-UCL	18.433406
549												
550	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
551					k star (bias corrected)	0.3783909	**Data appear Lognormal at 5% Significance Level**					
552					Theta Star	15.050102						
553					nu star	10.594945						
554												
555					A-D Test Statistic	1.288502	**Nonparametric Statistics**					
556					5% A-D Critical Value	0.8085836					Kaplan-Meier (KM) Method	
557					K-S Test Statistic	0.8085836					Mean	2.2112302
558					5% K-S Critical Value	0.2440677					SD	7.4331208
559	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	1.2681425
560											95% KM (t) UCL	4.3522323
561	**Assuming Gamma Distribution**										95% KM (z) UCL	4.2971391
562					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	4.2820959
563					Minimum	0.000001					95% KM (bootstrap t) UCL	21.216513
564					Maximum	35.7					95% KM (BCA) UCL	4.6244906
565					Mean	2.1547979					95% KM (Percentile Bootstrap) UCL	4.46
566					Median	0.000001					95% KM (Chebyshev) UCL	7.7389354
567					SD	7.5519867					97.5% KM (Chebyshev) UCL	10.130778
568					k star	0.0995843					99% KM (Chebyshev) UCL	14.829089
569					Theta star	21.637927						
570					Nu star	7.3692387	**Potential UCLs to Use**					
571					AppChi2	2.3754167					97.5% KM (Chebyshev) UCL	10.130778
572					95% Gamma Approximate UCL	6.6848146						
573					95% Adjusted Gamma UCL	7.0446498						
574	**Note: DL/2 is not a recommended method.**											
575												
576	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
577	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
578	**For additional insight, the user may want to consult a statistician.**											
579												
580												
581	**Benzo(b)fluoranthene**											
582												
583	**General Statistics**											

	A–E	F	G–K	L
584	Number of Valid Data	37	Number of Detected Data	12
585	Number of Distinct Detected Data	12	Number of Non-Detect Data	25
586	Number of Missing Values	4	Percent Non-Detects	67.57%
587				
588	**Raw Statistics**		**Log-transformed Statistics**	
589	Minimum Detected	0.183	Minimum Detected	-1.698269
590	Maximum Detected	40.1	Maximum Detected	3.6913763
591	Mean of Detected	7.563	Mean of Detected	0.814524
592	SD of Detected	13.470224	SD of Detected	1.559341
593	Minimum Non-Detect	0.255	Minimum Non-Detect	-1.366492
594	Maximum Non-Detect	2.4	Maximum Non-Detect	0.8754687
595				
596	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	33
597	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
598	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	89.19%
599				
600	**UCL Statistics**			
601	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
602	Shapiro Wilk Test Statistic	0.5772209	Shapiro Wilk Test Statistic	0.9288066
603	5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
604	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
605				
606	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
607	DL/2 Substitution Method		DL/2 Substitution Method	
608	Mean	2.5820405	Mean	-0.988886
609	SD	8.2288059	SD	1.58192
610	95% DL/2 (t) UCL	4.865982	95% H-Stat (DL/2) UCL	2.9674989
611				
612	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
613	**MLE yields a negative mean**		Mean in Log Scale	-1.416944
614			SD in Log Scale	1.8362314
615			Mean in Original Scale	2.515965
616			SD in Original Scale	8.2468131
617			95% t UCL	4.8049044
618			95% Percentile Bootstrap UCL	5.0095658
619			95% BCA Bootstrap UCL	5.8708245
620			95% H-UCL	3.8089103
621				
622	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
623	k star (bias corrected)	0.4470611	**Data appear Lognormal at 5% Significance Level**	
624	Theta Star	16.917151		
625	nu star	10.729466		
626				
627	A-D Test Statistic	1.1037341	**Nonparametric Statistics**	
628	5% A-D Critical Value	0.7832375	Kaplan-Meier (KM) Method	
629	K-S Test Statistic	0.7832375	Mean	2.5842642
630	5% K-S Critical Value	0.2583393	SD	8.1148858
631	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	1.393487
632			95% KM (t) UCL	4.936885
633	**Assuming Gamma Distribution**		95% KM (z) UCL	4.8763464
634	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	4.6358469
635	Minimum	0.000001	95% KM (bootstrap t) UCL	17.140413
636	Maximum	40.1	95% KM (BCA) UCL	5.8617793

	A–E	F	G–K	L
637	Mean	2.4528655	95% KM (Percentile Bootstrap) UCL	5.1125946
638	Median	0.000001	95% KM (Chebyshev) UCL	8.6583333
639	SD	8.2658797	97.5% KM (Chebyshev) UCL	11.286588
640	k star	0.0945609	99% KM (Chebyshev) UCL	16.449285
641	Theta star	25.939526		
642	Nu star	6.9975083	**Potential UCLs to Use**	
643	AppChi2	2.1691746	97.5% KM (Chebyshev) UCL	11.286588
644	95% Gamma Approximate UCL	7.9126628		
645	95% Adjusted Gamma UCL	8.3546104		
646	**Note: DL/2 is not a recommended method.**			
647				
648	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
649	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
650	**For additional insight, the user may want to consult a statistician.**			
651				
652				
653	**Benzo(k)fluoranthene**			
654				
655	**General Statistics**			
656	Number of Valid Data	37	Number of Detected Data	11
657	Number of Distinct Detected Data	10	Number of Non-Detect Data	26
658	Number of Missing Values	1	Percent Non-Detects	70.27%
659				
660	**Raw Statistics**		**Log-transformed Statistics**	
661	Minimum Detected	0.182	Minimum Detected	-1.703749
662	Maximum Detected	10.8	Maximum Detected	2.3795461
663	Mean of Detected	2.6480909	Mean of Detected	0.0513395
664	SD of Detected	4.065841	SD of Detected	1.3801001
665	Minimum Non-Detect	0.255	Minimum Non-Detect	-1.366492
666	Maximum Non-Detect	2.66	Maximum Non-Detect	0.9783261
667				
668	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	35
669	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
670	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.59%
671				
672	**UCL Statistics**			
673	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
674	Shapiro Wilk Test Statistic	0.6004202	Shapiro Wilk Test Statistic	0.9041999
675	5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
676	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
677				
678	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
679	DL/2 Substitution Method		DL/2 Substitution Method	
680	Mean	0.9446351	Mean	-1.261876
681	SD	2.4329509	SD	1.2389073
682	95% DL/2 (t) UCL	1.6199114	95% H-Stat (DL/2) UCL	1.0598703
683				
684	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
685	**MLE method failed to converge properly**		Mean in Log Scale	-1.636651
686			SD in Log Scale	1.3756439
687			Mean in Original Scale	0.8600184
688			SD in Original Scale	2.4461016
689			95% t UCL	1.5389447

	A–E	F	G–K	L
690			95% Percentile Bootstrap UCL	1.6243116
691			95% BCA Bootstrap UCL	1.8655321
692			95% H-UCL	0.9640405
693				
694	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
695	k star (bias corrected)	0.5409753	**Data appear Lognormal at 5% Significance Level**	
696	Theta Star	4.8950309		
697	nu star	11.901457		
698				
699	A-D Test Statistic	0.9195872	**Nonparametric Statistics**	
700	5% A-D Critical Value	0.7691675	Kaplan-Meier (KM) Method	
701	K-S Test Statistic	0.7691675	Mean	0.9349959
702	5% K-S Critical Value	0.2664148	SD	2.391805
703	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.4128702
704			95% KM (t) UCL	1.6320437
705	**Assuming Gamma Distribution**		95% KM (z) UCL	1.6141069
706	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.5747881
707	Minimum	0.000001	95% KM (bootstrap t) UCL	4.4099433
708	Maximum	10.8	95% KM (BCA) UCL	1.8642046
709	Mean	0.787271	95% KM (Percentile Bootstrap) UCL	1.6938135
710	Median	0.000001	95% KM (Chebyshev) UCL	2.7346553
711	SD	2.4693366	97.5% KM (Chebyshev) UCL	3.5133694
712	k star	0.0982753	99% KM (Chebyshev) UCL	5.0430024
713	Theta star	8.0108696		
714	Nu star	7.2723755	**Potential UCLs to Use**	
715	AppChi2	2.3212486	95% KM (BCA) UCL	1.8642046
716	95% Gamma Approximate UCL	2.4664873		
717	95% Adjusted Gamma UCL	2.6005111		
718	**Note: DL/2 is not a recommended method.**			
719				
720	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
721	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
722	**For additional insight, the user may want to consult a statistician.**			
723				
724				
725	**Benzoic acid**			
726				
727	**General Statistics**			
728	Number of Valid Data	37	Number of Detected Data	2
729	Number of Distinct Detected Data	2	Number of Non-Detect Data	35
730	Number of Missing Values	1	Percent Non-Detects	94.59%
731				
732	**Raw Statistics**		**Log-transformed Statistics**	
733	Minimum Detected	1.16	Minimum Detected	0.14842
734	Maximum Detected	1.39	Maximum Detected	0.3293037
735	Mean of Detected	1.275	Mean of Detected	0.2388619
736	SD of Detected	0.1626346	SD of Detected	0.1279041
737	Minimum Non-Detect	1.53	Minimum Non-Detect	0.4252677
738	Maximum Non-Detect	19	Maximum Non-Detect	2.944439
739				
740	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	37
741	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
742	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.6189189	Mean	0.0938005
SD	2.1459348	SD	0.7141105
95% DL/2 (t) UCL	2.2145326	95% H-Stat (DL/2) UCL	1.8180743
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	1.275
5% K-S Critical Value	N/A	SD	0.115
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.115
		95% KM (t) UCL	1.4691542
Assuming Gamma Distribution		95% KM (z) UCL	1.4641582
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.5458396
Minimum	N/A	95% KM (bootstrap t) UCL	1.4475
Maximum	N/A	95% KM (BCA) UCL	1.39
Mean	N/A	95% KM (Percentile Bootstrap) UCL	1.39

	A	B	C	D	E	F	G	H	I	J	K	L
796					Median	N/A					95% KM (Chebyshev) UCL	1.7762734
797					SD	N/A					97.5% KM (Chebyshev) UCL	1.9931748
798					k star	N/A					99% KM (Chebyshev) UCL	2.4192356
799					Theta star	N/A						
800					Nu star	N/A	**Potential UCLs to Use**					
801					AppChi2	N/A					95% KM (t) UCL	1.4691542
802					95% Gamma Approximate UCL	N/A					95% KM (% Bootstrap) UCL	1.39
803					95% Adjusted Gamma UCL	N/A						
804	**Warning: Recommended UCL exceeds the maximum observation**											
805	**Note: DL/2 is not a recommended method.**											
806												
807	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
808	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
809	**For additional insight, the user may want to consult a statistician.**											
810												
811												
812	**bis(2-ethylhexyl) Phthalate**											
813												
814	**General Statistics**											
815					Number of Valid Data	37					Number of Detected Data	3
816					Number of Distinct Detected Data	3					Number of Non-Detect Data	34
817					Number of Missing Values	1					Percent Non-Detects	91.89%
818												
819	**Raw Statistics**						**Log-transformed Statistics**					
820					Minimum Detected	0.128					Minimum Detected	-2.055725
821					Maximum Detected	5.44					Maximum Detected	1.6937791
822					Mean of Detected	1.9833333					Mean of Detected	-0.441427
823					SD of Detected	2.9962539					SD of Detected	1.9282645
824					Minimum Non-Detect	0.255					Minimum Non-Detect	-1.366492
825					Maximum Non-Detect	2.66					Maximum Non-Detect	0.9783261
826												
827	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	36
828	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	1
829	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	97.30%
830												
831	**Warning: There are only 3 Distinct Detected Values in this data set**											
832	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
833	**Those methods will return a 'N/A' value on your output display!**											
834												
835	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
836	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
837	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
838												
839												
840	**UCL Statistics**											
841	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
842					Shapiro Wilk Test Statistic	0.7857612					Shapiro Wilk Test Statistic	0.9452488
843					5% Shapiro Wilk Critical Value	0.767					5% Shapiro Wilk Critical Value	0.767
844	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
845												
846	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
847					DL/2 Substitution Method						DL/2 Substitution Method	
848					Mean	0.3771486					Mean	-1.657006

	A	B	C	D	E	F	G	H	I	J	K	L
849					SD	0.9005945					SD	0.8448204
850					95% DL/2 (t) UCL	0.6271126					95% H-Stat (DL/2) UCL	0.3725483
851												
852					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
853	**MLE method failed to converge properly**										Mean in Log Scale	-2.140611
854											SD in Log Scale	0.7664213
855											Mean in Original Scale	0.2597602
856											SD in Original Scale	0.8772201
857											95% t UCL	0.5032365
858											95% Percentile Bootstrap UCL	0.5407597
859											95% BCA Bootstrap UCL	0.693318
860											95% H-UCL	0.2073703
861												
862	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
863					k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**					
864					Theta Star	N/A						
865					nu star	N/A						
866												
867					A-D Test Statistic	N/A	**Nonparametric Statistics**					
868					5% A-D Critical Value	N/A					Kaplan-Meier (KM) Method	
869					K-S Test Statistic	N/A					Mean	0.2792905
870					5% K-S Critical Value	N/A					SD	0.8612222
871	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.1734321
872											95% KM (t) UCL	0.5720956
873	**Assuming Gamma Distribution**										95% KM (z) UCL	0.564561
874					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.5141667
875					Minimum	N/A					95% KM (bootstrap t) UCL	2.3854279
876					Maximum	N/A					95% KM (BCA) UCL	5.44
877					Mean	N/A					95% KM (Percentile Bootstrap) UCL	5.44
878					Median	N/A					95% KM (Chebyshev) UCL	1.0352636
879					SD	N/A					97.5% KM (Chebyshev) UCL	1.3623738
880					k star	N/A					99% KM (Chebyshev) UCL	2.0049183
881					Theta star	N/A						
882					Nu star	N/A	**Potential UCLs to Use**					
883					AppChi2	N/A					95% KM (t) UCL	0.5720956
884					95% Gamma Approximate UCL	N/A					95% KM (Percentile Bootstrap) UCL	5.44
885					95% Adjusted Gamma UCL	N/A						
886	**Note: DL/2 is not a recommended method.**											
887												
888	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
889	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
890	**For additional insight, the user may want to consult a statistician.**											
891												
892												
893	**Cadmium**											
894												
895	**General Statistics**											
896					Number of Valid Observations	34					Number of Distinct Observations	33
897					Number of Missing Values	8						
898												
899	**Raw Statistics**						**Log-transformed Statistics**					
900					Minimum	0.0789					Minimum of Log Data	-2.539574
901					Maximum	15.6					Maximum of Log Data	2.7472709

	A	B	C	D	E	F	G	H	I	J	K	L
902					Mean	0.8317912					Mean of log Data	-1.288182
903					Median	0.2175					SD of log Data	1.1153661
904					SD	2.6538084						
905					Std. Error of Mean	0.4551244						
906					Coefficient of Variation	3.1904743						
907					Skewness	5.5423169						
908												
909	**Relevant UCL Statistics**											
910	**Normal Distribution Test**						**Lognormal Distribution Test**					
911					Shapiro Wilk Test Statistic	0.2824875					Shapiro Wilk Test Statistic	0.8501219
912					Shapiro Wilk Critical Value	0.933					Shapiro Wilk Critical Value	0.933
913	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
914												
915	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
916					95% Student's-t UCL	1.6020257					95% H-UCL	0.8492925
917	**95% UCLs (Adjusted for Skewness)**										95% Chebyshev (MVUE) UCL	0.9930425
918					95% Adjusted-CLT UCL (Chen-1995)	2.0426387					97.5% Chebyshev (MVUE) UCL	1.2066623
919					95% Modified-t UCL (Johnson-1978)	1.6741249					99% Chebyshev (MVUE) UCL	1.626277
920												
921	**Gamma Distribution Test**						**Data Distribution**					
922					k star (bias corrected)	0.5345157	**Data do not follow a Discernable Distribution (0.05)**					
923					Theta Star	1.5561585						
924					MLE of Mean	0.8317912						
925					MLE of Standard Deviation	1.1377165						
926					nu star	36.347068						
927					Approximate Chi Square Value (.05)	23.54825	**Nonparametric Statistics**					
928					Adjusted Level of Significance	0.0422					95% CLT UCL	1.5804042
929					Adjusted Chi Square Value	23.037956					95% Jackknife UCL	1.6020257
930											95% Standard Bootstrap UCL	1.5942234
931					Anderson-Darling Test Statistic	4.4286093					95% Bootstrap-t UCL	4.8206691
932					Anderson-Darling 5% Critical Value	0.8054279					95% Hall's Bootstrap UCL	4.0484017
933					Kolmogorov-Smirnov Test Statistic	0.3247332					95% Percentile Bootstrap UCL	1.7006
934					Kolmogorov-Smirnov 5% Critical Value	0.1588618					95% BCA Bootstrap UCL	2.3134706
935	**Data not Gamma Distributed at 5% Significance Level**										95% Chebyshev(Mean, Sd) UCL	2.8156324
936											97.5% Chebyshev(Mean, Sd) UCL	3.6740421
937	**Assuming Gamma Distribution**										99% Chebyshev(Mean, Sd) UCL	5.3602217
938					95% Approximate Gamma UCL	1.2838818						
939					95% Adjusted Gamma UCL	1.31232						
940												
941	**Potential UCL to Use**										Use 95% Chebyshev (Mean, Sd) UCL	2.8156324
942												
943	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
944	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
945	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
946												
947												
948	**Carbon disulfide**											
949												
950	**General Statistics**											
951					Number of Valid Data	37					Number of Detected Data	4
952					Number of Distinct Detected Data	4					Number of Non-Detect Data	33
953					Number of Missing Values	1					Percent Non-Detects	89.19%
954												

	A–E	F	G–K	L
955	**Raw Statistics**		**Log-transformed Statistics**	
956	Minimum Detected	0.00014	Minimum Detected	-8.873868
957	Maximum Detected	0.00065	Maximum Detected	-7.338538
958	Mean of Detected	0.000315	Mean of Detected	-8.236672
959	SD of Detected	0.0002296	SD of Detected	0.6561857
960	Minimum Non-Detect	0.00098	Minimum Non-Detect	-6.927958
961	Maximum Non-Detect	0.509	Maximum Non-Detect	-0.675307
962				
963	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	37
964	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
965	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
966				
967	**Warning: There are only 4 Distinct Detected Values in this data**			
968	**Note: It should be noted that even though bootstrap may be performed on this data set**			
969	**the resulting calculations may not be reliable enough to draw conclusions**			
970				
971	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
972				
973				
974	**UCL Statistics**			
975	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
976	Shapiro Wilk Test Statistic	0.8298343	Shapiro Wilk Test Statistic	0.945952
977	5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
978	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
979				
980	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
981	DL/2 Substitution Method		DL/2 Substitution Method	
982	Mean	0.0267405	Mean	-4.474363
983	SD	0.0426498	SD	1.6556576
984	95% DL/2 (t) UCL	0.0385782	95% H-Stat (DL/2) UCL	0.1095318
985				
986	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
987	**MLE method failed to converge properly**		Mean in Log Scale	-8.236672
988			SD in Log Scale	0.1894245
989			Mean in Original Scale	0.0002702
990			SD in Original Scale	6.813E-05
991			95% t UCL	0.0002891
992			95% Percentile Bootstrap UCL	0.0002912
993			95% BCA Bootstrap UCL	0.0003032
994			95% H-UCL	0.0002847
995				
996	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
997	k star (bias corrected)	0.9252663	**Data appear Normal at 5% Significance Level**	
998	Theta Star	0.0003404		
999	nu star	7.4021307		
1000				
1001	A-D Test Statistic	0.3550553	**Nonparametric Statistics**	
1002	5% A-D Critical Value	0.6593918	Kaplan-Meier (KM) Method	
1003	K-S Test Statistic	0.6593918	Mean	0.000315
1004	5% K-S Critical Value	0.3965462	SD	0.0001988
1005	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0001148
1006			95% KM (t) UCL	0.0005088
1007	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0005038

	A–E	F	G–K	L
1008	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0005357
1009	Minimum	0.00014	95% KM (bootstrap t) UCL	0.0010324
1010	Maximum	0.00065	95% KM (BCA) UCL	0.0005
1011	Mean	0.0003116	95% KM (Percentile Bootstrap) UCL	0.0005375
1012	Median	0.0003111	95% KM (Chebyshev) UCL	0.0008153
1013	SD	6.628E-05	97.5% KM (Chebyshev) UCL	0.0010318
1014	k star	24.623233	99% KM (Chebyshev) UCL	0.0014571
1015	Theta star	1.265E-05		
1016	Nu star	1822.1192	**Potential UCLs to Use**	
1017	AppChi2	1723.9734	95% KM (t) UCL	0.0005088
1018	95% Gamma Approximate UCL	0.0003293	95% KM (Percentile Bootstrap) UCL	0.0005375
1019	95% Adjusted Gamma UCL	N/A		
1020	**Note: DL/2 is not a recommended method.**			
1021				
1022	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1023	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1024	**For additional insight, the user may want to consult a statistician.**			
1025				
1026				
1027	**Chromium, Hexavalent**			
1028				
1029	**General Statistics**			
1030	Number of Valid Data	9	Number of Detected Data	5
1031	Number of Distinct Detected Data	5	Number of Non-Detect Data	4
1032	Number of Missing Values	31	Percent Non-Detects	44.44%
1033				
1034	**Raw Statistics**		**Log-transformed Statistics**	
1035	Minimum Detected	0.12	Minimum Detected	-2.120264
1036	Maximum Detected	6.8	Maximum Detected	1.9169226
1037	Mean of Detected	1.526	Mean of Detected	-0.930301
1038	SD of Detected	2.9491999	SD of Detected	1.6360033
1039	Minimum Non-Detect	0.51	Minimum Non-Detect	-0.673345
1040	Maximum Non-Detect	12	Maximum Non-Detect	2.4849066
1041				
1042	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	9
1043	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
1044	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
1045				
1046	**Warning: There are only 5 Detected Values in this data**			
1047	**Note: It should be noted that even though bootstrap may be performed on this data set**			
1048	**the resulting calculations may not be reliable enough to draw conclusions**			
1049				
1050	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
1051				
1052				
1053	**UCL Statistics**			
1054	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1055	Shapiro Wilk Test Statistic	0.5757819	Shapiro Wilk Test Statistic	0.7588819
1056	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
1057	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1058				
1059	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1060	DL/2 Substitution Method		DL/2 Substitution Method	

	A	B	C	D	E	F	G	H	I	J	K	L
1061					Mean	1.6022222					Mean	-0.762622
1062					SD	2.7280626					SD	1.5147074
1063					95% DL/2 (t) UCL	3.29321					95% H-Stat (DL/2) UCL	16.17582
1064												
1065					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
1066	**MLE method failed to converge properly**										Mean in Log Scale	-1.12962
1067											SD in Log Scale	1.1832783
1068											Mean in Original Scale	0.9604332
1069											SD in Original Scale	2.1906934
1070											95% t UCL	2.3183331
1071											95% Percentile Bootstrap UCL	2.4147595
1072											95% BCA Bootstrap UCL	2.4525373
1073											95% H-UCL	3.0089276
1074												
1075	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1076					k star (bias corrected)	0.3227279	**Data do not follow a Discernable Distribution (0.05)**					
1077					Theta Star	4.728441						
1078					nu star	3.2272793						
1079												
1080					A-D Test Statistic	0.9415129	**Nonparametric Statistics**					
1081					5% A-D Critical Value	0.7146984					Kaplan-Meier (KM) Method	
1082					K-S Test Statistic	0.7146984					Mean	1.0315625
1083					5% K-S Critical Value	0.372719					SD	2.1813816
1084	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.8625978
1085											95% KM (t) UCL	2.6356046
1086	**Assuming Gamma Distribution**										95% KM (z) UCL	2.4504097
1087					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	2.5778685
1088					Minimum	0.000001					95% KM (bootstrap t) UCL	30.076437
1089					Maximum	6.8					95% KM (BCA) UCL	2.634375
1090					Mean	0.8809039					95% KM (Percentile Bootstrap) UCL	2.66875
1091					Median	0.15					95% KM (Chebyshev) UCL	4.7915393
1092					SD	2.2231581					97.5% KM (Chebyshev) UCL	6.4184843
1093					k star	0.1739755					99% KM (Chebyshev) UCL	9.6143026
1094					Theta star	5.0633803						
1095					Nu star	3.1315584	**Potential UCLs to Use**					
1096					AppChi2	0.4124357					99% KM (Chebyshev) UCL	9.6143026
1097					95% Gamma Approximate UCL	6.6885627						
1098					95% Adjusted Gamma UCL	10.546169						
1099	**Warning: Recommended UCL exceeds the maximum observation**											
1100	**Note: DL/2 is not a recommended method.**											
1101												
1102	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1103	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1104	**For additional insight, the user may want to consult a statistician.**											
1105												
1106												
1107	**Chromium, Total**											
1108												
1109	**General Statistics**											
1110					Number of Valid Observations	34					Number of Distinct Observations	33
1111					Number of Missing Values	6						
1112												
1113	**Raw Statistics**						**Log-transformed Statistics**					

1114	Minimum	15.6	Minimum of Log Data	2.7472709
1115	Maximum	65	Maximum of Log Data	4.1743873
1116	Mean	29.023529	Mean of log Data	3.3177442
1117	Median	26.9	SD of log Data	0.3130295
1118	SD	10.135448		
1119	Std. Error of Mean	1.738215		
1120	Coefficient of Variation	0.3492149		
1121	Skewness	1.6134808		
1122				
1123	**Relevant UCL Statistics**			
1124	**Normal Distribution Test**		**Lognormal Distribution Test**	
1125	Shapiro Wilk Test Statistic	0.8776252	Shapiro Wilk Test Statistic	0.9732588
1126	Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
1127	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
1128				
1129	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1130	95% Student's-t UCL	31.965216	95% H-UCL	31.982664
1131	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	35.83824
1132	95% Adjusted-CLT UCL (Chen-1995)	32.396574	97.5% Chebyshev (MVUE) UCL	38.823016
1133	95% Modified-t UCL (Johnson-1978)	32.045379	99% Chebyshev (MVUE) UCL	44.686031
1134				
1135	**Gamma Distribution Test**		**Data Distribution**	
1136	k star (bias corrected)	9.2209466	**Data appear Gamma Distributed at 5% Significance Level**	
1137	Theta Star	3.1475651		
1138	MLE of Mean	29.023529		
1139	MLE of Standard Deviation	9.5578998		
1140	nu star	627.02437		
1141	Approximate Chi Square Value (.05)	569.9349	**Nonparametric Statistics**	
1142	Adjusted Level of Significance	0.0422	95% CLT UCL	31.882639
1143	Adjusted Chi Square Value	567.25289	95% Jackknife UCL	31.965216
1144			95% Standard Bootstrap UCL	31.913696
1145	Anderson-Darling Test Statistic	0.4945357	95% Bootstrap-t UCL	32.535708
1146	Anderson-Darling 5% Critical Value	0.7477005	95% Hall's Bootstrap UCL	32.826432
1147	Kolmogorov-Smirnov Test Statistic	0.1095227	95% Percentile Bootstrap UCL	31.944118
1148	Kolmogorov-Smirnov 5% Critical Value	0.1508937	95% BCA Bootstrap UCL	32.35
1149	**Data appear Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	36.600233
1150			97.5% Chebyshev(Mean, Sd) UCL	39.878679
1151	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	46.31855
1152	95% Approximate Gamma UCL	31.93077		
1153	95% Adjusted Gamma UCL	32.081741		
1154				
1155	**Potential UCL to Use**		Use 95% Approximate Gamma UCL	31.93077
1156				
1157	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1158	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
1159	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
1160				
1161				
1162	**Chrysene**			
1163				
1164	**General Statistics**			
1165	Number of Valid Data	37	Number of Detected Data	12
1166	Number of Distinct Detected Data	12	Number of Non-Detect Data	25

	A	B	C	D	E	F	G	H	I	J	K	L
1167					Number of Missing Values	4					Percent Non-Detects	67.57%
1168												
1169	**Raw Statistics**						**Log-transformed Statistics**					
1170					Minimum Detected	0.182					Minimum Detected	-1.703749
1171					Maximum Detected	43.4					Maximum Detected	3.7704594
1172					Mean of Detected	7.7584167					Mean of Detected	0.424602
1173					SD of Detected	15.606125					SD of Detected	1.7311222
1174					Minimum Non-Detect	0.255					Minimum Non-Detect	-1.366492
1175					Maximum Non-Detect	3.17					Maximum Non-Detect	1.1537316
1176												
1177	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	34
1178	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	3
1179	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	91.89%
1180												
1181	**UCL Statistics**											
1182	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
1183					Shapiro Wilk Test Statistic	0.5218898					Shapiro Wilk Test Statistic	0.8692498
1184					5% Shapiro Wilk Critical Value	0.859					5% Shapiro Wilk Critical Value	0.859
1185	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
1186												
1187	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1188					DL/2 Substitution Method						DL/2 Substitution Method	
1189					Mean	2.7093784					Mean	-1.016999
1190					SD	9.3332029					SD	1.5265007
1191					95% DL/2 (t) UCL	5.2998501					95% H-Stat (DL/2) UCL	2.5223711
1192												
1193					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
1194	**MLE yields a negative mean**										Mean in Log Scale	-1.85027
1195											SD in Log Scale	1.9101843
1196											Mean in Original Scale	2.5565056
1197											SD in Original Scale	9.3684848
1198											95% t UCL	5.15677
1199											95% Percentile Bootstrap UCL	4.9379801
1200											95% BCA Bootstrap UCL	6.8006662
1201											95% H-UCL	3.063923
1202												
1203	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1204					k star (bias corrected)	0.3588804	**Data appear Lognormal at 5% Significance Level**					
1205					Theta Star	21.618389						
1206					nu star	8.6131303						
1207												
1208					A-D Test Statistic	1.5400266	**Nonparametric Statistics**					
1209					5% A-D Critical Value	0.8035421					Kaplan-Meier (KM) Method	
1210					K-S Test Statistic	0.8035421					Mean	2.6552888
1211					5% K-S Critical Value	0.2618624					SD	9.2154646
1212	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	1.5825311
1213											95% KM (t) UCL	5.3270723
1214	**Assuming Gamma Distribution**										95% KM (z) UCL	5.2583208
1215					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	5.1763456
1216					Minimum	0.000001					95% KM (bootstrap t) UCL	36.74688
1217					Maximum	43.4					95% KM (BCA) UCL	5.9837857
1218					Mean	2.5162439					95% KM (Percentile Bootstrap) UCL	5.1750631
1219					Median	0.000001					95% KM (Chebyshev) UCL	9.5533818

	A–E	F	G–K	L
1220	SD	9.3795196	97.5% KM (Chebyshev) UCL	12.538192
1221	k star	0.0935301	99% KM (Chebyshev) UCL	18.401274
1222	Theta star	26.90304		
1223	Nu star	6.9212272	**Potential UCLs to Use**	
1224	AppChi2	2.1274145	97.5% KM (Chebyshev) UCL	12.538192
1225	95% Gamma Approximate UCL	8.186226		
1226	95% Adjusted Gamma UCL	8.6470553		
1227	**Note: DL/2 is not a recommended method.**			
1228				
1229	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1230	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1231	**For additional insight, the user may want to consult a statistician.**			
1232				
1233				
1234	**Dibenz(a,h)anthracene**			
1235				
1236	**General Statistics**			
1237	Number of Valid Data	37	Number of Detected Data	5
1238	Number of Distinct Detected Data	5	Number of Non-Detect Data	32
1239	Number of Missing Values	1	Percent Non-Detects	86.49%
1240				
1241	**Raw Statistics**		**Log-transformed Statistics**	
1242	Minimum Detected	0.154	Minimum Detected	-1.870803
1243	Maximum Detected	6.12	Maximum Detected	1.8115621
1244	Mean of Detected	2.1944	Mean of Detected	-0.25979
1245	SD of Detected	2.7709332	SD of Detected	1.7478527
1246	Minimum Non-Detect	0.0795	Minimum Non-Detect	-2.531998
1247	Maximum Non-Detect	0.989	Maximum Non-Detect	-0.011061
1248				
1249	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	35
1250	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
1251	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.59%
1252				
1253	**Warning: There are only 5 Detected Values in this data**			
1254	**Note: It should be noted that even though bootstrap may be performed on this data set**			
1255	**the resulting calculations may not be reliable enough to draw conclusions**			
1256				
1257	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
1258				
1259				
1260	**UCL Statistics**			
1261	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1262	Shapiro Wilk Test Statistic	0.7875705	Shapiro Wilk Test Statistic	0.8331872
1263	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
1264	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
1265				
1266	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1267	DL/2 Substitution Method		DL/2 Substitution Method	
1268	Mean	0.364873	Mean	-2.574078
1269	SD	1.1840876	SD	1.2655529
1270	95% DL/2 (t) UCL	0.6935217	95% H-Stat (DL/2) UCL	0.3006842
1271				
1272	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	

	A–F	F	G–K	L
1273	**MLE method failed to converge properly**		Mean in Log Scale	-6.937529
1274			SD in Log Scale	2.7979927
1275			Mean in Original Scale	0.2968984
1276			SD in Original Scale	1.1963805
1277			95% t UCL	0.6289591
1278			95% Percentile Bootstrap UCL	0.6334564
1279			95% BCA Bootstrap UCL	0.8557187
1280			95% H-UCL	0.4873388
1281				
1282	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1283	k star (bias corrected)	0.3701501	**Data appear Normal at 5% Significance Level**	
1284	Theta Star	5.9284064		
1285	nu star	3.7015006		
1286				
1287	A-D Test Statistic	0.57243	**Nonparametric Statistics**	
1288	5% A-D Critical Value	0.7062806	Kaplan-Meier (KM) Method	
1289	K-S Test Statistic	0.7062806	Mean	0.4303632
1290	5% K-S Critical Value	0.3697976	SD	1.1473462
1291	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.2108965
1292			95% KM (t) UCL	0.7864192
1293	**Assuming Gamma Distribution**		95% KM (z) UCL	0.777257
1294	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.7285461
1295	Minimum	0.000001	95% KM (bootstrap t) UCL	6.0092564
1296	Maximum	6.12	95% KM (BCA) UCL	4.3005405
1297	Mean	0.2965414	95% KM (Percentile Bootstrap) UCL	4.14
1298	Median	0.000001	95% KM (Chebyshev) UCL	1.3496395
1299	SD	1.1964714	97.5% KM (Chebyshev) UCL	1.7474111
1300	k star	0.0894372	99% KM (Chebyshev) UCL	2.5287564
1301	Theta star	3.3156394		
1302	Nu star	6.6183505	**Potential UCLs to Use**	
1303	AppChi2	1.9636005	95% KM (t) UCL	0.7864192
1304	95% Gamma Approximate UCL	0.9994981	95% KM (Percentile Bootstrap) UCL	4.14
1305	95% Adjusted Gamma UCL	1.0576008		
1306	**Note: DL/2 is not a recommended method.**			
1307				
1308	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1309	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1310	**For additional insight, the user may want to consult a statistician.**			
1311				
1312				
1313	**Dibenzofuran**			
1314				
1315	**General Statistics**			
1316	Number of Valid Data	37	Number of Detected Data	8
1317	Number of Distinct Detected Data	8	Number of Non-Detect Data	29
1318	Number of Missing Values	1	Percent Non-Detects	78.38%
1319				
1320	**Raw Statistics**		**Log-transformed Statistics**	
1321	Minimum Detected	0.113	Minimum Detected	-2.180367
1322	Maximum Detected	7.09	Maximum Detected	1.9586853
1323	Mean of Detected	1.906125	Mean of Detected	-0.707879
1324	SD of Detected	2.9761094	SD of Detected	1.7687066
1325	Minimum Non-Detect	0.255	Minimum Non-Detect	-1.366492

	A	B	C	D	E	F	G	H	I	J	K	L
1326					Maximum Non-Detect	3.17					Maximum Non-Detect	1.1537316
1327												
1328	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	35
1329	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	2
1330	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	94.59%
1331												
1332	**Warning: There are only 8 Detected Values in this data**											
1333	**Note: It should be noted that even though bootstrap may be performed on this data set**											
1334	**the resulting calculations may not be reliable enough to draw conclusions**											
1335												
1336	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
1337												
1338												
1339	**UCL Statistics**											
1340	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
1341					Shapiro Wilk Test Statistic	0.649564					Shapiro Wilk Test Statistic	0.7883105
1342					5% Shapiro Wilk Critical Value	0.818					5% Shapiro Wilk Critical Value	0.818
1343	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
1344												
1345	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1346					DL/2 Substitution Method						DL/2 Substitution Method	
1347					Mean	0.619473					Mean	-1.527162
1348					SD	1.519119					SD	1.0943727
1349					95% DL/2 (t) UCL	1.0411112					95% H-Stat (DL/2) UCL	0.6233997
1350												
1351					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
1352	**MLE method failed to converge properly**										Mean in Log Scale	-1.497986
1353											SD in Log Scale	0.9457287
1354											Mean in Original Scale	0.5627367
1355											SD in Original Scale	1.4959511
1356											95% t UCL	0.9779445
1357											95% Percentile Bootstrap UCL	0.9870187
1358											95% BCA Bootstrap UCL	1.2227927
1359											95% H-UCL	0.5046762
1360												
1361	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1362					k star (bias corrected)	0.3792624	**Data do not follow a Discernable Distribution (0.05)**					
1363					Theta Star	5.0258733						
1364					nu star	6.0681992						
1365												
1366					A-D Test Statistic	1.0019095	**Nonparametric Statistics**					
1367					5% A-D Critical Value	0.7669953					Kaplan-Meier (KM) Method	
1368					K-S Test Statistic	0.7669953					Mean	0.5351039
1369					5% K-S Critical Value	0.3100452					SD	1.4826108
1370	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.2613546
1371											95% KM (t) UCL	0.9763483
1372	**Assuming Gamma Distribution**										95% KM (z) UCL	0.964994
1373					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.9541245
1374					Minimum	0.000001					95% KM (bootstrap t) UCL	3.4035715
1375					Maximum	7.09					95% KM (BCA) UCL	1.0491853
1376					Mean	0.54534					95% KM (Percentile Bootstrap) UCL	1.0045365
1377					Median	0.000001					95% KM (Chebyshev) UCL	1.6743224
1378					SD	1.5280516					97.5% KM (Chebyshev) UCL	2.1672631

	A	B	C	D	E	F	G	H	I	J	K	L
1379					k star	0.1176554					99% KM (Chebyshev) UCL	3.1355498
1380					Theta star	4.6350621						
1381					Nu star	8.7064979	**Potential UCLs to Use**					
1382					AppChi2	3.1506679					97.5% KM (Chebyshev) UCL	2.1672631
1383					95% Gamma Approximate UCL	1.5069825						
1384					95% Adjusted Gamma UCL	1.5791291						
1385	**Note: DL/2 is not a recommended method.**											
1386												
1387	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1388	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1389	**For additional insight, the user may want to consult a statistician.**											
1390												
1391												
1392	**Diesel Range Organics (DRO)**											
1393												
1394	**General Statistics**											
1395					Number of Valid Data	37					Number of Detected Data	29
1396					Number of Distinct Detected Data	29					Number of Non-Detect Data	8
1397					Number of Missing Values	5					Percent Non-Detects	21.62%
1398												
1399	**Raw Statistics**						**Log-transformed Statistics**					
1400					Minimum Detected	7.81					Minimum Detected	2.055405
1401					Maximum Detected	7360					Maximum Detected	8.9038152
1402					Mean of Detected	1123.1507					Mean of Detected	5.3014077
1403					SD of Detected	1882.057					SD of Detected	2.1217393
1404					Minimum Non-Detect	20.4					Minimum Non-Detect	3.0155349
1405					Maximum Non-Detect	22.2					Maximum Non-Detect	3.1000923
1406												
1407	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	13
1408	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	24
1409	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	35.14%
1410												
1411	**UCL Statistics**											
1412	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
1413					Shapiro Wilk Test Statistic	0.6558941					Shapiro Wilk Test Statistic	0.9387852
1414					5% Shapiro Wilk Critical Value	0.926					5% Shapiro Wilk Critical Value	0.926
1415	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
1416												
1417	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1418					DL/2 Substitution Method						DL/2 Substitution Method	
1419					Mean	882.62757					Mean	4.668216
1420					SD	1723.5235					SD	2.2350055
1421					95% DL/2 (t) UCL	1360.9991					95% H-Stat (DL/2) UCL	5915.1323
1422												
1423					Maximum Likelihood Estimate(MLE) Method						Log ROS Method	
1424					Mean	274.45103					Mean in Log Scale	4.6310094
1425					SD	2293.6977					SD in Log Scale	2.2836065
1426					95% MLE (t) UCL	911.07697					Mean in Original Scale	882.43688
1427					95% MLE (Tiku) UCL	961.99468					SD in Original Scale	1723.6237
1428											95% t UCL	1360.8363
1429											95% Percentile Bootstrap UCL	1354.9662
1430											95% BCA Bootstrap UCL	1503.9945
1431											95% H UCL	6759.8798

	A–E	F	G–K	L
1432				
1433	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1434	k star (bias corrected)	0.3676921	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
1435	Theta Star	3054.5955		
1436	nu star	21.326143		
1437				
1438	A-D Test Statistic	1.1305792	**Nonparametric Statistics**	
1439	5% A-D Critical Value	0.8373094	Kaplan-Meier (KM) Method	
1440	K-S Test Statistic	0.8373094	Mean	883.09341
1441	5% K-S Critical Value	0.1747597	SD	1699.8357
1442	**Data follow Appr. Gamma Distribution at 5% Significance Level**		SE of Mean	284.39822
1443			95% KM (t) UCL	1363.2423
1444	**Assuming Gamma Distribution**		95% KM (z) UCL	1350.8869
1445	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1361.3995
1446	Minimum	0.000001	95% KM (bootstrap t) UCL	1590.0928
1447	Maximum	7360	95% KM (BCA) UCL	1397.8274
1448	Mean	880.3073	95% KM (Percentile Bootstrap) UCL	1372.3549
1449	Median	49.3	95% KM (Chebyshev) UCL	2122.7565
1450	SD	1724.7352	97.5% KM (Chebyshev) UCL	2659.1598
1451	k star	0.145308	99% KM (Chebyshev) UCL	3712.82
1452	Theta star	6058.2171		
1453	Nu star	10.752791	**Potential UCLs to Use**	
1454	AppChi2	4.4175587	95% KM (Chebyshev) UCL	2122.7565
1455	95% Gamma Approximate UCL	2142.7582		
1456	95% Adjusted Gamma UCL	2231.5524		
1457	**Note: DL/2 is not a recommended method.**			
1458				
1459	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1460	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1461	**For additional insight, the user may want to consult a statistician.**			
1462				
1463				
1464	**Gasoline Range Organics (GRO)**			
1465				
1466	**General Statistics**			
1467	Number of Valid Data	29	Number of Detected Data	10
1468	Number of Distinct Detected Data	10	Number of Non-Detect Data	19
1469	Number of Missing Values	13	Percent Non-Detects	65.52%
1470				
1471	**Raw Statistics**		**Log-transformed Statistics**	
1472	Minimum Detected	0.454	Minimum Detected	-0.789658
1473	Maximum Detected	14.5	Maximum Detected	2.6741486
1474	Mean of Detected	3.014	Mean of Detected	0.2488698
1475	SD of Detected	4.9046118	SD of Detected	1.1924802
1476	Minimum Non-Detect	1.63	Minimum Non-Detect	0.48858
1477	Maximum Non-Detect	12.7	Maximum Non-Detect	2.541602
1478				
1479	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	28
1480	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
1481	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	96.55%
1482				
1483	**UCL Statistics**			
1484	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	

	A	B	C	D	E	F	G	H	I	J	K	L
1485	Shapiro Wilk Test Statistic					0.5680361	Shapiro Wilk Test Statistic					0.6879442
1486	5% Shapiro Wilk Critical Value					0.842	5% Shapiro Wilk Critical Value					0.842
1487	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
1488												
1489	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1490	DL/2 Substitution Method						DL/2 Substitution Method					
1491	Mean					2.04	Mean					0.2746655
1492	SD					3.0312593	SD					0.76542
1493	95% DL/2 (t) UCL					2.9975508	95% H-Stat (DL/2) UCL					2.4235259
1494												
1495	Maximum Likelihood Estimate(MLE) Method					N/A	Log ROS Method					
1496	**MLE method failed to converge properly**						Mean in Log Scale					0.0113433
1497							SD in Log Scale					0.6984951
1498							Mean in Original Scale					1.6241147
1499							SD in Original Scale					2.9639716
1500							95% t UCL					2.5604099
1501							95% Percentile Bootstrap UCL					2.5688793
1502							95% BCA Bootstrap UCL					3.0092562
1503							95% H-UCL					1.7092954
1504												
1505	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1506	k star (bias corrected)					0.5611692	**Data do not follow a Discernable Distribution (0.05)**					
1507	Theta Star					5.3709289						
1508	nu star					11.223385						
1509												
1510	A-D Test Statistic					1.939896	**Nonparametric Statistics**					
1511	5% A-D Critical Value					0.7604589	Kaplan-Meier (KM) Method					
1512	K-S Test Statistic					0.7604589	Mean					1.5444572
1513	5% K-S Critical Value					0.2768287	SD					2.9525692
1514	**Data not Gamma Distributed at 5% Significance Level**						SE of Mean					0.5829805
1515							95% KM (t) UCL					2.5361833
1516	**Assuming Gamma Distribution**						95% KM (z) UCL					2.5033748
1517	Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL					2.5032139
1518	Minimum					0.454	95% KM (bootstrap t) UCL					11.44704
1519	Maximum					14.5	95% KM (BCA) UCL					2.6588123
1520	Mean					1.7622922	95% KM (Percentile Bootstrap) UCL					2.5698049
1521	Median					1.0931909	95% KM (Chebyshev) UCL					4.0856102
1522	SD					2.9304265	97.5% KM (Chebyshev) UCL					5.1851691
1523	k star					1.2261672	99% KM (Chebyshev) UCL					7.3450397
1524	Theta star					1.4372364						
1525	Nu star					71.117697	**Potential UCLs to Use**					
1526	AppChi2					52.701745	95% KM (BCA) UCL					2.6588123
1527	95% Gamma Approximate UCL					2.3781027						
1528	95% Adjusted Gamma UCL					2.4216296						
1529	**Note: DL/2 is not a recommended method.**											
1530												
1531	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1532	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1533	**For additional insight, the user may want to consult a statistician.**											
1534												
1535												
1536	**Indeno(1,2,3-c,d)Pyrene**											
1537												

	A–E	F	G–K	L
1538	**General Statistics**			
1539	Number of Valid Data	37	Number of Detected Data	13
1540	Number of Distinct Detected Data	13	Number of Non-Detect Data	24
1541	Number of Missing Values	1	Percent Non-Detects	64.86%
1542				
1543	**Raw Statistics**		**Log-transformed Statistics**	
1544	Minimum Detected	0.117	Minimum Detected	-2.145581
1545	Maximum Detected	16.1	Maximum Detected	2.7788193
1546	Mean of Detected	2.9842308	Mean of Detected	-0.072888
1547	SD of Detected	5.5358715	SD of Detected	1.4549418
1548	Minimum Non-Detect	0.255	Minimum Non-Detect	-1.366492
1549	Maximum Non-Detect	2.4	Maximum Non-Detect	0.8754687
1550				
1551	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	35
1552	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
1553	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.59%
1554				
1555	**UCL Statistics**			
1556	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1557	Shapiro Wilk Test Statistic	0.5291613	Shapiro Wilk Test Statistic	0.898106
1558	5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
1559	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
1560				
1561	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1562	DL/2 Substitution Method		DL/2 Substitution Method	
1563	Mean	1.1739595	Mean	-1.225176
1564	SD	3.4743565	SD	1.2647026
1565	95% DL/2 (t) UCL	2.1382825	95% H-Stat (DL/2) UCL	1.1566414
1566				
1567	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
1568	**MLE method failed to converge properly**		Mean in Log Scale	-1.538478
1569			SD in Log Scale	1.4028038
1570			Mean in Original Scale	1.1145554
1571			SD in Original Scale	3.4874094
1572			95% t UCL	2.0825012
1573			95% Percentile Bootstrap UCL	2.101967
1574			95% BCA Bootstrap UCL	2.4782331
1575			95% H-UCL	1.1281355
1576				
1577	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1578	k star (bias corrected)	0.4654924	**Data appear Lognormal at 5% Significance Level**	
1579	Theta Star	6.4109123		
1580	nu star	12.102802		
1581				
1582	A-D Test Statistic	1.4318849	**Nonparametric Statistics**	
1583	5% A-D Critical Value	0.7869275	Kaplan-Meier (KM) Method	
1584	K-S Test Statistic	0.7869275	Mean	1.1725249
1585	5% K-S Critical Value	0.2492037	SD	3.4241569
1586	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.5868125
1587			95% KM (t) UCL	2.163239
1588	**Assuming Gamma Distribution**		95% KM (z) UCL	2.1377455
1589	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.141256
1590	Minimum	0.000001	95% KM (bootstrap t) UCL	8.6670007

	A	B	C	D	E	F	G	H	I	J	K	L
1591					Maximum	16.1					95% KM (BCA) UCL	2.4187838
1592					Mean	1.0485142					95% KM (Percentile Bootstrap) UCL	2.1483096
1593					Median	0.000001					95% KM (Chebyshev) UCL	3.7303812
1594					SD	3.5073201					97.5% KM (Chebyshev) UCL	4.8371676
1595					k star	0.1015938					99% KM (Chebyshev) UCL	7.0112353
1596					Theta star	10.32065						
1597					Nu star	7.5179421	**Potential UCLs to Use**					
1598					AppChi2	2.4591392					95% KM (BCA) UCL	2.4187838
1599					95% Gamma Approximate UCL	3.2054585						
1600					95% Adjusted Gamma UCL	3.3755741						
1601	**Note: DL/2 is not a recommended method.**											
1602												
1603	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1604	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1605	**For additional insight, the user may want to consult a statistician.**											
1606												
1607												
1608	**Isopropylbenzene**											
1609												
1610	**General Statistics**											
1611					Number of Valid Data	37					Number of Detected Data	1
1612					Number of Distinct Detected Data	1					Number of Non-Detect Data	36
1613					Number of Missing Values	1					Percent Non-Detects	97.30%
1614												
1615	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
1616	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**											
1617												
1618	**The data set for variable Isopropylbenzene was not processed!**											
1619												
1620												
1621												
1622	**Lead**											
1623												
1624	**General Statistics**											
1625					Number of Valid Observations	34					Number of Distinct Observations	31
1626					Number of Missing Values	8						
1627												
1628	**Raw Statistics**						**Log-transformed Statistics**					
1629					Minimum	6.14					Minimum of Log Data	1.8148247
1630					Maximum	208					Maximum of Log Data	5.3375381
1631					Mean	36.333529					Mean of log Data	2.920169
1632					Median	12.6					SD of log Data	1.063171
1633					SD	51.780029						
1634					Std. Error of Mean	8.8802016						
1635					Coefficient of Variation	1.4251307						
1636					Skewness	2.190731						
1637												
1638	**Relevant UCL Statistics**											
1639	**Normal Distribution Test**						**Lognormal Distribution Test**					
1640					Shapiro Wilk Test Statistic	0.6226056					Shapiro Wilk Test Statistic	0.8261215
1641					Shapiro Wilk Critical Value	0.933					Shapiro Wilk Critical Value	0.933
1642	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
1643												

	A–E	F	G–K	L
1644	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1645	95% Student's-t UCL	51.362031	95% H-UCL	52.061132
1646	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	61.49344
1647	95% Adjusted-CLT UCL (Chen-1995)	54.505106	97.5% Chebyshev (MVUE) UCL	74.328433
1648	95% Modified-t UCL (Johnson-1978)	51.91809	99% Chebyshev (MVUE) UCL	99.540292
1649				
1650	**Gamma Distribution Test**		**Data Distribution**	
1651	k star (bias corrected)	0.8152041	**Data do not follow a Discernable Distribution (0.05)**	
1652	Theta Star	44.569857		
1653	MLE of Mean	36.333529		
1654	MLE of Standard Deviation	40.241524		
1655	nu star	55.433878		
1656	Approximate Chi Square Value (.05)	39.323758	**Nonparametric Statistics**	
1657	Adjusted Level of Significance	0.0422	95% CLT UCL	50.940161
1658	Adjusted Chi Square Value	38.652154	95% Jackknife UCL	51.362031
1659			95% Standard Bootstrap UCL	50.742631
1660	Anderson-Darling Test Statistic	3.3823898	95% Bootstrap-t UCL	59.370562
1661	Anderson-Darling 5% Critical Value	0.7817952	95% Hall's Bootstrap UCL	55.722136
1662	Kolmogorov-Smirnov Test Statistic	0.2914255	95% Percentile Bootstrap UCL	51.744118
1663	Kolmogorov-Smirnov 5% Critical Value	0.1561468	95% BCA Bootstrap UCL	55.042941
1664	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	75.041431
1665			97.5% Chebyshev(Mean, Sd) UCL	91.790371
1666	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	124.69042
1667	95% Approximate Gamma UCL	51.218615		
1668	95% Adjusted Gamma UCL	52.108569		
1669				
1670	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	75.041431
1671				
1672	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1673	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
1674	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
1675				
1676				
1677	**Mercury**			
1678				
1679	**General Statistics**			
1680	Number of Valid Observations	34	Number of Distinct Observations	32
1681	Number of Missing Values	4		
1682				
1683	**Raw Statistics**		**Log-transformed Statistics**	
1684	Minimum	0.0229	Minimum of Log Data	-3.776618
1685	Maximum	1.92	Maximum of Log Data	0.6523252
1686	Mean	0.1480794	Mean of log Data	-2.3368
1687	Median	0.0978	SD of log Data	0.657544
1688	SD	0.3146726		
1689	Std. Error of Mean	0.0539659		
1690	Coefficient of Variation	2.125026		
1691	Skewness	5.7379838		
1692				
1693	**Relevant UCL Statistics**			
1694	**Normal Distribution Test**		**Lognormal Distribution Test**	
1695	Shapiro Wilk Test Statistic	0.2568166	Shapiro Wilk Test Statistic	0.7459753
1696	Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933

	A–E	F	G–K	L
1697	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
1698				
1699	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1700	95% Student's-t UCL	0.2394092	95% H-UCL	0.1521442
1701	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	0.1820221
1702	95% Adjusted-CLT UCL (Chen-1995)	0.2935894	97.5% Chebyshev (MVUE) UCL	0.2092703
1703	95% Modified-t UCL (Johnson-1978)	0.2482601	99% Chebyshev (MVUE) UCL	0.2627943
1704				
1705	**Gamma Distribution Test**		**Data Distribution**	
1706	k star (bias corrected)	1.2169253	**Data do not follow a Discernable Distribution (0.05)**	
1707	Theta Star	0.1216832		
1708	MLE of Mean	0.1480794		
1709	MLE of Standard Deviation	0.1342341		
1710	nu star	82.750921		
1711	Approximate Chi Square Value (.05)	62.786735	**Nonparametric Statistics**	
1712	Adjusted Level of Significance	0.0422	95% CLT UCL	0.2368454
1713	Adjusted Chi Square Value	61.926762	95% Jackknife UCL	0.2394092
1714			95% Standard Bootstrap UCL	0.2340774
1715	Anderson-Darling Test Statistic	5.1947118	95% Bootstrap-t UCL	0.7966234
1716	Anderson-Darling 5% Critical Value	0.7695213	95% Hall's Bootstrap UCL	0.6742943
1717	Kolmogorov-Smirnov Test Statistic	0.3522267	95% Percentile Bootstrap UCL	0.2557735
1718	Kolmogorov-Smirnov 5% Critical Value	0.1543538	95% BCA Bootstrap UCL	0.3142324
1719	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	0.3833113
1720			97.5% Chebyshev(Mean, Sd) UCL	0.4850964
1721	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	0.6850334
1722	95% Approximate Gamma UCL	0.195164		
1723	95% Adjusted Gamma UCL	0.1978742		
1724				
1725	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	0.3833113
1726				
1727	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1728	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
1729	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
1730				
1731				
1732	**Naphthalene**			
1733				
1734	**General Statistics**			
1735	Number of Valid Data	37	Number of Detected Data	16
1736	Number of Distinct Detected Data	16	Number of Non-Detect Data	21
1737	Number of Missing Values	3	Percent Non-Detects	56.76%
1738				
1739	**Raw Statistics**		**Log-transformed Statistics**	
1740	Minimum Detected	0.00078	Minimum Detected	-7.156217
1741	Maximum Detected	2.91	Maximum Detected	1.0681531
1742	Mean of Detected	0.3894538	Mean of Detected	-3.642174
1743	SD of Detected	0.8396258	SD of Detected	2.817063
1744	Minimum Non-Detect	0.0302	Minimum Non-Detect	-3.499913
1745	Maximum Non-Detect	0.254	Maximum Non-Detect	-1.370421
1746				
1747	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	34
1748	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
1749	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	91.89%

	A–E	F	G–K	L
1750				
1751	**UCL Statistics**			
1752	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
1753	Shapiro Wilk Test Statistic	0.5362162	Shapiro Wilk Test Statistic	0.9001338
1754	5% Shapiro Wilk Critical Value	0.887	5% Shapiro Wilk Critical Value	0.887
1755	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
1756				
1757	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
1758	DL/2 Substitution Method		DL/2 Substitution Method	
1759	Mean	0.1856773	Mean	-3.624976
1760	SD	0.5714404	SD	1.8448638
1761	95% DL/2 (t) UCL	0.3442831	95% H-Stat (DL/2) UCL	0.4291495
1762				
1763	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
1764	**MLE yields a negative mean**		Mean in Log Scale	-4.648356
1765			SD in Log Scale	2.0433592
1766			Mean in Original Scale	0.1711105
1767			SD in Original Scale	0.5753886
1768			95% t UCL	0.3308122
1769			95% Percentile Bootstrap UCL	0.3425143
1770			95% BCA Bootstrap UCL	0.4285014
1771			95% H-UCL	0.2812005
1772				
1773	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
1774	k star (bias corrected)	0.2539578	**Data appear Lognormal at 5% Significance Level**	
1775	Theta Star	1.5335372		
1776	nu star	8.12665		
1777				
1778	A-D Test Statistic	0.9784687	**Nonparametric Statistics**	
1779	5% A-D Critical Value	0.8535172	Kaplan-Meier (KM) Method	
1780	K-S Test Statistic	0.8535172	Mean	0.1757577
1781	5% K-S Critical Value	0.2347443	SD	0.5663393
1782	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0962122
1783			95% KM (t) UCL	0.3381925
1784	**Assuming Gamma Distribution**		95% KM (z) UCL	0.3340127
1785	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.3352225
1786	Minimum	0.000001	95% KM (bootstrap t) UCL	0.6796402
1787	Maximum	2.91	95% KM (BCA) UCL	0.3606901
1788	Mean	0.168413	95% KM (Percentile Bootstrap) UCL	0.3353983
1789	Median	0.000001	95% KM (Chebyshev) UCL	0.5951369
1790	SD	0.5761927	97.5% KM (Chebyshev) UCL	0.7766027
1791	k star	0.1150836	99% KM (Chebyshev) UCL	1.1330569
1792	Theta star	1.463397		
1793	Nu star	8.5161864	**Potential UCLs to Use**	
1794	AppChi2	3.0374593	99% KM (Chebyshev) UCL	1.1330569
1795	95% Gamma Approximate UCL	0.472183		
1796	95% Adjusted Gamma UCL	0.4951389		
1797	**Note: DL/2 is not a recommended method.**			
1798				
1799	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
1800	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
1801	**For additional insight, the user may want to consult a statistician.**			
1802				

n-Butylbenzene

General Statistics

Number of Valid Data	37	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	36
Number of Missing Values	1	Percent Non-Detects	97.30%

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable n-Butylbenzene was not processed!

Nickel

General Statistics

Number of Valid Observations	34	Number of Distinct Observations	30
Number of Missing Values	8		

Raw Statistics		**Log-transformed Statistics**	
Minimum	15.9	Minimum of Log Data	2.7663191
Maximum	49.1	Maximum of Log Data	3.893859
Mean	29.029412	Mean of log Data	3.3471549
Median	30.05	SD of log Data	0.2113009
SD	6.0254777		
Std. Error of Mean	1.0333609		
Coefficient of Variation	0.2075646		
Skewness	0.6078003		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9318037	Shapiro Wilk Test Statistic	0.9439918
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	30.778231	95% H-UCL	30.998214
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	33.670947
95% Adjusted-CLT UCL (Chen-1995)	30.844234	97.5% Chebyshev (MVUE) UCL	35.673068
95% Modified-t UCL (Johnson-1978)	30.796183	99% Chebyshev (MVUE) UCL	39.605848
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	21.720467	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	1.3365004		
MLE of Mean	29.029412		
MLE of Standard Deviation	6.2287896		
nu star	1476.9917		
Approximate Chi Square Value (.05)	1388.7444	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	30.729139
Adjusted Chi Square Value	1384.5313	95% Jackknife UCL	30.778231
		95% Standard Bootstrap UCL	30.680934

Anderson-Darling Test Statistic	0.8222741	95% Bootstrap-t UCL	30.905529
Anderson-Darling 5% Critical Value	0.7460347	95% Hall's Bootstrap UCL	31.062777
Kolmogorov-Smirnov Test Statistic	0.1421718	95% Percentile Bootstrap UCL	30.664706
Kolmogorov-Smirnov 5% Critical Value	0.1506272	95% BCA Bootstrap UCL	30.829412
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	33.533727
		97.5% Chebyshev(Mean, Sd) UCL	35.482749
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	39.311223
95% Approximate Gamma UCL	30.874077		
95% Adjusted Gamma UCL	30.968025		
Potential UCL to Use		Use 95% Approximate Gamma UCL	30.874077

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

n-Propylbenzene

General Statistics

Number of Valid Data	37	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	35
Number of Missing Values	5	Percent Non-Detects	94.59%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0156	Minimum Detected	-4.160484
Maximum Detected	0.0202	Maximum Detected	-3.902073
Mean of Detected	0.0179	Mean of Detected	-4.031279
SD of Detected	0.0032527	SD of Detected	0.1827247
Minimum Non-Detect	0.00092	Minimum Non-Detect	-6.991137
Maximum Non-Detect	0.127	Maximum Non-Detect	-2.063568
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	37
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
However, results obtained using 4 to 9 distinct values may not be reliable.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A

	A	B	C	D	E	F	G	H	I	J	K	L
1909	5% Shapiro Wilk Critical Value					N/A	5% Shapiro Wilk Critical Value					N/A
1910	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
1911												
1912	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
1913	DL/2 Substitution Method						DL/2 Substitution Method					
1914	Mean					0.0123193	Mean					-4.79428
1915	SD					0.0099865	SD					1.1888391
1916	95% DL/2 (t) UCL					0.0150911	95% H-Stat (DL/2) UCL					0.0281617
1917												
1918	Maximum Likelihood Estimate(MLE) Method					N/A	Log ROS Method					
1919	**MLE method failed to converge properly**						Mean in Log Scale					N/A
1920							SD in Log Scale					N/A
1921							Mean in Original Scale					N/A
1922							SD in Original Scale					N/A
1923							95% t UCL					N/A
1924							95% Percentile Bootstrap UCL					N/A
1925							95% BCA Bootstrap UCL					N/A
1926							95% H-UCL					N/A
1927												
1928	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
1929	k star (bias corrected)					N/A	**Data do not follow a Discernable Distribution (0.05)**					
1930	Theta Star					N/A						
1931	nu star					N/A						
1932												
1933	A-D Test Statistic					N/A	**Nonparametric Statistics**					
1934	5% A-D Critical Value					N/A	Kaplan-Meier (KM) Method					
1935	K-S Test Statistic					N/A	Mean					0.0159286
1936	5% K-S Critical Value					N/A	SD					0.0011847
1937	**Data not Gamma Distributed at 5% Significance Level**						SE of Mean					0.0004478
1938							95% KM (t) UCL					0.0166845
1939	**Assuming Gamma Distribution**						95% KM (z) UCL					0.0166651
1940	Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL					0.0188377
1941	Minimum					N/A	95% KM (bootstrap t) UCL					0.0161272
1942	Maximum					N/A	95% KM (BCA) UCL					0.0202
1943	Mean					N/A	95% KM (Percentile Bootstrap) UCL					0.0202
1944	Median					N/A	95% KM (Chebyshev) UCL					0.0178803
1945	SD					N/A	97.5% KM (Chebyshev) UCL					0.0187249
1946	k star					N/A	99% KM (Chebyshev) UCL					0.0203838
1947	Theta star					N/A						
1948	Nu star					N/A	**Potential UCLs to Use**					
1949	AppChi2					N/A	95% KM (t) UCL					0.0166845
1950	95% Gamma Approximate UCL					N/A	95% KM (% Bootstrap) UCL					0.0202
1951	95% Adjusted Gamma UCL					N/A						
1952	**Note: DL/2 is not a recommended method.**											
1953												
1954	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
1955	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
1956	**For additional insight, the user may want to consult a statistician.**											
1957												
1958												
1959	**Pentachlorophenol**											
1960												
1961	**General Statistics**											

	A	B	C	D	E	F	G	H	I	J	K	L
1962					Number of Valid Data	37					Number of Detected Data	1
1963					Number of Distinct Detected Data	1					Number of Non-Detect Data	36
1964					Number of Missing Values	1					Percent Non-Detects	97.30%
1965												
1966	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
1967	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**											
1968												
1969	**The data set for variable Pentachlorophenol was not processed!**											
1970												
1971												
1972												
1973	**Perchlorate**											
1974												
1975	**General Statistics**											
1976					Number of Valid Data	8					Number of Detected Data	3
1977					Number of Distinct Detected Data	3					Number of Non-Detect Data	5
1978					Number of Missing Values	28					Percent Non-Detects	62.50%
1979												
1980	**Raw Statistics**						**Log-transformed Statistics**					
1981					Minimum Detected	0.0002					Minimum Detected	-8.517193
1982					Maximum Detected	0.00043					Maximum Detected	-7.751725
1983					Mean of Detected	0.0002833					Mean of Detected	-8.230267
1984					SD of Detected	0.0001274					SD of Detected	0.4171603
1985					Minimum Non-Detect	0.00046					Minimum Non-Detect	-7.684284
1986					Maximum Non-Detect	0.00051					Maximum Non-Detect	-7.5811
1987												
1988	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	8
1989	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	0
1990	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	100.00%
1991												
1992	**Warning: There are only 3 Distinct Detected Values in this data set**											
1993	**The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.**											
1994	**Those methods will return a 'N/A' value on your output display!**											
1995												
1996	**It is necessary to have 4 or more Distinct Values for bootstrap methods.**											
1997	**However, results obtained using 4 to 9 distinct values may not be reliable.**											
1998	**It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.**											
1999												
2000												
2001	**UCL Statistics**											
2002	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
2003					Shapiro Wilk Test Statistic	0.8146661					Shapiro Wilk Test Statistic	0.8417432
2004					5% Shapiro Wilk Critical Value	0.767					5% Shapiro Wilk Critical Value	0.767
2005	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
2006												
2007	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
2008					DL/2 Substitution Method						DL/2 Substitution Method	
2009					Mean	0.0002556					Mean	-8.298761
2010					SD	7.233E-05					SD	0.2325653
2011					95% DL/2 (t) UCL	0.0003041					95% H-Stat (DL/2) UCL	0.0003042
2012												
2013					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
2014	**MLE method failed to converge properly**										Mean in Log Scale	-8.230267

	A–E	F	G–K	L
2015			SD in Log Scale	0.258435
2016			Mean in Original Scale	0.0002748
2017			SD in Original Scale	7.704E-05
2018			95% t UCL	0.0003264
2019			95% Percentile Bootstrap UCL	0.0003195
2020			95% BCA Bootstrap UCL	0.0003287
2021			95% H-UCL	0.0003352
2022				
2023	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
2024	k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**	
2025	Theta Star	N/A		
2026	nu star	N/A		
2027				
2028	A-D Test Statistic	N/A	**Nonparametric Statistics**	
2029	5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
2030	K-S Test Statistic	N/A	Mean	0.0002833
2031	5% K-S Critical Value	N/A	SD	0.000104
2032	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	7.356E-05
2033			95% KM (t) UCL	0.0004227
2034	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0004043
2035	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.000443
2036	Minimum	N/A	95% KM (bootstrap t) UCL	0.0014358
2037	Maximum	N/A	95% KM (BCA) UCL	N/A
2038	Mean	N/A	95% KM (Percentile Bootstrap) UCL	0.00043
2039	Median	N/A	95% KM (Chebyshev) UCL	0.000604
2040	SD	N/A	97.5% KM (Chebyshev) UCL	0.0007427
2041	k star	N/A	99% KM (Chebyshev) UCL	0.0010152
2042	Theta star	N/A		
2043	Nu star	N/A	**Potential UCLs to Use**	
2044	AppChi2	N/A	95% KM (t) UCL	0.0004227
2045	95% Gamma Approximate UCL	N/A	95% KM (Percentile Bootstrap) UCL	0.00043
2046	95% Adjusted Gamma UCL	N/A		
2047	**Note: DL/2 is not a recommended method.**			
2048				
2049	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
2050	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
2051	**For additional insight, the user may want to consult a statistician.**			
2052				
2053				
2054	**Phenanthrene**			
2055				
2056	**General Statistics**			
2057	Number of Valid Data	37	Number of Detected Data	20
2058	Number of Distinct Detected Data	20	Number of Non-Detect Data	17
2059	Number of Missing Values	5	Percent Non-Detects	45.95%
2060				
2061	**Raw Statistics**		**Log-transformed Statistics**	
2062	Minimum Detected	0.0884	Minimum Detected	-2.425883
2063	Maximum Detected	60.1	Maximum Detected	4.0960098
2064	Mean of Detected	6.82059	Mean of Detected	-0.195715
2065	SD of Detected	16.915576	SD of Detected	1.9673844
2066	Minimum Non-Detect	0.258	Minimum Non-Detect	-1.354796
2067	Maximum Non-Detect	3.17	Maximum Non-Detect	1.1537316

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	34
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	91.89%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.442722	Shapiro Wilk Test Statistic	0.8915196
5% Shapiro Wilk Critical Value	0.905	5% Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.8506838	Mean	-0.827798
SD	12.719596	SD	1.6990558
95% DL/2 (t) UCL	7.381064	95% H-Stat (DL/2) UCL	4.7048229
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	44.940065	Mean in Log Scale	-0.867864
SD	21.436158	SD in Log Scale	1.6147104
95% MLE (t) UCL	50.889765	Mean in Original Scale	3.7761678
95% MLE (Tiku) UCL	65.597233	SD in Original Scale	12.73674
		95% t UCL	7.3113062
		95% Percentile Bootstrap UCL	7.2469841
		95% BCA Bootstrap UCL	9.3569493
		95% H UCL	3.6346261
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.3071722	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	22.20445		
nu star	12.286888		
A-D Test Statistic	2.1284631	**Nonparametric Statistics**	
5% A-D Critical Value	0.8400357	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.8400357	Mean	3.7826768
5% K-S Critical Value	0.2095515	SD	12.562913
Data not Gamma Distributed at 5% Significance Level		SE of Mean	2.1192097
		95% KM (t) UCL	7.3605335
Assuming Gamma Distribution		95% KM (z) UCL	7.2684665
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	7.318076
Minimum	0.000001	95% KM (bootstrap t) UCL	25.550736
Maximum	60.1	95% KM (BCA) UCL	7.8229313
Mean	3.6868059	95% KM (Percentile Bootstrap) UCL	7.3470973
Median	0.0974	95% KM (Chebyshev) UCL	13.020098
SD	12.762883	97.5% KM (Chebyshev) UCL	17.017137
k star	0.1137149	99% KM (Chebyshev) UCL	24.868547
Theta star	32.421497		
Nu star	8.4148994	**Potential UCLs to Use**	
AppChi2	2.9775722	99% KM (Chebyshev) UCL	24.868547
95% Gamma Approximate UCL	10.419261		
95% Adjusted Gamma UCL	10.930056		
Note: DL/2 is not a recommended method.			

	A–E	F	G–K	L
2121	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
2122	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
2123	**For additional insight, the user may want to consult a statistician.**			
2124				
2125				
2126	**p-Isopropyltoluene**			
2127				
2128		**General Statistics**		
2129	Number of Valid Data	37	Number of Detected Data	1
2130	Number of Distinct Detected Data	1	Number of Non-Detect Data	36
2131	Number of Missing Values	1	Percent Non-Detects	97.30%
2132				
2133	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**			
2134	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**			
2135				
2136	**The data set for variable p-Isopropyltoluene was not processed!**			
2137				
2138				
2139				
2140	**Pyrene**			
2141				
2142		**General Statistics**		
2143	Number of Valid Data	37	Number of Detected Data	21
2144	Number of Distinct Detected Data	21	Number of Non-Detect Data	16
2145	Number of Missing Values	5	Percent Non-Detects	43.24%
2146				
2147	**Raw Statistics**		**Log-transformed Statistics**	
2148	Minimum Detected	0.0832	Minimum Detected	-2.486508
2149	Maximum Detected	78	Maximum Detected	4.3567088
2150	Mean of Detected	8.2364143	Mean of Detected	-0.216319
2151	SD of Detected	22.169063	SD of Detected	2.034221
2152	Minimum Non-Detect	0.258	Minimum Non-Detect	-1.354796
2153	Maximum Non-Detect	3.17	Maximum Non-Detect	1.1537316
2154				
2155	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	33
2156	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
2157	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	89.19%
2158				
2159		**UCL Statistics**		
2160	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
2161	Shapiro Wilk Test Statistic	0.3974737	Shapiro Wilk Test Statistic	0.8875046
2162	5% Shapiro Wilk Critical Value	0.908	5% Shapiro Wilk Critical Value	0.908
2163	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
2164				
2165	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
2166	DL/2 Substitution Method		DL/2 Substitution Method	
2167	Mean	4.8350054	Mean	-0.790257
2168	SD	16.992623	SD	1.7601947
2169	95% DL/2 (t) UCL	9.551383	95% H-Stat (DL/2) UCL	5.7608429
2170				
2171	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
2172	**MLE yields a negative mean**		Mean in Log Scale	-0.940947
2173			SD in Log Scale	1.7426025

		Mean in Original Scale	4.7424222
		SD in Original Scale	17.014891
		95% t UCL	9.4649804
		95% Percentile Bootstrap UCL	9.3915668
		95% BCA Bootstrap UCL	12.296708
		95% H-UCL	4.7226041
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.2863829	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	28.760147		
nu star	12.028082		
A-D Test Statistic	2.407686	**Nonparametric Statistics**	
5% A-D Critical Value	0.8470613	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.8470613	Mean	4.7545814
5% K-S Critical Value	0.205526	SD	16.781195
Data not Gamma Distributed at 5% Significance Level		SE of Mean	2.8271218
		95% KM (t) UCL	9.5276045
Assuming Gamma Distribution		95% KM (z) UCL	9.4047831
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	9.4768507
Minimum	0.000001	95% KM (bootstrap t) UCL	60.767317
Maximum	78	95% KM (BCA) UCL	10.510835
Mean	4.6747221	95% KM (Percentile Bootstrap) UCL	9.1858698
Median	0.107	95% KM (Chebyshev) UCL	17.07772
SD	17.033785	97.5% KM (Chebyshev) UCL	22.409952
k star	0.1150349	99% KM (Chebyshev) UCL	32.884089
Theta star	40.637427		
Nu star	8.512582	**Potential UCLs to Use**	
AppChi2	3.0353238	99% KM (Chebyshev) UCL	32.884089
95% Gamma Approximate UCL	13.110283		
95% Adjusted Gamma UCL	13.747851		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			
Residual range organics (RRO)			
General Statistics			
Number of Valid Data	37	Number of Detected Data	36
Number of Distinct Detected Data	35	Number of Non-Detect Data	1
Number of Missing Values	3	Percent Non-Detects	2.70%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	11	Minimum Detected	2.3978953
Maximum Detected	24400	Maximum Detected	10.102338
Mean of Detected	1617.4306	Mean of Detected	5.5679382
SD of Detected	4274.1476	SD of Detected	1.94696
Minimum Non-Detect	20.4	Minimum Non-Detect	3.0155349
Maximum Non-Detect	20.4	Maximum Non-Detect	3.0155349

	A–E	F	G–K	L
2227				
2228			**UCL Statistics**	
2229	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
2230	Shapiro Wilk Test Statistic	0.4110416	Shapiro Wilk Test Statistic	0.9601226
2231	5% Shapiro Wilk Critical Value	0.935	5% Shapiro Wilk Critical Value	0.935
2232	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
2233				
2234	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
2235	DL/2 Substitution Method		DL/2 Substitution Method	
2236	Mean	1573.9919	Mean	5.4802206
2237	SD	4222.6413	SD	1.9924982
2238	95% DL/2 (t) UCL	2746.0047	95% H-Stat (DL/2) UCL	6004.3518
2239				
2240	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
2241	Mean	1325.6838	Mean in Log Scale	5.4657446
2242	SD	4392.9942	SD in Log Scale	2.0178621
2243	95% MLE (t) UCL	2544.9788	Mean in Original Scale	1573.8776
2244	95% MLE (Tiku) UCL	2439.9939	SD in Original Scale	4222.6849
2245			95% t UCL	2745.9024
2246			95% Percentile Bootstrap UCL	2836.5173
2247			95% BCA Bootstrap UCL	3480.9397
2248			95% H UCL	6405.368
2249				
2250	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
2251	k star (bias corrected)	0.3545405	**Data appear Lognormal at 5% Significance Level**	
2252	Theta Star	4562.0474		
2253	nu star	25.526916		
2254				
2255	A-D Test Statistic	1.8938889	**Nonparametric Statistics**	
2256	5% A-D Critical Value	0.8419575	Kaplan-Meier (KM) Method	
2257	K-S Test Statistic	0.8419575	Mean	1574.0649
2258	5% K-S Critical Value	0.1579727	SD	4165.1604
2259	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	694.46137
2260			95% KM (t) UCL	2746.5224
2261	**Assuming Gamma Distribution**		95% KM (z) UCL	2716.3522
2262	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2746.0699
2263	Minimum	0.000001	95% KM (bootstrap t) UCL	5207.1525
2264	Maximum	24400	95% KM (BCA) UCL	3033.0108
2265	Mean	1573.7162	95% KM (Percentile Bootstrap) UCL	2875.4243
2266	Median	159	95% KM (Chebyshev) UCL	4601.1518
2267	SD	4222.7466	97.5% KM (Chebyshev) UCL	5910.9748
2268	k star	0.2917919	99% KM (Chebyshev) UCL	8483.8683
2269	Theta star	5393.2824		
2270	Nu star	21.592602	**Potential UCLs to Use**	
2271	AppChi2	12.033364	99% KM (Chebyshev) UCL	8483.8683
2272	95% Gamma Approximate UCL	2823.8677		
2273	95% Adjusted Gamma UCL	2898.6704		
2274	**Note: DL/2 is not a recommended method.**			
2275				
2276	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
2277	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
2278	**For additional insight, the user may want to consult a statistician.**			
2279				

	A	B	C	D	E	F	G	H	I	J	K	L
2280												
2281	**Selenium**											
2282												
2283	**General Statistics**											
2284					Number of Valid Data	34					Number of Detected Data	27
2285					Number of Distinct Detected Data	26					Number of Non-Detect Data	7
2286					Number of Missing Values	3					Percent Non-Detects	20.59%
2287												
2288	**Raw Statistics**						**Log-transformed Statistics**					
2289					Minimum Detected	0.167					Minimum Detected	-1.789761
2290					Maximum Detected	1.34					Maximum Detected	0.2926696
2291					Mean of Detected	0.3036667					Mean of Detected	-1.321248
2292					SD of Detected	0.2274731					SD of Detected	0.4438771
2293					Minimum Non-Detect	0.491					Minimum Non-Detect	-0.711311
2294					Maximum Non-Detect	0.546					Maximum Non-Detect	-0.605136
2295												
2296	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	32
2297	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	2
2298	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	94.12%
2299												
2300	**UCL Statistics**											
2301	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
2302					Shapiro Wilk Test Statistic	0.5224508					Shapiro Wilk Test Statistic	0.8118862
2303					5% Shapiro Wilk Critical Value	0.923					5% Shapiro Wilk Critical Value	0.923
2304	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
2305												
2306	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
2307					DL/2 Substitution Method						DL/2 Substitution Method	
2308					Mean	0.2944118					Mean	-1.327775
2309					SD	0.2028165					SD	0.3947071
2310					95% DL/2 (t) UCL	0.3532767					95% H-Stat (DL/2) UCL	0.3256283
2311												
2312					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
2313	**MLE method failed to converge properly**										Mean in Log Scale	-1.331088
2314											SD in Log Scale	0.3944845
2315											Mean in Original Scale	0.2935134
2316											SD in Original Scale	0.2029228
2317											95% t UCL	0.3524092
2318											95% Percentile Bootstrap UCL	0.3577074
2319											95% BCA Bootstrap UCL	0.3913472
2320											95% H-UCL	0.324496
2321												
2322	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
2323					k star (bias corrected)	3.6001599	**Data do not follow a Discernable Distribution (0.05)**					
2324					Theta Star	0.0843481						
2325					nu star	194.40864						
2326												
2327					A-D Test Statistic	2.1063535	**Nonparametric Statistics**					
2328					5% A-D Critical Value	0.7489544					Kaplan-Meier (KM) Method	
2329					K-S Test Statistic	0.7489544					Mean	0.2926753
2330					5% K-S Critical Value	0.1688726					SD	0.2023608
2331	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.0358678
2332											95% KM (t) UCL	0.3533766

	A–E	F	G–K	L
2333	**Assuming Gamma Distribution**		95% KM (z) UCL	0.3516726
2334	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.353208
2335	Minimum	0.167	95% KM (bootstrap t) UCL	0.4342786
2336	Maximum	1.34	95% KM (BCA) UCL	0.3646824
2337	Mean	0.3058629	95% KM (Percentile Bootstrap) UCL	0.3585515
2338	Median	0.283	95% KM (Chebyshev) UCL	0.4490196
2339	SD	0.2019583	97.5% KM (Chebyshev) UCL	0.5166698
2340	k star	4.5975316	99% KM (Chebyshev) UCL	0.6495557
2341	Theta star	0.0665276		
2342	Nu star	312.63215	**Potential UCLs to Use**	
2343	AppChi2	272.67012	95% KM (BCA) UCL	0.3646824
2344	95% Gamma Approximate UCL	0.3506896		
2345	95% Adjusted Gamma UCL	0.3530731		
2346	**Note: DL/2 is not a recommended method.**			
2347				
2348	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
2349	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
2350	**For additional insight, the user may want to consult a statistician.**			
2351				
2352				
2353	**trans-1,3-Dichloropropene**			
2354				
2355	**General Statistics**			
2356	Number of Valid Data	37	Number of Detected Data	1
2357	Number of Distinct Detected Data	1	Number of Non-Detect Data	36
2358	Number of Missing Values	1	Percent Non-Detects	97.30%
2359				
2360	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**			
2361	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**			
2362				
2363	**The data set for variable trans-1,3-Dichloropropene was not processed!**			
2364				
2365				
2366				
2367	**Trichloroethylene (TCE)**			
2368				
2369	**General Statistics**			
2370	Number of Valid Data	37	Number of Detected Data	11
2371	Number of Distinct Detected Data	11	Number of Non-Detect Data	26
2372	Number of Missing Values	5	Percent Non-Detects	70.27%
2373				
2374	**Raw Statistics**		**Log-transformed Statistics**	
2375	Minimum Detected	0.00038	Minimum Detected	-7.875339
2376	Maximum Detected	0.29	Maximum Detected	-1.237874
2377	Mean of Detected	0.0771709	Mean of Detected	-3.599853
2378	SD of Detected	0.0921593	SD of Detected	1.9309283
2379	Minimum Non-Detect	0.00098	Minimum Non-Detect	-6.927958
2380	Maximum Non-Detect	0.0397	Maximum Non-Detect	-3.226404
2381				
2382	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	32
2383	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
2384	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	86.49%
2385				

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.8150699	Shapiro Wilk Test Statistic	0.9280701
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0260182	Mean	-4.996231
SD	0.0592008	SD	1.4515648
95% DL/2 (t) UCL	0.0424497	95% H-Stat (DL/2) UCL	0.0396219
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-6.00419
		SD in Log Scale	1.9104332
		Mean in Original Scale	0.0236127
		SD in Original Scale	0.0600554
		95% t UCL	0.0402814
		95% Percentile Bootstrap UCL	0.0413057
		95% BCA Bootstrap UCL	0.0477579
		95% H-UCL	0.0481476
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.4939186	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	0.1562422		
nu star	10.866208		
A-D Test Statistic	0.184395	**Nonparametric Statistics**	
5% A-D Critical Value	0.7739736	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7739736	Mean	0.0243898
5% K-S Critical Value	0.2674811	SD	0.0589896
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0102064
		95% KM (t) UCL	0.0416212
Assuming Gamma Distribution		95% KM (z) UCL	0.0411778
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0395932
Minimum	0.000001	95% KM (bootstrap t) UCL	0.0556188
Maximum	0.29	95% KM (BCA) UCL	0.0469086
Mean	0.0229434	95% KM (Percentile Bootstrap) UCL	0.0433951
Median	0.000001	95% KM (Chebyshev) UCL	0.0688783
SD	0.0603152	97.5% KM (Chebyshev) UCL	0.0881285
k star	0.122782	99% KM (Chebyshev) UCL	0.1259418
Theta star	0.186863		
Nu star	9.0858647	**Potential UCLs to Use**	
AppChi2	3.3789008	95% KM (t) UCL	0.0416212
95% Gamma Approximate UCL	0.0616948		
95% Adjusted Gamma UCL	0.0645625		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

For additional insight, the user may want to consult a statistician.

APPENDIX E - 4

Lower Site Summit Subsurface Soil ProUCL Output - 95% UCLs for COPCs

	A	B	C	D	E	F	G	H	I	J	K	L
1				General UCL Statistics for Data Sets with Non-Detects								
2			User Selected Options									
3			From File	LSS_ SX.wst								
4			Full Precision	ON								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												
9	1,1,2,2-Tetrachloroethane											
10												
11						General Statistics						
12					Number of Valid Data	29					Number of Detected Data	1
13					Number of Distinct Detected Data	1					Number of Non-Detect Data	28
14											Percent Non-Detects	96.55%
15												
16		Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!										
17	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).											
18												
19				The data set for variable 1,1,2,2-Tetrachloroethane was not processed!								
20												
21												
22												
23	1,1,2-Trichloroethane											
24												
25						General Statistics						
26					Number of Valid Data	29					Number of Detected Data	1
27					Number of Distinct Detected Data	1					Number of Non-Detect Data	28
28											Percent Non-Detects	96.55%
29												
30		Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!										
31	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).											
32												
33				The data set for variable 1,1,2-Trichloroethane was not processed!								
34												
35												
36												
37	1,2,3-Trichloropropane											
38												
39						General Statistics						
40					Number of Valid Data	29					Number of Detected Data	1
41					Number of Distinct Detected Data	1					Number of Non-Detect Data	28
42											Percent Non-Detects	96.55%
43												
44		Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!										
45	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).											
46												
47				The data set for variable 1,2,3-Trichloropropane was not processed!								
48												
49												
50												
51	1,2-Dibromo-3-chloropropane											
52												
53						General Statistics						

Number of Valid Data	29	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	28
		Percent Non-Detects	96.55%
Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!			
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).			
The data set for variable 1,2-Dibromo-3-chloropropane was not processed!			
Benzo(a)pyrene			
General Statistics			
Number of Valid Data	29	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	26
Number of Missing Values	2	Percent Non-Detects	89.66%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.112	Minimum Detected	-2.189256
Maximum Detected	0.347	Maximum Detected	-1.05843
Mean of Detected	0.2636667	Mean of Detected	-1.450102
SD of Detected	0.1315611	SD of Detected	0.6405073
Minimum Non-Detect	0.0795	Minimum Non-Detect	-2.531998
Maximum Non-Detect	0.0866	Maximum Non-Detect	-2.446455
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	26
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	89.66%
Warning: There are only 3 Distinct Detected Values in this data set			
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.			
Those methods will return a 'N/A' value on your output display!			
It is necessary to have 4 or more Distinct Values for bootstrap methods.			
However, results obtained using 4 to 9 distinct values may not be reliable.			
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.			
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.7976496	Shapiro Wilk Test Statistic	0.7792467
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0643293	Mean	-3.00684
SD	0.0773677	SD	0.5651688
95% DL/2 (t) UCL	0.0887692	95% H-Stat (DL/2) UCL	0.0718374
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-4.659038

	A–E	F	G–K	L
107			SD in Log Scale	1.2133852
108			Mean in Original Scale	0.0338386
109			SD in Original Scale	0.0869497
110			95% t UCL	0.0613053
111			95% Percentile Bootstrap UCL	0.0639993
112			95% BCA Bootstrap UCL	0.0766475
113			95% H-UCL	0.0371104
114				
115	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
116	k star (bias corrected)	N/A	**Data appear Normal at 5% Significance Level**	
117	Theta Star	N/A		
118	nu star	N/A		
119				
120	A-D Test Statistic	N/A	**Nonparametric Statistics**	
121	5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
122	K-S Test Statistic	N/A	Mean	0.1276897
123	5% K-S Critical Value	N/A	SD	0.0576811
124	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0131184
125			95% KM (t) UCL	0.1500057
126	**Assuming Gamma Distribution**		95% KM (z) UCL	0.1492675
127	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.2674441
128	Minimum	N/A	95% KM (bootstrap t) UCL	0.1385136
129	Maximum	N/A	95% KM (BCA) UCL	0.347
130	Mean	N/A	95% KM (Percentile Bootstrap) UCL	0.347
131	Median	N/A	95% KM (Chebyshev) UCL	0.1848714
132	SD	N/A	97.5% KM (Chebyshev) UCL	0.2096139
133	k star	N/A	99% KM (Chebyshev) UCL	0.2582159
134	Theta star	N/A		
135	Nu star	N/A	**Potential UCLs to Use**	
136	AppChi2	N/A	95% KM (t) UCL	0.1500057
137	95% Gamma Approximate UCL	N/A	95% KM (Percentile Bootstrap) UCL	0.347
138	95% Adjusted Gamma UCL	N/A		
139	**Note: DL/2 is not a recommended method.**			
140				
141	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
142	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
143	**For additional insight, the user may want to consult a statistician.**			
144				
145				
146	**Chromium, Total**			
147				
148	**General Statistics**			
149	Number of Valid Observations	16	Number of Distinct Observations	16
150	Number of Missing Values	11		
151				
152	**Raw Statistics**		**Log-transformed Statistics**	
153	Minimum	15.7	Minimum of Log Data	2.7536607
154	Maximum	171	Maximum of Log Data	5.1416636
155	Mean	34.54375	Mean of log Data	3.3382968
156	Median	25.55	SD of log Data	0.5191296
157	SD	36.700808		
158	Std. Error of Mean	9.1752019		
159	Coefficient of Variation	1.0624442		

	A–E	F	G–K	L
160	Skewness	3.884294		
161				
162	**Relevant UCL Statistics**			
163	**Normal Distribution Test**		**Lognormal Distribution Test**	
164	Shapiro Wilk Test Statistic	0.3934077	Shapiro Wilk Test Statistic	0.6424404
165	Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
166	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
167				
168	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
169	95% Student's-t UCL	50.628341	95% H-UCL	42.542314
170	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	50.611593
171	95% Adjusted-CLT UCL (Chen-1995)	59.15586	97.5% Chebyshev (MVUE) UCL	58.693
172	95% Modified-t UCL (Johnson-1978)	52.113307	99% Chebyshev (MVUE) UCL	74.56736
173				
174	**Gamma Distribution Test**		**Data Distribution**	
175	k star (bias corrected)	2.1593969	**Data do not follow a Discernable Distribution (0.05)**	
176	Theta Star	15.996943		
177	MLE of Mean	34.54375		
178	MLE of Standard Deviation	23.507327		
179	nu star	69.100701		
180	Approximate Chi Square Value (.05)	50.965828	**Nonparametric Statistics**	
181	Adjusted Level of Significance	0.03348	95% CLT UCL	49.635614
182	Adjusted Chi Square Value	49.195127	95% Jackknife UCL	50.628341
183			95% Standard Bootstrap UCL	49.377242
184	Anderson-Darling Test Statistic	2.8369622	95% Bootstrap-t UCL	122.31716
185	Anderson-Darling 5% Critical Value	0.7466596	95% Hall's Bootstrap UCL	121.76671
186	Kolmogorov-Smirnov Test Statistic	0.3559004	95% Percentile Bootstrap UCL	52.50625
187	Kolmogorov-Smirnov 5% Critical Value	0.2171362	95% BCA Bootstrap UCL	60.63125
188	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	74.537528
189			97.5% Chebyshev(Mean, Sd) UCL	91.842868
190	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	125.83586
191	95% Approximate Gamma UCL	46.835251		
192	95% Adjusted Gamma UCL	48.521012		
193				
194	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	74.537528
195				
196	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
197	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
198	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
199				
200				
201	**Naphthalene**			
202				
203	**General Statistics**			
204	Number of Valid Data	29	Number of Detected Data	7
205	Number of Distinct Detected Data	7	Number of Non-Detect Data	22
206	Number of Missing Values	1	Percent Non-Detects	75.86%
207				
208	**Raw Statistics**		**Log-transformed Statistics**	
209	Minimum Detected	0.0238	Minimum Detected	-3.73807
210	Maximum Detected	4.32	Maximum Detected	1.4632554
211	Mean of Detected	1.0814	Mean of Detected	-2.112165
212	SD of Detected	1.8271088	SD of Detected	2.3413123

	A	B	C	D	E	F	G	H	I	J	K	L
213					Minimum Non-Detect	0.0327					Minimum Non-Detect	-3.42038
214					Maximum Non-Detect	0.0559					Maximum Non-Detect	-2.884191
215												
216	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	27
217	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	2
218	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	93.10%
219												
220	**Warning: There are only 7 Detected Values in this data**											
221	**Note: It should be noted that even though bootstrap may be performed on this data set**											
222	**the resulting calculations may not be reliable enough to draw conclusions**											
223												
224	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
225												
226												
227	**UCL Statistics**											
228	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
229					Shapiro Wilk Test Statistic	0.6503461					Shapiro Wilk Test Statistic	0.6924663
230					5% Shapiro Wilk Critical Value	0.803					5% Shapiro Wilk Critical Value	0.803
231	**Data not Normal at 5% Significance Level**						**Data not Lognormal at 5% Significance Level**					
232												
233	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
234					DL/2 Substitution Method						DL/2 Substitution Method	
235					Mean	0.2774483					Mean	-3.426243
236					SD	0.9635154					SD	1.3273339
237					95% DL/2 (t) UCL	0.5818152					95% H-Stat (DL/2) UCL	0.1623533
238												
239					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
240	**MLE method failed to converge properly**										Mean in Log Scale	-3.291366
241											SD in Log Scale	1.2835645
242											Mean in Original Scale	0.2805983
243											SD in Original Scale	0.9626509
244											95% t UCL	0.5846921
245											95% Percentile Bootstrap UCL	0.5980226
246											95% BCA Bootstrap UCL	0.7469688
247											95% H-UCL	0.1688152
248												
249	**Gamma Distribution Test with Detected Values Only**						**Data Distribution Test with Detected Values Only**					
250					k star (bias corrected)	0.273917	**Data do not follow a Discernable Distribution (0.05)**					
251					Theta Star	3.9479117						
252					nu star	3.8348375						
253												
254					A-D Test Statistic	1.2369387	**Nonparametric Statistics**					
255					5% A-D Critical Value	0.7820344					Kaplan-Meier (KM) Method	
256					K-S Test Statistic	0.7820344					Mean	0.2814529
257					5% K-S Critical Value	0.334592					SD	0.945683
258	**Data not Gamma Distributed at 5% Significance Level**										SE of Mean	0.1896852
259											95% KM (t) UCL	0.6041323
260	**Assuming Gamma Distribution**										95% KM (z) UCL	0.5934573
261					Gamma ROS Statistics using Extrapolated Data						95% KM (jackknife) UCL	0.58549
262					Minimum	0.000001					95% KM (bootstrap t) UCL	27.061926
263					Maximum	4.32					95% KM (BCA) UCL	0.6214007
264					Mean	0.2610283					95% KM (Percentile Bootstrap) UCL	0.6197548
265					Median	0.000001					95% KM (Chebyshev) UCL	1.1082715

266	SD	0.9680615	97.5% KM (Chebyshev) UCL	1.4660366
267	k star	0.0998851	99% KM (Chebyshev) UCL	2.1687968
268	Theta star	2.6132869		
269	Nu star	5.793334	**Potential UCLs to Use**	
270	AppChi2	1.5351792	99% KM (Chebyshev) UCL	2.1687968
271	95% Gamma Approximate UCL	0.9850475		
272	95% Adjusted Gamma UCL	1.0732456		
273	**Note: DL/2 is not a recommended method.**			
274				
275	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
276	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
277	**For additional insight, the user may want to consult a statistician.**			
278				
279				
280	**Trichloroethylene (TCE)**			
281				
282	**General Statistics**			
283	Number of Valid Data	29	Number of Detected Data	19
284	Number of Distinct Detected Data	19	Number of Non-Detect Data	10
285			Percent Non-Detects	34.48%
286				
287	**Raw Statistics**		**Log-transformed Statistics**	
288	Minimum Detected	0.00952	Minimum Detected	-4.65436
289	Maximum Detected	0.613	Maximum Detected	-0.48939
290	Mean of Detected	0.1620905	Mean of Detected	-2.257022
291	SD of Detected	0.1484167	SD of Detected	1.0689916
292	Minimum Non-Detect	0.00581	Minimum Non-Detect	-5.148175
293	Maximum Non-Detect	0.0815	Maximum Non-Detect	-2.507152
294				
295	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	15
296	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	14
297	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	51.72%
298				
299	**UCL Statistics**			
300	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
301	Shapiro Wilk Test Statistic	0.841726	Shapiro Wilk Test Statistic	0.9603011
302	5% Shapiro Wilk Critical Value	0.901	5% Shapiro Wilk Critical Value	0.901
303	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
304				
305	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
306	DL/2 Substitution Method		DL/2 Substitution Method	
307	Mean	0.1087614	Mean	-3.328842
308	SD	0.1407172	SD	1.7863559
309	95% DL/2 (t) UCL	0.1532128	95% H-Stat (DL/2) UCL	0.5913027
310				
311	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
312	Mean	0.0569882	Mean in Log Scale	-3.071989
313	SD	0.1980124	SD in Log Scale	1.4320288
314	95% MLE (t) UCL	0.1195388	Mean in Original Scale	0.1096428
315	95% MLE (Tiku) UCL	0.1360107	SD in Original Scale	0.1399107
316			95% t UCL	0.1538395
317			95% Percentile Bootstrap UCL	0.1550079
318			95% BCA Bootstrap UCL	0.1661107

	A–E	F	G–K	L
319			95% H UCL	0.2947425
320				
321	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
322	k star (bias corrected)	1.1164689	**Data appear Gamma Distributed at 5% Significance Level**	
323	Theta Star	0.1451814		
324	nu star	42.425818		
325				
326	A-D Test Statistic	0.1627775	**Nonparametric Statistics**	
327	5% A-D Critical Value	0.7622458	Kaplan-Meier (KM) Method	
328	K-S Test Statistic	0.7622458	Mean	0.1097101
329	5% K-S Critical Value	0.2030357	SD	0.1374464
330	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0262261
331			95% KM (t) UCL	0.1543242
332	**Assuming Gamma Distribution**		95% KM (z) UCL	0.1528482
333	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.1523133
334	Minimum	0.000001	95% KM (bootstrap t) UCL	0.1693642
335	Maximum	0.613	95% KM (BCA) UCL	0.1625414
336	Mean	0.1061976	95% KM (Percentile Bootstrap) UCL	0.1549934
337	Median	0.0433	95% KM (Chebyshev) UCL	0.2240272
338	SD	0.1425068	97.5% KM (Chebyshev) UCL	0.2734922
339	k star	0.1897837	99% KM (Chebyshev) UCL	0.3706568
340	Theta star	0.5595718		
341	Nu star	11.007453	**Potential UCLs to Use**	
342	AppChi2	4.5807942	95% KM (Percentile Bootstrap) UCL	0.1549934
343	95% Gamma Approximate UCL	0.2551883		
344	95% Adjusted Gamma UCL	0.2696759		
345	**Note: DL/2 is not a recommended method.**			
346				
347	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
348	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
349	**For additional insight, the user may want to consult a statistician.**			
350				
351				
352	**Vanadium**			
353				
354	**General Statistics**			
355	Number of Valid Observations	16	Number of Distinct Observations	16
356	Number of Missing Values	11		
357				
358	**Raw Statistics**		**Log-transformed Statistics**	
359	Minimum	42.2	Minimum of Log Data	3.7424202
360	Maximum	106	Maximum of Log Data	4.6634391
361	Mean	55.15625	Mean of log Data	3.9833411
362	Median	50.5	SD of log Data	0.2227661
363	SD	15.342619		
364	Std. Error of Mean	3.8356548		
365	Coefficient of Variation	0.2781665		
366	Skewness	2.7551735		
367				
368	**Relevant UCL Statistics**			
369	**Normal Distribution Test**		**Lognormal Distribution Test**	
370	Shapiro Wilk Test Statistic	0.6663201	Shapiro Wilk Test Statistic	0.778242
371	Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887

	A–E	F	G–K	L
372	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
373				
374	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
375	95% Student's-t UCL	61.880346	95% H-UCL	61.102004
376	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	68.389047
377	95% Adjusted-CLT UCL (Chen-1995)	64.288328	97.5% Chebyshev (MVUE) UCL	74.200633
378	95% Modified-t UCL (Johnson-1978)	62.320675	99% Chebyshev (MVUE) UCL	85.616367
379				
380	**Gamma Distribution Test**		**Data Distribution**	
381	k star (bias corrected)	15.318045	**Data do not follow a Discernable Distribution (0.05)**	
382	Theta Star	3.6007369		
383	MLE of Mean	55.15625		
384	MLE of Standard Deviation	14.092663		
385	nu star	490.17744		
386	Approximate Chi Square Value (.05)	439.8379	**Nonparametric Statistics**	
387	Adjusted Level of Significance	0.03348	95% CLT UCL	61.465341
388	Adjusted Chi Square Value	434.41213	95% Jackknife UCL	61.880346
389			95% Standard Bootstrap UCL	61.153734
390	Anderson-Darling Test Statistic	1.4948911	95% Bootstrap-t UCL	71.493783
391	Anderson-Darling 5% Critical Value	0.7367972	95% Hall's Bootstrap UCL	89.204319
392	Kolmogorov-Smirnov Test Statistic	0.2940712	95% Percentile Bootstrap UCL	61.8125
393	Kolmogorov-Smirnov 5% Critical Value	0.2146835	95% BCA Bootstrap UCL	65.025
394	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	71.875481
395			97.5% Chebyshev(Mean, Sd) UCL	79.109906
396	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	93.320533
397	95% Approximate Gamma UCL	61.468895		
398	95% Adjusted Gamma UCL	62.236636		
399				
400	**Potential UCL to Use**		Use 95% Student's-t UCL	61.880346
401			or 95% Modified-t UCL	62.320675
402				
403	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
404	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
405	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
406				

APPENDIX E - 5

Area A Surface Soil ProUCL Output - 95% UCLs for COPCs and COPECs

1		**General UCL Statistics for Data Sets with Non-Detects**		
2	**User Selected Options**			
3	From File	ARA_SO.wst		
4	Full Precision	ON		
5	Confidence Coefficient	95%		
6	Number of Bootstrap Operations	2000		
7				
8				
9	**Barium**			
10				
11		**General Statistics**		
12	Number of Valid Observations	16	Number of Distinct Observations	15
13				
14	**Raw Statistics**		**Log-transformed Statistics**	
15	Minimum	69.1	Minimum of Log Data	4.2355547
16	Maximum	908	Maximum of Log Data	6.8112444
17	Mean	151.93125	Mean of log Data	4.7385331
18	Median	110	SD of log Data	0.589196
19	SD	202.55513		
20	Std. Error of Mean	50.638783		
21	Coefficient of Variation	1.3332026		
22	Skewness	3.9364784		
23				
24		**Relevant UCL Statistics**		
25	**Normal Distribution Test**		**Lognormal Distribution Test**	
26	Shapiro Wilk Test Statistic	0.3579912	Shapiro Wilk Test Statistic	0.5955843
27	Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
28	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
29				
30	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
31	95% Student's-t UCL	240.70359	95% H-UCL	188.4436
32	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	224.11053
33	95% Adjusted-CLT UCL (Chen-1995)	288.47365	97.5% Chebyshev (MVUE) UCL	262.99129
34	95% Modified-t UCL (Johnson-1978)	249.00936	99% Chebyshev (MVUE) UCL	339.36502
35				
36	**Gamma Distribution Test**		**Data Distribution**	
37	k star (bias corrected)	1.589321	**Data do not follow a Discernable Distribution (0.05)**	
38	Theta Star	95.59507		
39	MLE of Mean	151.93125		
40	MLE of Standard Deviation	120.51505		
41	nu star	50.858271		
42	Approximate Chi Square Value (.05)	35.48138	**Nonparametric Statistics**	
43	Adjusted Level of Significance	0.03348	95% CLT UCL	235.22464
44	Adjusted Chi Square Value	34.02211	95% Jackknife UCL	240.70359
45			95% Standard Bootstrap UCL	232.09072
46	Anderson-Darling Test Statistic	3.2273263	95% Bootstrap-t UCL	740.77881
47	Anderson-Darling 5% Critical Value	0.7511196	95% Hall's Bootstrap UCL	738.11319
48	Kolmogorov-Smirnov Test Statistic	0.4227886	95% Percentile Bootstrap UCL	251.6125
49	Kolmogorov-Smirnov 5% Critical Value	0.2180661	95% BCA Bootstrap UCL	303.51875
50	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	372.66059
51			97.5% Chebyshev(Mean, Sd) UCL	468.17035
52	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	655.78078
53	95% Approximate Gamma UCL	217.77509		

	A–E	F	G–K	L
54	95% Adjusted Gamma UCL	227.11586		
55				
56	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	372.66059
57				
58	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
59	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
60	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
61				
62				
63	**Cadmium**			
64				
65	**General Statistics**			
66	Number of Valid Data	16	Number of Detected Data	15
67	Number of Distinct Detected Data	15	Number of Non-Detect Data	1
68			Percent Non-Detects	6.25%
69				
70	**Raw Statistics**		**Log-transformed Statistics**	
71	Minimum Detected	0.0739	Minimum Detected	-2.605042
72	Maximum Detected	3.06	Maximum Detected	1.1184149
73	Mean of Detected	0.4187933	Mean of Detected	-1.68828
74	SD of Detected	0.7866989	SD of Detected	1.1085683
75	Minimum Non-Detect	0.207	Minimum Non-Detect	-1.575036
76	Maximum Non-Detect	0.207	Maximum Non-Detect	-1.575036
77				
78				
79	**UCL Statistics**			
80	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
81	Shapiro Wilk Test Statistic	0.4966689	Shapiro Wilk Test Statistic	0.7946662
82	5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
83	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
84				
85	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
86	DL/2 Substitution Method		DL/2 Substitution Method	
87	Mean	0.3990875	Mean	-1.724524
88	SD	0.7640999	SD	1.0807467
89	95% DL/2 (t) UCL	0.7339639	95% H-Stat (DL/2) UCL	0.7041403
90				
91	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
92	**MLE yields a negative mean**		Mean in Log Scale	-1.718206
93			SD in Log Scale	1.0776479
94			Mean in Original Scale	0.3997756
95			SD in Original Scale	0.7638209
96			95% t UCL	0.7345297
97			95% Percentile Bootstrap UCL	0.7250136
98			95% BCA Bootstrap UCL	0.934475
99			95% H-UCL	0.7036751
100				
101	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
102	k star (bias corrected)	0.631692	**Data do not follow a Discernable Distribution (0.05)**	
103	Theta Star	0.6629708		
104	nu star	18.950759		
105				
106	A-D Test Statistic	1.9215511	**Nonparametric Statistics**	

A	B	C	D	E	F	G	H	I	J	K	L
				5% A-D Critical Value	0.7762501					Kaplan-Meier (KM) Method	
				K-S Test Statistic	0.7762501					Mean	0.3991869
				5% K-S Critical Value	0.2304489					SD	0.7398604
Data not Gamma Distributed at 5% Significance Level										SE of Mean	0.1914751
										95% KM (t) UCL	0.7348524
Assuming Gamma Distribution										95% KM (z) UCL	0.7141354
Gamma ROS Statistics using Extrapolated Data										95% KM (jackknife) UCL	0.7341127
				Minimum	0.0522472					95% KM (bootstrap t) UCL	2.2598944
				Maximum	3.06					95% KM (BCA) UCL	0.7602875
				Mean	0.3958842					95% KM (Percentile Bootstrap) UCL	0.7331688
				Median	0.10615					95% KM (Chebyshev) UCL	1.2338076
				SD	0.7655278					97.5% KM (Chebyshev) UCL	1.5949487
				k star	0.6239005					99% KM (Chebyshev) UCL	2.3043403
				Theta star	0.634531						
				Nu star	19.964815	**Potential UCLs to Use**					
				AppChi2	10.825206					97.5% KM (Chebyshev) UCL	1.5949487
				95% Gamma Approximate UCL	0.7301251						
				95% Adjusted Gamma UCL	0.7852666						
Note: DL/2 is not a recommended method.											
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
For additional insight, the user may want to consult a statistician.											
Chromium, Hexavalent											
General Statistics											
				Number of Valid Data	10					Number of Detected Data	7
				Number of Distinct Detected Data	7					Number of Non-Detect Data	3
										Percent Non-Detects	30.00%
Raw Statistics						**Log-transformed Statistics**					
				Minimum Detected	0.13					Minimum Detected	-2.040221
				Maximum Detected	1.98					Maximum Detected	0.6830968
				Mean of Detected	0.6814286					Mean of Detected	-0.792816
				SD of Detected	0.6652676					SD of Detected	0.9873095
				Minimum Non-Detect	0.55					Minimum Non-Detect	-0.597837
				Maximum Non-Detect	0.58					Maximum Non-Detect	-0.544727
Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	3
Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	70.00%
Warning: There are only 7 Detected Values in this data											
Note: It should be noted that even though bootstrap may be performed on this data set											
the resulting calculations may not be reliable enough to draw conclusions											
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.											
UCL Statistics											
Normal Distribution Test with Detected Values Only						**Lognormal Distribution Test with Detected Values Only**					

	A–E	F	G–K	L
160	Shapiro Wilk Test Statistic	0.8267914	Shapiro Wilk Test Statistic	0.9489072
161	5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
162	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
163				
164	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
165	DL/2 Substitution Method		DL/2 Substitution Method	
166	Mean	0.562	Mean	-0.933384
167	SD	0.5762339	SD	0.8374031
168	95% DL/2 (t) UCL	0.896032	95% H-Stat (DL/2) UCL	1.213223
169				
170	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
171	Mean	1.3645157	Mean in Log Scale	-0.986788
172	SD	0.5003998	SD in Log Scale	0.864523
173	95% MLE (t) UCL	1.6545881	Mean in Original Scale	0.5481217
174	95% MLE (Tiku) UCL	1.8807847	SD in Original Scale	0.5840601
175			95% t UCL	0.8866904
176			95% Percentile Bootstrap UCL	0.8444145
177			95% BCA Bootstrap UCL	0.9641217
178			95% H UCL	1.2251982
179				
180	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
181	k star (bias corrected)	0.8748784	**Data appear Normal at 5% Significance Level**	
182	Theta Star	0.7788838		
183	nu star	12.248297		
184				
185	A-D Test Statistic	0.3438865	**Nonparametric Statistics**	
186	5% A-D Critical Value	0.7229381	Kaplan-Meier (KM) Method	
187	K-S Test Statistic	0.7229381	Mean	0.54675
188	5% K-S Critical Value	0.3177126	SD	0.5564323
189	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.1909931
190			95% KM (t) UCL	0.896862
191	**Assuming Gamma Distribution**		95% KM (z) UCL	0.8609057
192	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.8896144
193	Minimum	0.13	95% KM (bootstrap t) UCL	1.2339158
194	Maximum	1.98	95% KM (BCA) UCL	0.8816667
195	Mean	0.5512139	95% KM (Percentile Bootstrap) UCL	0.87
196	Median	0.2686898	95% KM (Chebyshev) UCL	1.3792697
197	SD	0.5822488	97.5% KM (Chebyshev) UCL	1.7395017
198	k star	1.0926951	99% KM (Chebyshev) UCL	2.4471076
199	Theta star	0.5044535		
200	Nu star	21.853902	**Potential UCLs to Use**	
201	AppChi2	12.228823	95% KM (t) UCL	0.896862
202	95% Gamma Approximate UCL	0.9850641	95% KM (Percentile Bootstrap) UCL	0.87
203	95% Adjusted Gamma UCL	1.0954285		
204	**Note: DL/2 is not a recommended method.**			
205				
206	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
207	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
208	**For additional insight, the user may want to consult a statistician.**			
209				
210				
211	**Lead**			
212				

	A–E	F	G–K	L
213	**General Statistics**			
214	Number of Valid Observations	16	Number of Distinct Observations	16
215				
216	**Raw Statistics**		**Log-transformed Statistics**	
217	Minimum	5.37	Minimum of Log Data	1.6808279
218	Maximum	116	Maximum of Log Data	4.7535902
219	Mean	20.36125	Mean of log Data	2.5777297
220	Median	9.36	SD of log Data	0.8124703
221	SD	28.019287		
222	Std. Error of Mean	7.0048218		
223	Coefficient of Variation	1.3761084		
224	Skewness	3.073521		
225				
226	**Relevant UCL Statistics**			
227	**Normal Distribution Test**		**Lognormal Distribution Test**	
228	Shapiro Wilk Test Statistic	0.5335304	Shapiro Wilk Test Statistic	0.7941511
229	Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
230	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
231				
232	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
233	95% Student's-t UCL	32.641055	95% H-UCL	30.489142
234	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	34.794504
235	95% Adjusted-CLT UCL (Chen-1995)	37.634293	97.5% Chebyshev (MVUE) UCL	42.128324
236	95% Modified-t UCL (Johnson-1978)	33.538117	99% Chebyshev (MVUE) UCL	56.534195
237				
238	**Gamma Distribution Test**		**Data Distribution**	
239	k star (bias corrected)	1.0883317	**Data do not follow a Discernable Distribution (0.05)**	
240	Theta Star	18.70868		
241	MLE of Mean	20.36125		
242	MLE of Standard Deviation	19.517482		
243	nu star	34.826615		
244	Approximate Chi Square Value (.05)	22.326073	**Nonparametric Statistics**	
245	Adjusted Level of Significance	0.03348	95% CLT UCL	31.883157
246	Adjusted Chi Square Value	21.190509	95% Jackknife UCL	32.641055
247			95% Standard Bootstrap UCL	31.637884
248	Anderson-Darling Test Statistic	2.015344	95% Bootstrap-t UCL	72.131962
249	Anderson-Darling 5% Critical Value	0.7583371	95% Hall's Bootstrap UCL	75.528553
250	Kolmogorov-Smirnov Test Statistic	0.3196376	95% Percentile Bootstrap UCL	32.6725
251	Kolmogorov-Smirnov 5% Critical Value	0.2198573	95% BCA Bootstrap UCL	38.404375
252	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	50.894561
253			97.5% Chebyshev(Mean, Sd) UCL	64.106348
254	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	90.058347
255	95% Approximate Gamma UCL	31.761672		
256	95% Adjusted Gamma UCL	33.463728		
257				
258	**Potential UCL to Use**		Use 95% Chebyshev (Mean, Sd) UCL	50.894561
259				
260	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
261	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
262	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
263				
264				
265	**Nickel**			

	A	B	C	D	E	F	G	H	I	J	K	L
266												
267	**General Statistics**											
268	Number of Valid Observations					16	Number of Distinct Observations					16
269												
270	**Raw Statistics**						**Log-transformed Statistics**					
271	Minimum					27.7	Minimum of Log Data					3.3214324
272	Maximum					52.2	Maximum of Log Data					3.9550825
273	Mean					38.54375	Mean of log Data					3.6411019
274	Median					38.3	SD of log Data					0.1512427
275	SD					5.8397453						
276	Std. Error of Mean					1.4599363						
277	Coefficient of Variation					0.1515095						
278	Skewness					0.4601577						
279												
280	**Relevant UCL Statistics**											
281	**Normal Distribution Test**						**Lognormal Distribution Test**					
282	Shapiro Wilk Test Statistic					0.9750942	Shapiro Wilk Test Statistic					0.9848031
283	Shapiro Wilk Critical Value					0.887	Shapiro Wilk Critical Value					0.887
284	**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
285												
286	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
287	95% Student's-t UCL					41.103092	95% H-UCL					41.333642
288	**95% UCLs (Adjusted for Skewness)**						95% Chebyshev (MVUE) UCL					44.917184
289	95% Adjusted-CLT UCL (Chen-1995)					41.124589	97.5% Chebyshev (MVUE) UCL					47.674581
290	95% Modified-t UCL (Johnson-1978)					41.131084	99% Chebyshev (MVUE) UCL					53.090954
291												
292	**Gamma Distribution Test**						**Data Distribution**					
293	k star (bias corrected)					38.172139	**Data appear Normal at 5% Significance Level**					
294	Theta Star					1.0097351						
295	MLE of Mean					38.54375						
296	MLE of Standard Deviation					6.2385077						
297	nu star					1221.5085						
298	Approximate Chi Square Value (.05)					1141.3613	**Nonparametric Statistics**					
299	Adjusted Level of Significance					0.03348	95% CLT UCL					40.945132
300	Adjusted Chi Square Value					1132.5468	95% Jackknife UCL					41.103092
301							95% Standard Bootstrap UCL					40.897735
302	Anderson-Darling Test Statistic					0.1792683	95% Bootstrap-t UCL					41.208419
303	Anderson-Darling 5% Critical Value					0.7354946	95% Hall's Bootstrap UCL					41.636981
304	Kolmogorov-Smirnov Test Statistic					0.1290079	95% Percentile Bootstrap UCL					40.9875
305	Kolmogorov-Smirnov 5% Critical Value					0.2144584	95% BCA Bootstrap UCL					41.025
306	**Data appear Gamma Distributed at 5% Significance Level**						95% Chebyshev(Mean, Sd) UCL					44.907465
307							97.5% Chebyshev(Mean, Sd) UCL					47.661049
308	**Assuming Gamma Distribution**						99% Chebyshev(Mean, Sd) UCL					53.069933
309	95% Approximate Gamma UCL					41.250319						
310	95% Adjusted Gamma UCL					41.571367						
311												
312	**Potential UCL to Use**						Use 95% Student's-t UCL					41.103092
313												
314	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
315	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
316	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
317												
318												

	A–E	F	G–K	L
319	**Benzoic acid**			
320				
321	**General Statistics**			
322	Number of Valid Data	16	Number of Detected Data	5
323	Number of Distinct Detected Data	4	Number of Non-Detect Data	11
324			Percent Non-Detects	68.75%
325				
326	**Raw Statistics**		**Log-transformed Statistics**	
327	Minimum Detected	1.24	Minimum Detected	0.2151114
328	Maximum Detected	1.52	Maximum Detected	0.4187103
329	Mean of Detected	1.334	Mean of Detected	0.2857036
330	SD of Detected	0.1078425	SD of Detected	0.0776698
331	Minimum Non-Detect	1.61	Minimum Non-Detect	0.4762342
332	Maximum Non-Detect	48.1	Maximum Non-Detect	3.8732822
333				
334	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
335	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
336	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
337				
338	**Warning: There are only 4 Distinct Detected Values in this data**			
339	**Note: It should be noted that even though bootstrap may be performed on this data set**			
340	**the resulting calculations may not be reliable enough to draw conclusions**			
341				
342	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
343				
344				
345	**UCL Statistics**			
346	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
347	Shapiro Wilk Test Statistic	0.7834943	Shapiro Wilk Test Statistic	0.8009718
348	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
349	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
350				
351	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
352	DL/2 Substitution Method		DL/2 Substitution Method	
353	Mean	5.0990625	Mean	0.6268552
354	SD	8.6521092	SD	1.2518968
355	95% DL/2 (t) UCL	8.8909583	95% H-Stat (DL/2) UCL	11.206079
356				
357	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
358	**MLE method failed to converge properly**		Mean in Log Scale	0.2857036
359			SD in Log Scale	0.0401085
360			Mean in Original Scale	1.3317299
361			SD in Original Scale	0.055712
362			95% t UCL	1.3561464
363			95% Percentile Bootstrap UCL	1.3566863
364			95% BCA Bootstrap UCL	1.3623549
365			95% H-UCL	N/A
366				
367	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
368	k star (bias corrected)	80.900228	**Data appear Normal at 5% Significance Level**	
369	Theta Star	0.0164894		
370	nu star	809.00228		
371				

	A B C D E	F	G H I J K	L
372	A-D Test Statistic	0.6642303	**Nonparametric Statistics**	
373	5% A-D Critical Value	0.67808	Kaplan-Meier (KM) Method	
374	K-S Test Statistic	0.67808	Mean	1.334
375	5% K-S Critical Value	0.35682	SD	0.0964572
376	**Data follow Appr. Gamma Distribution at 5% Significance Level**		SE of Mean	0.0482286
377			95% KM (t) UCL	1.4185472
378	**Assuming Gamma Distribution**		95% KM (z) UCL	1.413329
379	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.425525
380	Minimum	1.24	95% KM (bootstrap t) UCL	1.618017
381	Maximum	1.52	95% KM (BCA) UCL	1.4266667
382	Mean	1.3444558	95% KM (Percentile Bootstrap) UCL	1.415
383	Median	1.3492085	95% KM (Chebyshev) UCL	1.5442237
384	SD	0.0561635	97.5% KM (Chebyshev) UCL	1.6351876
385	k star	515.55553	99% KM (Chebyshev) UCL	1.8138687
386	Theta star	0.0026078		
387	Nu star	16497.777	**Potential UCLs to Use**	
388	AppChi2	16200.136	95% KM (t) UCL	1.4185472
389	95% Gamma Approximate UCL	1.3691572	95% KM (Percentile Bootstrap) UCL	1.415
390	95% Adjusted Gamma UCL	1.3719986		
391	**Note: DL/2 is not a recommended method.**			
392				
393	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
394	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
395	**For additional insight, the user may want to consult a statistician.**			
396				
397				
398	**Diesel Range Organics (DRO)**			
399				
400	**General Statistics**			
401	Number of Valid Data	16	Number of Detected Data	15
402	Number of Distinct Detected Data	15	Number of Non-Detect Data	1
403			Percent Non-Detects	6.25%
404				
405	**Raw Statistics**		**Log-transformed Statistics**	
406	Minimum Detected	22.3	Minimum Detected	3.1045867
407	Maximum Detected	19200	Maximum Detected	9.8626656
408	Mean of Detected	3070.2267	Mean of Detected	6.0841111
409	SD of Detected	5142.5377	SD of Detected	2.4685814
410	Minimum Non-Detect	40.6	Minimum Non-Detect	3.7037681
411	Maximum Non-Detect	40.6	Maximum Non-Detect	3.7037681
412				
413				
414	**UCL Statistics**			
415	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
416	Shapiro Wilk Test Statistic	0.6563548	Shapiro Wilk Test Statistic	0.8790223
417	5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
418	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
419				
420	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
421	DL/2 Substitution Method		DL/2 Substitution Method	
422	Mean	2879.6063	Mean	5.892018
423	SD	5026.3333	SD	2.5055999
424	95% DL/2 (t) UCL	5082.4601	95% H-Stat (DL/2) UCL	283294.37

	A–E	F	G–K	L
425				
426	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
427	Mean	1450.4502	Mean in Log Scale	5.9056775
428	SD	6351.6028	SD in Log Scale	2.4893877
429	95% MLE (t) UCL	4234.1201	Mean in Original Scale	2879.9162
430	95% MLE (Tiku) UCL	4379.6431	SD in Original Scale	5026.1454
431			95% t UCL	5082.6877
432			95% Percentile Bootstrap UCL	5125.5787
433			95% BCA Bootstrap UCL	5719.7688
434			95% H UCL	264131.11
435				
436	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
437	k star (bias corrected)	0.3214533	**Data appear Gamma Distributed at 5% Significance Level**	
438	Theta Star	9551.0827		
439	nu star	9.6435978		
440				
441	A-D Test Statistic	0.6973307	**Nonparametric Statistics**	
442	5% A-D Critical Value	0.8256749	Kaplan-Meier (KM) Method	
443	K-S Test Statistic	0.8256749	Mean	2880.0188
444	5% K-S Critical Value	0.2385836	SD	4866.4842
445	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	1259.3225
446			95% KM (t) UCL	5087.6744
447	**Assuming Gamma Distribution**		95% KM (z) UCL	4951.4199
448	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5082.7631
449	Minimum	0.000001	95% KM (bootstrap t) UCL	7349.523
450	Maximum	19200	95% KM (BCA) UCL	5271.725
451	Mean	2878.3375	95% KM (Percentile Bootstrap) UCL	5021.2333
452	Median	288	95% KM (Chebyshev) UCL	8369.2781
453	SD	5027.1056	97.5% KM (Chebyshev) UCL	10744.485
454	k star	0.2288117	99% KM (Chebyshev) UCL	15410.119
455	Theta star	12579.504		
456	Nu star	7.3219739	**Potential UCLs to Use**	
457	AppChi2	2.3489484	95% KM (Chebyshev) UCL	8369.2781
458	95% Gamma Approximate UCL	8972.1476		
459	95% Adjusted Gamma UCL	10325.015		
460	**Note: DL/2 is not a recommended method.**			
461				
462	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
463	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
464	**For additional insight, the user may want to consult a statistician.**			
465				
466				
467	**Gasoline Range Organics (GRO)**			
468				
469	**General Statistics**			
470	Number of Valid Data	16	Number of Detected Data	6
471	Number of Distinct Detected Data	6	Number of Non-Detect Data	10
472			Percent Non-Detects	62.50%
473				
474	**Raw Statistics**		**Log-transformed Statistics**	
475	Minimum Detected	1.09	Minimum Detected	0.0861777
476	Maximum Detected	1.71	Maximum Detected	0.5364934
477	Mean of Detected	1.4416667	Mean of Detected	0.3534088

	A B C D E	F	G H I J K	L
478	SD of Detected	0.2423565	SD of Detected	0.1746945
479	Minimum Non-Detect	2.12	Minimum Non-Detect	0.7514161
480	Maximum Non-Detect	4.77	Maximum Non-Detect	1.5623463
481				
482	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
483	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
484	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
485				
486	**Warning: There are only 6 Detected Values in this data**			
487	**Note: It should be noted that even though bootstrap may be performed on this data set**			
488	**the resulting calculations may not be reliable enough to draw conclusions**			
489				
490	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
491				
492				
493	**UCL Statistics**			
494	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
495	Shapiro Wilk Test Statistic	0.9195938	Shapiro Wilk Test Statistic	0.9132944
496	5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
497	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
498				
499	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
500	DL/2 Substitution Method		DL/2 Substitution Method	
501	Mean	1.55625	Mean	0.4159345
502	SD	0.3742036	SD	0.236103
503	95% DL/2 (t) UCL	1.7202494	95% H-Stat (DL/2) UCL	1.741944
504				
505	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
506	**MLE method failed to converge properly**		Mean in Log Scale	0.3534088
507			SD in Log Scale	0.1008599
508			Mean in Original Scale	1.4305707
509			SD in Original Scale	0.1402059
510			95% t UCL	1.4920177
511			95% Percentile Bootstrap UCL	1.4851903
512			95% BCA Bootstrap UCL	1.4822011
513			95% H-UCL	1.4976503
514				
515	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
516	k star (bias corrected)	20.369972	**Data appear Normal at 5% Significance Level**	
517	Theta Star	0.0707741		
518	nu star	244.43966		
519				
520	A-D Test Statistic	0.3644961	**Nonparametric Statistics**	
521	5% A-D Critical Value	0.6969464	Kaplan-Meier (KM) Method	
522	K-S Test Statistic	0.6969464	Mean	1.4416667
523	5% K-S Critical Value	0.3317847	SD	0.2212402
524	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0989416
525			95% KM (t) UCL	1.6151163
526	**Assuming Gamma Distribution**		95% KM (z) UCL	1.6044112
527	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.6256378
528	Minimum	1.09	95% KM (bootstrap t) UCL	1.6230354
529	Maximum	1.71	95% KM (BCA) UCL	1.6
530	Mean	1.4687133	95% KM (Percentile Bootstrap) UCL	1.595

Median	1.4849413	95% KM (Chebyshev) UCL	1.8729432
SD	0.1415877	97.5% KM (Chebyshev) UCL	2.0595569
k star	85.723215	99% KM (Chebyshev) UCL	2.4261234
Theta star	0.0171332		
Nu star	2743.1429	**Potential UCLs to Use**	
AppChi2	2622.457	95% KM (t) UCL	1.6151163
95% Gamma Approximate UCL	1.5363037	95% KM (Percentile Bootstrap) UCL	1.595
95% Adjusted Gamma UCL	1.5442086		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			
Residual range organics (RRO)			
General Statistics			
Number of Valid Observations	16	Number of Distinct Observations	16
Raw Statistics		**Log-transformed Statistics**	
Minimum	17	Minimum of Log Data	2.8332133
Maximum	161000	Maximum of Log Data	11.98916
Mean	18230.625	Mean of log Data	7.0283482
Median	415.5	SD of log Data	2.5715298
SD	41897.146		
Std. Error of Mean	10474.286		
Coefficient of Variation	2.2981739		
Skewness	3.0222819		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.509133	Shapiro Wilk Test Statistic	0.883442
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	36592.577	95% H-UCL	1246990.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	69853.91
95% Adjusted-CLT UCL (Chen-1995)	43915.583	97.5% Chebyshev (MVUE) UCL	92856.302
95% Modified-t UCL (Johnson-1978)	37911.587	99% Chebyshev (MVUE) UCL	138040.05
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.2484727	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	73370.731		
MLE of Mean	18230.625		
MLE of Standard Deviation	36573.136		
nu star	7.951127		
Approximate Chi Square Value (.05)	2.7067485	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03348	95% CLT UCL	35459.293
Adjusted Chi Square Value	2.3705422	95% Jackknife UCL	36592.577
		95% Standard Bootstrap UCL	34813.082
Anderson-Darling Test Statistic	1.7202837	95% Bootstrap-t UCL	67016.914

	A	B	C	D	E	F	G	H	I	J	K	L
584	Anderson-Darling 5% Critical Value					0.8562506	95% Hall's Bootstrap UCL					82814.729
585	Kolmogorov-Smirnov Test Statistic					0.3349643	95% Percentile Bootstrap UCL					37098.563
586	Kolmogorov-Smirnov 5% Critical Value					0.2350589	95% BCA Bootstrap UCL					48546.688
587	**Data not Gamma Distributed at 5% Significance Level**						95% Chebyshev(Mean, Sd) UCL					63886.981
588							97.5% Chebyshev(Mean, Sd) UCL					83642.523
589	**Assuming Gamma Distribution**						99% Chebyshev(Mean, Sd) UCL					122448.46
590	95% Approximate Gamma UCL					53552.82						
591	95% Adjusted Gamma UCL					61148.043						
592												
593	**Potential UCL to Use**						Use 99% Chebyshev (Mean, Sd) UCL					122448.46
594												
595	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
596	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**											
597	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**											
598												
599												
600	**Trichloroethylene (TCE)**											
601												
602	**General Statistics**											
603	Number of Valid Data					16	Number of Detected Data					1
604	Number of Distinct Detected Data					1	Number of Non-Detect Data					15
605							Percent Non-Detects					93.75%
606												
607	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
608	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**											
609												
610	**The data set for variable Trichloroethylene (TCE) was not processed!**											
611												
612												

APPENDIX E - 6

Area A Subsurface Soil ProUCL Output - 95% UCLs for COPCs

	A	B	C	D	E	F	G	H	I	J	K	L
1				**General UCL Statistics for Data Sets with Non-Detects**								
2			**User Selected Options**									
3			From File	ARA_SX.wst								
4			Full Precision	ON								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												
9	**Chromium, Total**											
10												
11						**General Statistics**						
12					Number of Valid Observations	15					Number of Distinct Observations	15
13												
14			**Raw Statistics**						**Log-transformed Statistics**			
15					Minimum	22.3					Minimum of Log Data	3.1045867
16					Maximum	45.1					Maximum of Log Data	3.8088822
17					Mean	31.14					Mean of log Data	3.4195382
18					Median	30.4					SD of log Data	0.201291
19					SD	6.3254362						
20					Std. Error of Mean	1.6332206						
21					Coefficient of Variation	0.203129						
22					Skewness	0.529337						
23												
24						**Relevant UCL Statistics**						
25			**Normal Distribution Test**						**Lognormal Distribution Test**			
26					Shapiro Wilk Test Statistic	0.9633543					Shapiro Wilk Test Statistic	0.9739769
27					Shapiro Wilk Critical Value	0.881					Shapiro Wilk Critical Value	0.881
28			**Data appear Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**			
29												
30			**Assuming Normal Distribution**						**Assuming Lognormal Distribution**			
31					95% Student's-t UCL	34.016608					95% H-UCL	34.369268
32			**95% UCLs (Adjusted for Skewness)**								95% Chebyshev (MVUE) UCL	38.228952
33					95% Adjusted-CLT UCL (Chen-1995)	34.064922					97.5% Chebyshev (MVUE) UCL	41.297274
34					95% Modified-t UCL (Johnson-1978)	34.053811					99% Chebyshev (MVUE) UCL	47.324399
35												
36			**Gamma Distribution Test**						**Data Distribution**			
37					k star (bias corrected)	21.279609			**Data appear Normal at 5% Significance Level**			
38					Theta Star	1.4633728						
39					MLE of Mean	31.14						
40					MLE of Standard Deviation	6.7505131						
41					nu star	638.38827						
42					Approximate Chi Square Value (.05)	580.77314			**Nonparametric Statistics**			
43					Adjusted Level of Significance	0.03235					95% CLT UCL	33.826409
44					Adjusted Chi Square Value	574.0083					95% Jackknife UCL	34.016608
45											95% Standard Bootstrap UCL	33.729993
46					Anderson-Darling Test Statistic	0.181447					95% Bootstrap-t UCL	34.374313
47					Anderson-Darling 5% Critical Value	0.7346142					95% Hall's Bootstrap UCL	34.640721
48					Kolmogorov-Smirnov Test Statistic	0.1213					95% Percentile Bootstrap UCL	33.82
49					Kolmogorov-Smirnov 5% Critical Value	0.221142					95% BCA Bootstrap UCL	33.92
50			**Data appear Gamma Distributed at 5% Significance Level**								95% Chebyshev(Mean, Sd) UCL	38.259044
51											97.5% Chebyshev(Mean, Sd) UCL	41.339459
52			**Assuming Gamma Distribution**								99% Chebyshev(Mean, Sd) UCL	47.39034
53					95% Approximate Gamma UCL	34.229219						

	A–E	F	G–K	L
54	95% Adjusted Gamma UCL	34.632619		
55				
56	**Potential UCL to Use**		Use 95% Student's-t UCL	34.016608
57				
58	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
59	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
60	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
61				
62				
63	**Trichloroethylene (TCE)**			
64				
65	**General Statistics**			
66	Number of Valid Data	15	Number of Detected Data	5
67	Number of Distinct Detected Data	5	Number of Non-Detect Data	10
68			Percent Non-Detects	66.67%
69				
70	**Raw Statistics**		**Log-transformed Statistics**	
71	Minimum Detected	0.0124	Minimum Detected	-4.390059
72	Maximum Detected	0.0866	Maximum Detected	-2.446455
73	Mean of Detected	0.04172	Mean of Detected	-3.481219
74	SD of Detected	0.0345162	SD of Detected	0.8822447
75	Minimum Non-Detect	0.00558	Minimum Non-Detect	-5.188567
76	Maximum Non-Detect	0.0152	Maximum Non-Detect	-4.18646
77				
78	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	11
79	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
80	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	73.33%
81				
82	**Warning: There are only 5 Detected Values in this data**			
83	**Note: It should be noted that even though bootstrap may be performed on this data set**			
84	**the resulting calculations may not be reliable enough to draw conclusions**			
85				
86	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
87				
88				
89	**UCL Statistics**			
90	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
91	Shapiro Wilk Test Statistic	0.8212918	Shapiro Wilk Test Statistic	0.8729772
92	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
93	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
94				
95	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
96	DL/2 Substitution Method		DL/2 Substitution Method	
97	Mean	0.016805	Mean	-4.826973
98	SD	0.0259772	SD	1.1293976
99	95% DL/2 (t) UCL	0.0286186	95% H-Stat (DL/2) UCL	0.0369874
100				
101	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
102	**MLE yields a negative mean**		Mean in Log Scale	-5.404647
103			SD in Log Scale	1.4865256
104			Mean in Original Scale	0.0150568
105			SD in Original Scale	0.0268563
106			95% t UCL	0.0272702

	A–E	F	G–K	L
107			95% Percentile Bootstrap UCL	0.0268746
108			95% BCA Bootstrap UCL	0.0313944
109			95% H-UCL	0.0564346
110				
111	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
112	k star (bias corrected)	0.8497168	**Data appear Normal at 5% Significance Level**	
113	Theta Star	0.0490987		
114	nu star	8.4971684		
115				
116	A-D Test Statistic	0.4910106	**Nonparametric Statistics**	
117	5% A-D Critical Value	0.6852611	Kaplan-Meier (KM) Method	
118	K-S Test Statistic	0.6852611	Mean	0.0221733
119	5% K-S Critical Value	0.3609717	SD	0.0225551
120	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0065111
121			95% KM (t) UCL	0.0336414
122	**Assuming Gamma Distribution**		95% KM (z) UCL	0.0328831
123	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0316238
124	Minimum	0.000001	95% KM (bootstrap t) UCL	0.0746715
125	Maximum	0.0866	95% KM (BCA) UCL	0.0721333
126	Mean	0.0139073	95% KM (Percentile Bootstrap) UCL	0.03738
127	Median	0.000001	95% KM (Chebyshev) UCL	0.0505546
128	SD	0.0274734	97.5% KM (Chebyshev) UCL	0.0628352
129	k star	0.1475186	99% KM (Chebyshev) UCL	0.086958
130	Theta star	0.0942751		
131	Nu star	4.4255594	**Potential UCLs to Use**	
132	AppChi2	0.8966736	95% KM (t) UCL	0.0336414
133	95% Gamma Approximate UCL	0.0686401	95% KM (Percentile Bootstrap) UCL	0.03738
134	95% Adjusted Gamma UCL	0.0852474		
135	**Note: DL/2 is not a recommended method.**			
136				
137	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
138	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
139	**For additional insight, the user may want to consult a statistician.**			
140				
141				
142	**Diesel Range Organics (DRO)**			
143				
144	**General Statistics**			
145	Number of Valid Data	15	Number of Detected Data	8
146	Number of Distinct Detected Data	8	Number of Non-Detect Data	7
147			Percent Non-Detects	46.67%
148				
149	**Raw Statistics**		**Log-transformed Statistics**	
150	Minimum Detected	84.1	Minimum Detected	4.4320066
151	Maximum Detected	28400	Maximum Detected	10.254144
152	Mean of Detected	8123.6875	Mean of Detected	7.3171297
153	SD of Detected	11440.293	SD of Detected	2.4398515
154	Minimum Non-Detect	21.1	Minimum Non-Detect	3.049273
155	Maximum Non-Detect	115	Maximum Non-Detect	4.7449321
156				
157	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	9
158	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
159	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	60.00%

	A B C D E	F	G H I J K	L
160				
161	**Warning: There are only 8 Detected Values in this data**			
162	**Note: It should be noted that even though bootstrap may be performed on this data set**			
163	**the resulting calculations may not be reliable enough to draw conclusions**			
164				
165	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
166				
167				
168	**UCL Statistics**			
169	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
170	Shapiro Wilk Test Statistic	0.7384836	Shapiro Wilk Test Statistic	0.8649577
171	5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
172	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
173				
174	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
175	DL/2 Substitution Method		DL/2 Substitution Method	
176	Mean	4340.7333	Mean	5.1194061
177	SD	9108.4382	SD	3.0107397
178	95% DL/2 (t) UCL	8482.9625	95% H-Stat (DL/2) UCL	3127187.6
179				
180	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
181	**MLE yields a negative mean**		Mean in Log Scale	4.4289544
182			SD in Log Scale	3.6893053
183			Mean in Original Scale	4334.6721
184			SD in Original Scale	9111.5155
185			95% t UCL	8478.3007
186			95% Percentile Bootstrap UCL	8679.8019
187			95% BCA Bootstrap UCL	10362.992
188			95% H-UCL	194600000
189				
190	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
191	k star (bias corrected)	0.3281752	**Data appear Gamma Distributed at 5% Significance Level**	
192	Theta Star	24754.119		
193	nu star	5.2508029		
194				
195	A-D Test Statistic	0.4488911	**Nonparametric Statistics**	
196	5% A-D Critical Value	0.7812547	Kaplan-Meier (KM) Method	
197	K-S Test Statistic	0.7812547	Mean	4371.9992
198	5% K-S Critical Value	0.3132985	SD	8784.269
199	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	2424.6886
200			95% KM (t) UCL	8642.6279
201	**Assuming Gamma Distribution**		95% KM (z) UCL	8360.2571
202	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	8501.9985
203	Minimum	0.000001	95% KM (bootstrap t) UCL	18998.633
204	Maximum	28400	95% KM (BCA) UCL	8582.7333
205	Mean	4332.6333	95% KM (Percentile Bootstrap) UCL	8536.3867
206	Median	84.1	95% KM (Chebyshev) UCL	14940.972
207	SD	9112.5536	97.5% KM (Chebyshev) UCL	19514.175
208	k star	0.1058495	99% KM (Chebyshev) UCL	28497.346
209	Theta star	40932.003		
210	Nu star	3.175486	**Potential UCLs to Use**	
211	AppChi2	0.4262494	95% KM (BCA) UCL	8582.7333
212	95% Gamma Approximate UCL	32277.384		

	A	B	C	D	E	F	G	H	I	J	K	L
213					95% Adjusted Gamma UCL	41932.684						
214	**Note: DL/2 is not a recommended method.**											
215												
216	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**											
217	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**											
218	**For additional insight, the user may want to consult a statistician.**											
219												
220												
221	**Residual Range Organics (RRO)**											
222												
223	**General Statistics**											
224					Number of Valid Data	15					Number of Detected Data	9
225					Number of Distinct Detected Data	9					Number of Non-Detect Data	6
226											Percent Non-Detects	40.00%
227												
228	**Raw Statistics**						**Log-transformed Statistics**					
229					Minimum Detected	79.1					Minimum Detected	4.3707129
230					Maximum Detected	18900					Maximum Detected	9.8469172
231					Mean of Detected	2441.9222					Mean of Detected	6.0133145
232					SD of Detected	6180.5729					SD of Detected	1.7232381
233					Minimum Non-Detect	21.1					Minimum Non-Detect	3.049273
234					Maximum Non-Detect	21.8					Maximum Non-Detect	3.08191
235												
236	Note: Data have multiple DLs - Use of KM Method is recommended										Number treated as Non-Detect	6
237	For all methods (except KM, DL/2, and ROS Methods),										Number treated as Detected	9
238	Observations < Largest ND are treated as NDs										Single DL Non-Detect Percentage	40.00%
239												
240	**Warning: There are only 9 Detected Values in this data**											
241	**Note: It should be noted that even though bootstrap may be performed on this data set**											
242	**the resulting calculations may not be reliable enough to draw conclusions**											
243												
244	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**											
245												
246												
247	**UCL Statistics**											
248	**Normal Distribution Test with Detected Values Only**						**Lognormal Distribution Test with Detected Values Only**					
249					Shapiro Wilk Test Statistic	0.4362303					Shapiro Wilk Test Statistic	0.8610241
250					5% Shapiro Wilk Critical Value	0.829					5% Shapiro Wilk Critical Value	0.829
251	**Data not Normal at 5% Significance Level**						**Data appear Lognormal at 5% Significance Level**					
252												
253	**Assuming Normal Distribution**						**Assuming Lognormal Distribution**					
254					DL/2 Substitution Method						DL/2 Substitution Method	
255					Mean	1469.42					Mean	4.5548066
256					SD	4832.0024					SD	2.2618001
257					95% DL/2 (t) UCL	3666.8617					95% H-Stat (DL/2) UCL	26453.876
258												
259					Maximum Likelihood Estimate(MLE) Method	N/A					Log ROS Method	
260	**MLE yields a negative mean**										Mean in Log Scale	4.2474901
261											SD in Log Scale	2.62008
262											Mean in Original Scale	1467.5009
263											SD in Original Scale	4832.6242
264											95% t UCL	3665.2254
265											95% Percentile Bootstrap UCL	3912.1883

	A	F	G	L
266			95% BCA Bootstrap UCL	5253.187
267			95% H-UCL	125523.14
268				
269	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
270	k star (bias corrected)	0.3223813	**Data appear Lognormal at 5% Significance Level**	
271	Theta Star	7574.6402		
272	nu star	5.8028631		
273				
274	A-D Test Statistic	1.2760901	**Nonparametric Statistics**	
275	5% A-D Critical Value	0.7940233	Kaplan-Meier (KM) Method	
276	K-S Test Statistic	0.7940233	Mean	1496.7933
277	5% K-S Critical Value	0.2987862	SD	4659.7167
278	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	1276.116
279			95% KM (t) UCL	3744.4294
280	**Assuming Gamma Distribution**		95% KM (z) UCL	3595.8173
281	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3687.5611
282	Minimum	0.000001	95% KM (bootstrap t) UCL	35140.661
283	Maximum	18900	95% KM (BCA) UCL	4043.8533
284	Mean	1465.1533	95% KM (Percentile Bootstrap) UCL	3966.08
285	Median	87	95% KM (Chebyshev) UCL	7059.2539
286	SD	4833.3853	97.5% KM (Chebyshev) UCL	9466.135
287	k star	0.1159795	99% KM (Chebyshev) UCL	14193.987
288	Theta star	12632.865		
289	Nu star	3.4793849	**Potential UCLs to Use**	
290	AppChi2	0.5275616	99% KM (Chebyshev) UCL	14193.987
291	95% Gamma Approximate UCL	9663.0083		
292	95% Adjusted Gamma UCL	12421.408		
293	**Note: DL/2 is not a recommended method.**			
294				
295	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
296	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
297	**For additional insight, the user may want to consult a statistician.**			
298				

APPENDIX E - 7

Downgradient Off-Site Drainage ProUCL Output - 95% UCLs for COPECs

	A–E	F	G–K	L
1	**General UCL Statistics for Data Sets with Non-Detects**			
2	**User Selected Options**			
3	From File	Sheet1.wst		
4	Full Precision	OFF		
5	Confidence Coefficient	95%		
6	Number of Bootstrap Operations	2000		
7				
8				
9	**Barium**			
10				
11	**General Statistics**			
12	Number of Valid Observations	6	Number of Distinct Observations	6
13				
14	**Raw Statistics**		**Log-transformed Statistics**	
15	Minimum	0.00585	Minimum of Log Data	-5.141
16	Maximum	0.0105	Maximum of Log Data	-4.556
17	Mean	0.00911	Mean of log Data	-4.715
18	Median	0.00963	SD of log Data	0.212
19	SD	0.00165		
20	Coefficient of Variation	0.181		
21	Skewness	-2.115		
22				
23				
24	**Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!**			
25				
26	**It is suggested to collect at least 8 to 10 observations using these statistical methods!**			
27	**If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.**			
28				
29				
30	**Warning: There are only 6 Values in this data**			
31	**Note: It should be noted that even though bootstrap methods may be performed on this data set,**			
32	**the resulting calculations may not be reliable enough to draw conclusions**			
33				
34	**The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.**			
35				
36	**Relevant UCL Statistics**			
37	**Normal Distribution Test**		**Lognormal Distribution Test**	
38	Shapiro Wilk Test Statistic	0.718	Shapiro Wilk Test Statistic	0.672
39	Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
40	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
41				
42	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
43	95% Student's-t UCL	0.0105	95% H-UCL	0.0112
44	**95% UCLs (Adjusted for Skewness)**		95% Chebyshev (MVUE) UCL	0.0126
45	95% Adjusted-CLT UCL (Chen-1995)	0.0096	97.5% Chebyshev (MVUE) UCL	0.0141
46	95% Modified-t UCL (Johnson-1978)	0.0104	99% Chebyshev (MVUE) UCL	0.017
47				
48	**Gamma Distribution Test**		**Data Distribution**	
49	k star (bias corrected)	15	**Data do not follow a Discernable Distribution (0.05)**	
50	Theta Star	0.0006075		
51	MLE of Mean	0.00911		
52	MLE of Standard Deviation	0.00235		
53	nu star	179.9		

	A–E	F	G–K	L
54	Approximate Chi Square Value (.05)	149.9	**Nonparametric Statistics**	
55	Adjusted Level of Significance	0.0122	95% CLT UCL	0.0102
56	Adjusted Chi Square Value	140	95% Jackknife UCL	0.0105
57			95% Standard Bootstrap UCL	0.0101
58	Anderson-Darling Test Statistic	1.046	95% Bootstrap-t UCL	0.01
59	Anderson-Darling 5% Critical Value	0.697	95% Hall's Bootstrap UCL	0.00974
60	Kolmogorov-Smirnov Test Statistic	0.405	95% Percentile Bootstrap UCL	0.00992
61	Kolmogorov-Smirnov 5% Critical Value	0.332	95% BCA Bootstrap UCL	0.00984
62	**Data not Gamma Distributed at 5% Significance Level**		95% Chebyshev(Mean, Sd) UCL	0.012
63			97.5% Chebyshev(Mean, Sd) UCL	0.0133
64	**Assuming Gamma Distribution**		99% Chebyshev(Mean, Sd) UCL	0.0158
65	95% Approximate Gamma UCL	0.0109		
66	95% Adjusted Gamma UCL	0.0117		
67				
68	**Potential UCL to Use**		Use 95% Student's-t UCL	0.0105
69			or 95% Modified-t UCL	0.0104
70				
71	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
72	**These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)**			
73	**and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.**			
74				
75				
76	**Chromium**			
77				
78		**General Statistics**		
79	Number of Valid Data	6	Number of Detected Data	5
80	Number of Distinct Detected Data	5	Number of Non-Detect Data	1
81			Percent Non-Detects	16.67%
82				
83	**Raw Statistics**		**Log-transformed Statistics**	
84	Minimum Detected	0.00121	Minimum Detected	-6.717
85	Maximum Detected	0.00206	Maximum Detected	-6.185
86	Mean of Detected	0.00147	Mean of Detected	-6.54
87	SD of Detected	0.0003422	SD of Detected	0.211
88	Minimum Non-Detect	0.004	Minimum Non-Detect	-5.521
89	Maximum Non-Detect	0.004	Maximum Non-Detect	-5.521
90				
91				
92	**Warning: There are only 5 Detected Values in this data**			
93	**Note: It should be noted that even though bootstrap may be performed on this data set**			
94	**the resulting calculations may not be reliable enough to draw conclusions**			
95				
96	**It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.**			
97				
98				
99		**UCL Statistics**		
100	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
101	Shapiro Wilk Test Statistic	0.797	Shapiro Wilk Test Statistic	0.843
102	5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
103	**Data appear Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
104				
105	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
106	DL/2 Substitution Method		DL/2 Substitution Method	
107	Mean	0.00156	Mean	-6.486

	A–E	F	G–K	L
108	SD	0.0003743	SD	0.231
109	95% DL/2 (t) UCL	0.00187	95% H-Stat (DL/2) UCL	0.00195
110				
111	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
112	**MLE method failed to converge properly**		Mean in Log Scale	-6.54
113			SD in Log Scale	0.189
114			Mean in Original Scale	0.00147
115			SD in Original Scale	0.0003062
116			95% t UCL	0.00172
117			95% Percentile Bootstrap UCL	0.00167
118			95% BCA Bootstrap UCL	0.00174
119				
120	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
121	k star (bias corrected)	10.72	**Data appear Normal at 5% Significance Level**	
122	Theta Star	0.0001373		
123	nu star	107.2		
124				
125	A-D Test Statistic	0.529	**Nonparametric Statistics**	
126	5% A-D Critical Value	0.679	Kaplan-Meier (KM) Method	
127	K-S Test Statistic	0.679	Mean	0.00147
128	5% K-S Critical Value	0.357	SD	0.000306
129	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.000153
130			95% KM (t) UCL	0.00178
131	**Assuming Gamma Distribution**		95% KM (z) UCL	0.00172
132	Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.00179
133	Minimum	0.00121	95% KM (bootstrap t) UCL	0.00225
134	Maximum	0.00206	95% KM (BCA) UCL	0.0017
135	Mean	0.00148	95% KM (Percentile Bootstrap) UCL	0.00171
136	Median	0.00142	95% KM (Chebyshev) UCL	0.00214
137	SD	0.0003065	97.5% KM (Chebyshev) UCL	0.00243
138	k star	15.93	99% KM (Chebyshev) UCL	0.00299
139	Theta star	9.282E-05		
140	Nu star	191.2	**Potential UCLs to Use**	
141	AppChi2	160.2	95% KM (t) UCL	0.00178
142	95% Gamma Approximate UCL	0.00176	95% KM (Percentile Bootstrap) UCL	0.00171
143	95% Adjusted Gamma UCL	0.00189		
144	**Note: DL/2 is not a recommended method.**			
145				
146	**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.**			
147	**These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).**			
148	**For additional insight, the user may want to consult a statistician.**			
149				

APPENDIX F

Summary Statistics and EPCs for COPCs and COPECs

Table F-1 Exposure Point Concentrations and Data Summary for Surface Soil
Detected Results for COPCs/COPECs at Upper Site Summit

	Surface Soil Data [a]								
Analyte	**Number of Samples**	**Number of Detects**	**Frequency of Detection (Percent)**	**Maximum Detected Concentration (mg/Kg)**	**Minimum Detected Concentration (mg/Kg)**	**Assumed Distribution**	**ProUCL 95% UCL (mg/Kg) b**		**EPC (mg/Kg) c**
Inorganics									
Arsenic	14	14	100	19.1	2.16	Normal	9.84		9.84
Barium	14	14	100	1240	72.2	Nonparametric	592		592
Cadmium	14	14	100	23.9	0.115	Nonparametric	9.62		9.62
Chromium, Hexavalent	4	3	75	0.890	0.160	NC	NC	d	0.890
Lead	14	14	100	950	8.85	Nonparametric	386		386
Mercury	14	14	100	0.815	0.0294	Nonparametric	0.398		0.398
Nickel	14	14	100	47.6	14.1	Gamma	29.9		29.9
Selenium	14	10	71	2.91	0.174	Nonparametric	1.57		1.57
Silver	14	14	100	38.2	0.0434	Nonparametric	14.8		14.8
Vanadium	14	14	100	134	18.1	Normal	75.6		75.6
Volatile Organic Compounds (VOCs)									
1,2,4-Trimethylbenzene	23	8	35	0.0393	0.000430	Nonparametric	0.0156		0.0156
1,3,5-Trimethylbenzene	23	3	13	0.0322	0.00617	Nonparametric	0.0145		0.0322
Carbon disulfide	23	1	4	0.000170	0.000170	NC	NC	d	0.00017
n-Propylbenzene	23	1	4	0.0219	0.0219	NC	NC	d	0.0219
p-Isopropyltoluene	23	1	4	0.0137	0.0137	NC	NC	d	0.0137
Semi-Volatile Organic Compounds (SVOCs)									
bis(2-ethylhexyl) Phthalate	23	2	9	2.12	0.923	Nonparametric	1.10		2.12
Polycyclic Aromatic Hydrocarbons (PAHs)									
Anthracene	23	8	35	2.30	0.108	Nonparametric	0.65		0.646
Benzo(a)anthracene	23	10	43	8.61	0.0944	Nonparametric	1.78		1.78
Benzo(a)pyrene	23	8	35	5.75	0.197	Nonparametric	1.37		1.37
Benzo(b)fluoranthene	23	8	35	10.6	0.213	Nonparametric	2.37		2.37
Benzo(k)fluoranthene	23	7	30	4.48	0.0848	Nonparametric	0.956		0.956
Dibenz(a,h)anthracene	23	5	22	2.42	0.160	Nonparametric	0.493		0.493
Indeno(1,2,3-c,d)Pyrene	23	8	35	1.88	0.0957	Nonparametric	0.664		0.664
Naphthalene	23	14	61	0.145	0.000810	Nonparametric	0.0719		0.0719
Phenanthrene	23	10	43	8.93	0.124	Nonparametric	1.70		1.70
Pyrene	23	11	48	16.6	0.145	Nonparametric	3.55		3.55
Total Petroleum Hydrocarbons (TPHs)									
Diesel Range Organics (DRO)	23	19	83	2,270	6.80	Nonparametric	651		651
Gasoline Range Organics (GRO	23	2	9	1.80	0.924	Nonparametric	1.79		1.80
Residual range organics (RRO)	23	23	100	3,330	8.06	Nonparametric	1,505		1,505

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Surface soil samples were collected from zero to two feet below ground surface.
[b] Calculated using ProUCL ver. 4.1. If ProUCL recommended the 97.5% or 99% UCL, the comparable 95% UCL was selected.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.
[d] ProUCL did not calculate a 95% UCL for this analyte due to insufficient number of samples or detected values within the data set.

Table F-2 Exposure Point Concentrations and Data Summary for Subsurface Soil Detected Results for COPCs at Upper Site Summit

	Subsurface Soil Data [a]							
Analyte	**Number of Samples**	**Number of Detects**	**Frequency of Detection (Percent)**	**Maximum Detected Concentration (mg/Kg)**	**Minimum Detected Concentration (mg/Kg)**	**Assumed Distribution**	**ProUCL 95% UCL (mg/Kg)b**	**EPC (mg/Kg)c**
Inorganics								
Vanadium	21	21	100	102	34.4	Nonparametric	75.8	75.8
Volatile Organic Compounds (VOCs)								
1,2,3-Trichloropropane	31	1	3	0.0247	0.0247	NC	NC [d]	0.0247
Trichloroethylene (TCE)	31	15	48	0.0790	0.00570	Nonparametric	0.0283	0.0283
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	31	3	10	3.43	0.268	Nonparametric	0.611	3.43
Benzo(a)pyrene	31	3	10	3.71	0.231	Nonparametric	0.632	3.71
Benzo(b)fluoranthene	31	4	13	1.53	0.111	Nonparametric	0.308	1.53
Benzo(k)fluoranthene	31	3	10	5.63	0.135	Nonparametric	0.683	5.63
Dibenz(a,h)anthracene	31	2	6	0.846	0.273	Nonparametric	0.335	0.846
Indeno(1,2,3-c,d)Pyrene	31	3	10	2.09	0.111	Nonparametric	0.337	2.09

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Subsurface soil samples were collected from 2 to 15 feet below ground surface.
[b] Calculated using ProUCL ver. 4.1.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.
[d] ProUCL did not calculate a 95% UCL for this analyte due to insufficient number of samples or detected values within the data set.

Table F-3 Exposure Point Concentrations and Data Summary for Surface Soil
Detected Results for COPCs/COPECs at Lower Site Summit

Analyte	Surface Soil Data [a] Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Assumed Distribution	ProUCL 95% UCL (mg/Kg) b	EPC (mg/Kg) c
Inorganics								
Arsenic	34	34	100	19.0	4.14	Normal	8.15	8.15
Barium	34	34	100	330	61.7	Normal	135	135
Cadmium	34	34	100	15.6	0.0789	Nonparametric	2.82	2.82
Chromium, Hexavalent	9	5	56	6.80	0.120	Nonparametric	4.79	4.79
Chromium, Total	34	34	100	65.0	15.6	Gamma	31.9	31.9
Lead	34	34	100	208	6.14	Nonparametric	75.0	75.0
Mercury	34	34	100	1.92	0.0229	Nonparametric	0.383	0.383
Nickel	34	34	100	49.1	15.9	Gamma	30.9	30.9
Selenium	34	27	79	1.34	0.167	Nonparametric	0.365	0.365
Volatile Organic Compounds (VOCs)								
1,2,4-Trimethylbenzene	37	5	14	0.0388	0.0103	Nonparametric	0.0146	0.0388
1,3,5-Trimethylbenzene	37	2	5	0.0239	0.00853	Nonparametric	0.0109	0.0239
2-Hexanone	37	4	11	0.00840	0.00180	Nonparametric	0.00629	0.00840
Carbon disulfide	37	4	11	0.000650	0.000140	Nonparametric	0.000509	0.000650
Dibenzofuran	37	8	22	7.09	0.113	Nonparametric	1.67	1.67
Isopropylbenzene	37	1	3	0.0145	0.0145	NC	NC [d]	0.0145
n-Butylbenzene	37	1	3	0.0123	0.0123	NC	NC [d]	0.0123
n-Propylbenzene	37	2	5	0.0202	0.0156	Nonparametric	0.0167	0.0202
p-Isopropyltoluene	37	1	3	0.0107	0.0107	NC	NC [d]	0.0107
trans-1,3-Dichloropropene	37	1	3	0.000270	0.000270	NC	NC [d]	0.000270
Trichloroethylene (TCE)	37	11	30	0.290	0.000380	Nonparametric	0.0416	0.0416
Semi-Volatile Organic Compounds (SVOCs)								
Benzoic acid	37	2	5	1.39	1.16	Nonparametric	1.47	1.39
bis(2-ethylhexyl) Phthalate	37	3	8	5.44	0.128	Nonparametric	0.572	5.44
Pentachlorophenol	37	1	3	46.5	46.5	NC	NC [d]	46.5
Polycyclic Aromatic Hydrocarbons (PAHs)								
Anthracene	37	12	32	26.0	0.0936	Nonparametric	5.82	5.82
Benzo(a)anthracene	37	14	38	37.0	0.0860	Nonparametric	7.98	7.98
Benzo(a)pyrene	37	14	38	35.7	0.0855	Nonparametric	7.74	7.74
Benzo(b)fluoranthene	37	12	32	40.1	0.183	Nonparametric	8.66	8.66
Benzo(k)fluoranthene	37	11	30	10.8	0.182	Nonparametric	1.86	1.86
Chrysene	37	12	32	43.4	0.182	Nonparametric	9.55	9.55
Dibenz(a,h)anthracene	37	5	14	6.12	0.154	Nonparametric	0.786	6.12
Indeno(1,2,3-c,d)Pyrene	37	13	35	16.1	0.117	Nonparametric	2.42	2.42
Naphthalene	37	16	43	2.91	0.000780	Nonparametric	0.595	0.595
Phenanthrene	37	20	54	60.1	0.0884	Nonparametric	13.0	13.0
Pyrene	37	21	57	78.0	0.0832	Nonparametric	17.1	17.1
Energetics								
Perchlorate	8	3	38	0.000430	0.000200	Nonparametric	0.000423	0.000423
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	37	29	78	7,360	7.81	Nonparametric	2,123	2,123
Gasoline Range Organics (GRO)	29	10	34	14.5	0.454	Nonparametric	2.66	2.66
Residual range organics (RRO)	37	36	97	24,400	11.0	Nonparametric	4,601	4,601

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Surface soil samples were collected from zero to two feet below ground surface.
[b] Calculated using ProUCL ver. 4.1. If ProUCL recommended the 97.5% or 99% UCL, the comparable 95% UCL was selected.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.
[d] ProUCL did not calculate a 95% UCL for this analyte due to insufficient number of samples or detected values within the data set.

Table F-4 Exposure Point Concentrations and Data Summary for Subsurface Soil Detected Results for COPCs at Lower Site Summit

Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Assumed Distribution	ProUCL 95% UCL (mg/Kg) b		EPC (mg/Kg) c
	Subsurface Soil Data [a]								
Inorganics									
Vanadium	16	16	100	106	42.2	Normal	61.9		61.9
Volatile Organic Compounds (VOCs)									
1,1,2,2-Tetrachloroethane	29	1	3	1.21	1.21	NC	NC	d	1.21
1,1,2-Trichloroethane	29	1	3	1.65	1.65	NC	NC	d	1.65
1,2,3-Trichloropropane	29	1	3	0.491	0.491	NC	NC	d	0.491
1,2-Dibromo-3-chloropropane	29	1	3	3.04	3.04	NC	NC	d	3.04
Trichloroethylene (TCE)	29	19	66	0.613	0.00952	Nonparametric	0.155		0.155
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a)pyrene	29	3	10	0.347	0.112	Nonparametric	0.150		0.347
Naphthalene	29	7	24	4.32	0.0238	Nonparametric	1.11		1.11

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Subsurface soil samples were collected from 2 to 15 feet below ground surface.
[b] Calculated using ProUCL ver. 4.1. If ProUCL recommended the 97.5% or 99% UCL, the comparable 95% UCL was selected.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.
[d] ProUCL did not calculate a 95% UCL for this analyte due to insufficient number of samples or detected values within the data set.

Table F-5 Exposure Point Concentrations and Data Summary for Groundwater Detected Results for COPCs at Lower Site Summit

	Groundwater Data					
Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	EPC (mg/L) [b]
Inorganics						
Arsenic	7	6	86	0.0322	0.00874	Pathway Specific
Barium	7	7	100	0.964	0.0372	Pathway Specific
Cadmium	7	1	14	0.00107	0.00107	Pathway Specific
Chromium, Total	7	6	86	0.0857	0.0170	Pathway Specific
Lead	7	6	86	0.0333	0.00777	Pathway Specific
Mercury	7	3	43	0.000299	0.0000744	Pathway Specific
Nickel	7	7	100	0.0798	0.00108	Pathway Specific
Vanadium	7	6	86	0.137	0.0329	Pathway Specific
Inorganics, Filtered						
Arsenic	7	4	57	0.00681	0.00310	Pathway Specific
Chromium, Total	7	1	14	0.0159	0.0159	Pathway Specific
Nickel	7	7	100	0.0142	0.00113	Pathway Specific
Vanadium	7	1	14	0.0327	0.0327	Pathway Specific
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	7	2	29	0.0356	0.00376	Pathway Specific
1,2-Dichloroethane	7	1	14	0.000520	0.000520	Pathway Specific
1,3,5-Trimethylbenzene	7	2	29	0.0164	0.00809	Pathway Specific
Benzene	7	2	29	0.00539	0.00111	Pathway Specific
Ethylbenzene	7	2	29	0.00720	0.00713	Pathway Specific
Methylene chloride	7	4	57	0.00121	0.00104	Pathway Specific
n-Butylbenzene	7	1	14	0.00975	0.00975	Pathway Specific
n-Propylbenzene	7	2	29	0.0117	0.00356	Pathway Specific
sec-Butylbenzene	7	2	29	0.0100	0.00287	Pathway Specific
Trichloroethylene (TCE)	7	4	57	0.0175	0.000620	Pathway Specific
Polycyclic Aromatic Hydrocarbons (PAHs)						
2-Methylnaphthalene	7	2	29	0.0735	0.0466	Pathway Specific
Acenaphthene	7	1	14	0.00360	0.00360	Pathway Specific
Fluorene	7	1	14	0.00390	0.00390	Pathway Specific
Naphthalene	7	3	43	0.168	0.00176	Pathway Specific
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	7	5	71	29.4	0.403	Pathway Specific

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Calculated using ProUCL ver. 4.1.

[b] The EPC is based on the detected concentration in the highest risk well for the groundwater to indoor air vapor intrusion (for volatile COPCs) and potable use pathways, as described in Section 4.2.1.

Table F-6 Exposure Point Concentrations and Data Summary for Surface Soil - Detected Results for COPCs/COPECs at Area A

	Surface Soil Data [a]							
Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Assumed Distribution	ProUCL 95% UCL (mg/Kg) [b]	EPC (mg/Kg) [c]
Inorganics								
Barium	16	16	100	908	69.1	Nonparametric	373	373
Cadmium	16	15	94	3.06	0.0739	Nonparametric	1.23	1.23
Chromium, Hexavalent	10	7	70	1.98	0.130	Nonparametric	0.897	0.897
Lead	16	16	100	116	5.37	Nonparametric	50.9	50.9
Nickel	16	16	100	52.2	27.7	Normal	41.1	41.1
Volatile Organic Compounds (VOCs)								
Trichloroethylene (TCE)	16	1	6	0.0818	0.0818	NC	NC [d]	0.0818
Semi-Volatile Organic Compounds (SVOCs)								
Benzoic acid	16	5	31	1.52	1.24	Nonparametric	1.42	1.42
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	16	15	94	19,200	22.3	Nonparametric	8,369	8,369
Gasoline Range Organics (GRO)	16	6	38	1.71	1.09	Nonparametric	1.62	1.62
Residual range organics (RRO)	16	16	100	161,000	17.0	Nonparametric	63,887	63,887

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Surface soil samples were collected from zero to two feet below ground surface.
[b] Calculated using ProUCL ver. 4.1. If ProUCL recommended the 97.5% or 99% UCL, the comparable 95% UCL was selected.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.
[d] ProUCL did not calculate a 95% UCL for this analyte due to insufficient number of samples or detected values within the data set.

Table F-7 Exposure Point Concentrations and Data Summary for Subsurface Soil - Detected Results for COPCs at Area A

	Subsurface Soil Data [a]							
Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Assumed Distribution	ProUCL 95% UCL (mg/Kg)b	EPC (mg/Kg)c
Inorganics								
Chromium, Total	15	15	100	45.1	22.3	Normal	34.0	34.0
Volatile Organic Compounds (VOCs)								
Trichloroethylene (TCE)	15	5	33	0.0866	0.0124	Nonparametric	0.0336	0.0336
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	15	8	53	28,400	84.1	Nonparametric	8,583	8,583
Residual range organics (RRO)	15	9	60	18,900	79.1	Nonparametric	7,059	7,059

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Subsurface soil samples were collected from 2 to 15 feet below ground surface.
[b] Calculated using ProUCL ver. 4.1. If ProUCL recommended the 97.5% or 99% UCL, the comparable 95% UCL was selected.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Table F-8 Exposure Point Concentrations and Data Summary for Surface Soil Detected Results for COPCs/COPECs at Area C

	Surface Soil Data [a]							
Analyte	Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Assumed Distribution	ProUCL 95% UCL (mg/Kg)b	EPC (mg/Kg)c
Inorganics								
Lead	3	3	100	18.5	8.44	NC	NC	18.5
Nickel	3	3	100	37.7	31.9	NC	NC	37.7
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	3	1	33	1.80	1.80	NC	NC	1.80
Benzo(a)pyrene	3	1	33	1.62	1.62	NC	NC	1.62
Benzo(b)fluoranthene	3	1	33	2.08	2.08	NC	NC	2.08
Benzo(k)fluoranthene	3	1	33	0.599	0.599	NC	NC	0.599
Indeno(1,2,3-c,d)Pyrene	3	1	33	0.818	0.818	NC	NC	0.818
Naphthalene	3	1	33	0.542	0.542	NC	NC	0.542
Phenanthrene	3	1	33	6.49	6.49	NC	NC	6.49
Pyrene	3	1	33	4.36	4.36	NC	NC	4.36
Total Petroleum Hydrocarbons (TPHs)								
Diesel Range Organics (DRO)	3	1	33	62.6	62.6	NC	NC	62.6
Residual range organics (RRO)	3	3	100	260	57.3	NC	NC	260

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] Surface soil samples were collected from zero to two feet below ground surface.
[b] No 95% UCL was calculated due to insufficient sample size for use with ProUCL Version 4.1.
[c] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Table F-9 Exposure Point Concentrations and Data Summary for Sediment
Detected Results for COPECs at Area C

Analyte	Sediment Data: Number of Samples	Number of Detects	Frequency of Detection (Percent)	Maximum Detected Concentration (mg/Kg)	Minimum Detected Concentration (mg/Kg)	Assumed Distribution	ProUCL 95% UCL (mg/Kg)b	EPC (mg/Kg)c
Inorganics								
Barium	1	1	100	53.1	53.1	NC	NC	53.1
Nickel	1	1	100	32.5	32.5	NC	NC	32.5
Selenium	1	1	100	0.284	0.284	NC	NC	0.284
Vanadium	1	1	100	50.8	50.8	NC	NC	50.8
Semi-Volatile Organic Compounds								
Di-n-octylphthalate	1	1	100	0.239	0.239	NC	NC	0.239
Polycyclic Aromatic Hydrocarbons								
Benzo(a)anthracene	1	1	100	0.0707	0.0707	NC	NC	0.0707
Chrysene	1	1	100	0.0772	0.0772	NC	NC	0.0772
Fluoranthene	1	1	100	0.171	0.171	NC	NC	0.171
Phenanthrene	1	1	100	0.179	0.179	NC	NC	0.179
Pyrene	1	1	100	0.146	0.146	NC	NC	0.146
Total Petroleum Hydrocarbons								
Diesel Range Organics (DRO)	1	1	100	34.3	34.3	NC	NC	34.3
Residual range organics (RRO)	1	1	100	96.9	96.9	NC	NC	96.9

Notes:

% - percent
EPC - exposure point concentration
mg/Kg - milligrams per kilogram
NC - not calculated
UCL - upper confidence limits

[a] No 95% UCL was calculated due to insufficient sample size for use with ProUCL Version 4.1.

[b] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Table F-10 Exposure Point Concentrations and Data Summary for Surface Water Detected Results for COPECs in Downgradient Off-Site Drainages

	Surface Water Data [a]							
Analyte	**Number of Samples**	**Number of Detects**	**Frequency of Detection (Percent)**	**Maximum Detected Concentration (mg/L)**	**Minimum Detected Concentration (mg/L)**	**Assumed Distribution**	**ProUCL 95% UCL (mg/L)**	**EPC (mg/L) [b]**
Inorganics								
Barium	6	6	100	0.0105	0.00585	Parametric	0.0105	0.0105
Chromium, Total	6	5	83	0.00206	0.00121	Nonparametric	0.00178	0.00178

Notes:
EPC - exposure point concentration
mg/L - milligrams per liter
UCL - upper confidence limits

[a] Surface water samples were collected from drainage channels flowing from NSS Areas.

[b] The EPC is based on the lower of either the maximum detected concentration or 95% UCL. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

APPENDIX G

Human Health Exposure Dose Equations

APPENDIX G HUMAN HEALTH EXPOSURE DOSE EQUATIONS

Exposure Assessment Equations and Parameters:

Ingestion intake for soil /dust (carcinogenic chemicals):	Ingestion intake for soil/dust (non-carcinogenic chemicals):
$I = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT_c}$	$I = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT_n}$

Where:

I = intake (mg/kg-day)
CS = concentration in soil (mg/kg)
IR = soil ingestion rate (mg/day)
CF = conversion factor (10^{-6} kg/mg)
EF = exposure frequency (days/yr)
ED = exposure duration (yr)
BW = body weight (kg)
AT_c = averaging time for carcinogens (days)
AT_n = averaging time for non-carcinogens (days)

Inhalation intake of soil /dust (carcinogenic chemicals):	Inhalation intake of soil/dust (non-carcinogenic chemicals):
$Cc = \frac{CS \times (1/VF + 1/PEF) \times EF \times ED}{AT_c \times CF}$	$Cnc = \frac{CS \times (1/VF + 1/PEF) \times EF \times ED}{AT_n}$

Where:

Cc = concentration (ug/ m^3)
Cnc = concentration (mg/ m^3)
CF = conversion factor (1 mg/1000 ug)
CS = concentration in soil (mg/kg)
VF = volatilization factor (m^3/ kg)
PEF = particulate emission factor (m^3/ kg)
EF = exposure frequency (days/yr)
ED = exposure duration (yr)
AT_c = averaging time for carcinogens (days)
AT_n = averaging time for non-carcinogens (days)

<u>Volatilization Factor (m^3/kg)</u>:

$$VF = \frac{(Q/C \times 3.14x\ D_A \times T)^{0.5} \times 10^{-4} m^2/cm^2}{2 \times \rho_b \times D_A}$$

Where:

$$D_A = \frac{[(\theta_a^{10/3} D_i H' + \theta_w^{10/3} D_w)/n^2]}{\rho_b K_d + \theta_w + \theta_a H'}$$

θ_a = air-filled soil porosity (0.284)
θ_w = water-filled soil porosity (0.15)
ρ_b = dry soil bulk density (1.5 g/cm^3)
C = concentration of chemical in soil
D_A = apparent diffusivity (cm^2/s)
D_I = diffusivity in air (cm^2/s)
D_w = diffusivity in water (cm^2/s)
H' = dimensionless Henry's law constant (chemical specific [unitless])
K_d = soil-water partition coefficient (chemical specific [unitless])
n = total soil porosity (L_{pore}/L_{soil})
Q/C_{vf} = Inverse of the mean conc. At the center of a 0.5 acre^2 source (g/m^2-s per kg/m^3)
T = exposure interval(s) (9.5 x 10^8 s)

* Use VFs for volatile chemicals (defined as having a Henry's Law Constant [atm-m^3/mol] greater than 10^{-5} and a molecular weight less than 200 grams/mol) or PEF for non-volatile compounds.

Dermal intake for soil/dust (carcinogenic chemicals):	Dermal intake for soil/dust (non-carcinogenic chemicals):
$I = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT_c}$	$I = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT_n}$

Where:

I = intake (mg/kg-day)
CS = concentration in soil (mg/kg)
CF = conversion factor (10^{-6} kg/mg)
SA = surface area (cm^2)
AF = soil-to-dermal adherence factor (mg/cm^2)
ABS = absorption fraction through skin for chemicals in soil (unitless)
EF = exposure factor (d/yr)
ED = exposure duration (yr)
BW = body weight (kg)
AT_c = averaging time for carcinogens (days)
AT_n = averaging time for non-carcinogens (days)

Ingestion of subsurface water for potable uses (carcinogenic chemicals):	Ingestion of subsurface water for potable uses (non-carcinogenic chemicals):
$I = \frac{CW \times IR \times EF \times ED}{BW \times AT_c}$	$I = \frac{CW \times IR \times EF \times ED}{BW \times AT_n}$

Where:

I = intake (mg/kg-day)
CW = concentration in water (mg/L)
IR = ingestion rate (liters water/day)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
BW = body weight (kg)
AT_c = averaging time for carcinogens (days)
AT_n = averaging time for non-carcinogens (days)

Inhalation intake for VOCs in water while bathing (carcinogenic chemicals):	Inhalation intake for VOCs in water while bathing (non-carcinogenic chemicals):
$Cc = \frac{CW \times CF \times VF \times 1/24 \times ET \times EF \times ED}{AT_c}$	$Cnc = \frac{CW \times CF \times VF \times 1/24 \times ET \times EF \times ED}{AT_n}$

Where:

Cc = Concentration (ug/ m^3)
Cnc = Concentration (mg/ m^3)
CW = concentration in water (mg/L)
CF = Conversion factor
VF = volatility factor (L/m^3)
ET = exposure time (hours/day)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
AT_c = averaging time for carcinogens (yr)
AT_n = averaging time for non-carcinogens (yr)

Dermal intake for subsurface water while bathing (carcinogenic chemicals):	Dermal intake for subsurface water while bathing (non-carcinogenic chemicals):
$I = \frac{DAevent \times EV \times SA \times EF \times ED}{BW \times AT_c}$	$I = \frac{DAevent \times EV \times SA \times EF \times ED}{BW \times AT_n}$

Where:

I = intake (mg/kg-day)
DAevent = Absorbed dose per event (mg/cm^2-event)*
EV = event frequency (1 events/day)
SA = skin surface area exposed (cm^3)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
BW = body weight (kg)
AT_c = averaging time for carcinogens (yr)
AT_n = averaging time for non-carcinogens (yr)

<u>Absorbed dose per event (DAevent)(mg/cm^2-event)*</u>

DAevent for Inorganic Compounds = K_p x C_w x t_{event}

Where:
Kp = Dermal permeability coefficient of compound in water (cm/hr)
Cw = Chemical concentration in water (mg/cm^3)
Tevent = Event duration (hr/event)

DAevent for Organic Compounds = 2 FA x Kp x Cw $\sqrt{\frac{6\,\tau_{event} \times t_{event}}{\pi}}$

Where:
FA = Fraction absorbed water (dimensionless)
Cw = Chemical concentration in water (mg/cm^3)
τ_{event}= Lag time per event (hr/event)
t_{event} = Event duration (hr/event)

APPENDIX H

Johnson and Ettinger Model Input and Output

APPENDIX H - 1

MW02LSS Groundwater Well

Groundwater to Indoor Air Vapor Intrusion Modeling

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
91203	1.76E+00	Naphthalene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	338.328	S	6.18	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

Lookup Soil Parameters

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.10E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
9.1E-08	2.1E-03

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (µg/L)	Chemical
79016	6.20E-01	Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)	**ENTER** Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	338.328	S	6.18	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vandose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone SCS soil type (Lookup Soil Parameters)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)	**ENTER** Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.5E-07	4.4E-02

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

APPENDIX H - 2

MW03LSS Groundwater Well

Groundwater to Indoor Air Vapor Intrusion Modeling

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
95636	3.76E+00	1,2,4-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (^oC)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	5.70E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.0E-02

MESSAGE SUMMARY BELOW:

END

]

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108678	8.09E+00	1,3,5-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	2.00E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	4.1E-02

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432	1.11E+00	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.79E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.7E-07	2.6E-03

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
100414	7.20E+00	Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.69E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.3E-07	4.9E-04

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
104518	9.75E+00	n-Butylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type Lookup Soil Parameters	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET

Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	2.00E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.0E-02

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
103651	1.17E+01	n-Propylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET

Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	6.00E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	7.7E-04

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
91203	6.85E+01	Naphthalene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.10E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.7E-06	6.2E-02

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
135988	9.98E+00	sec-Butylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.94E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	3.4E-07

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	7.00E-01	Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	459.6384	S	4.64	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.4E-07	4.0E-02

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

APPENDIX H - 3

MW04LSS Groundwater Well

Groundwater to Indoor Air Vapor Intrusion Modeling

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016	3.72E+00	Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	448.36	S	3.8	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm²)	ENTER Vadose zone SCS soil type Lookup Soil Parameters	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm³)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
7.2E-07	2.1E-01

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

APPENDIX H - 4

MW06LSS Groundwater Well

Groundwater to Indoor Air Vapor Intrusion Modeling

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	1.75E+01	Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	261.2136	S	6.68	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.9E-06	1.4E+00

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

APPENDIX H - 5

MW07LSS Groundwater Well

Groundwater to Indoor Air Vapor Intrusion Modeling

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
95636	3.56E+01	1,2,4-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	5.70E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	3.6E-01

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET

Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108678	1.64E+01	1,3,5-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	2.00E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.6E-01

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432	5.39E+00	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

Lookup Soil Parameters

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.79E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.2E-06	2.2E-02

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
100414	7.13E+00	Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.69E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
9.5E-07	8.9E-04

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
103651	3.56E+00	n-Propylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	6.00E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	4.4E-04

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
91203	1.68E+02	Naphthalene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

Lookup Soil Parameters

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET

Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.10E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.3E-05	3.1E-01

MESSAGE SUMMARY BELOW:

END

]

DATA ENTRY SHEET
Nike Site Summit, Fort Richardson, Alaska

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
135988	2.87E+00	sec-Butylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	131.064	S	7.62	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

RESULTS SHEET
Nike Site Summit, Fort Richardson, Alaska

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	3.94E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.7E-06

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

]

APPENDIX I

Human Health Risk and Hazard Calculations

Table I-1 Cancer Calculation for a Current/Future Site Worker - Upper Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF ($\mu g/m3)^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Arsenic	9.84	3.4E-06	6.8E-07	1.8E-06	na	1.5E+00	1.5E+00	4.3E-03	5.2E-06	1.0E-06	7.6E-09	na	6.2E-06
Cadmium	9.62	3.4E-06	2.2E-08	1.7E-06	na	na	na	1.8E-03	na	na	3.1E-09	na	3.1E-09
PAHs													
Benzo(a)anthracene	1.78	6.2E-07	5.3E-07	3.2E-07	na	7.3E-01	7.3E-01	1.1E-04	4.5E-07	3.9E-07	3.5E-11	na	8.4E-07
Benzo(a)pyrene	1.37	4.8E-07	4.1E-07	2.5E-07	na	7.3E+00	7.3E+00	1.1E-03	3.5E-06	3.0E-06	2.7E-10	na	6.5E-06
Benzo(b)fluoranthene	2.37	8.3E-07	7.1E-07	4.3E-07	na	7.3E-01	7.3E-01	1.1E-04	6.0E-07	5.2E-07	4.7E-11	na	1.1E-06
Dibenz(a,h)anthracene	0.493	1.7E-07	1.5E-07	8.9E-08	na	7.3E+00	7.3E+00	1.2E-03	1.3E-06	1.1E-06	1.1E-10	na	2.3E-06
Indeno(1,2,3-c,d)Pyrene	0.664	2.3E-07	2.0E-07	1.2E-07	na	7.3E-01	7.3E-01	1.1E-04	1.7E-07	1.5E-07	1.3E-11	na	3.1E-07
												ILCR	2E-05

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
URF - unit risk factor

Table I-2 Noncancer Hazard Calculation for a Current/Future Site Worker - Upper Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) b Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Arsenic	9.84	9.6E-06	1.9E-06	5.0E-09	na	3.0E-04	3.0E-04	1.5E-05	3.2E-02	6.4E-03	3.3E-04	na	0.039
Cadmium	9.62	9.4E-06	6.2E-08	4.8E-09	na	1.0E-03	2.5E-05	2.0E-05	9.4E-03	2.5E-03	2.4E-04	na	0.012
Vanadium	75.6	7.4E-05	na	3.8E-08	na	5.0E-03	1.3E-04	na	1.5E-02	na	na	na	0.015
												HI	0.07

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/kd-d - milligrams per kilogram per day
na - not available
RfC - reference concentration

Table I-3 Cancer Calculation for a Current/Future Site Visitors - Upper Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (µg/m³)	VOC Inhalation Concentration (µg/m³)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m³)-1 b Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Arsenic	9.84	3.3E-07	6.5E-08	1.7E-07	na	1.5E+00	1.5E+00	4.3E-03	5.0E-07	9.8E-08	7.3E-10	na	5.9E-07
Cadmium	9.62	3.2E-07	2.1E-09	1.7E-07	na	na	na	1.8E-03	na	na	3.0E-10	na	3.0E-10
PAHs													
Benzo(a)anthracene	1.78	6.0E-08	5.1E-08	3.1E-08	na	7.3E-01	7.3E-01	1.1E-04	4.4E-08	3.7E-08	3.4E-12	na	8.1E-08
Benzo(a)pyrene	1.37	4.6E-08	3.9E-08	2.4E-08	na	7.3E+00	7.3E+00	1.1E-03	3.3E-07	2.9E-07	2.6E-11	na	6.2E-07
Benzo(b)fluoranthene	2.37	7.9E-08	6.8E-08	4.1E-08	na	7.3E-01	7.3E-01	1.1E-04	5.8E-08	5.0E-08	4.5E-12	na	1.1E-07
Dibenz(a,h)anthracene	0.493	1.7E-08	1.4E-08	8.5E-09	na	7.3E+00	7.3E+00	1.2E-03	1.2E-07	1.0E-07	1.0E-11	na	2.2E-07
Indeno(1,2,3-c,d)Pyrene	0.664	2.2E-08	1.9E-08	1.1E-08	na	7.3E-01	7.3E-01	1.1E-04	1.6E-08	1.4E-08	1.3E-12	na	3.0E-08
												ILCR	2E-06

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

µg/m³ - micrograms per cubic meter
ILCR - Incremental lifetime cancer risk
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
URF - unit risk factor

Table I-4 Noncancer Hazard Calculation for a Current/Future Site Visitor - Upper Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Arsenic	9.84	9.2E-07	1.8E-07	6.8E-12	na	3.0E-04	3.0E-04	1.5E-05	3.1E-03	6.1E-04	4.5E-07	na	0.0037
Cadmium	9.62	9.0E-07	6.0E-09	6.6E-12	na	1.0E-03	2.5E-05	2.0E-05	9.0E-04	2.4E-04	3.3E-07	na	0.0011
Vanadium	75.6	7.1E-06	na	5.2E-11	na	5.0E-03	1.3E-04	na	1.4E-03	na	na	na	0.0014
												HI	0.006

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/kd-d - milligrams per kilogram per day
na - not available
RfC - reference concentration

Table I-5 Cancer Calculation for a Hypothetical Future Resident - Upper Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (μg/m³)	VOC Inhalation Concentration (μg/m³)	Cancer Slope Factor (mg/Kg-d)-1 b		URF (ug/m3)-1 [b]	Pathway-Specific Cancer Risk				Chemical-Specific Risk
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
INORGANICS													
Arsenic	9.84	1.3E-05	1.2E-06	2.8E-06	na	1.5E+00	1.5E+00	4.3E-03	1.9E-05	1.8E-06	1.2E-08	na	2.1E-05
Cadmium	9.62	1.2E-05	4.0E-08	2.7E-06	na	na	na	1.8E-03	na	na	4.8E-09	na	4.8E-09
PAHs													
Benzo(a)anthracene	1.78	2.3E-06	9.7E-07	5.0E-07	na	7.3E-01	7.3E-01	1.1E-04	1.7E-06	7.1E-07	5.5E-11	na	2.4E-06
Benzo(a)pyrene	1.37	1.8E-06	7.4E-07	3.8E-07	na	7.3E+00	7.3E+00	1.1E-03	1.3E-05	5.4E-06	4.2E-10	na	1.8E-05
Benzo(b)fluoranthene	2.37	3.1E-06	1.3E-06	6.6E-07	na	7.3E-01	7.3E-01	1.1E-04	2.2E-06	9.4E-07	7.3E-11	na	3.2E-06
Dibenz(a,h)anthracene	0.493	6.4E-07	2.7E-07	1.4E-07	na	7.3E+00	7.3E+00	1.2E-03	4.7E-06	2.0E-06	1.7E-10	na	6.6E-06
Indeno(1,2,3-c,d)Pyrene	0.664	8.6E-07	3.6E-07	1.9E-07	na	7.3E-01	7.3E-01	1.1E-04	6.3E-07	2.6E-07	2.0E-11	na	8.9E-07
												ILCR	5E-05

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

μg/m³ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
URF - unit risk factor

Table I-6 Noncancer Hazard Calculation for a Hypothetical Future Resident - Upper Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Arsenic	9.84	1.1E-04	9.4E-06	1.1E-08	na	3.0E-04	3.0E-04	1.5E-05	3.6E-01	3.1E-02	7.1E-04	na	0.39
Cadmium	9.62	1.1E-04	3.1E-07	1.0E-08	na	1.0E-03	2.5E-05	2.0E-05	1.1E-01	1.2E-02	5.2E-04	na	0.12
Vanadium	75.6	8.3E-04	na	8.2E-08	na	5.0E-03	1.3E-04	na	1.7E-01	na	na	na	0.17
												HI	0.7

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/kd-d - milligrams per kilogram per day
na - not available
RfC - reference concentration

Table I-7 Summary of Human Health Risk Estimates for Upper Site Summit - Surface Soil

Surface Soil Constituent	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons									
Arsenic	19.1	9.84	9.84	6.2E-06	0.039	5.9E-07	0.0037	**2.1E-05**	0.39
Cadmium	23.9	9.62	9.62	3.1E-09	0.012	3.0E-10	0.0011	4.8E-09	0.12
Lead	950	386	386	NA	NA	NA	NA	NA	NA
Vanadium	134	75.6	75.6	NA	0.015	NA	0.0014	NA	0.17
Benzo(a)anthracene	8.61	1.78	1.78	8.4E-07	NA	8.1E-08	NA	2.4E-06	NA
Benzo(a)pyrene	5.75	1.37	1.37	6.5E-06	NA	6.2E-07	NA	**1.8E-05**	NA
Benzo(b)fluoranthene	10.6	2.37	2.37	1.1E-06	NA	1.1E-07	NA	3.2E-06	NA
Dibenz(a,h)anthracene	2.42	0.493	0.493	2.3E-06	NA	2.2E-07	NA	6.6E-06	NA
Indeno(1,2,3-c,d)Pyrene	1.88	0.664	0.664	3.1E-07	NA	3.0E-08	NA	8.9E-07	NA
Cumulative ILCR / HI:				**2E-05**	0.07	2E-06	0.006	**5E-05**	0.7
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Upper Site Summit sampling locations.

[b] The exposure point concentration (EPC) is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of the Alaska Department of Environmental Conservation acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
UCL - upper confidence limit
USEPA - U. S. Environmental Protection Agency

Table I-8 Cancer Calculation for a Current/Future Site Worker - Upper Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (μg/m³)	VOC Inhalation Concentration (μg/m³)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (μg/m3)[-1 b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
VOCs													
1,2,3-Trichloropropane	0.0247	8.6E-09	na	na	5.1E-04	3.0E+01	3.0E+01	2.0E-03	2.6E-07	na	na	1.0E-06	1.3E-06
Trichloroethylene (TCE)	0.0283	9.9E-09	na	na	3.3E-03	4.6E-02	4.6E-02	4.1E-06	4.6E-10	na	na	1.3E-08	1.4E-08
PAHs													
Benzo(a)anthracene	3.43	1.2E-06	1.0E-06	6.2E-07	na	7.3E-01	7.3E-01	1.1E-04	8.8E-07	7.5E-07	6.8E-11	na	1.6E-06
Benzo(a)pyrene	3.71	1.3E-06	1.1E-06	6.7E-07	na	7.3E+00	7.3E+00	1.1E-03	9.5E-06	8.1E-06	7.3E-10	na	1.8E-05
Benzo(b)fluoranthene	1.53	5.3E-07	4.6E-07	2.8E-07	na	7.3E-01	7.3E-01	1.1E-04	3.9E-07	3.3E-07	3.0E-11	na	7.3E-07
Benzo(k)fluoranthene	5.63	2.0E-06	1.7E-06	1.0E-06	na	7.3E-02	7.3E-02	1.1E-04	1.4E-07	1.2E-07	1.1E-10	na	2.7E-07
Dibenz(a,h)anthracene	0.846	3.0E-07	2.5E-07	1.5E-07	na	7.3E+00	7.3E+00	1.2E-03	2.2E-06	1.9E-06	1.8E-10	na	4.0E-06
Indeno(1,2,3-c,d)Pyrene	2.09	7.3E-07	6.3E-07	3.8E-07	na	7.3E-01	7.3E-01	1.1E-04	5.3E-07	4.6E-07	4.1E-11	na	9.9E-07
												ILCR	3E-05

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

μg/m³ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
URF - unit risk factor
VOC - volatile organic compound

Table I-9 Noncancer Hazard Calculation for a Current/Future Site Worker - Upper Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b		RfC (mg/m^3) [b]	Pathway-Specific Hazard				Chemical-Specific HQ
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
INORGANICS													
Vanadium	75.8	7.4E-05	na	3.8E-08	na	5.0E-03	1.3E-04	na	1.5E-02	na	na	na	0.015
VOCs													
1,2,3-Trichloropropane	0.0247	2.4E-08	na	na	1.4E-06	4.0E-03	4.0E-03	3.0E-04	6.0E-06	na	na	4.8E-03	0.0048
Trichloroethylene (TCE)	0.0283	2.8E-08	na	na	9.1E-06	5.0E-04	5.0E-04	2.0E-03	5.5E-05	na	na	4.6E-03	0.0046
												HI	0.02

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/kd-d - milligrams per kilogram per day
na - not available
RfC - reference concentration
VOC - volatile organic compound

Table I-10 Cancer Calculation for a Current/Future Site Visitor - Upper Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b		URF $(ug/m^3)^{-1}$ b	Pathway-Specific Cancer Risk				Chemical-Specific Risk
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
VOCs													
1,2,3-Trichloropropane	0.0247	8.3E-10	na	na	4.9E-05	3.0E+01	3.0E+01	2.0E-03	2.5E-08	na	na	9.8E-08	1.2E-07
Trichloroethylene (TCE)	0.0283	9.5E-10	na	na	3.1E-04	4.6E-02	4.6E-02	4.1E-06	4.4E-11	na	na	1.3E-09	1.3E-09
PAHs													
Benzo(a)anthracene	3.43	1.2E-07	9.9E-08	5.9E-08	na	7.3E-01	7.3E-01	1.1E-04	8.4E-08	7.2E-08	6.5E-12	na	1.6E-07
Benzo(a)pyrene	3.71	1.2E-07	1.1E-07	6.4E-08	na	7.3E+00	7.3E+00	1.1E-03	9.1E-07	7.8E-07	7.0E-11	na	1.7E-06
Benzo(b)fluoranthene	1.53	5.1E-08	4.4E-08	2.6E-08	na	7.3E-01	7.3E-01	1.1E-04	3.7E-08	3.2E-08	2.9E-12	na	7.0E-08
Benzo(k)fluoranthene	5.63	1.9E-07	1.6E-07	9.7E-08	na	7.3E-02	7.3E-02	1.1E-04	1.4E-08	1.2E-08	1.1E-11	na	2.6E-08
Dibenz(a,h)anthracene	0.846	2.8E-08	2.4E-08	1.5E-08	na	7.3E+00	7.3E+00	1.2E-03	2.1E-07	1.8E-07	1.8E-11	na	3.8E-07
Indeno(1,2,3-c,d)Pyrene	2.09	7.0E-08	6.0E-08	3.6E-08	na	7.3E-01	7.3E-01	1.1E-04	5.1E-08	4.4E-08	4.0E-12	na	9.5E-08
												ILCR	3E-06

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

$\mu g/m^3$ - micrograms per cubic meter
ILCR - Incremental lifetime cancer risk
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
URF - unit risk factor
VOC - volatile organic compound

Table I-11 Noncancer Hazard Calculation for a Current/Future Site Visitor - Upper Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Vanadium	75.8	7.1E-06	na	5.2E-11	na	5.0E-03	1.3E-04	na	1.4E-03	na	na	na	0.0014
VOCs													
1,2,3-Trichloropropane	0.0247	2.3E-09	na	na	1.4E-07	4.0E-03	4.0E-03	3.0E-04	5.8E-07	na	na	4.6E-04	0.00046
Trichloroethylene (TCE)	0.0283	2.7E-09	na	na	8.8E-07	5.0E-04	5.0E-04	2.0E-03	5.3E-06	na	na	4.4E-04	0.00044
												HI	0.002

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/kd-d - milligrams per kilogram per day
na - not available
RfC - reference concentration
VOC - volatile organic compound

Table I-12 Cancer Calculation for a Hypothetical Future Resident - Upper Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b		URF (ug/m3)-1 [b]	Pathway-Specific Cancer Risk				Chemical-Specific Risk
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
VOCs													
1,2,3-Trichloropropane	0.0247	3.2E-08	na	na	8.0E-04	3.0E+01	3.0E+01	2.0E-03	9.6E-07	na	na	1.6E-06	2.6E-06
Trichloroethylene (TCE)	0.0283	3.7E-08	na	na	5.1E-03	4.6E-02	4.6E-02	4.1E-06	1.7E-09	na	na	2.1E-08	2.2E-08
PAHs													
Benzo(a)anthracene	3.43	4.5E-06	1.9E-06	9.6E-07	na	7.3E-01	7.3E-01	1.1E-04	3.3E-06	1.4E-06	1.1E-10	na	4.6E-06
Benzo(a)pyrene	3.71	4.8E-06	2.0E-06	1.0E-06	na	7.3E+00	7.3E+00	1.1E-03	3.5E-05	1.5E-05	1.1E-09	na	5.0E-05
Benzo(b)fluoranthene	1.53	2.0E-06	8.3E-07	4.3E-07	na	7.3E-01	7.3E-01	1.1E-04	1.5E-06	6.1E-07	4.7E-11	na	2.1E-06
Benzo(k)fluoranthene	5.63	7.3E-06	3.1E-06	1.6E-06	na	7.3E-02	7.3E-02	1.1E-04	5.3E-07	2.2E-07	1.7E-10	na	7.6E-07
Dibenz(a,h)anthracene	0.846	1.1E-06	4.6E-07	2.4E-07	na	7.3E+00	7.3E+00	1.2E-03	8.0E-06	3.4E-06	2.8E-10	na	1.1E-05
Indeno(1,2,3-c,d)Pyrene	2.09	2.7E-06	1.1E-06	5.8E-07	na	7.3E-01	7.3E-01	1.1E-04	2.0E-06	8.3E-07	6.4E-11	na	2.8E-06
												ILCR	7E-05

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
URF - unit risk factor
VOC - volatile organic compound

Table I-13 Noncancer Hazard Calculation for a Hypothetical Future Resident - Upper Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Vanadium	75.8	8.3E-04	na	8.2E-08	na	5.0E-03	1.3E-04	na	1.7E-01	na	na	na	0.17
VOCs													
1,2,3-Trichloropropane	0.0247	2.7E-07	na	na	3.1E-06	4.0E-03	4.0E-03	3.0E-04	6.7E-05	na	na	1.0E-02	0.010
Trichloroethylene (TCE)	0.0283	3.1E-07	na	na	2.0E-05	5.0E-04	5.0E-04	2.0E-03	6.2E-04	na	na	9.9E-03	0.0105
												HI	0.2

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
RfC - reference concentration
VOC - volatile organic compound

Table I-14 Summary of Human Health Risk Estimates for Upper Site Summit - Subsurface Soil

Subsurface Soil Constituent	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons									
Vanadium	102	75.8	75.8	NA	0.015	NA	0.0014	NA	0.17
1,2,3-Trichloropropane	0.0247	NC	0.0247	1.3E-06	0.0048	1.2E-07	0.00046	2.6E-06	0.010
Trichloroethylene (TCE)	0.0790	0.0283	0.0283	1.4E-08	0.0046	1.3E-09	0.00044	2.2E-08	0.010
Benzo(a)anthracene	3.43	0.611	3.43	1.6E-06	NA	1.6E-07	NA	4.6E-06	NA
Benzo(a)pyrene	3.71	0.632	3.71	**1.8E-05**	NA	1.7E-06	NA	**5.0E-05**	NA
Benzo(b)fluoranthene	1.53	0.308	1.53	7.3E-07	NA	7.0E-08	NA	2.1E-06	NA
Benzo(k)fluoranthene	5.63	0.683	5.63	2.7E-07	NA	2.6E-08	NA	7.6E-07	NA
Dibenz(a,h)anthracene	0.846	0.335	0.846	4.0E-06	NA	3.8E-07	NA	**1.1E-05**	NA
Indeno(1,2,3-c,d)Pyrene	2.09	0.337	2.09	9.9E-07	NA	9.5E-08	NA	2.8E-06	NA
Cumulative ILCR / HI:				**3E-05**	0.02	3E-06	0.002	**7E-05**	0.2
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in subsurface soil samples collected from Upper Site Summit sampling locations.

[b] The exposure point concentration (EPC) is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of the Alaska Department of Environmental Conservation acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
UCL - upper confidence limit
USEPA - U. S. Environmental Protection Agency

Table I-15 Cancer Calculation for a Current/Future Site Worker - Lower Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF $(\mu g/m3)^{-1}$ b Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Arsenic	8.15	2.8E-06	5.6E-07	1.5E-06	na	1.5E+00	1.5E+00	4.3E-03	4.3E-06	8.5E-07	6.3E-09	na	5.1E-06
Cadmium	2.82	9.8E-07	6.5E-09	5.1E-07	na	na	na	1.8E-03	na	na	9.1E-10	na	9.1E-10
VOCs													
Trichloroethylene (TCE)	0.0416	1.5E-08	na	na	4.8E-03	4.6E-02	4.6E-02	4.1E-06	6.7E-10	na	na	2.0E-08	2.0E-08
SVOCs													
Pentachlorophenol	46.5	1.6E-05	2.7E-05	8.4E-06	na	4.0E-01	4.0E-01	5.1E-06	6.5E-06	1.1E-05	4.3E-11	na	1.7E-05
PAHs													
Benzo(a)anthracene	7.98	2.8E-06	2.4E-06	1.4E-06	na	7.3E-01	7.3E-01	1.1E-04	2.0E-06	1.7E-06	1.6E-10	na	3.8E-06
Benzo(a)pyrene	7.74	2.7E-06	2.3E-06	1.4E-06	na	7.3E+00	7.3E+00	1.1E-03	2.0E-05	1.7E-05	1.5E-09	na	3.7E-05
Benzo(b)fluoranthene	8.66	3.0E-06	2.6E-06	1.6E-06	na	7.3E-01	7.3E-01	1.1E-04	2.2E-06	1.9E-06	1.7E-10	na	4.1E-06
Benzo(k)fluoranthene	1.86	6.5E-07	5.6E-07	3.4E-07	na	7.3E-02	7.3E-02	1.1E-04	4.8E-08	4.1E-08	3.7E-11	na	8.8E-08
Dibenz(a,h)anthracene	6.12	2.1E-06	1.8E-06	1.1E-06	na	7.3E+00	7.3E+00	1.2E-03	1.6E-05	1.3E-05	1.3E-09	na	2.9E-05
Indeno(1,2,3-c,d)Pyrene	2.42	8.5E-07	7.3E-07	4.4E-07	na	7.3E-01	7.3E-01	1.1E-04	6.2E-07	5.3E-07	4.8E-11	na	1.1E-06
Naphthalene	0.595	2.1E-07	1.8E-07	1.1E-07	na	na	na	3.4E-05	na	na	3.6E-12	na	3.6E-12
												ILCR	1E-04

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
SVOCs - semi-volatile organic compounds
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-16 Noncancer Hazard Calculation for a Current/Future Site Worker - Lower Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) b Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Arsenic	8.15	8.0E-06	1.6E-06	4.1E-09	na	3.0E-04	3.0E-04	1.5E-05	2.7E-02	5.3E-03	2.7E-04	na	0.032
Cadmium	2.82	2.8E-06	1.8E-08	1.4E-09	na	1.0E-03	2.5E-05	2.0E-05	2.8E-03	7.3E-04	7.1E-05	na	0.0036
Mercury	0.383	3.8E-07	na	1.9E-10	na	3.0E-04	2.1E-05	3.0E-05	1.3E-03	na	6.4E-06	na	0.0013
VOCs													
Trichloroethylene (TCE)	0.0416	4.1E-08	na	na	1.3E-05	5.0E-04	5.0E-04	2.0E-03	8.1E-05	na	na	6.7E-03	0.0068
SVOCs													
Pentachlorophenol	46.5	4.5E-05	7.5E-05	2.3E-08	na	5.0E-03	5.0E-03	na	9.1E-03	1.5E-02	na	na	0.024
PAHs													
Naphthalene	0.595	5.8E-07	5.0E-07	3.0E-10	na	2.0E-02	2.0E-02	3.0E-03	2.9E-05	2.5E-05	1.0E-07	na	0.000054
												HI	0.07
PETROLEUM HYDROCARBONS													
Residual Range Organics (RRO)	4,601												
Residual Range Organics (RRO), Aliphatic	4,141	4.1E-03	na	2.1E-06	na	2.0E+00	na	na	2.0E-03	na	na	na	0.0020
Residual Range Organics (RRO), Aromati	1,380	1.4E-03	na	7.0E-07	na	3.0E-02	na	na	4.5E-02	na	na	na	0.045
												HI	0.05

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-17 Cancer Calculation for a Current/Future Site Visitor - Lower Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (µg/m³)	VOC Inhalation Concentration (µg/m³)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF $(ug/m^3)^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Arsenic	8.15	2.7E-07	5.4E-08	1.4E-07	na	1.5E+00	1.5E+00	4.3E-03	4.1E-07	8.1E-08	6.0E-10	na	4.9E-07
Cadmium	2.82	9.4E-08	6.2E-10	4.9E-08	na	na	na	1.8E-03	na	na	8.8E-11	na	8.8E-11
VOCs													
Trichloroethylene (TCE)	0.0416	1.4E-09	na	na	4.6E-04	4.6E-02	4.6E-02	4.1E-06	6.4E-11	na	na	1.9E-09	1.9E-09
SVOCs													
Pentachlorophenol	46.5	1.6E-06	2.6E-06	8.0E-07	na	4.0E-01	4.0E-01	5.1E-06	6.2E-07	1.0E-06	4.1E-12	na	1.7E-06
PAHs													
Benzo(a)anthracene	7.98	2.7E-07	2.3E-07	1.4E-07	na	7.3E-01	7.3E-01	1.1E-04	2.0E-07	1.7E-07	1.5E-11	na	3.6E-07
Benzo(a)pyrene	7.74	2.6E-07	2.2E-07	1.3E-07	na	7.3E+00	7.3E+00	1.1E-03	1.9E-06	1.6E-06	1.5E-10	na	3.5E-06
Benzo(b)fluoranthene	8.66	2.9E-07	2.5E-07	1.5E-07	na	7.3E-01	7.3E-01	1.1E-04	2.1E-07	1.8E-07	1.6E-11	na	3.9E-07
Benzo(k)fluoranthene	1.86	6.3E-08	5.4E-08	3.2E-08	na	7.3E-02	7.3E-02	1.1E-04	4.6E-09	3.9E-09	3.5E-12	na	8.5E-09
Dibenz(a,h)anthracene	6.12	2.1E-07	1.8E-07	1.1E-07	na	7.3E+00	7.3E+00	1.2E-03	1.5E-06	1.3E-06	1.3E-10	na	2.8E-06
Indeno(1,2,3-c,d)Pyrene	2.42	8.1E-08	7.0E-08	4.2E-08	na	7.3E-01	7.3E-01	1.1E-04	5.9E-08	5.1E-08	4.6E-12	na	1.1E-07
Naphthalene	0.595	2.0E-08	1.7E-08	1.0E-08	na	na	na	3.4E-05	na	na	3.5E-13	na	3.5E-13
												ILCR	9E-06

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

µg/m³ - micrograms per cubic meter
ILCR - Incremental lifetime cancer risk
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
SVOCs - semi-volatile organic compounds
UCL - upper condfidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-18 Noncancer Hazard Calculation for a Current/Future Site Visitor - Lower Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b		RfC (mg/m^3) b	Pathway-Specific Hazard				Chemical-Specific HQ
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
INORGANICS													
Arsenic	8.15	7.7E-07	1.5E-07	5.6E-12	na	3.0E-04	3.0E-04	1.5E-05	2.6E-03	5.0E-04	3.8E-07	na	0.0031
Cadmium	2.82	2.6E-07	1.7E-09	1.9E-12	na	1.0E-03	2.5E-05	2.0E-05	2.6E-04	7.0E-05	9.7E-08	na	0.00033
Mercury	0.383	3.6E-08	na	2.6E-13	na	3.0E-04	2.1E-05	3.0E-05	1.2E-04	na	8.8E-09	na	0.00012
VOCs													
Trichloroethylene (TCE)	0.0416	3.9E-09	na	na	1.3E-06	5.0E-04	5.0E-04	2.0E-03	7.8E-06	na	na	6.4E-04	0.00065
SVOCs													
Pentachlorophenol	46.5	4.4E-06	7.2E-06	3.2E-11	na	5.0E-03	5.0E-03	na	8.7E-04	1.4E-03	na	na	0.0023
PAHs													
Naphthalene	0.595	5.6E-08	4.8E-08	4.1E-13	na	2.0E-02	2.0E-02	3.0E-03	2.8E-06	2.4E-06	1.4E-10	na	5.19E-06
												HI	0.006
PETROLEUM HYDROCARBONS													
Residual Range Organics (RRO)	4,601												
Residual Range Organics (RRO), Aliphatic	4,141	3.9E-04	na	2.9E-09	na	2.0E+00	na	na	1.9E-04	na	na	na	0.00019
Residual Range Organics (RRO), Aromati	1,380	1.3E-04	na	9.5E-10	na	3.0E-02	na	na	4.3E-03	na	na	na	0.0043
												HI	0.005

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/kd-d - milligrams per kilogram per day
mg/Kg - milligrams per kilogram
mg/m^3 - milligrams per cubic meter
na - not available
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-19 Cancer Calculation for a Hypothetical Future Resident - Lower Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (µg/m³)	VOC Inhalation Concentration (µg/m³)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m3)-1 [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Arsenic	8.15	1.1E-05	1.0E-06	2.3E-06	na	1.5E+00	1.5E+00	4.3E-03	1.6E-05	1.5E-06	9.8E-09	na	1.7E-05
Cadmium	2.82	3.7E-06	1.2E-08	7.9E-07	na	na	na	1.8E-03	na	na	1.4E-09	na	1.4E-09
VOCs													
Trichloroethylene (TCE)	0.0416	5.4E-08	na	na	7.4E-03	4.6E-02	4.6E-02	4.1E-06	2.5E-09	na	na	3.1E-08	3.3E-08
SVOCs													
Pentachlorophenol	46.5	6.0E-05	4.9E-05	1.3E-05	na	4.0E-01	4.0E-01	5.1E-06	2.4E-05	1.9E-05	6.6E-11	na	4.4E-05
PAHs													
Benzo(a)anthracene	7.98	1.0E-05	4.3E-06	2.2E-06	na	7.3E-01	7.3E-01	1.1E-04	7.6E-06	3.2E-06	2.5E-10	na	1.1E-05
Benzo(a)pyrene	7.74	1.0E-05	4.2E-06	2.2E-06	na	7.3E+00	7.3E+00	1.1E-03	7.3E-05	3.1E-05	2.4E-09	na	1.0E-04
Benzo(b)fluoranthene	8.66	1.1E-05	4.7E-06	2.4E-06	na	7.3E-01	7.3E-01	1.1E-04	8.2E-06	3.4E-06	2.7E-10	na	1.2E-05
Benzo(k)fluoranthene	1.86	2.4E-06	1.0E-06	5.2E-07	na	7.3E-02	7.3E-02	1.1E-04	1.8E-07	7.4E-08	5.7E-11	na	2.5E-07
Dibenz(a,h)anthracene	6.12	7.9E-06	3.3E-06	1.7E-06	na	7.3E+00	7.3E+00	1.2E-03	5.8E-05	2.4E-05	2.1E-09	na	8.2E-05
Indeno(1,2,3-c,d)Pyrene	2.42	3.1E-06	1.3E-06	6.8E-07	na	7.3E-01	7.3E-01	1.1E-04	2.3E-06	9.6E-07	7.4E-11	na	3.3E-06
Naphthalene	0.595	7.7E-07	3.2E-07	1.7E-07	na	na	na	3.4E-05	na	na	5.7E-12	na	5.7E-12
												ILCR	3E-04

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
SVOCs - semi-volatile organic compounds
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-20 Noncancer Hazard Calculation for a Hypothetical Future Resident - Lower Site Summit - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b: Oral	Reference Dose (mg/Kg-d) b: Dermal	RfC (mg/m^3) b: Inhalation	Pathway-Specific Hazard: Soil Ingestion	Pathway-Specific Hazard: Dermal	Pathway-Specific Hazard: Dust Inhalation	Pathway-Specific Hazard: VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Arsenic	8.15	8.9E-05	7.8E-06	8.9E-09	na	3.0E-04	3.0E-04	1.5E-05	3.0E-01	2.6E-02	5.9E-04	na	0.32
Cadmium	2.82	3.1E-05	9.0E-08	3.1E-09	na	1.0E-03	2.5E-05	2.0E-05	3.1E-02	3.6E-03	1.5E-04	na	0.034
Mercury	0.383	4.2E-06	na	4.2E-10	na	3.0E-04	2.1E-05	3.0E-05	1.4E-02	na	1.4E-05	na	0.014
VOCs													
Trichloroethylene (TCE)	0.0416	4.5E-07	na	na	2.9E-05	5.0E-04	5.0E-04	2.0E-03	9.1E-04	na	na	1.4E-02	0.015
SVOCs													
Pentachlorophenol	46.5	5.1E-04	3.7E-04	5.1E-08	na	5.0E-03	5.0E-03	na	1.0E-01	7.4E-02	na	na	0.18
PAHs													
Naphthalene	0.595	6.5E-06	2.5E-06	6.5E-10	na	2.0E-02	2.0E-02	3.0E-03	3.2E-04	1.2E-04	2.2E-07	na	0.00045
												HI	0.6
PETROLEUM HYDROCARBONS													
Residual Range Organics (RRO)	4,601												
Residual Range Organics (RRO), Aliphatic	4,141	4.5E-02	na	4.5E-06	na	2.0E+00	na	na	2.3E-02	na	na	na	0.023
Residual Range Organics (RRO), Aromati	1,380	1.5E-02	na	1.5E-06	na	3.0E-02	na	na	5.0E-01	na	na	na	0.50
												HI	0.5

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

HI - hazard index
HQ - hazard quotient
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
na - not available
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-21 Summary of Human Health Risk Estimates for Lower Site Summit - Surface Soil

Surface Soil Constituent	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons									
Arsenic	19.0	8.15	8.15	5.1E-06	0.032	4.9E-07	0.0031	**1.7E-05**	0.32
Cadmium	15.6	2.82	2.82	9.1E-10	0.0036	8.8E-11	0.00033	1.4E-09	0.034
Mercury	1.92	0.383	0.383	NA	0.0013	NA	0.00012	NA	0.014
Trichloroethylene (TCE)	0.290	0.0416	0.0416	2.0E-08	0.0068	1.9E-09	0.00065	3.3E-08	0.015
Pentachlorophenol	46.5	NC	46.5	**1.7E-05**	0.024	1.7E-06	0.0023	**4.4E-05**	0.18
Benzo(a)anthracene	37.0	7.98	7.98	3.8E-06	NA	3.6E-07	NA	**1.1E-05**	NA
Benzo(a)pyrene	35.7	7.74	7.74	**3.7E-05**	NA	3.5E-06	NA	**1.0E-04**	NA
Benzo(b)fluoranthene	40.1	8.66	8.66	4.1E-06	NA	3.9E-07	NA	**1.2E-05**	NA
Benzo(k)fluoranthene	10.8	1.86	1.86	8.8E-08	NA	8.5E-09	NA	2.5E-07	NA
Dibenz(a,h)anthracene	6.12	0.786	6.12	**2.9E-05**	NA	2.8E-06	NA	**8.2E-05**	NA
Indeno(1,2,3-c,d)Pyrene	16.1	2.42	2.42	1.1E-06	NA	1.1E-07	NA	3.3E-06	NA
Naphthalene	2.91	0.595	0.595	3.6E-12	0.000054	3.5E-13	0.0000052	5.7E-12	0.00045
Cumulative ILCR / HI:				**1E-04**	0.07	9E-06	0.006	**3E-04**	0.6
Petroleum Hydrocarbons									
Residual Range Organics (RRO)	24,400	4,601	4,601	NA	0.047	NA	0.0045	NA	0.53
Residual Range Organics (RRO), Aliphatic			4,141	NA	0.0020	NA	0.00019	NA	0.023
Residual Range Organics (RRO), Aromatic			1,380	NA	0.045	NA	0.0043	NA	0.50
Cumulative ILCR / HI:				NA	0.05	NA	0.005	NA	0.5
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Lower Site Summit sampling locations.

[b] The exposure point concentration (EPC) is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of the Alaska Department of Environmental Conservation acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/kg - milligrams per kilogram
NA - not applicable
NC - not calculated
UCL - upper confidence limit
USEPA - U. S. Environmental Protection Agency

Table I-22 Cancer Calculation for a Current/Future Site Worker - Lower Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soi Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF $(\mu g/m3)^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
VOCs													
1,1,2,2-Tetrachloroethane	1.21	4.2E-07	na	na	2.5E-02	2.0E-01	2.0E-01	5.8E-05	8.5E-08	na	na	1.5E-06	1.5E-06
1,1,2-Trichloroethane	1.65	5.8E-07	na	na	6.5E-02	5.7E-02	5.7E-02	1.6E-05	3.3E-08	na	na	1.0E-06	1.1E-06
1,2,3-Trichloropropane	0.491	1.7E-07	na	na	1.0E-02	3.0E+01	3.0E+01	2.0E-03	5.1E-06	na	na	2.0E-05	2.6E-05
1,2-Dibromo-3-chloropropane	3.04	1.1E-06	na	na	3.1E-02	8.0E-01	8.0E-01	6.0E-03	8.5E-07	na	na	1.9E-04	1.9E-04
Trichloroethylene (TCE)	0.155	5.4E-08	na	na	1.8E-02	4.6E-02	4.6E-02	4.1E-06	2.5E-09	na	na	7.3E-08	7.6E-08
PAHs													
Benzo(a)pyrene	0.347	1.2E-07	1.0E-07	6.2E-08	na	7.3E+00	7.3E+00	1.1E-03	8.9E-07	7.6E-07	6.9E-11	na	1.6E-06
Naphthalene	1.11	3.9E-07	3.3E-07	2.0E-07	na	na	na	3.4E-05	na	na	6.8E-12	na	6.8E-12
												ILCR	2E-04

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
UCL - upper confidence level
URF - unit risk factor
VOC - volatile organic compound

Table I-23 Noncancer Hazard Calculation for a Current/Future Site Worker - Lower Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Vanadium	61.9	6.1E-05	na	3.1E-08	na	5.0E-03	1.3E-04	na	1.2E-02	na	na	na	0.012
VOCs													
1,1,2,2-Tetrachloroethane	1.21	1.2E-06	na	na	7.1E-05	2.0E-02	2.0E-02	na	5.9E-05	na	na	na	0.000059
1,1,2-Trichloroethane	1.65	1.6E-06	na	na	1.8E-04	4.0E-03	4.0E-03	2.0E-04	4.0E-04	na	na	9.2E-01	0.92
1,2,3-Trichloropropane	0.491	4.8E-07	na	na	2.9E-05	4.0E-03	4.0E-03	3.0E-04	1.2E-04	na	na	9.5E-02	0.095
1,2-Dibromo-3-chloropropane	3.04	3.0E-06	na	na	8.7E-05	2.0E-04	2.0E-04	2.0E-04	1.5E-02	na	na	4.3E-01	0.45
Trichloroethylene (TCE)	0.155	1.5E-07	na	na	5.0E-05	5.0E-04	5.0E-04	2.0E-03	3.0E-04	na	na	2.5E-02	0.025
PAHs													
Naphthalene	1.11	1.1E-06	9.3E-07	5.6E-10	na	2.0E-02	2.0E-02	3.0E-03	5.4E-05	4.7E-05	1.9E-07	na	0.00010
												HI	1

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

% - percent
HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
mg/Kg - milligrams per kilogram
mg/kd-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-24 Cancer Calculation for a Current/Future Site Visitor - Lower Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soi Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (μg/m^3)	VOC Inhalation Concentration (μg/m^3)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m^3)$^{-1}$ b Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
VOCs													
1,1,2,2-Tetrachloroethane	1.21	4.1E-08	na	na	2.4E-03	2.0E-01	2.0E-01	5.8E-05	8.1E-09	na	na	1.4E-07	1.5E-07
1,1,2-Trichloroethane	1.65	5.5E-08	na	na	6.3E-03	5.7E-02	5.7E-02	1.6E-05	3.2E-09	na	na	1.0E-07	1.0E-07
1,2,3-Trichloropropane	0.491	1.6E-08	na	na	9.8E-04	3.0E+01	3.0E+01	2.0E-03	4.9E-07	na	na	2.0E-06	2.4E-06
1,2-Dibromo-3-chloropropane	3.04	1.0E-07	na	na	3.0E-03	8.0E-01	8.0E-01	6.0E-03	8.2E-08	na	na	1.8E-05	1.8E-05
Trichloroethylene (TCE)	0.155	5.2E-09	na	na	1.7E-03	4.6E-02	4.6E-02	4.1E-06	2.4E-10	na	na	7.0E-09	7.3E-09
PAHs													
Benzo(a)pyrene	0.347	1.2E-08	1.0E-08	6.0E-09	na	7.3E+00	7.3E+00	1.1E-03	8.5E-08	7.3E-08	6.6E-12	na	1.6E-07
Naphthalene	1.11	3.7E-08	3.2E-08	1.9E-08	na	na	na	3.4E-05	na	na	6.5E-13	na	6.5E-13
												ILCR	2E-05

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
μg/m^3 - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-25 Noncancer Hazard Calculation for a Current/Future Site Visitor - Lower Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) b Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Vanadium	61.9	5.8E-06	na	4.3E-11	na	5.0E-03	1.3E-04	na	1.2E-03	na	na	na	0.0012
VOCs													
1,1,2,2-Tetrachloroethane	1.21	1.1E-07	na	na	6.8E-06	2.0E-02	2.0E-02	na	5.7E-06	na	na	na	0.0000057
1,1,2-Trichloroethane	1.65	1.5E-07	na	na	1.8E-05	4.0E-03	4.0E-03	2.0E-04	3.9E-05	na	na	8.8E-02	0.088
1,2,3-Trichloropropane	0.491	4.6E-08	na	na	2.7E-06	4.0E-03	4.0E-03	3.0E-04	1.2E-05	na	na	9.1E-03	0.0091
1,2-Dibromo-3-chloropropane	3.04	2.9E-07	na	na	8.3E-06	2.0E-04	2.0E-04	2.0E-04	1.4E-03	na	na	4.2E-02	0.043
Trichloroethylene (TCE)	0.155	1.5E-08	na	na	4.8E-06	5.0E-04	5.0E-04	2.0E-03	2.9E-05	na	na	2.4E-03	0.0024
PAHs													
Naphthalene	1.11	1.0E-07	8.9E-08	7.7E-13	na	2.0E-02	2.0E-02	3.0E-03	5.2E-06	4.5E-06	2.6E-10	na	0.0000097
												HI	0.1

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

% - percent
HI - hazard index
HQ - hazard quotient
mg/Kg-d - milligrams per kilogram per day
mg/Kg - milligrams per kilogram
mg/m^3 - milligrams per cubic meter
na - not available
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-26 Cancer Calculation for a Hypothetical Future Resident - Lower Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soi Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b		URF (ug/m3)-1 [b]	Pathway-Specific Cancer Risk				Chemical-Specific Risk
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
VOCs													
1,1,2,2-Tetrachloroethane	1.21	1.6E-06	na	na	3.9E-02	2.0E-01	2.0E-01	5.8E-05	3.1E-07	na	na	2.3E-06	2.6E-06
1,1,2-Trichloroethane	1.65	2.1E-06	na	na	1.0E-01	5.7E-02	5.7E-02	1.6E-05	1.2E-07	na	na	1.6E-06	1.8E-06
1,2,3-Trichloropropane	0.491	6.4E-07	na	na	1.6E-02	3.0E+01	3.0E+01	2.0E-03	1.9E-05	na	na	3.2E-05	5.1E-05
1,2-Dibromo-3-chloropropane	3.04	3.9E-06	na	na	4.8E-02	8.0E-01	8.0E-01	6.0E-03	3.2E-06	na	na	2.9E-04	2.9E-04
Trichloroethylene (TCE)	0.155	2.0E-07	na	na	2.8E-02	4.6E-02	4.6E-02	4.1E-06	9.3E-09	na	na	1.1E-07	1.2E-07
PAHs													
Benzo(a)pyrene	0.347	4.5E-07	1.9E-07	9.7E-08	na	7.3E+00	7.3E+00	1.1E-03	3.3E-06	1.4E-06	1.1E-10	na	4.7E-06
Naphthalene	1.11	1.4E-06	6.0E-07	3.1E-07	na	na	na	3.4E-05	na	na	1.1E-11	na	1.1E-11
												ILCR	4E-04

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-27 Noncancer Hazard Calculation for a Hypothetical Future Resident - Lower Site Summit - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Vanadium	61.9	6.8E-04	na	6.7E-08	na	5.0E-03	1.3E-04	na	1.4E-01	na	na	na	0.14
VOCs													
1,1,2,2-Tetrachloroethane	1.21	1.3E-05	na	na	1.5E-04	2.0E-02	2.0E-02	na	6.6E-04	na	na	na	0.00066
1,1,2-Trichloroethane	1.65	1.8E-05	na	na	4.0E-04	4.0E-03	4.0E-03	2.0E-04	4.5E-03	na	na	2.0E+00	2.0
1,2,3-Trichloropropane	0.491	5.4E-06	na	na	6.2E-05	4.0E-03	4.0E-03	3.0E-04	1.3E-03	na	na	2.1E-01	0.21
1,2-Dibromo-3-chloropropane	3.04	3.3E-05	na	na	1.9E-04	2.0E-04	2.0E-04	2.0E-04	1.7E-01	na	na	9.4E-01	1.1
Trichloroethylene (TCE)	0.155	1.7E-06	na	na	1.1E-04	5.0E-04	5.0E-04	2.0E-03	3.4E-03	na	na	5.4E-02	0.057
PAHs													
Naphthalene	1.11	1.2E-05	4.6E-06	1.2E-09	na	2.0E-02	2.0E-02	3.0E-03	6.1E-04	2.3E-04	4.0E-07	na	0.00083
												HI	3

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

% - percent
HI - hazard index
HQ - hazard quotient
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
na - not available
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-28 Summary of Human Health Risk Estimates for Lower Site Summit - Subsurface Soil

	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
Subsurface Soil Constituent	**Maximum**	**95% UCL**	**EPC[b]**	**ILCR**	**HQ**	**ILCR**	**HQ**	**ILCR**	**HQ**
Non-Petroleum Hydrocarbons									
Vanadium	106	61.9	61.9	NA	0.012	NA	0.0012	NA	0.14
1,1,2,2-Tetrachloroethane	1.21	NC	1.21	1.5E-06	0.000059	1.5E-07	0.0000057	2.6E-06	0.00066
1,1,2-Trichloroethane	1.65	NC	1.65	1.1E-06	0.92	1.0E-07	0.088	1.8E-06	**2.0**
1,2,3-Trichloropropane	0.491	NC	0.491	**2.6E-05**	0.095	2.4E-06	0.0091	**5.1E-05**	0.21
1,2-Dibromo-3-chloropropane	3.04	NC	3.04	**1.9E-04**	0.45	**1.8E-05**	0.043	**2.9E-04**	**1.1**
Trichloroethylene (TCE)	0.613	0.155	0.155	7.6E-08	0.025	7.3E-09	0.0024	1.2E-07	0.057
Benzo(a)pyrene	0.347	0.150	0.347	1.6E-06	NA	1.6E-07	NA	4.7E-06	NA
Naphthalene	4.32	1.11	1.11	6.8E-12	0.00010	6.5E-13	0.0000097	1.1E-11	0.00083
Cumulative ILCR / HI:				**2E-04**	1	**2E-05**	0.14	**4E-04**	**3**
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Lower Site Summit sampling locations.

[b] The EPC is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of the Alaska Department of Environmental Conservation acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
UCL - upper confidence limit

Table I-29 Cancer Risk Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (µg/m³)	Cancer Slope Factor (mg/kg-d)⁻¹ [b] Oral	Cancer Slope Factor (mg/kg-d)⁻¹ [b] Dermal	URF (ug/m³)⁻¹ [b] Inhalation	Pathway-Specific Cancer Risk Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Inhalation	Chemical-Specific Risk
MW02LSS											
INORGANICS, TOTAL [c]											
Arsenic	0.0158	3.2E-04	5.2E-07	na	1.5E+00	1.5E+00	4.3E-03	4.8E-04	7.8E-07	na	4.8E-04
Total chromium	0.0475										
Total chromium, assumed as Cr^{6+} [d]	0.0475	9.7E-04	2.6E-06	na	5.0E-01	2.0E+01	8.4E-02	4.8E-04	5.1E-05	na	5.3E-04
INORGANICS, DISSOLVED [c]											
Arsenic	0.00310	6.3E-05	1.0E-07	na	1.5E+00	1.5E+00	4.3E-03	9.5E-05	1.5E-07	na	9.5E-05
VOCs											
Methylene Chloride	0.00110	2.2E-05	2.7E-07	2.1E-02	7.5E-03	7.5E-03	4.7E-07	1.7E-07	2.0E-09	9.9E-09	1.8E-07
Trichloroethylene (TCE)	0.00062	1.3E-05	6.5E-07	2.5E-02	4.6E-02	4.6E-02	4.1E-06	5.8E-07	3.0E-08	1.0E-07	7.1E-07
PAHs											
Naphthalene	0.0018	3.6E-05	7.2E-06	1.8E-02	na	na	3.4E-05	na	na	6.1E-07	6.1E-07
ILCR - unfiltered, trivalent chromium [e]											5E-04
ILCR - unfiltered, hexavalent chromium [f]											1E-03
ILCR - filtered [g]											1E-04
MW03LSS											
INORGANICS, TOTAL [c]											
Arsenic	0.0322	6.6E-04	1.1E-06	na	1.5E+00	1.5E+00	4.3E-03	9.8E-04	1.6E-06	na	9.8E-04
Total chromium	0.0525										
Total chromium, assumed as Cr^{6+} [d]	0.0525	1.1E-03	2.8E-06	na	5.0E-01	2.0E+01	8.4E-02	5.3E-04	5.7E-05	na	5.9E-04
INORGANICS, DISSOLVED [c]											
Arsenic	0.00454	9.2E-05	1.5E-07	na	1.5E+00	1.5E+00	4.3E-03	1.4E-04	2.3E-07	na	1.4E-04
VOCs											
Benzene	0.00111	2.3E-05	1.1E-06	3.0E-02	5.5E-02	5.5E-02	7.8E-06	1.2E-06	5.8E-08	2.4E-07	1.5E-06
Trichloroethylene (TCE)	0.00070	1.4E-05	7.3E-07	2.9E-02	4.6E-02	4.6E-02	4.1E-06	6.6E-07	3.4E-08	1.2E-07	8.1E-07
PAHs											
Naphthalene	0.0685	1.4E-03	2.8E-04	7.0E-01	na	na	3.4E-05	na	na	2.4E-05	2.4E-05
ILCR - unfiltered, trivalent chromium [e]											1E-03
ILCR - unfiltered,hexavalent chromium [f]											2E-03
ILCR - filtered [g]											2E-04

Table I-29 Cancer Risk Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (μg/m^3)	Cancer Slope Factor (mg/kg-d)$^{-1}$ [b] Oral	Cancer Slope Factor (mg/kg-d)$^{-1}$ [b] Dermal	URF (ug/m^3)$^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Inhalation	Chemical-Specific Risk
MW04LSS											
INORGANICS, TOTAL [c]											
Arsenic	0.0285	5.8E-04	9.4E-07	na	1.5E+00	1.5E+00	4.3E-03	8.7E-04	1.4E-06	na	8.7E-04
Total chromium	0.0797										
Total chromium, assumed as Cr^{6+} [d]	0.0797	1.6E-03	4.3E-06	na	5.0E-01	2.0E+01	8.4E-02	8.1E-04	8.6E-05	na	9.0E-04
VOCs											
Trichloroethylene (TCE)	0.00372	7.6E-05	3.9E-06	1.5E-01	4.6E-02	4.6E-02	4.1E-06	3.5E-06	1.8E-07	6.2E-07	4.3E-06
										ILCR - unfiltered, trivalent chromium [e]	9E-04
										ILCR - unfiltered,hexavalent chromium [f]	2E-03
										ILCR - filtered [g]	4E-06
MW05LSS											
INORGANICS, TOTAL [c]											
Arsenic	0.0177	3.6E-04	5.9E-07	na	1.5E+00	1.5E+00	4.3E-03	5.4E-04	8.8E-07	na	5.4E-04
Total chromium	0.0607										
Total chromium, assumed as Cr^{6+} [d]	0.0607	1.2E-03	3.3E-06	na	5.0E-01	2.0E+01	8.4E-02	6.2E-04	6.6E-05	na	6.8E-04
										ILCR - unfiltered, trivalent chromium [e]	5E-04
										ILCR - unfiltered, hexavalent chromium [f]	1E-03
MW06LSS											
VOCs											
1,2-Dichloroethane	0.000520	1.1E-05	1.6E-07	6.6E-03	9.1E-02	9.1E-02	2.6E-05	9.6E-07	1.5E-08	1.7E-07	1.1E-06
Methylene Chloride	0.00121	2.5E-05	3.0E-07	2.3E-02	7.5E-03	7.5E-03	4.7E-07	1.8E-07	2.2E-09	1.1E-08	2.0E-07
Trichloroethylene (TCE)	0.01750	3.6E-04	1.8E-05	7.1E-01	4.6E-02	4.6E-02	4.1E-06	1.6E-05	8.4E-07	2.9E-06	2.0E-05
										ILCR - unfiltered [h]	2E-05
										ILCR - filtered [g]	2E-05
MW07LSS											
INORGANICS, TOTAL [c]											
Arsenic	0.0087	1.8E-04	2.9E-07	na	1.5E+00	1.5E+00	4.3E-03	2.7E-04	4.3E-07	na	2.7E-04
Total chromium	0.0170										
Total chromium, assumed as Cr^{6+} [d]	0.0170	3.5E-04	9.2E-07	na	5.0E-01	2.0E+01	8.4E-02	1.7E-04	1.8E-05	na	1.9E-04
INORGANICS, DISSOLVED [c]											
Arsenic	0.00479	9.7E-05	1.6E-07	na	1.5E+00	1.5E+00	4.3E-03	1.5E-04	2.4E-07	na	1.5E-04
VOCs											
Benzene	0.00539	1.1E-04	5.1E-06	1.5E-01	5.5E-02	5.5E-02	7.8E-06	6.0E-06	2.8E-07	1.1E-06	7.5E-06
Methylene Chloride	0.00104	2.1E-05	2.6E-07	2.0E-02	7.5E-03	7.5E-03	4.7E-07	1.6E-07	1.9E-09	9.4E-09	1.7E-07
PAHs											
Naphthalene	0.1680	3.4E-03	6.9E-04	1.7E+00	na	na	3.4E-05	na	na	5.8E-05	5.8E-05

Table I-29 Cancer Risk Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$ [b] Oral	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$ [b] Dermal	URF $(ug/m^3)^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Inhalation	Chemical-Specific Risk
										ILCR - unfiltered, trivalent chromium [e]	3E-04
										ILCR - unfiltered,hexavalent chromium [f]	5E-04
										ILCR - filtered [g]	2E-04
MW10LSS											
INORGANICS, TOTAL [c]											
Arsenic	0.0280	5.7E-04	9.3E-07	na	1.5E+00	1.5E+00	4.3E-03	8.5E-04	1.4E-06	na	8.6E-04
Total chromium	0.0857										
Total chromium, assumed as Cr^{6+} [d]	0.0857	1.7E-03	4.6E-06	na	5.0E-01	2.0E+01	8.4E-02	8.7E-04	9.3E-05	na	9.7E-04
INORGANICS, DISSOLVED [c]											
Arsenic	0.00681	1.4E-04	2.3E-07	na	1.5E+00	1.5E+00	4.3E-03	2.1E-04	3.4E-07	na	2.1E-04
Total chromium	0.0159										
Total chromium, assumed as Cr^{6+} [d]	0.0159	3.2E-04	8.6E-07	na	5.0E-01	2.0E+01	8.4E-02	1.6E-04	1.7E-05	na	1.8E-04
VOCs											
Methylene Chloride	0.00110	2.2E-05	2.7E-07	2.1E-02	7.5E-03	7.5E-03	4.7E-07	1.7E-07	2.0E-09	9.9E-09	1.8E-07
										ILCR - unfiltered, trivalent chromium [e]	9E-04
										ILCR - unfiltered, hexavalent chromium [f]	2E-03
										ILCR - filtered, trivalent chromium [i]	2E-04
										ILCR - filtered, hexavalent chromium [j]	4E-04

Notes:

[a] Detected concentration measured in groundwater collected from each Lower Site Summit monitoring well.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

[c] Unfiltered and field filtered groundwater samples were collected for total and dissolved metals analyses at Lower Site Summit. Given the low quality of groundwater at NSS, it is assumed that residents would filter groundwater before using it for potable applications. However it is ADEC policy to manage risk based on potable use of unfiltered water. For a balanced HHRA, risk and hazard results based on both dissolved and total metals data are presented here for comparison purposes.

[d] Groundwater samples at Lower Site Summit were analyzed for total chromium only. Although no suspected sources of hexavalent chromium are not present at the Lower Site Summit, risk estimates due to exposure to chromium were conservatively calculated as though total chromium were 100% hexavalent chromium.

[e] Cumulative ILCR calculated assuming exposure to total metals in unfiltered water, where all chromium measured as total chromium is present as trivalent chromium.

[f] Cumulative ILCR calculated assuming exposure to total metals in unfiltered water, where all chromium measured as total chromium is present as hexavalent chromium.

[g] Cumulative ILCR calculated assuming exposure to dissolved metals in filtered water.

[h] Cumulative ILCR calculated assuming exposure to total metals in unfiltered water.

[i] Cumulative ILCR calculated assuming exposure to dissolved metals in filtered water, where any chromium detected as total chromium is present as trivalent chromium.

[j] Cumulative ILCR calculated assuming exposure to dissolved metals in filtered water, where all chromium measured as total chromium is present as hexavalent chromium.

Cr^{6+} - trivalent chromium
ILCR - incremental lifetime cancer risk.
mg/kg-d - milligrams per kilogram per day.
mg/L - milligrams per liter.
na - not available.
PAH - polycyclic aromatic hydrocarbon
$\mu g/m^3$ - microgram per cubic meter.
URF - unit risk factor
VOC - Volatile Organic Compound

Table I-30 Noncancer Hazard Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/kg-d)[b] Oral	Reference Dose (mg/kg-d)[b] Dermal	RfC (mg/m^3)[b] Inhalation	Pathway-Specific Hazard Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Inhalation	Chemical-Specific HQ
MW02LSS											
INORGANICS, TOTAL[c]											
Arsenic	0.0158	2.5E-03	3.2E-06	na	3.0E-04	3.0E-04	1.5E-05	8.2E+00	1.1E-02	na	8.2
Barium	0.345	5.4E-02	6.9E-05	na	2.0E-01	1.4E-02	5.0E-04	2.7E-01	5.0E-03	na	0.27
Total chromium	0.0475										
Total chromium, assumed as Cr^{3+}[d]	0.0475	7.4E-03	9.5E-06	na	1.5E+00	2.0E-02	na	4.9E-03	4.9E-04	na	0.0054
Total chromium, assumed as Cr^{6+}[e]	0.0475	7.4E-03	9.5E-06	na	3.0E-03	7.5E-05	1.0E-04	2.5E+00	1.3E-01	na	2.6
Mercury	0.000074	1.2E-05	1.5E-08	na	3.0E-04	2.1E-05	3.0E-05	3.9E-02	7.1E-04	na	0.039
Nickel	0.0549	8.5E-03	1.1E-05	na	2.0E-02	8.0E-04	9.0E-05	4.3E-01	1.4E-02	na	0.44
Vanadium	0.094	1.5E-02	1.9E-05	na	5.0E-03	1.3E-04	na	2.9E+00	1.4E-01	na	3.1
INORGANICS, DISSOLVED[c]											
Arsenic	0.00310	4.8E-04	6.2E-07	na	3.0E-04	3.0E-04	1.5E-05	1.6E+00	2.1E-03	na	1.6
Nickel	0.0037	5.8E-04	7.5E-07	na	2.0E-02	8.0E-04	9.0E-05	2.9E-02	9.4E-04	na	0.030
VOCs											
Methylene Chloride	0.00110	1.7E-04	2.2E-07	1.8E-04	6.0E-02	6.0E-02	1.0E+00	2.8E-03	3.7E-06	1.8E-04	0.0030
Trichloroethylene (TCE)	0.00062	9.6E-05	1.2E-07	1.0E-04	5.0E-04	5.0E-04	2.0E-03	1.9E-01	2.5E-04	5.0E-02	0.24
PAHs											
Naphthalene	0.0018	2.7E-04	3.5E-07	2.8E-04	2.0E-02	2.0E-02	3.0E-03	1.4E-02	1.8E-05	9.4E-02	0.11

HI - unfiltered, trivalent chromium[f]	12
HI - unfiltered, hexavalent chromium[g]	15
HI - filtered[h]	2

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/kg-d)[b] Oral	Reference Dose (mg/kg-d)[b] Dermal	RfC (mg/m^3)[b] Inhalation	Pathway-Specific Hazard Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Inhalation	Chemical-Specific HQ
MW03LSS											
INORGANICS, TOTAL[c]											
Arsenic	0.0322	5.0E-03	6.5E-06	na	3.0E-04	3.0E-04	1.5E-05	1.7E+01	2.2E-02	na	17
Barium	0.442	6.9E-02	8.9E-05	na	2.0E-01	1.4E-02	5.0E-04	3.4E-01	6.3E-03	na	0.35
Total chromium	0.0525										
Total chromium, assumed as Cr^{3+}[d]	0.0525	8.2E-03	1.1E-05	na	1.5E+00	2.0E-02	na	5.4E-03	5.4E-04	na	0.0060
Total chromium, assumed as Cr^{6+}[e]	0.0525	8.2E-03	1.1E-05	na	3.0E-03	7.5E-05	1.0E-04	2.7E+00	1.4E-01	na	2.9
Mercury	0.000299	4.6E-05	6.0E-08	na	3.0E-04	2.1E-05	3.0E-05	1.5E-01	2.9E-03	na	0.16
Nickel	0.0606	9.4E-03	1.2E-05	na	2.0E-02	8.0E-04	9.0E-05	4.7E-01	1.5E-02	na	0.49
Vanadium	0.109	1.7E-02	2.2E-05	na	5.0E-03	1.3E-04	na	3.4E+00	1.7E-01	na	3.6
INORGANICS, DISSOLVED[c]											
Arsenic	0.00454	7.0E-04	9.1E-07	na	3.0E-04	3.0E-04	1.5E-05	2.3E+00	3.0E-03	na	2.4
Nickel	0.00264	4.1E-04	5.3E-07	na	2.0E-02	8.0E-04	9.0E-05	2.0E-02	6.6E-04	na	0.021
VOCs											
Benzene	0.00111	1.7E-04	2.2E-07	1.8E-04	4.0E-03	4.0E-03	3.0E-02	4.3E-02	5.6E-05	5.9E-03	0.049
Trichloroethylene (TCE)	0.0007	1.1E-04	1.4E-07	1.1E-04	5.0E-04	5.0E-04	2.0E-03	2.2E-01	2.8E-04	5.6E-02	0.27
PAHs											
2-Methylnaphthalene	0.0735	1.1E-02	1.5E-05	1.2E-02	4.0E-03	4.0E-03	na	2.9E+00	3.7E-03	na	2.9
Naphthalene	0.0685	1.1E-02	1.4E-05	1.1E-02	2.0E-02	2.0E-02	3.0E-03	5.3E-01	6.9E-04	3.7E+00	4.2

Table I-30 Noncancer Hazard Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/kg-d)[b] Oral	Reference Dose (mg/kg-d)[b] Dermal	RfC (mg/m^3)[b] Inhalation	Pathway-Specific Hazard Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Inhalation	Chemical-Specific HQ
										HI - unfiltered, trivalent chromium[f]	29
										HI - unfiltered, hexavalent chromium[g]	31
										HI - filtered[h]	10
MW04LSS											
INORGANICS, TOTAL[c]											
Arsenic	0.0285	4.4E-03	5.7E-06	na	3.0E-04	3.0E-04	1.5E-05	1.5E+01	1.9E-02	na	15
Barium	0.526	8.2E-02	1.1E-04	na	2.0E-01	1.4E-02	5.0E-04	4.1E-01	7.5E-03	na	0.42
Total chromium	0.0797										
Total chromium, assumed as Cr^{3+}[d]	0.0797	1.2E-02	1.6E-05	na	1.5E+00	2.0E-02	na	8.2E-03	8.2E-04	na	0.0091
Total chromium, assumed as Cr^{6+}[e]	0.0797	1.2E-02	1.6E-05	na	3.0E-03	7.5E-05	1.0E-04	4.1E+00	2.1E-01	na	4.3
Mercury	0.000123	1.9E-05	2.5E-08	na	3.0E-04	2.1E-05	3.0E-05	6.4E-02	1.2E-03	na	0.065
Nickel	0.0613	9.5E-03	1.2E-05	na	2.0E-02	8.0E-04	9.0E-05	4.8E-01	1.5E-02	na	0.49
Vanadium	0.0874	1.4E-02	1.8E-05	na	5.0E-03	1.3E-04	na	2.7E+00	1.4E-01	na	2.8
INORGANICS, DISSOLVED[c]											
Nickel	0.00268	4.2E-04	5.4E-07	na	2.0E-02	8.0E-04	9.0E-05	2.1E-02	6.7E-04	na	0.021
VOCs											
Trichloroethylene (TCE)	0.00372	5.8E-04	7.5E-07	6.0E-04	5.0E-04	5.0E-04	2.0E-03	1.2E+00	1.5E-03	3.0E-01	1.5
										HI - unfiltered, trivalent chromium[f]	20
										HI - unfiltered, hexavalent chromium[g]	24
										HI - filtered[h]	1
MW05LSS											
INORGANICS, TOTAL[c]											
Arsenic	0.0177	2.7E-03	3.6E-06	na	3.0E-04	3.0E-04	1.5E-05	9.2E+00	1.2E-02	na	9.2
Barium	0.964	1.5E-01	1.9E-04	na	2.0E-01	1.4E-02	5.0E-04	7.5E-01	1.4E-02	na	0.76
Cadmium	0.00107	1.7E-04	2.1E-07	na	5.0E-04	2.5E-05	2.0E-05	3.3E-01	8.6E-03	na	0.34
Total chromium	0.0607										
Total chromium, assumed as Cr^{3+}[d]	0.0607	9.4E-03	1.2E-05	na	1.5E+00	2.0E-02	na	6.3E-03	6.3E-04	na	0.0069
Total chromium, assumed as Cr^{6+}[e]	0.0607	9.4E-03	1.2E-05	na	3.0E-03	7.5E-05	1.0E-04	3.1E+00	1.6E-01	na	3.3
Nickel	0.0798	1.2E-02	1.6E-05	na	2.0E-02	8.0E-04	9.0E-05	6.2E-01	2.0E-02	na	0.64
Vanadium	0.126	2.0E-02	2.5E-05	na	5.0E-03	1.3E-04	na	3.9E+00	1.9E-01	na	4.1
INORGANICS, DISSOLVED[c]											
Nickel	0.00252	3.9E-04	5.1E-07	na	2.0E-02	8.0E-04	9.0E-05	2.0E-02	6.3E-04	na	0.020
										HI - unfiltered, trivalent chromium[f]	15
										HI - unfiltered, hexavalent chromium[g]	18
										HI - filtered[h]	0.02

Table I-30 Noncancer Hazard Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/kg-d)[b] Oral	Reference Dose (mg/kg-d)[b] Dermal	RfC (mg/m^3)[b] Inhalation	Pathway-Specific Hazard Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Inhalation	Chemical-Specific HQ
MW06LSS											
INORGANICS, TOTAL[c]											
Barium	0.0372	5.8E-03	7.5E-06	na	2.0E-01	1.4E-02	5.0E-04	2.9E-02	5.3E-04	na	0.029
Nickel	0.00108	1.7E-04	2.2E-07	na	2.0E-02	8.0E-04	9.0E-05	8.4E-03	2.7E-04	na	0.0087
INORGANICS, DISSOLVED[c]											
Nickel	0.00113	1.8E-04	2.3E-07	na	2.0E-02	8.0E-04	9.0E-05	8.8E-03	2.8E-04	na	0.0091
VOCs											
1,2-Dichloroethane	0.00052	8.1E-05	1.0E-07	8.3E-05	6.0E-03	2.0E-02	7.0E-03	1.3E-02	5.2E-06	1.2E-02	0.025
Methylene Chloride	0.00121	1.9E-04	2.4E-07	1.9E-04	6.0E-02	6.0E-02	1.0E+00	3.1E-03	4.1E-06	1.9E-04	0.0033
Trichloroethylene (TCE)	0.0175	2.7E-03	3.5E-06	2.8E-03	5.0E-04	5.0E-04	2.0E-03	5.4E+00	7.0E-03	1.4E+00	6.8
										HI - unfiltered[i]	7
										HI - filtered[h]	7
MW07LSS											
INORGANICS, TOTAL[c]											
Arsenic	0.00874	1.4E-03	1.8E-06	na	3.0E-04	3.0E-04	1.5E-05	4.5E+00	5.9E-03	na	4.5
Barium	0.21	3.3E-02	4.2E-05	na	2.0E-01	1.4E-02	5.0E-04	1.6E-01	3.0E-03	na	0.17
Total chromium	0.017										
Total chromium, assumed as Cr^{3+} [d]	0.017	2.6E-03	3.4E-06	na	1.5E+00	2.0E-02	na	1.8E-03	1.8E-04	na	0.0019
Total chromium, assumed as Cr^{6+} [e]	0.017	2.6E-03	3.4E-06	na	3.0E-03	7.5E-05	1.0E-04	8.8E-01	4.6E-02	na	0.93
Nickel	0.0159	2.5E-03	3.2E-06	na	2.0E-02	8.0E-04	9.0E-05	1.2E-01	4.0E-03	na	0.13
Vanadium	0.0329	5.1E-03	6.6E-06	na	5.0E-03	1.3E-04	na	1.0E+00	5.1E-02	na	1.1
INORGANICS, DISSOLVED[c]											
Arsenic	0.00479	7.4E-04	9.6E-07	na	3.0E-04	3.0E-04	1.5E-05	2.5E+00	3.2E-03	na	2.5
Nickel	0.0039	6.1E-04	7.8E-07	na	2.0E-02	8.0E-04	9.0E-05	3.0E-02	9.8E-04	na	0.031
Benzene	0.00539	8.4E-04	1.1E-06	8.7E-04	4.0E-03	4.0E-03	3.0E-02	2.1E-01	2.7E-04	2.9E-02	0.24
Methylene Chloride	0.00104	1.6E-04	2.1E-07	1.7E-04	6.0E-02	6.0E-02	1.0E+00	2.7E-03	3.5E-06	1.7E-04	0.0029
PAHs											
2-Methylnaphthalene	0.0466	7.2E-03	9.4E-06	7.5E-03	4.0E-03	4.0E-03	na	1.8E+00	2.3E-03	na	1.8
Naphthalene	0.168	2.6E-02	3.4E-05	2.7E-02	2.0E-02	2.0E-02	3.0E-03	1.3E+00	1.7E-03	9.0E+00	10
										HI - unfiltered, trivalent chromium[f]	18
										HI - unfiltered, hexavalent chromium[g]	19
										HI - filtered[h]	15
MW10LSS											
INORGANICS, TOTAL[c]											
Arsenic	0.028	4.3E-03	5.6E-06	na	3.0E-04	3.0E-04	1.5E-05	1.4E+01	1.9E-02	na	15
Barium	0.475	7.4E-02	9.5E-05	na	2.0E-01	1.4E-02	5.0E-04	3.7E-01	6.8E-03	na	0.38
Total chromium	0.0857										
Total chromium, assumed as Cr^{3+} [d]	0.0857	1.3E-02	1.7E-05	na	1.5E+00	2.0E-02	na	8.9E-03	8.8E-04	na	0.0098

Table I-30 Noncancer Hazard Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/kg-d) [b] Oral	Reference Dose (mg/kg-d) [b] Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Inhalation	Chemical-Specific HQ
Total chromium, assumed as Cr^{6+} [e]	0.0857	1.3E-02	1.7E-05	na	3.0E-03	7.5E-05	1.0E-04	4.4E+00	2.3E-01	na	4.7
Nickel	0.0662	1.0E-02	1.3E-05	na	2.0E-02	8.0E-04	9.0E-05	5.1E-01	1.7E-02	na	0.53
Vanadium	0.137	2.1E-02	2.8E-05	na	5.0E-03	1.3E-04	na	4.3E+00	2.1E-01	na	4.5
INORGANICS, DISSOLVED [c]											
Arsenic	0.00681	1.1E-03	1.4E-06	na	3.0E-04	3.0E-04	1.5E-05	3.5E+00	4.6E-03	na	3.5
Total chromium	0.0159										
Total chromium, assumed as Cr^{3+} [d]	0.0159	2.5E-03	3.2E-06	na	1.5E+00	2.0E-02	na	1.6E-03	1.6E-04	na	0.0018
Total chromium, assumed as Cr^{6+} [e]	0.0159	2.5E-03	3.2E-06	na	3.0E-03	7.5E-05	1.0E-04	8.2E-01	4.3E-02	na	0.87
Nickel	0.0142	2.2E-03	2.9E-06	na	2.0E-02	8.0E-04	9.0E-05	1.1E-01	3.6E-03	na	0
Vanadium	0.0327	5.1E-03	6.6E-06	na	5.0E-03	1.3E-04	na	1.0E+00	5.1E-02	na	1.1
Methylene Chloride	0.0011	1.7E-04	2.2E-07	1.8E-04	6.0E-02	6.0E-02	1.0E+00	2.8E-03	3.7E-06	1.8E-04	0.0030
										HI - unfiltered, trivalent chromium [f]	20
										HI - unfiltered, hexavalent chromium [g]	25
										HI - filtered, trivalent chromium [j]	5
										HI - filtered, hexavalent chromium [k]	6
PETROLEUM HYDROCARBONS											
MW02LSS											
Diesel Range Organics (DRO)	1.72										5.6
Diesel Range Organics (DRO), Aliphatic	1.376	2.1E-01	2.8E-04	2.2E-01	1.0E-01	na	1.0E+00	2.1E+00	na	2.2E-01	2.4
Diesel Range Organics (DRO), Aromatic	0.688	1.1E-01	1.4E-04	1.1E-01	4.0E-02	na	2.0E-01	2.7E+00	na	5.5E-01	3.2
										HI	6
MW03LSS											
Diesel Range Organics (DRO)	29.4										95
Diesel Range Organics (DRO), Aliphatic	23.52	3.7E+00	4.7E-03	3.8E+00	1.0E-01	na	1.0E+00	3.7E+01	na	3.8E+00	40
Diesel Range Organics (DRO), Aromatic	11.76	1.8E+00	2.4E-03	1.9E+00	4.0E-02	na	2.0E-01	4.6E+01	na	9.4E+00	55
										HI	95
MW05LSS											
Diesel Range Organics (DRO)	0.405										1.3
Diesel Range Organics (DRO), Aliphatic	0.324	5.0E-02	6.5E-05	5.2E-02	1.0E-01	na	1.0E+00	5.0E-01	na	5.2E-02	0.56
Diesel Range Organics (DRO), Aromatic	0.162	2.5E-02	3.3E-05	2.6E-02	4.0E-02	na	2.0E-01	6.3E-01	na	1.3E-01	0.76
										HI	1
MW07LSS											
Diesel Range Organics (DRO)	9.28										30
Diesel Range Organics (DRO), Aliphatic	7.424	1.2E+00	1.5E-03	1.2E+00	1.0E-01	na	1.0E+00	1.2E+01	na	1.2E+00	13
Diesel Range Organics (DRO), Aromatic	3.712	5.8E-01	7.5E-04	6.0E-01	4.0E-02	na	2.0E-01	1.4E+01	na	3.0E+00	17

Table I-30 Noncancer Hazard Calculations for a Hypothetical Future Resident - Lower Site Summit - Groundwater

Constituent	Groundwater Concentration[a] (mg/L)	Ingestion Dose (mg/kg-d)	Dermal Dose (mg/kg-d)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/kg-d) [b] Oral	Reference Dose (mg/kg-d) [b] Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Inhalation	Chemical-Specific HQ
										HI	30
MW10LSS											
Diesel Range Organics (DRO)	0.403										1.3
Diesel Range Organics (DRO), Aliphatic	0.3224	5.0E-02	6.5E-05	5.2E-02	1.0E-01	na	1.0E+00	5.0E-01	na	5.2E-02	0.55
Diesel Range Organics (DRO), Aromatic	0.1612	2.5E-02	3.2E-05	2.6E-02	4.0E-02	na	2.0E-01	6.3E-01	na	1.3E-01	0.76
										HI	1

Notes:

[a] Detected concentration measured in groundwater collected from each Lower Site Summit monitoring well.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

[c] Unfiltered and field filtered groundwater samples were collected for total and dissolved metals analyses at Lower Site Summit. Given the low quality of groundwater at NSS, it is assumed that residents would filter groundwater before using it for potable applications. However it is ADEC policy to manage risk based on potable use of unfiltered water. For a balanced HHRA, risk and hazard results based on both dissolved and total metals data are presented here for comparison purposes.

[d] Groundwater samples at Lower Site Summit were analyzed for total chromium only. No suspected sources of hexavalent chromium are present at the Lower Site Summit; therefore, chromium detected in groundwater was treated as though it were 100% trivalent chromium.

[e] Groundwater samples at Lower Site Summit were analyzed for total chromium only. Although no suspected sources of hexavalent chromium are not present at the Lower Site Summit, hazard estimates due to exposure to chromium were conservatively calculated as though total chromium were 100% hexavalent chromium.

[f] HI calculated assuming exposure to total metals in unfiltered water, where all chromium measured as total chromium is present as trivalent chromium.

[g] HI calculated assuming exposure to total metals in unfiltered water, where all chromium measured as total chromium is present as hexavalent chromium.

[h] HI calculated assuming exposure to dissolved metals in filtered water.

[i] HI calculated assuming exposure to total metals in unfiltered water.

[j] HI calculated assuming exposure to dissolved metals in filtered water, where all chromium measured as total chromium is present as trivalent chromium.

[k] HI calculated assuming exposure to dissolved metals in filtered water, where all chromium measured as total chromium is present as hexavalent chromium.

Cr^{3+} - trivalent chromium
Cr^{6+} - trivalent chromium
HI - hazard index
HQ - hazard quotient

mg/kg-d - milligrams per kilogram per day
mg/L - milligrams per liter
mg/m^3 - milligrams per cubic meter
na - not available

NA - not applicable
PAH - polycyclic aromatic hydrocarbon
RfC - reference concentration
VOC - volatile organic compound

Table I-31 Summary of Human Health Risk Estimates - Lower Site Summit - Groundwater

	Concentration [a] (mg/L)							Screening Benchmark [b]		MW02LSS		MW03LSS		MW04LSS		MW05LSS		MW06LSS		MW07LSS		MW10LSS	
Groundwater Constituent	MW02LSS	MW03LSS	MW04LSS	MW05LSS	MW06LSS	MW07LSS	MW10LSS	mg/L	Endpoint	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons																							
Inorganics, total [c]																							
Arsenic	**0.0158**	***0.0322***	**0.0285**	**0.0177**	ND	**0.00874**	**0.0280**	0.001	cancer	**4.8E-04**	**8.2**	**9.8E-04**	**17**	**8.7E-04**	**15**	**5.4E-04**	**9.2**	NA	NA	**2.7E-04**	**4.5**	**8.6E-04**	**15**
Barium	**0.3450**	**0.442**	**0.526**	***0.964***	0.0372	**0.210**	**0.475**	0.2	noncancer	NA	0.27	NA	0.35	NA	0.42	NA	0.76	NA	0.029	NA	0.17	NA	0.38
Cadmium	ND	ND	ND	***0.00107***	ND	ND	ND	0.0005	cancer	NA	NA	NA	NA	NA	NA	NA	0.34	NA	NA	NA	NA	NA	NA
Total chromium	**0.0475**	**0.0525**	**0.0797**	**0.0607**	ND	**0.0170**	***0.0857***	0.0100	noncancer														
Total, assumed as trivalent chromium [d]	**0.0475**	**0.0525**	**0.0797**	**0.0607**	ND	**0.0170**	***0.0857***	0.0100	noncancer	NA	0.0054	NA	0.0060	NA	0.0091	NA	0.0069	NA	NA	NA	0.0019	NA	0.0098
Total, assumed as hexavalent chromium [e]	**0.0475**	**0.0525**	**0.0797**	**0.0607**	ND	**0.0170**	***0.0857***	0.0100	noncancer	**5.3E-04**	**2.6**	**5.9E-04**	**2.9**	**9.0E-04**	**4.3**	**6.8E-04**	**3.3**	NA	NA	**1.9E-04**	0.93	**9.7E-04**	**4.7**
Lead	**0.0233**	***0.0333***	**0.0254**	**0.0250**	ND	0.00777	**0.0276**	0.015	cancer	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]	NA [f]
Mercury	0.0000744	***0.000299***	0.000123	ND	ND	ND	ND	0.0002	noncancer	NA	0.039	NA	0.16	NA	0.065	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	**0.0549**	**0.0606**	**0.0613**	***0.0798***	0.00108	**0.0159**	**0.0662**	0.01	noncancer	NA	0.44	NA	0.49	NA	0.49	NA	0.64	NA	0.0087	NA	0.13	NA	0.53
Vanadium	**0.0937**	**0.109**	**0.0874**	**0.126**	ND	**0.0329**	***0.137***	0.026	noncancer	NA	**3.1**	NA	**3.6**	NA	**2.8**	NA	**4.1**	NA	NA	NA	**1.1**	NA	**4.5**
Inorganics, dissolved [c]																							
Arsenic	**0.00310**	**0.00454**	ND	ND	ND	0.00479	***0.00681***	0.001	cancer	**9.5E-05**	**1.6**	**1.4E-04**	**2.4**	NA	NA	NA	NA	NA	NA	**1.5E-04**	**2.5**	**2.1E-04**	**3.5**
Total chromium	ND	ND	ND	ND	ND	ND	***0.0159***	0.0100	noncancer														
Total, assumed as trivalent chromium [d]	ND	ND	ND	ND	ND	ND	***0.0159***	0.0100	noncancer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0018
Total, assumed as hexavalent chromium [e]	ND	ND	ND	ND	ND	ND	***0.0159***	0.0100	noncancer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**1.8E-04**	0.87
Nickel	0.00374	0.00264	0.00268	0.00252	0.00113	0.00390	***0.0142***	0.01	noncancer	NA	0.030	NA	0.021	NA	0.021	NA	0.020	NA	0.0091	NA	0.031	NA	0.11
Vanadium	ND	ND	ND	ND	ND	ND	***0.0327***	0.026	noncancer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**1.1**
Organics																							
1,2-Dichloroethane	ND	ND	ND	ND	***0.000520***	ND	ND	0.0005	cancer	NA	NA	NA	NA	NA	NA	NA	NA	1.1E-06	0.025	NA	NA	NA	NA
Benzene	ND	**0.00111**	ND	ND	ND	***0.00539***	ND	0.0005	cancer	NA	NA	1.5E-06	0.049	NA	NA	NA	NA	NA	NA	7.5E-06	0.24	NA	NA
Methylene Chloride	**0.00110**	ND	ND	ND	***0.00121***	**0.00104**	**0.00110**	0.0005	cancer	1.8E-07	0.0030	NA	NA	NA	NA	NA	NA	2.0E-07	0.0033	1.7E-07	0.0029	1.8E-07	0.0030
Trichloroethylene (TCE)	**0.000620**	**0.000700**	**0.00372**	ND	***0.0175***	ND	ND	0.0005	cancer	7.1E-07	0.24	8.1E-07	0.27	4.3E-06	**1.5**	NA	NA	**2.0E-05**	**6.8**	NA	NA	NA	NA
PAHs																							
2-Methylnaphthalene	ND	***0.0735***	ND	ND	ND	**0.0466**	ND	0.015	noncancer	NA	NA	NA	**2.9**	NA	NA	NA	NA	NA	NA	NA	**1.8**	NA	NA
Naphthalene	0.00176	0.0685	ND	ND	ND	***0.168***	ND	0.073	noncancer	6.1E-07	0.11	**2.4E-05**	**4.2**	NA	NA	NA	NA	NA	NA	**5.8E-05**	**10**	NA	NA
Cumulative ILCR / HI - unfiltered, trivalent chromium [g] :										**5E-04**	**12**	***1E-03***	***29***	**9E-04**	**20**	**5E-04**	**15**	**2E-05**	**7**	**3E-04**	**18**	**9E-04**	**20**
Cumulative ILCR / HI - unfiltered, hexavalent chromium [h] :										**1E-03**	**15**	***2E-03***	***31***	**2E-03**	**24**	**1E-03**	**18**	**2E-05**	**7**	**5E-04**	**19**	***2E-03***	**25**
Cumulative ILCR / HI - filtered, trivalent chromium [i] :										**1E-04**	**2**	**2E-04**	**9.8**	4E-06	**1.5**	NA	0.02	**2E-05**	**7**	***2E-04***	***15***	**2E-04**	**5**
Cumulative ILCR / HI - filtered, hexavalent chromium [j] :										**1E-04**	**2**	**2E-04**	**9.8**	4E-06	**1.5**	NA	0.02	**2E-05**	**7**	**2E-04**	***15***	***4E-04***	**6**
Petroleum Hydrocarbons																							
Diesel Range Organics (DRO)	**1.72**	***29.4***	ND	0.405	ND	**9.28**	0.403	1.5	noncancer	NA	**5.6**	NA	**95**	NA	ND	NA	**1.3**	NA	ND	NA	**30**	NA	**1.3**
Diesel Range Organics (DRO), Aliphatic	1.4	23.5	ND	0.324	ND	7.42	0.322			NA	**2.4**	NA	**40**	NA	NA	NA	0.56	NA	NA	NA	**13**	NA	0.55
Diesel Range Organics (DRO), Aromatic	0.7	11.8	ND	0.162	ND	3.71	0.161			NA	**3.2**	NA	**55**	NA	NA	NA	0.76	NA	NA	NA	**17**	NA	0.76
Cumulative ILCR / HI :										NA	**6**	NA	***95***	NA	NA	NA	1	NA	NA	NA	**30**	NA	1
ADEC Risk Range :										10^{-5}	1												
USEPA Risk Range :										10^{-6} - 10^{-4}	1												

Notes:

Chemical concentrations displayed in **bold** exceed chemical specific screening benchmarks.

The maximum concentration of each groundwater constituent across all Lower Site Summit monitoring wells is indicated by ***bold italics*** .

ILCR or HI estimates in **bold** exceed ADEC's risk management criteria

The maximum risk or hazard estimate across all Lower Site Summit monitoring wells is indicated by ***bold italics*** .

[a] Detected concentration measured in groundwater collected from each Lower Site Summit monitoring well.

[b] Screening benchmark value and endpoint are as presented in Table 3-4.

[c] Unfiltered and field filtered groundwater samples were collected for total and dissolved metals analyses at Lower Site Summit. Given the low quality of groundwater at NSS, it is assumed that residents would filter groundwater before using it for potable applications. However it is ADEC policy to manage risk based on potable use of unfiltered water. For a balanced HHRA, risk and hazard results based on both dissolved and total metals data are presented here for comparison purposes.

[d] Groundwater samples at Lower Site Summit were analyzed for total chromium only. No suspected sources of hexavalent chromium are present at the Lower Site Summit; therefore, chromium detected in groundwater was treated as though it were 100% trivalent chromium.

Table I-31 Summary of Human Health Risk Estimates - Lower Site Summit - Groundwater

Groundwater Constituent	Concentration [a] (mg/L)							Screening Benchmark [b]		MW02LSS		MW03LSS		MW04LSS		MW05LSS		MW06LSS		MW07LSS		MW10LSS	
	MW02LSS	MW03LSS	MW04LSS	MW05LSS	MW06LSS	MW07LSS	MW10LSS	mg/L	Endpoint	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ	ILCR	HQ

[e] Groundwater samples at Lower Site Summit were analyzed for total chromium only. Although no suspected sources of hexavalent chromium are not present at the Lower Site Summit, risk and hazard estimates due to exposure to chromium were conservatively calculated as though total chromium were 100% hexavalent chromium.

[f] Exposure to lead in groundwater at the Lower Site Summit was evaluated with biokinetic models. Therefore, risk and hazard estimates were not calculated for lead.

[g] Cumulative ILCR and HI calculated assuming exposure to total metals in unfiltered water, where all chromium measured as total chromium is present as trivalent chromium.

[h] Cumulative ILCR and HI calculated assuming exposure to total metals in unfiltered water, where all chromium measured as total chromium is present as hexavalent chromium.

[i] Cumulative ILCR and HI calculated assuming exposure to dissolved metals in filtered water, where all chromium measured as total chromium is present as trivalent chromium.

[j] Cumulative ILCR and HI calculated assuming exposure to dissolved metals in filtered water, where all chromium measured as total chromium is present as hexavalent chromium.

ADEC - Alaska Department of Environmental Conservation
HQ - hazard quotient
HI - hazard index
ILCR - incremental lifetime cancer risk

mg/L - milligrams per liter
NA - not applicable
NC - not calculated
USEPA - U. S. Environmental Protection Agency

Table I-32 J&E Modeling Results Summary
Groundwater Vapor Intrusion COPCs at Lower Site Summit

Groundwater Well COPC		Detected Concentration (mg/L)	Current/Future Site Worker		Future Hypothetical Resident	
			ILCR	HQ	ILCR	HQ
MW02LSS						
Trichloroethylene (TCE)		0.000620	9.2E-08	0.031	1.5E-07	0.044
Naphthalene		0.00176	5.4E-08	0.0015	9.1E-08	0.0021
Cumulative ILCR/HQ:			1E-07	0.03	2E-07	0.05
MW03LSS						
1,2,4-Trimethylbenzene		0.00376	NA	0.014	NA	0.020
1,3,5-Trimethylbenzene		0.00809	NA	0.029	NA	0.041
Benzene		0.00111	1.6E-07	0.0019	2.7E-07	0.0026
Ethylbenzene		0.00720	3.2E-07	0.00035	5.3E-07	0.00049
n-Butylbenzene		0.0098	NA	0.014	NA	0.020
n-Propylbenzene		0.0117	NA	0.00055	NA	0.00077
sec-Butylbenzene		0.0100	NA	0.00000024	NA	0.00000034
Trichloroethylene (TCE)		0.000700	8.4E-08	0.029	1.4E-07	0.040
2-Methylnaphthalene	a	0.0735	na	na	na	na
Acenaphthene	a	0.00360	na	na	na	na
Fluorene	a	0.00390	na	na	na	na
Naphthalene		0.0685	1.6E-06	0.044	2.7E-06	0.062
Cumulative ILCR/HQ:			2E-06	0.1	4E-06	0.2
MW04LSS						
Trichloroethylene (TCE)		0.00372	4.3E-07	0.15	7.2E-07	0.21
Cumulative ILCR/HQ:			4E-07	0.1	7E-07	0.2
MW06LSS						
Trichloroethylene (TCE)		0.0175	2.9E-06	1.0	4.9E-06	**1.4**
Cumulative ILCR/HQ:			3E-06	1	5E-06	1
MW07LSS [b]						
1,2,4-Trimethylbenzene		0.0356	NA	0.25	NA	0.36
1,3,5-Trimethylbenzene		0.0164	NA	0.11	NA	0.16
Benzene		0.00539	1.3E-06	0.016	2.2E-06	0.022
Ethylbenzene		0.00713	5.7E-07	0.00064	9.5E-07	0.00089
n-Propylbenzene		0.00356	NA	0.00032	NA	0.00044
sec-Butylbenzene		0.00287	NA	0.0000012	NA	0.0000017
2-Methylnaphthalene	a	0.0466	na	na	na	na
Naphthalene		0.168	8.0E-06	0.22	**1.3E-05**	0.31
Cumulative ILCR/HQ:			1E-05	0.6	**2E-05**	1
ADEC Risk Criteria:			10^{-5}	1	10^{-5}	1
USEPA Risk Range:			10^{-6} - 10^{-4}	1	10^{-6} - 10^{-4}	1

Notes:

[a] Risks for this analyte were not calculated using the J&E model because inhalation toxicity values were unavailable.

[b] MW07LSS has the greatest cumulative ILCR of any monitoring well at LSS; MW06LSS and MW07LSS both have an HI of 1, which is the greatest HI of any well at LSS. Therefore, MW07LSS is considered to be the highest risk well, and results from MW07LSS will be incorporated in to the cumulative site ILCR and HI for the LSS. However, because trichloroethylene was identified as a risk driver in MW06LSS but not in MW07LSS, risk and hazard estimates for trichloroethylene in MW06LSS are presented in the LSS summary table (Table 4-5), even though they are not included in the cumulative risk.

Table I-32 J&E Modeling Results Summary
Groundwater Vapor Intrusion COPCs at Lower Site Summit

Groundwater Well COPC	Detected Concentration (mg/L)	Current/Future Site Worker		Future Hypothetical Resident	
		ILCR	HQ	ILCR	HQ

Bold indicates exceedence of the Alaska Department of Environmental Conservation acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
COPC - chemical of potential concern
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/L - milligrams per liter
NA - not applicable
na - not available
NC - not calculated
USEPA - United States Environmental Protection Agency

Table I-33 Cancer Calculation for a Current/Future Site Worker - Area A - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF ($\mu g/m3$)$^{-1}$ b Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
VOCs													
Trichloroethylene (TCE)	0.0818	2.9E-08	na	na	9.4E-03	4.6E-02	4.6E-02	4.1E-06	1.3E-09	na	na	3.9E-08	4.0E-08
												ILCR	4E-08

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Area A sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-34 Noncancer Hazard Calculation for a Current/Future Site Worker - Area A - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
VOCs													
Trichloroethylene (TCE)	0.0818	8.0E-08	na	na	2.6E-05	5.0E-04	5.0E-04	2.0E-03	1.6E-04	na	na	1.3E-02	0.013
												HI	0.01
PETROLEUM HYDROCARBONS													
Diesel Range Organics (DRO)	8,369												
Diesel Range Organics (DRO), Aliphatic	6,695	6.6E-03	na	na	1.5E-01	1.0E-01	na	1.0E+00	6.6E-02	na	na	1.5E-01	0.22
Diesel Range Organics (DRO), Aromatic	3,348	3.3E-03	na	na	7.6E-02	4.0E-02	na	2.0E-01	8.2E-02	na	na	3.8E-01	0.46
Residual Range Organics (RRO)	63,887												
Residual Range Organics (RRO), Aliphati	57,498	5.6E-02	na	2.9E-05	na	2.0E+00	na	na	2.8E-02	na	na	na	0.028
Residual Range Organics (RRO), Aromati	19,166	1.9E-02	na	9.7E-06	na	3.0E-02	na	na	6.3E-01	na	na	na	0.63
												HI	1

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area A sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

% - percent
HI - hazard index
HQ - hazard quotient
mg/Kg-d - milligrams per kilogram per day
mg/Kg - milligrams per kilogram
mg/m^3 - milligrams per cubic meter
na - not available
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-35 Cancer Calculation for a Current/Future Site Visitor - Area A - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b		URF $(ug/m^3)^{-1}$ [b]	Pathway-Specific Cancer Risk				Chemical-Specific Risk
						Oral	Dermal	Inhalation	Soil Ingestion	Dermal	Dust Inhalation	VOC Inhalation	
VOCs													
Trichloroethylene (TCE)	0.0818	2.7E-09	na	na	9.0E-04	4.6E-02	4.6E-02	4.1E-06	1.3E-10	na	na	3.7E-09	3.8E-09
												ILCR	4E-09

Notes:

[a] Maximum detected concentration or 95% upper confidence limit (UCL) on the mean concentration measured in surface soil samples collected from Area A sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - Incremental lifetime cancer risk
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-36 Noncancer Hazard Calculation for a Current/Future Site Visitor - Area A - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
VOCs													
Trichloroethylene (TCE)	0.0818	7.7E-09	na	na	2.5E-06	5.0E-04	5.0E-04	2.0E-03	1.5E-05	na	na	1.3E-03	0.0013
												HI	0.001
PETROLEUM HYDROCARBONS													
Diesel Range Organics (DRO)	8,369												
Diesel Range Organics (DRO), Aliphatic	6,695	6.3E-04	na	na	1.5E-02	1.0E-01	na	1.0E+00	6.3E-03	na	na	na	0.0063
Diesel Range Organics (DRO), Aromatic	3,348	3.1E-04	na	na	7.3E-03	4.0E-02	na	2.0E-01	7.9E-03	na	na	na	0.0079
Residual Range Organics (RRO)	63,887												
Residual Range Organics (RRO), Aliphati	57,498	5.4E-03	na	4.0E-08	na	2.0E+00	na	na	2.7E-03	na	na	na	0.0027
Residual Range Organics (RRO), Aromati	19,166	1.8E-03	na	1.3E-08	na	3.0E-02	na	na	6.0E-02	na	na	na	0.060
												HI	0.1

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area A sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

% - percent
HI - hazard index
HQ - hazard quotient
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
na - not available
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-37 Cancer Calculation for a Hypothetical Future Resident - Area A - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m3)-1 [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
VOCs													
Trichloroethylene (TCE)	0.0818	1.1E-07	na	na	1.5E-02	4.6E-02	4.6E-02	4.1E-06	4.9E-09	na	na	6.0E-08	6.5E-08
												ILCR	6E-08

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area A sampling locations.
[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-38 Noncancer Hazard Calculation for a Hypothetical Future Resident - Area A - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
VOCs													
Trichloroethylene (TCE)	0.0818	8.9E-07	na	na	5.7E-05	5.0E-04	5.0E-04	2.0E-03	1.8E-03	na	na	2.8E-02	0.030
												HI	0.03
PETROLEUM HYDROCARBONS													
Diesel Range Organics (DRO)	8,369												
Diesel Range Organics (DRO), Aliphatic	6,695	7.3E-02	na	na	3.3E-01	1.0E-01	na	1.0E+00	7.3E-01	na	na	3.3E-01	1.1
Diesel Range Organics (DRO), Aromatic	3,348	3.7E-02	na	na	1.6E-01	4.0E-02	na	2.0E-01	9.1E-01	na	na	8.2E-01	1.7
Residual Range Organics (RRO)	63,887												
Residual Range Organics (RRO), Aliphatic	57,498	6.3E-01	na	6.3E-05	na	2.0E+00	na	na	3.1E-01	na	na	na	0.31
Residual Range Organics (RRO), Aromati	19,166	2.1E-01	na	2.1E-05	na	3.0E-02	na	na	7.0E+00	na	na	na	7.0
												HI	**10**

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area A sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

% - percent
HI - hazard index
HQ - hazard quotient
mg/kd-d - milligrams per kilogram per day
mg/Kg - milligrams per kilogram
mg/m^3 - milligrams per cubic meter
na - not available
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-39 Summary of Human Health Risk Estimates for Area A - Surface Soil

Surface Soil Constituent	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons									
Trichloroethylene (TCE)	0.0818	NC	0.0818	4.0E-08	0.013	3.8E-09	0.0013	6.5E-08	0.030
Cumulative ILCR / HI:				4E-08	0.01	4E-09	0.001	6E-08	0.03
Petroleum Hydrocarbons									
Diesel Range Organics (DRO)	19,200	8,369	8,369	NA	0.68	NA	0.014	NA	**2.8**
Diesel Range Organics (DRO), Aliphatic			6,695	NA	0.22	NA	0.0063	NA	**1.1**
Diesel Range Organics (DRO), Aromatic			3,348	NA	0.46	NA	0.0079	NA	**1.7**
Residual Range Organics (RRO)	161,000	63,887	63,887	NA	0.65	NA	0.063	NA	**7.3**
Residual Range Organics (RRO), Aliphatic			57,498	NA	0.028	NA	0.0027	NA	0.31
Residual Range Organics (RRO), Aromatic			19,166	NA	0.63	NA	0.060	NA	**7.0**
Cumulative ILCR / HI:				NA	1	NA	0.08	NA	**10**
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area A sampling locations.

[b] The EPC is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of ADEC acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
NC - not calculated
UCL - upper confidence limit
USEPA - U. S. Environmental Protection Agency

Table I-40 Cancer Calculation for a Current/Future Site Worker - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (µg/m^3)	VOC Inhalation Concentration (µg/m^3)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (µg/m3)$^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Total chromium	34.0												
Total chromium, assumed as	34.0	1.2E-05	na	6.1E-06	na	5.0E-01	2.0E+01	8.4E-02	5.9E-06	na	5.1E-07	na	6.5E-06
VOCs													
Trichloroethylene (TCE)	0.0336	1.2E-08	na	na	3.9E-03	4.6E-02	4.6E-02	4.1E-06	5.4E-10	na	na	1.6E-08	1.6E-08
												ILCR [d]	2E-08
												ILCR [e]	6E-06

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both that all total chromium as trivalent chromium, and that all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

% - percent
µg/m^3 - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-41 Noncancer Hazard Calculation for a Current/Future Site Worker - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Total chromium	34.0												
Total chromium, assumed as Cr^{3+} [c]	34.0	3.3E-05	na	1.7E-08	na	1.5E+00	2.0E-02	na	2.2E-05	na	na	na	0.000022
Total chromium, assumed as Cr^{6+} [c]	34.0	3.3E-05	na	1.7E-08	na	3.0E-03	7.5E-05	1.0E-04	1.1E-02	na	1.7E-04	na	0.011
VOCs													
Trichloroethylene (TCE)	0.0336	3.3E-08	na	na	1.1E-05	5.0E-04	5.0E-04	2.0E-03	6.6E-05	na	na	5.4E-03	0.0055
												HI [d]	0.006
												HI [e]	0.02
PETROLEUM HYDROCARBONS													
Diesel Range Organics (DRO)	8,583												
Diesel Range Organics (DRO), Aliphatic	6,866	6.7E-03	na	na	1.6E-01	1.0E-01	na	1.0E+00	6.7E-02	na	na	1.6E-01	0.22
Diesel Range Organics (DRO), Aromatic	3,433	3.4E-03	na	na	7.8E-02	4.0E-02	na	2.0E-01	8.4E-02	na	na	3.9E-01	0.47
Residual Range Organics (RRO)	7,059												
Residual Range Organics (RRO), Aliphatic	6,353	6.2E-03	na	3.2E-06	na	2.0E+00	na	na	3.1E-03	na	na	na	0.0031
Residual Range Organics (RRO), Aromatic	2,118	2.1E-03	na	1.1E-06	na	3.0E-02	na	na	6.9E-02	na	na	na	0.069
												HI	0.8

Table I-41 Noncancer Hazard Calculation for a Current/Future Site Worker - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b Oral	Reference Dose (mg/Kg-d) b Dermal	RfC (mg/m^3) [b] Inhalation	Pathway-Specific Hazard Soil Ingestion	Pathway-Specific Hazard Dermal	Pathway-Specific Hazard Dust Inhalation	Pathway-Specific Hazard VOC Inhalation	Chemical-Specific HQ

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both that all total chromium as trivalent chromium, and that all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

Cr^{3+} - trivalent chromium
Cr^{6+} - hexavalent chromium

HI - hazard index
HQ - hazard quotient
mg/m^3 - milligrams per cubic meter
% - percent
UCL - upper confidence limit
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
RfC - reference concentration
VOC - volatile organic compound

Table I-42 Cancer Calculation for a Current/Future Site Visitor - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (µg/m^3)	VOC Inhalation Concentration (µg/m^3)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m^3)$^{-1}$ b Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Total chromium	34.0												
Total chromium, assumed as	34.0	1.1E-06	na	5.9E-07	na	5.0E-01	2.0E+01	8.4E-02	5.7E-07	na	4.9E-08	na	6.2E-07
VOCs													
Trichloroethylene (TCE)	0.0336	1.1E-09	na	na	3.7E-04	4.6E-02	4.6E-02	4.1E-06	5.2E-11	na	na	1.5E-09	1.6E-09
												ILCR [d]	2E-09
												ILCR [e]	6E-07

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both that all total chromium as trivalent chromium, and that all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

% - percent
µg/m^3 - micrograms per cubic meter
Cr^{3+} - trivalent chromium
Cr^{6+} - hexavalent chromium
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-43 Noncancer Hazard Calculation for a Current/Future Site Visitor - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b: Oral	Reference Dose (mg/Kg-d) b: Dermal	RfC (mg/m^3) b: Inhalation	Pathway-Specific Hazard: Soil Ingestion	Pathway-Specific Hazard: Dermal	Pathway-Specific Hazard: Dust Inhalation	Pathway-Specific Hazard: VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Total chromium	34.0												
Total chromium, assumed as Cr^{3+} c	34.0	3.2E-06	na	2.3E-11	na	1.5E+00	2.0E-02	na	2.1E-06	na	na	na	0.0000021
Total chromium, assumed as Cr^{6+} c	34.0	3.2E-06	na	2.3E-11	na	3.0E-03	7.5E-05	1.0E-04	1.1E-03	na	2.3E-07	na	0.0011
VOCs													
Trichloroethylene (TCE)	0.0336	3.2E-09	na	na	1.0E-06	5.0E-04	5.0E-04	2.0E-03	6.3E-06	na	na	5.2E-04	0.00053
												HI d	0.0005
												HI e	0.002
PETROLEUM HYDROCARBONS													
Diesel Range Organics (DRO)	8,583												
Diesel Range Organics (DRO), Aliphatic	6,866	6.4E-04	na	na	1.5E-02	1.0E-01	na	1.0E+00	6.4E-03	na	na	na	0.0064
Diesel Range Organics (DRO), Aromatic	3,433	3.2E-04	na	na	7.5E-03	4.0E-02	na	2.0E-01	8.1E-03	na	na	na	0.0081
Residual Range Organics (RRO)	7,059												
Residual Range Organics (RRO), Aliphatic	6,353	6.0E-04	na	4.4E-09	na	2.0E+00	na	na	3.0E-04	na	na	na	0.00030
Residual Range Organics (RRO), Aromatic	2,118	2.0E-04	na	1.5E-09	na	3.0E-02	na	na	6.6E-03	na	na	na	0.0066
												HI	0.02

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both that all total chromium as trivalent chromium, and that all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

% - percent
Cr^{3+} - trivalent chromium
Cr^{6+} - hexavalent chromium
HI - hazard index
HQ - hazard quotient
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
na - not available
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-44 Cancer Calculation for a Hypothetical Future Resident - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (µg/m^3)	VOC Inhalation Concentration (µg/m^3)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m3)-1 [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
INORGANICS													
Total chromium	34.0												
Total chromium, assumed as	34.0	4.4E-05	na	9.5E-06	na	5.0E-01	2.0E+01	8.4E-02	2.2E-05	na	8.0E-07	na	2.3E-05
VOCs													
Trichloroethylene (TCE)	0.0336	4.4E-08	na	na	6.0E-03	4.6E-02	4.6E-02	4.1E-06	2.0E-09	na	na	2.5E-08	2.7E-08
												ILCR [d]	3E-08
												ILCR [e]	2E-05

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both that all total chromium as trivalent chromium, and that all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

% - percent
µg/m^3 - micrograms per cubic meter
Cr^{3+} - trivalent chromium
Cr^{6+} - hexavalent chromium
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
UCL - upper confidence limit
URF - unit risk factor
VOC - volatile organic compound

Table I-45 Noncancer Hazard Calculation for a Hypothetical Future Resident - Area A - Subsurface Soil

Chemical of Potential Concern	Subsurface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (mg/m^3)	VOC Inhalation Concentration (mg/m^3)	Reference Dose (mg/Kg-d) b: Oral	Reference Dose (mg/Kg-d) b: Dermal	RfC (mg/m^3) b: Inhalation	Pathway-Specific Hazard: Soil Ingestion	Pathway-Specific Hazard: Dermal	Pathway-Specific Hazard: Dust Inhalation	Pathway-Specific Hazard: VOC Inhalation	Chemical-Specific HQ
INORGANICS													
Total chromium	34.0												
Total chromium, assumed as Cr^{3+} [c]	34.0	3.7E-04	na	3.7E-08	na	1.5E+00	2.0E-02	na	2.5E-04	na	na	na	0.00025
Total chromium, assumed as Cr^{6+} [c]	34.0	3.7E-04	na	3.7E-08	na	3.0E-03	7.5E-05	1.0E-04	1.2E-01	na	3.7E-04	na	0.12
VOCs													
Trichloroethylene (TCE)	0.0336	3.7E-07	na	na	2.3E-05	5.0E-04	5.0E-04	2.0E-03	7.3E-04	na	na	1.2E-02	0.012
												HI [d]	0.01
												HI [e]	0.1
PETROLEUM HYDROCARBONS													
Diesel Range Organics (DRO)	8,583												
Diesel Range Organics (DRO), Aliphatic	6,866	7.5E-02	na	na	3.4E-01	1.0E-01	na	1.0E+00	7.5E-01	na	na	3.4E-01	1.1
Diesel Range Organics (DRO), Aromatic	3,433	3.7E-02	na	na	1.7E-01	4.0E-02	na	2.0E-01	9.4E-01	na	na	8.4E-01	1.8
Residual Range Organics (RRO)	7,059												
Residual Range Organics (RRO), Aliphatic	6,353	6.9E-02	na	6.9E-06	na	2.0E+00	na	na	3.5E-02	na	na	na	0.035
Residual Range Organics (RRO), Aromatic	2,118	2.3E-02	na	2.3E-06	na	3.0E-02	na	na	7.7E-01	na	na	na	0.77
												HI	**4**

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] Doses and noncancer hazards shown only for noncarcinogenic chemicals with available toxicity values.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both that all total chromium as trivalent chromium, and that all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

% - percent
Cr^{3+} - trivalent chromium
Cr^{6+} - hexavalent chromium
HI - hazard index
HQ - hazard quotient
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
na - not available
RfC - reference concentration
UCL - upper confidence limit
VOC - volatile organic compound

Table I-46 Summary of Human Health Risk Estimates - Area A - Subsurface Soil

Subsurface Soil Constituent	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons									
Total chromium	45.1	34.0	34.0	NA	NA	NA	NA	NA	NA
Total chromium, assumed as trivalent chromium [c]	45.1	34.0	34.0	NA	0.000022	NA	0.0000021	NA	0.00025
Total chromium, assumed as hexalent chromium [c]	45.1	34.0	34.0	6.5E-06	0.011	6.2E-07	0.0011	**2.3E-05**	0.12
Trichloroethylene (TCE)	0.0866	0.03364	0.0336	1.6E-08	0.0055	1.6E-09	0.00053	2.7E-08	0.012
Cumulative ILCR / HI[d] :				2E-08	0.006	2E-09	0.00053	3E-08	0.01
Cumulative ILCR / HI[e] :				6E-06	0.02	6E-07	0.002	**2E-05**	0.1
Petroleum Hydrocarbons									
Diesel Range Organics (DRO)	28,400	8,583	8,583	NA	0.70	NA	0.015	NA	**2.9**
Diesel Range Organics (DRO), Aliphatic			6,866	NA	0.22	NA	0.0064	NA	**1.1**
Diesel Range Organics (DRO), Aromatic			3,433	NA	0.47	NA	0.0081	NA	**1.8**
Residual Range Organics (RRO)	18,900	7,059	7,059	NA	0.072	NA	0.0069	NA	0.81
Residual Range Organics (RRO), Aliphatic			6,353	NA	0.0031	NA	0.00030	NA	0.035
Residual Range Organics (RRO), Aromatic			2,118	NA	0.069	NA	0.0066	NA	0.77
Cumulative ILCR / HI:				NA	0.8	NA	0.02	NA	**4**
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in subsurface soil samples collected from Area A sampling locations.

[b] The EPC is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

[c] Subsurface soil samples at Area A were analyzed for total chromium only. The ratio of hexavalent to trivalent chromium in subsurface soil at Area A is not known; therefore, risk and hazard estimates were calculated for measured concentrations of total chromium in subsurface soil assuming both all total chromium as trivalent chromium, and all total chromium as hexavalent chromium.

[d] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as trivalent chromium.

[e] Cumulative ILCR and HI calculated assuming all chromium measured as total chromium is present as hexavalent chromium.

Table I-46 Summary of Human Health Risk Estimates - Area A - Subsurface Soil

	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
Subsurface Soil Constituent	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ

Bold indicates exceedance of the Alaska Department of Environmental Conservation acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
UCL - upper confidence limit
USEPA - U. S. Environmental Protection Agency

Table I-47 Cancer Calculation for a Current/Future Site Worker - Area C - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF ($\mu g/m3)^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
PAHs													
Benzo(a)anthracene	1.80	6.3E-07	5.4E-07	3.2E-07	na	7.3E-01	7.3E-01	1.1E-04	4.6E-07	3.9E-07	3.6E-11	na	8.5E-07
Benzo(a)pyrene	1.62	5.7E-07	4.9E-07	2.9E-07	na	7.3E+00	7.3E+00	1.1E-03	4.1E-06	3.5E-06	3.2E-10	na	7.7E-06
Benzo(b)fluoranthene	2.08	7.3E-07	6.2E-07	3.7E-07	na	7.3E-01	7.3E-01	1.1E-04	5.3E-07	4.6E-07	4.1E-11	na	9.9E-07
Indeno(1,2,3-c,d)Pyrene	0.818	2.9E-07	2.5E-07	1.5E-07	na	7.3E-01	7.3E-01	1.1E-04	2.1E-07	1.8E-07	1.6E-11	na	3.9E-07
												ILCR	1E-05

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area C sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
UCL - upper confidence limit
URF - unit risk factor

Table I-48 Cancer Calculation for a Current/Future Site Visitor - Area C - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration ($\mu g/m^3$)	VOC Inhalation Concentration ($\mu g/m^3$)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF $(ug/m^3)^{-1}$ [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
PAHs													
Benzo(a)anthracene	1.80	6.0E-08	5.2E-08	3.1E-08	na	7.3E-01	7.3E-01	1.1E-04	4.4E-08	3.8E-08	3.4E-12	na	8.2E-08
Benzo(a)pyrene	1.62	5.4E-08	4.7E-08	2.8E-08	na	7.3E+00	7.3E+00	1.1E-03	4.0E-07	3.4E-07	3.1E-11	na	7.4E-07
Benzo(b)fluoranthene	2.08	7.0E-08	6.0E-08	3.6E-08	na	7.3E-01	7.3E-01	1.1E-04	5.1E-08	4.4E-08	4.0E-12	na	9.5E-08
Indeno(1,2,3-c,d)Pyrene	0.818	2.7E-08	2.4E-08	1.4E-08	na	7.3E-01	7.3E-01	1.1E-04	2.0E-08	1.7E-08	1.6E-12	na	3.7E-08
												ILCR	1E-06

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area C sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
$\mu g/m^3$ - micrograms per cubic meter
ILCR - Incremental lifetime cancer risk
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
UCL - upper confidence limit
URF - unit risk factor

Table I-49 Cancer Calculation for a Hypothetical Future Resident - Area C - Surface Soil

Chemical of Potential Concern	Surface Soil Concentration[a] (mg/Kg)	Soil Ingestion Dose (mg/Kg-d)	Soil Dermal Dose (mg/Kg-d)	Dust Inhalation Concentration (μg/m³)	VOC Inhalation Concentration (μg/m³)	Cancer Slope Factor (mg/Kg-d)-1 b Oral	Cancer Slope Factor (mg/Kg-d)-1 b Dermal	URF (ug/m3)-1 [b] Inhalation	Pathway-Specific Cancer Risk Soil Ingestion	Pathway-Specific Cancer Risk Dermal	Pathway-Specific Cancer Risk Dust Inhalation	Pathway-Specific Cancer Risk VOC Inhalation	Chemical-Specific Risk
PAHs													
Benzo(a)anthracene	1.80	2.3E-06	9.8E-07	5.0E-07	na	7.3E-01	7.3E-01	1.1E-04	1.7E-06	7.1E-07	5.5E-11	na	2.4E-06
Benzo(a)pyrene	1.62	2.1E-06	8.8E-07	4.5E-07	na	7.3E+00	7.3E+00	1.1E-03	1.5E-05	6.4E-06	5.0E-10	na	2.2E-05
Benzo(b)fluoranthene	2.08	2.7E-06	1.1E-06	5.8E-07	na	7.3E-01	7.3E-01	1.1E-04	2.0E-06	8.2E-07	6.4E-11	na	2.8E-06
Indeno(1,2,3-c,d)Pyrene	0.818	1.1E-06	4.4E-07	2.3E-07	na	7.3E-01	7.3E-01	1.1E-04	7.8E-07	3.2E-07	2.5E-11	na	1.1E-06
												ILCR	3E-05

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area C sampling locations.

[b] Doses and risks shown only for carcinogenic chemicals with available toxicity values.

% - percent
μg/m³ - micrograms per cubic meter
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
mg/Kg-d - milligrams per kilogram per day
na - not available
PAH - polycyclic aromatic hydrocarbon
UCL - upper confidence limit
URF - unit risk factor

Table I-50 Summary of Human Health Risk Estimates - Area C - Surface Soil

Surface Soil Constituent	Concentration[a] (mg/Kg)			Current/Future Site Worker		Current/Future Site Visitor		Hypothetical Future Resident	
	Maximum	95% UCL	EPC[b]	ILCR	HQ	ILCR	HQ	ILCR	HQ
Non-Petroleum Hydrocarbons									
Benzo(a)anthracene	1.80	NC	1.80	8.5E-07	NA	8.2E-08	NA	2.4E-06	NA
Benzo(a)pyrene	1.62	NC	1.62	7.7E-06	NA	7.4E-07	NA	**2.2E-05**	NA
Benzo(b)fluoranthene	2.08	NC	2.08	9.9E-07	NA	9.5E-08	NA	2.8E-06	NA
Indeno(1,2,3-c,d)Pyrene	0.818	NC	0.818	3.9E-07	NA	3.7E-08	NA	1.1E-06	NA
Cumulative ILCR / HI:				1E-05	NA	1E-06	NA	**3E-05**	NA
ADEC Risk Range:				10^{-5}	1				
USEPA Risk Range:				10^{-6} - 10^{-4}	1				

Notes:

[a] Maximum detected concentration or 95% UCL on the mean concentration measured in surface soil samples collected from Area C sampling locations.

[b] The EPC is the lower of the maximum or 95% UCL concentration. For analytes with either fewer than 5 detects, or, if 5 or more detects, a detection frequency of less than 20%, the EPC is equal to the maximum detected concentration.

Bold indicates exceedance of the USEPA's risk management range and/or ADEC acceptable risk criteria.

% - percent
ADEC - Alaska Department of Environmental Conservation
EPC - exposure point concentration
HI - hazard index
HQ - hazard quotient
ILCR - incremental lifetime cancer risk
mg/Kg - milligrams per kilogram
NA - not applicable
UCL - upper confidence limit
USEPA - U. S. Environmental Protection Agency

APPENDIX J

Ecological Exposure Dose Equations

APPENDIX J ECOLOGICAL EXPOSURE DOSE EQUATIONS

Food Ingestion Rate Calculations

Food ingestion rates (FIR) for each indicator receptor were calculated using allometric equations provided in *Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles and Birds* (Nagy, 2001). Equations for deriving FIR values for ecological receptors provided in Nagy (2001) are based on established relationships between body size and metabolic requirements. Food ingestion rates expressed in grams of food (dry weight) per day for each receptor were calculated based on the following equations:

Tundra vole (equation for mammalian herbivore):

FIR (g dry wt/day) = 0.859 x Wt $^{0.628}$ (g)

Masked shrew (equation for mammalian invertivore):

FIR (g dry wt/day) = 0.373 x Wt $^{0.622}$ (g)

Least weasel (equation for mammalian carnivore):

FIR (g dry wt/day) = 0.153 x Wt $^{0.834}$ (g)

Northern Bog Lemming (equation for mammalian herbivore):

FIR (g dry wt/day) = 0.859 x Wt $^{0.628}$ (g)

Dark-eyed junco (equation for avian herbivore):

FIR (g dry wt/day) = 0.630 x Wt $^{0.683}$ (g)

American robin (equation for avian omnivore):

FIR (g dry wt/day) = 0.670 x Wt $^{0.627}$ (g)

Northern shrike (equation for avian invertivore):

FIR (g dry wt/day) = 0.849 x Wt $^{0.663}$ (g)

Mallard (equation for avian omnivore):
FIR (g dry wt/day) = 0.670 x Wt $^{0.627}$ (g)

American Dipper (equation for avian insectivore):
FIR (g dry wt/day) = 0.540 x Wt $^{0.705}$ (g)

Common snipe (equation for avian insectivore):
FIR (g dry wt/day) = 0.540 x Wt $^{0.705}$ (g)

With the exception of the American robin (*Turdus migratorius*), mallard (*Anas platyrhynchos*), and common snipe (*Gallinago gallinago*), diets were assumed to be comprised of 100% plants (herbivores), 100% invertebrates (invertevores) or 100% meat (carnivores). The diet of the American robin was assumed to consist of 30% plant matter and 70% invertebrates, as described in *Wildlife Exposure Factors Handbook* (USEPA, 1993). The diet of the mallard was assumed to consist of 90% plants and 10% invertebrates (CDF&G, 2010), and the diet of the common snipe was assumed to consist of 90% invertebrates and 10% plants (Cornell, 2009).

<u>Water Ingestion Rate Calculations</u>

The water ingestion (WI) rate is used to estimate exposure intake of COPECs through consumption of surface water. Water ingestion rates were calculated based on equations described in *Wildlife Exposure Factors Handbook* (USEPA, 1993b), as follows.

All mammals (Equation 3-17):
$WI\ (L/day) = 0.099 \times Wt^{0.90}\ (kg)$

All birds (Equation 3-15):
$WI\ (L/day) = 0.059 \times Wt^{0.67}\ (kg)$

Notes:

WI	= Water Ingestion Rate
L/day	= Liters per day
kg	= Kilograms
Wt	= Average weight of indicator receptor

<u>Exposure Dose Calculations</u>

The initial step in calculating exposure doses for indicator receptors is calculation of COPEC concentrations in food items.

Average Concentrations of COPECs in Food Items

Food items for indicator receptors include terrestrial plants, invertebrates, and animal prey items. In the absence of measured concentrations in food items, exposure point concentrations (EPCs) in dietary tissues were estimated based on guidance provided in *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs* (USEPA, 2007c). These guidance documents provide methods for estimating COPEC distribution between abiotic media (i.e., soil or surface water) and plant or animal tissues. Inter-media transfer factors, or bioconcentration factors (BCFs), presented in USEPA (2007c) are chemical- or chemical class-specific.

Contaminant Concentrations in Terrestrial Plant Tissues

For the ecological assessment, COPEC concentrations in plants (C_{PLANTS}) were assumed to equal plant concentrations due to root uptake from soil or sediment. The equation used to compute COPEC concentrations in terrestrial plants due to root uptake is:

$C_{PLANTS} = C_{SOIL/SEDIMENT} \times BCF_{S\text{-}P \text{ or } Sd\text{-}P}$

Where:

C_{PLANTS} = Total COPEC concentration in plant tissue (mg COPEC/kg dry tissue).

$C_{SOIL/SEDIMENT}$ = Concentration of COPEC in soil or sediment (mg COPEC/kg dry soil or sediment)

$BCF_{S\text{-}P \text{ or } Sd\text{-}P}$ = Bioconcentration factor between soil or sediment and plant tissue (mg COPEC/kg dry plant tissue divided by mg COPEC/kg dry soil or sediment; kg dry soil or sediment/kg dry tissue).

Values of $BCF_{S\text{-}P \text{ or } Sd\text{-}P}$, or methods for calculating $BCF_{S\text{-}P \text{ or } Sd\text{-}P}$, were derived from the following sources:

- *Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs* (USEPA, 2007c).
- Uptake of Inorganic Chemicals from Soil by Plant Leaves: Regressions of Field Data (Efroymson et al., 2001).
- Literature-derived Bioaccumulation Models for Energetic Compounds in Plants and Soil Invertebrates Technical Memorandum (CH2M Hill, 2005).

Contaminant Concentrations in Invertebrate Prey Tissues

The ERA for NSS Areas considers three invertivore receptors (i.e., the masked shrew, Northern shrike, and American dipper) and three invertebrate consuming omnivore receptors (i.e., the American robin, mallard, and common snipe). COPEC concentrations in invertebrate tissues are modeled based on the following equation:

$$C_{INVERTS} = C_{SOIL/SEDIMENT \text{ or } SURFACE\ WATER} \times BCF_{S\text{-}I,\ Sd\text{-}I \text{ or } SW\text{-}I}$$

Where:

$C_{INVERTS}$ = Total COPEC concentration in invertebrate tissue (mg COPEC/kg dry tissue).

$C_{SOIL/SEDIMENT}$ = Concentration of COPEC in soil or sediment (mg COPEC/kg dry soil or sediment)

$C_{SURFACE\ WATER}$ = Concentration of COPEC in surface water (mg COPEC/L surface water)

$BCF_{S\text{-}I \text{ or } Sd\text{-}I}$ = Bioconcentration factor between soil or sediment and invertebrate tissue (mg COPEC/kg dry invertebrate tissue divided by mg COPEC/kg dry soil or sediment; kg dry soil or sediment/kg dry tissue).

$BCF_{SW\text{-}I}$ = Bioconcentration factor between surface water and invertebrate tissue (mg COPEC/kg dry invertebrate tissue divided by mg COPEC/L surface water; L surface water/kg dry tissue).

Values of $BCF_{S\text{-}I,\ Sd\text{-}I\ or\ SW\text{-}I}$, or methods for calculating $BCF_{S\text{-}I,\ Sd\text{-}I\ or\ SW\text{-}I}$, were derived from the following sources:

- *Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs* (USEPA, 2007c).
- *Development and Validation of Bioaccumulation Models for Earthworms.* Table 11 (Sample et al., 1998b).
- Literature-derived Bioaccumulation Models for Energetic Compounds in Plants and Soil Invertebrates Technical Memorandum (CH2M Hill, 2005).
- Biota-Sediment Accumulation Factors for Invertebrates (Bechtel Jacobs, 1998).

Contaminant Concentrations in Mammalian Prey Tissues

The ERA for NSS Areas considers one carnivorous receptor (i.e., the least weasel). COPEC concentrations in mammalian prey tissues are modeled based on the following equation:

$$C_{MAMMAL} = C_{SOIL} \times BCF_{S\text{-}M}$$

Where:

C_{MAMMAL}	= COPEC concentration in mammalian prey tissue (mg/kg dry tissue)
C_{SOIL}	= COPEC concentration in soil (mg/kg dry soil)
$BCF_{S\text{-}M}$	= Bioconcentration factor between soil and mammal tissue (mg COPEC/kg dry mammal tissue divided by mg COPEC/kg dry soil; kg dry soil /kg dry tissue).

Values of $BCF_{S\text{-}M}$, or methods for calculating $BCF_{S\text{-}M}$, were derived from the following sources:

- *Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs* (USEPA, 2007c).
- *Development and Validation of Bioaccumulation Models for Small Mammals.* Table 7 and Appendix B (Sample et al., 1998a).

Ingestion Dose Calculation

Exposure dose calculation consolidates all exposure pathways and routes, exposure point concentrations (EPCs), and exposure parameters into an equation that provides an exposure dose estimate in units of mg/kg-day.

Ingestion dose estimates were calculated using the following general equations derived from USEPA's Wildlife Exposure Factors Handbook (USEPA, 1993b):

$$Dose_{\ Ingestion} = \frac{[(IR_{Biotic} \times EPC_{Biotic}) + (IR_{Abiotic} \times EPC_{Abiotic})] \times ED \times SUF}{BW}$$

Where:

$Dose_{\ Ingestion}$	= Estimated exposure dose from ingestion of food and ingestion of abiotic media (mg/kg-day)

IR_{Biotic}	= Food ingestion rate (kg tissue dry wt./day)
C_{Biotic}	= Concentration of COPEC in food items (mg COPEC/kg dry wt.)
$IR_{Abiotic}$	= Abiotic media ingestion rate (kg soil or sediment dry wt./day)
$EPC_{Abiotic}$	= Concentration of COPEC in abiotic media (kg COPEC /kg dry wt. soil or sediment)
ED	= Exposure duration (unitless)
SUF	= Site utilization factor (unitless)
BW	= Body weight (kg)

Ecological Hazard Calculation

Estimated exposure doses for each chemical and indicator receptor were compared to ecological TRVs to calculate a chemical-specific HQ and a total cumulative HI for each toxicological endpoint at each Site. The equation for calculating HQ is:

$$HQ = \frac{Dose}{TRV}$$

Where:

HQ	= Hazard quotient (unitless)
Dose	= Modeled exposure dose for indicator species (mg/kg-day)
TRV	= Toxicity reference value for the indicator species (mg/kg-day)

HI were calculated by summing the HQs obtained from food chain modeling for all COPECs identified at NSS Areas, for each indicator receptor and toxicological endpoint.

APPENDIX K

Ecological Hazard Calculations

Table K-1 Ecological Hazard Calculations for Tundra Vole - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	9.84	0.038	3.7E-01	1.2E-01	1.9E+00	0.062
Barium	592	0.156	9.2E+01	2.1E+01	6.7E+01	0.31
Cadmium	9.62	Regression	2.1E+00	4.7E-01	1.3E+00	0.36
Chromium, Hexavalent	0.890	0.041	3.6E-02	1.1E-02	1.0E+01	0.0011
Lead	386	Regression	7.5E+00	3.3E+00	7.2E+00	0.45
Mercury	0.398	Regression	2.2E-01	4.6E-02	2.1E+00	0.022
Nickel	29.9	Regression	1.4E+00	4.1E-01	1.4E+00	0.29
Selenium	1.57	Regression	8.3E-01	1.7E-01	6.1E-01	0.28
Silver	14.8	0.014	2.1E-01	1.1E-01	2.2E+01	0.005
Vanadium	75.6	0.005	3.7E-01	4.3E-01	4.0E+00	0.11
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0156	1.558	2.4E-02	4.9E-03	1.8E+00	0.0027
1,3,5-Trimethylbenzene	0.0322	1.74	5.6E-02	1.1E-02	1.8E+00	0.0063
Carbon disulfide	0.000170	--	0.0E+00	8.0E-07	2.4E+01	0.000000034
n-Propylbenzene	0.0219	1.509	3.3E-02	6.6E-03	7.8E+01	0.000085
p-Isopropyltoluene	0.0137	1.216	1.7E-02	3.3E-03	1.8E+00	0.0019
Semivolatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	2.12	--	0.0E+00	1.0E-02	1.6E+01	0.00063
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	0.646	Regression	2.6E-01	5.5E-02	9.6E+01	0.00057
Benzo(a)anthracene	1.78	Regression	9.4E-02	2.7E-02	5.7E-01	0.048
Benzo(a)pyrene	1.37	Regression	1.7E-01	4.0E-02	5.7E-01	0.071
Benzo(b)fluoranthene	2.37	0.31	7.3E-01	1.6E-01	5.7E-01	0.27
Benzo(k)fluoranthene	0.956	Regression	1.1E-01	2.6E-02	5.7E-01	0.047
Dibenz(a,h)anthracene	0.493	0.13	6.4E-02	1.5E-02	5.7E-01	0.026
Indeno(1,2,3-c,d)Pyrene	0.664	0.309	2.1E-01	4.4E-02	5.7E-01	0.077
Naphthalene	0.0719	12.2	8.8E-01	1.7E-01	9.6E+01	0.0018
Phenanthrene	1.70	Regression	1.2E+00	2.4E-01	9.6E+01	0.0025
Pyrene	3.55	0.72	2.6E+00	5.2E-01	5.7E-01	0.92

Table K-1 Ecological Hazard Calculations for Tundra Vole - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	651	--	0.0E+00	3.1E+00	9.6E+01	0.032
Gasoline Range Organics (GRO)	1.80	--	0.0E+00	8.5E-03	2.3E+01	0.00037
Residual Range organics (RRO)	1,505	--	0.0E+00	7.1E+00	5.7E-01	**13**

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0525	kg
Food Ingestion Rate (FIR):	0.010	kg (dry wt)/day
FIR_Plants (100%)	0.010	kg (dry wt)/day
FIR_Soil (2.4%)	0.00025	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	0.067	acres
Water Ingestion Rate:	0.0070	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a tundra vole accounts for exposure to soil based upon foraging habits of the vole.

Table K-2 Ecological Hazard Calculations for Masked Shrew - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	9.84	Regression	1.2E+00	3.1E-01	3.6E+00	0.086
Barium	592	0.091	5.4E+01	1.4E+01	1.2E+02	0.12
Cadmium	9.62	Regression	5.0E+01	1.1E+01	2.4E+00	**4.4**
Chromium, Hexavalent	0.890	0.31	2.7E-01	6.2E-02	1.9E+01	0.0032
Lead	386	Regression	9.8E+01	2.3E+01	1.3E+01	**1.7**
Mercury	0.398	Regression	4.5E-01	9.8E-02	3.9E+00	0.025
Nickel	29.9	--	0.0E+00	1.5E-01	2.6E+00	0.058
Selenium	1.57	Regression	1.3E+00	2.8E-01	1.1E+00	0.25
Silver	14.8	2.0	3.0E+01	6.5E+00	4.0E+01	0.16
Vanadium	75.6	0.042	3.2E+00	1.1E+00	7.5E+00	0.14
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0156	Log Kow model	1.7E-01	3.5E-02	3.3E+00	0.011
1,3,5-Trimethylbenzene	0.0322	Log Kow model	3.1E-01	6.7E-02	3.3E+00	0.020
Carbon disulfide	0.000170	Log Kow model	8.7E-04	1.8E-04	4.4E+01	0.0000042
n-Propylbenzene	0.0219	Log Kow model	2.4E-01	5.1E-02	1.4E+02	0.00035
p-Isopropyltoluene	0.0137	Log Kow model	1.8E-01	3.8E-02	3.3E+00	0.012
Semivolatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	2.12	Log Kow model	1.3E+02	2.8E+01	2.9E+01	0.94
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	0.646	2.4	1.6E+00	3.3E-01	1.8E+02	0.0019
Benzo(a)anthracene	1.78	1.6	2.8E+00	6.1E-01	1.0E+00	0.58
Benzo(a)pyrene	1.37	1.3	1.8E+00	3.9E-01	1.0E+00	0.37
Benzo(b)fluoranthene	2.37	2.6	6.2E+00	1.3E+00	1.0E+00	**1.3**
Benzo(k)fluoranthene	0.956	2.6	2.5E+00	5.3E-01	1.0E+00	0.51
Dibenz(a,h)anthracene	0.493	2.3	1.1E+00	2.4E-01	1.0E+00	0.23
Indeno(1,2,3-c,d)Pyrene	0.664	2.9	1.9E+00	4.0E-01	1.0E+00	0.39
Naphthalene	0.0719	4.4	3.2E-01	6.7E-02	1.8E+02	0.00038
Phenanthrene	1.70	1.7	2.9E+00	6.3E-01	1.8E+02	0.0035
Pyrene	3.55	1.8	6.2E+00	1.3E+00	1.0E+00	**1.3**

Table K-2 Ecological Hazard Calculations for Masked Shrew - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	651	--	0.0E+00	3.3E+00	1.8E+02	0.018
Gasoline Range Organics (GRO)	1.80	--	0.0E+00	9.1E-03	4.2E+01	0.00022
Residual Range organics (RRO)	1,505	--	0.0E+00	7.6E+00	1.0E+00	**7.3**

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0045	kg
Food Ingestion Rate (FIR):	0.00095	kg (dry wt)/day
FIR_Inverts (100%)	0.00095	kg (dry wt)/day
FIR_Soil (2.4%)	0.000023	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	1.1	acres
Exposure area:	3.8	acres
Water Ingestion Rate:	0.0007648	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a masked shrew accounts for exposure to soil based upon foraging habits of the shrew.

Table K-3 Ecological Hazard Calculations for Least Weasel - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-M}	Exposure Point Concentration C_{MAMMAL} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	9.84	Regression	5.1E-02	2.7E-02	2.0E+00	0.013
Barium	592	0.0075	4.4E+00	1.7E+00	7.0E+01	0.025
Cadmium	9.62	Regression	8.3E-01	8.9E-02	1.4E+00	0.066
Chromium, Hexavalent	0.890	Regression	2.1E-01	1.9E-02	1.1E+01	0.0018
Lead	386	Regression	1.5E+01	2.1E+00	7.6E+00	0.28
Mercury	0.398	0.2	7.6E-02	7.1E-03	2.2E+00	0.0033
Nickel	29.9	Regression	3.8E+00	3.8E-01	1.5E+00	0.26
Selenium	1.57	Regression	7.8E-01	6.7E-02	6.4E-01	0.11
Silver	14.8	0.0	5.9E-02	3.9E-02	2.3E+01	0.0017
Vanadium	75.6	0.0	9.3E-01	2.5E-01	4.2E+00	0.059
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0156	--	0.0E+00	3.6E-05	1.9E+00	0.000019
1,3,5-Trimethylbenzene	0.0322	--	0.0E+00	7.3E-05	1.9E+00	0.000039
Carbon disulfide	0.000170	--	0.0E+00	3.9E-07	2.5E+01	0.000000016
n-Propylbenzene	0.0219	--	0.0E+00	5.0E-05	8.1E+01	0.0000006
p-Isopropyltoluene	0.0137	--	0.0E+00	3.1E-05	1.9E+00	0.000017
Semivolatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	2.12	--	0.0E+00	4.8E-03	1.7E+01	0.00029
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	0.646	0	0.0E+00	1.5E-03	1.0E+02	0.000015
Benzo(a)anthracene	1.78	0	0.0E+00	4.1E-03	5.9E-01	0.0069
Benzo(a)pyrene	1.37	0	0.0E+00	3.1E-03	5.9E-01	0.0053
Benzo(b)fluoranthene	2.37	0	0.0E+00	5.4E-03	5.9E-01	0.0091
Benzo(k)fluoranthene	0.956	0	0.0E+00	2.2E-03	5.9E-01	0.0037
Dibenz(a,h)anthracene	0.493	0	0.0E+00	1.1E-03	5.9E-01	0.0019
Indeno(1,2,3-c,d)Pyrene	0.664	0	0.0E+00	1.5E-03	5.9E-01	0.0026
Naphthalene	0.0719	0	0.0E+00	1.6E-04	1.0E+02	0.0000016
Phenanthrene	1.70	0	0.0E+00	3.9E-03	1.0E+02	0.00004
Pyrene	3.55	0	0.0E+00	8.1E-03	5.9E-01	0.014

Table K-3 Ecological Hazard Calculations for Least Weasel - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	$BCF_{S\text{-}M}$	Exposure Point Concentration C_{MAMMAL} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	651	--	0.0E+00	1.5E+00	1.0E+02	0.015
Gasoline Range Organics (GRO)	1.80	--	0.0E+00	4.1E-03	2.4E+01	0.00017
Residual Range organics (RRO)	1,505	--	0.0E+00	3.4E+00	5.9E-01	**5.8**

Notes:

-- not available

$BCF_{S\text{-}M}$ - bioconcentration factor from soil to mammals

COPEC - chemical of potential ecological concern

HQ - hazard quotient

Kg - kilogram(s)

L - liter(s)

mg/Kg - milligrams per kilogram

mg/Kg-day - milligrams per kilogram per day

wt - weight

Body Weight:	0.045	kg
Food Ingestion Rate (FIR):	0.0037	kg (dry wt)/day
FIR_Mammals (100%)	0.0037	kg (dry wt)/day
FIR_Soil (2.8%)	0.00010	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	2.9	acres
Exposure area:	3.8	acres

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.

[b] The ingestion dose for a least weasel accounts for exposure to soil based upon foraging habits of the weasel.

Table K-4 Ecological Hazard Calculations for American Robin - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Inorganics								
Arsenic	9.84	0.038	3.7E-01	Regression	1.2E+00	2.2E-02	4.7E+00	0.0047
Barium	592	0.156	9.2E+01	0.0910	5.4E+01	1.4E+00	2.3E+01	0.061
Cadmium	9.62	Regression	2.1E+00	Regression	5.0E+01	4.1E-01	2.4E+00	0.17
Chromium, Hexavalent	0.890	0.041	3.6E-02	0.3060	2.7E-01	3.3E-03	--	--
Lead	386	Regression	7.5E+00	Regression	9.8E+01	1.2E+00	3.5E+00	0.35
Mercury	0.398	Regression	2.2E-01	Regression	4.5E-01	4.7E-03	5.2E-01	0.0090
Nickel	29.9	Regression	1.4E+00	--	0.0E+00	3.9E-02	1.2E+01	0.0032
Selenium	1.57	Regression	8.3E-01	Regression	1.3E+00	1.5E-02	4.1E-01	0.035
Silver	14.8	0.014	2.1E-01	2.0450	3.0E+01	2.5E-01	3.4E+00	0.074
Vanadium	75.6	0.005	3.7E-01	0.0420	3.2E+00	1.1E-01	6.5E-01	0.17
Volatile Organic Compounds								
1,2,4-Trimethylbenzene	0.0156	1.558	2.4E-02	Log Kow model	1.7E-01	1.4E-03	--	--
1,3,5-Trimethylbenzene	0.0322	1.740	5.6E-02	Log Kow model	3.1E-01	2.7E-03	--	--
Carbon disulfide	0.000170	--	0.0E+00	Log Kow model	8.7E-04	6.9E-06	--	--
n-Propylbenzene	0.0219	1.509	3.3E-02	Log Kow model	2.4E-01	2.0E-03	--	--
p-Isopropyltoluene	0.0137	1.216	1.7E-02	Log Kow model	1.8E-01	1.5E-03	2.9E+00	0.00051
Semivolatile Organic Compounds (SVOCs)								
bis(2-ethylhexyl) Phthalate	2.12	--	0.0E+00	Log Kow model	1.3E+02	1.0E+00	1.3E+00	0.78
Polynuclear Aromatic Hydrocarbons (PAHs)								
Anthracene	0.646	Regression	2.6E-01	2.4200	1.6E+00	1.4E-02	1.0E+00	0.014
Benzo(a)anthracene	1.78	Regression	9.4E-02	1.5900	2.8E+00	2.4E-02	4.1E+01	0.00060
Benzo(a)pyrene	1.37	Regression	1.7E-01	1.3300	1.8E+00	1.6E-02	4.1E+01	0.00040
Benzo(b)fluoranthene	2.37	0.310	7.3E-01	2.6000	6.2E+00	5.3E-02	4.1E+01	0.0013
Benzo(k)fluoranthene	0.956	Regression	1.1E-01	2.6000	2.5E+00	2.1E-02	4.1E+01	0.00051
Dibenz(a,h)anthracene	0.493	0.130	6.4E-02	2.3100	1.1E+00	9.6E-03	4.1E+01	0.00024
Indeno(1,2,3-c,d)Pyrene	0.664	0.309	2.1E-01	2.8600	1.9E+00	1.6E-02	--	--
Naphthalene	0.0719	12.200	8.8E-01	4.4000	3.2E-01	5.5E-03	7.8E+01	0.000070
Phenanthrene	1.70	Regression	1.2E+00	1.7200	2.9E+00	2.9E-02	1.0E+00	0.028
Pyrene	3.55	0.720	2.6E+00	1.7500	6.2E+00	6.1E-02	1.0E+00	0.059

Table K-4 Ecological Hazard Calculations for American Robin - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Petroleum Hydrocarbons								
Diesel Range Organics (DRO)	651	--	0.0E+00	--	0.0E+00	7.5E-01	7.8E+01	0.010
Gasoline Range Organics (GRO)	1.80	--	0.0E+00	--	0.0E+00	2.1E-03	--	--
Residual Range organics (RRO)	1,505	--	0.0E+00	--	0.0E+00	1.7E+00	4.1E+01	0.042

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.081	kg
Food Ingestion Rate (FIR):	0.0105	kg (dry wt)/day
FIR_Plants (30%)	0.0032	kg (dry wt)/day
FIR_Inverts (70%)	0.0074	kg (dry wt)/day
FIR_Soil (10.4%)	0.0011	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.17	unitless
Home range:	22	acres
Exposure area:	3.8	acres
Water Ingestion Rate:	0.010953098	L/day

[a] Ingestion doses, in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the American robin accounts for exposure to soil based upon foraging habits.

Table K-5 Ecological Hazard Calculations for Dark-eyed Junco - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	9.84	0.038	3.7E-01	1.8E-02	6.4E+00	0.0028
Barium	592	0.156	9.2E+01	2.9E+00	3.1E+01	0.093
Cadmium	9.62	Regression	2.1E+00	6.3E-02	3.3E+00	0.019
Chromium, Hexavalent	0.890	0.041	3.6E-02	1.7E-03	--	--
Lead	386	Regression	7.5E+00	5.2E-01	4.8E+00	0.11
Mercury	0.398	Regression	2.2E-01	6.1E-03	7.1E-01	0.0086
Nickel	29.9	Regression	1.4E+00	6.1E-02	1.7E+01	0.0037
Selenium	1.57	Regression	8.3E-01	2.3E-02	5.6E-01	0.041
Silver	14.8	0.014	2.1E-01	1.8E-02	4.6E+00	0.0039
Vanadium	75.6	0.005	3.7E-01	7.4E-02	8.8E-01	0.084
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0156	1.558	2.4E-02	6.4E-04	--	--
1,3,5-Trimethylbenzene	0.0322	1.740	5.6E-02	1.5E-03	--	--
Carbon disulfide	0.000170	--	0.0E+00	1.4E-07	--	--
n-Propylbenzene	0.0219	1.509	3.3E-02	8.7E-04	--	--
p-Isopropyltoluene	0.0137	1.216	1.7E-02	4.4E-04	3.9E+00	0.00011
Semivolatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	2.12	--	0.0E+00	1.8E-03	1.8E+00	0.0010
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	0.646	Regression	2.6E-01	7.4E-03	1.4E+00	0.0054
Benzo(a)anthracene	1.78	Regression	9.4E-02	3.9E-03	5.5E+01	0.000071
Benzo(a)pyrene	1.37	Regression	1.7E-01	5.6E-03	5.5E+01	0.00010
Benzo(b)fluoranthene	2.37	0.310	7.3E-01	2.1E-02	5.5E+01	0.00038
Benzo(k)fluoranthene	0.956	Regression	1.1E-01	3.7E-03	5.5E+01	0.000067
Dibenz(a,h)anthracene	0.493	0.130	6.4E-02	2.1E-03	5.5E+01	0.000038
Indeno(1,2,3-c,d)Pyrene	0.664	0.309	2.1E-01	5.9E-03	--	--
Naphthalene	0.0719	12.200	8.8E-01	2.3E-02	1.1E+02	0.00021
Phenanthrene	1.70	Regression	1.2E+00	3.2E-02	1.4E+00	0.023
Pyrene	3.55	0.720	2.6E+00	6.9E-02	1.4E+00	0.050

Table K-5 Ecological Hazard Calculations for Dark-eyed Junco - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	651	--	0.0E+00	5.5E-01	1.1E+02	0.0052
Gasoline Range Organics (GRO)	1.80	--	0.0E+00	1.5E-03	--	--
Residual Range organics (RRO)	1,505	--	0.0E+00	1.3E+00	5.5E+01	0.023

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.024	kg
Food Ingestion Rate (FIR):	0.0055	kg (dry wt)/day
FIR_Plants (100%)	0.0055	kg (dry wt)/day
FIR_Soil (3.3%)	0.000182196	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.22	unitless
Home range:	17	acres
Exposure area:	3.8	acres
Water Ingestion Rate:	0.004848345	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the dark-eyed junco accounts for exposure to soil based upon foraging habits.

Table K-6 Ecological Hazard Calculations for Northern Shrike - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	9.84	Regression	1.2E+00	3.7E-03	4.9E+00	0.00075
Barium	592	0.1	5.4E+01	1.8E-01	2.4E+01	0.0074
Cadmium	9.62	Regression	5.0E+01	1.2E-01	2.5E+00	0.048
Chromium, Hexavalent	0.890	0.3	2.7E-01	7.3E-04	--	--
Lead	386	Regression	9.8E+01	2.7E-01	3.7E+00	0.072
Mercury	0.398	Regression	4.5E-01	1.1E-03	5.5E-01	0.0020
Nickel	29.9	--	0.0E+00	2.4E-03	1.3E+01	0.00019
Selenium	1.57	Regression	1.3E+00	3.2E-03	4.3E-01	0.0075
Silver	14.8	2.0	3.0E+01	7.4E-02	3.6E+00	0.021
Vanadium	75.6	0.0	3.2E+00	1.4E-02	6.8E-01	0.020
Volatile Organic Compounds						
1,2,4-Trimethylbenzene	0.0156	Log Kow model	1.7E-01	4.0E-04	--	--
1,3,5-Trimethylbenzene	0.0322	Log Kow model	3.1E-01	7.6E-04	--	--
Carbon disulfide	0.000170	Log Kow model	8.7E-04	2.1E-06	--	--
n-Propylbenzene	0.0219	Log Kow model	2.4E-01	5.8E-04	--	--
p-Isopropyltoluene	0.0137	Log Kow model	1.8E-01	4.4E-04	3.0E+00	0.00015
Semivolatile Organic Compounds (SVOCs)						
bis(2-ethylhexyl) Phthalate	2.12	Log Kow model	1.3E+02	3.1E-01	1.4E+00	0.23
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	0.646	2.4	1.6E+00	3.8E-03	1.1E+00	0.0036
Benzo(a)anthracene	1.78	1.6	2.8E+00	7.0E-03	4.3E+01	0.00016
Benzo(a)pyrene	1.37	1.3	1.8E+00	4.5E-03	4.3E+01	0.00011
Benzo(b)fluoranthene	2.37	2.6	6.2E+00	1.5E-02	4.3E+01	0.00035
Benzo(k)fluoranthene	0.956	2.6	2.5E+00	6.1E-03	4.3E+01	0.00014
Dibenz(a,h)anthracene	0.493	2.3	1.1E+00	2.8E-03	4.3E+01	0.000065
Indeno(1,2,3-c,d)Pyrene	0.664	2.9	1.9E+00	4.6E-03	--	--
Naphthalene	0.0719	4.4	3.2E-01	7.7E-04	8.1E+01	0.0000094
Phenanthrene	1.70	1.7	2.9E+00	7.2E-03	1.1E+00	0.0067
Pyrene	3.55	1.8	6.2E+00	1.5E-02	1.1E+00	0.014

Table K-6 Ecological Hazard Calculations for Northern Shrike - Upper Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	651	--	0.0E+00	5.2E-02	8.1E+01	0.00063
Gasoline Range Organics (GRO)	1.80	--	0.0E+00	1.4E-04	--	**--**
Residual Range organics (RRO)	1,505	--	0.0E+00	1.2E-01	4.3E+01	0.0028

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0675	kg
Food Ingestion Rate (FIR):	0.0139	kg (dry wt)/day
FIR_Inverts (100%)	0.0139	kg (dry wt)/day
FIR_Soil (3.3%)	0.00046	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.012	unitless
Home range:	320	acres
Exposure area:	3.8	acres
Water Ingestion Rate:	0.00969361	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the Northern shrike accounts for exposure to soil based upon foraging habits.

Table K-7 Ecological Hazard Calculations for Tundra Vole - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	$BCF_{S\text{-}P}$	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	8.15	0.038	3.1E-01	9.9E-02	1.9E+00	0.051
Barium	135	0.156	2.1E+01	4.8E+00	6.7E+01	0.072
Cadmium	2.82	Regression	1.1E+00	2.3E-01	1.3E+00	0.18
Chromium, Hexavalent	4.79	0.041	2.0E-01	6.1E-02	1.0E+01	0.0059
Chromium, Total	31.9	0.041	1.3E+00	4.1E-01	6.0E+00	0.068
Lead	75.0	Regression	3.0E+00	9.4E-01	7.2E+00	0.13
Mercury	0.383	Regression	2.2E-01	4.5E-02	2.1E+00	0.022
Nickel	30.9	Regression	1.4E+00	4.2E-01	1.4E+00	0.30
Selenium	0.365	Regression	1.7E-01	3.5E-02	6.1E-01	0.056
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0388	1.558	6.0E-02	1.2E-02	1.8E+00	0.0068
1,3,5-Trimethylbenzene	0.0239	1.740	4.2E-02	8.3E-03	1.8E+00	0.0046
2-Hexanone	0.00840	--	0.0E+00	4.0E-05	9.6E+00	0.0000041
Carbon disulfide	0.000650	--	0.0E+00	3.1E-06	2.4E+01	0.00000013
Dibenzofuran	1.67	1.203	2.0E+00	4.0E-01	9.6E+01	0.0042
Isopropylbenzene	0.0145	1.533	2.2E-02	4.4E-03	8.8E+01	0.000050
n-Butylbenzene	0.0123	1.049	1.3E-02	2.6E-03	7.8E+01	0.000033
n-Propylbenzene	0.0202	1.509	3.0E-02	6.1E-03	7.8E+01	0.000078
p-Isopropyltoluene	0.0107	1.216	1.3E-02	2.6E-03	1.8E+00	0.0015
trans-1,3-Dichloropropene	0.000270	--	0.0E+00	1.3E-06	8.2E+00	0.00000016
Trichloroethylene (TCE)	0.0416	--	0.0E+00	2.0E-04	6.1E-01	0.00032
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.39	--	0.0E+00	6.6E-03	2.7E+01	0.00025
bis(2-ethylhexyl) Phthalate	5.44	--	0.0E+00	2.6E-02	1.6E+01	0.0016
Pentachlorophenol	46.5	5.93	2.8E+02	5.4E+01	1.3E+01	**4.2**

Table K-7 Ecological Hazard Calculations for Tundra Vole - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	5.82	Regression	1.5E+00	3.2E-01	9.6E+01	0.0033
Benzo(a)anthracene	7.98	Regression	2.3E-01	8.3E-02	5.7E-01	0.15
Benzo(a)pyrene	7.74	Regression	9.4E-01	2.2E-01	5.7E-01	0.39
Benzo(b)fluoranthene	8.66	0.31	2.7E+00	5.7E-01	5.7E-01	1.0
Benzo(k)fluoranthene	1.86	Regression	2.0E-01	4.8E-02	5.7E-01	0.084
Chrysene	9.55	Regression	2.6E-01	9.5E-02	5.7E-01	0.17
Dibenz(a,h)anthracene	6.12	0.13	8.0E-01	1.9E-01	5.7E-01	0.33
Indeno(1,2,3-c,d)Pyrene	2.42	0.309	7.5E-01	1.6E-01	5.7E-01	0.28
Naphthalene	0.595	12.2	7.3E+00	1.4E+00	9.6E+01	0.015
Phenanthrene	13.0	Regression	4.2E+00	8.8E-01	9.6E+01	0.0091
Pyrene	17.1	0.72	1.2E+01	2.5E+00	5.7E-01	**4.4**
Energetics						
Perchlorate	0.000423	Regression	1.1E-01	2.3E-02	1.86E+01	0.0012
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	2,123	--	0.0E+00	1.0E+01	9.6E+01	0.10
Gasoline Range Organics (GRO)	2.66	--	0.0E+00	1.3E-02	2.3E+01	0.00055
Residual Range organics (RRO)	4,601	--	0.0E+00	2.2E+01	5.7E-01	**38**

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0525	kg
Food Ingestion Rate (FIR):	0.010	kg (dry wt)/day
FIR_Plants (100%)	0.010	kg (dry wt)/day
FIR_Soil (2.4%)	0.00025	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	0.067	acres
Exposure area:	19	acres

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a tundra vole accounts for exposure to soil based upon foraging habits of the vole.

Table K-8 Ecological Hazard Calculations for Masked Shrew - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	8.15	Regression	1.1E+00	2.7E-01	3.6E+00	0.074
Barium	135	0.091	1.2E+01	3.3E+00	1.2E+02	0.027
Cadmium	2.82	Regression	1.9E+01	4.0E+00	2.4E+00	**1.7**
Chromium, Hexavalent	4.79	0.31	1.5E+00	3.3E-01	1.9E+01	0.017
Chromium, Total	31.9	0.31	9.8E+00	2.2E+00	1.1E+01	0.20
Lead	75.0	Regression	2.6E+01	5.9E+00	1.3E+01	0.44
Mercury	0.383	Regression	4.5E-01	9.7E-02	3.9E+00	0.025
Nickel	30.9	--	0.0E+00	1.6E-01	2.6E+00	0.060
Selenium	0.365	Regression	4.4E-01	9.5E-02	1.1E+00	0.084
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0388	Log Kow model	4.2E-01	8.8E-02	3.3E+00	0.027
1,3,5-Trimethylbenzene	0.0239	Log Kow model	2.3E-01	4.9E-02	3.3E+00	0.015
2-Hexanone	0.00840	--	0.0E+00	4.3E-05	1.8E+01	0.0000024
Carbon disulfide	0.000650	Log Kow model	3.3E-03	7.0E-04	4.4E+01	0.000016
Dibenzofuran	1.67	Log Kow model	2.2E+01	4.7E+00	1.8E+02	0.026
Isopropylbenzene	0.0145	Log Kow model	1.6E-01	3.3E-02	1.6E+02	0.00020
n-Butylbenzene	0.0123	Log Kow model	1.8E-01	3.9E-02	1.4E+02	0.00027
n-Propylbenzene	0.0202	Log Kow model	2.2E-01	4.7E-02	1.4E+02	0.00033
p-Isopropyltoluene	0.0107	Log Kow model	1.4E-01	3.0E-02	3.3E+00	0.0090
trans-1,3-Dichloropropene	0.000270	--	0.0E+00	1.4E-06	1.5E+01	0.000000090
Trichloroethylene (TCE)	0.0416	Log Kow model	2.6E-01	5.6E-02	1.1E+00	0.049
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.39	Log Kow model	6.9E+00	1.5E+00	4.9E+01	0.030
bis(2-ethylhexyl) Phthalate	5.44	Log Kow model	3.3E+02	7.1E+01	2.9E+01	**2.4**
Pentachlorophenol	46.5	14.6	6.8E+02	1.4E+02	2.4E+01	**6.1**

Table K-8 Ecological Hazard Calculations for Masked Shrew - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	5.82	2.4	1.4E+01	3.0E+00	1.8E+02	0.017
Benzo(a)anthracene	7.98	1.6	1.3E+01	2.7E+00	1.0E+00	**2.6**
Benzo(a)pyrene	7.74	1.3	1.0E+01	2.2E+00	1.0E+00	**2.1**
Benzo(b)fluoranthene	8.66	2.6	2.3E+01	4.8E+00	1.0E+00	**4.6**
Benzo(k)fluoranthene	1.86	2.6	4.8E+00	1.0E+00	1.0E+00	1.0
Chrysene	9.55	2.3	2.2E+01	4.7E+00	1.0E+00	**4.5**
Dibenz(a,h)anthracene	6.12	2.3	1.4E+01	3.0E+00	1.0E+00	**2.9**
Indeno(1,2,3-c,d)Pyrene	2.42	2.9	6.9E+00	1.5E+00	1.0E+00	**1.4**
Naphthalene	0.595	4.4	2.6E+00	5.6E-01	1.8E+02	0.0031
Phenanthrene	13.0	1.7	2.2E+01	4.8E+00	1.8E+02	0.027
Pyrene	17.1	1.8	3.0E+01	6.4E+00	1.0E+00	**6.1**
Energetics						
Perchlorate	0.000423	0.28	1.2E-04	2.7E-05	3.45E+01	0.00000079
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	2,123	--	0.0E+00	1.1E+01	1.8E+02	0.060
Gasoline Range Organics (GRO)	2.66	--	0.0E+00	1.3E-02	4.2E+01	0.00032
Residual Range organics (RRO)	4,601	--	0.0E+00	2.3E+01	1.0E+00	**22**

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0045	kg
Food Ingestion Rate (FIR):	0.00095	kg (dry wt)/day
FIR_Inverts (100%)	0.00095	kg (dry wt)/day
FIR_Soil (2.4%)	0.000023	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	1.1	acres
Exposure area:	19	acres
Water Ingestion Rate:	0.0007648	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a masked shrew accounts for exposure to soil based upon foraging habits of the shrew.

Table K-9 Ecological Hazard Calculations for Least Weasel - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-M}	Exposure Point Concentration C_{MAMMAL} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	8.15	Regression	4.4E-02	2.2E-02	2.0E+00	0.011
Barium	135	0.0075	1.0E+00	3.9E-01	7.0E+01	0.0056
Cadmium	2.82	Regression	4.6E-01	4.4E-02	1.4E+00	0.033
Chromium, Hexavalent	4.79	Regression	7.3E-01	7.1E-02	1.1E+01	0.0065
Chromium, Total	31.9	Regression	2.9E+00	3.1E-01	6.2E+00	0.050
Lead	75.0	Regression	7.3E+00	7.6E-01	7.6E+00	0.10
Mercury	0.383	0.2	7.4E-02	6.9E-03	2.2E+00	0.0032
Nickel	30.9	Regression	3.9E+00	3.8E-01	1.5E+00	0.26
Selenium	0.365	Regression	4.5E-01	3.8E-02	6.4E-01	0.059
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0388	--	0.0E+00	8.8E-05	1.9E+00	0.000047
1,3,5-Trimethylbenzene	0.0239	--	0.0E+00	5.4E-05	1.9E+00	0.000029
2-Hexanone	0.00840	--	0.0E+00	1.9E-05	1.0E+01	0.0000019
Carbon disulfide	0.000650	--	0.0E+00	1.5E-06	2.5E+01	0.000000060
Dibenzofuran	1.67	--	0.0E+00	3.8E-03	1.0E+02	0.000038
Isopropylbenzene	0.0145	--	0.0E+00	3.3E-05	9.2E+01	0.00000036
n-Butylbenzene	0.0123	--	0.0E+00	2.8E-05	8.1E+01	0.00000035
n-Propylbenzene	0.0202	--	0.0E+00	4.6E-05	8.1E+01	0.00000057
p-Isopropyltoluene	0.0107	--	0.0E+00	2.4E-05	1.9E+00	0.000013
trans-1,3-Dichloropropene	0.000270	--	0.0E+00	6.1E-07	8.5E+00	0.000000072
Trichloroethylene (TCE)	0.0416	--	0.0E+00	9.5E-05	6.3E-01	0.00015
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.39	--	0.0E+00	3.2E-03	2.8E+01	0.00011
bis(2-ethylhexyl) Phthalate	5.44	--	0.0E+00	1.2E-02	1.7E+01	0.00075
Pentachlorophenol	46.5	Regression	1.2E+00	2.1E-01	1.3E+01	0.015

Table K-9 Ecological Hazard Calculations for Least Weasel - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-M}	Exposure Point Concentration C_{MAMMAL} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	5.82	0	0.0E+00	1.3E-02	1.0E+02	0.00013
Benzo(a)anthracene	7.98	0	0.0E+00	1.8E-02	5.9E-01	0.031
Benzo(a)pyrene	7.74	0	0.0E+00	1.8E-02	5.9E-01	0.030
Benzo(b)fluoranthene	8.66	0	0.0E+00	2.0E-02	5.9E-01	0.033
Benzo(k)fluoranthene	1.86	0	0.0E+00	4.2E-03	5.9E-01	0.0072
Chrysene	9.55	0	0.0E+00	2.2E-02	5.9E-01	0.037
Dibenz(a,h)anthracene	6.12	0	0.0E+00	1.4E-02	5.9E-01	0.024
Indeno(1,2,3-c,d)Pyrene	2.42	0	0.0E+00	5.5E-03	5.9E-01	0.0093
Naphthalene	0.595	0	0.0E+00	1.4E-03	1.0E+02	0.000013
Phenanthrene	13.0	0	0.0E+00	3.0E-02	1.0E+02	0.00030
Pyrene	17.1	0	0.0E+00	3.9E-02	5.9E-01	0.066
Energetics						
Perchlorate	0.000423	--	0.0E+00	9.6E-07	1.9E+01	0.000000050
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	2,123	--	0.0E+00	4.8E+00	1.0E+02	0.048
Gasoline Range Organics (GRO)	2.66	--	0.0E+00	6.1E-03	2.4E+01	0.00025
Residual Range organics (RRO)	4,601	--	0.0E+00	1.0E+01	6.2E-01	**17**

Notes:

-- not available
BCF_{S-M} - bioconcentration factor from soil to mammals
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.045	kg
Food Ingestion Rate (FIR):	0.0037	kg (dry wt)/day
FIR_Mammals (100%)	0.0037	kg (dry wt)/day
FIR_Soil (2.8%)	0.00010	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	2.9	acres
Exposure area:	19	acres

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a least weasel accounts for exposure to soil based upon foraging habits of the weasel.

Table K-10 Ecological Hazard Calculations for American Robin - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Inorganics								
Arsenic	8.15	0.038	3.1E-01	Regression	1.1E+00	9.2E-02	4.7E+00	0.019
Barium	135	0.156	2.1E+01	0.0910	1.2E+01	1.6E+00	2.3E+01	0.069
Cadmium	2.82	Regression	1.1E+00	Regression	1.9E+01	7.6E-01	2.4E+00	0.31
Chromium, Hexavalent	4.79	0.041	2.0E-01	0.3060	1.5E+00	8.7E-02	--	**--**
Chromium, Total	31.9	0.041	1.3E+00	0.3060	9.8E+00	5.8E-01	5.1E+00	0.11
Lead	75.0	Regression	3.0E+00	Regression	2.6E+01	1.5E+00	3.5E+00	0.42
Mercury	0.383	Regression	2.2E-01	Regression	4.5E-01	2.3E-02	5.2E-01	0.044
Nickel	30.9	Regression	1.4E+00	--	0.0E+00	2.0E-01	1.2E+01	0.016
Selenium	0.365	Regression	1.7E-01	Regression	4.4E-01	2.2E-02	4.1E-01	0.053
Volatile Organic Compounds (VOCs)								
1,2,4-Trimethylbenzene	0.0388	1.558	6.0E-02	Log Kow model	4.2E-01	1.7E-02	--	**--**
1,3,5-Trimethylbenzene	0.0239	1.740	4.2E-02	Log Kow model	2.3E-01	9.8E-03	--	**--**
2-Hexanone	0.00840	--	0.0E+00	--	0.0E+00	4.8E-05	--	**--**
Carbon disulfide	0.000650	--	0.0E+00	Log Kow model	3.3E-03	1.3E-04	--	**--**
Dibenzofuran	1.67	1.203	2.0E+00	Log Kow model	2.2E+01	9.0E-01	9.2E-01	0.97
Isopropylbenzene	0.0145	1.533	2.2E-02	Log Kow model	1.6E-01	6.5E-03	8.9E-01	0.01
n-Butylbenzene	0.0123	1.049	1.3E-02	Log Kow model	1.8E-01	7.3E-03	--	**--**
n-Propylbenzene	0.0202	1.509	3.0E-02	Log Kow model	2.2E-01	9.1E-03	--	**--**
p-Isopropyltoluene	0.0107	1.216	1.3E-02	Log Kow model	1.4E-01	5.7E-03	2.9E+00	0.0020
trans-1,3-Dichloropropene	0.000270	--	0.0E+00	--	0.0E+00	1.5E-06	--	**--**
Trichloroethylene (TCE)	0.0416	--	0.0E+00	Log Kow model	2.6E-01	1.0E-02	--	**--**
Semivolatile Organic Compounds (SVOCs)								
Benzoic acid	1.39	--	0.0E+00	Log Kow model	6.9E+00	2.7E-01	9.1E-01	0.30
bis(2-ethylhexyl) Phthalate	5.44	--	0.0E+00	Log Kow model	3.3E+02	1.3E+01	1.3E+00	**9.9**
Pentachlorophenol	46.5	5.930	2.8E+02	14.6300	6.8E+02	3.1E+01	1.1E+01	**2.7**
Polynuclear Aromatic Hydrocarbons (PAHs)								
Anthracene	5.82	Regression	1.5E+00	2.4200	1.4E+01	6.0E-01	1.0E+00	0.59
Benzo(a)anthracene	7.98	Regression	2.3E-01	1.5900	1.3E+01	5.4E-01	4.1E+01	0.013
Benzo(a)pyrene	7.74	Regression	9.4E-01	1.3300	1.0E+01	4.5E-01	4.1E+01	0.011
Benzo(b)fluoranthene	8.66	0.310	2.7E+00	2.6000	2.3E+01	9.6E-01	4.1E+01	0.023

Table K-10 Ecological Hazard Calculations for American Robin - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Benzo(k)fluoranthene	1.86	Regression	2.0E-01	2.6000	4.8E+00	2.0E-01	4.1E+01	0.0049
Chrysene	9.55	Regression	2.6E-01	2.2900	2.2E+01	9.0E-01	4.1E+01	0.022
Dibenz(a,h)anthracene	6.12	0.130	8.0E-01	2.3100	1.4E+01	5.9E-01	4.1E+01	0.014
Indeno(1,2,3-c,d)Pyrene	2.42	0.309	7.5E-01	2.8600	6.9E+00	2.9E-01	--	**--**
Naphthalene	0.595	12.200	7.3E+00	4.4000	2.6E+00	2.2E-01	7.8E+01	0.0029
Phenanthrene	13.0	Regression	4.2E+00	1.7200	2.2E+01	1.0E+00	1.0E+00	0.98
Pyrene	17.1	0.720	1.2E+01	1.7500	3.0E+01	1.4E+00	1.0E+00	**1.4**
Energetics								
Perchlorate	0.000423	Regression	1.1E-01	0.2810	1.2E-04	1.9E-03	1.55E+01	0.00012
Petroleum Hydrocarbons								
Diesel Range Organics (DRO)	2,123	--	0.0E+00	--	0.0E+00	1.2E+01	7.8E+01	0.15
Gasoline Range Organics (GRO)	2.66	--	0.0E+00	--	0.0E+00	1.5E-02	--	**--**
Residual Range organics (RRO)	4,601	--	0.0E+00	--	0.0E+00	2.6E+01	4.1E+01	0.64

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.081	kg
Food Ingestion Rate (FIR):	0.0105	kg (dry wt)/day
FIR_Plants (30%)	0.0032	kg (dry wt)/day
FIR_Inverts (70%)	0.0074	kg (dry wt)/day
FIR_Soil (10.4%)	0.0011	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.84	unitless
Home range:	22	acres
Exposure area:	19	acres
Water Ingestion Rate:	0.010953098	L/day

[a] Ingestion doses, in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the American robin accounts for exposure to soil based upon foraging habits.

Table K-11 Ecological Hazard Calculations for Dark-eyed Junco - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	8.15	0.038	3.1E-01	6.6E-02	6.4E+00	0.010
Barium	135	0.156	2.1E+01	2.9E+00	3.1E+01	0.094
Cadmium	2.82	Regression	1.1E+00	1.4E-01	3.3E+00	0.042
Chromium, Hexavalent	4.79	0.041	2.0E-01	4.1E-02	--	**--**
Chromium, Total	31.9	0.041	1.3E+00	2.7E-01	6.9E+00	0.039
Lead	75.0	Regression	3.0E+00	6.3E-01	4.8E+00	0.13
Mercury	0.383	Regression	2.2E-01	2.7E-02	7.1E-01	0.037
Nickel	30.9	Regression	1.4E+00	2.8E-01	1.7E+01	0.017
Selenium	0.365	Regression	1.7E-01	2.1E-02	5.6E-01	0.037
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0388	1.558	6.0E-02	7.1E-03	--	**--**
1,3,5-Trimethylbenzene	0.0239	1.740	4.2E-02	4.9E-03	--	**--**
2-Hexanone	0.00840	--	0.0E+00	3.2E-05	--	**--**
Carbon disulfide	0.000650	--	0.0E+00	2.5E-06	--	**--**
Dibenzofuran	1.67	1.203	2.0E+00	2.4E-01	1.3E+00	0.19
Isopropylbenzene	0.0145	1.533	2.2E-02	2.6E-03	1.2E+00	0.0022
n-Butylbenzene	0.0123	1.049	1.3E-02	1.5E-03	--	**--**
n-Propylbenzene	0.0202	1.509	3.0E-02	3.6E-03	--	**--**
p-Isopropyltoluene	0.0107	1.216	1.3E-02	1.5E-03	3.9E+00	0.00040
trans-1,3-Dichloropropene	0.000270	--	0.0E+00	1.0E-06	--	**--**
Trichloroethylene (TCE)	0.0416	--	0.0E+00	1.6E-04	--	**--**
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.39	--	0.0E+00	5.3E-03	1.2E+00	0.0043
bis(2-ethylhexyl) Phthalate	5.44	--	0.0E+00	2.1E-02	1.8E+00	0.012
Pentachlorophenol	46.5	5.930	2.8E+02	3.2E+01	1.5E+01	**2.1**

Table K-11 Ecological Hazard Calculations for Dark-eyed Junco - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	5.82	Regression	1.5E+00	1.9E-01	1.4E+00	0.14
Benzo(a)anthracene	7.98	Regression	2.3E-01	5.7E-02	5.5E+01	0.0010
Benzo(a)pyrene	7.74	Regression	9.4E-01	1.4E-01	5.5E+01	0.0025
Benzo(b)fluoranthene	8.66	0.310	2.7E+00	3.4E-01	5.5E+01	0.0062
Benzo(k)fluoranthene	1.86	Regression	2.0E-01	3.0E-02	5.5E+01	0.00054
Chrysene	9.55	Regression	2.6E-01	6.6E-02	5.5E+01	0.0012
Dibenz(a,h)anthracene	6.12	0.130	8.0E-01	1.1E-01	5.5E+01	0.0021
Indeno(1,2,3-c,d)Pyrene	2.42	0.309	7.5E-01	9.5E-02	--	**--**
Naphthalene	0.595	12.200	7.3E+00	8.4E-01	1.1E+02	0.0079
Phenanthrene	13.0	Regression	4.2E+00	5.3E-01	1.4E+00	0.38
Pyrene	17.1	0.720	1.2E+01	1.5E+00	1.4E+00	**1.1**
Energetics						
Perchlorate	0.000423	Regression	1.1E-01	1.3E-02	2.11E+01	0.00063
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	2,123	--	0.0E+00	8.1E+00	1.1E+02	0.076
Gasoline Range Organics (GRO)	2.66	--	0.0E+00	1.0E-02	--	**--**
Residual Range organics (RRO)	4,601	--	0.0E+00	1.7E+01	5.5E+01	0.32

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.024	kg
Food Ingestion Rate (FIR):	0.0055	kg (dry wt)/day
FIR_Plants (100%)	0.0055	kg (dry wt)/day
FIR_Soil (3.3%)	0.000182196	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	17	acres
Exposure area:	19	acres
Water Ingestion Rate:	0.004848345	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the dark-eyed junco accounts for exposure to soil based upon foraging habits.

Table K-12 Ecological Hazard Calculations for Northern Shrike - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Arsenic	8.15	Regression	1.1E+00	1.6E-02	4.9E+00	0.0032
Barium	135	0.1	1.2E+01	2.0E-01	2.4E+01	0.0083
Cadmium	2.82	Regression	1.9E+01	2.2E-01	2.5E+00	0.089
Chromium, Hexavalent	4.79	0.3	1.5E+00	1.9E-02	--	**--**
Chromium, Total	31.9	0.3	9.8E+00	1.3E-01	5.3E+00	0.024
Lead	75.0	Regression	2.6E+01	3.4E-01	3.7E+00	0.092
Mercury	0.383	Regression	4.5E-01	5.5E-03	5.5E-01	0.010
Nickel	30.9	--	0.0E+00	1.2E-02	1.3E+01	0.00094
Selenium	0.365	Regression	4.4E-01	5.4E-03	4.3E-01	0.013
Volatile Organic Compounds (VOCs)						
1,2,4-Trimethylbenzene	0.0388	Log Kow model	4.2E-01	5.0E-03	--	**--**
1,3,5-Trimethylbenzene	0.0239	Log Kow model	2.3E-01	2.8E-03	--	**--**
2-Hexanone	0.00840	--	0.0E+00	3.3E-06	--	**--**
Carbon disulfide	0.000650	Log Kow model	3.3E-03	4.0E-05	--	**--**
Dibenzofuran	1.67	Log Kow model	2.2E+01	2.7E-01	9.7E-01	0.27
Isopropylbenzene	0.0145	Log Kow model	1.6E-01	1.9E-03	9.3E-01	0.0020
n-Butylbenzene	0.0123	Log Kow model	1.8E-01	2.2E-03	--	**--**
n-Propylbenzene	0.0202	Log Kow model	2.2E-01	2.6E-03	--	**--**
p-Isopropyltoluene	0.0107	Log Kow model	1.4E-01	1.7E-03	3.0E+00	0.00056
trans-1,3-Dichloropropene	0.000270	--	0.0E+00	1.1E-07	--	**--**
Trichloroethylene (TCE)	0.0416	Log Kow model	2.6E-01	3.1E-03	--	**--**
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.39	Log Kow model	6.9E+00	8.2E-02	9.5E-01	0.087
bis(2-ethylhexyl) Phthalate	5.44	Log Kow model	3.3E+02	4.0E+00	1.4E+00	**2.9**
Pentachlorophenol	46.5	14.6	6.8E+02	8.1E+00	1.2E+01	0.7

Table K-12 Ecological Hazard Calculations for Northern Shrike - Lower Site Summit

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Polynuclear Aromatic Hydrocarbons (PAHs)						
Anthracene	5.82	2.4	1.4E+01	1.7E-01	1.1E+00	0.16
Benzo(a)anthracene	7.98	1.6	1.3E+01	1.5E-01	4.3E+01	0.0036
Benzo(a)pyrene	7.74	1.3	1.0E+01	1.3E-01	4.3E+01	0.0029
Benzo(b)fluoranthene	8.66	2.6	2.3E+01	2.7E-01	4.3E+01	0.0063
Benzo(k)fluoranthene	1.86	2.6	4.8E+00	5.8E-02	4.3E+01	0.0014
Chrysene	9.55	2.3	2.2E+01	2.6E-01	4.3E+01	0.0062
Dibenz(a,h)anthracene	6.12	2.3	1.4E+01	1.7E-01	4.3E+01	0.0040
Indeno(1,2,3-c,d)Pyrene	2.42	2.9	6.9E+00	8.3E-02	--	--
Naphthalene	0.595	4.4	2.6E+00	3.1E-02	8.1E+01	0.00038
Phenanthrene	13.0	1.7	2.2E+01	2.7E-01	1.1E+00	0.25
Pyrene	17.1	1.8	3.0E+01	3.6E-01	1.1E+00	0.34
Energetics						
Perchlorate	0.000423	0.3	1.2E-04	1.6E-06	1.62E+01	0.00000010
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	2,123	--	0.0E+00	8.3E-01	8.1E+01	0.010
Gasoline Range Organics (GRO)	2.66	--	0.0E+00	1.0E-03	--	--
Residual Range organics (RRO)	4,601	--	0.0E+00	1.8E+00	4.3E+01	0.042

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0675	kg
Food Ingestion Rate (FIR):	0.0139	kg (dry wt)/day
FIR_Inverts (100%)	0.0139	kg (dry wt)/day
FIR_Soil (3.3%)	0.00046	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.058	unitless
Home range:	320	acres
Exposure area:	19	acres
Water Ingestion Rate:	0.00969361	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the Northern shrike accounts for exposure to soil based upon foraging habits.

Table K-13 Ecological Hazard Calculations for Tundra Vole - Area A

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a, b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Barium	373	0.156	5.8E+01	1.3E+01	6.7E+01	0.20
Cadmium	1.23	Regression	7.0E-01	1.4E-01	1.3E+00	0.11
Chromium, Hexavalent	0.897	0.041	3.7E-02	1.1E-02	1.0E+01	0.0011
Lead	50.9	Regression	2.4E+00	7.1E-01	7.2E+00	0.10
Nickel	41.1	Regression	1.7E+00	5.4E-01	1.4E+00	0.38
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.42	--	0.0E+00	6.7E-03	2.7E+01	0.00025
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	8,369	--	0.0E+00	4.0E+01	9.6E+01	0.41
Gasoline Range Organics (GRO)	1.62	--	0.0E+00	7.6E-03	2.3E+01	0.00033
Residual Range organics (RRO)	63,887	--	0.0E+00	3.0E+02	5.7E-01	**533**

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.053	kg
Food Ingestion Rate (FIR):	0.010	kg (dry wt)/day
FIR_Plants (100%)	0.010	kg (dry wt)/day
FIR_Soil (2.4%)	0.00025	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	0.067	acres
Exposure area:	1.5	acres
Water Ingestion Rate:	0.0070	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a tundra vole accounts for exposure to soil based upon foraging habits of the vole.

Table K-14 Ecological Hazard Calculations for Masked Shrew - Area A

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Barium	373	0.091	3.4E+01	9.1E+00	1.2E+02	0.073
Cadmium	1.23	Regression	9.8E+00	2.1E+00	2.4E+00	0.86
Chromium, Hexavalent	0.897	0.306	2.7E-01	6.3E-02	1.9E+01	0.0032
Lead	50.9	Regression	1.9E+01	4.3E+00	1.3E+01	0.32
Nickel	41.1	--	0.0E+00	2.1E-01	2.6E+00	0.080
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.42	Log Kow model	7.0E+00	1.5E+00	4.9E+01	0.030
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	8,369	--	0.0E+00	4.2E+01	1.8E+02	0.24
Gasoline Range Organics (GRO)	1.62	--	0.0E+00	8.2E-03	4.2E+01	0.00019
Residual Range organics (RRO)	63,887	--	0.0E+00	3.2E+02	1.0E+00	**309**

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0045	kg
Food Ingestion Rate (FIR):	0.00095	kg (dry wt)/day
FIR_Inverts (100%)	0.00095	kg (dry wt)/day
FIR_Soil (2.4%)	0.000023	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	1.1	acres
Exposure area:	1.5	acres
Water Ingestion Rate:	0.0007648	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a masked shrew accounts for exposure to soil based upon foraging habits of the shrew.

Table K-15 Ecological Hazard Calculations for Least Weasel - Area A

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-M}	Exposure Point Concentration C_{MAMMAL} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Barium	373	0.0075	2.8E+00	5.6E-01	7.0E+01	0.0081
Cadmium	1.23	Regression	3.1E-01	1.5E-02	1.4E+00	0.011
Chromium, Hexavalent	0.897	Regression	2.1E-01	1.0E-02	1.1E+01	0.00094
Lead	50.9	Regression	6.1E+00	3.2E-01	7.6E+00	0.042
Nickel	41.1	Regression	4.4E+00	2.4E-01	1.5E+00	0.16
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.42	--	0.0E+00	1.7E-03	2.8E+01	0.000061
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	8,369	--	0.0E+00	9.9E+00	1.0E+02	0.10
Gasoline Range Organics (GRO)	1.62	--	0.0E+00	1.9E-03	2.4E+01	0.000081
Residual Range organics (RRO)	63,887	--	0.0E+00	7.6E+01	5.9E-01	**129**

Notes:

-- not available
BCF_{S-M} - bioconcentration factor from soil to mammals
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.045	kg
Food Ingestion Rate (FIR):	0.0037	kg (dry wt)/day
FIR_Mammals (100%)	0.0037	kg (dry wt)/day
FIR_Soil (2.8%)	0.00010	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.5	unitless
Home range:	2.9	acres
Exposure area:	1.5	acres

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a least weasel accounts for exposure to soil based upon foraging habits of the weasel.

Table K-16 Ecological Hazard Calculations for Dark-eyed Junco - Area A

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Barium	373	0.156	5.8E+01	7.3E-01	3.1E+01	0.023
Cadmium	1.23	Regression	7.0E-01	7.6E-03	3.3E+00	0.0023
Chromium, Hexavalent	0.897	0.041	3.7E-02	6.9E-04	--	--
Lead	50.9	Regression	2.4E+00	4.2E-02	4.8E+00	0.0088
Nickel	41.1	Regression	1.7E+00	3.2E-02	1.7E+01	0.0019
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.42	--	0.0E+00	4.8E-04	1.2E+00	0.00039
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	8,369	--	0.0E+00	2.9E+00	1.1E+02	0.027
Gasoline Range Organics (GRO)	1.62	--	0.0E+00	5.5E-04	--	--
Residual Range organics (RRO)	63,887	--	0.0E+00	2.2E+01	5.5E+01	0.39

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.024	kg
Food Ingestion Rate (FIR):	0.0055	kg (dry wt)/day
FIR_Plants (100%)	0.0055	kg (dry wt)/day
FIR_Soil (3.3%)	0.000182196	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.090	unitless
Home range:	17	acres
Exposure area:	1.5	acres
Water Ingestion Rate:	0.004848345	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the dark-eyed junco accounts for exposure to soil based upon foraging habits.

Table K-17 Ecological Hazard Calculations for American Robin - Area A

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Inorganics								
Barium	373	0.156	5.8E+01	0.0910	3.4E+01	3.5E-01	2.3E+01	0.015
Cadmium	1.23	Regression	7.0E-01	Regression	9.8E+00	3.2E-02	2.4E+00	0.013
Chromium, Hexavalent	0.897	0.041	3.7E-02	0.3060	2.7E-01	1.3E-03	--	--
Lead	50.9	Regression	2.4E+00	Regression	1.9E+01	8.6E-02	3.5E+00	0.024
Nickel	41.1	Regression	1.7E+00	--	0.0E+00	2.1E-02	1.2E+01	0.0017
Semivolatile Organic Compounds								
Benzoic acid	1.42	--	0.0E+00	Log Kow model	7.0E+00	2.2E-02	9.1E-01	0.025
Petroleum Hydrocarbons								
Diesel Range Organics (DRO)	8,369	--	0.0E+00	--	0.0E+00	3.9E+00	7.8E+01	0.049
Gasoline Range Organics (GRO)	1.62	--	0.0E+00	--	0.0E+00	7.4E-04	--	--
Residual Range organics (RRO)	63,887	--	0.0E+00	--	0.0E+00	2.9E+01	4.1E+01	0.72

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.081	kg
Food Ingestion Rate (FIR):	0.0105	kg (dry wt)/day
FIR_Plants (30%)	0.0032	kg (dry wt)/day
FIR_Inverts (70%)	0.0074	kg (dry wt)/day
FIR_Soil (10.4%)	0.0011	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.068	unitless
Home range:	22	acres
Exposure area:	1.5	acres
Water Ingestion Rate:	0.010953098	L/day

[a] Ingestion doses, in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the American robin accounts for exposure to soil based upon foraging habits.

Table K-18 Ecological Hazard Calculations for Northern Shrike - Area A

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Barium	373	0.1	3.4E+01	4.4E-02	2.4E+01	0.0019
Cadmium	1.23	Regression	9.8E+00	9.5E-03	2.5E+00	0.0038
Chromium, Hexavalent	0.897	0.3	2.7E-01	2.9E-04	--	--
Lead	50.9	Regression	1.9E+01	2.0E-02	3.7E+00	0.0054
Nickel	41.1	--	0.0E+00	1.3E-03	1.3E+01	0.00010
Semivolatile Organic Compounds (SVOCs)						
Benzoic acid	1.42	Log Kow model	7.0E+00	6.8E-03	9.5E-01	0.0072
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	8,369	--	0.0E+00	2.7E-01	8.1E+01	0.0033
Gasoline Range Organics (GRO)	1.62	--	0.0E+00	5.1E-05	--	--
Residual Range organics (RRO)	63,887	--	0.0E+00	2.0E+00	4.3E+01	0.048

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0675	kg
Food Ingestion Rate (FIR):	0.0139	kg (dry wt)/day
FIR_Inverts (100%)	0.0139	kg (dry wt)/day
FIR_Soil (3.3%)	0.00046	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.0047	unitless
Home range:	320	acres
Exposure area:	1.5	acres
Water Ingestion Rate:	0.00969361	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the Northern shrike accounts for exposure to soil based upon foraging habits.

Table K-19 Ecological Hazard Calculations for Tundra Vole - Area C

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Lead	18.5	Regression	1.4E+00	1.6E-01	7.2E+00	0.022
Nickel	37.7	Regression	1.6E+00	2.2E-01	1.4E+00	0.16
Polynuclear Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	1.80	Regression	9.5E-02	1.2E-02	5.7E-01	0.021
Benzo(a)pyrene	1.62	Regression	2.0E-01	2.1E-02	5.7E-01	0.038
Benzo(b)fluoranthene	2.08	0.31	6.4E-01	6.1E-02	5.7E-01	0.11
Benzo(k)fluoranthene	0.599	Regression	7.4E-02	7.8E-03	5.7E-01	0.014
Indeno(1,2,3-c,d)Pyrene	0.818	0.309	2.5E-01	2.4E-02	5.7E-01	0.042
Naphthalene	0.542	12.2	6.6E+00	5.8E-01	9.6E+01	0.0061
Phenanthrene	6.49	Regression	2.7E+00	2.5E-01	9.6E+01	0.0026
Pyrene	4.36	0.72	3.1E+00	2.9E-01	5.7E-01	0.51
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	62.6	--	0.0E+00	1.3E-01	9.6E+01	0.0014
Residual Range organics (RRO)	260	--	0.0E+00	5.5E-01	5.7E-01	0.97

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0525	kg
Food Ingestion Rate (FIR):	0.010	kg (dry wt)/day
FIR_Plants (100%)	0.010	kg (dry wt)/day
FIR_Soil (2.4%)	0.00025	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.448	unitless
Home range:	0.067	acres
Exposure area:	0.030	acres
Water Ingestion Rate:	0.0070	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a tundra vole accounts for exposure to soil based upon foraging habits of the vole.

Table K-20 Ecological Hazard Calculations for Masked Shrew - Area C

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Lead	18.5	Regression	8.5E+00	5.1E-02	1.3E+01	0.0038
Nickel	37.7	--	0.0E+00	5.2E-03	2.6E+00	0.0020
Polynuclear Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	1.80	1.6	2.9E+00	1.7E-02	1.0E+00	0.016
Benzo(a)pyrene	1.62	1.3	2.2E+00	1.3E-02	1.0E+00	0.012
Benzo(b)fluoranthene	2.08	2.6	5.4E+00	3.1E-02	1.0E+00	0.030
Benzo(k)fluoranthene	0.599	2.6	1.6E+00	9.1E-03	1.0E+00	0.0086
Indeno(1,2,3-c,d)Pyrene	0.818	2.9	2.3E+00	1.4E-02	1.0E+00	0.013
Naphthalene	0.542	4.4	2.4E+00	1.4E-02	1.8E+02	0.000077
Phenanthrene	6.49	1.7	1.1E+01	6.5E-02	1.8E+02	0.00037
Pyrene	4.36	1.8	7.6E+00	4.5E-02	1.0E+00	0.043
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	62.6	--	0.0E+00	8.7E-03	1.8E+02	0.000048
Residual Range organics (RRO)	260	--	0.0E+00	3.6E-02	1.0E+00	0.034

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0045	kg
Food Ingestion Rate (FIR):	0.00095	kg (dry wt)/day
FIR_Inverts (100%)	0.00095	kg (dry wt)/day
FIR_Soil (2.4%)	0.000023	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.03	unitless
Home range:	1.1	acres
Exposure area:	0.030	acres
Water Ingestion Rate:	0.0007648	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a masked shrew accounts for exposure to soil based upon foraging habits of the shrew.

Table K-21 Ecological Hazard Calculations for Least Weasel - Area C

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	$BCF_{S\text{-}M}$	Exposure Point Concentration C_{MAMMAL} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Lead	18.5	Regression	3.9E+00	3.8E-03	7.6E+00	0.00050
Nickel	37.7	Regression	4.2E+00	4.5E-03	1.5E+00	0.0031
Polynuclear Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	1.80	0	0.0E+00	4.3E-05	5.9E-01	0.000073
Benzo(a)pyrene	1.62	0	0.0E+00	3.8E-05	5.9E-01	0.000065
Benzo(b)fluoranthene	2.08	0	0.0E+00	4.9E-05	5.9E-01	0.000084
Benzo(k)fluoranthene	0.599	0	0.0E+00	1.4E-05	5.9E-01	0.000024
Indeno(1,2,3-c,d)Pyrene	0.818	0	0.0E+00	1.9E-05	5.9E-01	0.000033
Naphthalene	0.542	0	0.0E+00	1.3E-05	1.0E+02	0.00000013
Phenanthrene	6.49	0	0.0E+00	1.5E-04	1.0E+02	0.0000015
Pyrene	4.36	0	0.0E+00	1.0E-04	5.9E-01	0.00018
Petroleum hydrocarbons						
Diesel Range Organics (DRO)	62.6	--	0.0E+00	1.5E-03	1.0E+02	0.000015
Residual Range organics (RRO)	260	--	0.0E+00	6.2E-03	5.9E-01	0.010

Notes:

-- not available
$BCF_{S\text{-}M}$ - bioconcentration factor from soil to mammals
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.045	kg
Food Ingestion Rate (FIR):	0.0037	kg (dry wt)/day
FIR_Mammals (100%)	0.0037	kg (dry wt)/day
FIR_Soil (2.8%)	0.00010	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.0	unitless
Home range:	2.9	acres
Exposure area:	0.030	acres
Water Ingestion Rate:	0.006074723	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a least weasel accounts for exposure to soil based upon foraging habits of the weasel.

Table K-22 Ecological Hazard Calculations for American Robin - Area C

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Inorganics								
Lead	18.5	Regression	1.4E+00	Regression	8.5E+00	7.3E-04	3.5E+00	0.00021
Nickel	37.7	Regression	1.6E+00	--	0.0E+00	3.9E-04	1.2E+01	0.000032
Polynuclear Aromatic Hydrocarbons								
Benzo(a)anthracene	1.8	Regression	9.5E-02	1.5900	2.9E+00	2.0E-04	4.1E+01	0.0000048
Benzo(a)pyrene	1.62	Regression	2.0E-01	1.3300	2.2E+00	1.5E-04	4.1E+01	0.0000038
Benzo(b)fluoranthene	2.08	0.310	6.4E-01	2.6000	5.4E+00	3.7E-04	4.1E+01	0.0000091
Benzo(k)fluoranthene	0.599	Regression	7.4E-02	2.6000	1.6E+00	1.0E-04	4.1E+01	0.0000026
Indeno(1,2,3-c,d)Pyrene	0.818	0.309	2.5E-01	2.8600	2.3E+00	1.6E-04	--	--
Naphthalene	0.542	12.200	6.6E+00	4.4000	2.4E+00	3.3E-04	7.8E+01	0.0000042
Phenanthrene	6.49	Regression	2.7E+00	1.7200	1.1E+01	8.2E-04	1.0E+00	0.00081
Pyrene	4.36	0.720	3.1E+00	1.7500	7.6E+00	6.0E-04	1.0E+00	0.00058
Petroleum Hydrocarbons								
Diesel Range Organics (DRO)	62.6	--	0.0E+00	--	0.0E+00	5.8E-04	7.8E+01	0.0000074
Residual Range organics (RRO)	260	--	0.0E+00	--	0.0E+00	2.4E-03	4.1E+01	0.000059

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.081	kg
Food Ingestion Rate (FIR):	0.0105	kg (dry wt)/day
FIR_Plants (30%)	0.0032	kg (dry wt)/day
FIR_Inverts (70%)	0.0074	kg (dry wt)/day
FIR_Soil (10.4%)	0.0011	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.0014	unitless
Home range:	22	acres
Exposure area:	0.030	acres

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the American robin accounts for exposure to soil based upon foraging habits.

Table K-23 Ecological Hazard Calculations for Dark-eyed Junco - Area C

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Lead	18.5	Regression	1.4E+00	4.1E-04	4.8E+00	0.000085
Nickel	37.7	Regression	1.6E+00	5.9E-04	1.7E+01	0.000036
Polynuclear Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	1.8	Regression	9.5E-02	3.2E-05	5.5E+01	0.00000057
Benzo(a)pyrene	1.62	Regression	2.0E-01	5.3E-05	5.5E+01	0.00000096
Benzo(b)fluoranthene	2.08	0.310	6.4E-01	1.5E-04	5.5E+01	0.0000027
Benzo(k)fluoranthene	0.599	Regression	7.4E-02	1.9E-05	5.5E+01	0.00000035
Indeno(1,2,3-c,d)Pyrene	0.818	0.309	2.5E-01	5.8E-05	--	**--**
Naphthalene	0.542	12.200	6.6E+00	1.4E-03	1.1E+02	0.000013
Phenanthrene	6.49	Regression	2.7E+00	6.0E-04	1.4E+00	0.00043
Pyrene	4.36	0.720	3.1E+00	6.8E-04	1.4E+00	0.00049
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	62.6	--	0.0E+00	4.3E-04	1.1E+02	0.0000040
Residual Range organics (RRO)	260	--	0.0E+00	1.8E-03	5.5E+01	0.000032

Notes:

-- not available
BCF_{S-P} - bioconcentration factor from soil to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.024	kg
Food Ingestion Rate (FIR):	0.0055	kg (dry wt)/day
FIR_Plants (100%)	0.0055	kg (dry wt)/day
FIR_Soil (3.3%)	0.000182196	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.0018	unitless
Home range:	17	acres
Exposure area:	0.030	acres
Water Ingestion Rate:	0.004848345	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.

[b] The ingestion dose for the dark-eyed junco accounts for exposure to soil based upon foraging habits.

Table K-24 Ecological Hazard Calculations for Northern Shrike - Area C

COPEC	Exposure Point Concentration C_{SOIL} (mg/Kg)	BCF_{S-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons						
Inorganics						
Lead	18.5	Regression	8.5E+00	1.7E-04	3.7E+00	0.000047
Nickel	37.7	--	0.0E+00	2.4E-05	1.3E+01	0.0000019
Polynuclear Aromatic Hydrocarbons						
Benzo(a)anthracene	1.8	1.6	2.9E+00	5.6E-05	4.3E+01	0.0000013
Benzo(a)pyrene	1.62	1.3	2.2E+00	4.3E-05	4.3E+01	0.0000010
Benzo(b)fluoranthene	2.08	2.6	5.4E+00	1.1E-04	4.3E+01	0.0000025
Benzo(k)fluoranthene	0.599	2.6	1.6E+00	3.0E-05	4.3E+01	0.00000071
Indeno(1,2,3-c,d)Pyrene	0.818	2.9	2.3E+00	4.6E-05	--	--
Naphthalene	0.542	4.4	2.4E+00	4.6E-05	8.1E+01	0.00000057
Phenanthrene	6.49	1.7	1.1E+01	2.2E-04	1.1E+00	0.00020
Pyrene	4.36	1.8	7.6E+00	1.5E-04	1.1E+00	0.00014
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	62.6	--	0.0E+00	4.0E-05	8.1E+01	0.00000049
Residual Range organics (RRO)	260	--	0.0E+00	1.7E-04	4.3E+01	0.0000039

Notes:

-- not available
BCF_{S-I} - bioconcentration factor from soil to invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
Kg - kilogram(s)
L - liter(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
wt - weight

Body Weight:	0.0675	kg
Food Ingestion Rate (FIR):	0.0139	kg (dry wt)/day
FIR_Inverts (100%)	0.0139	kg (dry wt)/day
FIR_Soil (3.3%)	0.00046	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.000094	unitless
Home range:	320	acres
Exposure area:	0.030	acres
Water Ingestion Rate:	0.00969361	L/day

[a] Ingestion doses, in units of mg COPEC per kg of body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the Northern shrike accounts for exposure to soil based upon foraging habits.

Table K-25 Evaluation of Potential Effects to Benthic Invertebrates - Area C

Chemical of Potential Ecological Concern	EPC [a] (mg/Kg)	Effects Threshold-Low (mg/Kg)		Effects Threshold-High (mg/Kg)		Potential Effects [b]
Inorganics						
Barium	53.1	48	c	130	d	possible
Nickel	32.5	22.7	e	48.6	f	possible
Selenium	0.284	1	c	4	g	unlikely
Vanadium	50.8	57	c	na		unlikely
Semi-Volatile Organic Compounds (SVOCs)						
Di-n-octylphthalate	0.239	0.061	c	0.750	h,i	unlikely
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	0.0707	0.108	e	1.05	f	unlikely
Chrysene	0.0772	0.166	e	1.29	f	unlikely
Fluoranthene	0.171	0.423	e	2.23	f	unlikely
Phenanthrene	0.179	0.204	e	1.17	f	unlikely
Pyrene	0.15	0.195	e	1.52	f	unlikely
Total Petroleum Hydrocarbons (TPHs)						
Diesel Range Organics (DRO)	34.3	na		na		na [j]
Residual Range Organics (RRO)	96.9	na		na		na [j]

Notes:

EPC - exposure point concentration
mg/Kg - milligrams per kilogram
na - not available

[a] The exposure point concentration is equal to the maximum detected concentration in sediment from the Area C Pond.

[b] Potential effects to benthic invertebrates exposed to COPECs in sediment in the Area C Pond are unlikely if the EPC does not exceed the effects threshold-low, possible but not probable, if the EPC exceeds the effects threshold-low but does not exceed the effects threshold-high, and probable if the EPC exceeds the effects threshold-high.

[c] Marine Apparent Effects Threshold (AET) (Buchman, 2008)

[d] Marine Threshold Effects Level (TEL) (Buchman, 2008)

[e] Consensus-based Threshold Effects Concentration (TEC) (MacDonald et al., 2000)

[f] Consensus-based Probable Effects Concentration (PEC) (MacDonald et al., 2000)

[g] Van Derveer and Canton (1997)

[h] Freshwater Upper Effects Threshold (UET) (Buchman, 2008)

[i] Bis(2-ethylhexyl) phthalate used as a surrogate.

[j] Effects threshold-low and -high values were not available for petroleum hydrocarbon mixtures. However, detected concentrations of individual components of petroleum hydrocarbon mixtures were not selected as COPECs or were below effects threshold-low concentrations; therefore, effects due to exposure to petroleum hydrocarbons are not considered likely.

Table K-26 Ecological Hazard Calculations for Northern Bog Lemming - Downgradient Off-Site Drainages

COPEC	Surface Water Exposure Point Concentration C_{WATER} (mg/L)	K_d (L/Kg)	Sediment Exposure Point Concentration $C_{SEDIMENT}$ (mg/Kg)	$BCF_{Sd\text{-}P}$	Exposure Point Concentration C_{PLANT} (mg/Kg)	Ingestion Dose [a,b] (mg/Kg-day)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Inorganics								
Barium	0.0105	41	0.431	0.156	6.7E-02	5.4E-03	7.5E+01	0.000072
Chromium, Total	0.00178	150,000	267	0.041	1.1E+01	1.1E+00	6.7E+00	0.17

Notes:

$BCF_{Sd\text{-}P}$ - bioconcentration factor from sediment to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
L - liter(s)
L/Kg - liter per kilogram
K_d - surface water to sediment partitioning coefficient
Kg - kilogram(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
mg/L - milligrams per liter
wt - weight

Body Weight:	0.033	kg
Food Ingestion Rate (FIR):	0.0077	kg (dry wt)/day
FIR_Plants (100%)	0.0077	kg (dry wt)/day
FIR_Sediment (2.4%)	0.00019	kg (dry wt)/day
Exposure Duration (ED):	1	unitless
Site Utilization Factor (SUF):	0.277	unitless
Home range:	1.0	acres
Exposure area:	0.28	acres
Water Ingestion Rate:	0.0046	L/day

[a] Ingestion doses, shown in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for a northern bog lemming accounts for exposure to surface water and sediment based upon foraging habits of the bog lemming.

Table K-27 Ecological Hazard Calculations for Mallard Duck - Downgradient Off-Site Drainages

COPEC	Surface Water Exposure Point Concentration C_{WATER} (mg/L)	K_d (L/Kg)	Sediment Exposure Point Concentration $C_{SEDIMENT}$ (mg/Kg)	$BCF_{Sd\text{-}P}$	Exposure Point Concentration C_{PLANT} (mg/Kg)	$BCF_{W\text{-}I}$	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg-day)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons										
Inorganics										
Barium	0.0105	41	0.431	0.156	6.7E-02	1,198	1.3E+01	1.6E-05	1.2E+01	0.0000013
Chromium, Total	0.00178	150,000	267	0.041	1.1E+01	17,970	3.2E+01	2.6E-04	2.6E+00	0.000099

Notes:

$BCF_{W\text{-}I}$ - bioconcentration factor from surface water to aquatic invertebrates
$BCF_{Sd\text{-}P}$ - bioconcentration factor from sediment to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
L - liter(s)
L/Kg - liter per kilogram
K_d - surface water to sediment partitioning coefficient
Kg - kilogram(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
mg/L - milligrams per liter
wt - weight

Body Weight:	1.171	kg
Food Ingestion Rate (FIR):	0.056	kg (dry wt)/day
FIR_Plants (90%)	0.050	kg (dry wt)/day
FIR_Inverts (10%)	0.0056	kg (dry wt)/day
FIR_Sediment (3.3%)	0.0018	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.00049	unitless
Home range:	560	acres
Exposure area:	0.28	acres
Water Ingestion Rate:	0.01095	L/day

[a] Ingestion doses, in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the mallard duck accounts for exposure to surface water and sediment based upon foraging habits.

Table K-28 Ecological Hazard Calculations for American Dipper - Downgradient Off-Site Drainages

COPEC	Surface Water Exposure Point Concentration C_{WATER} (mg/L)	K_d (L/Kg)	Sediment Exposure Point Concentration $C_{SEDIMENT}$ (mg/Kg)	BCF_{W-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg-day)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons								
Inorganics								
Barium	0.0105	41	0.43	1,198	1.3E+01	1.0E+00	2.5E+01	0.041
Chromium, Total	0.00178	150,000	267	17,970	3.2E+01	3.4E+00	5.6E+00	0.60

Notes:

BCF_{W-I} - bioconcentration factor from surface water to aquatic invertebrates
COPEC - chemical of potential ecological concern
HQ - hazard quotient
L - liter(s)
L/Kg - liter per kilogram
K_d - surface water to sediment partitioning coefficient
Kg - kilogram(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
mg/L - milligrams per liter
wt - weight

Body Weight:	0.055	kg
Food Ingestion Rate (FIR):	0.0091	kg (dry wt)/day
FIR_Inverts (100%)	0.0091	kg (dry wt)/day
FIR_Sediment (3.3%)	0.00030	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	1	unitless
Home range:	0.10	acres
Exposure area:	0.28	acres
Water Ingestion Rate:	0.0085	L/day

[a] Ingestion doses, in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the American dipper accounts for exposure to surface water and sediment based upon foraging habits.

Table K-29 Ecological Hazard Calculations for Common Snipe - Downgradient Off-Site Drainages

COPEC	Surface Water Exposure Point Concentration C_{WATER} (mg/L)	K_d (L/Kg)	Sediment Exposure Point Concentration $C_{SEDIMENT}$ (mg/Kg)	BCF_{Sd-P}	Exposure Point Concentration C_{PLANT} (mg/Kg)	BCF_{Sd-I}	Exposure Point Concentration $C_{INVERTS}$ (mg/Kg)	Ingestion Dose [a,b] (mg/Kg-day)	Toxicity Reference Value (mg/Kg-day)	Ecological Hazard HQ
Non-Petroleum Hydrocarbons										
Inorganics										
Barium	0.0105	41	0.43	0.156	6.7E-02	0.091	3.9E-02	8.7E-05	2.1E+01	0.0000041
Chromium, Total	0.00178	150,000	267	0.041	1.1E+01	0.588	1.6E+02	1.4E-01	4.7E+00	0.030

Notes:

BCF_{Sd-I} - bioconcentration factor from sediment to benthic invertebrates
BCF_{Sd-P} - bioconcentration factor from sediment to plants
COPEC - chemical of potential ecological concern
HQ - hazard quotient
L - liter(s)
L/Kg - liter per kilogram
K_d - surface water to sediment partitioning coefficient
Kg - kilogram(s)
mg/Kg - milligrams per kilogram
mg/Kg-day - milligrams per kilogram per day
mg/L - milligrams per liter
wt - weight

Body Weight:	0.113	kg
Food Ingestion Rate (FIR):	0.015	kg (dry wt)/day
FIR_Plants (10%)	0.0015	kg (dry wt)/day
FIR_Inverts (90%)	0.014	kg (dry wt)/day
FIR_Sediment (14.1%)	0.0021	kg (dry wt)/day
Exposure Duration (ED):	0.5	unitless
Site Utilization Factor (SUF):	0.01	unitless
Home range:	24	acres
Exposure area:	0.28	acres
Water Ingestion Rate:	0.014	L/day

[a] Ingestion doses, in mg COPEC per kg body weight, were calculated as described in Appendix J.
[b] The ingestion dose for the common snipe accounts for exposure to surface water and sediment based upon foraging habits.