

Clinton Creek Remediation Project

Human Health and Ecological Risk Assessment Update
Clinton Creek, Yukon
Project # VE52705D.100.1

Prepared for:

**Government of Yukon Energy, Mines and Resources
Assessment and Abandoned Mines**

2C – 4114 4th Avenue, Whitehorse, Yukon, Y1A 4N7

July 2019

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2C – 4114 4th Avenue, Whitehorse, Yukon, Y1A 4N7

Prepared by:

Wood Environment & Infrastructure Solutions
#600 – 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Canada
T: 604-294-3811

July 2019

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Executive Summary

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood), was retained by the Government of Yukon (YG) to complete an update to the human health and ecological risk assessment (HHERA) for the Clinton Creek mine (the Site) completed by Amec Foster Wheeler (now Wood) in March 2017 (Amec Foster Wheeler 2017a). The Site is a former asbestos mine, located approximately 90 km northwest of Dawson City, Yukon (YT), near the confluence of the Fortymile River and the Yukon River, within the traditional territory of the Tr'ondëk Hwëch'in First Nation.

The Clinton Creek site is an abandoned site designated as a "Type II" site under the Yukon Devolution Transfer Agreement. That Agreement provides for the participation of the Tr'ondëk Hwëch'in First Nation, YG, and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) in a process to remediate the Site. The remediation project involves development of a 10% design for different remediation concepts.

Additional investigations have been completed at the Site since March 2017 and the purpose of this report is to update the 2017 HHERA with this new information. This HHERA Update does not replace the 2017 HHERA, rather it supplements it with new information and should be read in conjunction with the previous report. The HHERA update has the following general objectives:

- To conduct soil, small mammal, and air (asbestos fibres) sampling programs at the Site.
- To update the previous human health risk assessment using this new information to characterize and quantify the potential human health risks at the Site.
- To update the previous ecological risk assessment using this new information to characterize and quantify the potential ecological risks at the Site.

The surface and groundwater data compiled since 2016 under ongoing Site monitoring programs have not identified conditions that would warrant a change in the treatment of these media. Therefore, there are no updates to the HHRA or ERA for these media and this report focuses on potential exposure to soil, air (asbestos fibres), and country foods. Based on the HHERA Update, we provide the following conclusions.

HHRA

The conclusions of the HHRA Update are as follows:

- Unacceptable risks to campers due to direct exposure to nickel in tailings cannot be ruled out.
- Unacceptable risks due to direct exposure to metals are not predicted for all receptor groups assessed (campers, hunter/gatherers, and occasional visitors) in other Site areas investigated (i.e., soil at the mine and mill areas and waste rock).
- Unacceptable risks are not predicted associated with hunting/gathering on the Site.
- Unacceptable risks due to airborne asbestos exposure are predicted for the hunter/gatherer and camper receptor groups under current Site conditions.
- Unacceptable risks due to airborne asbestos exposure are not predicted for occasional Site visitors under current Site conditions.
- For scenarios in which tailings remain accessible and could be disturbed, there are potential unacceptable risks to human health due to inhalation of airborne asbestos and/or direct exposure to nickel in tailings.

- For scenarios in which there is no access to and no disturbance of the tailings, unacceptable risks are not predicted.
- The tailings contain consistently higher metals and asbestos content than both the waste rock and the soil samples from the remainder of the Site. The tailings are the major source of asbestos on Site.

The objective of the HHRA Update was to assess the human health risks associated with current Site conditions. In the event that Site conditions change during Site closure and reclamation activities, the findings of this HHRA would need to be revised.

ERA

The conclusions of the ERA Update are as follows:

- The soil chemistry results compared to the literature-based effects benchmarks for plants and soil invertebrates indicate that the waste rock and tailings pile areas have the potential for effects to plant and/or soil invertebrate communities. It should be noted that the tailings and waste rock are barren and largely devoid of vegetative cover. Should risk management plans include active revegetation of tailings or waste rock, further investigations to validate these conclusions could be collected, such as:
 - o Vegetation community surveys
 - o Chemistry analysis of metals in vegetation
 - o Invertebrate community investigations
 - o Chemistry analysis of metals in invertebrates
- Livers of trapped voles were submitted for metals analysis. Based on the statistical evaluation conducted on the liver concentrations of COPCs as well as a literature review to identify studies which used small mammal trapping to evaluate liver concentrations of metals, it is unlikely that the bioaccumulation of metals from soil at the Site is affecting the populations of voles.
- Samples from the small mammals collected from both the mill site and control were submitted for histological examination for lesions and signs of disease. There was no appreciable difference in the prevalence of various lesions in the Mill Site vs. Control Site groups. Overall, the voles appear to be in good health with no significant signs of overt disease.
- Based on the results of food web modelling, combined with the results of the small mammal trapping study, it is concluded that the potential risk to small mammal populations at the mill site from current soil conditions is low.
- Elevated hazard quotients for the American robin were calculated for chromium and nickel in both the tailings and waste rock areas. Calculated HQs are expected to overestimate risk as the food web models assume 100% of invertebrates are earthworms and do not account for reduced bioaccessibility from soil. The potential risk to other avian species such as grouse and red-tailed hawk from current soil conditions is low.

The statements made in this Executive Summary are subject to the same limitations included in Section 7.0 (Closing), and are to be read in conjunction with the remainder of this report.

Table of Contents

1.0	Introduction	1
1.1	Project Background	1
1.2	Objectives	2
1.3	Report Organization	3
2.0	Site Description	4
2.1	Main Components	4
2.2	Common Elements	4
2.3	Buildings and Structures	5
2.4	Water Supply/Groundwater Usage	5
3.0	Site Investigations	6
3.1	Summary of Previous Investigations	6
3.2	2018 Investigations	6
3.2.1	Soil, Waste Rock, and Tailings	6
3.2.1.1	Metals Chemistry	7
3.2.1.2	Chromium Speciation and Bioaccessibility	7
3.2.2	Small Mammal Trapping	8
3.2.2.1	Capture	8
3.2.2.2	Metal Analyses	8
3.2.2.3	Histology	8
3.2.3	Asbestos Air Monitoring	8
3.2.3.1	Monitoring Scope and Execution	8
3.2.3.2	Air Quality and Occupational Exposure Monitoring Results	9
4.0	Human Health Risk Assessment Update	10
4.1	Summary of 2017 HHRA	10
4.2	General Approach	11
4.3	Problem Formulation	11
4.3.1	Site Characterization	12
4.3.2	Hazard Identification	12
4.3.2.1	Soil	12
4.3.2.2	Asbestos in Air	15
4.3.3	Receptor Identification	16
4.3.4	Exposure Pathway Identification	16
4.3.5	Human Health Conceptual Site Model	17
4.4	Exposure Assessment	17
4.4.1	Exposure Point Concentrations	19
4.4.1.1	Tailings	19
4.4.1.2	Waste Rock	19
4.4.1.3	Remainder of Site	20
4.4.1.4	EPC Summary	21
4.4.2	Modelling Tools	22
4.4.2.1	Metals in Soil	22
4.4.2.2	Metals in Country Foods	22
4.4.2.3	Asbestos in Air	22
4.4.3	Receptor Characteristics and Exposures	23
4.5	Toxicity Assessment	24
4.5.1	Chromium Speciation	24

Table of Contents (cont'd)

4.5.2	Toxicity Reference Values.....	25
4.5.3	Bioavailability	25
4.6	Risk Characterization	27
4.6.1	Soil.....	27
4.6.1.1	Non-Carcinogenic Risk.....	27
4.6.1.2	Carcinogenic Risk.....	28
4.6.2	Country Foods	29
4.6.3	Asbestos in Air.....	32
4.6.3.1	Review of 2017 HHRA.....	32
4.6.3.2	Revised Assessment of Asbestos in Air.....	33
5.0	Ecological Risk Assessment Update	37
5.1	Problem Formulation for ERA	37
5.1.1	Site Characterization	37
5.1.2	Hazard Identification.....	38
5.1.3	Receptor Identification.....	40
5.1.4	Exposure Pathway Identification	42
5.1.5	Summary of Previous Aquatic Risk Assessment Findings	43
5.1.6	Assessment Endpoints.....	43
5.1.7	Conceptual Site Model for Ecological Receptors	44
5.2	Exposure Assessment	45
5.2.1	Exposure Point Concentrations.....	45
5.2.2	Terrestrial Plants and Soil Invertebrates.....	47
5.2.3	Daily Dose for Representative Avian and Mammalian Receptors.....	48
5.3	Effects and Toxicity Assessment.....	48
5.3.1	Plants and Invertebrates	48
5.3.2	Mammals and Birds Toxicity Reference Values.....	49
5.3.3	Red Backed Voles Weight and Morphological Parameters.....	50
5.3.4	Red Backed Voles Liver Concentrations of Metals.....	52
5.3.5	Small Mammal Pathology	53
5.3.5.1	Lungs	53
5.3.5.2	Liver.....	53
5.3.5.3	Kidney.....	54
5.3.5.4	Thyroid Gland.....	54
5.3.5.5	Heart	54
5.3.5.6	Esophagus	54
5.3.5.7	Summary	54
5.4	Risk Characterization for ERA.....	54
5.4.1	Plants and Soil Invertebrates	55
5.4.2	Birds and Mammals.....	56
5.4.2.1	Mill Area	57
5.4.2.2	Tailings and Waste Rock Areas	60
6.0	Conclusions	61
6.1	HHRA.....	61
6.2	ERA.....	62
7.0	Closing	63
8.0	References	64



Table of Contents (cont'd)

List of Figures

Figure 4.1:	Human Health Conceptual Site Model.....	18
Figure 4.2:	Chromium Intake by Country Food.....	30
Figure 4.3:	Cobalt Intake by Country Food	30
Figure 4.4:	Manganese Intake by Country Food	31
Figure 4.5:	Nickel Intake by Country Food	31
Figure 4.6:	Asbestos Concentrations by Site Area.....	36
Figure 5.1:	Ecological Health Conceptual Site Model	46
Figure 5.2:	Weights of Red Backed Voles collected at Mill and Control	50
Figure 5.3:	Length of Red Backed Voles collected at Mill and Control.....	51
Figure 5.4:	Length of tails for Red Backed Voles collected at Mill and Control	51

List of Tables

Table 4.1:	Human Health Screening of Surface Soil.....	13
Table 4.2:	Summary of 2018 Asbestos Sample Results (f/ml)	15
Table 4.3:	Potential Exposure Scenarios - Human Receptors	16
Table 4.4:	Human Health Screening of Tailings.....	19
Table 4.5:	Human Health Screening of Waste Rock	20
Table 4.6:	Human Health Screening of Remainder of the Site.....	21
Table 4.7:	EPC Summary by Area (mg/kg)	21
Table 4.8:	Summary of Receptor Characteristics.....	23
Table 4.9:	Chromium Speciation.....	24
Table 4.10:	Cr(III) and Cr(VI) Soil EPCs.....	24
Table 4.11:	Selected Toxicity Reference Values.....	25
Table 4.12:	Chromium Bioaccessibility.....	26
Table 4.13:	Bioavailability Factors	27
Table 4.14:	Hazard Quotients – Tailings.....	28
Table 4.15:	Hazard Quotients – Waste Rock	28
Table 4.16:	Hazard Quotients – Remainder of the Site.....	28
Table 4.17:	Cr(VI) and Nickel ILCRs	29
Table 4.18:	Hazard Quotients – Country Foods	32
Table 4.19:	IELCR – Asbestos in Air (2017 HHRA).....	33
Table 4.20:	Summary of 2018 Asbestos Sample Results (f/ml)	35
Table 4.21:	Revised IELCR – Asbestos in Air	35
Table 5.1:	Ecological Screening of Soil.....	38
Table 5.2:	Potential Exposure Scenarios - Ecological Receptors.....	42
Table 5.3:	Assessment and Measurement Endpoints.....	44
Table 5.4:	Soil Chemistry UCLMs Utilized in the ERA (mg/kg).....	47
Table 5.5:	Soil Benchmark Values for Terrestrial Plants and Soil Invertebrates	48
Table 5.6:	Toxicity Reference Values for Mammals and Birds.....	49
Table 5.7:	Statistical Evaluation of Morphological Parameters	52
Table 5.8:	Statistical Evaluation of Liver Concentrations of COPCs	52
Table 5.9:	Small Mammal Biomonitoring Studies for Arsenic and Nickel	53
Table 5.10:	Risk Estimates for Plants and Soil Invertebrates.....	55
Table 5.11:	Distribution of Exceedances for Plants and Soil Invertebrates	55



Table of Contents (cont'd)

Table 5.12:	Assessment Endpoint, LOE and Ecological Relevance.....	56
Table 5.13:	HQs for Mammals and Birds at the Mill Site.....	58
Table 5.14:	HQs for Mammals and Birds at the Tailings Area	58
Table 5.15:	HQs for Mammals and Birds at the Waste Rock Area.....	59

List of Appendices

Appendix A:	Drawings
Appendix B:	Statistical Analyses and Exposure Point Concentrations
Appendix C:	HHRA Supporting Information
Appendix D:	ERA Supporting Information
Appendix E:	Limitations

1.0 Introduction

Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited (Wood), was retained by the Government of Yukon (YG) to update the human health and ecological risk assessment (HHERA) for the Clinton Creek mine (the Site) completed by Amec Foster Wheeler (now Wood) in March 2017 (Amec Foster Wheeler 2017a). The Site is a former asbestos mine, located approximately 90 km northwest of Dawson City, Yukon (YT), near the confluence of the Fortymile River and the Yukon River, within the traditional territory of the Tr'ondëk Hwëch'in First Nation (Drawing 1, Appendix A).

Additional investigations have been completed at the Site since March 2017 and the purpose of this report is to update the 2017 HHERA with this new information. The HHERA Update quantifies potential risks based on the current Site conditions that will require remediation or risk management as part of Site remediation and reclamation activities. This HHERA Update does not replace the 2017 HHERA, but rather supplements it with new information and should be read in conjunction with the previous report.

1.1 Project Background

Cassiar Asbestos Corporation Ltd. operated the Clinton Creek Mine from 1967 to 1978 (RRU, 1999). During the mine operation, the ore - a serpentinite rock containing white asbestos (known as chrysotile) - was excavated from three open pits and transported by aerial tramway to the mill, located on a ridge along the west side of Wolverine Creek, which is a tributary of Clinton Creek (Drawing 2, Appendix A). Waste rock was placed along the south valley wall of Clinton Creek (60 million tons) and tailings from the milling operation were placed along the west valley wall of Wolverine Creek (12 million tons) (UMA/AECOM, 2006). In 1974, waste rock deposited on the north-facing slope of the Clinton Creek valley failed and blocked the valley. This created a landslide dam and impounded water now referred to as Hudgeon Lake. Down-slope movement of the tailings pile deposits resulted in two lobes of tailings blocking Wolverine Creek creating two ponds (North and South Ponds).

The Clinton Creek site is an abandoned site designated as a "Type II" site under the Yukon Devolution Transfer Agreement. That Agreement provides for the participation of the Tr'ondëk Hwëch'in First Nation, YG, and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC), herein referred to as the "Project Parties", in a process to remediate the Site. The remediation project involves the development of a 10% design for different remediation concepts, presented in general terms below.

- Clinton Creek
 - a. Water Passage and Catastrophic Failure Mitigation
 - b. Water Passage, Catastrophic Failure Mitigation, and Lowering Lake
 - c. Water Passage with Reduction of the Lake Level, Eliminating the Dam, and Mitigating Catastrophic Failure
- Wolverine Creek
 - a. Sediment Control Only
 - b. Water Passage and Stability Improvement
 - c. Isolate the Asbestos

The purpose of a HHERA is to quantitatively assess the potential risks associated with exposure to contaminants of potential concern (COPC) in various media (e.g., soil, surface water, sediment, or groundwater) to people and ecological receptors using the Site. The HHERA will be undertaken for current Site conditions. A separate assessment will not be undertaken for each of the remediation concepts, as many of them have overlapping design aspects and many of the design components do not have human

or ecological health implications (beyond physical stability/safety considerations, which are beyond the scope of this HHERA). From the perspective of human and ecological health, the three concepts considered for Clinton Creek are not markedly different, as the main differences are with respect to channel alignment, slope, and lake level. The exception to this would be Concept C, which involves draining Hudgeon Lake which could expose previously inaccessible sediments containing COPC.

From the perspective of human and ecological health, the main differences in the concepts considered for Wolverine Creek are fish passage and isolation of asbestos. With respect to fish passage, fish cannot enter Wolverine Creek at present but are believed to have done so in the past. Removal of the existing culvert would restore access to the creek, as Wolverine Creek has an acceptable gradient and sufficient flow under most conditions to allow long term seasonal use by Arctic grayling and juvenile Chinook salmon as far upstream as the mouth of the first tributary entering from the east (von Finster, 2016). Asbestos is seen as one of the primary drivers of risk at the mine site. Due to the high concentrations of asbestos in the tailings pile, restricting direct and indirect exposure/access to the asbestos by way of a cover could considerably affect estimates of potential risk.

1.2 Objectives

There are five wide-ranging Final Clinton Creek Remediation Project Objectives. Three of these final project objectives relate specifically to human health and the environment, as follows:

1. Protect human health and safety.
 - Reduce or eliminate risks to worker health and safety.
 - Prevent, minimize, or mitigate any adverse effects on the health and safety of people accessing the Site.
 - Animals, plants, and berries around the mine site are safe for humans to harvest.
2. Protect the environment, including land, air, water, fish, and wildlife.
 - Prevent, minimize, or mitigate adverse effects on the aquatic environment, including fish and fish habitat.
 - Prevent, minimize, or mitigate adverse effects on the terrestrial environment.
 - Protect, and to the extent possible, restore aquatic and terrestrial habitats using methods conducive to natural regeneration.
3. Return and/or retain the Site to a state that supports community and traditional land uses.
 - Maximize access for public use.
 - Reclaim disturbed areas to support community and traditional land use.
 - Water flowing from the mine site will be safe for recreational use.

The HHERA update has the following general objectives:

- To conduct a soil, small mammal, and air (asbestos fibres) sampling programs at the Site.
- To update the previous human health risk assessment using this new information to characterize and quantify the potential human health risks at the Site.
- To update the previous ecological risk assessment using this new information to characterize and quantify the potential ecological risks at the Site.

The surface and groundwater data compiled since 2016 under ongoing Site monitoring programs have not identified conditions that would warrant a change in the treatment of these media. Therefore, there are no updates to the HHRA or ERA for these media and this report focuses on potential exposure to soil, air (asbestos fibres), and country foods.

1.3 Report Organization

This report is organized in nine sections. Section 1 and 2 provide background information on the Site and the HHRA. Environmental investigations completed in 2018 are summarized in Section 3. The updates to the HHRA and ERA are presented in Sections 4 and 5. Uncertainties associated with the risk assessment are discussed in Section 6. Section 7 provides the main conclusions of the HHRA update. Closing statements are provided in Section 8 and a list of references is included in Section 9.

2.0 Site Description

The Clinton Creek Mine Site is an abandoned property with no active mining or other industrial, commercial, or residential use. The Site is very remote; accessed via the Top of the World Highway (Highway #9) and the Clinton Creek Road, which are typically maintained between the months of June to September, or when the ferry is running from Dawson City. During the fall and winter months, the Site can only be accessed via helicopter or snowmobile. The access is restricted by YG via a locked gate. Signage is in place at the start of the Clinton Creek Road outlining the restricted access, hazards present, and risk of serious injury or death.

The mine consists of three open pits (i.e., Porcupine Pit, Snowshoe Pit, and Creek Pit), two waste rock dumps (i.e., Porcupine Creek and Clinton Creek) along the south side of Clinton Creek, and a tailings pile on the west side of Wolverine Creek (Drawing 2, Appendix A).

2.1 Main Components

The Site consists of the following main components (See Drawing 2, Appendix A):

- Clinton Creek Channel
- Hudgeon Lake
- Gabion Drop Structures and Drop Chute
- Clinton Creek Waste Rock Pile
- Wolverine Creek Channel
- Wolverine Creek Tailings Piles
- Wolverine Creek Ponds (North and South Ponds)

Water discharging from Hudgeon Lake travels southeast via Clinton Creek to Fortymile River, approximately 8 km downstream. Four gabion drop structures (i.e., DS1, DS2, DS3, and DS4) were constructed across the upper portion of Clinton Creek between 2002 and 2004 to stabilize the waste rock pile to the south and promote aeration of discharge from Hudgeon Lake. Discharge from the Wolverine Creek ponds travels south via Wolverine Creek to its confluence with Clinton Creek near the Site entrance.

2.2 Common Elements

In addition to the main components, the Site also contains a number of other elements, collectively referred to as the Common Elements (Drawing 2, Appendix A). These include the following:

- Porcupine Creek waste rock pile
- Snowshoe Pit waste rock pile
- Three Open Pits
- Former mill site
- Air strip
- Some pieces of equipment
- Clinton Creek access road
- Clinton Creek site roads
- Other Roads
- Clinton Creek ford crossings
- Hudgeon Lake outlet abutments and log boom

- Ore piles
- Miscellaneous borrow areas
- Miscellaneous infrastructure
- Miscellaneous waste

The former mill site is located at the top of the slope above Clinton Creek and Wolverine Creek and the air strip is located north of the tailings piles.

2.3 Buildings and Structures

In 2004, YG undertook a hazard mitigation program to address hazards identified in a Hazard Assessment Report (UMA, 2004). In general, the work program, completed by Hän Construction Ltd., involved demolition of most of the structures on the Site and regrading work to block access to some areas of the Site, cover areas having significant concentrations of asbestos fibres, and backfill demolished concrete structures (UMA/AECOM, 2006).

There are no buildings remaining at the Site; however, large, heavily reinforced concrete foundations remain at the former mill site, the crusher building, and Tram Tower #3. These structures were left in-place due to difficulties in demolishing them (reinforced steel), accessibility concerns, and low hazard classifications (UMA/AECOM, 2006).

2.4 Water Supply/Groundwater Usage

There is no water supply or groundwater usage at the Site.

3.0 Site Investigations

3.1 Summary of Previous Investigations

A large number of previous investigations has been completed at the Site and reports supplied to Amec Foster Wheeler for review in 2016. The full list of reports was included in the Gap Analysis Report (Amec Foster Wheeler, 2017b). In addition, Amec Foster Wheeler completed field work at the Site in the fall of 2016 in support of the 2017 HHERA. Previous studies relevant to human and environmental health and/or risk include:

- 1999 - Royal Roads University – Applied Research Division (RRU), 1999. An Environmental Review of the Clinton Creek Abandoned Asbestos Mine, Yukon, Canada. 180 pp.
- 2003 - SENES Consultants Ltd., 2003a. Ecological Risk Evaluation for Clinton Creek Mine Site – Level 1 Custodial Input Section. Prepared for the Department of Indian Affairs and Northern Development.
- 2003 - SENES Consultants Ltd., 2003b. Human Health Screening Level Risk Assessment for Clinton Creek Abandoned Asbestos Mine. Prepared for the Department of Indian Affairs and Northern Development.
- 2006 - UMA Engineering Ltd/AECOM, 2006. Summary of 2004 Hazard Mitigation Work, Monitoring and a Screening Level Risk Assessment for Airborne Asbestos. UMA Project No. 6029 006 01 (4.6.1).
- 2017 - Amec Foster Wheeler, 2017c. Draft Field Program Summary Report. Submitted to Yukon Government Energy, Mine and Resources Assessment and Abandoned Mines.

These reports were reviewed and discussed in the 2017 HHERA and the reader is referred to that report for a summary of findings. This section summarizes the results of additional Site investigations completed by Wood in 2018 including: sampling of soil, waste rock, and tailings; a small mammal trapping program; and air monitoring for asbestos fibres.

3.2 2018 Investigations

Environmental data gaps and their significance were identified and assessed by Amec Foster Wheeler in a report entitled General Site Characterization and Gap Assessment dated 29 March 2018 (Amec Foster Wheeler 2018). Based on the identified gaps in Amec Foster Wheeler (2018) and discussions with the Project Partners and the Independent Peer Review Panel (IPRP), an environmental scope of work was developed. Investigations completed at the Site in 2018 and relevant to the risk assessment include;

- Sampling of soil, waste rock, and tailings;
- Small mammal trapping; and
- Asbestos air monitoring.

These investigations are documented in *Clinton Creek Remediation Project 2018 Site Investigation Report* (Wood 2019a) and the *Environmental Site Characterization Update Report* (Wood 2019b) and briefly summarized in the following sections. Sample locations are illustrated on Drawing 3 and Drawing 4 in Appendix A.

3.2.1 Soil, Waste Rock, and Tailings

The scope for the environmental component of the 2018 investigation program included:

- Completion of two test holes to 10 m in the former mill area;

- Collection of surficial material samples from geotechnical test hole locations and testing for asbestos and metal contents;
- Collection of material samples from the mid completion depth (approximately) for each geotechnical test hole location and testing for asbestos and metal contents;
- Collection of the following additional surficial material samples for asbestos and metal analyses:
 - o Clinton Creek Waste Rock – five samples
 - o Porcupine Creek Waste Rock – five samples
 - o Tailings Pile – five samples
 - o Former Mill Area and Access Road – ten samples

Results from this sampling are reported in Wood (2019a,b) and summarized below.

3.2.1.1 Metals Chemistry

The following observations can be made from a review of the data:

- The asbestos and metals data compiled in 2018 are generally consistent with that from previous investigations and do not alter the general perspectives and Site characterizations.
- Significant asbestos levels are present at surface and at depth in the tailings pile. While asbestos can be found in the waste rock and Porcupine Creek at levels comparable to those in the tailings, these high concentrations are not as pervasive as is evident in and on the tailings.
- Both chromium and nickel are present at significant levels throughout the tailings matrix (i.e., at surface and depth). Similar to the asbestos profile, maximum chromium and nickel levels at surface and depth in the waste rock and Porcupine Creek are similar to those evident in the tailings; however, the median levels are much lower in the rock and Porcupine Creek.
- Chromium and nickel concentrations similar to those observed in waste rock are evident in some surface soils in the mill and common areas, but not in the undisturbed soils at depth (supporting the supposition that rock and/or tails have been used or distributed on-site by design (road construction) or via environmental vectors).

3.2.1.2 Chromium Speciation and Bioaccessibility

Chromium was the primary contaminant of concern in the 2017 HHRA and chromium toxicity and bioavailability are strongly influenced by speciation. Chromium occurs in soil in the trivalent (III) and hexavalent (VI) oxidation states. Trivalent chromium hydroxide, which has low solubility, is the most prevalent form of natural chromium in soils, hexavalent chromium mostly being a result of anthropogenic sources (Kelley et al. 2002). Soils at Clinton Creek are not expected to contain anthropogenic sources of Cr (VI) however six soil samples were submitted for analysis of chromium speciation, as listed below:

- 18-BH05-01 Waste rock
- 18-BH06-02 Waste rock
- 18-BH07-02 Waste rock
- 18-BH08-01 Waste rock
- 18-MILL-DUP-05 Mill area soil
- BH2018-05-02/151' Waste rock

Results of this analysis are tabulated and used in the HHRA Update (Section 4.5). Laboratory certificates of analysis are included in Appendix C.

3.2.2 Small Mammal Trapping

The 2018 field investigation included the conduct of a small mammals sampling and assessment program to assess the potential contamination and histological effects of asbestos and metals in small mammals on and near the tailings area. Methods and results are reported in Wood (2019a) and summarized below.

3.2.2.1 Capture

Two species of small mammals were captured in the Clinton Creek Asbestos Mine area: red-backed vole (n = 32) and meadow vole (n = 4), both herbivores. Similar numbers of red-backed voles were captured in the Mill and Control areas (n = 13 and 19, respectively). No voles were captured adjacent to the tailings area during 281 trap nights.

3.2.2.2 Metal Analyses

Chromium and nickel are the two primary metals of concern at Clinton Creek. The small mammal sampling at the Clinton Creek asbestos mine did not indicate increased levels of those metals in any of the vole livers sampled. The results of the metals analyses are used in the HHRA and ERA updates (Section 4.0 and Section 5.0).

3.2.2.3 Histology

The only substantive histological difference between voles captured in the Mill and Control areas was the presence of erythrocytes (indicating blood) in lung tissue of voles captured in the Mill area. That condition may be an artifact of euthanasia; however, because animals were handled similarly in both areas, there may be environmental factors involved. There were no other indications that the animals were affected by exposure to contaminants. Histology examinations are used in the updated ERA (Section 5.0).

3.2.3 Asbestos Air Monitoring

The air monitoring program conducted during the 2018 investigation program at the Clinton Creek property provides an expanded dataset on asbestos in air levels required to update the HHRA. A report describing the conduct and findings of the Air Quality and Occupational Exposure Monitoring Program is provided in Wood (2019a). The following sections are a summary of key scope elements and outcomes.

3.2.3.1 Monitoring Scope and Execution

Area air sampling for asbestos was completed by installing sampling pumps in target areas. This consisted of areas where disturbance activities were occurring and areas where the build-up of ground materials might occur due to cross contamination by personnel. Sampling media were set at an approximate height of 1.5 metres (m) above ground (approximate average human height). Sample pumps were set to operate in a downward facing manner for collection times generally representing full shifts (approximately 8 to 12 hours).

Additional area air samples were collected at locations of the Site where no activity was undertaken. These samples were referred to as passive and were collected for evaluating exposure risk in areas where soils and tailings materials were not actively disturbed.

Air samples were also collected from personnel directly involved in drilling and sample preparation, as well as personnel performing ancillary functions. These personal samples were collected from general labourers, the on-site medic, heavy equipment operators, driller operators/helpers, environmental samplers, geotechnical logging personnel, lab technicians, and office staff.

In total, 44 area, 53 personal and 68 passive samples were collected and analyzed over the course of the field program.

3.2.3.2 Air Quality and Occupational Exposure Monitoring Results

The air monitoring results identified elevated levels of asbestos fibres in several locations, within and outside of restricted areas. Elevated asbestos fibre levels were also associated with several personnel performing tasks within the restricted areas of the Site. The results indicated that intrusive Site activities have the potential to generate airborne asbestos fibres in the waste rock and tailings areas of the Site. Further, the elevated levels of asbestos fibres present in some non-restricted areas indicated that a degree of transport from restricted areas was occurring either via wind or through cross-contamination.

4.0 Human Health Risk Assessment Update

4.1 Summary of 2017 HHRA

Amec Foster Wheeler completed a HHRA for the Site in 2017 (Amec Foster Wheeler 2017a) which assessed potential exposure to metals and asbestos (COPC identified at the Site) in groundwater, surface water, soil/sediment, country foods, and asbestos in air. The main conclusions were as follows:

- **Groundwater** - There is currently no known use of groundwater at the Site for potable purposes and it is not reasonably foreseeable that groundwater will be used for potable purposes in the future. Further, the available data for source materials and monitoring data for surface waters suggest a limited potential for the movement of contaminants from source materials to groundwater and thereafter to any downstream media and/or receptors. For these reasons (i.e., the lack of groundwater utility and limited contaminant solubility), groundwater was not considered as a medium of concern for the HHRA.
- **Surface Water** - There is no known use of surface water at the Site for potable purposes, however people may be incidentally exposed to surface water while wading in Clinton Creek or Wolverine Creek, or when boating in Hudgeon Lake. Surface water data was compared to the Guidelines for Canadian Drinking Water Quality (GCDWQ) and only iron and manganese exceeded guidelines. The GCDWQ for iron and manganese are not health-based but are aesthetic objectives (e.g., staining on plumbing fixtures). As the surface water at the Site is not used for consumption, nor does it support a local potable water supply or associated infrastructure, exceedances of the aesthetic objectives did not warrant further assessment in the HHRA.
- **Soil** - Chromium, cobalt, manganese, and nickel were identified as COPC in soil/sediment. Risks due to soil/sediment exposure (ingestion, dermal contact) were assessed for occasional visitors to the Site, hunters/gatherers, and campers. Predicted risks calculated in the HHRA were acceptable except for exposure to chromium in soil. The hazard quotient (HQ) for chromium was greater than 0.2, indicating that unacceptable risks to the camper (toddler visitor) due to exposure to soil (dermal/ingestion and inhalation) could not be ruled out.
- **Sediment** - Monitoring data have indicated that some sediments on, or immediately downstream of the property have been impacted by metals, particularly chromium and nickel. However, monitoring and assessments have also suggested that there is a healthy aquatic community in the reaches below the gabion structure of Clinton Creek which support periphyton communities, benthic invertebrate communities and fish. For this reason, sediment was not considered as a medium of concern for the HHRA.
- **Country Foods** - COPC and exposure scenarios were the same as for soil/sediment. Hazard quotients calculated for the intake of COPCs by ingestion of country foods for all groups of receptors were all less than the target HQ of 0.2, indicating that unacceptable risks due to ingestion of country foods hunted/gathered at the Site were not expected.
- **Asbestos in Air** - Consistent with previous HHRA's conducted at the Site (SENES (2003b) and UMA (2006)), the findings of the HHRA indicated that, based on the current Site conditions, there is a potential unacceptable risk to human health due to inhalation of airborne asbestos.

Based on the above, unacceptable risks were not identified associated with exposure to groundwater or surface water. The surface and groundwater data compiled since 2016 under ongoing Site monitoring programs have not identified conditions that would warrant a change in the treatment of these media. Surface and groundwater media were therefore not considered in this HHRA update.

Additional data has been collected in 2018 for soil, small mammals, and asbestos in air, as described in Section 3.0. Unacceptable risks were previously predicted for exposure to chromium in soil and asbestos in air. Therefore, the HHRA update will focus on re-assessing potential risks due to exposure to soil, country foods, and asbestos in air, augmenting previous data with the results of the 2018 Site investigations.

4.2 General Approach

For a risk to exist at a site, three components must be present to contribute a risk to human health. As indicated in the Venn diagram, these are:

- An elevated concentration (hazard).
- A receptor to come in contact with the hazard.
- An exposure pathway to facilitate contact between the receptor and the hazard.

This HHRA update will be conducted by evaluating these components and included the following four-step paradigm:

1. Problem Formulation
2. Toxicity (Hazard) Assessment
3. Exposure Assessment
4. Risk Characterization



This HHRA update is conducted in accordance with applicable federal and territorial guidance. Specifically, the following documents are referenced:

- Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA) (Health Canada, 2010a).
- Federal Contaminated Site Risk Assessment in Canada, Part II: Health Canada Toxicological Reference Values (TRVs) (Health Canada, 2010b).
- Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment (Health Canada, 2010c).
- CCME Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines (CCME, 2006).
- Yukon Government Contaminated Sites Regulation (O.I.C. 2002/171), Yukon Regulation under the Environment Act (YG, 2014).

In addition to the regulatory guidance stated above, and due to limited toxicological information and guidelines regarding inhalation of asbestos, in particular related to mining and milling, a literature search of assessment methodologies was conducted.

4.3 Problem Formulation

The Problem Formulation step is an important information gathering and interpretation stage, which serves to plan and focus the approach of the HHRA. The data gathered and evaluated in this stage provides information regarding the physical and geographic features of the site, identification of potential human receptors, possible exposure pathways, and any other specific areas or issues of concern to be addressed. For the current assessment, key tasks requiring evaluation within the Problem Formulation Step included the following:

- Site Characterization.
- Determination of the contaminants of concern.
- Selection and characterization of human receptors.
- Selection of exposure pathways and scenarios based on the chemicals of concern.

The outcome of these tasks forms the basis of the approach taken in the current assessment. The risk assessment is being conducted to establish whether unacceptable health risks may exist as a step in identifying the need for further action.

4.3.1 Site Characterization

The Site is currently an abandoned asbestos mine site in a very remote location. From the perspective of human receptors, it is accessible by road only during the summer months, when the ferry is running in Dawson City, and only by YG personnel and/or other approved visitors. The mine is located approximately 40 km off the main Top of the World Highway on a dirt road with occasional potholes, uneven surfaces, and minor washboarding, such that a speed limit of 30 km/h is typically observed and the travel takes approximately an hour. The entrance to the Site is marked by a locked gate, which is further blockaded with boulders to prevent trespassing.

4.3.2 Hazard Identification

The screening of COPC in soil and air is discussed below. Receptors may also be exposed to COPC by ingesting country foods. Based on information provided by discussion with the Project Parties and information provided in the Oral History Project (Midnight Arts and Crowberry Consulting and Communications, 2017), country foods harvested in the area include wild fruit (berries), fish, small game and waterfowl (e.g., hare, grouse and ducks) and large game (e.g., caribou and moose). Since concentrations of COPC in soil, sediment, and surface water are used to predict concentrations in country foods, no screening of COPC in country foods themselves is required. COPC in soil will be adopted as COPC for country foods.

4.3.2.1 Soil

The soil data collected as part of the 2018 Site Investigation have been compared to applicable human health guidelines, as outlined below. The soil data collected by RRU (1999) and Amec Foster Wheeler (2017c) were used to complement the current data, where available (not all parameters were analyzed by RRU). In accordance with Health Canada PQRA requirements, the maximum concentration of each COPC detected was used in the screening process. Historical and current soil data has been reviewed and compared to the following guidelines for inclusion in the HHRA:

- Government of Yukon (2002, rev. 2014) Contaminated Sites Regulation (CSR) – Matrix Numerical Soil Standards – Parkland, non-potable land use, human health specific guidelines.
- CCME (CCME, 1999a) Canadian Soil Quality Guidelines (SQGs) for Human Health (SQGHH) – Residential/Parkland, non-potable land use (accessed on-line, January 2019), human health specific guidelines.
- Ontario Ministry of the Environment (OMOE, 2011) Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act for the protection of human health – Residential/Parkland, non-potable land use, S1 Risk (Appendix A2: Soil Components for Table 3). The S1 component pertains to surface soil for Residential / Parkland uses and presumes a residential setting in which all age categories may be present.

- United States Environmental Protection Agency (USEPA) (revised November 2018). Regional Screening Levels Master Table - Resident soil (adjusted for non-carcinogens to reflect 20% of the USEPA Reference Dose (RfD), in accordance with Health Canada guidance).

Preference was given to territorial (Yukon) soil quality guidelines for screening. Where these were not available, CCME SQGs were used, followed by those published by Ontario Ministry of Environment (OMOE) and the United States Environmental Protection Agency (USEPA). In all cases, the lowest of any calculated human health specific guidelines was selected for screening, with the exception of those calculated to protect potable water supplies. It is noted that while YG Matrix Numerical Soil Standards show pathway-specific values, the Generic Numerical Soil Standards appear to be a straight adoption of CCME's interim (1991) SQG, the toxicological basis of which (human health, ecological, check value, etc.) is not published. Therefore, Schedule 1 Generic Numerical Soil Standards were not used for screening and other sources were consulted for human-health specific values.

While the Clinton Creek Mine Site would be considered an industrial site based on its previous Site activities and land use, residential/parkland guidelines have been adopted for the purposes of screening. The Site does not fit neatly within the definition of any of the land use categories typically used by regulatory bodies (i.e., agricultural, commercial, industrial, residential/parkland); however, it is felt that, in its natural state, the Site best fits the residential/parkland definition, despite its exclusion of wildlands (CCME, 2006), as it is not, by definition an agricultural property. Categorization of the Site as residential/parkland is considered to be conservative, however since the Site is no longer in operation (and will not be in operation as a mine site in the foreseeable future), comparison to industrial or commercial screening criteria is not applicable. In addition, the use of residential/parkland was selected based on nearby seasonal cabin occupants, as well as members of the Tr'ondëk Hwëch'in First Nation that may occupy the Site for hunting/trapping.

The maximum concentrations and human health screening guidelines for the contaminants of potential concern in soil are compared in Table 4.1. Full screening tables are presented in Appendix B.

Table 4.1: Human Health Screening of Surface Soil

Chemical	Maximum Concentration (mg/kg)	Human Health Screening Guidelines (mg/kg)	Comment
Trace Metals			
Aluminum (Al)	21271	15600⁴	Max exceeds screening guideline
Antimony (Sb)	50	7.5³	Max exceeds screening guideline
Arsenic (As)	321	100¹	Max exceeds screening guideline
Barium (Ba)	1659	6800 ²	Max meets screening guideline
Beryllium (Be)	1.5	38 ¹	Max meets screening guideline
Bismuth (Bi)	0.5	NG	No guideline established
Boron (B)	241	4300 ³	Max meets screening guideline
Cadmium (Cd)	6	3¹	Max exceeds screening guideline
Calcium (Ca)	47100	NG	No guideline established
Chromium (Cr)	1810	100¹	Max exceeds screening guideline
Cobalt (Co)	111	22³	Max exceeds screening guideline
Copper (Cu)	83	15000 ¹	Max meets screening guideline
Iron (Fe)	66372	11000⁴	Max exceeds screening guideline
Lead (Pb)	150	500 ¹	Max meets screening guideline
Lithium (Li)	40	32⁴	Max exceeds screening guideline

Table 4.1: Human Health Screening of Surface Soil

Chemical	Maximum Concentration (mg/kg)	Human Health Screening Guidelines (mg/kg)	Comment
Magnesium (Mg)	225589	NG	No guideline established
Manganese (Mn)	1026	380⁴	Max exceeds screening guideline
Mercury (Hg)	0.7	15 ³	Max meets screening guideline
Molybdenum (Mo)	29	110 ³	Max meets screening guideline
Nickel (Ni)	2647	200²	Max exceeds screening guideline
Phosphorus (P)	1074	NG	No guideline established
Potassium (K)	1409	NG	No guideline established
Selenium (Se)	10	80 ²	Max meets screening guideline
Silver (Ag)	5	77 ³	Max meets screening guideline
Sodium (Na)	331	NG	No guideline established
Strontium (Sr)	259	9400 ⁴	Max meets screening guideline
Thallium (Tl)	0.76	1 ²	Max meets screening guideline
Tin (Sn)	25	9400 ⁴	Max meets screening guideline
Titanium (Ti)	797	NG	No guideline established
Uranium (U)	3.87	23 ²	Max meets screening guideline
Vanadium (V)	66	39³	Max exceeds screening guideline
Zinc (Zn)	403	10000 ³	Max meets screening guideline
Zirconium (Zr)	17	1.3⁴	Max exceeds screening guideline
Asbestos			
Asbestos (%)	50-75%	NG	No guideline established
Hydrocarbons			
Benzene	<0.005	110 ²	Max meets screening guideline
Ethylbenzene	<0.01	10000 ²	Max meets screening guideline
Toluene	<0.01	22000 ²	Max meets screening guideline
Total Xylenes	<0.1	150000 ²	Max meets screening guideline
F1 (C6-C10)	<10	12000 ⁶	Max meets screening guideline
F2 (C10-C16)	<10	6800 ⁶	Max meets screening guideline
F3 (C16-C34)	57	15000 ⁶	Max meets screening guideline
F4 (C34-C50)	<20	21000 ⁶	Max meets screening guideline
Polychlorinated Biphenyls			
Total PCBs	<0.05	0.35 ³	Max meets screening guideline

Notes:

- 1) YG CSR Matrix Numerical Standard, Parkland site
- 2) CCME SQG_{HH}, Residential/parkland site with coarse grained soil.
- 3) OMOE Site Condition Standards (S1 Risk) for a residential/parkland site with coarse grained soil, April 2011. (Appendix A.2 (1) Table 3).
- 4) USEPA Regional Soil Screening Level for resident soil (divided by 5)
- 5) NG = No guideline published
- 6) Canada Wide Standards for Petroleum Hydrocarbons CCME 2008, residential/parkland site, coarse grained soil, direct contact pathway

Some metals have a low inherent toxicity (e.g., aluminum, calcium, iron, magnesium, potassium and sodium) and/or an absence of guidelines (e.g., bismuth, lithium, magnesium, phosphorus, potassium, and titanium). Due to the low level of concern, these metals also have limited toxicological information for further risk characterization and therefore have not been carried forward in the HHRA.

Metals for which the maximum Site concentrations exceed their respective human health screening guidelines (i.e., antimony, arsenic, cadmium, chromium, cobalt, manganese, nickel, vanadium and zirconium), have been carried forward as COPC requiring assessment and/or risk management within the HHRA.

4.3.2.2 Asbestos in Air

A review of air monitoring data provided in historical reports completed by SENES (2003b), UMA (2006), Amec Foster Wheeler (2016), and the most current study (Wood 2018) were reviewed to determine the suitability for use in the risk assessment.

Sampling conducted by Amec Foster Wheeler in 2016 was for occupational exposure purposes and was completed with mitigative measures in place (surface area was wetted to control dust and prevent asbestos from becoming airborne). Ambient background air samples, collected prior to the commencement of drilling and other major disturbance work, as well as during ground disturbance (preparation and drilling) were below the investigative criteria of 0.01 fibres per cubic centimetre (f/cc).

Both UMA and SENES conducted air monitoring at the Clinton Creek Mine. The first set of data was obtained by UMA during September 2002 and August 2003, and the second set was obtained by SENES during September 2003. No mitigative measures were in place during these sampling events, however ground conditions were generally damp or snow covered when the samples were taken. The highest concentrations in both studies were detected when dusting was occurring (i.e., driving, walking on-site). It is assumed that drier conditions (e.g., during the summer) would likely result in higher airborne asbestos fibre levels. Sampling included both area samples and personal samples. Phase Contrast Microscopy (PCM) has generally been the technique used in the calculation of exposure and risk estimates. PCM data from both studies were reviewed and the maximum concentration detected in the SENES report (0.22 f/cc) was carried forward for risk characterization in the 2017 HHERA.

Additional air samples were collected at the Site in 2018 as described in Section 3.2.3, and summarized below:

- **Passive samples** - Samples collected in locations of the Site where no drilling or other activities were being conducted. These samples were collected for evaluating exposure risk in areas where soils and tailings materials were not being actively disturbed.
- **Area samples** - Samples from areas where airborne asbestos fibre exposures were anticipated to be a risk, such as areas where disturbance activities were occurring and areas where build-up of ground materials might occur due to cross contamination by personnel.
- **Personal samples** - Personal air samples were collected from personnel directly involved in drilling and sample preparation, as well as personnel performing ancillary functions (e.g., general labourers, equipment operators, driller operators/ helpers, environmental samplers, lab technicians, and office staff).

Passive samples represent conditions with no disturbance of tailings and reflect an exposure scenario in which access to the tailings is prevented. Area and personal samples better reflect an exposure scenario in which there are no access restrictions to the tailings. Sampling results are summarized in Table 4.2.

Table 4.2: Summary of 2018 Asbestos Sample Results (f/ml)

	Passive	Area	Personal
N	68	44	53
Minimum	<0.0001	<0.002	<0.002
Maximum	0.008	0.063	0.037
Mean	0.003	0.014	0.013

4.3.3 Receptor Identification

It is recognized that, even if Site access restrictions are lifted in the future, the Site is very remote and difficult to access. The nearest town, Dawson City, is approximately two hours by car (when the ferry is operational across the Yukon River – i.e., in the summer months). Otherwise, the Site is accessible only by helicopter or snowmobile. The main groups of people who may be expected to access the Site are:

- Occasional visitors which include people working at the Clinton Creek Mine Site as part of ongoing care and maintenance, regular visits by Government employees and Canadian Rangers who may frequent the Site on a regular basis.
- Members of the Tr'ondëk Hwëch'in First Nation and others who may frequent the Site to engage in traditional activities such as hunting/gathering/fishing.
- People who may frequent the Site for camping and recreational purposes.

Details regarding the receptor characterization selected for this HHRA are discussed in Section 8.2.3.

4.3.4 Exposure Pathway Identification

The exposure assessment evaluates the likelihood that human receptors may come into contact with hazards. The likelihood of exposure is determined through consideration of the properties of individual hazards that control chemical mobility, and the various pathways through which the hazard could be transported to contact the receptor, or through which the receptor could move to contact the hazard. The exposure analysis also considers the possible mechanisms through which a hazard can be introduced to a human receptor (i.e., ingestion, dermal contact, and inhalation).

Exposure pathways are used to describe how a substance could move from the impacted media (soil, water, etc.) to a point where it can come in contact with a human receptor. The exposure scenarios that have been considered for human receptors at the Site include:

- ingestion/dermal contact with soil or sediment
- inhalation/ingestion/dermal contact with dust
- inhalation of asbestos fibres
- ingestion of vegetation/country foods
- ingestion/dermal contact with surface water
- inhalation of vapours.

The relevant exposure pathways are summarized in Table 4.3, which includes an evaluation of each pathway based on site-specific conditions. Those complete hazard-exposure-receptor combinations considered to have the highest likelihood to contribute to human health risk are carried forward for further quantitative analysis.

Table 4.3: Potential Exposure Scenarios - Human Receptors

Exposure Pathway Description	Pathway Complete?	Carried Forward?	Justification
Ingestion/inhalation of soil	Yes	Yes	Trace metals and asbestos impacts have been identified in the surface soil. On-site receptors may be exposed to the impacted soil/dust.
Dermal contact with soil			
Ingestion/inhalation of dust			
Dermal contact with dust			
Inhalation of asbestos fibres	Yes	Yes	Loose asbestos fibres are present across the Site. On-site receptors may inhale the fibres while on-site.
Ingestion of/dermal contact with sediment	Yes	Yes	It is possible receptors may wade in Clinton Creek or Wolverine Creek or Hudgeon Lake, and incidental contact with sediment may occur. Potential that direct exposure may occur in the event Hudgeon Lake is drained.
Dermal contact with/ Ingestion of surface water	Yes	Yes	It is possible receptors may wade in Clinton Creek, Wolverine Creek or Hudgeon Lake, and incidental contact with surface water may occur.
Ingestion of groundwater	No	No	There is no access to groundwater at the Site.
Ingestion of vegetation, fish, game, and other country foods	Yes	Yes	Trace metals may be taken up into plants and berries. It is possible receptors may hunt, fish, or forage at the Site.
Inhalation of vapours (indoors)	No	No	There are no buildings at the Site.
Inhalation of vapours (outdoors)	No	No	Metals and asbestos are not volatile.

4.3.5 Human Health Conceptual Site Model

The conceptual site model (CSM) developed for this Site is presented Figure 4.1. It indicates that Site visitors may be exposed to trace metals and asbestos in surface soil through ingestion and dermal contact, and particulate inhalation. Further, they may be exposed to COPC in sediment and surface water as well as fish, game, and other country foods obtained from the Site.

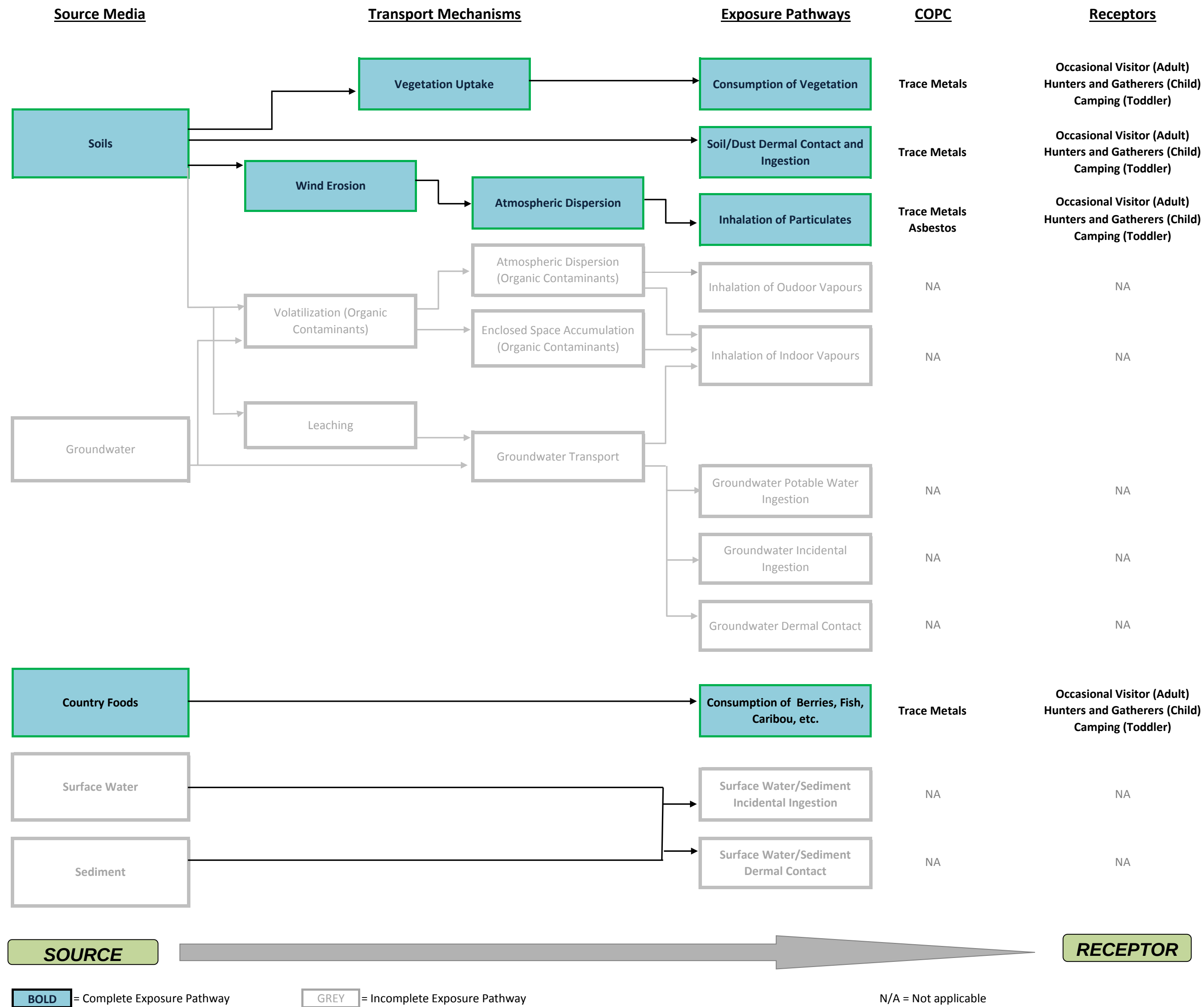
4.4 Exposure Assessment

Soil data available for the 2017 HHRA was insufficient to assess different areas of the Site separately and the risk assessment was based on estimates of Site-wide average concentrations. One purpose of the 2018 field program was to provide sufficient soil samples that distinct areas could be assessed, as follows:

- Tailings;
- Waste rock; and
- Remainder of the Site.

In the following sections, the exposure assessment and risk characterization will assess area-specific exposure within the above three groupings.

Figure 4-1 Conceptual Site Model for Human Receptors - HHRA Update, Clinton Creek Former Mine Site



4.4.1 Exposure Point Concentrations

Maximum concentrations of antimony, arsenic, cadmium, chromium, cobalt, manganese, nickel, vanadium, and zirconium exceeded their respective human health screening guidelines, and therefore, required further assessment and/or risk management. Subsequent risk assessments use exposure point concentrations (EPCs) to represent contaminant concentrations. The EPC is an estimate of a reasonable upper limit value for the average chemical concentration in the medium, determined for each exposure unit (USEPA, 1989; USEPA, 2013). EPCs are represented by the upper confidence limit of the mean (UCLM) (95% or above) calculated with ProUCL (Version 5.1). In the case of laboratory duplicates or field duplicates, the sample with the highest concentration at each location was used in the calculation of the EPC. Only samples collected to a depth of 0.15 m were included in the EPC calculation as it is most likely that human receptors at the Site identified in Section 4.3.3 will come into contact with only surficial soils rather than soils at depth. The results of the statistical analyses are provided in Appendix B.

4.4.1.1 Tailings

Maximum concentrations from tailings samples that exceeded the human health screening criteria (Table 8.1, Section 4.3.2.1) and are carried forward for further assessment are presented in Table 4.4.

Table 4.4: Human Health Screening of Tailings

Chemical	Maximum Concentration (mg/kg)	EPC (mg/kg)	Human Health Screening Guidelines (mg/kg)	Comment
Antimony (Sb)	50	24.4	7.5 ³	EPC exceeds screening guideline
Arsenic (As)	321	70.5	100 ¹	EPC meets screening guideline
Cadmium (Cd)	6	0.47	3 ¹	EPC meets screening guideline
Chromium (Cr)	1810	1,429	100 ¹	EPC exceeds screening guideline
Cobalt (Co)	111	93.8	22 ³	EPC exceeds screening guideline
Manganese (Mn)	1026	636	380 ⁴	EPC exceeds screening guideline
Nickel (Ni)	2647	2,013	200 ²	EPC exceeds screening guideline
Vanadium (V)	66	28.2	39 ³	EPC meets screening guideline
Zirconium (Zr)	17	0.5	1.3 ⁴	EPC meets screening guideline

Notes:

- 1) YG CSR Matrix Numerical Standard, Parkland site
- 2) CCME SQG_{HH}, Residential/parkland site with coarse grained soil.
- 3) OMOE Site Condition Standards (S1 Risk) for a residential/parkland site with coarse grained soil, April 2011. (Appendix A.2 (1) Table 3).
- 4) USEPA Regional Soil Screening Level for resident soil (divided by 5)

Metals for which the EPC exceeds their respective human health screening guidelines (i.e., antimony, chromium, cobalt, manganese, and nickel) are carried forward within the HHRA.

4.4.1.2 Waste Rock

Maximum concentrations from waste rock samples that exceeded the human health screening criteria (Table 8.1, Section 4.3.2.1) and were carried forward for further assessment are presented in Table 4.5.

Table 4.5: Human Health Screening of Waste Rock

Chemical	Maximum Concentration (mg/kg)	EPC (mg/kg)	Human Health Screening Guidelines (mg/kg)	Comment
Antimony (Sb)	50	17.9	7.5³	EPC exceeds screening guideline
Arsenic (As)	321	37.8	100 ¹	EPC meets screening guideline
Cadmium (Cd)	6	2.14	3 ¹	EPC meets screening guideline
Chromium (Cr)	1810	656	100¹	EPC exceeds screening guideline
Cobalt (Co)	111	54.6	22³	EPC exceeds screening guideline
Manganese (Mn)	1026	564	380⁴	EPC exceeds screening guideline
Nickel (Ni)	2647	982	200²	EPC exceeds screening guideline
Vanadium (V)	66	31.6	39 ³	EPC meets screening guideline
Zirconium (Zr)	17	8.4	1.3⁴	EPC exceeds screening guideline

Notes:

- 1) YG CSR Matrix Numerical Standard, Parkland site
- 2) CCME SQG_{HH}, Residential/parkland site with coarse grained soil.
- 3) OMOE Site Condition Standards (S1 Risk) for a residential/parkland site with coarse grained soil, April 2011. (Appendix A.2 (1) Table 3).
- 4) USEPA Regional Soil Screening Level for resident soil (divided by 5)

It is possible that concentrations of some trace metals represent natural background conditions so therefore, a comparison of Site concentrations to background soil concentrations was completed in the 2017 HHRA. Background samples were collected in 2017 from a reference area across the bridge over the Fortymile River. The primary purpose of deriving a background estimate is to screen contaminated site investigation data to determine if concentrations identified are likely to be naturally occurring. Rather than comparing a site-specific maximum measured concentration to a background maximum concentration, the Wilcoxon Rank-Sum Test, a non-parametric statistical hypothesis test, was used to test the difference between the regional background data and the Site data (i.e., to determine whether the samples are likely to have come from the same sample population or not).

The Wilcoxon Rank-Sum Test for zirconium indicated that the Site data and background data are likely from the same population (i.e., it can be concluded, with confidence, that the current Site concentrations are not statistically different to the range of concentrations attributed to background surficial geology in the area). On this basis, further assessment of zirconium in surface soil was not conducted.

Metals for which the EPC exceeds their respective human health screening guidelines and for which Site concentrations are elevated compared to background concentrations (antimony, chromium, cobalt, manganese, and nickel) are carried forward within the HHRA.

4.4.1.3 Remainder of Site

Maximum concentrations from surface soil samples collected across the mine and mill areas that exceeded the human health screening criteria (Table 8.1, Section 4.3.2.1) and were carried forward for further assessment are presented in Table 4.6.

Table 4.6: Human Health Screening of Remainder of the Site

Chemical	Maximum Concentration (mg/kg)	EPC (mg/kg)	Human Health Screening Guidelines (mg/kg)	Comment
Antimony (Sb)	50	3.8	7.5 ³	EPC meets screening guideline
Arsenic (As)	321	15.2	100 ¹	EPC meets screening guideline
Cadmium (Cd)	6	0.67	3 ¹	EPC meets screening guideline
Chromium (Cr)	1810	393	100 ¹	EPC exceeds screening guideline
Cobalt (Co)	111	34.3	22 ³	EPC exceeds screening guideline
Manganese (Mn)	1026	517	380 ⁴	EPC exceeds screening guideline
Nickel (Ni)	2647	546	200 ²	EPC exceeds screening guideline
Vanadium (V)	66	33.5	39 ³	Max exceeds screening guideline
Zirconium (Zr)	17	3.07	1.3 ⁴	Max exceeds screening guideline

Notes:

- 1) YG CSR Matrix Numerical Standard, Parkland site
- 2) CCME SQG_{HH}, Residential/parkland site with coarse grained soil.
- 3) OMOE Site Condition Standards (S1 Risk) for a residential/parkland site with coarse grained soil, April 2011. (Appendix A.2 (1) Table 3).
- 4) USEPA Regional Soil Screening Level for resident soil (divided by 5)

As discussed in Section 4.4.1.2, the Wilcoxon Rank-Sum Test for zirconium indicated that the Site data and background data are likely from the same population (i.e., it can be concluded, with confidence, that the current Site concentrations are not statistically different to the range of concentrations attributed to background surficial geology in the area). On this basis, further assessment of zirconium in surface soil was not conducted.

Metals for which the EPC exceeded their respective human health screening guidelines and for which Site concentrations were elevated compared to background concentrations (chromium, cobalt, manganese, and nickel) were carried forward within the HHRA.

4.4.1.4 EPC Summary

A summary of soil EPCs for each COPC carried forward to the HHRA for each area of the Site (tailings, waste rock, remainder of Site) is provided in Table 4.7 below.

Table 4.7: EPC Summary by Area (mg/kg)

Chemical	Tailings	Waste Rock	Remainder of Site
Antimony (Sb)	24.4	17.9	3.8
Chromium (Cr)	1,429	656	393
Cobalt (Co)	93.8	54.6	34.3
Manganese (Mn)	636	564	517
Nickel (Ni)	2,013	982	546

COPC concentrations are highest in the tailings and lowest across the general Site areas. The antimony EPC meets the screening guideline in the remainder of the Site and is only identified as a COPC in the waste rock and tailings. Separation of the Site into these areas was not possible in the 2017 HHRA and allows more direct assessment of risks associated with tailings and suitability of waste rock as potential cover material.

4.4.2 Modelling Tools

4.4.2.1 Metals in Soil

Wood used the same in-house risk assessment models as were used in the 2017 HHRA to calculate the human health risk estimates associated with metals impacts identified in soil (i.e., antimony, chromium, cobalt, manganese and nickel) at the Site. In this HHRA Update, models were run for each Site area separately (tailings, waste rock, remainder of Site). The specific methods employed to calculate the hazard quotients (HQs) were consistent with CCME and Health Canada protocols and with standard HHRA methodologies. The equations used in the modelling of metal impacts are shown on the spreadsheets in Appendix C.

4.4.2.2 Metals in Country Foods

Intake of COPCs through the ingestion of country foods hunted and gathered at the Site was conducted using the same models as were used in the 2017 HHRA, which were based on Health Canada Guidance (2010d). Country foods considered to be representative of the Site and included in the HHRA were:

- Berries
- Fish
- Hare
- Grouse
- Duck
- Moose
- Caribou

EPCs calculated for each COPC in soil were used in the calculations. The soil EPCs for the remainder of the Site were used in the country foods modelling as this best represents the areas where animals are expected to forage for food, given the barren and exposed nature of the tailings and waste rock. This approach is supported by the small mammal survey during which no animals were captured in traps set on the tailings. Metals concentrations in vole livers were analyzed as part of the 2018 small mammal survey (Section 3.2.2). These liver concentrations were used in place of uptake modelling to represent hare and grouse tissue concentrations in this HHRA Update. This likely overestimates muscle tissue and whole body concentrations as metals are typically more concentrated in organs (e.g., kidney, liver) than in muscle. Vole liver concentrations were not considered applicable to aquatic species (fish, duck) or large ungulates with extensive home ranges (moose, caribou).

Receptor information (i.e., body weight, ingestion rates for water, food and soil) was obtained from the Health Canada (Health Canada, 2010a,b,c) publications. If no data were available for a given media, generic distribution coefficients and transfer factors from the literature were used to calculate the concentrations in these media.

4.4.2.3 Asbestos in Air

Inhalation is the principal route of exposure to asbestos resulting in cancer or asbestos-related disorders. Health Canada (1989) states that based on information available in extensive toxicological and epidemiological studies conducted to date, there is no consistent, convincing evidence that ingested asbestos is hazardous to health. Additionally, Marsh (1983) conducted a critical review of thirteen epidemiologic studies of ingested asbestos conducted in five areas of the United States and Canada and

determined that no individual study or aggregation of studies exist that would establish risk levels from ingested asbestos. Therefore, for the purpose of this HHRA Update, the only relevant exposure pathway considered for exposure to asbestos is through inhalation.

4.4.3 Receptor Characteristics and Exposures

Receptor characteristics and exposures are unchanged from the 2017 HHRA and include workers as part of ongoing care and maintenance (non-intrusive) of the former mine site, Government workers who visit the Site on a regular basis, and transient users of the Site for activities such as hiking, hunting, fishing, gathering country foods, or harvesting plants for traditional uses. The following three main groups of people assessed as part of the HHRA include:

- Occasional Visitors
 - o Government workers, Site maintenance worker, Canadian Ranger
 - o 10 hrs/day, 1 day/month, 35 year working career
- Hunters/Gatherers
 - o Members of the Tr'ondëk Hwëch'in First Nation
 - o 2 days/week, 6 months/year, 50 years (ages 5 to 65)
- Campers
 - o People that may camp or have a cottage in the area
 - o On-site 24 hrs/day, 3 months/year (summer months)

Other groups (e.g., tourists, trespassers, town site residents) may visit the Site but their exposure would be less than or similar to those groups above. Important receptor characteristics are presented in Table 4.8 and Appendix C.

Table 4.8: Summary of Receptor Characteristics

Characteristic		Occasional Visitor	Hunter/Gatherer	Camper
Exposure Term (ET)	ET ₁ (hours per day exposed)	10	24	24
	ET ₂ (days per week exposed)	1 day/month	2	7
	ET ₃ (months/year)	12	6	3
Body Weight (BW)	BW (kg)	62.2	32.9	16.5
Soil Ingestion Rate (SIR)	SIR (g/d)	0.02	0.02	0.08
Inhalation Rate – Air (IR _{air})	IR _{air} (m ³ /d)	16.6	14.5	8.3
Skin Surface Area – Hands (SA _H)	SA _H (cm ²)	820	590	430
Skin Surface Area – Other (SA _{body})	SA _{body} (cm ²)	2,270	4,550	2,580
Adherence Factor – Hands (M _{hands})	M _{hands} (mg/cm ²)	0.1	0.1	0.1
Adherence Factor – Other (M _{body})	M _{body} (mg/cm ²)	0.01	0.01	0.01
Fraction of Country Food Obtained from the Site		1	1	1

Notes:

Receptor ingestion rates for each country food are provided in Appendix C.

The exposures for each receptor are calculated for each of the defined exposure areas (i.e., tailings, waste rock, remainder of the Site). This permits an assessment of three conceptual scenarios:

- Unrestricted access to uncovered tailings (tailings EPC);
- Suitability of waste rock as cover material (waste rock EPC); and
- Unrestricted use of the remainder of the Site (remainder of the Site EPC).

4.5 Toxicity Assessment

The purpose of the toxicity assessment is to identify the types of adverse health effects a chemical may potentially cause as well as the relationship between the magnitude of exposure (dose) and the likelihood of an adverse effect (response). This is called the dose-response relationship. The toxicity assessment provides an estimate of how much chemical exposure may occur without unacceptable health effects occurring from lifetime exposure (or significant portion of a lifetime) and provides a basis to interpret exposure rates.

4.5.1 Chromium Speciation

Chromium occurs in soil in the trivalent (III) and hexavalent (VI) oxidation states with very different TRVs. Trivalent chromium hydroxide, which has low solubility, is the most prevalent form of natural chromium in soils while hexavalent chromium is mostly being a result of anthropogenic sources (Kelley et al. 2002). Characterization of chromium oxidation states is recommended if it is necessary to establish that hexavalent chromium is not present. Default risk-based clean-up levels based on ingestion of soils containing Cr (III) are higher than those for Cr (VI) and can only be applied if Cr (VI) is not present. Soils at Clinton Creek are not expected to contain anthropogenic sources of Cr (VI); however, six soil samples were submitted for laboratory analysis of chromium speciation, as listed in Table 4.9 in order to confirm this assumption.

Table 4.9: Chromium Speciation

Sample	Sample Type	Cr (III) mg/kg	Cr (VI) mg/kg	Cr (III) / Total Cr %
18-BH05-01	Waste rock	24.9	<0.1	100%
18-BH06-02	Waste rock	8.6	<0.1	100%
18-BH07-02	Waste rock	12.2	<0.1	100%
18-BH08-01	Waste rock	20.4	0.14	99.3%
18-MILL-DUP-05	Mill area soil	39.2	0.88	97.7%
BH2018-05-02/151'	Waste rock	24.7	<0.1	100%

The results of the speciation suggest that most of the total chromium measured at the site is trivalent chromium (Cr III) with trace amounts of hexavalent chromium (Cr VI) (up to 2.3% in the samples tested). To account for the small percentage of Cr(VI), the total chromium EPCs (Tables 4.4 – 4.6) will be divided into Cr(III) and Cr(VI) fractions based on a distribution of 98% Cr(III) and 2% Cr(VI) as indicated in Table 4.10.

Table 4.10: Cr(III) and Cr(VI) Soil EPCs

Sample Type	Cr Total (mg/kg)	Cr (III) mg/kg	Cr (VI) mg/kg
Tailings	1,429	1,400	29
Waste Rock	656	642	14
Remainder of Site	393	385	8

The HHRA will be conducted independently for Cr(III) and Cr(VI) using toxicity reference values specific to the chromium species as described in the following section.

4.5.2 Toxicity Reference Values

An essential part of the risk assessment is the identification of appropriate toxicity reference values (TRVs). This is typically done by a literature review of published toxicological assessments. TRVs have been established by several agencies including Health Canada, the USEPA, and the World Health Organization (WHO). Preference has been given to Health Canada values and where these are not established, values from other Canadian sources have been employed as the best basis upon which to evaluate health risks. Except for the addition of antimony as a COPC and the separation of chromium into Cr (III) and Cr (VI), the selection of TRVs is unchanged from the 2017 HHRA. Summaries of the toxicity values selected for inclusion in the risk assessment are provided in Table 4.11.

Table 4.11: Selected Toxicity Reference Values

Chemical	Route of Exposure	TRV (mg/kg-day)	Toxicological Basis	Source Agency
Antimony	Ingestion /Dermal contact	0.0004	Longevity, blood glucose, and cholesterol	USEPA (1987)
	Inhalation	0.0004	Longevity, blood glucose, and cholesterol	USEPA (1987)
Cr(III)	Ingestion /Dermal contact	0.3	No effects observed at highest doses assessed	EFSA (2014) ¹
	Inhalation	0.3	No effects observed at highest doses assessed	EFSA (2014)
Cr(VI)	Ingestion /Dermal contact	0.001	Intestinal hyperplasia	Health Canada (2010b)
	Inhalation	320 (mg/kg-day) ⁻¹	Lung cancer	Health Canada (2010b)
Cobalt	Ingestion /Dermal contact	0.001	Polycythemia production in humans	OMOE (2011)
	Inhalation	0.001		OMOE (2011)
Manganese	Ingestion /Dermal contact	0.14	Parkinsonian-like Neurotoxicity	Health Canada (2010b)
	Inhalation	0.14		Health Canada (2010b)
Nickel	Ingestion /Dermal contact	0.011	Post-implantation perinatal lethality	Health Canada (2010b)
	Inhalation	5.3 (mg/kg-day) ⁻¹	Lung and nasal cancer	Health Canada (2010b)

Notes:

1. European Food Safety Authority. Scientific Opinion on the risks to public health related to the presence of chromium in food and drinking water.

4.5.3 Bioavailability

Soil ingestion can be a significant exposure pathway, especially for young children. Subsequent to ingestion, a portion of the metals in the soil are released and absorbed during the digestive process. This fraction that is released into the gastrointestinal tract is termed the “bioaccessible” fraction. The “bioavailable” fraction is the fraction of the metals absorbed from the gastrointestinal tract and into the bloodstream.

Bioaccessibility testing is designed to simulate the human gastrointestinal environment and provide an estimate of soil-bound metals bioaccessibility. This approach is considered to be an acceptable surrogate for the bioavailability of soil bound metals. Metals bioavailability from soil can be significantly lower than bioavailability from diet and water. Toxicity studies used to derive TRVs are typically based on

administered doses in diet or water. To account for this difference in media effects in the HHRA, a relative bioavailability factor (RBF) can be used where the RBF is the ratio of the bioavailability of the metal in soil to the bioavailability of the metal in the medium used in the toxicity study (e.g., diet):

$$\text{RBF} = \frac{\text{Bioavailability of metal in site-specific exposure medium}}{\text{Bioavailability of metal in toxicity study}}$$

In the 2017 HHRA, chromium in soil was identified as a potential concern due to direct soil contact (i.e., ingestion and dermal contact). Six surface soil samples were submitted to the ALS laboratory in Kelso, Washington, USA for site-specific estimation of soil bioaccessibility for chromium. The results of the bioaccessibility testing are presented in Table 4.12.

Table 4.12: Chromium Bioaccessibility

Sample	Sample Type	Total Chromium	Bioaccessible Chromium	Bioaccessible fraction
18-BH05-01	Waste rock	21.1	1.2	5.7%
18-BH06-02	Waste rock	7.5	2.1	28%
18-BH07-02	Waste rock	11.5	1.67	15%
18-BH08-01	Waste rock	18.1	0.35	1.9%
18-MILL-DUP-05	Mill area soil	26.3	0.78	3%
BH2018-05-02/151'	Waste rock	29.6	0.98	3.3%

The bioaccessibility testing suggests that chromium in soil from the site has low availability for human uptake, ranging from <2% up to 28% in the samples tested. This range of values must then be compared to bioavailability values from toxicity studies to determine if there is a relative difference that would require the use of an RBF in the HHRA. Toxicological studies have identified that Cr III is poorly absorbed from the gastrointestinal tract (ATSDR 2008). Typically, ≤1% of an orally administered dose of trivalent chromium has been recovered in the urine of experimental animals. Approximately 0.5–2.0% of dietary chromium (III) is absorbed via the gastrointestinal tract of humans as inferred from urinary excretion measurements (ATSDR 2008). The absorption fraction of soluble chromium (VI) is higher than that of soluble chromium (III) and had a rate of 10% compared to chromium III at 2% in a study which examined the absorption rates of the two chromium species (ATSDR 2008). In summary, absorption of dietary chromium from the intestinal tract is low, ranging from less than 0.4% to 2.5% of the amount consumed.

The results indicate that the range of bioavailability of chromium from Site soil is similar to the range in dietary studies and the bioavailability from soil is not less than bioavailability from diet. Therefore, an oral RBF is not required for chromium in the HHRA (i.e., a default RBF = 1 will be adopted).

These factors were applied in the risk assessment to more realistically represent the portion of soil contaminants that are available. For instance, a relative bioavailability factor of 0.5 indicates that 50% of the administered (e.g., ingested) metal is absorbed into the bloodstream compared to the absorption in the toxicity study. The bioavailability factors used in this assessment are provided in Table 4.13.

Table 4.13: Bioavailability Factors

Chemical	Bioavailability Factor (or Relative Absorption Factor)		
	Oral ^a	Dermal ^b	Inhalation ^a
Antimony	1	0.01 ^c	1
Chromium	1 ^d	0.1	1
Cobalt	1	0.01 ^c	1
Manganese	1	0.01 ^c	1
Nickel	1	0.091	1

Notes:

^a Default

^b Health Canada (2010b)

^c USEPA RAGS E default value

^d Site-specific bioaccessibility testing

4.6 Risk Characterization

Health Canada (2010c) states that on-site exposures (excluding background estimates for off-site sources including soil/dust, food, air and water) should be assessed based on a target hazard quotient (THQ) equal to 0.2. This is consistent with the CCME (2006), and has become accepted common practice in Canada. However, in cases where the risks associated with the Site and the background sources are combined, the guideline can be based on a THQ up to 1.0. CCME (2006) suggest that the THQ is based on the number of applicable exposure media such that the THQ is equal to 1.0 divided by the number of applicable exposure media. This HHRA will be focusing on potential effects due to exposure to soil (THQ = 0.2) and country foods obtained from the Site (THQ = 0.2) which would contribute up to 0.4 of the total permissible exposure (THQ of 1.0). Since there is no source of potable water at the Site, ingestion of water was not included and background intakes (e.g., foods obtained from the supermarket) were not included.

4.6.1 Soil

4.6.1.1 Non-Carcinogenic Risk

Risk characterization compares the estimated exposures with the identified toxicity values for each substance to determine the potential for an adverse effect. Based on the published toxicity value (TDI), and calculation of intake rate from ingestion, inhalation, and dermal contact with soil, an HQ can be calculated, as follows:

$$\text{Hazard Quotient (HQ)} = \frac{\text{Average Daily Intake from Site}}{\text{Tolerable Daily Intake}}$$

Where Target Hazard Quotient = 0.2

Details of the equations and parameter values used in the analysis are provided in Appendix C. The calculated HQs for each COPC are presented in Tables 4.14 to 4.16 for each Site area (tailings, waste rock, remainder of the site).

Table 4.14: Hazard Quotients – Tailings

COPC	Occasional Visitor	Hunters/Gatherers	Campers	Comment
Antimony	0.0007	0.006	0.075	HQ≤0.2
Chromium (III)	0.00008	0.0006	0.0062	HQ≤0.2
Chromium (VI)	0.00046	0.0038	0.038	HQ≤0.2
Cobalt	0.001	0.009	0.12	HQ≤0.2
Manganese	0.00005	0.0005	0.006	HQ≤0.2
Nickel	0.003	0.02	0.24	HQ>0.2

As indicated in Table 4.14, the Camper HQ for nickel is greater than 0.2 for the camper soil exposure scenario, indicating that unacceptable risks to the camper (toddler visitor) due to exposure to tailings (dermal/ingestion and inhalation) cannot be ruled out. This scenario is used as an estimate of exposure for a setting in which there is unrestricted access to uncovered tailings.

Table 4.15: Hazard Quotients – Waste Rock

COPC	Occasional Visitor	Hunters/Gatherers	Campers	Comment
Antimony	0.0005	0.004	0.06	HQ≤0.2
Chromium	0.00003	0.0003	0.0028	HQ≤0.2
Chromium (VI)	0.0002	0.0017	0.017	HQ≤0.2
Cobalt	0.0006	0.005	0.07	HQ≤0.2
Manganese	0.00004	0.0004	0.005	HQ≤0.2
Nickel	0.001	0.01	0.12	HQ≤0.2

As indicated in Table 4.15, the HQs for all COPC are less than 0.2, indicating that unacceptable risks are not predicted due to exposure to metals in waste rock (i.e., dermal/ingestion and inhalation). These results indicate that use of waste rock as cover material would not result in unacceptable metals exposure.

Table 4.16: Hazard Quotients – Remainder of the Site

COPC	Occasional Visitor	Hunters/Gatherers	Campers	Comment
Chromium (III)	0.00002	0.0002	0.0018	HQ≤0.2
Chromium (VI)	0.0001	0.001	0.01	HQ≤0.2
Cobalt	0.0004	0.003	0.04	HQ≤0.2
Manganese	0.00004	0.0004	0.005	HQ≤0.2
Nickel	0.0008	0.006	0.07	HQ≤0.2

As indicated in Table 4.16, the HQs for all COPC are less than 0.2, indicating that unacceptable risks are not predicted due to exposure to metals in surface soil across the remainder of the Site for all exposure scenarios assessed (i.e., occasional visitors, hunters/gatherers, and campers).

4.6.1.2 Carcinogenic Risk

Chromium (VI) and nickel are considered to be carcinogenic by the inhalation route of exposure. Risk characterization for carcinogenic COPC is conducted based on published toxicity values called cancer slope factors (CSF) published by Health Canada (2010b). The intake rate from inhalation of dust is used to calculate a Lifetime Average Daily Dose (LADD) which is multiplied by the CSF to calculate an Incremental Lifetime Cancer Risk (ILCR), as follows:

$$\text{ILCR} = \text{CSF (mg/kg-day)}^{-1} \times \text{LADD (mg/kg-day)}$$

Health Canada define an ILCR of 0.00001 (10^{-5}) as essentially negligible. Details of the equations and parameter values used in the analysis are provided in Appendix C. The calculated ILCRs for Cr(VI) and Ni are presented in Table 4.17 for each Site area (tailings, waste rock, remainder of the site).

Table 4.17: Cr(VI) and Nickel ILCRs

COPC	Occasional Visitor	Hunters/Gatherers	Campers	Comment
Tailings				
Chromium (VI)	0.00000001	0.0000003	0.0000005	ILCR $\leq$ 0.00001
Nickel	0.00000002	0.0000003	0.0000005	ILCR $\leq$ 0.00001
Waste Rock				
Chromium (VI)	0.000000006	0.0000001	0.0000002	ILCR $\leq$ 0.00001
Nickel	0.000000007	0.0000002	0.0000003	ILCR $\leq$ 0.00001
Remainder of Site				
Chromium (VI)	0.000000004	0.00000007	0.0000001	ILCR $\leq$ 0.00001
Nickel	0.000000004	0.00000008	0.0000001	ILCR $\leq$ 0.00001

As indicated in Table 4.17, the ILCRs for both COPC are less than 0.00001, indicating that unacceptable risks are not predicted due to inhalation exposure to dust from surface soil across the Site for all exposure scenarios assessed (i.e., occasional visitors, hunters/gatherers, and campers).

4.6.2 Country Foods

The assessment of country foods assumes that 100% of the diet comes from the Site. It does not include other portions of the diet that comes from the supermarket or hunted/gathered from areas outside of the Site boundaries. In accordance with EFSA (2014), it is assumed that total chromium in food occurs as Cr (III).

Wild fruit and plants can accumulate COPC that are present in the soil. Small game may ingest these plants and accumulate COPC through their diet, as well as foraging and grooming (during which they incidentally ingest soil). In the absence of Site-specific tissue data (e.g., small mammals), food chain models are required to calculate the uptake of COPC into country foods. Sources of uptake models used in this HHRA include:

- USEPA companion database of chemical-specific parameter values for the Human Health Risk Assessment Protocol (HHRAP, 2005a);
- USEPA Ecological Soil Screening Levels (EcoSSLs) chemical-specific documents; and
- Primary scientific literature.

As discussed in Section 4.4.2.2, Site-specific metals concentrations in vole livers collected at the Site in 2018 were used to replace the uptake models for hare and grouse tissue concentrations. This is likely a conservative approach as organ concentrations (i.e., liver, kidney) are typically higher than muscle concentrations. A summary of the intake of each country food by COPC for the camper scenario is illustrated in the pie charts for each COPC below:

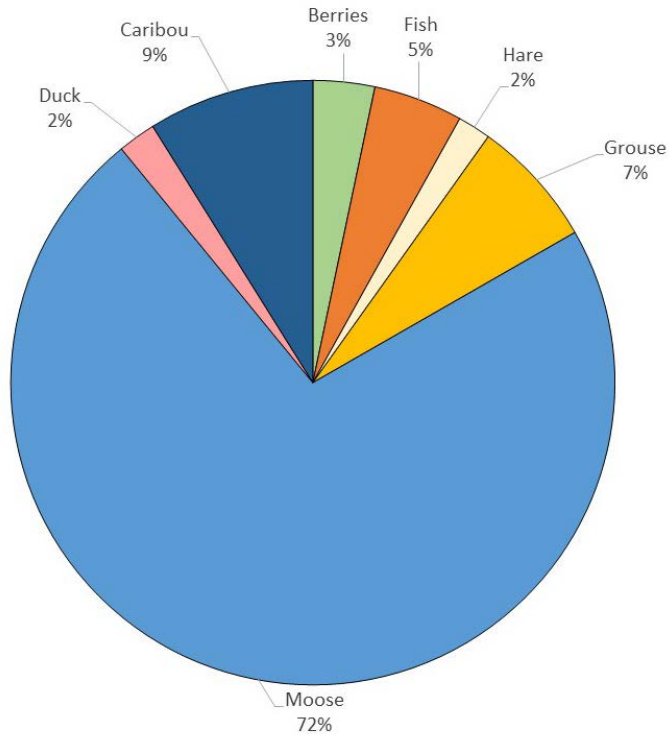


Figure 4.2: Chromium Intake by Country Food

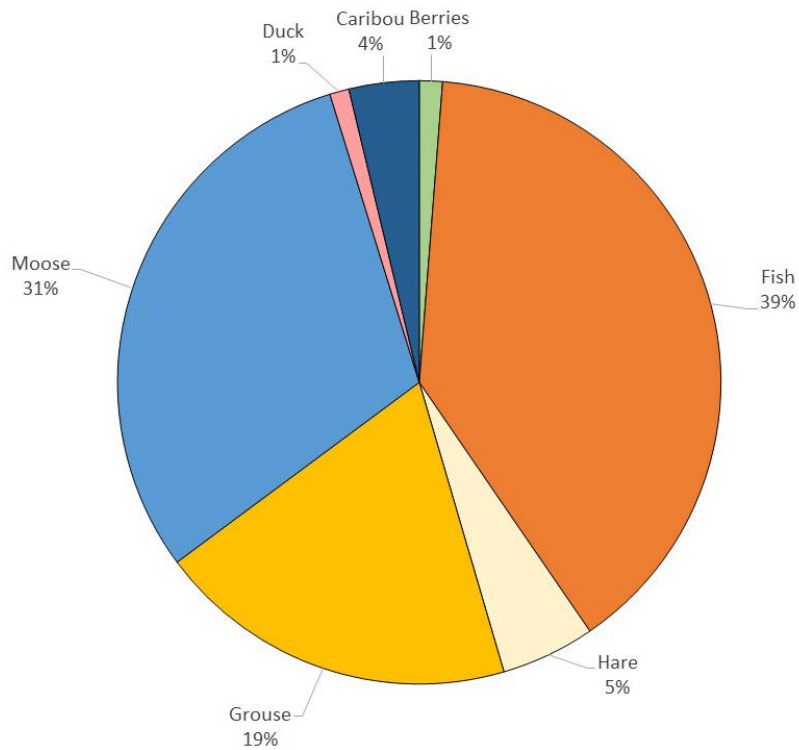


Figure 4.3: Cobalt Intake by Country Food

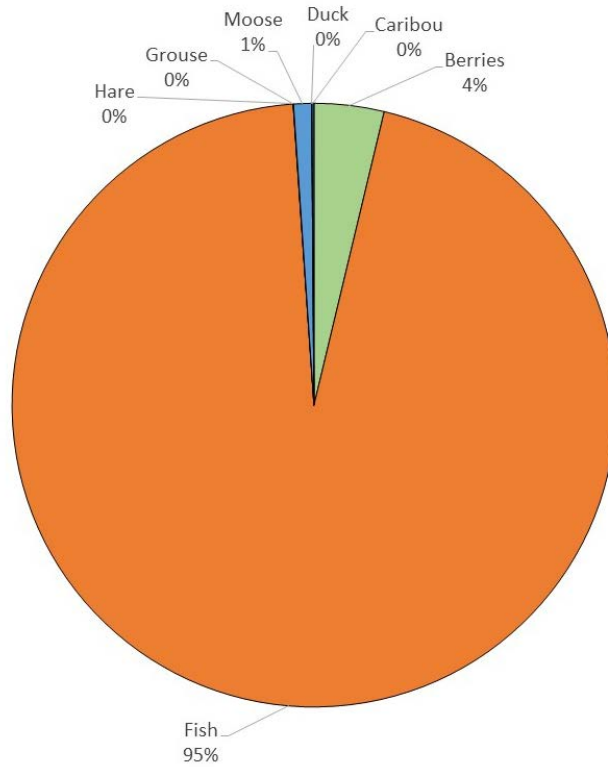


Figure 4.4: Manganese Intake by Country Food

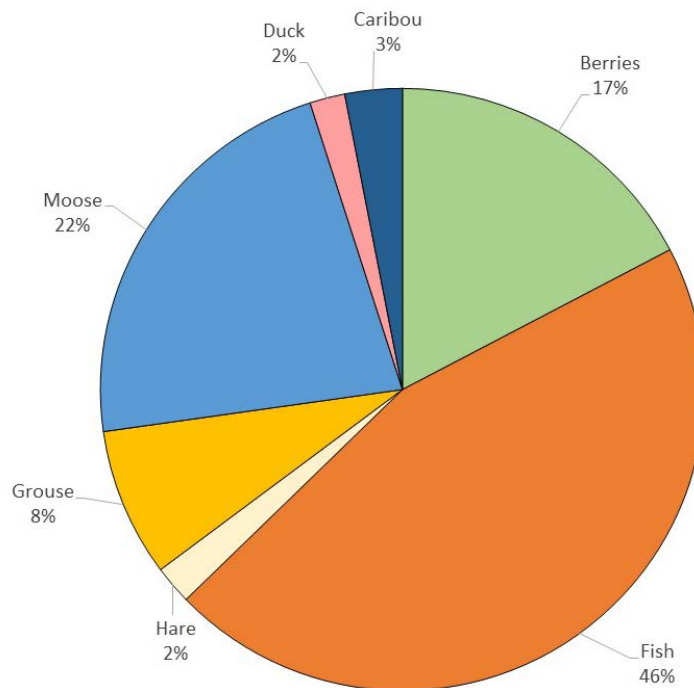


Figure 4.5: Nickel Intake by Country Food

Risk calculations to determine the intake of each COPC due to the ingestion of country foods takes the calculated country food tissue concentrations and receptor characteristics (ingestion rates, body weight etc.) of each receptor group into consideration. Receptor ingestion rates are provided in Appendix C. Dietary information was obtained from an assessment of dietary benefit/risk in western Inuit communities (e.g., Aklavik) (CINE, 2000). The study did not include dietary information for toddlers, therefore the body weight for the hunter/gatherer and camper scenarios was based on a teen (59.7 kg) as that is the age group represented in the dietary intake study (CINE, 2000). This avoids the uncertainty that would be introduced by trying to apply a correction factor to the reported country food intakes for teens to derive consumption rates for toddlers. Sample equations are provided in Appendix C. The calculated HQ for each COPC and its corresponding receptor group are presented in Table 4.18.

Table 4.18: Hazard Quotients – Country Foods

COPC	Campers	Hunters/Gatherers	Occasional Visitors
Chromium	0.12	0.12	0.11
Cobalt	0.13	0.13	0.11
Manganese	0.03	0.03	0.02
Nickel	0.16	0.16	0.15

Hazard quotients calculated for the intake of COPCs by ingestion of country foods for all groups of receptors are all less than the target risk level of 0.2, indicating that unacceptable risks due to ingestion of country foods hunted/gathered at the Site are not expected.

4.6.3 Asbestos in Air

4.6.3.1 Review of 2017 HHRA

In the 2017 HHRA, assessment of risks due to inhalation of airborne asbestos fibres was conducted using a relative risk model. The linear, non-threshold model to determine the relative risk between the number of observed cases and the number of cases expected in the absence of exposure to chrysotile asbestos is given as:

$$\text{Relative Risk} = O/E = 1 + b \times CE$$

Where:

- O = number of observed cases
- E = number of cases expected in the absence of chrysotile exposure
- b = constant (slope of the equation)
- CE = cumulative exposure (f/ml.years)

The assessment of inhalation of asbestos fibres and the value for the constant (b) were based on studies on the effects on health due to exposure to asbestos in the mining industry (McDonald et al., 1980a). McDonald et al. (1980a, 1983) conducted studies of occupational exposure to asbestos in Quebec chrysotile mining and in textile factory workers to determine the effect of mineral fibre type and industrial process on malignant mesothelioma, respiratory cancer, and asbestosis. McDonald analysed the mortality and exposure data based on standardised mortality ratios (SMRs) which was a comparison of observed numbers of deaths to expected mortality rates in a standard population. Overall, the SMRs for the textile factory workers appeared to be somewhat higher than predicted for miners. It was thought that the difference could be attributable to the length/size of the asbestos fibres in manufacturing compared to mining and milling. The findings of the studies indicated that the relationship of exposure-response for

lung cancer in the textile industry compared to miners and millers was linear; however, the SMR related to industrial workers is 50 times greater than that observed in miners and millers. McDonald et al. (1980a) developed a linear dose-response relationship for mine workers:

$$\text{Relative risk} = 1 + 0.0014 (\text{mpcf-y})$$

Where mpcf-y = millions of particles per cubic foot multiplied by the years of exposure

The relationship developed by McDonald et al. (1980a) was based on units of mpcf-y which must be converted to units of f/ml for use with Site data. Doll and Peto (1985) reviewed different conversion methods and concluded that the most convenient approach is to assume that 1 mpcf = 1 f/ml. This approach was adopted in the 2017 HHRA.

To account for cumulative exposure (CE) via inhalation of asbestos fibres, the concentration of asbestos (f/ml) is multiplied by the exposure term (ET) to account for the years of exposure for each of the three receptor groups assessed (i.e., occasional visitor, hunter/gatherers and campers):

$$\text{CE} = \text{C} \times \text{ET} (\text{f/ml.years})$$

The exposure term for each receptor group was adjusted from the occupational exposure which was the basis of the original studies reviewed (McDonald et al., 1980a). For example, the ET for the camper (assumed to be on-site 24 hours/day, 3 months/year) was corrected from the original study's 8 hour work day for 240 days/year, as follows:

$$\text{Equivalent Years of Exposure} = \frac{24 \text{ hours/day}}{8 \text{ hours/day}} \times \frac{90 \text{ days/years}}{240 \text{ days/year}} \times 80 \text{ years}$$

Health Canada considers cancer risks to be negligible when the Incremental Excess Lifetime Cancer Risk (IELCR) is less than 1×10^{-5} . An IELCR was calculated for each receptor group taking the baseline risk into consideration. The Canadian Cancer Society (2017) states that 1 in 12 men (i.e., 8%) are expected to get lung cancer in their lifetime. This baseline lung cancer risk of 8% was incorporated to convert the relative risk, calculated above, to an IELCR, as follows:

$$\text{IELCR} = (\text{Baseline Risk} \times \text{Relative Risk}) - \text{Baseline Risk}$$

A summary of the 2017 IELCR estimates based on the maximum concentration (0.22 fibres/ml), the geometric mean of the PCM data (0.016 fibres/ml) obtained from previous studies, as well as the laboratory detection limit (0.01 fibres/ml) from the 2016 assessment are shown in Table 4.19.

Table 4.19: IELCR – Asbestos in Air (2017 HHRA)

	Occasional Visitor	Hunters/Gatherers	Campers
IELCR (based on maximum concentration)	5.4×10^{-5}	8.0×10^{-4}	2.2×10^{-3}
IELCR (based on Geometric Mean)	3.9×10^{-6}	5.8×10^{-5}	1.6×10^{-4}
IELCR (based on lab detection limit)	2.5×10^{-6}	3.6×10^{-5}	1.0×10^{-4}

Consistent with previous HHRAs conducted including SENES (2003b) and UMA (2006), the 2017 HHRA indicated that, based on the current Site conditions, there is a potential risk to human health due to inhalation of airborne asbestos.

4.6.3.2 Revised Assessment of Asbestos in Air

Additional review of the scientific literature has been completed as part of this HHRA Update to refine the risk estimates in the 2017 HHRA and is summarized below.

McDonald et al. (1980b) conducted further review of their study of Québec chrysotile miners and converted their relative risk estimate into units of f/ml and provided an estimate of lung cancer risks given by the equation:

$$\text{Relative risk} = 1 + 0.00038 \text{ f/ml.yr}$$

This does not represent a change in the cancer potency estimate, rather it is the change in units from mpcf-yr to f/ml-yr, and indicates that the simplified conversion approach of Doll and Peto (1985) (i.e., to assume that 1 mpcf = 1 f/ml) may not best represent the data of McDonald et al. (1980a).

Hughes (1994) reviewed various estimates of lung cancer risk associated with asbestos exposure (McDonald et al. (1984), Berry and Newhouse (1983), and Hughes et al. (1987)) and reported the slope of the equation (b) was 0.0006 or less. A value of 0.01 for the slope has been used by U.S. government agencies in estimating risk for all populations however, for a population exposed to non-textile chrysotile, a slope of 0.0006 was concluded to be more appropriate.

Berman and Crump (2008) conducted an update of potency factors for asbestos related lung cancer and mesothelioma using the USEPA models but incorporating data from studies published since the USEPA assessment in 1988. Potency factors were estimated from published data covering a broader range of environments than those originally addressed by USEPA. Berman and Crump re-assessed two studies of chrysotile exposure in mining and milling (McDonald et al. (1980a) and Piolatto et al. (1990)) and derived values for the slope of the equation (b) of 0.00029 and 0.00051.

Based on this additional review, a range of cancer potency estimates from 0.00029 up to 0.0006 is identified. For this HHRA Update, the original value (0.00038) calculated by McDonald et al. (1980b) will be adopted as this best represents the original data upon which the other studies are based.

In addition to the literature review, additional air samples were collected at the Site in 2018 as described in Section 3.2.3, and summarized below:

- Passive samples - Samples collected in locations of the Site where no drilling or other activities were being conducted. These samples were collected for evaluating exposure risk in areas where soils and tailings materials were not being actively disturbed.
- Area samples - Samples from areas where airborne asbestos fibre exposures were anticipated to be a risk, such as areas where disturbance activities were occurring and areas where build-up of ground materials might occur due to cross contamination by personnel.
- Personal samples - Personal air samples were collected from personnel directly involved in drilling and sample preparation, as well as personnel performing ancillary functions (e.g., general labourers, equipment operators, driller operators/helpers, environmental samplers, lab technicians and office staff).

Passive samples represent conditions with no disturbance of tailings and reflect an exposure scenario in which access to the tailings is prevented. Area and personal samples better reflect an exposure scenario in which there are no access restrictions to the tailings. Sampling results are summarized in Table 4.20.

Table 4.20: Summary of 2018 Asbestos Sample Results (f/ml)

	Passive	Area	Personal
N	68	44	53
Minimum	<0.0001	<0.002	<0.002
Maximum	0.008	0.063	0.037
Mean	0.003	0.014	0.013

A summary of the 2018 IELCR estimates based on the revised relative risk equation and the average and maximum concentrations from the 2018 sampling are shown in Table 4.21.

Table 4.21: Revised IELCR – Asbestos in Air

Sample	Concentration (f/ml)	Occasional Visitor	Hunters/Gatherers	Campers
Passive Samples – average	0.003	2.00×10^{-7}	3.56×10^{-6}	8.21×10^{-6}
Passive Samples – maximum	0.008	5.32×10^{-7}	9.48×10^{-6}	2.19×10^{-5}
Personal Samples – average	0.013	8.64×10^{-7}	1.54×10^{-5}	3.56×10^{-5}
Area Samples – average	0.014	9.31×10^{-7}	1.66×10^{-5}	3.83×10^{-5}
Personal Samples – maximum	0.037	2.46×10^{-6}	4.39×10^{-5}	1.01×10^{-4}
Area Samples – maximum	0.063	4.19×10^{-6}	7.47×10^{-5}	1.72×10^{-4}

Notes:

Bold - Indicates IELCR exceeds Acceptable IELCR (1×10^{-5})

Risk estimates for the occasional visitor are less than the essentially negligible target risk of 1×10^{-5} for all sample results indicating that unacceptable risks due to airborne asbestos exposure are not predicted for this receptor under current Site conditions.

Risk estimates for the hunter/gatherer and camper receptor groups indicate that IELCRs are acceptable when using the average of the passive sampling results. This represents a scenario in which there is no access to and no disturbance of the tailings. Based on both personal and area sampling, unacceptable risks are predicted for both receptor groups. This represents a scenario in which tailings remain accessible and could be disturbed.

It is not possible to link the area or personal sample results specifically to the tailings as the samples were collected in different areas of the Site. However, the tailings contain consistently higher asbestos content than both the waste rock and the soil samples from the remainder of the Site. Asbestos results are illustrated on Figure 4.6 and indicate that the tailings are the major source of asbestos on Site.

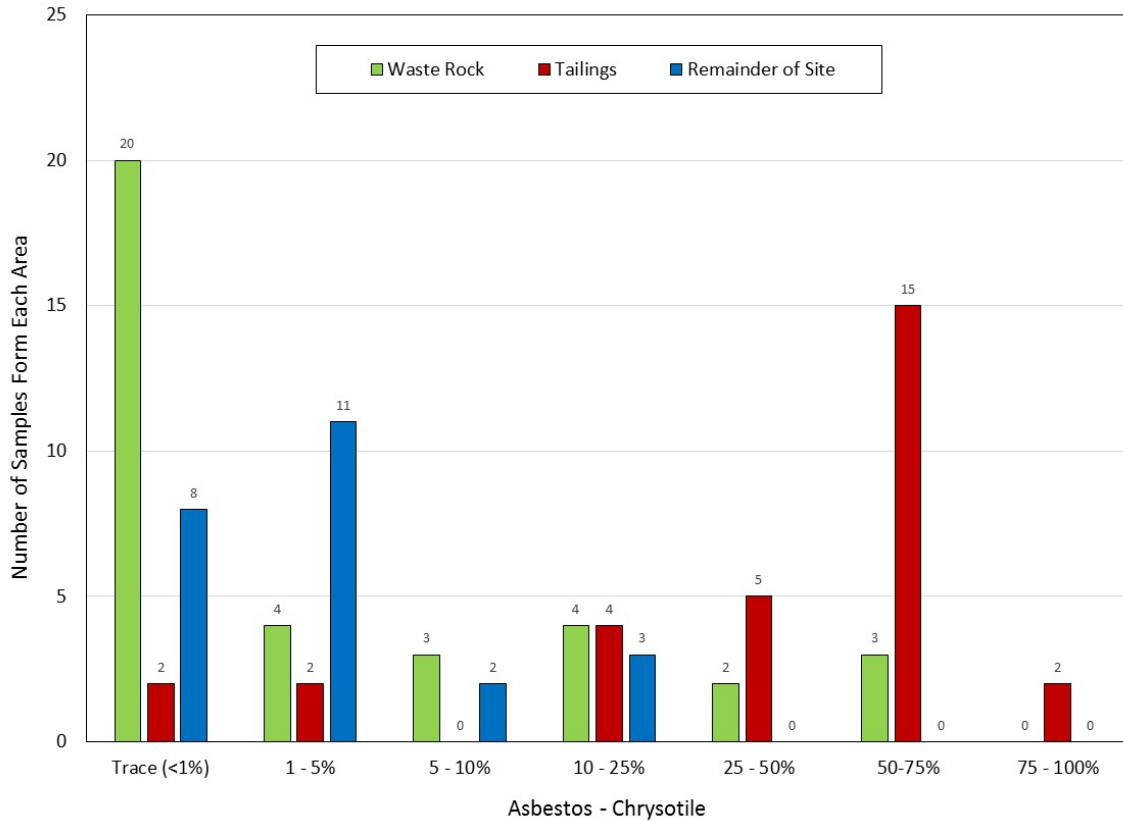


Figure 4.6: Asbestos Concentrations by Site Area

In summary, exposure scenarios in which tailings can be disturbed are predicted to result in unacceptable risks to hunter/gatherers and campers. Exposure scenarios in which tailings are not disturbed are not predicted to result in unacceptable risks to any of the receptors assessed. These results are similar to the assessment of metals in soil (Section 4.6.1) in which unacceptable risks associated with chromium and nickel in tailings could not be discounted whereas no unacceptable risks were predicted for metals in waste rock or the remainder of the Site.

5.0 Ecological Risk Assessment Update

The surface and groundwater data compiled since 2016 under ongoing Site monitoring programs have not identified conditions that would warrant a change in the treatment of these media. Therefore, there are no updates to the ERA for these media. Additional data has been collected in 2018 for soil and small mammals, as described in Section 3.0. The ERA update will focus on re-assessing potential risks due to exposure to soil, augmenting previous data with the results of the 2018 Site investigations.

This ERA Update has been conducted in a manner consistent with accepted ERA methodologies and guidance published by regulatory agencies, including the following:

- CCME. 1996. A Framework for Ecological Risk Assessment: General Guidance. CCME Subcommittee on Environmental Quality Criteria for Contaminated Sites. March 1996.
- CCME. 1997. A Framework for Ecological Risk Assessment: Technical Appendices. CCME Subcommittee on Environmental Quality Criteria for Contaminated Sites. March 1997.
- USEPA. 1998. Guidelines for Ecological Risk Assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/630/R095/002F.
- Federal Contaminated Sites Action Plan (FCSAP). 2012a. Ecological Risk Assessment Guidance. March 2012.
- Federal Contaminated Sites Action Plan (FCSAP). 2010b. Ecological Risk Assessment Guidance Module 2: Selection or Development of Site-specific Toxicity Reference Values.
- Federal Contaminated Sites Action Plan (FCSAP). 2012b. Ecological Risk Assessment Guidance Module 3: Standardization of Wildlife Receptor Characteristics.
- Yukon Government Contaminated Sites Regulation (O.I.C. 2002/171), Yukon Regulation under the *Environment Act*, 2014.

5.1 Problem Formulation for ERA

The ERA performs an effects evaluation that consists of comparing the maximum detected concentrations of Site-related analytes to ecological screening benchmarks. If concentrations are above the screening benchmarks, specific analytes are identified as COPC and are further evaluated. The ERA then evaluates the presence of ecological habitat and reviews whether exposure pathways are complete. If exposure pathways are not complete, or concentrations of COPC are below screening benchmarks, then the ERA will conclude that risk to ecological receptors is negligible and no further evaluation is warranted. If exposure pathways are complete and COPC concentrations are above benchmarks, the ERA will propose a path forward. The ERA will examine the potential ecological health impacts, if any, which could result from ecological exposure to the identified hazards at the Site.

The framework used for this ERA Update considered a qualitative evaluation of terrestrial plant and soil invertebrate communities, an effects assessment at the population level for common mammals and birds, and at the individual level for species identified as endangered, threatened, or extirpated under the *Species at Risk Act* (SARA) or similar territorial legislation.

5.1.1 Site Characterization

The Site is currently an abandoned asbestos mine site in a very remote location. This region is naturally dominated by mature alpine spruce forests with a mix of other tree species including willow, birch, berry plants (shrubs), and balsam poplar. Ground cover consists of moss, lichen species, woodland grasses, and

wildflowers, where it exists; mining activities have left large expanses of virtually barren areas devoid of any vegetative ground cover. Clinton Creek, Wolverine Creek, and Hudgeon Lake are the main waterbodies.

5.1.2 Hazard Identification

It is possible that soils, waste rock, and/or tailings are contributing contaminants to the terrestrial ecosystem. Therefore, the screening of contaminants in soil will be used as the primary basis for the ecological Problem Formulation.

Soil, waste rock, and tailings data collected during the 2018 Site Investigation have been compared to applicable ecological health guidelines, as outlined below. The soil data collected by Amec Foster Wheeler in 2016 and by RRU (1999) were used to complement the current data, where available (not all parameters were analyzed by RRU). The maximum concentration of each COPC detected was used for screening purposes.

While the Clinton Creek Mine Site would be considered an industrial site, for the protection of ecological health, agricultural guidelines have been adopted for the purposes of screening. The Site does not fit neatly within the definition of any of the land use categories typically used by regulatory bodies and is demonstrably not an agricultural site; however, unlike other land use categories, agricultural guidelines account for a soil and food ingestion pathway for resident and transient wildlife. Therefore, agricultural screening guidelines are reasonable and conservative.

Preference was given to territorial (Yukon) soil quality guidelines for screening. Where these were not available, CCME SQGs were used, followed by OMOE (2011). In all cases, the lowest of any calculated ecological health specific guidelines was selected for screening. Schedule 1 Generic Numerical Soil Standards were not used for screening and other sources were consulted for ecological-health specific values, in order of preference listed below:

- Government of Yukon (2002, rev. 2014) Contaminated Sites Regulation – Matrix Numerical Soil Standards – Agricultural, ecological health specific guidelines.
- CCME (CCME, 1999b) Canadian SQGs for Ecological Health (SQG_{ECO}) – Agricultural, non-potable land use (accessed on-line, November 2016), ecological health specific guidelines.
- Ontario Ministry of the Environment (OMOE, 2011) Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the *Environmental Protection Act* for the protection of ecological health – Agricultural, plants & soil organisms or mammals & birds component value (Appendix A2: Soil Components for Table 2).

The maximum concentrations and ecological health screening guidelines for the contaminants of potential concern in soil are compared in Table 5.1. Full screening tables are presented in Appendix B.

Table 5.1: Ecological Screening of Soil

Chemical	Maximum Concentration (mg/kg)	Ecological Screening Guidelines (mg/kg)	Comment
Trace Metals			
Aluminum (Al)	21271	NG	No guideline established
Antimony (Sb)	50	20³	Max exceeds screening guideline
Arsenic (As)	321	25¹	Max exceeds screening guideline
Barium (Ba)	1659	390³	Max exceeds screening guideline
Beryllium (Be)	1.5	4 ³	Max meets screening guideline

Table 5.1: Ecological Screening of Soil

Chemical	Maximum Concentration (mg/kg)	Ecological Screening Guidelines (mg/kg)	Comment
Bismuth (Bi)	0.5	NG	No guideline established
Boron (B)	241	120³	Max exceeds screening guideline
Cadmium (Cd)	6	9 ¹	Max meets screening guideline
Calcium (Ca)	47100	NG	No guideline established
Chromium (Cr)	1810	50¹	Max exceeds screening guideline
Cobalt (Co)	111	180 ³	Max meets screening guideline
Copper (Cu)	83	150 ¹	Max meets screening guideline
Iron (Fe)	66372	NG	No guideline established
Lead (Pb)	150	350 ¹	Max meets screening guideline
Lithium (Li)	40	NG	No guideline established
Magnesium (Mg)	225589	NG	No guideline established
Manganese (Mn)	1026	NG	No guideline established
Mercury (Hg)	0.7	0.6¹	Max exceeds screening guideline
Molybdenum (Mo)	29	6.9³	Max exceeds screening guideline
Nickel (Ni)	2647	45²	Max exceeds screening guideline
Phosphorus (P)	1074	NG	No guideline established
Potassium (K)	1409	NG	No guideline established
Selenium (Se)	10	1²	Max exceeds screening guideline
Silver (Ag)	5	20 ³	Max meets screening guideline
Sodium (Na)	331	NG	No guideline established
Strontium (Sr)	259	NG	No guideline established
Thallium (Tl)	0.76	1 ²	Max meets screening guideline
Tin (Sn)	25	NG	No guideline established
Titanium (Ti)	797	NG	No guideline established
Uranium (U)	3.87	33 ²	Max meets screening guideline
Vanadium (V)	47	130 ²	Max meets screening guideline
Zinc (Zn)	403	200¹	Max exceeds screening guideline
Zirconium (Zr)	1.3	NG	No guideline established
Asbestos			
Asbestos (%)	50-75%	NG	No guideline established
Hydrocarbons			
Benzene	<0.005	62 ²	Max meets screening guideline
Ethylbenzene	<0.01	110 ²	Max meets screening guideline
Toluene	<0.01	75 ²	Max meets screening guideline
Total Xylenes	<0.1	95 ²	Max meets screening guideline
F1 (C6-C10)	<10	210 ⁴	Max meets screening guideline
F2 (C10-C16)	<10	150 ⁴	Max meets screening guideline
F3 (C16-C34)	57	300 ⁴	Max meets screening guideline
F4 (C34-C50)	<20	2800 ⁴	Max meets screening guideline

Table 5.1: Ecological Screening of Soil

Chemical	Maximum Concentration (mg/kg)	Ecological Screening Guidelines (mg/kg)	Comment
Polychlorinated Biphenyls			
Total PCBs	<0.05	1.3	Max meets screening guideline

Notes:

- 1) YG CSR Matrix Numerical Standard, Agricultural site
- 2) CCME SQG_{ECO}, Agricultural site with coarse grained soil.
- 3) OMOE Site Condition Standards (PSO, M&B) for an agricultural site with coarse grained soil, April 2011. (Appendix A.2 (1) Table 2).
- 4) Canada Wide Standards for Petroleum Hydrocarbons CCME 2008, agricultural site, coarse grained soil, Eco contact pathway

As shown in Table 5.1, maximum concentrations of several trace metals (i.e., antimony, arsenic, barium, boron, chromium, mercury, molybdenum, nickel, selenium, and zinc) exceeded their respective agricultural screening guideline. These metals will be carried into the ERA.

There are no screening guidelines found for aluminum, bismuth, calcium, iron, lithium, magnesium, manganese, phosphorus, potassium, sodium, strontium, tin, titanium, and zirconium. As discussed in the HHRA, some metals have a low inherent toxicity and/or an absence of guidelines. These metals were not carried forward in the ERA.

For oral exposures to asbestos (i.e., amosite, chrysotile, tremolite, or crocidolite), there is generally little or no evidence of histological or clinical injury to any systemic tissues, with the possible exception of effects on the gastrointestinal tract (ATSDR 2001, USEPA 2009). Insufficient toxicological studies have been conducted to identify the implications of asbestos inhalation for birds and mammals. The general consensus of the USEPA (2014) is that small mammal populations are most exposed and conservative for interpretation of potential effects. Small mammal trapping studies have been used at sites in the USA to evaluate the potential effects of asbestos mines. A small mammal trapping program was completed during 2018 and the results of the study will be assessed during the ERA.

While maximum measured concentrations have been used to identify COPC within the Problem Formulation, the ERA will examine any differences in concentrations in the tailings, waste rock, mill, or general mine areas as well as any changes in concentration with depth.

5.1.3 Receptor Identification

For the purpose of the ERA, it is not practical or necessary to individually assess each wildlife species that may potentially visit or occupy the site. Instead, the potential for adverse effects imposed on a selected subset of wildlife receptors exposed to COPC at the site will be evaluated. The receptors were selected for the ERA by focusing on ecological species that are:

- indigenous to the area (taking into consideration the habitat types and areas available on the Site)
- likely to be highly exposed to COPC due to their habitat preference, behavioural traits, and home range
- representative of various feeding guilds or levels in the trophic web (i.e., herbivore, insectivore, carnivore)
- of cultural, economic, or social importance

In the case of higher trophic levels, such as large mammals or birds, the receptor of concern (ROC) is commonly defined at the species level (FCSAP, 2012a); however, ROC can also represent communities deemed to be important. For example, the soil invertebrate community has been identified as an important ecological component due to its roles in nutrient cycling and as prey for birds and mammals, but individual species of invertebrates are not identified as ROC. Plants and invertebrates were identified as ROC as explained below.

- **Plants:** The terrestrial plant communities were selected as ROC. As primary producers, plants are the base of the food chain in terrestrial ecosystems. Plants provide forage and provide habitat for terrestrial species. Plants are important in soil stabilization. Terrestrial plants may be exposed to and accumulate COPC from soil solutions, where ions and dissolved fractions are freely available for absorption by plant roots. Plants may accumulate COPC in roots, stems, leaves, or fruits, which are then transferred to animals when consumed.
- **Invertebrates:** The soil invertebrate communities were identified as ROC. Soil invertebrates, such as insects and earthworms, may be exposed to and accumulate COPC. Exposure could result from direct contact between soil and outer membranes and respiratory surfaces, from the direct ingestion of soil during feeding activities, and from the consumption of affected prey or detritus, depending on species-specific feeding habits. Consumers may be exposed to COPC accumulated in tissues of invertebrates.

A wide variety of birds and mammals have been observed to use the Site, either directly or indirectly, during various field assessments, including raptors (hawks and owls) for foraging, waterfowl swimming on Hudgeon Lake, snowshoe hare and crows along Clinton Creek, beavers, moose, and bears. This information was used to identify appropriate ROC that are likely exposed to COPC. When defining ROCs for the ERA, surrogate species are often used to represent a group of species that share similar ecological traits and would likely be exposed to COPC via similar exposure pathways. For the purposes of this ERA, the following common species were selected for evaluation. Where possible, species described in FCSAP (2012b) have been selected:

- Masked shrew (*Sorex cinereus*) - selected because of its likely presence, small home range, and as a representative insectivorous mammal.
- Meadow vole (*Microtus pennsylvanicus*) - selected because of its likely presence, small home range, and as a representative herbivorous mammal.
- Deer mouse (*Peromyscus maniculatus*) – selected because of its likely presence, small home range, and as a representative omnivorous mammal;
- Snowshoe hare (*Lepus americanus*) - selected because of its likely presence and as a representative herbivorous mammal.
- Red fox (*Vulpes vulpes*) - selected because of its likely presence and as a representative for carnivorous mammals, preying extensively on mice, voles and other small mammals (e.g., hares, insects, and occasionally seeds, berries, and fruits).
- Moose (*Alces alces*) – selected because of its likely presence and as a representative of large, herbivorous mammals.
- Caribou (*Rangifer tarandus*) – selected because of likely presence and cultural importance for northern communities. The Caribou will be assessed using the white-tailed deer receptor characteristics from FCSAP (2012). Bodyweight for the Barren-ground Caribou (Yukon government, 2017) (i.e. 150 kg) is utilized in the assessment. Based on data from the Yukon government, the Clinton Creek site is outside the range of the Woodland Caribou.

- Black Bear (*Ursus americanus*) – selected because of its likely presence and as a representative of large, omnivorous mammals.
- American robin (*Turdus migratorius*) - selected because of its potential presence, and as a representative for omnivorous birds.
- Spruce grouse (*Falcapennis canadensis*) - selected because of its potential presence, and as a representative for herbivorous birds.
- Red-tailed hawk (*Buteo jamaicensis*) – selected to represent avian predators, feeding primarily on small rodents such as mice, voles, shrews, rabbits, and squirrels.

5.1.4 Exposure Pathway Identification

In order for chemicals to have deleterious effects, they need to gain access to the organism or receptor. The route by which this occurs is referred to as an exposure pathway, and is dependent on the nature of both the chemical and receptor. A complete exposure pathway is one that meets the following four criteria (USEPA, 1989):

- a source of COPC must be present
- transport mechanisms and media must be available to move the chemicals from the source to the ecological receptors
- an opportunity must exist for the ecological receptors to contact the affected media
- a means must exist by which the chemical is taken up by ecological receptors, such as direct contact, ingestion or inhalation

The relevant exposure pathways are summarized in Table 5.2, which includes a qualitative evaluation of each pathway and a discussion about whether the pathways are complete. Those complete hazard-exposure-receptor combinations considered to have the highest likelihood to contribute to an ecological health risk were carried forward in the quantitative ERA.

Table 5.2: Potential Exposure Scenarios - Ecological Receptors

Exposure Pathway Description	Complete Pathway?	Carried Forward for Analysis?	Justification
Ingestion of soil	Yes	Yes	COPC are present in surface soils at the Site. Dermal contact for soil invertebrates is considered active and will be assessed by comparison to soil benchmarks which incorporate ingestion and dermal exposure. Although terrestrial avian and mammalian receptors may come into contact with chemicals identified in surface soil, direct dermal contact is considered unlikely due to the presence of fur or feathers. However, ecological receptors may ingest soil through grooming, foraging or other related behaviours. As such, the ingestion of soil containing COPC was considered further within this ERA.
Dermal contact with soil			
Ingestion of terrestrial invertebrates, vegetation, or small animal prey living at the Site and exposed to contaminated soil	Yes	Yes	Terrestrial receptors on the Site may ingest terrestrial invertebrates and terrestrial vegetation that are living at the Site and have been exposed to the impacts in surface soil. Some receptors prey on small animals.
Ingestion of surface water, freshwater, sediments, plants, invertebrates or fish	No	No	Not assessed as part of the update. Summary of findings related to the aquatic environment is provided in Section 5.1.5.

Table 5.2: Potential Exposure Scenarios - Ecological Receptors

Exposure Pathway Description	Complete Pathway?	Carried Forward for Analysis?	Justification
Dermal contact with surface water or freshwater sediments			Not assessed as part of the update. Summary of findings related to the aquatic environment is provided in Section 5.1.5.
Dermal contact with marine water or sediments	No	No	There are no marine water bodies at or in the vicinity of the Site
Ingestion of marine invertebrates or fish	No	No	

5.1.5 Summary of Previous Aquatic Risk Assessment Findings

During the aquatic risk assessment for the site (Amec Foster Wheeler 2017a), maximum concentrations of arsenic, chromium, nickel, and selenium exceeded their respective sediment screening guideline. Surface water had very few exceedances of the screening guidelines for freshwater aquatic life and only aluminium, iron and sulphate were identified as COPCs. Based on the lack of exceedance for aquatic life guidelines it is unlikely that surface water would pose a risk to wildlife or humans which may consume drinking water from Wolverine Creek, Clinton Creek or Porcupine Creek since drinking water guidelines are less stringent than the freshwater aquatic life guidelines. Sediment concentrations which were collected during the aquatic monitoring programs and fish tissue collected by Laberge (2016) were utilized during risk characterization of the aquatic environments. The maximum fish tissue concentrations were used as food items for the mallard duck to assess the potential risk to wildlife from the ingestion of fish near the site. All hazard quotients for the Mallard were low (<0.2) indicating a low risk to birds which may feed from the tributaries.

Previous investigations of fish (WMEC 2008, Minnow 2010) have identified that fish were not found in any of the habitats upstream of the Gabion structure in Clinton Creek. Fish recorded during the assessments were found just below the Gabion structure in Clinton Creek and consisted of juvenile Arctic grayling, slimy sculpin and juvenile Chinook salmon.

Several historic studies have been conducted on the benthic invertebrate community structure in the surrounding watershed. Minnow (2010) concluded that the benthic community in Clinton Creek was influenced by the mine and the downstream community composition had higher relative proportions of chironomid (midge) taxa and lower relative proportions of stoneflies compared to local reference streams. Of the mine-exposed areas sampled in Clinton Creek and Wolverine Creek, the benthic invertebrate community in Wolverine Creek downstream of the tailings area was most different from reference communities. Based on the data collected to date it appears that there is a healthy aquatic community in the reaches below the gabion structure of Clinton Creek which supports periphyton communities, benthic invertebrate communities and fish and baseline conditions have a low risk to aquatic life.

5.1.6 Assessment Endpoints

Assessment endpoints are explicit expressions of the environmental value that is to be protected (Suter, 1993; FCSAP, 2012). Assessment endpoints evaluated in the ERA are consistent with the FCSAP (2012). Societal values address the need to protect species that are endangered, threatened, of special interest, important as game or commercial species, or that are recognized as having aesthetic value. Ecological relevance refers to the importance of the species to the function of the ecosystem. Evaluation of potential for adverse effects at the population level is used to infer potential for adverse effects at

higher levels of organization, such as communities and ecosystems. For birds and mammals inhabiting the Site, assessment endpoints focus on maintenance and protection of their populations, such that contaminants in the soil would not significantly impact either species abundance or diversity. For plants and soil invertebrates inhabiting the Site, assessment endpoints focus on the protection of communities, such that soil contamination would not impact diversity and function for providing cover and food for wildlife.

The information needed to deal directly with the assessment endpoints is difficult to generate and rarely available. Therefore, measurement endpoints are used to bridge the gap. Measurement endpoints are measurable responses to stressors related to assessment endpoints, and are intended to provide a basis for assessing risk potential for the assessment endpoint. They may be defined in terms of an unacceptable level of impact to ecological receptors, such as a certain relative percent decrease in survival, growth or reproduction of ecological populations (Suter, 1993). The assessment and measurement endpoints for the ecological risk assessment are displayed in Table 5.3.

Table 5.3: Assessment and Measurement Endpoints

Receptor Group	Assessment Endpoint	Measurement Endpoints	Line of Evidence
Plants	Vegetation community will not have adverse effects from soil at the Site	1A: Soil Chemistry of COPCs	1A: Compare Site soil concentrations to benchmarks for plants.
Invertebrates	Soil invertebrate community functions as food for wildlife.	2A: Soil Chemistry of COPCs	2A: Compare Site soil concentrations of COPCs to benchmarks for invertebrates.
Mammals	Mammalian populations will not have adverse effects from soil at the Site.	3A: Estimated daily exposure from COPCs in soil and food from the Site.	3A: Compare the results of a food web model to toxicity reference values for COPCs identified from soil.
		3B: Evaluation of histological tissues for damage	3B: Compare the proportion of identified lesions and disease to reference conditions.
		3C: Evaluation of liver concentrations of COPCs identified in soil	3C: Compare liver concentrations of COPCs to the reference area and journal articles which have identified no potential effects.
		3D: Mammalian weight, and morphological parameters	3D: Compare body weight, total length, tail length for mammals collected at the Site to mammals collected at a reference site
Birds	Avian populations will not have adverse effects from soil at the Site.	4A: Estimated daily exposure from COPCs in soil and food from the Site.	4A: Compare the results of a food web model to toxicity reference values for COPCs identified from soil.

5.1.7 Conceptual Site Model for Ecological Receptors

Based on the problem formulation, the conceptual site model (CSM) developed for screening ecological receptors is:

- Terrestrial plants can be exposed to contaminants in shallow soil via root uptake, either through active uptake or passive migration into root tissues.
- Soil invertebrates can be exposed to COPC through dermal contact and ingestion.
- Ecological receptors may ingest COPC identified in surface soil at the Site.

- Ecological receptors may ingest terrestrial invertebrates, terrestrial vegetation, and/or smaller mammals/birds that have accumulated COPC identified at the Site.

The CSM developed for this Site, presented in Figure 5.1, schematically represents the interactions between the receptors and the COPC, via the identified exposure pathways. The relevant exposure pathways are designated by arrows leading from the contaminant source media to each receptor.

The pathway is considered to be complete (i.e., functioning) for a receptor when the exposure pathway box is marked with an "X" and is assessed quantitatively in the report. Where the exposure pathway is marked with an "O", the pathway is assessed qualitatively. The CSM does not account for magnitude of exposure, simply whether a route of exposure is active or not. Differences in exposure will be assessed within the ERA.

5.2 Exposure Assessment

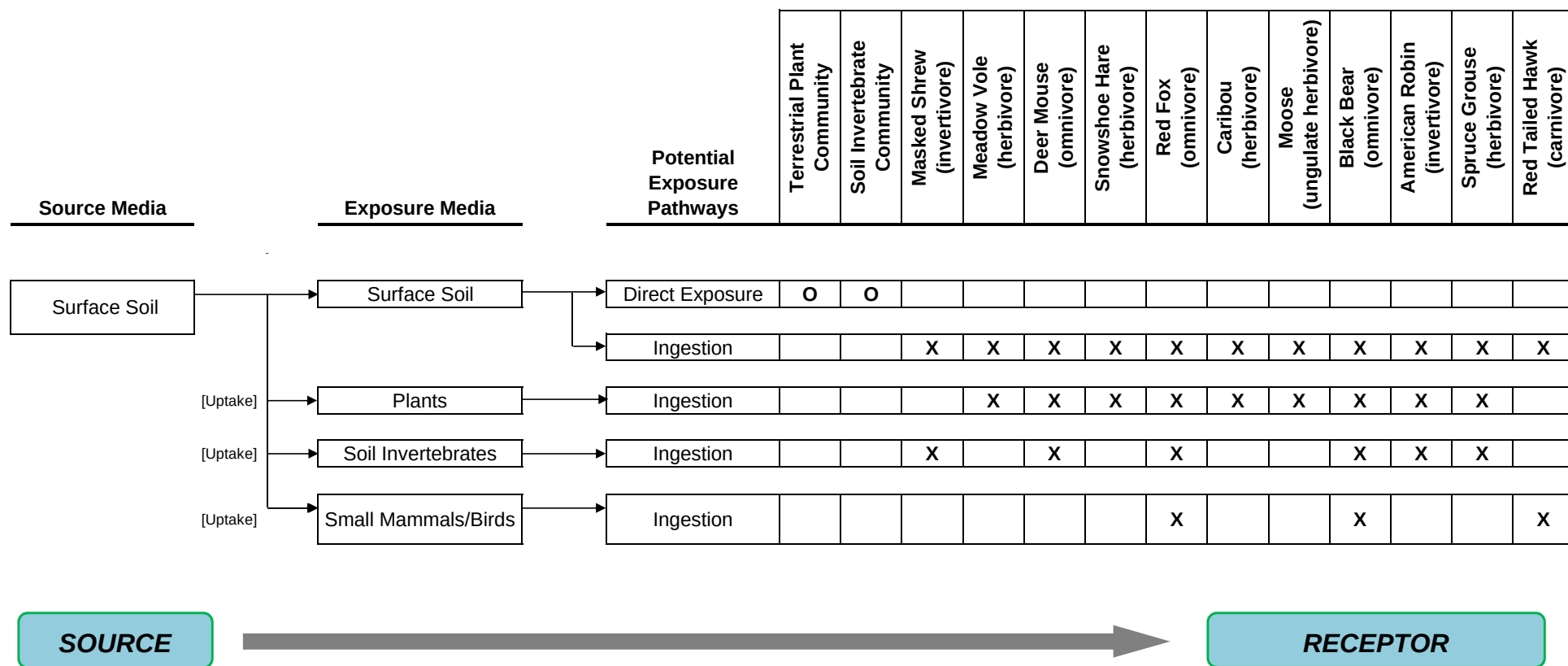
Exposure assessment characterizes the mechanisms by which receptor groups are exposed to COPCs and quantifies the magnitude of these exposures.

5.2.1 Exposure Point Concentrations

To evaluate the exposure for each ecological receptor to each potential COPC, it is necessary to first estimate the concentration of each COPC in various media or biological tissues. This includes soil, and representative soil invertebrate, plant, and small mammal/bird tissues.

Surface soil COPC concentrations were characterized using results from available data through the use of statistically derived EPCs. The suitability of historical and current data for risk assessment was reviewed. As COPC have been identified at concentrations exceeding the applicable criteria, ecological receptors at the Site could be exposed to unacceptable levels of the identified COPC in surface soil. Further risk assessment and possibly risk management is required. Subsequent risk assessments, presented in the following sections, use the Upper Confidence Limit of the Mean (UCLM) to represent contaminant concentrations. The UCLM is an estimate of a reasonable upper limit value for the average chemical concentration in the medium, determined for each exposure unit (USEPA, 1989; USEPA, 2013). EPCs are represented by maxima, where data are not suitable for EPC calculations or by UCLMs (95% or above) calculated with ProUCL (Version 5.1). The results of the statistical analyses are provided in Appendix B.

Figure 5.1 Conceptual Site Model for Ecological Receptors - Clinton Creek Former Mine Site



Notes:

X - Indicates a potentially complete exposure pathway for quantitative analysis.

O - Indicates a potentially complete exposure pathway for qualitative or quantitative analysis.

Unlike sedentary organisms such as plants and earthworms, birds and mammals can integrate exposure from different areas of the Site, not only the areas with the highest concentrations of COPCs (FCSAP, 2012). Mobile terrestrial receptors therefore receive a dose of COPC related to the average concentrations of COPCs in soil and food items. UCLMs were calculated by area of concern and are displayed in Table 5.4.

Table 5.4: Soil Chemistry UCLMs Utilized in the ERA (mg/kg)

Metal	Tailings Area	Waste Rock Pile	Mill Area	Background
Antimony	24.41	17.89	3.8	0.73
Arsenic	70.5	37.8	15.2	21.6
Barium	269.4	198.7	420.6	177
Boron	177.1	41.6	29.1	3
Chromium	1429	655.6	393.4	27.4
Mercury	0.148	0.3	0.17	0.03
Molybdenum	6.15	14.1	2.7	1.8
Nickel	2013	981.9	545.5	34.2
Selenium	0.86	4.81	2.6	0.66
Zinc	39.9	175.6	75.5	72.56

Representative concentrations of COPCs in soil invertebrates were characterized using regression equations or other uptake factor estimates developed in literature sources of bioaccumulation studies. The regression equations or uptake factors use the soil EPC value to calculate expected earthworm tissue metal concentrations as described in Appendix D. Concentrations of COPCs in plant and small mammals/birds were calculated using published regression equations from:

- USEPA (2007) Guidance for Developing Ecological Soil Screening Levels (EcoSSLs) – Attachment 4-1 Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. April 2007 Revision. OSWER Directive 9285.7-25.
- Sample et al. (1998a) to estimate the concentration of mercury from soil to invertebrates.
- Baes et al. (1998) to estimate the concentration of mercury from soil to plants.
- Sample et al. (1998b) to estimate concentrations in small mammals from soil concentrations

Uptake factors were not identified for:

- Boron – for soil to invertebrate, soil to plant or soil to small mammals in the literature review. Therefore, the ERA will discuss boron qualitatively for each area of concern.
- Molybdenum – for soil to small mammals. Therefore, the ERA assumed that tissue concentration for soil invertebrates (i.e., Sample et al. 1998) was conservative for small mammal concentrations of molybdenum.

5.2.2 Terrestrial Plants and Soil Invertebrates

Because plants and invertebrates are immobile, exposure to contaminants cannot be averaged or integrated among areas of the property with higher and lower concentrations. Some fractions of individuals in a population at a Site are potentially exposed to the highest concentrations of COPCs. As such, the soil concentrations measured in each area of concern are used when assessing exposure to plants and invertebrates.

5.2.3 Daily Dose for Representative Avian and Mammalian Receptors

For representative avian and mammalian receptors, exposure to a COPC was calculated as the average daily dose (ADD) ingested. The ADD was defined as the amount of a COPC a modeled species might be exposed to on a mg/kg - body weight (bw)/day basis. For each modeled species and COPC combination, the ADD was calculated by summing the intake from each applicable exposure pathway.

The intake factor (IF) is not specific to each COPC, but is a characteristic of the modeled species and is calculated for each receptor and exposure pathway combination as follows:

$$IF_j = IR_j / BW$$

Where: IR_j = medium-specific ingestion rate (kg medium/day); and
 BW = receptor body weight (kg).

For exposure pathway j, the generalized equation for ADD is:

$$ADD_j = IF_j \times AF_j \times EPC_j$$

Where: ADD_j = average daily dose for exposure pathway j (mg/kg - bw/day);
 IF_j = intake factor (kg medium/kg - bw/day);
 AF_j = absorption factor (default value of 1; most conservative); and
 EPC_j = exposure point concentration (mg/kg).

The AF relates to the potential for COPCs to be absorbed across the gut wall following ingestion. Trace elements are part of the natural environment and exist in many different forms, having potentially differing relative bioavailability. In this ERA the AF is assumed to have a value of 1 for all ingested food items. Average daily dose for each applicable environmental media can be found in Appendix D.

5.3 Effects and Toxicity Assessment

The following section discusses the toxicity reference values and results of the small mammal trapping program used in the ERA.

5.3.1 Plants and Invertebrates

TRVs for plants and invertebrates are representative of soil concentrations. In the identification of a soil toxicity reference value for terrestrial plants and soil invertebrates, values available from the CCME (or supporting EC documents used by CCME) and OMOE (2011) were evaluated. If a value was not identified, or the data was limited, benchmarks provided in the USEPA Eco-SSL documents were evaluated. A summary of the soil benchmarks used in the ERA are summarized in Table 5.5.

Table 5.5: Soil Benchmark Values for Terrestrial Plants and Soil Invertebrates

Metal	Plants (mg/kg)	Invertebrates (mg/kg)	Endpoint and Reference
Antimony	20	78	Plants – OMOE (2011) screening value retained for the risk assessment; soil invertebrates is based on the geometric mean for reproduction (USEPA 2005b)
Arsenic	17	50	Plants – CCME soil contact (CCME 1997); soil invertebrates – mortality NOEC (OMOE, 2011)
Barium	750	330	Plants- phytotoxicity (OMOE, 2011); Soil invertebrates - Reproduction (USEPA 2005b)

Table 5.5: Soil Benchmark Values for Terrestrial Plants and Soil Invertebrates

Metal	Plants (mg/kg)	Invertebrates (mg/kg)	Endpoint and Reference
Boron	NA	NA	Toxicity values for boron to plants and invertebrates were not identified in the literature review.
Chromium	64	310	Plants – CCME soil contact (CCME 1997); soil invertebrates soil contact (OMOE, 2011)
Mercury	100	100	Plants and Soil standard from the Yukon Contaminated Sites Regulations (2002)
Molybdenum	5	5	CCME soil contact guideline (CCME 1991)
Nickel	45	280	Plants -Soil Contact value (CCME 1997, revised 2015); soil invertebrates- MATC for five species (USEPA 2007a)
Selenium	10	4.1	Plants- phytotoxicity (OMOE, 2011); Soil invertebrates - Reproduction (USEPA 2007b)
Zinc	200	400	Plants – soil contact CCME (1999); Soil Invertebrates - Weight of Evidence Approach (OMOE, 2011)

5.3.2 Mammals and Birds Toxicity Reference Values

The toxicological database supporting a TRV preferably includes a number of chronic or multi-generational exposure studies involving exposure of relevant test species (i.e., the ecological receptor of interest or a phylogenetically similar species) to appropriate chemical forms of the substance of interest. Ideally, one or more relevant biological endpoints such as growth, reproductive effects, or survival were measured in the study. Databases that meet this requirement are available for some chemicals, but in most cases, available toxicity data is limited to studies conducted with laboratory animals (e.g., mammals: mice, rats, rabbits; birds: quail, chicken, ducks).

Mammalian and avian TRVs for selected COPCs were primarily derived from data presented in USEPA Ecological Soil Screening Level (EcoSSL) rationale documents (USEPA, 2010). For species with no conservation status, the geomean of Lowest Observed Adverse Effect Levels (LOAELs) for survival, growth and reproduction endpoints was used to derive a TRV. The LOAEL-based benchmark represents a threshold level at which adverse effects are likely to become evident (Sample et al., 1996). For COPCs for which an EcoSSL document was not available, chronic LOAEL (or No Observed Adverse Effect Level [NOAEL]) data derived from studies that determine reproductive, growth and survival endpoints were used. In order of preference, chronic LOAEL data were gathered from EcoSSL documents (if available), followed by data reported by Sample et al. (1996), or Agency for Toxic Substances and Disease Registry (ATSDR) documents. A summary of the TRVs used for mammals and birds is presented in Table 5.6.

Table 5.6: Toxicity Reference Values for Mammals and Birds

Parameter	Mammals (mg/kg/day)	Birds (mg/kg/day)	Endpoint and Reference
Antimony	7.6	NA	geometric mean of the LOAEL for growth, reproduction and survival (USEPA 2005b)
Arsenic	5.7	4.5	geometric mean of the LOAEL for growth, reproduction and survival (USEPA 2005b)
Barium	119	420	Sample et al. 1996
Boron	NA	NA	Toxicity values for birds and mammals were not identified in the literature review
Chromium	35.1	11.1	geometric mean of the LOAEL for growth, reproduction and survival (USEPA 2008)

Table 5.6: Toxicity Reference Values for Mammals and Birds

Parameter	Mammals (mg/kg/day)	Birds (mg/kg/day)	Endpoint and Reference
Mercury	1.9	0.9	Sample et al. 1996
Molybdenum	2.6	35.3	Sample et al. 1996
Nickel	13.3	21.7	geometric mean of the LOAEL for growth, reproduction and survival (USEPA 2007a)
Selenium	0.79	1.17	geometric mean of the LOAEL for growth, reproduction and survival (USEPA 2007b)
Zinc	292	187	geometric mean of the LOAEL for growth, reproduction and survival (USEPA 2007c)

5.3.3 Red Backed Voles Weight and Morphological Parameters

During the 2018 small mammal survey, weight and length measurements were recorded for each specimen collected (Appendix D). The majority of the small mammal specimens which were captured at both sites were red backed voles (*Myodes rutilus*). All statistical analysis was conducted with the data for the juveniles as an unequal number of adult specimens (i.e. 3 from mill and 2 from control) could bias the comparative analysis of weight and size. Plots were prepared for organism body weight, total length, and tail length by calculating the average (mean) and standard error of the mean (SEM) for the Mill and Control location (Figures 5.2 to 5.4).

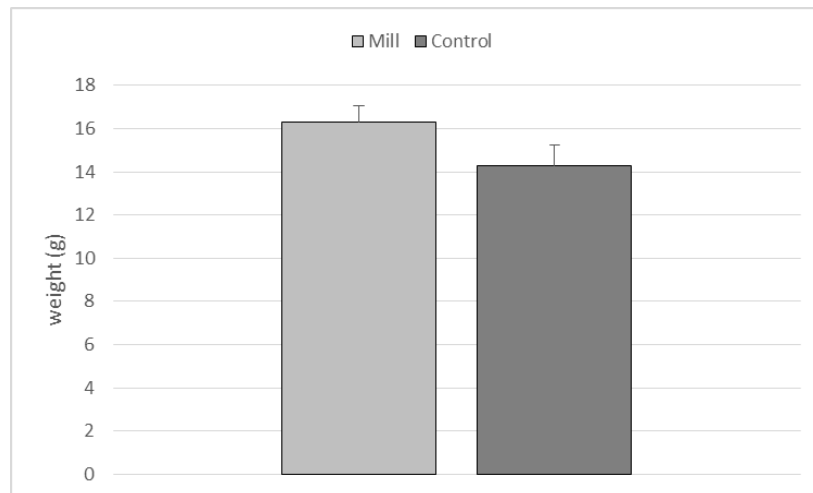


Figure 5.2: Weights of Red Backed Voles collected at Mill and Control

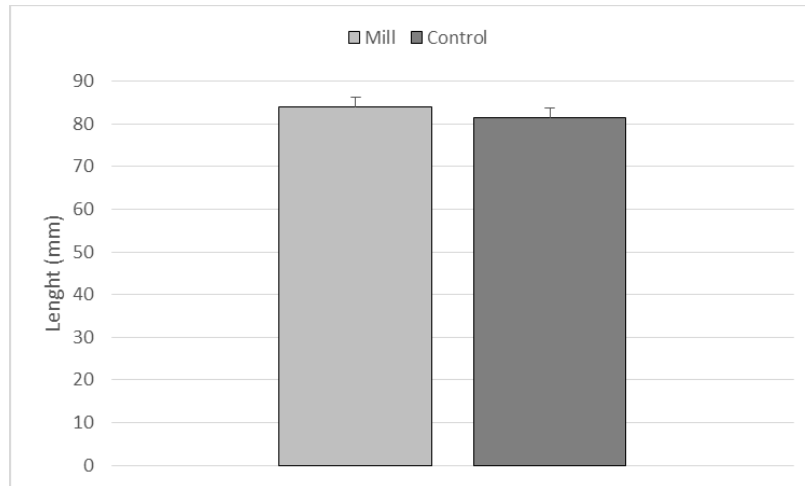


Figure 5.3: Length of Red Backed Voles collected at Mill and Control

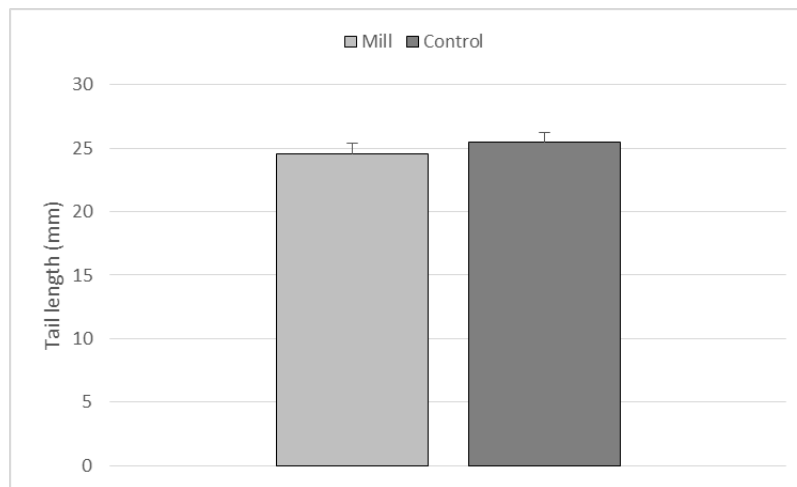


Figure 5.4: Length of tails for Red Backed Voles collected at Mill and Control

A Wilcoxon-Mann-Whitney test is a simple non-parametric statistical hypothesis test commonly used when comparing samples to assess whether their population mean ranks differ. This is the test recommended by the British Columbia Ministry of the Environment (BCMOE) for comparing soil samples from contaminated sites with background data and it is equally applicable to site and reference morphological data. The Wilcoxon-Mann-Whitney test is similar to a t-test but the data sets do not have to be normally distributed. The results of the Wilcoxon-Mann-Whitney are displayed in Table 5.7. The P-values are used to identify if there is a significant difference between the mean/median and variability of the data. In this case we are comparing the lengths and weights of voles collected from the Mill and Control. If the P-value is small (i.e., <0.05) then it is concluded that there is a significant difference between the samples collected from the Mill and Control. As displayed in Table 5.7, all the P-values are greater than 0.05, indicating that there are no significant differences between the weights and lengths of voles collected from the Mill and Control.

Table 5.7: Statistical Evaluation of Morphological Parameters

Parameter	Statistic	Mill	Control	WMW P-Value
Weight	Mean	16.3	14.28	0.112
	standard error	0.752	0.965	
Length	Mean	84	81.5	0.191
	standard error	2.3	2.17	
Tail length	Mean	24.6	25.5	0.846
	standard error	0.78	0.76	

5.3.4 Red Backed Voles Liver Concentrations of Metals

During the 2018 field investigation, livers of trapped mammals were submitted for metals analysis. The majority of the small mammal specimens which were captured at both sites were red backed voles (*Myodes rutilus*). A statistical analysis using the Wilcoxon-Mann-Whitney test was used to compare the concentrations of metals COPCs from individuals collected at the Mill and Control areas of the Site. A summary of the statistical analysis is displayed in Table 5.8.

Table 5.8: Statistical Evaluation of Liver Concentrations of COPCs

Parameter	Statistic	Mill	Control	WMW P-Value
Antimony (µg/kg ww)	Mean	7.34	9.5	0.764
	standard error	1.0	1.96	
Arsenic (µg/kg ww)	Mean	24.43	9.7	0.01
	standard error	8.23	1.2	
Barium	Mean	NA	NA	NA
	standard error	NA	NA	
Boron	Mean	NA	NA	NA
	standard error	NA	NA	
Chromium (µg/kg ww)	Mean	173.2	121.5	0.425
	standard error	14.26	11.1	
Mercury	Mean	NA	NA	NA
	standard error	NA	NA	
Molybdenum (mg/kg ww)	Mean	1.38	1.26	0.285
	standard error	0.14	0.11	
Nickel (µg/kg ww)	Mean	386.4	269.1	0.04
	standard error	48.3	38.2	
Selenium (mg/kg ww)	Mean	1.32	1.2	0.367
	standard error	0.11	0.08	
Zinc (mg/kg ww)	Mean	41.6	43.6	0.69
	standard error	1.73	2.06	

Based on the statistical evaluation conducted on the liver concentrations of COPCs, it can be concluded that arsenic and nickel have greater concentrations compared to the control. Therefore, a literature review was conducted to identify studies which used small mammal trapping to evaluate liver concentrations of metals. The results of the literature search are displayed in Table 5.9.

Table 5.9: Small Mammal Biomonitoring Studies for Arsenic and Nickel

Parameter	Organ	Area	Species	µg/g DW	µg/kg WW	Source
Nickel	liver	Reference	Meadow vole	1.36	387.6 ¹	Environmental reviews 1993
Nickel	liver	Aljustrel Mine, Portugal	Shrew	1.48	421.8 ¹	Environmental Pollution 2008
Arsenic	liver	Reference	Meadow vole	NA	340	Environmental Monitoring 2011
Arsenic	liver	Lower Seal Harbour, NS	Meadow vole	NA	970	Environmental Monitoring 2011

¹- Denotes where tissues were changed from dry weight to wet weight using a moisture content of 71.5% as identified in Zuercher (et. al 1999) for Red Backed Voles.

Based on the review conducted above, it is concluded that concentrations of nickel and arsenic are elevated at the Mill compared to the control but still similar to concentrations that have been identified in other areas of low exposure (i.e., reference areas). Therefore, it is unlikely that the bioaccumulation of nickel and arsenic from soil at the mill area of the Site is affecting the populations of voles.

5.3.5 Small Mammal Pathology

Samples from the small mammals collected from both the mill site and control were submitted for histopathological examination for lesions and signs of disease. The samples were assessed by Dr. Jamie Rothenburger from the Faculty of Veterinary Medicine, University of Calgary. The main tissues examined during the evaluation were lungs, kidney, liver, heart, thyroid gland, and skeletal muscle. Additional examinations for some individuals included adrenal gland, esophagus, trachea, stomach, pancreas, testes, ovary, and urinary bladder.

Among Mill Site voles, there were a total of 18 lesions in 56 tissues compared to 12 lesions in 52 tissues from Control Site voles (excluding pulmonary edema and congestion, which likely resulted from euthanasia). There is no statistically significant difference between these groups (chi-square $p=0.293$). The following observations and conclusions were developed during the histopathology review.

5.3.5.1 Lungs

Pulmonary edema and congestion are common changes found in the lungs of animals and can occur for a number of reasons. In these voles, this likely resulted from their capture, handling, and euthanasia. Inducible bronchus-associated lymphoid tissue can develop in rodents following exposure to infectious agents. Their changes in the lungs likely occurred due to past exposure to viruses and/or bacterial infections which were subsequently cleared by the immune system.

5.3.5.2 Liver

Necrosis (tissue death) and accumulations of inflammatory cells (lymphocytes and plasma cells) in the liver can occur for a variety of causes. There were no obvious infection agents in the affected areas so the exact cause remained unknown. Because the affected areas were rare and small, the clinical significance of these changes was likely minimal. Vacuoles can occur in liver cells most often due to accumulation of fat or glycogen. These can be seen commonly in rodents, especially after consuming high fat diets and are likely of no to minimal clinical significance. One vole from the control site had a trematode parasite in the liver. Liver parasites occur frequently in rodent species as they serve as intermediate hosts in many lifecycles. The parasite was likely of minimal clinical significance to this individual.

5.3.5.3 Kidney

Interstitial nephritis is inflammation of the connective tissue portions of the kidney. This lesion is commonly present as a background lesion in a wide range of mammals and is likely of minimal clinical significance to this individual.

5.3.5.4 Thyroid Gland

Follicular hyperplasia in the thyroid includes collapse of the normal follicle structure with limited to no colloid. The remaining cells are clumped and larger than normal. This can occur for several causes, including seasonal changes, iodine deficiency, and presence of goitrogenic substances. This lesion can be associated with signs of ill health including reduced body condition, poor hair coat, decreased reproductive capacity, and increased susceptibility to infection. There was no obvious evidence of this in the tissues examined, however additional tests would be necessary to determine if there was reduced thyroid function (i.e., hypothyroidism).

5.3.5.5 Heart

Small areas of inflammation in the heart muscle can be seen with a variety of disease conditions but can also occur as a background change without associated disease. The changes were mild and likely of minimal clinical significance to these individuals.

5.3.5.6 Esophagus

There was mild inflammation in the deeper esophageal tissues. This can be seen in other rodent species and likely reflects immune system stimulation. The changes were mild and likely of minimal clinical significance to these individuals.

5.3.5.7 Summary

Tissues from a total of 20 northern red-backed voles, ten each from the Mill and Control sites, were examined for signs of damage (lesions). The identified lesions were typically mild and likely of limited clinical significance to the health of individual animals. Overall, the voles appear to be in good health with no significant signs of overt disease. The exception was thyroid follicular hyperplasia in four individuals (three from the Mill site and one from the Control site) and the presence of a liver parasite in a different individual from the Control site. There was no appreciable difference in the prevalence of various lesions in the Mill Site vs. Control Site groups. This applied to individual lesions and aggregated lesions considering all voles collected from each of the Mill and Control sites.

5.4 Risk Characterization for ERA

Risk characterization is the final step of an ERA. It includes a quantification of the potential nature and magnitude of adverse effects that may occur to receptor species due to the presence of chemicals in identified ecological habitats at the Site. In this step, characterization of exposure and characterization of ecological effects for each COPC are integrated into quantitative HQ estimates of the potential for adverse effects to ecological receptors.

The HQ is a unitless value defined as the ratio of the magnitude of exposure to magnitude of a standard effect. Exposure ratios are interpreted as follows: if the HQ is less than one, no unacceptable risks to ecological receptors would be expected, because concentrations are below levels known to cause adverse effects. Conversely, if the HQ exceeds one, it may be inferred that adverse effects to individuals are possible. Given a certain magnitude and type of effect associated with a particular benchmark or assessment endpoint, inferences about potential effects can be made. For example, if the level of

exposure exceeds a benchmark based on a 25% reduction in a growth-based endpoint (HQ >1), it can be inferred that one possible outcome may be diminished growth of individuals, potentially (but not necessarily) leading to a reduction in population abundance of that receptor.

It is important to note that exceeding an HQ of one does not necessarily mean adverse effects will occur; rather, it suggests that we have less confidence that adverse effects will not occur. For a variety of reasons, adverse effects demonstrated in laboratory studies often fail to manifest in the field as a measurable or meaningful impact. It is also important to recognize that the magnitude of HQs is not directly associated with the magnitude of potential effects. That is, a large HQ (e.g., >10) should not be interpreted as a ten-fold greater risk than an HQ of one.

5.4.1 Plants and Soil Invertebrates

A summary of the HQs for plants and soil invertebrates is displayed in Table 5.10. All COPCs with a HQ>1 were evaluated further to assess distribution at the Site, as presented in Table 5.11.

Table 5.10: Risk Estimates for Plants and Soil Invertebrates

Parameter	Exposure Concentration (mg/kg)	Plant TRV (mg/kg)	Plant HQ (unitless)	Terrestrial Invertebrate TRV (mg/kg)	Terrestrial Invertebrate HQ (unitless)
Antimony	50	20	2.5	78	0.64
Arsenic	321	17	18.9	50	6.4
Barium	1060	750	7.8	330	3.2
Boron	241	NA	NA	NA	NA
Chromium	1810	64	28.3	310	5.8
Mercury	0.7	100	0.07	100	0.07
Molybdenum	22.5	5	4.5	5	4.5
Nickel	2647	45	58.8	280	9.4
Selenium	9.69	10	0.97	4.1	2.3
Zinc	261	200	1.3	400	0.65

Table 5.11: Distribution of Exceedances for Plants and Soil Invertebrates

Parameter	Plants			Invertebrates		
	Tailings Area	Waste Rock	Mill Area	Tailings Area	Waste Rock	Mill Area
Antimony	5/24	5/40	0/22	0/24	0/40	0/22
Arsenic	12/24	15/40	2/22	6/24	2/40	0/22
Barium	0/17	1/40	2/22	2/17	4/40	5/22
Boron	NA	NA	NA	NA	NA	NA
Chromium	24/24	17/40	11/22	24/24	14/40	3/22
Mercury	0/24	0/40	0/22	0/24	0/40	0/22
Molybdenum	5/24	33/40	1/22	5/24	33/40	1/22
Nickel	24/24	38/40	17/22	24/24	16/40	4/22
Selenium	0/24	1/40	0/22	0/24	20/40	1/22
Zinc	0/24	13/40	0/22	0/24	1/40	0/22

The soil chemistry results compared to the literature-based effects benchmarks for plants and soil invertebrates indicate that the areas which have the potential for effects to communities are the waste rock and tailings pile area. Further investigations to validate these conclusions could be collected prior to consideration of risk management of these areas such as:

- Vegetation community surveys
- Chemistry analysis of metals in vegetation
- Invertebrate community investigations
- Chemistry analysis of metals in invertebrates

However, the relevance and utility of these further investigations will be limited if the selected closure landscape for the rock and tailings areas do not involve the active re-establishment of substantial vegetative covers.

5.4.2 Birds and Mammals

Multiple lines of evidence are used in the risk characterization to evaluate the potential effects to mammals from data collected at the Site. For the risk characterization for small mammals, the multiple lines of evidence were acquired for the mill site only and therefore the weight of evidence (WOE) is conducted for this area of the Site only. The WOE was evaluated based on the guidance provided in FCSAP (2012) which indicates that ecological relevance is used to assess the degree to which the line of evidence (LOE) is aligned with (or predictive of) the assessment endpoint. For example, biological investigations are given greater weight than literature studies on COPCs. Table 5.12 displays the rationale for how the ecological relevance for each LOE was assigned for the assessment.

Table 5.12: Assessment Endpoint, LOE and Ecological Relevance

Assessment Endpoint	Measurement Endpoint	Line of Evidence	Ecological Relevance
Mammalian populations will not have adverse effects from soil at the Site.	3A: Estimated daily exposure from COPCs in soil and food from the Site.	3A: Compare the results of a food web model to toxicity reference values for COPCs identified from soil.	Low – based on literature values used for uptake factors in food web model and Toxicity Reference Values used to evaluate dose response model.
	3B: Evaluation of histological tissues for damage	3B: Compare the proportion of identified lesions and disease to reference conditions.	High – biological study was conducted based on small mammals at the Mill site with a histopathological evaluation conducted by a Doctor of Veterinary Medicine.
	3C: Evaluation of liver concentrations of COPCs identified in soil	3C: Compare liver concentrations of COPCs to the reference area and journal articles which have identified no potential effects.	Moderate –Site specific biological study which uses a statistical analysis and literature studies to develop risk conclusions.
	3D: Mammalian weight, and morphological parameters	3D: Compare body weight, total length, tail length for mammals collected at the Site to mammals collected at a reference site	High –site specific biological study with a statistical evaluation of the growth (weight and length) for the mill site compared to the control.

The potential risk to mammals and birds was examined in three areas of potential concern. Hazard quotients for the tailings area, waste rock area, and mill are displayed in Tables 5.13 to 5.15. For the tailings and the waste rock areas, the risk characterization is based on the results of the food web models (i.e., Tables 5.14 and 5.15).

5.4.2.1 Mill Area

The food web model predicted an elevated risk for two receptors – the shrew and American robin. Both receptors have diets which consist of mainly invertebrates (i.e., 95% and 40%, respectively). The largest HQs were for the masked shrew. For chromium, 69 percent of the dose was from modelled earthworm concentrations and, for nickel, approximately 85 percent of the HQ for the masked shrew was from earthworms. The remainder of the dose for chromium and nickel was from incidental soil exposure.

The risk to avians is also presented in Table 5.13 and the only receptor which had a predicted risk (i.e., HQ > 1) was the small omnivore, the American robin from chromium and nickel. For chromium, 67 percent of the dose was from modelled earthworm concentrations and, for nickel, 86 percent of the dose to the American robin was from earthworms.

Earthworms represent only a single component of the soil invertebrate community, which also includes a wide variety of other forms including insects, other arthropods, and mollusks (slugs and snails). Importantly, where different components of the soil invertebrate community have been tested, earthworms typically have much higher trace element concentrations than mollusks, which in turn have higher concentrations than insects and other arthropods. Therefore, where wildlife species such as the shrew and American robin are feeding on a mixed diet of soil invertebrates (i.e., not exclusively earthworms, but primarily insects), their actual dietary exposure would be much less than that predicted assuming a diet of 100% earthworms.

The HQs calculated in this ERA make no adjustment for relative bioaccessibility of metals in different environmental media (i.e., metals in soil may be less bioaccessible than metals in diet). The inherent assumption is that bioaccessibility in Site media (i.e., soil, plants, and earthworms) is similar to the bioaccessibility in the studies used as the basis for the TRVs. Significant research has been completed to assess the effects of relative bioaccessibility of contaminants from different media and results consistently indicate a decreased relative bioaccessibility of metals from soil.

The effects assessment for the biological LOE (i.e., histology, tissue concentrations, and growth) did not indicate that the voles which were captured at the Mill site had significant differences compared to the control.

Table 5.13: HQs for Mammals and Birds at the Mill Site

Parameter	Meadow vole	Masked shrew	Deer mouse	Snow-shoe hare	Red fox	Caribou	Moose	Black Bear	American Robin	Spruce Grouse	Red-tailed Hawk
Antimony	0.002	0.2	0.01	0.003	0.0007	0.0005	0.0001	0.0003	NC	NC	NC
Arsenic	0.008	0.2	0.009	0.02	0.004	0.004	0.004	0.006	0.07	0.02	0.002
Barium	0.03	0.3	0.02	0.05	0.002	0.01	0.005	0.007	0.03	0.01	0.0006
Chromium	0.04	1.6	0.09	0.07	0.003	0.01	0.001	0.003	1.3	0.2	0.01
Mercury	0.004	0.08	0.006	0.005	0.2	0.002	0.0006	0.1	0.05	0.01	0.03
Molybdenum	0.01	0.4	0.03	0.02	0.009	0.007	0.004	0.008	0.008	0.002	0.001
Nickel	0.09	12.1	0.7	0.2	0.03	0.03	0.004	0.01	1.8	0.2	0.03
Selenium	0.09	0.9	0.09	0.1	0.02	0.04	0.01	0.02	0.3	0.09	0.03
Zinc	0.009	0.4	0.03	0.01	0.01	0.005	0.004	0.008	0.2	0.03	0.02

Table 5.14: HQs for Mammals and Birds at the Tailings Area

Parameter	Meadow vole	Masked shrew	Deer mouse	Snow-shoe hare	Red fox	Caribou	Moose	Black Bear	American Robin	Spruce Grouse	Red-tailed Hawk
Antimony	0.009	1.2	0.07	0.02	0.002	0.003	0.0002	0.0007	NC	NC	NC
Arsenic	0.04	0.8	0.03	0.08	0.005	0.01	0.004	0.007	0.3	0.08	0.007
Barium	0.02	0.2	0.01	0.03	0.003	0.01	0.006	0.006	0.02	0.008	0.0004
Chromium	0.13	6	0.3	0.3	0.009	0.04	0.003	0.008	4.6	0.8	0.2
Mercury	0.004	0.07	0.006	0.005	0.2	0.002	0.0006	0.13	0.05	0.01	0.03
Molybdenum	0.03	0.9	0.06	0.05	0.01	0.01	0.004	0.009	0.02	0.004	0.003
Nickel	0.3	45	2.7	0.7	0.05	0.08	0.006	0.02	6.4	0.6	0.07
Selenium	0.03	0.4	0.04	0.04	0.02	0.02	0.008	0.02	0.1	0.03	0.02
Zinc	0.007	0.3	0.02	0.008	0.01	0.004	0.004	0.008	0.1	0.02	0.02

Table 5.15: HQs for Mammals and Birds at the Waste Rock Area

Parameter	Meadow vole	Masked shrew	Deer mouse	Snow-shoe hare	Red fox	Caribou	Moose	Black Bear	American Robin	Spruce Grouse	Red-tailed Hawk
Antimony	0.007	0.9	0.05	0.01	0.003	0.003	0.0003	0.001	NC	NC	NC
Arsenic	0.02	0.5	0.02	0.04	0.005	0.009	0.004	0.007	0.2	0.04	0.004
Barium	0.02	0.13	0.009	0.02	0.002	0.008	0.005	0.006	0.02	0.006	0.0003
Chromium	0.06	2.7	0.2	0.1	0.01	0.03	0.003	0.008	2.1	0.4	0.1
Mercury	0.005	0.08	0.007	0.007	0.2	0.003	0.0007	0.1	0.06	0.02	0.004
Molybdenum	0.08	2	0.1	0.1	0.02	0.04	0.006	0.02	0.04	0.009	0.006
Nickel	0.2	22	1.3	0.4	0.06	0.06	0.007	0.02	3.2	0.3	0.04
Selenium	0.2	1.5	0.2	0.2	0.02	0.1	0.02	0.03	0.5	0.2	0.03
Zinc	0.02	0.5	0.04	0.02	0.01	0.009	0.004	0.009	0.3	0.04	0.02

While it is acknowledged that shrews were not captured during the biomonitoring program, it is likely a factor of the small mammal populations present at the Site rather than contamination because shrews were not captured at either the Mill or Control areas. Based on a 43 year study duration of small mammal populations in Ontario, Fryxell et al. (1998) identify the most abundant small mammals as:

- Deer mouse;
- Chipmunks;
- Red backed voles
- Jumping mice;
- Short tailed shrews;
- Red squirrels;
- Masked shrew

Based on a review of dietary preferences of avian (i.e., short eared owl, kestrel) and mammalian (i.e., weasel and stoat) predators, voles are identified as the primary prey (Strause et al. 2008, Korpimäki et al. 2005). Therefore, while it is acknowledged that the shrew is an important indicator species, it is concluded management decisions can be made based on survival and viability of populations of voles at the Site.

Therefore, it is concluded that the potential risk to small mammal populations at the mill site from current soil conditions is low.

5.4.2.2 Tailings and Waste Rock Areas

Small mammal trapping was attempted near the tailings area, however small mammals were not collected from any of traps. It cannot be confirmed if the habitat or contamination has had effects on the small mammal population in the tailings area. Based on the results of the food web model (Table 5.14), the potential risk to voles from soil contamination is low in the tailings area and the lack of captures during the small mammal trapping indicates poor habitat or lack of food. Based on the results of the small mammal trapping program (histology and tissue chemistry), it was concluded that the risk to small mammal populations was low.

Elevated hazard quotients for the masked shrew and American Robin were calculated for chromium and nickel in both the tailings and waste rock areas. For the American Robin, 67 percent of the dose for chromium and 86 percent of the dose from nickel was from earthworms in the waste rock area. For the American Robin, 67 percent of the dose for chromium and 87 percent of the dose from nickel was from earthworms in the tailings area. The masked shrew also had an elevated hazard quotient for antimony associated with the tailings area and 88 percent of the estimated dose was based on the estimated concentrations in earthworms. All other receptors had hazard quotients below 1.0.

As discussed in Section 5.4.2.1, calculated HQs are expected to overestimate risk as the food web models assume 100% of invertebrates are earthworms and do not account for reduced bioavailability from soil. The effects assessment for the biological LOE (i.e., histology, tissue concentrations, and growth) did not indicate that the voles captured at the Mill site were adversely affected by contamination.

6.0 Conclusions

Wood has completed an update to the HHERA for the Clinton Creek mine completed by Amec Foster Wheeler (now Wood) in March 2017 (Amec Foster Wheeler 2017a). Additional investigations were completed at the Site in 2018 and the purpose of this report is to update the 2017 HHERA with this new information. The surface and groundwater data compiled since 2016 under ongoing Site monitoring programs have not identified conditions that would warrant a change in the treatment of these media. Therefore, there are no updates to the HHERA for these media. Based on the HHERA Update, we provide the following conclusions.

6.1 HHRA

The conclusions of the HHRA Update are as follows:

- HQ for direct soil exposure for campers due to exposure to nickel in tailings is greater than 0.2, indicating that unacceptable risks to the camper cannot be ruled out.
- HQs for direct soil exposure for all receptor groups assessed (i.e., campers, hunter/gatherers, and occasional visitors) are less than 0.2 in all other Site areas investigated (i.e., soil at the mine and mill areas and waste rock), indicating that unacceptable risks are not predicted for these exposure scenarios.
- HQs for country food consumption for all receptor groups assessed (i.e., campers, hunter/gatherers, and occasional visitors) are less than 0.2, indicating that unacceptable risks are not predicted associated with hunting/gathering on the Site.
- IELCRs for exposure to asbestos fibres in air exceed the target IELCR for the hunter/gatherer and camper receptor groups based on personal and area sampling results from 2018, indicating that unacceptable risks due to airborne asbestos exposure are predicted for these receptors under current Site conditions.
- IELCRs for exposure to asbestos fibres in air for the occasional visitor are less than the essentially negligible target risk of 1×10^{-5} for all sample results indicating that unacceptable risks due to airborne asbestos exposure are not predicted for this receptor under current Site conditions.
- The findings of the risk assessment indicate that, based on the current Site conditions, there is a potential unacceptable risk to human health due to inhalation of airborne asbestos and/or direct exposure to nickel in tailings. This represents a scenario in which tailings remain accessible and could be disturbed.
- For scenarios in which there is no access to and no disturbance of the tailings (i.e., IELCRs calculated using the average of the passive asbestos sampling results, metals HQs for waste rock and mine/mill soil), no unacceptable risks are predicted.
- The tailings contain consistently higher metals and asbestos content than both the waste rock and the soil samples from the remainder of the Site. The tailings are the major source of asbestos on Site. The findings of the HHRA Update indicate that, from a human exposure perspective, waste rock would be a suitable cover material for the tailings should this risk management option be considered.

The objective of the HHRA Update was to assess the human health risks associated with current Site conditions. In the event that Site conditions change during Site closure and reclamation activities, the findings of this HHRA would need to be revised.

6.2 ERA

The conclusions of the ERA Update are as follows:

- The soil chemistry results compared to the literature-based effects benchmarks for plants and soil invertebrates indicate that the areas which have the potential for effects to plant and/or soil invertebrate communities are the waste rock and tailings pile areas. It should be noted that the tailings and waste rock are barren and largely devoid of vegetative cover. Should risk management plans include active revegetation of tailings or waste rock, further investigations to validate these conclusions could be collected, such as:
 - o Vegetation community surveys
 - o Chemistry analysis of metals in vegetation
 - o Invertebrate community investigations
 - o Chemistry analysis of metals in invertebrates
- Livers of trapped voles were submitted for metals analysis. Based on the statistical evaluation conducted on the liver concentrations of COPCs as well as a literature review to identify studies which used small mammal trapping to evaluate liver concentrations of metals, it is unlikely that the bioaccumulation of metals from soil at the Site is affecting the populations of voles.
- Samples from the small mammals collected from both the mill site and control were submitted for histopathological examination for lesions and signs of disease. There was no appreciable difference in the prevalence of various lesions in the Mill Site vs. Control Site groups. Overall, the voles appear to be in good health with no significant signs of overt disease.
- A food web model was used to predict risks to birds and mammals which may forage at or inhabit the Site. Based on the results of this modelling, combined with the results of the small mammal trapping study, it is concluded that the potential risk to small mammal populations at the mill site from current soil conditions is low.
- Elevated hazard quotients for the masked shrew and American robin were calculated for chromium and nickel in both the tailings and waste rock areas. Calculated HQs are expected to overestimate risk as the food web models assume 100% of invertebrates are earthworms and do not account for reduced bioaccessibility from soil. The potential risk to other avian species such as grouse and red-tailed hawk from current soil conditions is low.

7.0 Closing

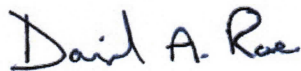
Based on the available information provided by the Project Parties, a human health and ecological risk assessment has been carried out in order to facilitate the advancement of conceptual designs for the Clinton Creek former mine site, to a Preliminary Remediation Design (10%).

This report was prepared exclusively for the Project Parties by the Wood project team. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in Wood's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This Report is intended to be used by the Project Parties, and its nominated representatives, subject to the terms and conditions of its contract with Wood. Any other use of, or reliance on, this report by a third party is at that party's sole risk. This report has been prepared in accordance with generally accepted engineering and scientific practice. No other warranty, expressed or implied, is made.

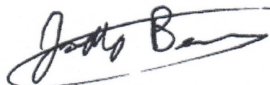
Wood makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel. This Report is also subject to the further Standard Limitations contained in Appendix E.

We trust that the information presented in this report meets your current requirements. Should you have any questions, or concerns, please do not hesitate to contact the undersigned.

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David A. Rae, Ph.D., P.Geo.
Senior Associate Risk Assessor

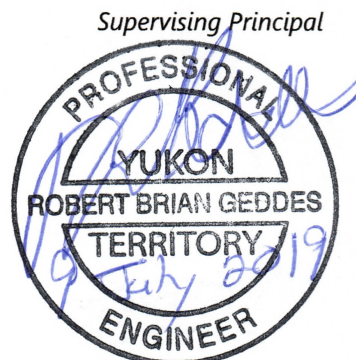
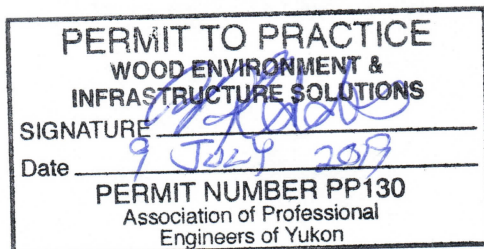


Jody Berry, P.Eng., M.E.S.
Senior Risk Assessor

Reviewed by:



Dennis Yee, M.Sc., P.Biol.
Senior Risk Assessor



R. Brian Geddes, P.Eng.
Principal Engineer

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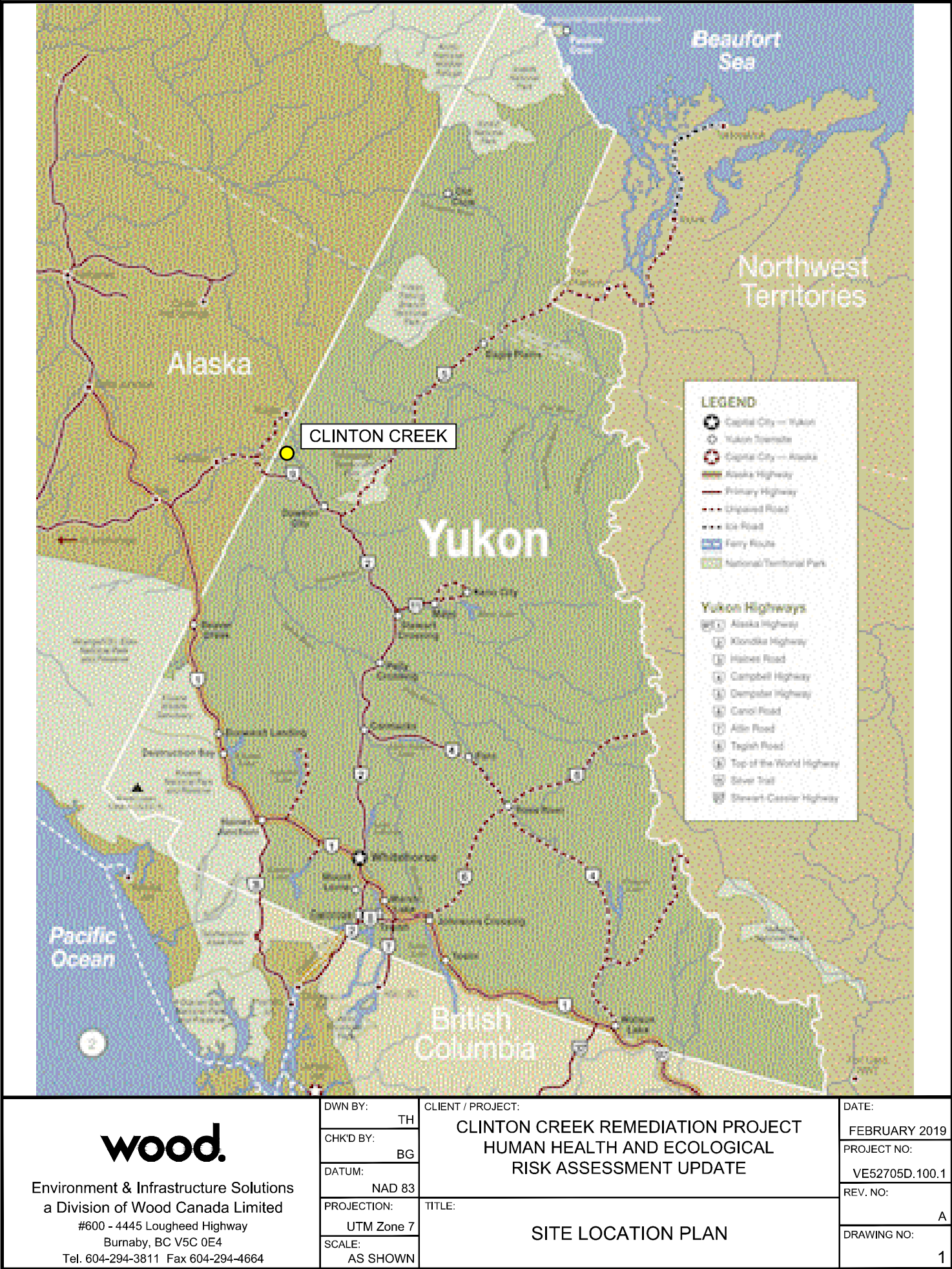
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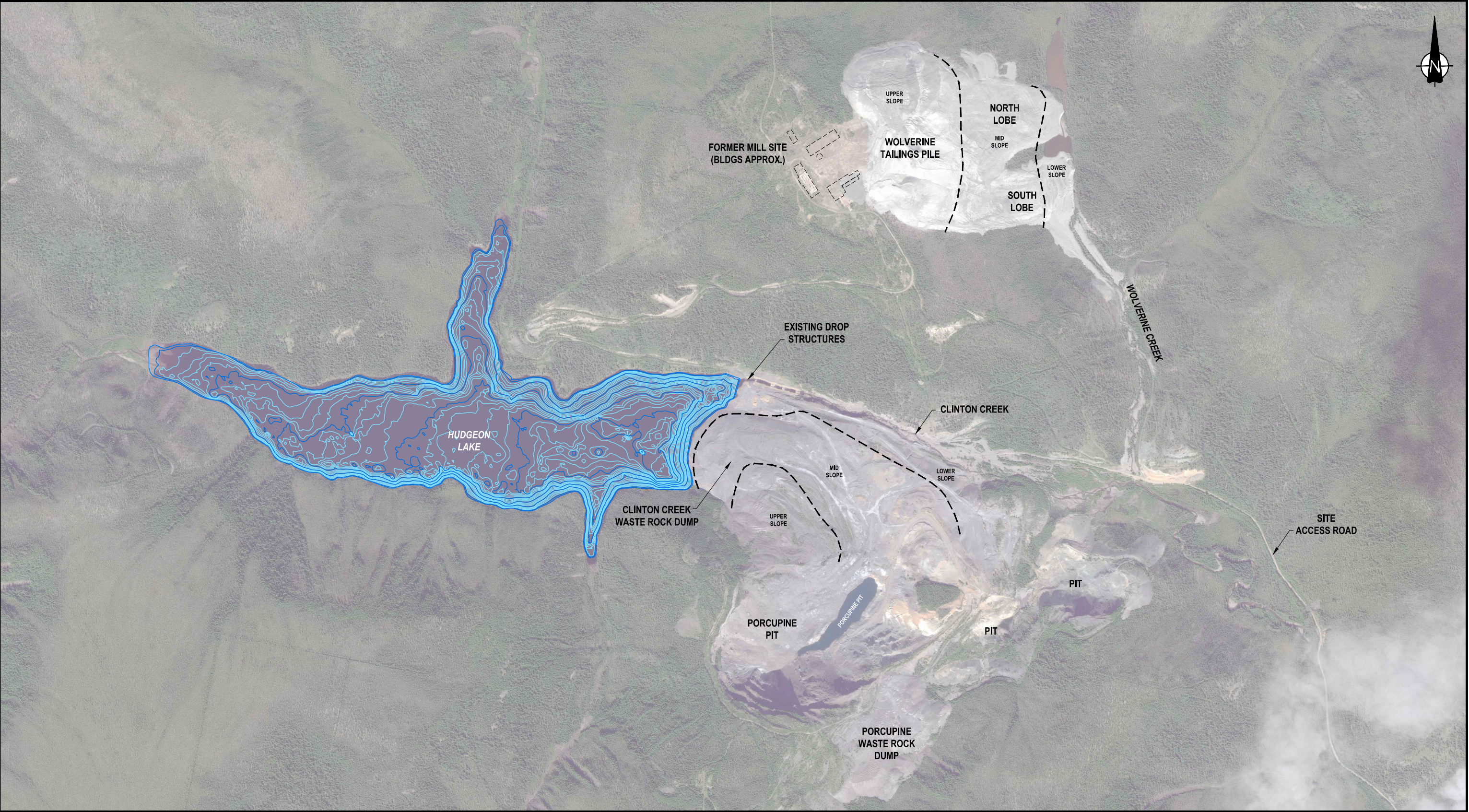
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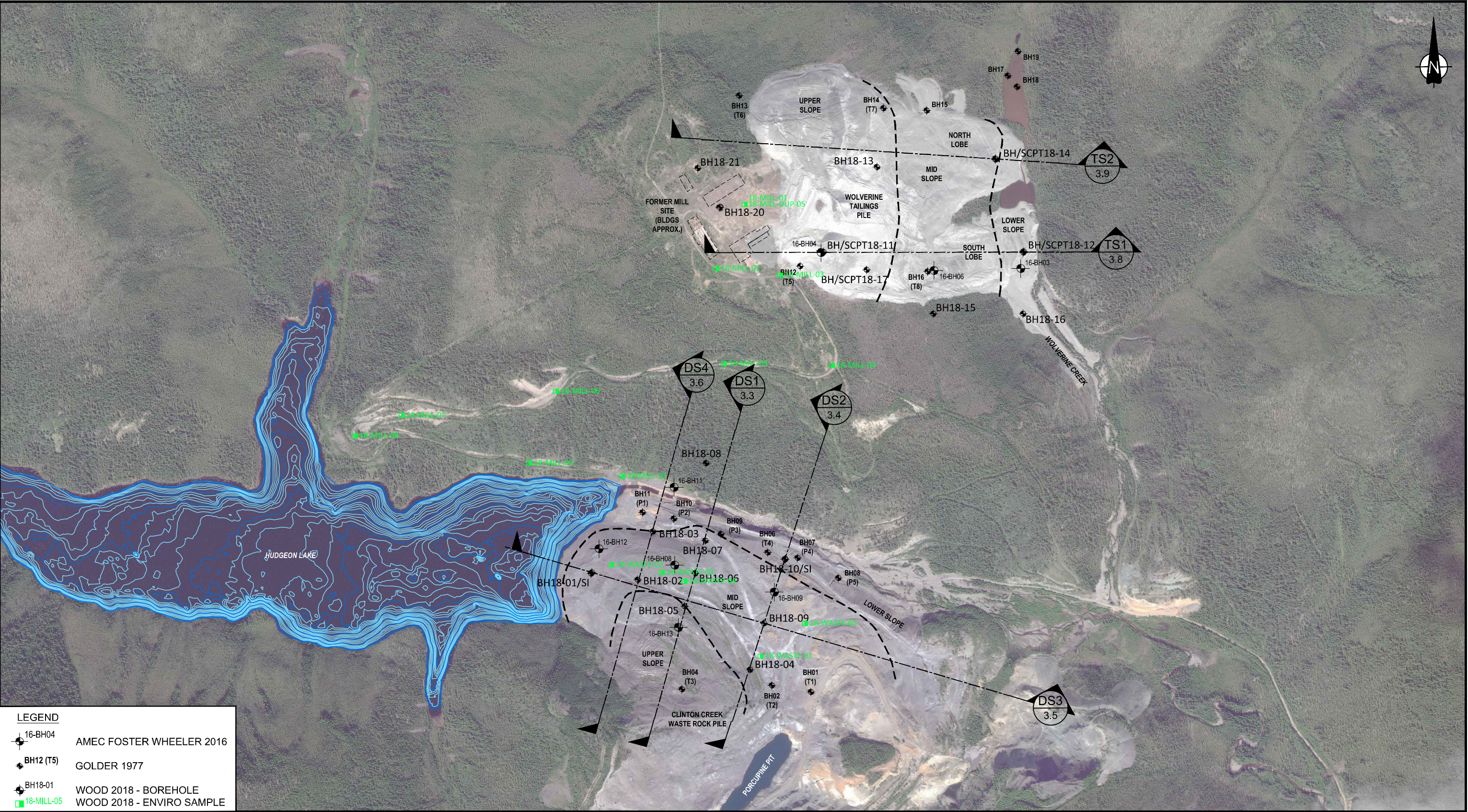
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Appendix A
Drawings





NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE WOOD ENVIRONMENT AND INFRASTRUCTURE SOLUTIONS REPORT No. VE52705D DATED FEBRUARY 2019. 0m100200300400500 1 : 12500	wood. Environment & Infrastructure Solutions a Division of Wood Canada Limited #600 - 4445 Lougheed Highway Burnaby, BC V5C 0E4 Tel. 604-294-3811 Fax 604-294-4664	CLIENT: GOVERNMENT OF YUKON	DWN BY: TH	PROJECT: CLINTON CREEK REMEDIATION PROJECT HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT UPDATE	DATE: FEBRUARY 2019
			CHK'D BY: BG		PROJECT NO: VE52705D.100.1
			DATUM: NAD 83		REV. NO: A
			PROJECTION: UTM Zone 7	TITLE: SITE LAYOUT	DRAWING NO: 2
			SCALE: AS SHOWN		



LEGEND

16-BH04

BH12 (T5)

BH18-01

18-MILL-05

AMEC FOSTER WHEELER 2016

GOLDER 1977

WOOD 2018 - BOREHOLE

WOOD 2018 - ENVIRO SAMPLE

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE
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REPORT No. VE52705D DATED FEBRUARY 2019.

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Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

GOVERNMENT OF YUKON

DWN BY:TH

CHK'D BY:BG

DATUM:NAD 83

PROJECTION:UTM Zone 7

SCALE:AS SHOWN

PROJECT:

CLINTON CREEK REMEDIATION PROJECT
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT UPDATE

TITLE:

SITE PLAN
NORTH

DATE:FEBRUARY 2019

PROJECT NO:VE52705D.100.1

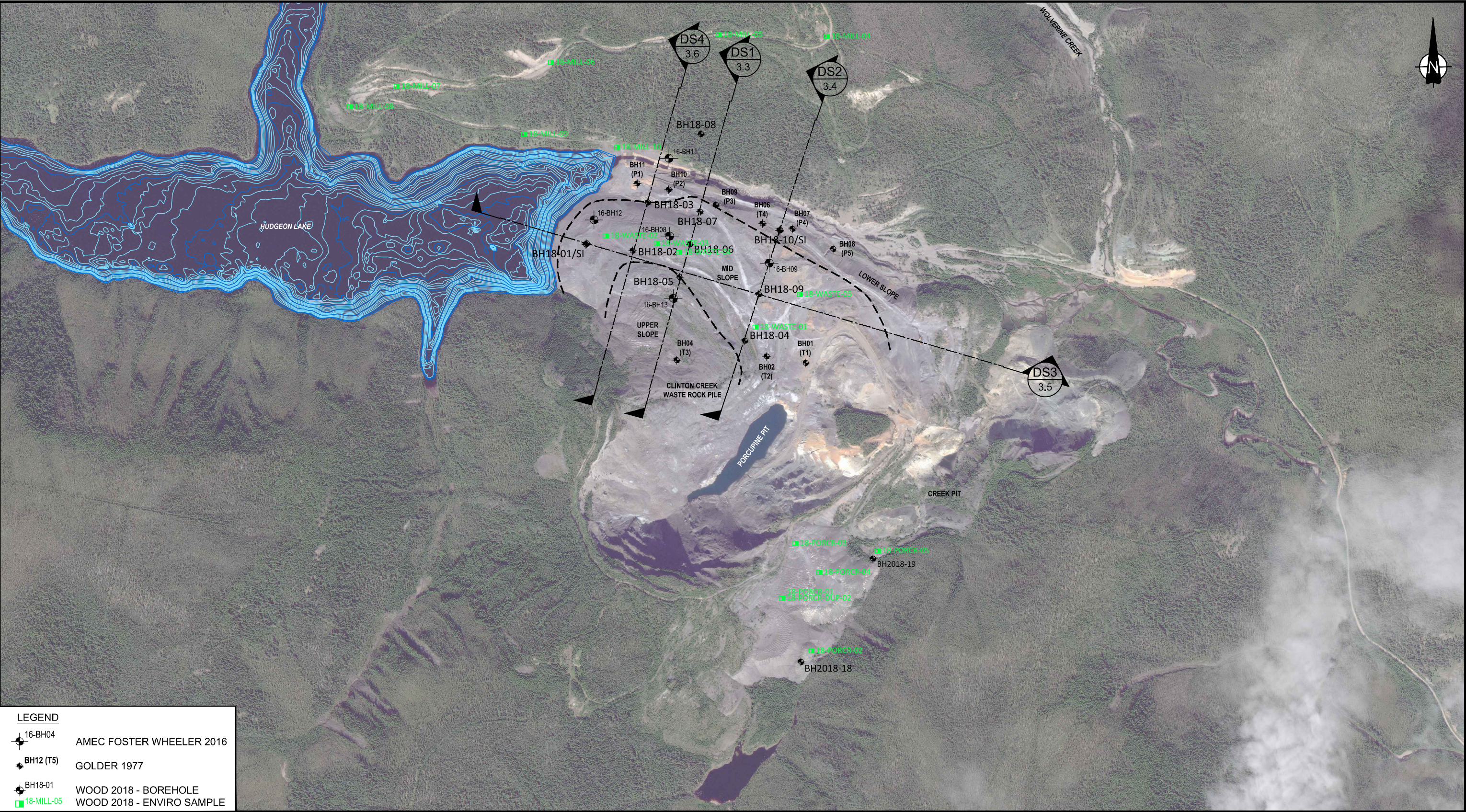
REV. NO:

A

DRAWING NO:

3

N:\Projects\52000\VE52600\VE52695 - GovtYukon - ClintonCreekPrelDesign\400 - Work in Progress\430 Geotechnical\435 KDH Working Files\KDH Working Files\2018 Site Investigation\VE52705D.100.1-003-004.dwg - 003 - Feb. 19, 2019 3:13pm - tim.hawker



LEGEND

16-BH04

BH12 (T5)

BH18-01

18-MILL-05

AMEC FOSTER WHEELER 2016

GOLDER 1977

WOOD 2018 - BOREHOLE

WOOD 2018 - ENVIRO SAMPLE

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE
WOOD ENVIRONMENT AND INFRASTRUCTURE SOLUTIONS
REPORT No. VE52705D DATED FEBRUARY 2019.

0m100200300400

1 : 10000

wood.

Environment & Infrastructure Solutions
a Division of Wood Canada Limited
#600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT:

GOVERNMENT OF YUKON

DWN BY:TH

CHK'D BY:BG

DATUM:NAD 83

PROJECTION:UTM Zone 7

SCALE:AS SHOWN

PROJECT:
CLINTON CREEK REMEDIATION PROJECT
HUMAN HEALTH AND ECOLOGICAL
RISK ASSESSMENT UPDATE

TITLE:
SITE PLAN
SOUTH

DATE:
FEBRUARY 2019

PROJECT NO:
VE52705D.100.1

REV. NO:
A

DRAWING NO:
4

N:\Projects\52000\VE52600\VE52695 - GovtYukon - ClintonCreekPrelDesign\400 - Work in Progress\430 Geotechnical\435 KDH Working Files\KDH Working Files\2018 Site Investigation\VE52705D.100.1-003-004.dwg - 004 - Feb. 19, 2019 3:13pm - tim.hawker

Appendix B
Statistical Analyses and Exposure Point
Concentrations

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Tailings											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.130/01/2019 12:49:29 PM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	AI											
12												
13	General Statistics											
14	Total Number of Observations				17		Number of Distinct Observations				17	
15							Number of Missing Observations				0	
16	Minimum				2567		Mean				4326	
17	Maximum				5585		Median				4537	
18	SD				890.1		Std. Error of Mean				215.9	
19	Coefficient of Variation				0.206		Skewness				-0.311	
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic				0.957		Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value				0.892		Data appear Normal at 5% Significance Level					
24	Lilliefors Test Statistic				0.123		Lilliefors GOF Test					
25	5% Lilliefors Critical Value				0.207		Data appear Normal at 5% Significance Level					
26	Data appear Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL				4703		95% Adjusted-CLT UCL (Chen-1995)				4664	
31							95% Modified-t UCL (Johnson-1978)				4700	
32												
33	Gamma GOF Test											
34	A-D Test Statistic				0.341		Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value				0.738		Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic				0.147		Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value				0.209		Detected data appear Gamma Distributed at 5% Significance Level					
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)				23.18		k star (bias corrected MLE)				19.13	
42	Theta hat (MLE)				186.6		Theta star (bias corrected MLE)				226.1	
43	nu hat (MLE)				788.1		nu star (bias corrected)				650.4	
44	MLE Mean (bias corrected)				4326		MLE Sd (bias corrected)				989.1	
45							Approximate Chi Square Value (0.05)				592.2	
46	Adjusted Level of Significance				0.0346		Adjusted Chi Square Value				586.4	
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))				4751		95% Adjusted Gamma UCL (use when n<50)				4798	
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic				0.937		Shapiro Wilk Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
53	5% Shapiro Wilk Critical Value					0.892	Data appear Lognormal at 5% Significance Level						
54	Lilliefors Test Statistic					0.153	Lilliefors Lognormal GOF Test						
55	5% Lilliefors Critical Value					0.207	Data appear Lognormal at 5% Significance Level						
56	Data appear Lognormal at 5% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data					7.85	Mean of logged Data					8.351	
60	Maximum of Logged Data					8.628	SD of logged Data					0.22	
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL					4790	90% Chebyshev (MVUE) UCL					5029	
64	95% Chebyshev (MVUE) UCL					5345	97.5% Chebyshev (MVUE) UCL					5785	
65	99% Chebyshev (MVUE) UCL					6647							
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data appear to follow a Discernible Distribution at 5% Significance Level												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL					4681	95% Jackknife UCL					4703	
72	95% Standard Bootstrap UCL					4676	95% Bootstrap-t UCL					4697	
73	95% Hall's Bootstrap UCL					4663	95% Percentile Bootstrap UCL					4678	
74	95% BCA Bootstrap UCL					4643							
75	90% Chebyshev(Mean, Sd) UCL					4973	95% Chebyshev(Mean, Sd) UCL					5267	
76	97.5% Chebyshev(Mean, Sd) UCL					5674	99% Chebyshev(Mean, Sd) UCL					6474	
77													
78	Suggested UCL to Use												
79	95% Student's-t UCL					4703							
80													
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
82	Recommendations are based upon data size, data distribution, and skewness.												
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
85													
86	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												
87	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												
88													
89													
90	Sb												
91													
92	General Statistics												
93	Total Number of Observations					24	Number of Distinct Observations					20	
94							Number of Missing Observations					0	
95	Minimum					1.794	Mean					16.6	
96	Maximum					50	Median					9.457	
97	SD					16.75	Std. Error of Mean					3.42	
98	Coefficient of Variation					1.009	Skewness					1.31	
99													
100	Normal GOF Test												
101	Shapiro Wilk Test Statistic					0.758	Shapiro Wilk GOF Test						
102	5% Shapiro Wilk Critical Value					0.916	Data Not Normal at 5% Significance Level						
103	Lilliefors Test Statistic					0.215	Lilliefors GOF Test						
104	5% Lilliefors Critical Value					0.177	Data Not Normal at 5% Significance Level						

	A	B	C	D	E	F	G	H	I	J	K	L		
105	Data Not Normal at 5% Significance Level													
106														
107	Assuming Normal Distribution													
108	95% Normal UCL						95% UCLs (Adjusted for Skewness)							
109	95% Student's-t UCL						22.46	95% Adjusted-CLT UCL (Chen-1995)						23.2
110								95% Modified-t UCL (Johnson-1978)						22.62
111														
112	Gamma GOF Test													
113	A-D Test Statistic						0.775	Anderson-Darling Gamma GOF Test						
114	5% A-D Critical Value						0.768	Data Not Gamma Distributed at 5% Significance Level						
115	K-S Test Statistic						0.161	Kolmogorov-Smirnov Gamma GOF Test						
116	5% K-S Critical Value						0.182	Detected data appear Gamma Distributed at 5% Significance Level						
117	Detected data follow Appr. Gamma Distribution at 5% Significance Level													
118														
119	Gamma Statistics													
120	k hat (MLE)						1.181	k star (bias corrected MLE)						1.061
121	Theta hat (MLE)						14.06	Theta star (bias corrected MLE)						15.64
122	nu hat (MLE)						56.69	nu star (bias corrected)						50.94
123	MLE Mean (bias corrected)						16.6	MLE Sd (bias corrected)						16.12
124								Approximate Chi Square Value (0.05)						35.55
125	Adjusted Level of Significance						0.0392	Adjusted Chi Square Value						34.64
126														
127	Assuming Gamma Distribution													
128	95% Approximate Gamma UCL (use when n>=50)						23.79	95% Adjusted Gamma UCL (use when n<50)						24.41
129														
130	Lognormal GOF Test													
131	Shapiro Wilk Test Statistic						0.947	Shapiro Wilk Lognormal GOF Test						
132	5% Shapiro Wilk Critical Value						0.916	Data appear Lognormal at 5% Significance Level						
133	Lilliefors Test Statistic						0.112	Lilliefors Lognormal GOF Test						
134	5% Lilliefors Critical Value						0.177	Data appear Lognormal at 5% Significance Level						
135	Data appear Lognormal at 5% Significance Level													
136														
137	Lognormal Statistics													
138	Minimum of Logged Data						0.584	Mean of logged Data						2.33
139	Maximum of Logged Data						3.912	SD of logged Data						1.018
140														
141	Assuming Lognormal Distribution													
142	95% H-UCL						29.71	90% Chebyshev (MVUE) UCL						28.56
143	95% Chebyshev (MVUE) UCL						33.93	97.5% Chebyshev (MVUE) UCL						41.37
144	99% Chebyshev (MVUE) UCL						56							
145														
146	Nonparametric Distribution Free UCL Statistics													
147	Data appear to follow a Discernible Distribution at 5% Significance Level													
148														
149	Nonparametric Distribution Free UCLs													
150	95% CLT UCL						22.23	95% Jackknife UCL						22.46
151	95% Standard Bootstrap UCL						22.18	95% Bootstrap-t UCL						23.83
152	95% Hall's Bootstrap UCL						22.55	95% Percentile Bootstrap UCL						22.3
153	95% BCA Bootstrap UCL						23.23							
154	90% Chebyshev(Mean, Sd) UCL						26.86	95% Chebyshev(Mean, Sd) UCL						31.51
155	97.5% Chebyshev(Mean, Sd) UCL						37.96	99% Chebyshev(Mean, Sd) UCL						50.63
156														

	A	B	C	D	E	F	G	H	I	J	K	L
157	Suggested UCL to Use											
158	95% Adjusted Gamma UCL					24.41						
159												
160	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
161	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
162												
163	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
164	Recommendations are based upon data size, data distribution, and skewness.											
165	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
166	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
167												
168												
169	As											
170												
171	General Statistics											
172	Total Number of Observations					24	Number of Distinct Observations					23
173							Number of Missing Observations					0
174	Minimum					2.06	Mean					41.11
175	Maximum					321	Median					16.33
176	SD					69.32	Std. Error of Mean					14.15
177	Coefficient of Variation					1.686	Skewness					3.287
178												
179	Normal GOF Test											
180	Shapiro Wilk Test Statistic					0.575	Shapiro Wilk GOF Test					
181	5% Shapiro Wilk Critical Value					0.916	Data Not Normal at 5% Significance Level					
182	Lilliefors Test Statistic					0.287	Lilliefors GOF Test					
183	5% Lilliefors Critical Value					0.177	Data Not Normal at 5% Significance Level					
184	Data Not Normal at 5% Significance Level											
185												
186	Assuming Normal Distribution											
187	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
188	95% Student's-t UCL					65.36	95% Adjusted-CLT UCL (Chen-1995)					74.53
189							95% Modified-t UCL (Johnson-1978)					66.94
190												
191	Gamma GOF Test											
192	A-D Test Statistic					0.713	Anderson-Darling Gamma GOF Test					
193	5% A-D Critical Value					0.793	Detected data appear Gamma Distributed at 5% Significance Level					
194	K-S Test Statistic					0.123	Kolmogorov-Smirnov Gamma GOF Test					
195	5% K-S Critical Value					0.186	Detected data appear Gamma Distributed at 5% Significance Level					
196	Detected data appear Gamma Distributed at 5% Significance Level											
197												
198	Gamma Statistics											
199	k hat (MLE)					0.635	k star (bias corrected MLE)					0.584
200	Theta hat (MLE)					64.72	Theta star (bias corrected MLE)					70.44
201	nu hat (MLE)					30.49	nu star (bias corrected)					28.01
202	MLE Mean (bias corrected)					41.11	MLE Sd (bias corrected)					53.81
203							Approximate Chi Square Value (0.05)					16.94
204	Adjusted Level of Significance					0.0392	Adjusted Chi Square Value					16.33
205												
206	Assuming Gamma Distribution											
207	95% Approximate Gamma UCL (use when n>=50)					67.98	95% Adjusted Gamma UCL (use when n<50)					70.51
208												

	A	B	C	D	E	F	G	H	I	J	K	L
209	Lognormal GOF Test											
210	Shapiro Wilk Test Statistic					0.945	Shapiro Wilk Lognormal GOF Test					
211	5% Shapiro Wilk Critical Value					0.916	Data appear Lognormal at 5% Significance Level					
212	Lilliefors Test Statistic					0.142	Lilliefors Lognormal GOF Test					
213	5% Lilliefors Critical Value					0.177	Data appear Lognormal at 5% Significance Level					
214	Data appear Lognormal at 5% Significance Level											
215												
216	Lognormal Statistics											
217	Minimum of Logged Data					0.723	Mean of logged Data					2.751
218	Maximum of Logged Data					5.771	SD of logged Data					1.458
219												
220	Assuming Lognormal Distribution											
221	95% H-UCL					120.3	90% Chebyshev (MVUE) UCL					87.27
222	95% Chebyshev (MVUE) UCL					107.9	97.5% Chebyshev (MVUE) UCL					136.5
223	99% Chebyshev (MVUE) UCL					192.7						
224												
225	Nonparametric Distribution Free UCL Statistics											
226	Data appear to follow a Discernible Distribution at 5% Significance Level											
227												
228	Nonparametric Distribution Free UCLs											
229	95% CLT UCL					64.38	95% Jackknife UCL					65.36
230	95% Standard Bootstrap UCL					63.74	95% Bootstrap-t UCL					105.8
231	95% Hall's Bootstrap UCL					169.4	95% Percentile Bootstrap UCL					67.08
232	95% BCA Bootstrap UCL					81.12						
233	90% Chebyshev(Mean, Sd) UCL					83.56	95% Chebyshev(Mean, Sd) UCL					102.8
234	97.5% Chebyshev(Mean, Sd) UCL					129.5	99% Chebyshev(Mean, Sd) UCL					181.9
235												
236	Suggested UCL to Use											
237	95% Adjusted Gamma UCL					70.51						
238												
239	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
240	Recommendations are based upon data size, data distribution, and skewness.											
241	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
242	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
243												
244												
245	Ba											
246												
247	General Statistics											
248	Total Number of Observations					17	Number of Distinct Observations					17
249							Number of Missing Observations					0
250	Minimum					18.15	Mean					196.2
251	Maximum					688.3	Median					148.4
252	SD					172.8	Std. Error of Mean					41.91
253	Coefficient of Variation					0.881	Skewness					1.687
254												
255	Normal GOF Test											
256	Shapiro Wilk Test Statistic					0.821	Shapiro Wilk GOF Test					
257	5% Shapiro Wilk Critical Value					0.892	Data Not Normal at 5% Significance Level					
258	Lilliefors Test Statistic					0.199	Lilliefors GOF Test					
259	5% Lilliefors Critical Value					0.207	Data appear Normal at 5% Significance Level					
260	Data appear Approximate Normal at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
261												
262	Assuming Normal Distribution											
263	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
264	95% Student's-t UCL					269.4	95% Adjusted-CLT UCL (Chen-1995)					283.5
265							95% Modified-t UCL (Johnson-1978)					272.3
266												
267	Gamma GOF Test											
268	A-D Test Statistic					0.361	Anderson-Darling Gamma GOF Test					
269	5% A-D Critical Value					0.755	Detected data appear Gamma Distributed at 5% Significance Level					
270	K-S Test Statistic					0.155	Kolmogorov-Smirnov Gamma GOF Test					
271	5% K-S Critical Value					0.213	Detected data appear Gamma Distributed at 5% Significance Level					
272	Detected data appear Gamma Distributed at 5% Significance Level											
273												
274	Gamma Statistics											
275	k hat (MLE)					1.576	k star (bias corrected MLE)					1.337
276	Theta hat (MLE)					124.5	Theta star (bias corrected MLE)					146.8
277	nu hat (MLE)					53.58	nu star (bias corrected)					45.46
278	MLE Mean (bias corrected)					196.2	MLE Sd (bias corrected)					169.7
279							Approximate Chi Square Value (0.05)					30.99
280	Adjusted Level of Significance					0.0346	Adjusted Chi Square Value					29.74
281												
282	Assuming Gamma Distribution											
283	95% Approximate Gamma UCL (use when n>=50))					287.8	95% Adjusted Gamma UCL (use when n<50)					299.9
284												
285	Lognormal GOF Test											
286	Shapiro Wilk Test Statistic					0.969	Shapiro Wilk Lognormal GOF Test					
287	5% Shapiro Wilk Critical Value					0.892	Data appear Lognormal at 5% Significance Level					
288	Lilliefors Test Statistic					0.129	Lilliefors Lognormal GOF Test					
289	5% Lilliefors Critical Value					0.207	Data appear Lognormal at 5% Significance Level					
290	Data appear Lognormal at 5% Significance Level											
291												
292	Lognormal Statistics											
293	Minimum of Logged Data					2.899	Mean of logged Data					4.93
294	Maximum of Logged Data					6.534	SD of logged Data					0.901
295												
296	Assuming Lognormal Distribution											
297	95% H-UCL					366.5	90% Chebyshev (MVUE) UCL					344.8
298	95% Chebyshev (MVUE) UCL					409.9	97.5% Chebyshev (MVUE) UCL					500.2
299	99% Chebyshev (MVUE) UCL					677.6						
300												
301	Nonparametric Distribution Free UCL Statistics											
302	Data appear to follow a Discernible Distribution at 5% Significance Level											
303												
304	Nonparametric Distribution Free UCLs											
305	95% CLT UCL					265.2	95% Jackknife UCL					269.4
306	95% Standard Bootstrap UCL					263.6	95% Bootstrap-t UCL					308.3
307	95% Hall's Bootstrap UCL					315	95% Percentile Bootstrap UCL					264.8
308	95% BCA Bootstrap UCL					293						
309	90% Chebyshev(Mean, Sd) UCL					322	95% Chebyshev(Mean, Sd) UCL					378.9
310	97.5% Chebyshev(Mean, Sd) UCL					457.9	99% Chebyshev(Mean, Sd) UCL					613.2
311												
312	Suggested UCL to Use											

	A	B	C	D	E	F	G	H	I	J	K	L
313	95% Student's-t UCL					269.4						
314												
315	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
316	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
317												
318	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
319	Recommendations are based upon data size, data distribution, and skewness.											
320	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
321	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
322												
323												
324	B											
325												
326		General Statistics										
327		Total Number of Observations				17	Number of Distinct Observations				17	
328							Number of Missing Observations				0	
329		Minimum				91.78	Mean				161.2	
330		Maximum				240.9	Median				160.2	
331		SD				37.51	Std. Error of Mean				9.097	
332		Coefficient of Variation				0.233	Skewness				0.194	
333												
334	Normal GOF Test											
335		Shapiro Wilk Test Statistic				0.983	Shapiro Wilk GOF Test					
336		5% Shapiro Wilk Critical Value				0.892	Data appear Normal at 5% Significance Level					
337		Lilliefors Test Statistic				0.0964	Lilliefors GOF Test					
338		5% Lilliefors Critical Value				0.207	Data appear Normal at 5% Significance Level					
339	Data appear Normal at 5% Significance Level											
340												
341	Assuming Normal Distribution											
342	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
343		95% Student's-t UCL				177.1	95% Adjusted-CLT UCL (Chen-1995)				176.6	
344							95% Modified-t UCL (Johnson-1978)				177.2	
345												
346	Gamma GOF Test											
347		A-D Test Statistic				0.189	Anderson-Darling Gamma GOF Test					
348		5% A-D Critical Value				0.738	Detected data appear Gamma Distributed at 5% Significance Level					
349		K-S Test Statistic				0.101	Kolmogorov-Smirnov Gamma GOF Test					
350		5% K-S Critical Value				0.209	Detected data appear Gamma Distributed at 5% Significance Level					
351	Detected data appear Gamma Distributed at 5% Significance Level											
352												
353	Gamma Statistics											
354		k hat (MLE)				19	k star (bias corrected MLE)				15.69	
355		Theta hat (MLE)				8.484	Theta star (bias corrected MLE)				10.28	
356		nu hat (MLE)				646	nu star (bias corrected)				533.3	
357		MLE Mean (bias corrected)				161.2	MLE Sd (bias corrected)				40.7	
358						Approximate Chi Square Value (0.05)				480.8		
359		Adjusted Level of Significance				0.0346	Adjusted Chi Square Value				475.6	
360												
361	Assuming Gamma Distribution											
362	95% Approximate Gamma UCL (use when n>=50))					178.8	95% Adjusted Gamma UCL (use when n<50)				180.8	
363												
364	Lognormal GOF Test											

	A	B	C	D	E	F	G	H	I	J	K	L	
365	Shapiro Wilk Test Statistic					0.976	Shapiro Wilk Lognormal GOF Test						
366	5% Shapiro Wilk Critical Value					0.892	Data appear Lognormal at 5% Significance Level						
367	Lilliefors Test Statistic					0.109	Lilliefors Lognormal GOF Test						
368	5% Lilliefors Critical Value					0.207	Data appear Lognormal at 5% Significance Level						
369	Data appear Lognormal at 5% Significance Level												
370													
371	Lognormal Statistics												
372	Minimum of Logged Data					4.519	Mean of logged Data					5.056	
373	Maximum of Logged Data					5.484	SD of logged Data					0.241	
374													
375	Assuming Lognormal Distribution												
376	95% H-UCL					180.3	90% Chebyshev (MVUE) UCL					189.9	
377	95% Chebyshev (MVUE) UCL					202.8	97.5% Chebyshev (MVUE) UCL					220.7	
378	99% Chebyshev (MVUE) UCL					256							
379													
380	Nonparametric Distribution Free UCL Statistics												
381	Data appear to follow a Discernible Distribution at 5% Significance Level												
382													
383	Nonparametric Distribution Free UCLs												
384	95% CLT UCL					176.2	95% Jackknife UCL					177.1	
385	95% Standard Bootstrap UCL					176.1	95% Bootstrap-t UCL					177.6	
386	95% Hall's Bootstrap UCL					176.8	95% Percentile Bootstrap UCL					175.6	
387	95% BCA Bootstrap UCL					176.1							
388	90% Chebyshev(Mean, Sd) UCL					188.5	95% Chebyshev(Mean, Sd) UCL					200.9	
389	97.5% Chebyshev(Mean, Sd) UCL					218	99% Chebyshev(Mean, Sd) UCL					251.7	
390													
391	Suggested UCL to Use												
392	95% Student's-t UCL					177.1							
393													
394	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
395	Recommendations are based upon data size, data distribution, and skewness.												
396	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
397	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
398													
399													
400	Cd												
401													
402	General Statistics												
403	Total Number of Observations					24	Number of Distinct Observations					11	
404							Number of Missing Observations					0	
405	Minimum					0.01	Mean					0.116	
406	Maximum					2	Median					0.038	
407	SD					0.402	Std. Error of Mean					0.082	
408	Coefficient of Variation					3.463	Skewness					4.881	
409													
410	Normal GOF Test												
411	Shapiro Wilk Test Statistic					0.248	Shapiro Wilk GOF Test						
412	5% Shapiro Wilk Critical Value					0.916	Data Not Normal at 5% Significance Level						
413	Lilliefors Test Statistic					0.497	Lilliefors GOF Test						
414	5% Lilliefors Critical Value					0.177	Data Not Normal at 5% Significance Level						
415	Data Not Normal at 5% Significance Level												
416													

	A	B	C	D	E	F	G	H	I	J	K	L
417	Assuming Normal Distribution											
418	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
419	95% Student's-t UCL				0.257	95% Adjusted-CLT UCL (Chen-1995)					0.338	
420						95% Modified-t UCL (Johnson-1978)					0.27	
421												
422	Gamma GOF Test											
423	A-D Test Statistic				4.385	Anderson-Darling Gamma GOF Test						
424	5% A-D Critical Value				0.806	Data Not Gamma Distributed at 5% Significance Level						
425	K-S Test Statistic				0.394	Kolmogorov-Smirnov Gamma GOF Test						
426	5% K-S Critical Value				0.188	Data Not Gamma Distributed at 5% Significance Level						
427	Data Not Gamma Distributed at 5% Significance Level											
428												
429	Gamma Statistics											
430	k hat (MLE)				0.503	k star (bias corrected MLE)					0.468	
431	Theta hat (MLE)				0.23	Theta star (bias corrected MLE)					0.248	
432	nu hat (MLE)				24.16	nu star (bias corrected)					22.47	
433	MLE Mean (bias corrected)				0.116	MLE Sd (bias corrected)					0.17	
434							Approximate Chi Square Value (0.05)				12.69	
435	Adjusted Level of Significance				0.0392	Adjusted Chi Square Value					12.18	
436												
437	Assuming Gamma Distribution											
438	95% Approximate Gamma UCL (use when n>=50))				0.205	95% Adjusted Gamma UCL (use when n<50)					0.214	
439												
440	Lognormal GOF Test											
441	Shapiro Wilk Test Statistic				0.753	Shapiro Wilk Lognormal GOF Test						
442	5% Shapiro Wilk Critical Value				0.916	Data Not Lognormal at 5% Significance Level						
443	Lilliefors Test Statistic				0.23	Lilliefors Lognormal GOF Test						
444	5% Lilliefors Critical Value				0.177	Data Not Lognormal at 5% Significance Level						
445	Data Not Lognormal at 5% Significance Level											
446												
447	Lognormal Statistics											
448	Minimum of Logged Data				-4.605	Mean of logged Data					-3.415	
449	Maximum of Logged Data				0.693	SD of logged Data					1.128	
450												
451	Assuming Lognormal Distribution											
452	95% H-UCL				0.118	90% Chebyshev (MVUE) UCL					0.107	
453	95% Chebyshev (MVUE) UCL				0.129	97.5% Chebyshev (MVUE) UCL					0.159	
454	99% Chebyshev (MVUE) UCL				0.218							
455												
456	Nonparametric Distribution Free UCL Statistics											
457	Data do not follow a Discernible Distribution (0.05)											
458												
459	Nonparametric Distribution Free UCLs											
460	95% CLT UCL				0.251	95% Jackknife UCL					0.257	
461	95% Standard Bootstrap UCL				0.245	95% Bootstrap-t UCL					2.119	
462	95% Hall's Bootstrap UCL				1.172	95% Percentile Bootstrap UCL					0.28	
463	95% BCA Bootstrap UCL				0.363							
464	90% Chebyshev(Mean, Sd) UCL				0.362	95% Chebyshev(Mean, Sd) UCL					0.473	
465	97.5% Chebyshev(Mean, Sd) UCL				0.628	99% Chebyshev(Mean, Sd) UCL					0.932	
466												
467	Suggested UCL to Use											
468	95% Chebyshev (Mean, Sd) UCL				0.473							

	A	B	C	D	E	F	G	H	I	J	K	L	
469													
470	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
471	Recommendations are based upon data size, data distribution, and skewness.												
472	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
473	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
474													
475													
476	Cr												
477													
478	General Statistics												
479	Total Number of Observations				24		Number of Distinct Observations				24		
480							Number of Missing Observations				0		
481	Minimum				771		Mean				1361		
482	Maximum				1650		Median				1375		
483	SD				193.2		Std. Error of Mean				39.44		
484	Coefficient of Variation				0.142		Skewness				-1.23		
485													
486	Normal GOF Test												
487	Shapiro Wilk Test Statistic				0.926		Shapiro Wilk GOF Test						
488	5% Shapiro Wilk Critical Value				0.916		Data appear Normal at 5% Significance Level						
489	Lilliefors Test Statistic				0.11		Lilliefors GOF Test						
490	5% Lilliefors Critical Value				0.177		Data appear Normal at 5% Significance Level						
491	Data appear Normal at 5% Significance Level												
492													
493	Assuming Normal Distribution												
494	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
495	95% Student's-t UCL			1429		95% Adjusted-CLT UCL (Chen-1995)					1415		
496						95% Modified-t UCL (Johnson-1978)					1427		
497													
498	Gamma GOF Test												
499	A-D Test Statistic			0.717		Anderson-Darling Gamma GOF Test							
500	5% A-D Critical Value			0.742		Detected data appear Gamma Distributed at 5% Significance Level							
501	K-S Test Statistic			0.132		Kolmogorov-Smirnov Gamma GOF Test							
502	5% K-S Critical Value			0.177		Detected data appear Gamma Distributed at 5% Significance Level							
503	Detected data appear Gamma Distributed at 5% Significance Level												
504													
505	Gamma Statistics												
506	k hat (MLE)			44.28		k star (bias corrected MLE)					38.77		
507	Theta hat (MLE)			30.74		Theta star (bias corrected MLE)					35.1		
508	nu hat (MLE)			2126		nu star (bias corrected)					1861		
509	MLE Mean (bias corrected)			1361		MLE Sd (bias corrected)					218.6		
510						Approximate Chi Square Value (0.05)					1762		
511	Adjusted Level of Significance			0.0392		Adjusted Chi Square Value					1755		
512													
513	Assuming Gamma Distribution												
514	95% Approximate Gamma UCL (use when n>=50))				1438		95% Adjusted Gamma UCL (use when n<50)					1443	
515													
516	Lognormal GOF Test												
517	Shapiro Wilk Test Statistic			0.849		Shapiro Wilk Lognormal GOF Test							
518	5% Shapiro Wilk Critical Value			0.916		Data Not Lognormal at 5% Significance Level							
519	Lilliefors Test Statistic			0.144		Lilliefors Lognormal GOF Test							
520	5% Lilliefors Critical Value			0.177		Data appear Lognormal at 5% Significance Level							

	A	B	C	D	E	F	G	H	I	J	K	L
521	Data appear Approximate Lognormal at 5% Significance Level											
522												
523	Lognormal Statistics											
524	Minimum of Logged Data				6.648		Mean of logged Data				7.205	
525	Maximum of Logged Data				7.409		SD of logged Data				0.161	
526												
527	Assuming Lognormal Distribution											
528	95% H-UCL				1446		90% Chebyshev (MVUE) UCL				1497	
529	95% Chebyshev (MVUE) UCL				1558		97.5% Chebyshev (MVUE) UCL				1643	
530	99% Chebyshev (MVUE) UCL				1810							
531												
532	Nonparametric Distribution Free UCL Statistics											
533	Data appear to follow a Discernible Distribution at 5% Significance Level											
534												
535	Nonparametric Distribution Free UCLs											
536	95% CLT UCL				1426		95% Jackknife UCL				1429	
537	95% Standard Bootstrap UCL				1425		95% Bootstrap-t UCL				1417	
538	95% Hall's Bootstrap UCL				1414		95% Percentile Bootstrap UCL				1421	
539	95% BCA Bootstrap UCL				1419							
540	90% Chebyshev(Mean, Sd) UCL				1479		95% Chebyshev(Mean, Sd) UCL				1533	
541	97.5% Chebyshev(Mean, Sd) UCL				1607		99% Chebyshev(Mean, Sd) UCL				1754	
542												
543	Suggested UCL to Use											
544	95% Student's-t UCL				1429							
545												
546	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
547	Recommendations are based upon data size, data distribution, and skewness.											
548	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
549	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
550												
551	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
552	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
553												
554												
555	Co											
556												
557	General Statistics											
558	Total Number of Observations				24		Number of Distinct Observations				22	
559							Number of Missing Observations				0	
560	Minimum				60		Mean				89.14	
561	Maximum				111		Median				88.2	
562	SD				13.43		Std. Error of Mean				2.741	
563	Coefficient of Variation				0.151		Skewness				-0.445	
564												
565	Normal GOF Test											
566	Shapiro Wilk Test Statistic				0.971		Shapiro Wilk GOF Test					
567	5% Shapiro Wilk Critical Value				0.916		Data appear Normal at 5% Significance Level					
568	Lilliefors Test Statistic				0.105		Lilliefors GOF Test					
569	5% Lilliefors Critical Value				0.177		Data appear Normal at 5% Significance Level					
570	Data appear Normal at 5% Significance Level											
571												
572	Assuming Normal Distribution											

	A	B	C	D	E	F	G	H	I	J	K	L	
573	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
574	95% Student's-t UCL					93.84	95% Adjusted-CLT UCL (Chen-1995)						93.39
575							95% Modified-t UCL (Johnson-1978)						93.8
576													
577	Gamma GOF Test												
578	A-D Test Statistic					0.358	Anderson-Darling Gamma GOF Test						
579	5% A-D Critical Value					0.742	Detected data appear Gamma Distributed at 5% Significance Level						
580	K-S Test Statistic					0.12	Kolmogorov-Smirnov Gamma GOF Test						
581	5% K-S Critical Value					0.177	Detected data appear Gamma Distributed at 5% Significance Level						
582	Detected data appear Gamma Distributed at 5% Significance Level												
583													
584	Gamma Statistics												
585	k hat (MLE)					43.03	k star (bias corrected MLE)					37.68	
586	Theta hat (MLE)					2.072	Theta star (bias corrected MLE)					2.366	
587	nu hat (MLE)					2065	nu star (bias corrected)					1808	
588	MLE Mean (bias corrected)					89.14	MLE Sd (bias corrected)					14.52	
589							Approximate Chi Square Value (0.05)					1711	
590	Adjusted Level of Significance					0.0392	Adjusted Chi Square Value					1704	
591													
592	Assuming Gamma Distribution												
593	95% Approximate Gamma UCL (use when n>=50))					94.24	95% Adjusted Gamma UCL (use when n<50)					94.61	
594													
595	Lognormal GOF Test												
596	Shapiro Wilk Test Statistic					0.947	Shapiro Wilk Lognormal GOF Test						
597	5% Shapiro Wilk Critical Value					0.916	Data appear Lognormal at 5% Significance Level						
598	Lilliefors Test Statistic					0.125	Lilliefors Lognormal GOF Test						
599	5% Lilliefors Critical Value					0.177	Data appear Lognormal at 5% Significance Level						
600	Data appear Lognormal at 5% Significance Level												
601													
602	Lognormal Statistics												
603	Minimum of Logged Data					4.094	Mean of logged Data					4.479	
604	Maximum of Logged Data					4.71	SD of logged Data					0.159	
605													
606	Assuming Lognormal Distribution												
607	95% H-UCL					94.55	90% Chebyshev (MVUE) UCL					97.91	
608	95% Chebyshev (MVUE) UCL					101.9	97.5% Chebyshev (MVUE) UCL					107.3	
609	99% Chebyshev (MVUE) UCL					118.1							
610													
611	Nonparametric Distribution Free UCL Statistics												
612	Data appear to follow a Discernible Distribution at 5% Significance Level												
613													
614	Nonparametric Distribution Free UCLs												
615	95% CLT UCL					93.65	95% Jackknife UCL					93.84	
616	95% Standard Bootstrap UCL					93.51	95% Bootstrap-t UCL					93.64	
617	95% Hall's Bootstrap UCL					93.75	95% Percentile Bootstrap UCL					93.61	
618	95% BCA Bootstrap UCL					93.03							
619	90% Chebyshev(Mean, Sd) UCL					97.37	95% Chebyshev(Mean, Sd) UCL					101.1	
620	97.5% Chebyshev(Mean, Sd) UCL					106.3	99% Chebyshev(Mean, Sd) UCL					116.4	
621													
622	Suggested UCL to Use												
623	95% Student's-t UCL					93.84							
624													

	A	B	C	D	E	F	G	H	I	J	K	L
625	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
626	Recommendations are based upon data size, data distribution, and skewness.											
627	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
628	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
629												
630	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
631	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
632												
633												
634	Fe											
635												
636	General Statistics											
637	Total Number of Observations				17		Number of Distinct Observations				17	
638							Number of Missing Observations				0	
639	Minimum				38667		Mean				51653	
640	Maximum				62178		Median				52546	
641	SD				6806		Std. Error of Mean				1651	
642	Coefficient of Variation				0.132		Skewness				-0.296	
643												
644	Normal GOF Test											
645	Shapiro Wilk Test Statistic				0.954		Shapiro Wilk GOF Test					
646	5% Shapiro Wilk Critical Value				0.892		Data appear Normal at 5% Significance Level					
647	Lilliefors Test Statistic				0.161		Lilliefors GOF Test					
648	5% Lilliefors Critical Value				0.207		Data appear Normal at 5% Significance Level					
649	Data appear Normal at 5% Significance Level											
650												
651	Assuming Normal Distribution											
652	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
653	95% Student's-t UCL				54534		95% Adjusted-CLT UCL (Chen-1995)				54241	
654							95% Modified-t UCL (Johnson-1978)				54515	
655												
656	Gamma GOF Test											
657	A-D Test Statistic				0.405		Anderson-Darling Gamma GOF Test					
658	5% A-D Critical Value				0.737		Detected data appear Gamma Distributed at 5% Significance Level					
659	K-S Test Statistic				0.171		Kolmogorov-Smirnov Gamma GOF Test					
660	5% K-S Critical Value				0.208		Detected data appear Gamma Distributed at 5% Significance Level					
661	Detected data appear Gamma Distributed at 5% Significance Level											
662												
663	Gamma Statistics											
664	k hat (MLE)				58.99		k star (bias corrected MLE)				48.62	
665	Theta hat (MLE)				875.6		Theta star (bias corrected MLE)				1062	
666	nu hat (MLE)				2006		nu star (bias corrected)				1653	
667	MLE Mean (bias corrected)				51653		MLE Sd (bias corrected)				7408	
668							Approximate Chi Square Value (0.05)				1560	
669	Adjusted Level of Significance				0.0346		Adjusted Chi Square Value				1550	
670												
671	Assuming Gamma Distribution											
672	95% Approximate Gamma UCL (use when n>=50))				54747		95% Adjusted Gamma UCL (use when n<50)				55082	
673												
674	Lognormal GOF Test											
675	Shapiro Wilk Test Statistic				0.945		Shapiro Wilk Lognormal GOF Test					
676	5% Shapiro Wilk Critical Value				0.892		Data appear Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
677	Lilliefors Test Statistic					0.166	Lilliefors Lognormal GOF Test						
678	5% Lilliefors Critical Value					0.207	Data appear Lognormal at 5% Significance Level						
679	Data appear Lognormal at 5% Significance Level												
680													
681	Lognormal Statistics												
682	Minimum of Logged Data					10.56	Mean of logged Data					10.84	
683	Maximum of Logged Data					11.04	SD of logged Data					0.136	
684													
685	Assuming Lognormal Distribution												
686	95% H-UCL					54866	90% Chebyshev (MVUE) UCL					56781	
687	95% Chebyshev (MVUE) UCL					59100	97.5% Chebyshev (MVUE) UCL					62318	
688	99% Chebyshev (MVUE) UCL					68640							
689													
690	Nonparametric Distribution Free UCL Statistics												
691	Data appear to follow a Discernible Distribution at 5% Significance Level												
692													
693	Nonparametric Distribution Free UCLs												
694	95% CLT UCL					54368	95% Jackknife UCL					54534	
695	95% Standard Bootstrap UCL					54328	95% Bootstrap-t UCL					54361	
696	95% Hall's Bootstrap UCL					54229	95% Percentile Bootstrap UCL					54225	
697	95% BCA Bootstrap UCL					54313							
698	90% Chebyshev(Mean, Sd) UCL					56604	95% Chebyshev(Mean, Sd) UCL					58847	
699	97.5% Chebyshev(Mean, Sd) UCL					61961	99% Chebyshev(Mean, Sd) UCL					68076	
700													
701	Suggested UCL to Use												
702	95% Student's-t UCL					54534							
703													
704	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
705	Recommendations are based upon data size, data distribution, and skewness.												
706	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
707	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
708													
709	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												
710	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												
711													
712													
713	Li												
714													
715		General Statistics											
716	Total Number of Observations					17	Number of Distinct Observations					15	
717							Number of Missing Observations					0	
718	Minimum					1	Mean					4.566	
719	Maximum					12.63	Median					4.48	
720	SD					3.157	Std. Error of Mean					0.766	
721	Coefficient of Variation					0.691	Skewness					1.06	
722													
723	Normal GOF Test												
724	Shapiro Wilk Test Statistic					0.911	Shapiro Wilk GOF Test						
725	5% Shapiro Wilk Critical Value					0.892	Data appear Normal at 5% Significance Level						
726	Lilliefors Test Statistic					0.136	Lilliefors GOF Test						
727	5% Lilliefors Critical Value					0.207	Data appear Normal at 5% Significance Level						
728	Data appear Normal at 5% Significance Level												

	A	B	C	D	E	F	G	H	I	J	K	L
729												
730	Assuming Normal Distribution											
731	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
732	95% Student's-t UCL					5.903	95% Adjusted-CLT UCL (Chen-1995)					6.036
733							95% Modified-t UCL (Johnson-1978)					5.936
734												
735	Gamma GOF Test											
736	A-D Test Statistic					0.276	Anderson-Darling Gamma GOF Test					
737	5% A-D Critical Value					0.749	Detected data appear Gamma Distributed at 5% Significance Level					
738	K-S Test Statistic					0.113	Kolmogorov-Smirnov Gamma GOF Test					
739	5% K-S Critical Value					0.212	Detected data appear Gamma Distributed at 5% Significance Level					
740	Detected data appear Gamma Distributed at 5% Significance Level											
741												
742	Gamma Statistics											
743	k hat (MLE)					2.14	k star (bias corrected MLE)					1.801
744	Theta hat (MLE)					2.134	Theta star (bias corrected MLE)					2.535
745	nu hat (MLE)					72.75	nu star (bias corrected)					61.25
746	MLE Mean (bias corrected)					4.566	MLE Sd (bias corrected)					3.402
747							Approximate Chi Square Value (0.05)					44.25
748	Adjusted Level of Significance					0.0346	Adjusted Chi Square Value					42.74
749												
750	Assuming Gamma Distribution											
751	95% Approximate Gamma UCL (use when n>=50))					6.321	95% Adjusted Gamma UCL (use when n<50)					6.544
752												
753	Lognormal GOF Test											
754	Shapiro Wilk Test Statistic					0.938	Shapiro Wilk Lognormal GOF Test					
755	5% Shapiro Wilk Critical Value					0.892	Data appear Lognormal at 5% Significance Level					
756	Lilliefors Test Statistic					0.147	Lilliefors Lognormal GOF Test					
757	5% Lilliefors Critical Value					0.207	Data appear Lognormal at 5% Significance Level					
758	Data appear Lognormal at 5% Significance Level											
759												
760	Lognormal Statistics											
761	Minimum of Logged Data					0	Mean of logged Data					1.267
762	Maximum of Logged Data					2.536	SD of logged Data					0.776
763												
764	Assuming Lognormal Distribution											
765	95% H-UCL					7.545	90% Chebyshev (MVUE) UCL					7.531
766	95% Chebyshev (MVUE) UCL					8.817	97.5% Chebyshev (MVUE) UCL					10.6
767	99% Chebyshev (MVUE) UCL					14.11						
768												
769	Nonparametric Distribution Free UCL Statistics											
770	Data appear to follow a Discernible Distribution at 5% Significance Level											
771												
772	Nonparametric Distribution Free UCLs											
773	95% CLT UCL					5.826	95% Jackknife UCL					5.903
774	95% Standard Bootstrap UCL					5.787	95% Bootstrap-t UCL					6.233
775	95% Hall's Bootstrap UCL					6.309	95% Percentile Bootstrap UCL					5.856
776	95% BCA Bootstrap UCL					6.095						
777	90% Chebyshev(Mean, Sd) UCL					6.863	95% Chebyshev(Mean, Sd) UCL					7.904
778	97.5% Chebyshev(Mean, Sd) UCL					9.348	99% Chebyshev(Mean, Sd) UCL					12.18
779												
780	Suggested UCL to Use											

	A	B	C	D	E	F	G	H	I	J	K	L
781	95% Student's-t UCL					5.903						
782												
783	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
784	Recommendations are based upon data size, data distribution, and skewness.											
785	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
786	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
787												
788												
789	Mn											
790												
791	General Statistics											
792	Total Number of Observations				17	Number of Distinct Observations				17		
793						Number of Missing Observations				0		
794	Minimum				476.4	Mean				585.9		
795	Maximum				1009	Median				562.4		
796	SD				117.8	Std. Error of Mean				28.57		
797	Coefficient of Variation				0.201	Skewness				3.163		
798												
799	Normal GOF Test											
800	Shapiro Wilk Test Statistic				0.628	Shapiro Wilk GOF Test						
801	5% Shapiro Wilk Critical Value				0.892	Data Not Normal at 5% Significance Level						
802	Lilliefors Test Statistic				0.3	Lilliefors GOF Test						
803	5% Lilliefors Critical Value				0.207	Data Not Normal at 5% Significance Level						
804	Data Not Normal at 5% Significance Level											
805												
806	Assuming Normal Distribution											
807	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
808	95% Student's-t UCL				635.7	95% Adjusted-CLT UCL (Chen-1995)				656.3		
809						95% Modified-t UCL (Johnson-1978)				639.4		
810												
811	Gamma GOF Test											
812	A-D Test Statistic				1.535	Anderson-Darling Gamma GOF Test						
813	5% A-D Critical Value				0.737	Data Not Gamma Distributed at 5% Significance Level						
814	K-S Test Statistic				0.259	Kolmogorov-Smirnov Gamma GOF Test						
815	5% K-S Critical Value				0.209	Data Not Gamma Distributed at 5% Significance Level						
816	Data Not Gamma Distributed at 5% Significance Level											
817												
818	Gamma Statistics											
819	k hat (MLE)				34.67	k star (bias corrected MLE)				28.59		
820	Theta hat (MLE)				16.9	Theta star (bias corrected MLE)				20.49		
821	nu hat (MLE)				1179	nu star (bias corrected)				972.1		
822	MLE Mean (bias corrected)				585.9	MLE Sd (bias corrected)				109.6		
823						Approximate Chi Square Value (0.05)				900.7		
824	Adjusted Level of Significance				0.0346	Adjusted Chi Square Value				893.5		
825												
826	Assuming Gamma Distribution											
827	95% Approximate Gamma UCL (use when n>=50))				632.3	95% Adjusted Gamma UCL (use when n<50)				637.4		
828												
829	Lognormal GOF Test											
830	Shapiro Wilk Test Statistic				0.737	Shapiro Wilk Lognormal GOF Test						
831	5% Shapiro Wilk Critical Value				0.892	Data Not Lognormal at 5% Significance Level						
832	Lilliefors Test Statistic				0.244	Lilliefors Lognormal GOF Test						

	A	B	C	D	E	F	G	H	I	J	K	L	
833	5% Lilliefors Critical Value					0.207	Data Not Lognormal at 5% Significance Level						
834	Data Not Lognormal at 5% Significance Level												
835													
836	Lognormal Statistics												
837	Minimum of Logged Data				6.166	Mean of logged Data					6.359		
838	Maximum of Logged Data				6.917	SD of logged Data					0.165		
839													
840	Assuming Lognormal Distribution												
841	95% H-UCL				629.6	90% Chebyshev (MVUE) UCL					655.1		
842	95% Chebyshev (MVUE) UCL				687	97.5% Chebyshev (MVUE) UCL					731.1		
843	99% Chebyshev (MVUE) UCL				817.9								
844													
845	Nonparametric Distribution Free UCL Statistics												
846	Data do not follow a Discernible Distribution (0.05)												
847													
848	Nonparametric Distribution Free UCLs												
849	95% CLT UCL				632.9	95% Jackknife UCL					635.7		
850	95% Standard Bootstrap UCL				632.5	95% Bootstrap-t UCL					691.4		
851	95% Hall's Bootstrap UCL				828.5	95% Percentile Bootstrap UCL					636.3		
852	95% BCA Bootstrap UCL				661.2								
853	90% Chebyshev(Mean, Sd) UCL				671.6	95% Chebyshev(Mean, Sd) UCL					710.4		
854	97.5% Chebyshev(Mean, Sd) UCL				764.3	99% Chebyshev(Mean, Sd) UCL					870.1		
855													
856	Suggested UCL to Use												
857	95% Student's-t UCL				635.7	or 95% Modified-t UCL					639.4		
858													
859	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
860	Recommendations are based upon data size, data distribution, and skewness.												
861	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
862	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
863													
864													
865	Hg												
866													
867	General Statistics												
868	Total Number of Observations				24	Number of Distinct Observations					10		
869						Number of Missing Observations					0		
870	Minimum				0.0025	Mean					0.0619		
871	Maximum				0.444	Median					0.025		
872	SD				0.0968	Std. Error of Mean					0.0198		
873	Coefficient of Variation				1.563	Skewness					3.155		
874													
875	Normal GOF Test												
876	Shapiro Wilk Test Statistic				0.513	Shapiro Wilk GOF Test							
877	5% Shapiro Wilk Critical Value				0.916	Data Not Normal at 5% Significance Level							
878	Lilliefors Test Statistic				0.405	Lilliefors GOF Test							
879	5% Lilliefors Critical Value				0.177	Data Not Normal at 5% Significance Level							
880	Data Not Normal at 5% Significance Level												
881													
882	Assuming Normal Distribution												
883	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
884	95% Student's-t UCL				0.0958	95% Adjusted-CLT UCL (Chen-1995)					0.108		

	A	B	C	D	E	F	G	H	I	J	K	L
885							95% Modified-t UCL (Johnson-1978)					0.0979
886												
887	Gamma GOF Test											
888	A-D Test Statistic					3.691	Anderson-Darling Gamma GOF Test					
889	5% A-D Critical Value					0.774	Data Not Gamma Distributed at 5% Significance Level					
890	K-S Test Statistic					0.379	Kolmogorov-Smirnov Gamma GOF Test					
891	5% K-S Critical Value					0.183	Data Not Gamma Distributed at 5% Significance Level					
892	Data Not Gamma Distributed at 5% Significance Level											
893												
894	Gamma Statistics											
895	k hat (MLE)					0.955	k star (bias corrected MLE)					0.863
896	Theta hat (MLE)					0.0649	Theta star (bias corrected MLE)					0.0717
897	nu hat (MLE)					45.82	nu star (bias corrected)					41.43
898	MLE Mean (bias corrected)					0.0619	MLE Sd (bias corrected)					0.0666
899							Approximate Chi Square Value (0.05)					27.68
900	Adjusted Level of Significance					0.0392	Adjusted Chi Square Value					26.88
901												
902	Assuming Gamma Distribution											
903	95% Approximate Gamma UCL (use when n>=50))					0.0927	95% Adjusted Gamma UCL (use when n<50)					0.0954
904												
905	Lognormal GOF Test											
906	Shapiro Wilk Test Statistic					0.765	Shapiro Wilk Lognormal GOF Test					
907	5% Shapiro Wilk Critical Value					0.916	Data Not Lognormal at 5% Significance Level					
908	Lilliefors Test Statistic					0.325	Lilliefors Lognormal GOF Test					
909	5% Lilliefors Critical Value					0.177	Data Not Lognormal at 5% Significance Level					
910	Data Not Lognormal at 5% Significance Level											
911												
912	Lognormal Statistics											
913	Minimum of Logged Data					-5.991	Mean of logged Data					-3.39
914	Maximum of Logged Data					-0.812	SD of logged Data					1.022
915												
916	Assuming Lognormal Distribution											
917	95% H-UCL					0.0982	90% Chebyshev (MVUE) UCL					0.0942
918	95% Chebyshev (MVUE) UCL					0.112	97.5% Chebyshev (MVUE) UCL					0.137
919	99% Chebyshev (MVUE) UCL					0.185						
920												
921	Nonparametric Distribution Free UCL Statistics											
922	Data do not follow a Discernible Distribution (0.05)											
923												
924	Nonparametric Distribution Free UCLs											
925	95% CLT UCL					0.0944	95% Jackknife UCL					0.0958
926	95% Standard Bootstrap UCL					0.0934	95% Bootstrap-t UCL					0.137
927	95% Hall's Bootstrap UCL					0.188	95% Percentile Bootstrap UCL					0.0967
928	95% BCA Bootstrap UCL					0.111						
929	90% Chebyshev(Mean, Sd) UCL					0.121	95% Chebyshev(Mean, Sd) UCL					0.148
930	97.5% Chebyshev(Mean, Sd) UCL					0.185	99% Chebyshev(Mean, Sd) UCL					0.258
931												
932	Suggested UCL to Use											
933	95% Chebyshev (Mean, Sd) UCL					0.148						
934												
935	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
936	Recommendations are based upon data size, data distribution, and skewness.											

	A	B	C	D	E	F	G	H	I	J	K	L
937	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
938	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
939												
940												
941	Mo											
942												
943	General Statistics											
944	Total Number of Observations				24	Number of Distinct Observations				13		
945						Number of Missing Observations				0		
946	Minimum				0.05	Mean				2.549		
947	Maximum				10	Median				0.225		
948	SD				4.048	Std. Error of Mean				0.826		
949	Coefficient of Variation				1.588	Skewness				1.322		
950												
951	Normal GOF Test											
952	Shapiro Wilk Test Statistic				0.608	Shapiro Wilk GOF Test						
953	5% Shapiro Wilk Critical Value				0.916	Data Not Normal at 5% Significance Level						
954	Lilliefors Test Statistic				0.407	Lilliefors GOF Test						
955	5% Lilliefors Critical Value				0.177	Data Not Normal at 5% Significance Level						
956	Data Not Normal at 5% Significance Level											
957												
958	Assuming Normal Distribution											
959	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
960	95% Student's-t UCL				3.965	95% Adjusted-CLT UCL (Chen-1995)				4.146		
961						95% Modified-t UCL (Johnson-1978)				4.002		
962												
963	Gamma GOF Test											
964	A-D Test Statistic				2.582	Anderson-Darling Gamma GOF Test						
965	5% A-D Critical Value				0.831	Data Not Gamma Distributed at 5% Significance Level						
966	K-S Test Statistic				0.322	Kolmogorov-Smirnov Gamma GOF Test						
967	5% K-S Critical Value				0.191	Data Not Gamma Distributed at 5% Significance Level						
968	Data Not Gamma Distributed at 5% Significance Level											
969												
970	Gamma Statistics											
971	k hat (MLE)				0.389	k star (bias corrected MLE)				0.368		
972	Theta hat (MLE)				6.548	Theta star (bias corrected MLE)				6.919		
973	nu hat (MLE)				18.68	nu star (bias corrected)				17.68		
974	MLE Mean (bias corrected)				2.549	MLE Sd (bias corrected)				4.2		
975						Approximate Chi Square Value (0.05)				9.161		
976	Adjusted Level of Significance				0.0392	Adjusted Chi Square Value				8.731		
977												
978	Assuming Gamma Distribution											
979	95% Approximate Gamma UCL (use when n>=50))				4.92	95% Adjusted Gamma UCL (use when n<50)				5.162		
980												
981	Lognormal GOF Test											
982	Shapiro Wilk Test Statistic				0.827	Shapiro Wilk Lognormal GOF Test						
983	5% Shapiro Wilk Critical Value				0.916	Data Not Lognormal at 5% Significance Level						
984	Lilliefors Test Statistic				0.228	Lilliefors Lognormal GOF Test						
985	5% Lilliefors Critical Value				0.177	Data Not Lognormal at 5% Significance Level						
986	Data Not Lognormal at 5% Significance Level											
987												
988	Lognormal Statistics											

	A	B	C	D	E	F	G	H	I	J	K	L
989	Minimum of Logged Data					-2.996	Mean of logged Data					-0.762
990	Maximum of Logged Data					2.303	SD of logged Data					1.961
991												
992	Assuming Lognormal Distribution											
993	95% H-UCL					16.51	90% Chebyshev (MVUE) UCL					6.656
994	95% Chebyshev (MVUE) UCL					8.483	97.5% Chebyshev (MVUE) UCL					11.02
995	99% Chebyshev (MVUE) UCL					16						
996												
997	Nonparametric Distribution Free UCL Statistics											
998	Data do not follow a Discernible Distribution (0.05)											
999												
1000	Nonparametric Distribution Free UCLs											
1001	95% CLT UCL					3.908	95% Jackknife UCL					3.965
1002	95% Standard Bootstrap UCL					3.899	95% Bootstrap-t UCL					4.298
1003	95% Hall's Bootstrap UCL					3.847	95% Percentile Bootstrap UCL					3.926
1004	95% BCA Bootstrap UCL					4.109						
1005	90% Chebyshev(Mean, Sd) UCL					5.028	95% Chebyshev(Mean, Sd) UCL					6.151
1006	97.5% Chebyshev(Mean, Sd) UCL					7.709	99% Chebyshev(Mean, Sd) UCL					10.77
1007												
1008	Suggested UCL to Use											
1009	95% Chebyshev (Mean, Sd) UCL					6.151						
1010												
1011	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1012	Recommendations are based upon data size, data distribution, and skewness.											
1013	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1014	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1015												
1016												
1017	Ni											
1018												
1019		General Statistics										
1020	Total Number of Observations					24	Number of Distinct Observations					24
1021							Number of Missing Observations					0
1022	Minimum					1150	Mean					1920
1023	Maximum					2300	Median					1966
1024	SD					264	Std. Error of Mean					53.89
1025	Coefficient of Variation					0.137	Skewness					-1.065
1026												
1027	Normal GOF Test											
1028	Shapiro Wilk Test Statistic					0.927	Shapiro Wilk GOF Test					
1029	5% Shapiro Wilk Critical Value					0.916	Data appear Normal at 5% Significance Level					
1030	Lilliefors Test Statistic					0.129	Lilliefors GOF Test					
1031	5% Lilliefors Critical Value					0.177	Data appear Normal at 5% Significance Level					
1032	Data appear Normal at 5% Significance Level											
1033												
1034	Assuming Normal Distribution											
1035	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1036	95% Student's-t UCL					2013	95% Adjusted-CLT UCL (Chen-1995)					1996
1037							95% Modified-t UCL (Johnson-1978)					2011
1038												
1039	Gamma GOF Test											
1040	A-D Test Statistic					0.658	Anderson-Darling Gamma GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
1041	5% A-D Critical Value					0.742	Detected data appear Gamma Distributed at 5% Significance Level						
1042	K-S Test Statistic					0.132	Kolmogorov-Smirnov Gamma GOF Test						
1043	5% K-S Critical Value					0.177	Detected data appear Gamma Distributed at 5% Significance Level						
1044	Detected data appear Gamma Distributed at 5% Significance Level												
1045													
1046	Gamma Statistics												
1047	k hat (MLE)					48.58	k star (bias corrected MLE)					42.53	
1048	Theta hat (MLE)					39.53	Theta star (bias corrected MLE)					45.15	
1049	nu hat (MLE)					2332	nu star (bias corrected)					2042	
1050	MLE Mean (bias corrected)					1920	MLE Sd (bias corrected)					294.4	
1051							Approximate Chi Square Value (0.05)					1938	
1052	Adjusted Level of Significance					0.0392	Adjusted Chi Square Value					1930	
1053													
1054	Assuming Gamma Distribution												
1055	95% Approximate Gamma UCL (use when n>=50))					2023	95% Adjusted Gamma UCL (use when n<50)					2031	
1056													
1057	Lognormal GOF Test												
1058	Shapiro Wilk Test Statistic					0.87	Shapiro Wilk Lognormal GOF Test						
1059	5% Shapiro Wilk Critical Value					0.916	Data Not Lognormal at 5% Significance Level						
1060	Lilliefors Test Statistic					0.129	Lilliefors Lognormal GOF Test						
1061	5% Lilliefors Critical Value					0.177	Data appear Lognormal at 5% Significance Level						
1062	Data appear Approximate Lognormal at 5% Significance Level												
1063													
1064	Lognormal Statistics												
1065	Minimum of Logged Data					7.048	Mean of logged Data					7.55	
1066	Maximum of Logged Data					7.741	SD of logged Data					0.152	
1067													
1068	Assuming Lognormal Distribution												
1069	95% H-UCL					2032	90% Chebyshev (MVUE) UCL					2102	
1070	95% Chebyshev (MVUE) UCL					2183	97.5% Chebyshev (MVUE) UCL					2296	
1071	99% Chebyshev (MVUE) UCL					2518							
1072													
1073	Nonparametric Distribution Free UCL Statistics												
1074	Data appear to follow a Discernible Distribution at 5% Significance Level												
1075													
1076	Nonparametric Distribution Free UCLs												
1077	95% CLT UCL					2009	95% Jackknife UCL					2013	
1078	95% Standard Bootstrap UCL					2004	95% Bootstrap-t UCL					2006	
1079	95% Hall's Bootstrap UCL					2001	95% Percentile Bootstrap UCL					2004	
1080	95% BCA Bootstrap UCL					1997							
1081	90% Chebyshev(Mean, Sd) UCL					2082	95% Chebyshev(Mean, Sd) UCL					2155	
1082	97.5% Chebyshev(Mean, Sd) UCL					2257	99% Chebyshev(Mean, Sd) UCL					2456	
1083													
1084	Suggested UCL to Use												
1085	95% Student's-t UCL					2013							
1086													
1087	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1088	Recommendations are based upon data size, data distribution, and skewness.												
1089	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1090	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
1091													
1092	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												

	A	B	C	D	E	F	G	H	I	J	K	L	
1093	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												
1094													
1095													
1096	Se												
1097													
1098		General Statistics											
1099	Total Number of Observations				24		Number of Distinct Observations				4		
1100							Number of Missing Observations				0		
1101	Minimum				0.05		Mean				0.236		
1102	Maximum				3.5		Median				0.1		
1103	SD				0.696		Std. Error of Mean				0.142		
1104	Coefficient of Variation				2.945		Skewness				4.88		
1105													
1106	Normal GOF Test												
1107	Shapiro Wilk Test Statistic				0.24		Shapiro Wilk GOF Test						
1108	5% Shapiro Wilk Critical Value				0.916		Data Not Normal at 5% Significance Level						
1109	Lilliefors Test Statistic				0.494		Lilliefors GOF Test						
1110	5% Lilliefors Critical Value				0.177		Data Not Normal at 5% Significance Level						
1111	Data Not Normal at 5% Significance Level												
1112													
1113	Assuming Normal Distribution												
1114	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
1115	95% Student's-t UCL			0.48		95% Adjusted-CLT UCL (Chen-1995)					0.621		
1116						95% Modified-t UCL (Johnson-1978)					0.503		
1117													
1118	Gamma GOF Test												
1119	A-D Test Statistic			6.511		Anderson-Darling Gamma GOF Test							
1120	5% A-D Critical Value			0.784		Data Not Gamma Distributed at 5% Significance Level							
1121	K-S Test Statistic			0.508		Kolmogorov-Smirnov Gamma GOF Test							
1122	5% K-S Critical Value			0.185		Data Not Gamma Distributed at 5% Significance Level							
1123	Data Not Gamma Distributed at 5% Significance Level												
1124													
1125	Gamma Statistics												
1126	k hat (MLE)			0.73		k star (bias corrected MLE)					0.667		
1127	Theta hat (MLE)			0.324		Theta star (bias corrected MLE)					0.355		
1128	nu hat (MLE)			35.04		nu star (bias corrected)					31.99		
1129	MLE Mean (bias corrected)			0.236		MLE Sd (bias corrected)					0.289		
1130						Approximate Chi Square Value (0.05)					20.07		
1131	Adjusted Level of Significance			0.0392		Adjusted Chi Square Value					19.4		
1132													
1133	Assuming Gamma Distribution												
1134	95% Approximate Gamma UCL (use when n>=50))				0.377		95% Adjusted Gamma UCL (use when n<50)					0.39	
1135													
1136	Lognormal GOF Test												
1137	Shapiro Wilk Test Statistic			0.509		Shapiro Wilk Lognormal GOF Test							
1138	5% Shapiro Wilk Critical Value			0.916		Data Not Lognormal at 5% Significance Level							
1139	Lilliefors Test Statistic			0.435		Lilliefors Lognormal GOF Test							
1140	5% Lilliefors Critical Value			0.177		Data Not Lognormal at 5% Significance Level							
1141	Data Not Lognormal at 5% Significance Level												
1142													
1143	Lognormal Statistics												
1144	Minimum of Logged Data			-2.996		Mean of logged Data					-2.266		

	A	B	C	D	E	F	G	H	I	J	K	L
1145	Maximum of Logged Data					1.253	SD of logged Data					0.825
1146												
1147	Assuming Lognormal Distribution											
1148	95% H-UCL				0.217	90% Chebyshev (MVUE) UCL					0.223	
1149	95% Chebyshev (MVUE) UCL				0.259	97.5% Chebyshev (MVUE) UCL					0.308	
1150	99% Chebyshev (MVUE) UCL				0.407							
1151												
1152	Nonparametric Distribution Free UCL Statistics											
1153	Data do not follow a Discernible Distribution (0.05)											
1154												
1155	Nonparametric Distribution Free UCLs											
1156	95% CLT UCL				0.47	95% Jackknife UCL					0.48	
1157	95% Standard Bootstrap UCL				N/A	95% Bootstrap-t UCL					N/A	
1158	95% Hall's Bootstrap UCL				N/A	95% Percentile Bootstrap UCL					N/A	
1159	95% BCA Bootstrap UCL				N/A							
1160	90% Chebyshev(Mean, Sd) UCL				0.663	95% Chebyshev(Mean, Sd) UCL					0.856	
1161	97.5% Chebyshev(Mean, Sd) UCL				1.124	99% Chebyshev(Mean, Sd) UCL					1.65	
1162												
1163	Suggested UCL to Use											
1164	95% Chebyshev (Mean, Sd) UCL				0.856							
1165												
1166	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1167	Recommendations are based upon data size, data distribution, and skewness.											
1168	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1169	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1170												
1171												
1172	V											
1173												
1174		General Statistics										
1175	Total Number of Observations				24	Number of Distinct Observations					23	
1176						Number of Missing Observations					0	
1177	Minimum				8	Mean					25.77	
1178	Maximum				35.83	Median					26.61	
1179	SD				7.065	Std. Error of Mean					1.442	
1180	Coefficient of Variation				0.274	Skewness					-0.882	
1181												
1182	Normal GOF Test											
1183	Shapiro Wilk Test Statistic				0.939	Shapiro Wilk GOF Test						
1184	5% Shapiro Wilk Critical Value				0.916	Data appear Normal at 5% Significance Level						
1185	Lilliefors Test Statistic				0.0921	Lilliefors GOF Test						
1186	5% Lilliefors Critical Value				0.177	Data appear Normal at 5% Significance Level						
1187	Data appear Normal at 5% Significance Level											
1188												
1189	Assuming Normal Distribution											
1190	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1191	95% Student's-t UCL				28.24	95% Adjusted-CLT UCL (Chen-1995)					27.87	
1192						95% Modified-t UCL (Johnson-1978)					28.2	
1193												
1194	Gamma GOF Test											
1195	A-D Test Statistic				0.918	Anderson-Darling Gamma GOF Test						
1196	5% A-D Critical Value				0.744	Data Not Gamma Distributed at 5% Significance Level						

	A	B	C	D	E	F	G	H	I	J	K	L	
1197	K-S Test Statistic					0.138	Kolmogorov-Smirnov Gamma GOF Test						
1198	5% K-S Critical Value					0.178	Detected data appear Gamma Distributed at 5% Significance Level						
1199	Detected data follow Appr. Gamma Distribution at 5% Significance Level												
1200													
1201	Gamma Statistics												
1202	k hat (MLE)					10.22	k star (bias corrected MLE)					8.974	
1203	Theta hat (MLE)					2.521	Theta star (bias corrected MLE)					2.872	
1204	nu hat (MLE)					490.8	nu star (bias corrected)					430.8	
1205	MLE Mean (bias corrected)					25.77	MLE Sd (bias corrected)					8.603	
1206							Approximate Chi Square Value (0.05)					383.6	
1207	Adjusted Level of Significance					0.0392	Adjusted Chi Square Value					380.5	
1208													
1209	Assuming Gamma Distribution												
1210	95% Approximate Gamma UCL (use when n>=50))					28.94	95% Adjusted Gamma UCL (use when n<50)					29.17	
1211													
1212	Lognormal GOF Test												
1213	Shapiro Wilk Test Statistic					0.817	Shapiro Wilk Lognormal GOF Test						
1214	5% Shapiro Wilk Critical Value					0.916	Data Not Lognormal at 5% Significance Level						
1215	Lilliefors Test Statistic					0.16	Lilliefors Lognormal GOF Test						
1216	5% Lilliefors Critical Value					0.177	Data appear Lognormal at 5% Significance Level						
1217	Data appear Approximate Lognormal at 5% Significance Level												
1218													
1219	Lognormal Statistics												
1220	Minimum of Logged Data					2.079	Mean of logged Data					3.2	
1221	Maximum of Logged Data					3.579	SD of logged Data					0.354	
1222													
1223	Assuming Lognormal Distribution												
1224	95% H-UCL					29.96	90% Chebyshev (MVUE) UCL					31.8	
1225	95% Chebyshev (MVUE) UCL					34.42	97.5% Chebyshev (MVUE) UCL					38.04	
1226	99% Chebyshev (MVUE) UCL					45.16							
1227													
1228	Nonparametric Distribution Free UCL Statistics												
1229	Data appear to follow a Discernible Distribution at 5% Significance Level												
1230													
1231	Nonparametric Distribution Free UCLs												
1232	95% CLT UCL					28.14	95% Jackknife UCL					28.24	
1233	95% Standard Bootstrap UCL					28.05	95% Bootstrap-t UCL					27.99	
1234	95% Hall's Bootstrap UCL					27.92	95% Percentile Bootstrap UCL					28.12	
1235	95% BCA Bootstrap UCL					27.84							
1236	90% Chebyshev(Mean, Sd) UCL					30.1	95% Chebyshev(Mean, Sd) UCL					32.06	
1237	97.5% Chebyshev(Mean, Sd) UCL					34.78	99% Chebyshev(Mean, Sd) UCL					40.12	
1238													
1239	Suggested UCL to Use												
1240	95% Student's-t UCL					28.24							
1241													
1242	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1243	Recommendations are based upon data size, data distribution, and skewness.												
1244	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1245	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
1246													
1247	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												
1248	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												

	A	B	C	D	E	F	G	H	I	J	K	L
1249												
1250												
1251	Zn											
1252												
1253		General Statistics										
1254		Total Number of Observations					24	Number of Distinct Observations				
1255							Number of Missing Observations					0
1256	Minimum					7.8	Mean					17.76
1257	Maximum					133	Median					12.57
1258	SD					24.91	Std. Error of Mean					5.084
1259	Coefficient of Variation					1.403	Skewness					4.685
1260												
1261	Normal GOF Test											
1262	Shapiro Wilk Test Statistic					0.324	Shapiro Wilk GOF Test					
1263	5% Shapiro Wilk Critical Value					0.916	Data Not Normal at 5% Significance Level					
1264	Lilliefors Test Statistic					0.446	Lilliefors GOF Test					
1265	5% Lilliefors Critical Value					0.177	Data Not Normal at 5% Significance Level					
1266	Data Not Normal at 5% Significance Level											
1267												
1268	Assuming Normal Distribution											
1269	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1270	95% Student's-t UCL					26.47	95% Adjusted-CLT UCL (Chen-1995)					31.32
1271							95% Modified-t UCL (Johnson-1978)					27.28
1272												
1273	Gamma GOF Test											
1274	A-D Test Statistic					4.412	Anderson-Darling Gamma GOF Test					
1275	5% A-D Critical Value					0.755	Data Not Gamma Distributed at 5% Significance Level					
1276	K-S Test Statistic					0.381	Kolmogorov-Smirnov Gamma GOF Test					
1277	5% K-S Critical Value					0.18	Data Not Gamma Distributed at 5% Significance Level					
1278	Data Not Gamma Distributed at 5% Significance Level											
1279												
1280	Gamma Statistics											
1281	k hat (MLE)					1.992	k star (bias corrected MLE)					1.77
1282	Theta hat (MLE)					8.917	Theta star (bias corrected MLE)					10.03
1283	nu hat (MLE)					95.59	nu star (bias corrected)					84.98
1284	MLE Mean (bias corrected)					17.76	MLE Sd (bias corrected)					13.35
1285							Approximate Chi Square Value (0.05)					64.73
1286	Adjusted Level of Significance					0.0392	Adjusted Chi Square Value					63.49
1287												
1288	Assuming Gamma Distribution											
1289	95% Approximate Gamma UCL (use when n>=50))					23.31	95% Adjusted Gamma UCL (use when n<50)					23.77
1290												
1291	Lognormal GOF Test											
1292	Shapiro Wilk Test Statistic					0.618	Shapiro Wilk Lognormal GOF Test					
1293	5% Shapiro Wilk Critical Value					0.916	Data Not Lognormal at 5% Significance Level					
1294	Lilliefors Test Statistic					0.309	Lilliefors Lognormal GOF Test					
1295	5% Lilliefors Critical Value					0.177	Data Not Lognormal at 5% Significance Level					
1296	Data Not Lognormal at 5% Significance Level											
1297												
1298	Lognormal Statistics											
1299	Minimum of Logged Data					2.054	Mean of logged Data					2.605
1300	Maximum of Logged Data					4.89	SD of logged Data					0.553

	A	B	C	D	E	F	G	H	I	J	K	L
1301												
1302	Assuming Lognormal Distribution											
1303	95% H-UCL					19.93	90% Chebyshev (MVUE) UCL					21.22
1304	95% Chebyshev (MVUE) UCL					23.74	97.5% Chebyshev (MVUE) UCL					27.24
1305	99% Chebyshev (MVUE) UCL					34.11						
1306												
1307	Nonparametric Distribution Free UCL Statistics											
1308	Data do not follow a Discernible Distribution (0.05)											
1309												
1310	Nonparametric Distribution Free UCLs											
1311	95% CLT UCL					26.12	95% Jackknife UCL					26.47
1312	95% Standard Bootstrap UCL					25.91	95% Bootstrap-t UCL					89.13
1313	95% Hall's Bootstrap UCL					72.73	95% Percentile Bootstrap UCL					27.58
1314	95% BCA Bootstrap UCL					33.64						
1315	90% Chebyshev(Mean, Sd) UCL					33.01	95% Chebyshev(Mean, Sd) UCL					39.92
1316	97.5% Chebyshev(Mean, Sd) UCL					49.51	99% Chebyshev(Mean, Sd) UCL					68.35
1317												
1318	Suggested UCL to Use											
1319	95% Chebyshev (Mean, Sd) UCL					39.92						
1320												
1321	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1322	Recommendations are based upon data size, data distribution, and skewness.											
1323	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1324	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1325												
1326												
1327	Zr											
1328												
1329	General Statistics											
1330	Total Number of Observations					17	Number of Distinct Observations					1
1331							Number of Missing Observations					0
1332	Minimum					0.5	Mean					0.5
1333	Maximum					0.5	Median					0.5
1334												
1335	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
1336	ProUCL (or any other software) should not be used on such a data set!											
1337	The data set for variable Zr was not processed!											
1338												
1339	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
1340	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
1341												
1342												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Waste Rock											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.130/01/2019 1:03:07 PM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	AI											
12												
13	General Statistics											
14	Total Number of Observations				33		Number of Distinct Observations				32	
15							Number of Missing Observations				0	
16	Minimum				1713		Mean				8233	
17	Maximum				21271		Median				7262	
18	SD				5252		Std. Error of Mean				914.3	
19	Coefficient of Variation				0.638		Skewness				1.015	
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic				0.901		Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value				0.931		Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic				0.137		Lilliefors GOF Test					
25	5% Lilliefors Critical Value				0.152		Data appear Normal at 5% Significance Level					
26	Data appear Approximate Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL				9782		95% Adjusted-CLT UCL (Chen-1995)				9910	
31							95% Modified-t UCL (Johnson-1978)				9809	
32												
33	Gamma GOF Test											
34	A-D Test Statistic				0.199		Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value				0.755		Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic				0.0783		Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value				0.155		Detected data appear Gamma Distributed at 5% Significance Level					
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)				2.616		k star (bias corrected MLE)				2.398	
42	Theta hat (MLE)				3147		Theta star (bias corrected MLE)				3433	
43	nu hat (MLE)				172.6		nu star (bias corrected)				158.3	
44	MLE Mean (bias corrected)				8233		MLE Sd (bias corrected)				5316	
45							Approximate Chi Square Value (0.05)				130.2	
46	Adjusted Level of Significance				0.0419		Adjusted Chi Square Value				128.9	
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))				10009		95% Adjusted Gamma UCL (use when n<50)				10111	
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic				0.973		Shapiro Wilk Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
53	5% Shapiro Wilk Critical Value					0.931	Data appear Lognormal at 5% Significance Level						
54	Lilliefors Test Statistic					0.0866	Lilliefors Lognormal GOF Test						
55	5% Lilliefors Critical Value					0.152	Data appear Lognormal at 5% Significance Level						
56	Data appear Lognormal at 5% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data					7.446	Mean of logged Data					8.813	
60	Maximum of Logged Data					9.965	SD of logged Data					0.669	
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL					10750	90% Chebyshev (MVUE) UCL					11474	
64	95% Chebyshev (MVUE) UCL					12895	97.5% Chebyshev (MVUE) UCL					14868	
65	99% Chebyshev (MVUE) UCL					18743							
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data appear to follow a Discernible Distribution at 5% Significance Level												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL					9737	95% Jackknife UCL					9782	
72	95% Standard Bootstrap UCL					9729	95% Bootstrap-t UCL					9963	
73	95% Hall's Bootstrap UCL					9910	95% Percentile Bootstrap UCL					9760	
74	95% BCA Bootstrap UCL					9922							
75	90% Chebyshev(Mean, Sd) UCL					10976	95% Chebyshev(Mean, Sd) UCL					12219	
76	97.5% Chebyshev(Mean, Sd) UCL					13943	99% Chebyshev(Mean, Sd) UCL					17331	
77													
78	Suggested UCL to Use												
79	95% Student's-t UCL					9782							
80													
81	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test												
82	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL												
83													
84	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
85	Recommendations are based upon data size, data distribution, and skewness.												
86	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
87	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
88													
89													
90	Sb												
91													
92	General Statistics												
93	Total Number of Observations					40	Number of Distinct Observations					27	
94							Number of Missing Observations					0	
95	Minimum					1	Mean					8.92	
96	Maximum					50	Median					3.45	
97	SD					13.01	Std. Error of Mean					2.057	
98	Coefficient of Variation					1.459	Skewness					2.401	
99													
100	Normal GOF Test												
101	Shapiro Wilk Test Statistic					0.577	Shapiro Wilk GOF Test						
102	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level						
103	Lilliefors Test Statistic					0.317	Lilliefors GOF Test						
104	5% Lilliefors Critical Value					0.139	Data Not Normal at 5% Significance Level						

	A	B	C	D	E	F	G	H	I	J	K	L
105	Data Not Normal at 5% Significance Level											
106												
107	Assuming Normal Distribution											
108	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
109	95% Student's-t UCL				12.39		95% Adjusted-CLT UCL (Chen-1995)					13.14
110							95% Modified-t UCL (Johnson-1978)					12.52
111												
112	Gamma GOF Test											
113	A-D Test Statistic				3.411		Anderson-Darling Gamma GOF Test					
114	5% A-D Critical Value				0.781		Data Not Gamma Distributed at 5% Significance Level					
115	K-S Test Statistic				0.235		Kolmogorov-Smirnov Gamma GOF Test					
116	5% K-S Critical Value				0.144		Data Not Gamma Distributed at 5% Significance Level					
117	Data Not Gamma Distributed at 5% Significance Level											
118												
119	Gamma Statistics											
120	k hat (MLE)				0.937		k star (bias corrected MLE)					0.883
121	Theta hat (MLE)				9.522		Theta star (bias corrected MLE)					10.1
122	nu hat (MLE)				74.95		nu star (bias corrected)					70.66
123	MLE Mean (bias corrected)				8.92		MLE Sd (bias corrected)					9.491
124							Approximate Chi Square Value (0.05)					52.31
125	Adjusted Level of Significance				0.044		Adjusted Chi Square Value					51.71
126												
127	Assuming Gamma Distribution											
128	95% Approximate Gamma UCL (use when n>=50))				12.05		95% Adjusted Gamma UCL (use when n<50)					12.19
129												
130	Lognormal GOF Test											
131	Shapiro Wilk Test Statistic				0.88		Shapiro Wilk Lognormal GOF Test					
132	5% Shapiro Wilk Critical Value				0.94		Data Not Lognormal at 5% Significance Level					
133	Lilliefors Test Statistic				0.166		Lilliefors Lognormal GOF Test					
134	5% Lilliefors Critical Value				0.139		Data Not Lognormal at 5% Significance Level					
135	Data Not Lognormal at 5% Significance Level											
136												
137	Lognormal Statistics											
138	Minimum of Logged Data				0		Mean of logged Data					1.567
139	Maximum of Logged Data				3.912		SD of logged Data					1.006
140												
141	Assuming Lognormal Distribution											
142	95% H-UCL				11.72		90% Chebyshev (MVUE) UCL					12.15
143	95% Chebyshev (MVUE) UCL				14.11		97.5% Chebyshev (MVUE) UCL					16.85
144	99% Chebyshev (MVUE) UCL				22.21							
145												
146	Nonparametric Distribution Free UCL Statistics											
147	Data do not follow a Discernible Distribution (0.05)											
148												
149	Nonparametric Distribution Free UCLs											
150	95% CLT UCL				12.3		95% Jackknife UCL					12.39
151	95% Standard Bootstrap UCL				12.31		95% Bootstrap-t UCL					14.07
152	95% Hall's Bootstrap UCL				12.42		95% Percentile Bootstrap UCL					12.44
153	95% BCA Bootstrap UCL				13.18							
154	90% Chebyshev(Mean, Sd) UCL				15.09		95% Chebyshev(Mean, Sd) UCL					17.89
155	97.5% Chebyshev(Mean, Sd) UCL				21.77		99% Chebyshev(Mean, Sd) UCL					29.39
156												

	A	B	C	D	E	F	G	H	I	J	K	L
157	Suggested UCL to Use											
158	95% Chebyshev (Mean, Sd) UCL					17.89						
159												
160	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
161	Recommendations are based upon data size, data distribution, and skewness.											
162	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
163	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
164												
165												
166	As											
167												
168	General Statistics											
169	Total Number of Observations					40	Number of Distinct Observations					38
170							Number of Missing Observations					0
171	Minimum					8.8	Mean					23.12
172	Maximum					108	Median					15.75
173	SD					21.28	Std. Error of Mean					3.365
174	Coefficient of Variation					0.921	Skewness					3.254
175												
176	Normal GOF Test											
177	Shapiro Wilk Test Statistic					0.557	Shapiro Wilk GOF Test					
178	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level					
179	Lilliefors Test Statistic					0.278	Lilliefors GOF Test					
180	5% Lilliefors Critical Value					0.139	Data Not Normal at 5% Significance Level					
181	Data Not Normal at 5% Significance Level											
182												
183	Assuming Normal Distribution											
184	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
185	95% Student's-t UCL					28.79	95% Adjusted-CLT UCL (Chen-1995)					30.5
186							95% Modified-t UCL (Johnson-1978)					29.08
187												
188	Gamma GOF Test											
189	A-D Test Statistic					3.407	Anderson-Darling Gamma GOF Test					
190	5% A-D Critical Value					0.757	Data Not Gamma Distributed at 5% Significance Level					
191	K-S Test Statistic					0.243	Kolmogorov-Smirnov Gamma GOF Test					
192	5% K-S Critical Value					0.141	Data Not Gamma Distributed at 5% Significance Level					
193	Data Not Gamma Distributed at 5% Significance Level											
194												
195	Gamma Statistics											
196	k hat (MLE)					2.571	k star (bias corrected MLE)					2.395
197	Theta hat (MLE)					8.992	Theta star (bias corrected MLE)					9.653
198	nu hat (MLE)					205.7	nu star (bias corrected)					191.6
199	MLE Mean (bias corrected)					23.12	MLE Sd (bias corrected)					14.94
200							Approximate Chi Square Value (0.05)					160.6
201	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					159.5
202												
203	Assuming Gamma Distribution											
204	95% Approximate Gamma UCL (use when n>=50))					27.58	95% Adjusted Gamma UCL (use when n<50)					27.77
205												
206	Lognormal GOF Test											
207	Shapiro Wilk Test Statistic					0.835	Shapiro Wilk Lognormal GOF Test					
208	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
209	Lilliefors Test Statistic					0.206	Lilliefors Lognormal GOF Test						
210	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level						
211	Data Not Lognormal at 5% Significance Level												
212													
213	Lognormal Statistics												
214	Minimum of Logged Data					2.175	Mean of logged Data					2.934	
215	Maximum of Logged Data					4.682	SD of logged Data					0.561	
216													
217	Assuming Lognormal Distribution												
218	95% H-UCL					26.26	90% Chebyshev (MVUE) UCL					28.08	
219	95% Chebyshev (MVUE) UCL					30.88	97.5% Chebyshev (MVUE) UCL					34.77	
220	99% Chebyshev (MVUE) UCL					42.4							
221													
222	Nonparametric Distribution Free UCL Statistics												
223	Data do not follow a Discernible Distribution (0.05)												
224													
225	Nonparametric Distribution Free UCLs												
226	95% CLT UCL					28.65	95% Jackknife UCL					28.79	
227	95% Standard Bootstrap UCL					28.56	95% Bootstrap-t UCL					35.82	
228	95% Hall's Bootstrap UCL					55.31	95% Percentile Bootstrap UCL					29.05	
229	95% BCA Bootstrap UCL					31.27							
230	90% Chebyshev(Mean, Sd) UCL					33.21	95% Chebyshev(Mean, Sd) UCL					37.79	
231	97.5% Chebyshev(Mean, Sd) UCL					44.13	99% Chebyshev(Mean, Sd) UCL					56.6	
232													
233	Suggested UCL to Use												
234	95% Chebyshev (Mean, Sd) UCL					37.79							
235													
236	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
237	Recommendations are based upon data size, data distribution, and skewness.												
238	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
239	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
240													
241													
242	Ba												
243													
244	General Statistics												
245	Total Number of Observations					40	Number of Distinct Observations					33	
246							Number of Missing Observations					0	
247	Minimum					10	Mean					148.6	
248	Maximum					1060	Median					88.5	
249	SD					181.7	Std. Error of Mean					28.74	
250	Coefficient of Variation					1.223	Skewness					3.598	
251													
252	Normal GOF Test												
253	Shapiro Wilk Test Statistic					0.618	Shapiro Wilk GOF Test						
254	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level						
255	Lilliefors Test Statistic					0.253	Lilliefors GOF Test						
256	5% Lilliefors Critical Value					0.139	Data Not Normal at 5% Significance Level						
257	Data Not Normal at 5% Significance Level												
258													
259	Assuming Normal Distribution												
260	95% Normal UCL						95% UCLs (Adjusted for Skewness)						

	A	B	C	D	E	F	G	H	I	J	K	L
261	95% Student's-t UCL					197	95% Adjusted-CLT UCL (Chen-1995)					213.3
262							95% Modified-t UCL (Johnson-1978)					199.7
263												
264	Gamma GOF Test											
265	A-D Test Statistic				1.296	Anderson-Darling Gamma GOF Test						
266	5% A-D Critical Value				0.77	Data Not Gamma Distributed at 5% Significance Level						
267	K-S Test Statistic				0.146	Kolmogorov-Smirnov Gamma GOF Test						
268	5% K-S Critical Value				0.143	Data Not Gamma Distributed at 5% Significance Level						
269	Data Not Gamma Distributed at 5% Significance Level											
270												
271	Gamma Statistics											
272	k hat (MLE)				1.34	k star (bias corrected MLE)						1.256
273	Theta hat (MLE)				110.9	Theta star (bias corrected MLE)						118.3
274	nu hat (MLE)				107.2	nu star (bias corrected)						100.5
275	MLE Mean (bias corrected)				148.6	MLE Sd (bias corrected)						132.6
276						Approximate Chi Square Value (0.05)						78.37
277	Adjusted Level of Significance				0.044	Adjusted Chi Square Value						77.64
278												
279	Assuming Gamma Distribution											
280	95% Approximate Gamma UCL (use when n>=50))				190.5	95% Adjusted Gamma UCL (use when n<50)					192.3	
281												
282	Lognormal GOF Test											
283	Shapiro Wilk Test Statistic				0.977	Shapiro Wilk Lognormal GOF Test						
284	5% Shapiro Wilk Critical Value				0.94	Data appear Lognormal at 5% Significance Level						
285	Lilliefors Test Statistic				0.104	Lilliefors Lognormal GOF Test						
286	5% Lilliefors Critical Value				0.139	Data appear Lognormal at 5% Significance Level						
287	Data appear Lognormal at 5% Significance Level											
288												
289	Lognormal Statistics											
290	Minimum of Logged Data				2.303	Mean of logged Data						4.584
291	Maximum of Logged Data				6.966	SD of logged Data						0.88
292												
293	Assuming Lognormal Distribution											
294	95% H-UCL				198.7	90% Chebyshev (MVUE) UCL					209.7	
295	95% Chebyshev (MVUE) UCL				240.3	97.5% Chebyshev (MVUE) UCL					282.6	
296	99% Chebyshev (MVUE) UCL				365.8							
297												
298	Nonparametric Distribution Free UCL Statistics											
299	Data appear to follow a Discernible Distribution at 5% Significance Level											
300												
301	Nonparametric Distribution Free UCLs											
302	95% CLT UCL				195.8	95% Jackknife UCL					197	
303	95% Standard Bootstrap UCL				195.1	95% Bootstrap-t UCL					233.3	
304	95% Hall's Bootstrap UCL				389.8	95% Percentile Bootstrap UCL					198.2	
305	95% BCA Bootstrap UCL				219							
306	90% Chebyshev(Mean, Sd) UCL				234.8	95% Chebyshev(Mean, Sd) UCL					273.8	
307	97.5% Chebyshev(Mean, Sd) UCL				328	99% Chebyshev(Mean, Sd) UCL					434.5	
308												
309	Suggested UCL to Use											
310	95% H-UCL				198.7							
311												
312	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

	A	B	C	D	E	F	G	H	I	J	K	L
313	Recommendations are based upon data size, data distribution, and skewness.											
314	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
315	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
316												
317	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.											
318	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.											
319	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.											
320	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.											
321												
322												
323	B											
324												
325	General Statistics											
326	Total Number of Observations				33	Number of Distinct Observations				11		
327						Number of Missing Observations				0		
328	Minimum				3	Mean				19.58		
329	Maximum				99	Median				3		
330	SD				29.02	Std. Error of Mean				5.051		
331	Coefficient of Variation				1.482	Skewness				1.705		
332												
333	Normal GOF Test											
334	Shapiro Wilk Test Statistic				0.637	Shapiro Wilk GOF Test						
335	5% Shapiro Wilk Critical Value				0.931	Data Not Normal at 5% Significance Level						
336	Lilliefors Test Statistic				0.383	Lilliefors GOF Test						
337	5% Lilliefors Critical Value				0.152	Data Not Normal at 5% Significance Level						
338	Data Not Normal at 5% Significance Level											
339												
340	Assuming Normal Distribution											
341	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
342	95% Student's-t UCL				28.13	95% Adjusted-CLT UCL (Chen-1995)				29.49		
343						95% Modified-t UCL (Johnson-1978)				28.38		
344												
345	Gamma GOF Test											
346	A-D Test Statistic				5.262	Anderson-Darling Gamma GOF Test						
347	5% A-D Critical Value				0.799	Data Not Gamma Distributed at 5% Significance Level						
348	K-S Test Statistic				0.419	Kolmogorov-Smirnov Gamma GOF Test						
349	5% K-S Critical Value				0.161	Data Not Gamma Distributed at 5% Significance Level						
350	Data Not Gamma Distributed at 5% Significance Level											
351												
352	Gamma Statistics											
353	k hat (MLE)				0.626	k star (bias corrected MLE)				0.589		
354	Theta hat (MLE)				31.26	Theta star (bias corrected MLE)				33.21		
355	nu hat (MLE)				41.33	nu star (bias corrected)				38.91		
356	MLE Mean (bias corrected)				19.58	MLE Sd (bias corrected)				25.5		
357						Approximate Chi Square Value (0.05)				25.62		
358	Adjusted Level of Significance				0.0419	Adjusted Chi Square Value				25.06		
359												
360	Assuming Gamma Distribution											
361	95% Approximate Gamma UCL (use when n>=50))				29.73	95% Adjusted Gamma UCL (use when n<50)				30.39		
362												
363	Lognormal GOF Test											
364	Shapiro Wilk Test Statistic				0.659	Shapiro Wilk Lognormal GOF Test						

	A	B	C	D	E	F	G	H	I	J	K	L	
365	5% Shapiro Wilk Critical Value					0.931	Data Not Lognormal at 5% Significance Level						
366	Lilliefors Test Statistic					0.414	Lilliefors Lognormal GOF Test						
367	5% Lilliefors Critical Value					0.152	Data Not Lognormal at 5% Significance Level						
368	Data Not Lognormal at 5% Significance Level												
369													
370	Lognormal Statistics												
371	Minimum of Logged Data					1.099	Mean of logged Data					1.994	
372	Maximum of Logged Data					4.595	SD of logged Data					1.341	
373													
374	Assuming Lognormal Distribution												
375	95% H-UCL					35.71	90% Chebyshev (MVUE) UCL					32.1	
376	95% Chebyshev (MVUE) UCL					38.86	97.5% Chebyshev (MVUE) UCL					48.23	
377	99% Chebyshev (MVUE) UCL					66.65							
378													
379	Nonparametric Distribution Free UCL Statistics												
380	Data do not follow a Discernible Distribution (0.05)												
381													
382	Nonparametric Distribution Free UCLs												
383	95% CLT UCL					27.88	95% Jackknife UCL					28.13	
384	95% Standard Bootstrap UCL					27.73	95% Bootstrap-t UCL					30.91	
385	95% Hall's Bootstrap UCL					28.71	95% Percentile Bootstrap UCL					27.73	
386	95% BCA Bootstrap UCL					29.73							
387	90% Chebyshev(Mean, Sd) UCL					34.73	95% Chebyshev(Mean, Sd) UCL					41.59	
388	97.5% Chebyshev(Mean, Sd) UCL					51.12	99% Chebyshev(Mean, Sd) UCL					69.84	
389													
390	Suggested UCL to Use												
391	95% Chebyshev (Mean, Sd) UCL					41.59							
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	Recommendations are based upon data size, data distribution, and skewness.												
395	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
396	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
397													
398													
399	Cd												
400													
401	General Statistics												
402	Total Number of Observations					40	Number of Distinct Observations					37	
403							Number of Missing Observations					0	
404	Minimum					0.05	Mean					1.769	
405	Maximum					5.75	Median					1.52	
406	SD					1.381	Std. Error of Mean					0.218	
407	Coefficient of Variation					0.78	Skewness					1.081	
408													
409	Normal GOF Test												
410	Shapiro Wilk Test Statistic					0.903	Shapiro Wilk GOF Test						
411	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level						
412	Lilliefors Test Statistic					0.116	Lilliefors GOF Test						
413	5% Lilliefors Critical Value					0.139	Data appear Normal at 5% Significance Level						
414	Data appear Approximate Normal at 5% Significance Level												
415													
416	Assuming Normal Distribution												

	A	B	C	D	E	F	G	H	I	J	K	L	
417	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
418	95% Student's-t UCL					2.137	95% Adjusted-CLT UCL (Chen-1995)						2.168
419							95% Modified-t UCL (Johnson-1978)						2.143
420													
421	Gamma GOF Test												
422	A-D Test Statistic					0.787	Anderson-Darling Gamma GOF Test						
423	5% A-D Critical Value					0.774	Data Not Gamma Distributed at 5% Significance Level						
424	K-S Test Statistic					0.125	Kolmogorov-Smirnov Gamma GOF Test						
425	5% K-S Critical Value					0.143	Detected data appear Gamma Distributed at 5% Significance Level						
426	Detected data follow Appr. Gamma Distribution at 5% Significance Level												
427													
428	Gamma Statistics												
429	k hat (MLE)					1.178	k star (bias corrected MLE)					1.106	
430	Theta hat (MLE)					1.502	Theta star (bias corrected MLE)					1.6	
431	nu hat (MLE)					94.2	nu star (bias corrected)					88.47	
432	MLE Mean (bias corrected)					1.769	MLE Sd (bias corrected)					1.682	
433							Approximate Chi Square Value (0.05)					67.79	
434	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					67.11	
435													
436	Assuming Gamma Distribution												
437	95% Approximate Gamma UCL (use when n>=50))					2.309	95% Adjusted Gamma UCL (use when n<50)					2.332	
438													
439	Lognormal GOF Test												
440	Shapiro Wilk Test Statistic					0.851	Shapiro Wilk Lognormal GOF Test						
441	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level						
442	Lilliefors Test Statistic					0.149	Lilliefors Lognormal GOF Test						
443	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level						
444	Data Not Lognormal at 5% Significance Level												
445													
446	Lognormal Statistics												
447	Minimum of Logged Data					-2.996	Mean of logged Data					0.0892	
448	Maximum of Logged Data					1.749	SD of logged Data					1.25	
449													
450	Assuming Lognormal Distribution												
451	95% H-UCL					4.11	90% Chebyshev (MVUE) UCL					4	
452	95% Chebyshev (MVUE) UCL					4.765	97.5% Chebyshev (MVUE) UCL					5.828	
453	99% Chebyshev (MVUE) UCL					7.915							
454													
455	Nonparametric Distribution Free UCL Statistics												
456	Data appear to follow a Discernible Distribution at 5% Significance Level												
457													
458	Nonparametric Distribution Free UCLs												
459	95% CLT UCL					2.128	95% Jackknife UCL					2.137	
460	95% Standard Bootstrap UCL					2.118	95% Bootstrap-t UCL					2.167	
461	95% Hall's Bootstrap UCL					2.207	95% Percentile Bootstrap UCL					2.144	
462	95% BCA Bootstrap UCL					2.169							
463	90% Chebyshev(Mean, Sd) UCL					2.424	95% Chebyshev(Mean, Sd) UCL					2.721	
464	97.5% Chebyshev(Mean, Sd) UCL					3.133	99% Chebyshev(Mean, Sd) UCL					3.941	
465													
466	Suggested UCL to Use												
467	95% Student's-t UCL					2.137							
468													

	A	B	C	D	E	F	G	H	I	J	K	L
469	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
470	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
471												
472	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
473	Recommendations are based upon data size, data distribution, and skewness.											
474	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
475	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
476												
477												
478	Cr											
479												
480	General Statistics											
481	Total Number of Observations				40		Number of Distinct Observations				33	
482							Number of Missing Observations				0	
483	Minimum				10		Mean				330.9	
484	Maximum				1810		Median				30	
485	SD				471.2		Std. Error of Mean				74.5	
486	Coefficient of Variation				1.424		Skewness				1.525	
487												
488	Normal GOF Test											
489	Shapiro Wilk Test Statistic				0.715		Shapiro Wilk GOF Test					
490	5% Shapiro Wilk Critical Value				0.94		Data Not Normal at 5% Significance Level					
491	Lilliefors Test Statistic				0.308		Lilliefors GOF Test					
492	5% Lilliefors Critical Value				0.139		Data Not Normal at 5% Significance Level					
493	Data Not Normal at 5% Significance Level											
494												
495	Assuming Normal Distribution											
496	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
497	95% Student's-t UCL				456.4		95% Adjusted-CLT UCL (Chen-1995)				472.6	
498							95% Modified-t UCL (Johnson-1978)				459.4	
499												
500	Gamma GOF Test											
501	A-D Test Statistic				3.531		Anderson-Darling Gamma GOF Test					
502	5% A-D Critical Value				0.815		Data Not Gamma Distributed at 5% Significance Level					
503	K-S Test Statistic				0.305		Kolmogorov-Smirnov Gamma GOF Test					
504	5% K-S Critical Value				0.148		Data Not Gamma Distributed at 5% Significance Level					
505	Data Not Gamma Distributed at 5% Significance Level											
506												
507	Gamma Statistics											
508	k hat (MLE)				0.49		k star (bias corrected MLE)				0.47	
509	Theta hat (MLE)				674.7		Theta star (bias corrected MLE)				703.6	
510	nu hat (MLE)				39.23		nu star (bias corrected)				37.62	
511	MLE Mean (bias corrected)				330.9		MLE Sd (bias corrected)				482.5	
512						Approximate Chi Square Value (0.05)					24.58	
513	Adjusted Level of Significance				0.044		Adjusted Chi Square Value				24.18	
514												
515	Assuming Gamma Distribution											
516	95% Approximate Gamma UCL (use when n>=50))				506.5		95% Adjusted Gamma UCL (use when n<50)				514.8	
517												
518	Lognormal GOF Test											
519	Shapiro Wilk Test Statistic				0.808		Shapiro Wilk Lognormal GOF Test					
520	5% Shapiro Wilk Critical Value				0.94		Data Not Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
521	Lilliefors Test Statistic					0.283	Lilliefors Lognormal GOF Test						
522	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level						
523	Data Not Lognormal at 5% Significance Level												
524													
525	Lognormal Statistics												
526	Minimum of Logged Data					2.303	Mean of logged Data					4.503	
527	Maximum of Logged Data					7.501	SD of logged Data					1.722	
528													
529	Assuming Lognormal Distribution												
530	95% H-UCL					1005	90% Chebyshev (MVUE) UCL					770.2	
531	95% Chebyshev (MVUE) UCL					953.5	97.5% Chebyshev (MVUE) UCL					1208	
532	99% Chebyshev (MVUE) UCL					1708							
533													
534	Nonparametric Distribution Free UCL Statistics												
535	Data do not follow a Discernible Distribution (0.05)												
536													
537	Nonparametric Distribution Free UCLs												
538	95% CLT UCL					453.4	95% Jackknife UCL					456.4	
539	95% Standard Bootstrap UCL					453.2	95% Bootstrap-t UCL					484.8	
540	95% Hall's Bootstrap UCL					469.7	95% Percentile Bootstrap UCL					453.1	
541	95% BCA Bootstrap UCL					475.9							
542	90% Chebyshev(Mean, Sd) UCL					554.4	95% Chebyshev(Mean, Sd) UCL					655.6	
543	97.5% Chebyshev(Mean, Sd) UCL					796.1	99% Chebyshev(Mean, Sd) UCL					1072	
544													
545	Suggested UCL to Use												
546	95% Chebyshev (Mean, Sd) UCL					655.6							
547													
548	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
549	Recommendations are based upon data size, data distribution, and skewness.												
550	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
551	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
552													
553													
554	Co												
555													
556	General Statistics												
557	Total Number of Observations					40	Number of Distinct Observations					25	
558							Number of Missing Observations					0	
559	Minimum					6	Mean					35	
560	Maximum					107	Median					20.5	
561	SD					28.46	Std. Error of Mean					4.499	
562	Coefficient of Variation					0.813	Skewness					1.477	
563													
564	Normal GOF Test												
565	Shapiro Wilk Test Statistic					0.755	Shapiro Wilk GOF Test						
566	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level						
567	Lilliefors Test Statistic					0.312	Lilliefors GOF Test						
568	5% Lilliefors Critical Value					0.139	Data Not Normal at 5% Significance Level						
569	Data Not Normal at 5% Significance Level												
570													
571	Assuming Normal Distribution												
572	95% Normal UCL						95% UCLs (Adjusted for Skewness)						

	A	B	C	D	E	F	G	H	I	J	K	L
573	95% Student's-t UCL					42.58	95% Adjusted-CLT UCL (Chen-1995)					43.52
574							95% Modified-t UCL (Johnson-1978)					42.76
575												
576	Gamma GOF Test											
577	A-D Test Statistic					2.398	Anderson-Darling Gamma GOF Test					
578	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level					
579	K-S Test Statistic					0.26	Kolmogorov-Smirnov Gamma GOF Test					
580	5% K-S Critical Value					0.141	Data Not Gamma Distributed at 5% Significance Level					
581	Data Not Gamma Distributed at 5% Significance Level											
582												
583	Gamma Statistics											
584	k hat (MLE)					2.048	k star (bias corrected MLE)					1.911
585	Theta hat (MLE)					17.09	Theta star (bias corrected MLE)					18.31
586	nu hat (MLE)					163.8	nu star (bias corrected)					152.9
587	MLE Mean (bias corrected)					35	MLE Sd (bias corrected)					25.32
588							Approximate Chi Square Value (0.05)					125.3
589	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					124.4
590												
591	Assuming Gamma Distribution											
592	95% Approximate Gamma UCL (use when n>=50))					42.7	95% Adjusted Gamma UCL (use when n<50)					43.02
593												
594	Lognormal GOF Test											
595	Shapiro Wilk Test Statistic					0.905	Shapiro Wilk Lognormal GOF Test					
596	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level					
597	Lilliefors Test Statistic					0.216	Lilliefors Lognormal GOF Test					
598	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level					
599	Data Not Lognormal at 5% Significance Level											
600												
601	Lognormal Statistics											
602	Minimum of Logged Data					1.792	Mean of logged Data					3.292
603	Maximum of Logged Data					4.673	SD of logged Data					0.708
604												
605	Assuming Lognormal Distribution											
606	95% H-UCL					43.82	90% Chebyshev (MVUE) UCL					46.84
607	95% Chebyshev (MVUE) UCL					52.52	97.5% Chebyshev (MVUE) UCL					60.42
608	99% Chebyshev (MVUE) UCL					75.93						
609												
610	Nonparametric Distribution Free UCL Statistics											
611	Data do not follow a Discernible Distribution (0.05)											
612												
613	Nonparametric Distribution Free UCLs											
614	95% CLT UCL					42.4	95% Jackknife UCL					42.58
615	95% Standard Bootstrap UCL					42.28	95% Bootstrap-t UCL					44
616	95% Hall's Bootstrap UCL					43.32	95% Percentile Bootstrap UCL					42.23
617	95% BCA Bootstrap UCL					43.7						
618	90% Chebyshev(Mean, Sd) UCL					48.5	95% Chebyshev(Mean, Sd) UCL					54.61
619	97.5% Chebyshev(Mean, Sd) UCL					63.1	99% Chebyshev(Mean, Sd) UCL					79.77
620												
621	Suggested UCL to Use											
622	95% Chebyshev (Mean, Sd) UCL					54.61						
623												
624	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

	A	B	C	D	E	F	G	H	I	J	K	L	
625	Recommendations are based upon data size, data distribution, and skewness.												
626	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
627	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
628													
629													
630	Fe												
631													
632	General Statistics												
633	Total Number of Observations				33		Number of Distinct Observations				33		
634							Number of Missing Observations				0		
635	Minimum				23753		Mean				40715		
636	Maximum				66372		Median				39763		
637	SD				8195		Std. Error of Mean				1427		
638	Coefficient of Variation				0.201		Skewness				0.638		
639													
640	Normal GOF Test												
641	Shapiro Wilk Test Statistic				0.958		Shapiro Wilk GOF Test						
642	5% Shapiro Wilk Critical Value				0.931		Data appear Normal at 5% Significance Level						
643	Lilliefors Test Statistic				0.119		Lilliefors GOF Test						
644	5% Lilliefors Critical Value				0.152		Data appear Normal at 5% Significance Level						
645	Data appear Normal at 5% Significance Level												
646													
647	Assuming Normal Distribution												
648	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
649	95% Student's-t UCL				43132		95% Adjusted-CLT UCL (Chen-1995)				43231		
650							95% Modified-t UCL (Johnson-1978)				43158		
651													
652	Gamma GOF Test												
653	A-D Test Statistic				0.414		Anderson-Darling Gamma GOF Test						
654	5% A-D Critical Value				0.746		Detected data appear Gamma Distributed at 5% Significance Level						
655	K-S Test Statistic				0.106		Kolmogorov-Smirnov Gamma GOF Test						
656	5% K-S Critical Value				0.153		Detected data appear Gamma Distributed at 5% Significance Level						
657	Detected data appear Gamma Distributed at 5% Significance Level												
658													
659	Gamma Statistics												
660	k hat (MLE)				25.72		k star (bias corrected MLE)				23.4		
661	Theta hat (MLE)				1583		Theta star (bias corrected MLE)				1740		
662	nu hat (MLE)				1697		nu star (bias corrected)				1544		
663	MLE Mean (bias corrected)				40715		MLE Sd (bias corrected)				8417		
664						Approximate Chi Square Value (0.05)					1454		
665	Adjusted Level of Significance				0.0419		Adjusted Chi Square Value					1450	
666													
667	Assuming Gamma Distribution												
668	95% Approximate Gamma UCL (use when n>=50))				43243		95% Adjusted Gamma UCL (use when n<50)					43377	
669													
670	Lognormal GOF Test												
671	Shapiro Wilk Test Statistic				0.972		Shapiro Wilk Lognormal GOF Test						
672	5% Shapiro Wilk Critical Value				0.931		Data appear Lognormal at 5% Significance Level						
673	Lilliefors Test Statistic				0.12		Lilliefors Lognormal GOF Test						
674	5% Lilliefors Critical Value				0.152		Data appear Lognormal at 5% Significance Level						
675	Data appear Lognormal at 5% Significance Level												
676													

	A	B	C	D	E	F	G	H	I	J	K	L
677	Lognormal Statistics											
678	Minimum of Logged Data					10.08	Mean of logged Data					10.59
679	Maximum of Logged Data					11.1	SD of logged Data					0.202
680												
681	Assuming Lognormal Distribution											
682	95% H-UCL					43376	90% Chebyshev (MVUE) UCL					45060
683	95% Chebyshev (MVUE) UCL					47023	97.5% Chebyshev (MVUE) UCL					49748
684	99% Chebyshev (MVUE) UCL					55101						
685												
686	Nonparametric Distribution Free UCL Statistics											
687	Data appear to follow a Discernible Distribution at 5% Significance Level											
688												
689	Nonparametric Distribution Free UCLs											
690	95% CLT UCL					43062	95% Jackknife UCL					43132
691	95% Standard Bootstrap UCL					43038	95% Bootstrap-t UCL					43437
692	95% Hall's Bootstrap UCL					43538	95% Percentile Bootstrap UCL					43030
693	95% BCA Bootstrap UCL					43137						
694	90% Chebyshev(Mean, Sd) UCL					44995	95% Chebyshev(Mean, Sd) UCL					46934
695	97.5% Chebyshev(Mean, Sd) UCL					49624	99% Chebyshev(Mean, Sd) UCL					54910
696												
697	Suggested UCL to Use											
698	95% Student's-t UCL					43132						
699												
700	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
701	Recommendations are based upon data size, data distribution, and skewness.											
702	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
703	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
704												
705												
706	Li											
707												
708	General Statistics											
709	Total Number of Observations					33	Number of Distinct Observations					20
710							Number of Missing Observations					0
711	Minimum					1	Mean					12.79
712	Maximum					40	Median					11
713	SD					9.813	Std. Error of Mean					1.708
714	Coefficient of Variation					0.767	Skewness					0.844
715												
716	Normal GOF Test											
717	Shapiro Wilk Test Statistic					0.926	Shapiro Wilk GOF Test					
718	5% Shapiro Wilk Critical Value					0.931	Data Not Normal at 5% Significance Level					
719	Lilliefors Test Statistic					0.115	Lilliefors GOF Test					
720	5% Lilliefors Critical Value					0.152	Data appear Normal at 5% Significance Level					
721	Data appear Approximate Normal at 5% Significance Level											
722												
723	Assuming Normal Distribution											
724	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
725	95% Student's-t UCL					15.68	95% Adjusted-CLT UCL (Chen-1995)					15.87
726							95% Modified-t UCL (Johnson-1978)					15.72
727												
728	Gamma GOF Test											

	A	B	C	D	E	F	G	H	I	J	K	L	
729	A-D Test Statistic					0.576	Anderson-Darling Gamma GOF Test						
730	5% A-D Critical Value					0.769	Detected data appear Gamma Distributed at 5% Significance Level						
731	K-S Test Statistic					0.12	Kolmogorov-Smirnov Gamma GOF Test						
732	5% K-S Critical Value					0.157	Detected data appear Gamma Distributed at 5% Significance Level						
733	Detected data appear Gamma Distributed at 5% Significance Level												
734													
735	Gamma Statistics												
736	k hat (MLE)					1.312	k star (bias corrected MLE)					1.213	
737	Theta hat (MLE)					9.749	Theta star (bias corrected MLE)					10.55	
738	nu hat (MLE)					86.57	nu star (bias corrected)					80.03	
739	MLE Mean (bias corrected)					12.79	MLE Sd (bias corrected)					11.61	
740							Approximate Chi Square Value (0.05)					60.42	
741	Adjusted Level of Significance					0.0419	Adjusted Chi Square Value					59.54	
742													
743	Assuming Gamma Distribution												
744	95% Approximate Gamma UCL (use when n>=50))					16.94	95% Adjusted Gamma UCL (use when n<50)					17.19	
745													
746	Lognormal GOF Test												
747	Shapiro Wilk Test Statistic					0.878	Shapiro Wilk Lognormal GOF Test						
748	5% Shapiro Wilk Critical Value					0.931	Data Not Lognormal at 5% Significance Level						
749	Lilliefors Test Statistic					0.182	Lilliefors Lognormal GOF Test						
750	5% Lilliefors Critical Value					0.152	Data Not Lognormal at 5% Significance Level						
751	Data Not Lognormal at 5% Significance Level												
752													
753	Lognormal Statistics												
754	Minimum of Logged Data					0	Mean of logged Data					2.121	
755	Maximum of Logged Data					3.689	SD of logged Data					1.105	
756													
757	Assuming Lognormal Distribution												
758	95% H-UCL					25.37	90% Chebyshev (MVUE) UCL					25.11	
759	95% Chebyshev (MVUE) UCL					29.72	97.5% Chebyshev (MVUE) UCL					36.12	
760	99% Chebyshev (MVUE) UCL					48.69							
761													
762	Nonparametric Distribution Free UCL Statistics												
763	Data appear to follow a Discernible Distribution at 5% Significance Level												
764													
765	Nonparametric Distribution Free UCLs												
766	95% CLT UCL					15.6	95% Jackknife UCL					15.68	
767	95% Standard Bootstrap UCL					15.51	95% Bootstrap-t UCL					15.81	
768	95% Hall's Bootstrap UCL					16	95% Percentile Bootstrap UCL					15.55	
769	95% BCA Bootstrap UCL					15.64							
770	90% Chebyshev(Mean, Sd) UCL					17.91	95% Chebyshev(Mean, Sd) UCL					20.23	
771	97.5% Chebyshev(Mean, Sd) UCL					23.46	99% Chebyshev(Mean, Sd) UCL					29.78	
772													
773	Suggested UCL to Use												
774	95% Student's-t UCL					15.68							
775													
776	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test												
777	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL												
778													
779	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
780	Recommendations are based upon data size, data distribution, and skewness.												

	A	B	C	D	E	F	G	H	I	J	K	L
781	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
782	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
783												
784												
785	Mn											
786												
787	General Statistics											
788	Total Number of Observations				33		Number of Distinct Observations				32	
789							Number of Missing Observations				0	
790	Minimum				148		Mean				523.3	
791	Maximum				869		Median				534	
792	SD				136.4		Std. Error of Mean				23.74	
793	Coefficient of Variation				0.261		Skewness				0.0113	
794												
795	Normal GOF Test											
796	Shapiro Wilk Test Statistic				0.971		Shapiro Wilk GOF Test					
797	5% Shapiro Wilk Critical Value				0.931		Data appear Normal at 5% Significance Level					
798	Lilliefors Test Statistic				0.0946		Lilliefors GOF Test					
799	5% Lilliefors Critical Value				0.152		Data appear Normal at 5% Significance Level					
800	Data appear Normal at 5% Significance Level											
801												
802	Assuming Normal Distribution											
803	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
804	95% Student's-t UCL			563.5		95% Adjusted-CLT UCL (Chen-1995)					562.4	
805						95% Modified-t UCL (Johnson-1978)					563.6	
806												
807	Gamma GOF Test											
808	A-D Test Statistic			0.597		Anderson-Darling Gamma GOF Test						
809	5% A-D Critical Value			0.747		Detected data appear Gamma Distributed at 5% Significance Level						
810	K-S Test Statistic			0.116		Kolmogorov-Smirnov Gamma GOF Test						
811	5% K-S Critical Value			0.153		Detected data appear Gamma Distributed at 5% Significance Level						
812	Detected data appear Gamma Distributed at 5% Significance Level											
813												
814	Gamma Statistics											
815	k hat (MLE)			12.77		k star (bias corrected MLE)					11.63	
816	Theta hat (MLE)			41		Theta star (bias corrected MLE)					45.02	
817	nu hat (MLE)			842.5		nu star (bias corrected)					767.3	
818	MLE Mean (bias corrected)			523.3		MLE Sd (bias corrected)					153.5	
819						Approximate Chi Square Value (0.05)					704	
820	Adjusted Level of Significance			0.0419		Adjusted Chi Square Value					700.9	
821												
822	Assuming Gamma Distribution											
823	95% Approximate Gamma UCL (use when n>=50))			570.4		95% Adjusted Gamma UCL (use when n<50)					572.9	
824												
825	Lognormal GOF Test											
826	Shapiro Wilk Test Statistic			0.866		Shapiro Wilk Lognormal GOF Test						
827	5% Shapiro Wilk Critical Value			0.931		Data Not Lognormal at 5% Significance Level						
828	Lilliefors Test Statistic			0.14		Lilliefors Lognormal GOF Test						
829	5% Lilliefors Critical Value			0.152		Data appear Lognormal at 5% Significance Level						
830	Data appear Approximate Lognormal at 5% Significance Level											
831												
832	Lognormal Statistics											

	A	B	C	D	E	F	G	H	I	J	K	L
833	Minimum of Logged Data					4.997	Mean of logged Data					6.221
834	Maximum of Logged Data					6.767	SD of logged Data					0.308
835												
836	Assuming Lognormal Distribution											
837	95% H-UCL					581.8	90% Chebyshev (MVUE) UCL					612.9
838	95% Chebyshev (MVUE) UCL					652	97.5% Chebyshev (MVUE) UCL					706.2
839	99% Chebyshev (MVUE) UCL					812.7						
840												
841	Nonparametric Distribution Free UCL Statistics											
842	Data appear to follow a Discernible Distribution at 5% Significance Level											
843												
844	Nonparametric Distribution Free UCLs											
845	95% CLT UCL					562.4	95% Jackknife UCL					563.5
846	95% Standard Bootstrap UCL					562.1	95% Bootstrap-t UCL					566.6
847	95% Hall's Bootstrap UCL					565.5	95% Percentile Bootstrap UCL					562.6
848	95% BCA Bootstrap UCL					559.9						
849	90% Chebyshev(Mean, Sd) UCL					594.6	95% Chebyshev(Mean, Sd) UCL					626.8
850	97.5% Chebyshev(Mean, Sd) UCL					671.6	99% Chebyshev(Mean, Sd) UCL					759.5
851												
852	Suggested UCL to Use											
853	95% Student's-t UCL					563.5						
854												
855	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
856	Recommendations are based upon data size, data distribution, and skewness.											
857	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
858	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
859												
860												
861	Hg											
862												
863	General Statistics											
864	Total Number of Observations					40	Number of Distinct Observations					20
865							Number of Missing Observations					0
866	Minimum					0.03	Mean					0.202
867	Maximum					0.72	Median					0.215
868	SD					0.135	Std. Error of Mean					0.0213
869	Coefficient of Variation					0.67	Skewness					1.865
870												
871	Normal GOF Test											
872	Shapiro Wilk Test Statistic					0.82	Shapiro Wilk GOF Test					
873	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level					
874	Lilliefors Test Statistic					0.207	Lilliefors GOF Test					
875	5% Lilliefors Critical Value					0.139	Data Not Normal at 5% Significance Level					
876	Data Not Normal at 5% Significance Level											
877												
878	Assuming Normal Distribution											
879	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
880	95% Student's-t UCL					0.237	95% Adjusted-CLT UCL (Chen-1995)					0.243
881							95% Modified-t UCL (Johnson-1978)					0.239
882												
883	Gamma GOF Test											
884	A-D Test Statistic					1.421	Anderson-Darling Gamma GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
885	5% A-D Critical Value					0.758	Data Not Gamma Distributed at 5% Significance Level						
886	K-S Test Statistic					0.184	Kolmogorov-Smirnov Gamma GOF Test						
887	5% K-S Critical Value					0.141	Data Not Gamma Distributed at 5% Significance Level						
888	Data Not Gamma Distributed at 5% Significance Level												
889													
890	Gamma Statistics												
891	k hat (MLE)					2.272	k star (bias corrected MLE)					2.118	
892	Theta hat (MLE)					0.0887	Theta star (bias corrected MLE)					0.0951	
893	nu hat (MLE)					181.8	nu star (bias corrected)					169.5	
894	MLE Mean (bias corrected)					0.202	MLE Sd (bias corrected)					0.138	
895							Approximate Chi Square Value (0.05)					140.4	
896	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					139.4	
897													
898	Assuming Gamma Distribution												
899	95% Approximate Gamma UCL (use when n>=50))					0.243	95% Adjusted Gamma UCL (use when n<50)					0.245	
900													
901	Lognormal GOF Test												
902	Shapiro Wilk Test Statistic					0.88	Shapiro Wilk Lognormal GOF Test						
903	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level						
904	Lilliefors Test Statistic					0.217	Lilliefors Lognormal GOF Test						
905	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level						
906	Data Not Lognormal at 5% Significance Level												
907													
908	Lognormal Statistics												
909	Minimum of Logged Data					-3.507	Mean of logged Data					-1.838	
910	Maximum of Logged Data					-0.329	SD of logged Data					0.765	
911													
912	Assuming Lognormal Distribution												
913	95% H-UCL					0.278	90% Chebyshev (MVUE) UCL					0.296	
914	95% Chebyshev (MVUE) UCL					0.334	97.5% Chebyshev (MVUE) UCL					0.388	
915	99% Chebyshev (MVUE) UCL					0.492							
916													
917	Nonparametric Distribution Free UCL Statistics												
918	Data do not follow a Discernible Distribution (0.05)												
919													
920	Nonparametric Distribution Free UCLs												
921	95% CLT UCL					0.237	95% Jackknife UCL					0.237	
922	95% Standard Bootstrap UCL					0.236	95% Bootstrap-t UCL					0.245	
923	95% Hall's Bootstrap UCL					0.264	95% Percentile Bootstrap UCL					0.238	
924	95% BCA Bootstrap UCL					0.243							
925	90% Chebyshev(Mean, Sd) UCL					0.266	95% Chebyshev(Mean, Sd) UCL					0.295	
926	97.5% Chebyshev(Mean, Sd) UCL					0.335	99% Chebyshev(Mean, Sd) UCL					0.414	
927													
928	Suggested UCL to Use												
929	95% Chebyshev (Mean, Sd) UCL					0.295							
930													
931	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
932	Recommendations are based upon data size, data distribution, and skewness.												
933	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
934	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
935													
936													

	A	B	C	D	E	F	G	H	I	J	K	L
937	Mo											
938												
939	General Statistics											
940	Total Number of Observations					40	Number of Distinct Observations					33
941							Number of Missing Observations					0
942	Minimum					0.4	Mean					12.19
943	Maximum					29.1	Median					11.85
944	SD					7.325	Std. Error of Mean					1.158
945	Coefficient of Variation					0.601	Skewness					0.446
946												
947	Normal GOF Test											
948	Shapiro Wilk Test Statistic					0.962	Shapiro Wilk GOF Test					
949	5% Shapiro Wilk Critical Value					0.94	Data appear Normal at 5% Significance Level					
950	Lilliefors Test Statistic					0.0766	Lilliefors GOF Test					
951	5% Lilliefors Critical Value					0.139	Data appear Normal at 5% Significance Level					
952	Data appear Normal at 5% Significance Level											
953												
954	Assuming Normal Distribution											
955	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
956	95% Student's-t UCL					14.14	95% Adjusted-CLT UCL (Chen-1995)					14.18
957							95% Modified-t UCL (Johnson-1978)					14.16
958												
959	Gamma GOF Test											
960	A-D Test Statistic					0.704	Anderson-Darling Gamma GOF Test					
961	5% A-D Critical Value					0.76	Detected data appear Gamma Distributed at 5% Significance Level					
962	K-S Test Statistic					0.141	Kolmogorov-Smirnov Gamma GOF Test					
963	5% K-S Critical Value					0.141	Detected data appear Gamma Distributed at 5% Significance Level					
964	Detected data appear Gamma Distributed at 5% Significance Level											
965												
966	Gamma Statistics											
967	k hat (MLE)					1.941	k star (bias corrected MLE)					1.812
968	Theta hat (MLE)					6.283	Theta star (bias corrected MLE)					6.73
969	nu hat (MLE)					155.2	nu star (bias corrected)					144.9
970	MLE Mean (bias corrected)					12.19	MLE Sd (bias corrected)					9.058
971							Approximate Chi Square Value (0.05)					118.1
972	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					117.2
973												
974	Assuming Gamma Distribution											
975	95% Approximate Gamma UCL (use when n>=50))					14.96	95% Adjusted Gamma UCL (use when n<50)					15.08
976												
977	Lognormal GOF Test											
978	Shapiro Wilk Test Statistic					0.867	Shapiro Wilk Lognormal GOF Test					
979	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level					
980	Lilliefors Test Statistic					0.185	Lilliefors Lognormal GOF Test					
981	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level					
982	Data Not Lognormal at 5% Significance Level											
983												
984	Lognormal Statistics											
985	Minimum of Logged Data					-0.916	Mean of logged Data					2.222
986	Maximum of Logged Data					3.371	SD of logged Data					0.917
987												
988	Assuming Lognormal Distribution											

	A	B	C	D	E	F	G	H	I	J	K	L
989	95% H-UCL					19.73	90% Chebyshev (MVUE) UCL					20.73
990	95% Chebyshev (MVUE) UCL					23.85	97.5% Chebyshev (MVUE) UCL					28.17
991	99% Chebyshev (MVUE) UCL					36.68						
992												
993	Nonparametric Distribution Free UCL Statistics											
994	Data appear to follow a Discernible Distribution at 5% Significance Level											
995												
996	Nonparametric Distribution Free UCLs											
997	95% CLT UCL					14.1	95% Jackknife UCL					14.14
998	95% Standard Bootstrap UCL					14.03	95% Bootstrap-t UCL					14.28
999	95% Hall's Bootstrap UCL					14.13	95% Percentile Bootstrap UCL					14.05
1000	95% BCA Bootstrap UCL					14.14						
1001	90% Chebyshev(Mean, Sd) UCL					15.67	95% Chebyshev(Mean, Sd) UCL					17.24
1002	97.5% Chebyshev(Mean, Sd) UCL					19.43	99% Chebyshev(Mean, Sd) UCL					23.72
1003												
1004	Suggested UCL to Use											
1005	95% Student's-t UCL					14.14						
1006												
1007	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1008	Recommendations are based upon data size, data distribution, and skewness.											
1009	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1010	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1011												
1012												
1013	Ni											
1014												
1015		General Statistics										
1016	Total Number of Observations					40	Number of Distinct Observations					37
1017							Number of Missing Observations					0
1018	Minimum					33	Mean					513.8
1019	Maximum					2647	Median					83.5
1020	SD					679.2	Std. Error of Mean					107.4
1021	Coefficient of Variation					1.322	Skewness					1.549
1022												
1023	Normal GOF Test											
1024	Shapiro Wilk Test Statistic					0.722	Shapiro Wilk GOF Test					
1025	5% Shapiro Wilk Critical Value					0.94	Data Not Normal at 5% Significance Level					
1026	Lilliefors Test Statistic					0.298	Lilliefors GOF Test					
1027	5% Lilliefors Critical Value					0.139	Data Not Normal at 5% Significance Level					
1028	Data Not Normal at 5% Significance Level											
1029												
1030	Assuming Normal Distribution											
1031	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1032	95% Student's-t UCL					694.7	95% Adjusted-CLT UCL (Chen-1995)					718.5
1033							95% Modified-t UCL (Johnson-1978)					699.1
1034												
1035	Gamma GOF Test											
1036	A-D Test Statistic					3.406	Anderson-Darling Gamma GOF Test					
1037	5% A-D Critical Value					0.797	Data Not Gamma Distributed at 5% Significance Level					
1038	K-S Test Statistic					0.275	Kolmogorov-Smirnov Gamma GOF Test					
1039	5% K-S Critical Value					0.146	Data Not Gamma Distributed at 5% Significance Level					
1040	Data Not Gamma Distributed at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
1041												
1042	Gamma Statistics											
1043	k hat (MLE)					0.664	k star (bias corrected MLE)					0.631
1044	Theta hat (MLE)					773.6	Theta star (bias corrected MLE)					814.2
1045	nu hat (MLE)					53.13	nu star (bias corrected)					50.48
1046	MLE Mean (bias corrected)					513.8	MLE Sd (bias corrected)					646.8
1047							Approximate Chi Square Value (0.05)					35.17
1048	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					34.69
1049												
1050	Assuming Gamma Distribution											
1051	95% Approximate Gamma UCL (use when n>=50))					737.5	95% Adjusted Gamma UCL (use when n<50)					747.7
1052												
1053	Lognormal GOF Test											
1054	Shapiro Wilk Test Statistic					0.825	Shapiro Wilk Lognormal GOF Test					
1055	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level					
1056	Lilliefors Test Statistic					0.255	Lilliefors Lognormal GOF Test					
1057	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level					
1058	Data Not Lognormal at 5% Significance Level											
1059												
1060	Lognormal Statistics											
1061	Minimum of Logged Data					3.497	Mean of logged Data					5.325
1062	Maximum of Logged Data					7.881	SD of logged Data					1.382
1063												
1064	Assuming Lognormal Distribution											
1065	95% H-UCL					1012	90% Chebyshev (MVUE) UCL					936.4
1066	95% Chebyshev (MVUE) UCL					1129	97.5% Chebyshev (MVUE) UCL					1397
1067	99% Chebyshev (MVUE) UCL					1922						
1068												
1069	Nonparametric Distribution Free UCL Statistics											
1070	Data do not follow a Discernible Distribution (0.05)											
1071												
1072	Nonparametric Distribution Free UCLs											
1073	95% CLT UCL					690.4	95% Jackknife UCL					694.7
1074	95% Standard Bootstrap UCL					689	95% Bootstrap-t UCL					751.9
1075	95% Hall's Bootstrap UCL					718.6	95% Percentile Bootstrap UCL					696.6
1076	95% BCA Bootstrap UCL					727.8						
1077	90% Chebyshev(Mean, Sd) UCL					836	95% Chebyshev(Mean, Sd) UCL					981.9
1078	97.5% Chebyshev(Mean, Sd) UCL					1184	99% Chebyshev(Mean, Sd) UCL					1582
1079												
1080	Suggested UCL to Use											
1081	95% Chebyshev (Mean, Sd) UCL					981.9						
1082												
1083	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1084	Recommendations are based upon data size, data distribution, and skewness.											
1085	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1086	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1087												
1088												
1089	Se											
1090												
1091	General Statistics											
1092	Total Number of Observations					40	Number of Distinct Observations					31

	A	B	C	D	E	F	G	H	I	J	K	L	
1093						Number of Missing Observations						0	
1094	Minimum					0.1	Mean						4.05
1095	Maximum					10.5	Median						4.2
1096	SD					2.861	Std. Error of Mean						0.452
1097	Coefficient of Variation					0.706	Skewness						0.355
1098													
1099	Normal GOF Test												
1100	Shapiro Wilk Test Statistic					0.943	Shapiro Wilk GOF Test						
1101	5% Shapiro Wilk Critical Value					0.94	Data appear Normal at 5% Significance Level						
1102	Lilliefors Test Statistic					0.116	Lilliefors GOF Test						
1103	5% Lilliefors Critical Value					0.139	Data appear Normal at 5% Significance Level						
1104	Data appear Normal at 5% Significance Level												
1105													
1106	Assuming Normal Distribution												
1107	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
1108	95% Student's-t UCL					4.812	95% Adjusted-CLT UCL (Chen-1995)						4.821
1109							95% Modified-t UCL (Johnson-1978)						4.816
1110													
1111	Gamma GOF Test												
1112	A-D Test Statistic					1.315	Anderson-Darling Gamma GOF Test						
1113	5% A-D Critical Value					0.775	Data Not Gamma Distributed at 5% Significance Level						
1114	K-S Test Statistic					0.199	Kolmogorov-Smirnov Gamma GOF Test						
1115	5% K-S Critical Value					0.143	Data Not Gamma Distributed at 5% Significance Level						
1116	Data Not Gamma Distributed at 5% Significance Level												
1117													
1118	Gamma Statistics												
1119	k hat (MLE)					1.138	k star (bias corrected MLE)						1.069
1120	Theta hat (MLE)					3.559	Theta star (bias corrected MLE)						3.787
1121	nu hat (MLE)					91.04	nu star (bias corrected)						85.55
1122	MLE Mean (bias corrected)					4.05	MLE Sd (bias corrected)						3.917
1123							Approximate Chi Square Value (0.05)						65.23
1124	Adjusted Level of Significance					0.044	Adjusted Chi Square Value						64.56
1125													
1126	Assuming Gamma Distribution												
1127	95% Approximate Gamma UCL (use when n>=50))					5.312	95% Adjusted Gamma UCL (use when n<50)						5.366
1128													
1129	Lognormal GOF Test												
1130	Shapiro Wilk Test Statistic					0.804	Shapiro Wilk Lognormal GOF Test						
1131	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level						
1132	Lilliefors Test Statistic					0.229	Lilliefors Lognormal GOF Test						
1133	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level						
1134	Data Not Lognormal at 5% Significance Level												
1135													
1136	Lognormal Statistics												
1137	Minimum of Logged Data					-2.303	Mean of logged Data						0.899
1138	Maximum of Logged Data					2.351	SD of logged Data						1.328
1139													
1140	Assuming Lognormal Distribution												
1141	95% H-UCL					10.81	90% Chebyshev (MVUE) UCL						10.23
1142	95% Chebyshev (MVUE) UCL					12.27	97.5% Chebyshev (MVUE) UCL						15.11
1143	99% Chebyshev (MVUE) UCL					20.69							
1144													

	A	B	C	D	E	F	G	H	I	J	K	L
1145	Nonparametric Distribution Free UCL Statistics											
1146	Data appear to follow a Discernible Distribution at 5% Significance Level											
1147												
1148	Nonparametric Distribution Free UCLs											
1149	95% CLT UCL				4.794	95% Jackknife UCL				4.812		
1150	95% Standard Bootstrap UCL				4.801	95% Bootstrap-t UCL				4.906		
1151	95% Hall's Bootstrap UCL				4.854	95% Percentile Bootstrap UCL				4.788		
1152	95% BCA Bootstrap UCL				4.825							
1153	90% Chebyshev(Mean, Sd) UCL				5.407	95% Chebyshev(Mean, Sd) UCL				6.022		
1154	97.5% Chebyshev(Mean, Sd) UCL				6.875	99% Chebyshev(Mean, Sd) UCL				8.551		
1155												
1156	Suggested UCL to Use											
1157	95% Student's-t UCL				4.812							
1158												
1159	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1160	Recommendations are based upon data size, data distribution, and skewness.											
1161	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1162	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1163												
1164												
1165	V											
1166												
1167	General Statistics											
1168	Total Number of Observations				40	Number of Distinct Observations				24		
1169						Number of Missing Observations				0		
1170	Minimum				4	Mean				28.9		
1171	Maximum				66	Median				27		
1172	SD				9.961	Std. Error of Mean				1.575		
1173	Coefficient of Variation				0.345	Skewness				1.218		
1174												
1175	Normal GOF Test											
1176	Shapiro Wilk Test Statistic				0.906	Shapiro Wilk GOF Test						
1177	5% Shapiro Wilk Critical Value				0.94	Data Not Normal at 5% Significance Level						
1178	Lilliefors Test Statistic				0.156	Lilliefors GOF Test						
1179	5% Lilliefors Critical Value				0.139	Data Not Normal at 5% Significance Level						
1180	Data Not Normal at 5% Significance Level											
1181												
1182	Assuming Normal Distribution											
1183	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1184	95% Student's-t UCL				31.55	95% Adjusted-CLT UCL (Chen-1995)				31.81		
1185						95% Modified-t UCL (Johnson-1978)				31.6		
1186												
1187	Gamma GOF Test											
1188	A-D Test Statistic				1.233	Anderson-Darling Gamma GOF Test						
1189	5% A-D Critical Value				0.75	Data Not Gamma Distributed at 5% Significance Level						
1190	K-S Test Statistic				0.163	Kolmogorov-Smirnov Gamma GOF Test						
1191	5% K-S Critical Value				0.14	Data Not Gamma Distributed at 5% Significance Level						
1192	Data Not Gamma Distributed at 5% Significance Level											
1193												
1194	Gamma Statistics											
1195	k hat (MLE)				7.684	k star (bias corrected MLE)				7.124		
1196	Theta hat (MLE)				3.761	Theta star (bias corrected MLE)				4.057		

	A	B	C	D	E	F	G	H	I	J	K	L
1197	nu hat (MLE)					614.7	nu star (bias corrected)					569.9
1198	MLE Mean (bias corrected)					28.9	MLE Sd (bias corrected)					10.83
1199							Approximate Chi Square Value (0.05)					515.6
1200	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					513.6
1201												
1202	Assuming Gamma Distribution											
1203	95% Approximate Gamma UCL (use when n>=50))					31.95	95% Adjusted Gamma UCL (use when n<50)					32.07
1204												
1205	Lognormal GOF Test											
1206	Shapiro Wilk Test Statistic					0.805	Shapiro Wilk Lognormal GOF Test					
1207	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level					
1208	Lilliefors Test Statistic					0.197	Lilliefors Lognormal GOF Test					
1209	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level					
1210	Data Not Lognormal at 5% Significance Level											
1211												
1212	Lognormal Statistics											
1213	Minimum of Logged Data					1.386	Mean of logged Data					3.297
1214	Maximum of Logged Data					4.19	SD of logged Data					0.412
1215												
1216	Assuming Lognormal Distribution											
1217	95% H-UCL					33.26	90% Chebyshev (MVUE) UCL					35.29
1218	95% Chebyshev (MVUE) UCL					37.97	97.5% Chebyshev (MVUE) UCL					41.69
1219	99% Chebyshev (MVUE) UCL					49						
1220												
1221	Nonparametric Distribution Free UCL Statistics											
1222	Data do not follow a Discernible Distribution (0.05)											
1223												
1224	Nonparametric Distribution Free UCLs											
1225	95% CLT UCL					31.49	95% Jackknife UCL					31.55
1226	95% Standard Bootstrap UCL					31.53	95% Bootstrap-t UCL					32.03
1227	95% Hall's Bootstrap UCL					32.36	95% Percentile Bootstrap UCL					31.48
1228	95% BCA Bootstrap UCL					31.55						
1229	90% Chebyshev(Mean, Sd) UCL					33.62	95% Chebyshev(Mean, Sd) UCL					35.77
1230	97.5% Chebyshev(Mean, Sd) UCL					38.74	99% Chebyshev(Mean, Sd) UCL					44.57
1231												
1232	Suggested UCL to Use											
1233	95% Student's-t UCL					31.55	or 95% Modified-t UCL					31.6
1234												
1235	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1236	Recommendations are based upon data size, data distribution, and skewness.											
1237	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1238	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1239												
1240												
1241	Zn											
1242												
1243	General Statistics											
1244	Total Number of Observations					40	Number of Distinct Observations					38
1245							Number of Missing Observations					0
1246	Minimum					8	Mean					150.5
1247	Maximum					403	Median					152
1248	SD					94.21	Std. Error of Mean					14.9

	A	B	C	D	E	F	G	H	I	J	K	L
1249	Coefficient of Variation					0.626	Skewness					0.54
1250												
1251	Normal GOF Test											
1252	Shapiro Wilk Test Statistic					0.956	Shapiro Wilk GOF Test					
1253	5% Shapiro Wilk Critical Value					0.94	Data appear Normal at 5% Significance Level					
1254	Lilliefors Test Statistic					0.0816	Lilliefors GOF Test					
1255	5% Lilliefors Critical Value					0.139	Data appear Normal at 5% Significance Level					
1256	Data appear Normal at 5% Significance Level											
1257												
1258	Assuming Normal Distribution											
1259	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1260	95% Student's-t UCL					175.6	95% Adjusted-CLT UCL (Chen-1995)					176.4
1261							95% Modified-t UCL (Johnson-1978)					175.8
1262												
1263	Gamma GOF Test											
1264	A-D Test Statistic					0.742	Anderson-Darling Gamma GOF Test					
1265	5% A-D Critical Value					0.761	Detected data appear Gamma Distributed at 5% Significance Level					
1266	K-S Test Statistic					0.132	Kolmogorov-Smirnov Gamma GOF Test					
1267	5% K-S Critical Value					0.141	Detected data appear Gamma Distributed at 5% Significance Level					
1268	Detected data appear Gamma Distributed at 5% Significance Level											
1269												
1270	Gamma Statistics											
1271	k hat (MLE)					1.864	k star (bias corrected MLE)					1.741
1272	Theta hat (MLE)					80.75	Theta star (bias corrected MLE)					86.47
1273	nu hat (MLE)					149.1	nu star (bias corrected)					139.3
1274	MLE Mean (bias corrected)					150.5	MLE Sd (bias corrected)					114.1
1275							Approximate Chi Square Value (0.05)					113
1276	Adjusted Level of Significance					0.044	Adjusted Chi Square Value					112.1
1277												
1278	Assuming Gamma Distribution											
1279	95% Approximate Gamma UCL (use when n>=50))					185.5	95% Adjusted Gamma UCL (use when n<50)					187
1280												
1281	Lognormal GOF Test											
1282	Shapiro Wilk Test Statistic					0.886	Shapiro Wilk Lognormal GOF Test					
1283	5% Shapiro Wilk Critical Value					0.94	Data Not Lognormal at 5% Significance Level					
1284	Lilliefors Test Statistic					0.161	Lilliefors Lognormal GOF Test					
1285	5% Lilliefors Critical Value					0.139	Data Not Lognormal at 5% Significance Level					
1286	Data Not Lognormal at 5% Significance Level											
1287												
1288	Lognormal Statistics											
1289	Minimum of Logged Data					2.079	Mean of logged Data					4.723
1290	Maximum of Logged Data					5.999	SD of logged Data					0.914
1291												
1292	Assuming Lognormal Distribution											
1293	95% H-UCL					239.6	90% Chebyshev (MVUE) UCL					251.8
1294	95% Chebyshev (MVUE) UCL					289.6	97.5% Chebyshev (MVUE) UCL					342.1
1295	99% Chebyshev (MVUE) UCL					445.1						
1296												
1297	Nonparametric Distribution Free UCL Statistics											
1298	Data appear to follow a Discernible Distribution at 5% Significance Level											
1299												
1300	Nonparametric Distribution Free UCLs											

	A	B	C	D	E	F	G	H	I	J	K	L
1301	95% CLT UCL					175	95% Jackknife UCL					175.6
1302	95% Standard Bootstrap UCL					174.7	95% Bootstrap-t UCL					176.8
1303	95% Hall's Bootstrap UCL					177.6	95% Percentile Bootstrap UCL					176
1304	95% BCA Bootstrap UCL					175.1						
1305	90% Chebyshev(Mean, Sd) UCL					195.2	95% Chebyshev(Mean, Sd) UCL					215.5
1306	97.5% Chebyshev(Mean, Sd) UCL					243.6	99% Chebyshev(Mean, Sd) UCL					298.7
1307												
1308	Suggested UCL to Use											
1309	95% Student's-t UCL					175.6						
1310												
1311	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1312	Recommendations are based upon data size, data distribution, and skewness.											
1313	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1314	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1315												
1316												
1317	Zr											
1318												
1319	General Statistics											
1320	Total Number of Observations					33	Number of Distinct Observations					28
1321							Number of Missing Observations					0
1322	Minimum					0.5	Mean					7.164
1323	Maximum					17.1	Median					7
1324	SD					4.32	Std. Error of Mean					0.752
1325	Coefficient of Variation					0.603	Skewness					0.448
1326												
1327	Normal GOF Test											
1328	Shapiro Wilk Test Statistic					0.962	Shapiro Wilk GOF Test					
1329	5% Shapiro Wilk Critical Value					0.931	Data appear Normal at 5% Significance Level					
1330	Lilliefors Test Statistic					0.0959	Lilliefors GOF Test					
1331	5% Lilliefors Critical Value					0.152	Data appear Normal at 5% Significance Level					
1332	Data appear Normal at 5% Significance Level											
1333												
1334	Assuming Normal Distribution											
1335	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1336	95% Student's-t UCL					8.437	95% Adjusted-CLT UCL (Chen-1995)					8.463
1337							95% Modified-t UCL (Johnson-1978)					8.447
1338												
1339	Gamma GOF Test											
1340	A-D Test Statistic					0.797	Anderson-Darling Gamma GOF Test					
1341	5% A-D Critical Value					0.761	Data Not Gamma Distributed at 5% Significance Level					
1342	K-S Test Statistic					0.146	Kolmogorov-Smirnov Gamma GOF Test					
1343	5% K-S Critical Value					0.155	Detected data appear Gamma Distributed at 5% Significance Level					
1344	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
1345												
1346	Gamma Statistics											
1347	k hat (MLE)					1.886	k star (bias corrected MLE)					1.735
1348	Theta hat (MLE)					3.799	Theta star (bias corrected MLE)					4.13
1349	nu hat (MLE)					124.5	nu star (bias corrected)					114.5
1350	MLE Mean (bias corrected)					7.164	MLE Sd (bias corrected)					5.439
1351							Approximate Chi Square Value (0.05)					90.78
1352	Adjusted Level of Significance					0.0419	Adjusted Chi Square Value					89.7

	A	B	C	D	E	F	G	H	I	J	K	L
1353												
1354	Assuming Gamma Distribution											
1355	95% Approximate Gamma UCL (use when n>=50))					9.034	95% Adjusted Gamma UCL (use when n<50)					9.143
1356												
1357	Lognormal GOF Test											
1358	Shapiro Wilk Test Statistic					0.83	Shapiro Wilk Lognormal GOF Test					
1359	5% Shapiro Wilk Critical Value					0.931	Data Not Lognormal at 5% Significance Level					
1360	Lilliefors Test Statistic					0.205	Lilliefors Lognormal GOF Test					
1361	5% Lilliefors Critical Value					0.152	Data Not Lognormal at 5% Significance Level					
1362	Data Not Lognormal at 5% Significance Level											
1363												
1364	Lognormal Statistics											
1365	Minimum of Logged Data					-0.693	Mean of logged Data					1.681
1366	Maximum of Logged Data					2.839	SD of logged Data					0.937
1367												
1368	Assuming Lognormal Distribution											
1369	95% H-UCL					12.34	90% Chebyshev (MVUE) UCL					12.75
1370	95% Chebyshev (MVUE) UCL					14.81	97.5% Chebyshev (MVUE) UCL					17.68
1371	99% Chebyshev (MVUE) UCL					23.32						
1372												
1373	Nonparametric Distribution Free UCL Statistics											
1374	Data appear to follow a Discernible Distribution at 5% Significance Level											
1375												
1376	Nonparametric Distribution Free UCLs											
1377	95% CLT UCL					8.401	95% Jackknife UCL					8.437
1378	95% Standard Bootstrap UCL					8.375	95% Bootstrap-t UCL					8.51
1379	95% Hall's Bootstrap UCL					8.406	95% Percentile Bootstrap UCL					8.403
1380	95% BCA Bootstrap UCL					8.421						
1381	90% Chebyshev(Mean, Sd) UCL					9.42	95% Chebyshev(Mean, Sd) UCL					10.44
1382	97.5% Chebyshev(Mean, Sd) UCL					11.86	99% Chebyshev(Mean, Sd) UCL					14.65
1383												
1384	Suggested UCL to Use											
1385	95% Student's-t UCL					8.437						
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	Recommendations are based upon data size, data distribution, and skewness.											
1389	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1390	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1391												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Remainder of the Site (Mine and Mill Areas)											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.130/01/2019 12:42:41 PM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	AI											
12												
13	General Statistics											
14	Total Number of Observations				22		Number of Distinct Observations				22	
15							Number of Missing Observations				0	
16	Minimum				1939		Mean				7769	
17	Maximum				18000		Median				6490	
18	SD				4411		Std. Error of Mean				940.4	
19	Coefficient of Variation				0.568		Skewness				0.887	
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic				0.915		Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value				0.911		Data appear Normal at 5% Significance Level					
24	Lilliefors Test Statistic				0.158		Lilliefors GOF Test					
25	5% Lilliefors Critical Value				0.184		Data appear Normal at 5% Significance Level					
26	Data appear Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL				9388		95% Adjusted-CLT UCL (Chen-1995)				9506	
31							95% Modified-t UCL (Johnson-1978)				9417	
32												
33	Gamma GOF Test											
34	A-D Test Statistic				0.224		Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value				0.749		Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic				0.107		Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value				0.187		Detected data appear Gamma Distributed at 5% Significance Level					
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)				3.308		k star (bias corrected MLE)				2.887	
42	Theta hat (MLE)				2349		Theta star (bias corrected MLE)				2691	
43	nu hat (MLE)				145.6		nu star (bias corrected)				127	
44	MLE Mean (bias corrected)				7769		MLE Sd (bias corrected)				4572	
45						Approximate Chi Square Value (0.05)				102		
46	Adjusted Level of Significance				0.0386		Adjusted Chi Square Value				100.3	
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))				9676		95% Adjusted Gamma UCL (use when n<50)				9838	
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic				0.975		Shapiro Wilk Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
53	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level						
54	Lilliefors Test Statistic					0.0878	Lilliefors Lognormal GOF Test						
55	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level						
56	Data appear Lognormal at 5% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data					7.57	Mean of logged Data					8.799	
60	Maximum of Logged Data					9.798	SD of logged Data					0.594	
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL					10369	90% Chebyshev (MVUE) UCL					10972	
64	95% Chebyshev (MVUE) UCL					12393	97.5% Chebyshev (MVUE) UCL					14364	
65	99% Chebyshev (MVUE) UCL					18237							
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data appear to follow a Discernible Distribution at 5% Significance Level												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL					9316	95% Jackknife UCL					9388	
72	95% Standard Bootstrap UCL					9243	95% Bootstrap-t UCL					9688	
73	95% Hall's Bootstrap UCL					9598	95% Percentile Bootstrap UCL					9296	
74	95% BCA Bootstrap UCL					9462							
75	90% Chebyshev(Mean, Sd) UCL					10591	95% Chebyshev(Mean, Sd) UCL					11868	
76	97.5% Chebyshev(Mean, Sd) UCL					13642	99% Chebyshev(Mean, Sd) UCL					17126	
77													
78	Suggested UCL to Use												
79	95% Student's-t UCL					9388							
80													
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
82	Recommendations are based upon data size, data distribution, and skewness.												
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
85													
86													
87	Sb												
88													
89	General Statistics												
90	Total Number of Observations					22	Number of Distinct Observations					15	
91							Number of Missing Observations					0	
92	Minimum					0.937	Mean					2.806	
93	Maximum					15.5	Median					1.5	
94	SD					3.268	Std. Error of Mean					0.697	
95	Coefficient of Variation					1.165	Skewness					3.164	
96													
97	Normal GOF Test												
98	Shapiro Wilk Test Statistic					0.585	Shapiro Wilk GOF Test						
99	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level						
100	Lilliefors Test Statistic					0.284	Lilliefors GOF Test						
101	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level						
102	Data Not Normal at 5% Significance Level												
103													
104	Assuming Normal Distribution												

	A	B	C	D	E	F	G	H	I	J	K	L	
105	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
106	95% Student's-t UCL					4.005	95% Adjusted-CLT UCL (Chen-1995)						4.455
107							95% Modified-t UCL (Johnson-1978)						4.084
108													
109	Gamma GOF Test												
110	A-D Test Statistic					1.595	Anderson-Darling Gamma GOF Test						
111	5% A-D Critical Value					0.758	Data Not Gamma Distributed at 5% Significance Level						
112	K-S Test Statistic					0.213	Kolmogorov-Smirnov Gamma GOF Test						
113	5% K-S Critical Value					0.188	Data Not Gamma Distributed at 5% Significance Level						
114	Data Not Gamma Distributed at 5% Significance Level												
115													
116	Gamma Statistics												
117	k hat (MLE)					1.608	k star (bias corrected MLE)					1.419	
118	Theta hat (MLE)					1.745	Theta star (bias corrected MLE)					1.978	
119	nu hat (MLE)					70.75	nu star (bias corrected)					62.43	
120	MLE Mean (bias corrected)					2.806	MLE Sd (bias corrected)					2.356	
121							Approximate Chi Square Value (0.05)					45.26	
122	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					44.17	
123													
124	Assuming Gamma Distribution												
125	95% Approximate Gamma UCL (use when n>=50))					3.871	95% Adjusted Gamma UCL (use when n<50)					3.967	
126													
127	Lognormal GOF Test												
128	Shapiro Wilk Test Statistic					0.865	Shapiro Wilk Lognormal GOF Test						
129	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level						
130	Lilliefors Test Statistic					0.183	Lilliefors Lognormal GOF Test						
131	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level						
132	Data appear Approximate Lognormal at 5% Significance Level												
133													
134	Lognormal Statistics												
135	Minimum of Logged Data					-0.0651	Mean of logged Data					0.69	
136	Maximum of Logged Data					2.741	SD of logged Data					0.744	
137													
138	Assuming Lognormal Distribution												
139	95% H-UCL					3.789	90% Chebyshev (MVUE) UCL					3.916	
140	95% Chebyshev (MVUE) UCL					4.517	97.5% Chebyshev (MVUE) UCL					5.352	
141	99% Chebyshev (MVUE) UCL					6.992							
142													
143	Nonparametric Distribution Free UCL Statistics												
144	Data appear to follow a Discernible Distribution at 5% Significance Level												
145													
146	Nonparametric Distribution Free UCLs												
147	95% CLT UCL					3.952	95% Jackknife UCL					4.005	
148	95% Standard Bootstrap UCL					3.943	95% Bootstrap-t UCL					5.72	
149	95% Hall's Bootstrap UCL					8.534	95% Percentile Bootstrap UCL					4.053	
150	95% BCA Bootstrap UCL					4.606							
151	90% Chebyshev(Mean, Sd) UCL					4.897	95% Chebyshev(Mean, Sd) UCL					5.843	
152	97.5% Chebyshev(Mean, Sd) UCL					7.158	99% Chebyshev(Mean, Sd) UCL					9.739	
153													
154	Suggested UCL to Use												
155	95% H-UCL					3.789							
156													

	A	B	C	D	E	F	G	H	I	J	K	L	
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
158	Recommendations are based upon data size, data distribution, and skewness.												
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
161													
162	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.												
163	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.												
164	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.												
165	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.												
166													
167													
168	As												
169													
170	General Statistics												
171	Total Number of Observations				22	Number of Distinct Observations				21			
172						Number of Missing Observations				0			
173	Minimum				3.18	Mean				11.72			
174	Maximum				49	Median				9.7			
175	SD				9.675	Std. Error of Mean				2.063			
176	Coefficient of Variation				0.826	Skewness				3.089			
177													
178	Normal GOF Test												
179	Shapiro Wilk Test Statistic				0.638	Shapiro Wilk GOF Test							
180	5% Shapiro Wilk Critical Value				0.911	Data Not Normal at 5% Significance Level							
181	Lilliefors Test Statistic				0.284	Lilliefors GOF Test							
182	5% Lilliefors Critical Value				0.184	Data Not Normal at 5% Significance Level							
183	Data Not Normal at 5% Significance Level												
184													
185	Assuming Normal Distribution												
186	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
187	95% Student's-t UCL				15.27	95% Adjusted-CLT UCL (Chen-1995)				16.56			
188						95% Modified-t UCL (Johnson-1978)				15.49			
189													
190	Gamma GOF Test												
191	A-D Test Statistic				0.956	Anderson-Darling Gamma GOF Test							
192	5% A-D Critical Value				0.751	Data Not Gamma Distributed at 5% Significance Level							
193	K-S Test Statistic				0.184	Kolmogorov-Smirnov Gamma GOF Test							
194	5% K-S Critical Value				0.187	Detected data appear Gamma Distributed at 5% Significance Level							
195	Detected data follow Appr. Gamma Distribution at 5% Significance Level												
196													
197	Gamma Statistics												
198	k hat (MLE)				2.733	k star (bias corrected MLE)				2.39			
199	Theta hat (MLE)				4.288	Theta star (bias corrected MLE)				4.902			
200	nu hat (MLE)				120.2	nu star (bias corrected)				105.2			
201	MLE Mean (bias corrected)				11.72	MLE Sd (bias corrected)				7.579			
202						Approximate Chi Square Value (0.05)				82.51			
203	Adjusted Level of Significance				0.0386	Adjusted Chi Square Value				81.01			
204													
205	Assuming Gamma Distribution												
206	95% Approximate Gamma UCL (use when n>=50)				14.94	95% Adjusted Gamma UCL (use when n<50)				15.21			
207													
208	Lognormal GOF Test												

	A	B	C	D	E	F	G	H	I	J	K	L	
209	Shapiro Wilk Test Statistic					0.941	Shapiro Wilk Lognormal GOF Test						
210	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level						
211	Lilliefors Test Statistic					0.143	Lilliefors Lognormal GOF Test						
212	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level						
213	Data appear Lognormal at 5% Significance Level												
214													
215	Lognormal Statistics												
216	Minimum of Logged Data					1.157	Mean of logged Data					2.267	
217	Maximum of Logged Data					3.892	SD of logged Data					0.588	
218													
219	Assuming Lognormal Distribution												
220	95% H-UCL					14.99	90% Chebyshev (MVUE) UCL					15.87	
221	95% Chebyshev (MVUE) UCL					17.91	97.5% Chebyshev (MVUE) UCL					20.74	
222	99% Chebyshev (MVUE) UCL					26.3							
223													
224	Nonparametric Distribution Free UCL Statistics												
225	Data appear to follow a Discernible Distribution at 5% Significance Level												
226													
227	Nonparametric Distribution Free UCLs												
228	95% CLT UCL					15.11	95% Jackknife UCL					15.27	
229	95% Standard Bootstrap UCL					15.07	95% Bootstrap-t UCL					20.47	
230	95% Hall's Bootstrap UCL					32.39	95% Percentile Bootstrap UCL					15.47	
231	95% BCA Bootstrap UCL					16.68							
232	90% Chebyshev(Mean, Sd) UCL					17.91	95% Chebyshev(Mean, Sd) UCL					20.71	
233	97.5% Chebyshev(Mean, Sd) UCL					24.6	99% Chebyshev(Mean, Sd) UCL					32.24	
234													
235	Suggested UCL to Use												
236	95% Adjusted Gamma UCL					15.21							
237													
238	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test												
239	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL												
240													
241	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
242	Recommendations are based upon data size, data distribution, and skewness.												
243	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
244	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
245													
246													
247	Ba												
248													
249	General Statistics												
250	Total Number of Observations					22	Number of Distinct Observations					21	
251							Number of Missing Observations					0	
252	Minimum					64	Mean					289.1	
253	Maximum					1659	Median					140.5	
254	SD					384.1	Std. Error of Mean					81.89	
255	Coefficient of Variation					1.329	Skewness					2.816	
256													
257	Normal GOF Test												
258	Shapiro Wilk Test Statistic					0.587	Shapiro Wilk GOF Test						
259	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level						
260	Lilliefors Test Statistic					0.325	Lilliefors GOF Test						

	A	B	C	D	E	F	G	H	I	J	K	L	
261	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level						
262	Data Not Normal at 5% Significance Level												
263													
264	Assuming Normal Distribution												
265	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
266	95% Student's-t UCL					430	95% Adjusted-CLT UCL (Chen-1995)					476.3	
267							95% Modified-t UCL (Johnson-1978)					438.2	
268													
269	Gamma GOF Test												
270	A-D Test Statistic					1.6	Anderson-Darling Gamma GOF Test						
271	5% A-D Critical Value					0.766	Data Not Gamma Distributed at 5% Significance Level						
272	K-S Test Statistic					0.23	Kolmogorov-Smirnov Gamma GOF Test						
273	5% K-S Critical Value					0.19	Data Not Gamma Distributed at 5% Significance Level						
274	Data Not Gamma Distributed at 5% Significance Level												
275													
276	Gamma Statistics												
277	k hat (MLE)					1.215	k star (bias corrected MLE)					1.079	
278	Theta hat (MLE)					238	Theta star (bias corrected MLE)					267.8	
279	nu hat (MLE)					53.44	nu star (bias corrected)					47.49	
280	MLE Mean (bias corrected)					289.1	MLE Sd (bias corrected)					278.3	
281							Approximate Chi Square Value (0.05)					32.67	
282	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					31.75	
283													
284	Assuming Gamma Distribution												
285	95% Approximate Gamma UCL (use when n>=50))					420.1	95% Adjusted Gamma UCL (use when n<50)					432.3	
286													
287	Lognormal GOF Test												
288	Shapiro Wilk Test Statistic					0.896	Shapiro Wilk Lognormal GOF Test						
289	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level						
290	Lilliefors Test Statistic					0.16	Lilliefors Lognormal GOF Test						
291	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level						
292	Data appear Approximate Lognormal at 5% Significance Level												
293													
294	Lognormal Statistics												
295	Minimum of Logged Data					4.159	Mean of logged Data					5.202	
296	Maximum of Logged Data					7.414	SD of logged Data					0.872	
297													
298	Assuming Lognormal Distribution												
299	95% H-UCL					420.1	90% Chebyshev (MVUE) UCL					419	
300	95% Chebyshev (MVUE) UCL					491.3	97.5% Chebyshev (MVUE) UCL					591.6	
301	99% Chebyshev (MVUE) UCL					788.6							
302													
303	Nonparametric Distribution Free UCL Statistics												
304	Data appear to follow a Discernible Distribution at 5% Significance Level												
305													
306	Nonparametric Distribution Free UCLs												
307	95% CLT UCL					423.8	95% Jackknife UCL					430	
308	95% Standard Bootstrap UCL					415.9	95% Bootstrap-t UCL					673.7	
309	95% Hall's Bootstrap UCL					992	95% Percentile Bootstrap UCL					429.5	
310	95% BCA Bootstrap UCL					493.8							
311	90% Chebyshev(Mean, Sd) UCL					534.7	95% Chebyshev(Mean, Sd) UCL					646	
312	97.5% Chebyshev(Mean, Sd) UCL					800.5	99% Chebyshev(Mean, Sd) UCL					1104	

	A	B	C	D	E	F	G	H	I	J	K	L
313												
314	Suggested UCL to Use											
315	95% H-UCL				420.1							
316												
317	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
318	Recommendations are based upon data size, data distribution, and skewness.											
319	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
320	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
321												
322	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.											
323	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.											
324	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.											
325	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.											
326												
327												
328	B											
329												
330	General Statistics											
331	Total Number of Observations				22		Number of Distinct Observations				11	
332							Number of Missing Observations				0	
333	Minimum				2.5		Mean				12.3	
334	Maximum				73		Median				3	
335	SD				18.06		Std. Error of Mean				3.851	
336	Coefficient of Variation				1.469		Skewness				2.499	
337												
338	Normal GOF Test											
339	Shapiro Wilk Test Statistic				0.6		Shapiro Wilk GOF Test					
340	5% Shapiro Wilk Critical Value				0.911		Data Not Normal at 5% Significance Level					
341	Lilliefors Test Statistic				0.294		Lilliefors GOF Test					
342	5% Lilliefors Critical Value				0.184		Data Not Normal at 5% Significance Level					
343	Data Not Normal at 5% Significance Level											
344												
345	Assuming Normal Distribution											
346	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
347	95% Student's-t UCL				18.92		95% Adjusted-CLT UCL (Chen-1995)				20.82	
348							95% Modified-t UCL (Johnson-1978)				19.26	
349												
350	Gamma GOF Test											
351	A-D Test Statistic				2.615		Anderson-Darling Gamma GOF Test					
352	5% A-D Critical Value				0.777		Data Not Gamma Distributed at 5% Significance Level					
353	K-S Test Statistic				0.346		Kolmogorov-Smirnov Gamma GOF Test					
354	5% K-S Critical Value				0.192		Data Not Gamma Distributed at 5% Significance Level					
355	Data Not Gamma Distributed at 5% Significance Level											
356												
357	Gamma Statistics											
358	k hat (MLE)				0.881		k star (bias corrected MLE)				0.791	
359	Theta hat (MLE)				13.96		Theta star (bias corrected MLE)				15.54	
360	nu hat (MLE)				38.76		nu star (bias corrected)				34.8	
361	MLE Mean (bias corrected)				12.3		MLE Sd (bias corrected)				13.82	
362							Approximate Chi Square Value (0.05)				22.31	
363	Adjusted Level of Significance				0.0386		Adjusted Chi Square Value				21.56	
364												

	A	B	C	D	E	F	G	H	I	J	K	L
365	Assuming Gamma Distribution											
366	95% Approximate Gamma UCL (use when n>=50))					19.18	95% Adjusted Gamma UCL (use when n<50)					19.85
367												
368	Lognormal GOF Test											
369	Shapiro Wilk Test Statistic					0.764	Shapiro Wilk Lognormal GOF Test					
370	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level					
371	Lilliefors Test Statistic					0.349	Lilliefors Lognormal GOF Test					
372	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level					
373	Data Not Lognormal at 5% Significance Level											
374												
375	Lognormal Statistics											
376	Minimum of Logged Data					0.916	Mean of logged Data					1.844
377	Maximum of Logged Data					4.29	SD of logged Data					1.064
378												
379	Assuming Lognormal Distribution											
380	95% H-UCL					20.7	90% Chebyshev (MVUE) UCL					19.02
381	95% Chebyshev (MVUE) UCL					22.78	97.5% Chebyshev (MVUE) UCL					28.01
382	99% Chebyshev (MVUE) UCL					38.26						
383												
384	Nonparametric Distribution Free UCL Statistics											
385	Data do not follow a Discernible Distribution (0.05)											
386												
387	Nonparametric Distribution Free UCLs											
388	95% CLT UCL					18.63	95% Jackknife UCL					18.92
389	95% Standard Bootstrap UCL					18.5	95% Bootstrap-t UCL					27.05
390	95% Hall's Bootstrap UCL					43.18	95% Percentile Bootstrap UCL					18.64
391	95% BCA Bootstrap UCL					21.09						
392	90% Chebyshev(Mean, Sd) UCL					23.85	95% Chebyshev(Mean, Sd) UCL					29.08
393	97.5% Chebyshev(Mean, Sd) UCL					36.35	99% Chebyshev(Mean, Sd) UCL					50.61
394												
395	Suggested UCL to Use											
396	95% Chebyshev (Mean, Sd) UCL					29.08						
397												
398	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
399	Recommendations are based upon data size, data distribution, and skewness.											
400	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
401	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
402												
403												
404	Cd											
405												
406	General Statistics											
407	Total Number of Observations					22	Number of Distinct Observations					16
408							Number of Missing Observations					0
409	Minimum					0.137	Mean					0.402
410	Maximum					0.97	Median					0.29
411	SD					0.29	Std. Error of Mean					0.0618
412	Coefficient of Variation					0.721	Skewness					1.216
413												
414	Normal GOF Test											
415	Shapiro Wilk Test Statistic					0.737	Shapiro Wilk GOF Test					
416	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
417	Lilliefors Test Statistic					0.317	Lilliefors GOF Test						
418	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level						
419	Data Not Normal at 5% Significance Level												
420													
421	Assuming Normal Distribution												
422	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
423	95% Student's-t UCL					0.508	95% Adjusted-CLT UCL (Chen-1995)					0.521	
424							95% Modified-t UCL (Johnson-1978)					0.511	
425													
426	Gamma GOF Test												
427	A-D Test Statistic					1.601	Anderson-Darling Gamma GOF Test						
428	5% A-D Critical Value					0.752	Data Not Gamma Distributed at 5% Significance Level						
429	K-S Test Statistic					0.24	Kolmogorov-Smirnov Gamma GOF Test						
430	5% K-S Critical Value					0.187	Data Not Gamma Distributed at 5% Significance Level						
431	Data Not Gamma Distributed at 5% Significance Level												
432													
433	Gamma Statistics												
434	k hat (MLE)					2.544	k star (bias corrected MLE)					2.227	
435	Theta hat (MLE)					0.158	Theta star (bias corrected MLE)					0.181	
436	nu hat (MLE)					111.9	nu star (bias corrected)					97.99	
437	MLE Mean (bias corrected)					0.402	MLE Sd (bias corrected)					0.269	
438							Approximate Chi Square Value (0.05)					76.15	
439	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					74.72	
440													
441	Assuming Gamma Distribution												
442	95% Approximate Gamma UCL (use when n>=50))					0.517	95% Adjusted Gamma UCL (use when n<50)					0.527	
443													
444	Lognormal GOF Test												
445	Shapiro Wilk Test Statistic					0.875	Shapiro Wilk Lognormal GOF Test						
446	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level						
447	Lilliefors Test Statistic					0.194	Lilliefors Lognormal GOF Test						
448	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level						
449	Data Not Lognormal at 5% Significance Level												
450													
451	Lognormal Statistics												
452	Minimum of Logged Data					-1.988	Mean of logged Data					-1.12	
453	Maximum of Logged Data					-0.0305	SD of logged Data					0.636	
454													
455	Assuming Lognormal Distribution												
456	95% H-UCL					0.537	90% Chebyshev (MVUE) UCL					0.565	
457	95% Chebyshev (MVUE) UCL					0.642	97.5% Chebyshev (MVUE) UCL					0.749	
458	99% Chebyshev (MVUE) UCL					0.96							
459													
460	Nonparametric Distribution Free UCL Statistics												
461	Data do not follow a Discernible Distribution (0.05)												
462													
463	Nonparametric Distribution Free UCLs												
464	95% CLT UCL					0.504	95% Jackknife UCL					0.508	
465	95% Standard Bootstrap UCL					0.501	95% Bootstrap-t UCL					0.534	
466	95% Hall's Bootstrap UCL					0.5	95% Percentile Bootstrap UCL					0.506	
467	95% BCA Bootstrap UCL					0.521							
468	90% Chebyshev(Mean, Sd) UCL					0.588	95% Chebyshev(Mean, Sd) UCL					0.672	

	A	B	C	D	E	F	G	H	I	J	K	L
469	97.5% Chebyshev(Mean, Sd) UCL					0.788	99% Chebyshev(Mean, Sd) UCL					1.017
470												
471	Suggested UCL to Use											
472	95% Chebyshev (Mean, Sd) UCL					0.672						
473												
474	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
475	Recommendations are based upon data size, data distribution, and skewness.											
476	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
477	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
478												
479												
480	Hg											
481												
482	General Statistics											
483	Total Number of Observations					22	Number of Distinct Observations					9
484							Number of Missing Observations					0
485	Minimum					0.025	Mean					0.083
486	Maximum					0.38	Median					0.045
487	SD					0.0902	Std. Error of Mean					0.0192
488	Coefficient of Variation					1.088	Skewness					2.257
489												
490	Normal GOF Test											
491	Shapiro Wilk Test Statistic					0.659	Shapiro Wilk GOF Test					
492	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level					
493	Lilliefors Test Statistic					0.331	Lilliefors GOF Test					
494	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level					
495	Data Not Normal at 5% Significance Level											
496												
497	Assuming Normal Distribution											
498	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
499	95% Student's-t UCL					0.116	95% Adjusted-CLT UCL (Chen-1995)					0.124
500							95% Modified-t UCL (Johnson-1978)					0.118
501												
502	Gamma GOF Test											
503	A-D Test Statistic					1.988	Anderson-Darling Gamma GOF Test					
504	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level					
505	K-S Test Statistic					0.278	Kolmogorov-Smirnov Gamma GOF Test					
506	5% K-S Critical Value					0.189	Data Not Gamma Distributed at 5% Significance Level					
507	Data Not Gamma Distributed at 5% Significance Level											
508												
509	Gamma Statistics											
510	k hat (MLE)					1.477	k star (bias corrected MLE)					1.306
511	Theta hat (MLE)					0.0562	Theta star (bias corrected MLE)					0.0635
512	nu hat (MLE)					64.98	nu star (bias corrected)					57.46
513	MLE Mean (bias corrected)					0.083	MLE Sd (bias corrected)					0.0726
514							Approximate Chi Square Value (0.05)					41.03
515	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					40
516												
517	Assuming Gamma Distribution											
518	95% Approximate Gamma UCL (use when n>=50))					0.116	95% Adjusted Gamma UCL (use when n<50)					0.119
519												
520	Lognormal GOF Test											

	A	B	C	D	E	F	G	H	I	J	K	L	
521	Shapiro Wilk Test Statistic					0.821	Shapiro Wilk Lognormal GOF Test						
522	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level						
523	Lilliefors Test Statistic					0.286	Lilliefors Lognormal GOF Test						
524	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level						
525	Data Not Lognormal at 5% Significance Level												
526													
527	Lognormal Statistics												
528	Minimum of Logged Data					-3.689	Mean of logged Data					-2.865	
529	Maximum of Logged Data					-0.968	SD of logged Data					0.81	
530													
531	Assuming Lognormal Distribution												
532	95% H-UCL					0.12	90% Chebyshev (MVUE) UCL					0.122	
533	95% Chebyshev (MVUE) UCL					0.141	97.5% Chebyshev (MVUE) UCL					0.169	
534	99% Chebyshev (MVUE) UCL					0.223							
535													
536	Nonparametric Distribution Free UCL Statistics												
537	Data do not follow a Discernible Distribution (0.05)												
538													
539	Nonparametric Distribution Free UCLs												
540	95% CLT UCL					0.115	95% Jackknife UCL					0.116	
541	95% Standard Bootstrap UCL					0.114	95% Bootstrap-t UCL					0.14	
542	95% Hall's Bootstrap UCL					0.134	95% Percentile Bootstrap UCL					0.116	
543	95% BCA Bootstrap UCL					0.125							
544	90% Chebyshev(Mean, Sd) UCL					0.141	95% Chebyshev(Mean, Sd) UCL					0.167	
545	97.5% Chebyshev(Mean, Sd) UCL					0.203	99% Chebyshev(Mean, Sd) UCL					0.274	
546													
547	Suggested UCL to Use												
548	95% Chebyshev (Mean, Sd) UCL					0.167							
549													
550	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
551	Recommendations are based upon data size, data distribution, and skewness.												
552	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
553	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
554													
555													
556	Cr												
557													
558	General Statistics												
559	Total Number of Observations					22	Number of Distinct Observations					22	
560							Number of Missing Observations					0	
561	Minimum					14	Mean					155.7	
562	Maximum					1148	Median					63	
563	SD					255.8	Std. Error of Mean					54.54	
564	Coefficient of Variation					1.643	Skewness					3.201	
565													
566	Normal GOF Test												
567	Shapiro Wilk Test Statistic					0.56	Shapiro Wilk GOF Test						
568	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level						
569	Lilliefors Test Statistic					0.316	Lilliefors GOF Test						
570	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level						
571	Data Not Normal at 5% Significance Level												
572													

	A	B	C	D	E	F	G	H	I	J	K	L
573	Assuming Normal Distribution											
574	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
575	95% Student's-t UCL				249.5	95% Adjusted-CLT UCL (Chen-1995)					285.2	
576						95% Modified-t UCL (Johnson-1978)					255.7	
577												
578	Gamma GOF Test											
579	A-D Test Statistic				1.244	Anderson-Darling Gamma GOF Test						
580	5% A-D Critical Value				0.78	Data Not Gamma Distributed at 5% Significance Level						
581	K-S Test Statistic				0.196	Kolmogorov-Smirnov Gamma GOF Test						
582	5% K-S Critical Value				0.192	Data Not Gamma Distributed at 5% Significance Level						
583	Data Not Gamma Distributed at 5% Significance Level											
584												
585	Gamma Statistics											
586	k hat (MLE)				0.815	k star (bias corrected MLE)					0.734	
587	Theta hat (MLE)				191	Theta star (bias corrected MLE)					212.1	
588	nu hat (MLE)				35.86	nu star (bias corrected)					32.3	
589	MLE Mean (bias corrected)				155.7	MLE Sd (bias corrected)					181.7	
590						Approximate Chi Square Value (0.05)					20.31	
591	Adjusted Level of Significance				0.0386	Adjusted Chi Square Value					19.6	
592												
593	Assuming Gamma Distribution											
594	95% Approximate Gamma UCL (use when n>=50))				247.6	95% Adjusted Gamma UCL (use when n<50)					256.6	
595												
596	Lognormal GOF Test											
597	Shapiro Wilk Test Statistic				0.948	Shapiro Wilk Lognormal GOF Test						
598	5% Shapiro Wilk Critical Value				0.911	Data appear Lognormal at 5% Significance Level						
599	Lilliefors Test Statistic				0.135	Lilliefors Lognormal GOF Test						
600	5% Lilliefors Critical Value				0.184	Data appear Lognormal at 5% Significance Level						
601	Data appear Lognormal at 5% Significance Level											
602												
603	Lognormal Statistics											
604	Minimum of Logged Data				2.639	Mean of logged Data					4.321	
605	Maximum of Logged Data				7.046	SD of logged Data					1.128	
606												
607	Assuming Lognormal Distribution											
608	95% H-UCL				281.1	90% Chebyshev (MVUE) UCL					249.3	
609	95% Chebyshev (MVUE) UCL				300.5	97.5% Chebyshev (MVUE) UCL					371.6	
610	99% Chebyshev (MVUE) UCL				511.3							
611												
612	Nonparametric Distribution Free UCL Statistics											
613	Data appear to follow a Discernible Distribution at 5% Significance Level											
614												
615	Nonparametric Distribution Free UCLs											
616	95% CLT UCL				245.4	95% Jackknife UCL					249.5	
617	95% Standard Bootstrap UCL				244.8	95% Bootstrap-t UCL					404	
618	95% Hall's Bootstrap UCL				583.6	95% Percentile Bootstrap UCL					246.6	
619	95% BCA Bootstrap UCL				289.1							
620	90% Chebyshev(Mean, Sd) UCL				319.3	95% Chebyshev(Mean, Sd) UCL					393.4	
621	97.5% Chebyshev(Mean, Sd) UCL				496.3	99% Chebyshev(Mean, Sd) UCL					698.3	
622												
623	Suggested UCL to Use											
624	95% Chebyshev (Mean, Sd) UCL				393.4							

	A	B	C	D	E	F	G	H	I	J	K	L
625												
626	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
627	Recommendations are based upon data size, data distribution, and skewness.											
628	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
629	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
630												
631												
632	Mo											
633												
634	General Statistics											
635	Total Number of Observations					22	Number of Distinct Observations					15
636							Number of Missing Observations					0
637	Minimum					0.3	Mean					1.953
638	Maximum					8.3	Median					1.5
639	SD					1.702	Std. Error of Mean					0.363
640	Coefficient of Variation					0.871	Skewness					2.744
641												
642	Normal GOF Test											
643	Shapiro Wilk Test Statistic					0.696	Shapiro Wilk GOF Test					
644	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level					
645	Lilliefors Test Statistic					0.307	Lilliefors GOF Test					
646	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level					
647	Data Not Normal at 5% Significance Level											
648												
649	Assuming Normal Distribution											
650	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
651	95% Student's-t UCL					2.578	95% Adjusted-CLT UCL (Chen-1995)					2.777
652							95% Modified-t UCL (Johnson-1978)					2.613
653												
654	Gamma GOF Test											
655	A-D Test Statistic					0.77	Anderson-Darling Gamma GOF Test					
656	5% A-D Critical Value					0.755	Data Not Gamma Distributed at 5% Significance Level					
657	K-S Test Statistic					0.214	Kolmogorov-Smirnov Gamma GOF Test					
658	5% K-S Critical Value					0.188	Data Not Gamma Distributed at 5% Significance Level					
659	Data Not Gamma Distributed at 5% Significance Level											
660												
661	Gamma Statistics											
662	k hat (MLE)					2.148	k star (bias corrected MLE)					1.885
663	Theta hat (MLE)					0.909	Theta star (bias corrected MLE)					1.036
664	nu hat (MLE)					94.5	nu star (bias corrected)					82.95
665	MLE Mean (bias corrected)					1.953	MLE Sd (bias corrected)					1.423
666							Approximate Chi Square Value (0.05)					62.96
667	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					61.66
668												
669	Assuming Gamma Distribution											
670	95% Approximate Gamma UCL (use when n>=50))					2.573	95% Adjusted Gamma UCL (use when n<50)					2.628
671												
672	Lognormal GOF Test											
673	Shapiro Wilk Test Statistic					0.959	Shapiro Wilk Lognormal GOF Test					
674	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level					
675	Lilliefors Test Statistic					0.167	Lilliefors Lognormal GOF Test					
676	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
677	Data appear Lognormal at 5% Significance Level											
678												
679	Lognormal Statistics											
680	Minimum of Logged Data				-1.204		Mean of logged Data				0.419	
681	Maximum of Logged Data				2.116		SD of logged Data				0.707	
682												
683	Assuming Lognormal Distribution											
684	95% H-UCL				2.747		90% Chebyshev (MVUE) UCL				2.86	
685	95% Chebyshev (MVUE) UCL				3.283		97.5% Chebyshev (MVUE) UCL				3.87	
686	99% Chebyshev (MVUE) UCL				5.024							
687												
688	Nonparametric Distribution Free UCL Statistics											
689	Data appear to follow a Discernible Distribution at 5% Significance Level											
690												
691	Nonparametric Distribution Free UCLs											
692	95% CLT UCL				2.55		95% Jackknife UCL				2.578	
693	95% Standard Bootstrap UCL				2.541		95% Bootstrap-t UCL				3.137	
694	95% Hall's Bootstrap UCL				5.049		95% Percentile Bootstrap UCL				2.569	
695	95% BCA Bootstrap UCL				2.862							
696	90% Chebyshev(Mean, Sd) UCL				3.042		95% Chebyshev(Mean, Sd) UCL				3.535	
697	97.5% Chebyshev(Mean, Sd) UCL				4.219		99% Chebyshev(Mean, Sd) UCL				5.563	
698												
699	Suggested UCL to Use											
700	95% H-UCL				2.747							
701												
702	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
703	Recommendations are based upon data size, data distribution, and skewness.											
704	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
705	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
706												
707	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.											
708	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.											
709	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.											
710	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.											
711												
712												
713	Ni											
714												
715	General Statistics											
716	Total Number of Observations				22		Number of Distinct Observations				22	
717							Number of Missing Observations				0	
718	Minimum				26		Mean				234.9	
719	Maximum				1148		Median				92	
720	SD				334.1		Std. Error of Mean				71.24	
721	Coefficient of Variation				1.422		Skewness				2.094	
722												
723	Normal GOF Test											
724	Shapiro Wilk Test Statistic				0.632		Shapiro Wilk GOF Test					
725	5% Shapiro Wilk Critical Value				0.911		Data Not Normal at 5% Significance Level					
726	Lilliefors Test Statistic				0.323		Lilliefors GOF Test					
727	5% Lilliefors Critical Value				0.184		Data Not Normal at 5% Significance Level					
728	Data Not Normal at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
729												
730	Assuming Normal Distribution											
731	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
732	95% Student's-t UCL					357.5	95% Adjusted-CLT UCL (Chen-1995)					386.1
733							95% Modified-t UCL (Johnson-1978)					362.8
734												
735	Gamma GOF Test											
736	A-D Test Statistic					1.439	Anderson-Darling Gamma GOF Test					
737	5% A-D Critical Value					0.779	Data Not Gamma Distributed at 5% Significance Level					
738	K-S Test Statistic					0.224	Kolmogorov-Smirnov Gamma GOF Test					
739	5% K-S Critical Value					0.192	Data Not Gamma Distributed at 5% Significance Level					
740	Data Not Gamma Distributed at 5% Significance Level											
741												
742	Gamma Statistics											
743	k hat (MLE)					0.83	k star (bias corrected MLE)					0.747
744	Theta hat (MLE)					282.9	Theta star (bias corrected MLE)					314.3
745	nu hat (MLE)					36.54	nu star (bias corrected)					32.89
746	MLE Mean (bias corrected)					234.9	MLE Sd (bias corrected)					271.8
747							Approximate Chi Square Value (0.05)					20.78
748	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					20.06
749												
750	Assuming Gamma Distribution											
751	95% Approximate Gamma UCL (use when n>=50))					371.9	95% Adjusted Gamma UCL (use when n<50)					385.2
752												
753	Lognormal GOF Test											
754	Shapiro Wilk Test Statistic					0.918	Shapiro Wilk Lognormal GOF Test					
755	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level					
756	Lilliefors Test Statistic					0.15	Lilliefors Lognormal GOF Test					
757	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level					
758	Data appear Lognormal at 5% Significance Level											
759												
760	Lognormal Statistics											
761	Minimum of Logged Data					3.258	Mean of logged Data					4.748
762	Maximum of Logged Data					7.046	SD of logged Data					1.149
763												
764	Assuming Lognormal Distribution											
765	95% H-UCL					449.5	90% Chebyshev (MVUE) UCL					393.7
766	95% Chebyshev (MVUE) UCL					475.6	97.5% Chebyshev (MVUE) UCL					589.2
767	99% Chebyshev (MVUE) UCL					812.3						
768												
769	Nonparametric Distribution Free UCL Statistics											
770	Data appear to follow a Discernible Distribution at 5% Significance Level											
771												
772	Nonparametric Distribution Free UCLs											
773	95% CLT UCL					352.1	95% Jackknife UCL					357.5
774	95% Standard Bootstrap UCL					349.6	95% Bootstrap-t UCL					448.3
775	95% Hall's Bootstrap UCL					387.6	95% Percentile Bootstrap UCL					358.6
776	95% BCA Bootstrap UCL					385.4						
777	90% Chebyshev(Mean, Sd) UCL					448.7	95% Chebyshev(Mean, Sd) UCL					545.5
778	97.5% Chebyshev(Mean, Sd) UCL					679.8	99% Chebyshev(Mean, Sd) UCL					943.7
779												
780	Suggested UCL to Use											

	A	B	C	D	E	F	G	H	I	J	K	L
781	95% Chebyshev (Mean, Sd) UCL					545.5						
782												
783	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
784	Recommendations are based upon data size, data distribution, and skewness.											
785	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
786	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
787												
788												
789	Se											
790												
791	General Statistics											
792	Total Number of Observations				22	Number of Distinct Observations				11		
793						Number of Missing Observations				0		
794	Minimum				0.1	Mean				1.109		
795	Maximum				7.1	Median				0.5		
796	SD				1.591	Std. Error of Mean				0.339		
797	Coefficient of Variation				1.435	Skewness				2.904		
798												
799	Normal GOF Test											
800	Shapiro Wilk Test Statistic				0.599	Shapiro Wilk GOF Test						
801	5% Shapiro Wilk Critical Value				0.911	Data Not Normal at 5% Significance Level						
802	Lilliefors Test Statistic				0.329	Lilliefors GOF Test						
803	5% Lilliefors Critical Value				0.184	Data Not Normal at 5% Significance Level						
804	Data Not Normal at 5% Significance Level											
805												
806	Assuming Normal Distribution											
807	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
808	95% Student's-t UCL				1.693	95% Adjusted-CLT UCL (Chen-1995)				1.891		
809						95% Modified-t UCL (Johnson-1978)				1.728		
810												
811	Gamma GOF Test											
812	A-D Test Statistic				1.604	Anderson-Darling Gamma GOF Test						
813	5% A-D Critical Value				0.774	Data Not Gamma Distributed at 5% Significance Level						
814	K-S Test Statistic				0.259	Kolmogorov-Smirnov Gamma GOF Test						
815	5% K-S Critical Value				0.191	Data Not Gamma Distributed at 5% Significance Level						
816	Data Not Gamma Distributed at 5% Significance Level											
817												
818	Gamma Statistics											
819	k hat (MLE)				0.928	k star (bias corrected MLE)				0.832		
820	Theta hat (MLE)				1.195	Theta star (bias corrected MLE)				1.333		
821	nu hat (MLE)				40.84	nu star (bias corrected)				36.61		
822	MLE Mean (bias corrected)				1.109	MLE Sd (bias corrected)				1.216		
823						Approximate Chi Square Value (0.05)				23.76		
824	Adjusted Level of Significance				0.0386	Adjusted Chi Square Value				22.98		
825												
826	Assuming Gamma Distribution											
827	95% Approximate Gamma UCL (use when n>=50))				1.709	95% Adjusted Gamma UCL (use when n<50)				1.766		
828												
829	Lognormal GOF Test											
830	Shapiro Wilk Test Statistic				0.901	Shapiro Wilk Lognormal GOF Test						
831	5% Shapiro Wilk Critical Value				0.911	Data Not Lognormal at 5% Significance Level						
832	Lilliefors Test Statistic				0.224	Lilliefors Lognormal GOF Test						

	A	B	C	D	E	F	G	H	I	J	K	L	
833	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level						
834	Data Not Lognormal at 5% Significance Level												
835													
836	Lognormal Statistics												
837	Minimum of Logged Data				-2.303	Mean of logged Data					-0.524		
838	Maximum of Logged Data				1.96	SD of logged Data					1.097		
839													
840	Assuming Lognormal Distribution												
841	95% H-UCL				2.074	90% Chebyshev (MVUE) UCL					1.872		
842	95% Chebyshev (MVUE) UCL				2.25	97.5% Chebyshev (MVUE) UCL					2.774		
843	99% Chebyshev (MVUE) UCL				3.804								
844													
845	Nonparametric Distribution Free UCL Statistics												
846	Data do not follow a Discernible Distribution (0.05)												
847													
848	Nonparametric Distribution Free UCLs												
849	95% CLT UCL				1.667	95% Jackknife UCL					1.693		
850	95% Standard Bootstrap UCL				1.651	95% Bootstrap-t UCL					2.34		
851	95% Hall's Bootstrap UCL				3.487	95% Percentile Bootstrap UCL					1.668		
852	95% BCA Bootstrap UCL				1.955								
853	90% Chebyshev(Mean, Sd) UCL				2.127	95% Chebyshev(Mean, Sd) UCL					2.588		
854	97.5% Chebyshev(Mean, Sd) UCL				3.227	99% Chebyshev(Mean, Sd) UCL					4.484		
855													
856	Suggested UCL to Use												
857	95% Chebyshev (Mean, Sd) UCL				2.588								
858													
859	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
860	Recommendations are based upon data size, data distribution, and skewness.												
861	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
862	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
863													
864													
865	Zn												
866													
867	General Statistics												
868	Total Number of Observations				22	Number of Distinct Observations					19		
869						Number of Missing Observations					0		
870	Minimum				20.46	Mean					63.57		
871	Maximum				151	Median					59.5		
872	SD				31.3	Std. Error of Mean					6.674		
873	Coefficient of Variation				0.492	Skewness					1.27		
874													
875	Normal GOF Test												
876	Shapiro Wilk Test Statistic				0.903	Shapiro Wilk GOF Test							
877	5% Shapiro Wilk Critical Value				0.911	Data Not Normal at 5% Significance Level							
878	Lilliefors Test Statistic				0.167	Lilliefors GOF Test							
879	5% Lilliefors Critical Value				0.184	Data appear Normal at 5% Significance Level							
880	Data appear Approximate Normal at 5% Significance Level												
881													
882	Assuming Normal Distribution												
883	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
884	95% Student's-t UCL				75.05	95% Adjusted-CLT UCL (Chen-1995)					76.47		

	A	B	C	D	E	F	G	H	I	J	K	L
885							95% Modified-t UCL (Johnson-1978)					75.35
886												
887	Gamma GOF Test											
888	A-D Test Statistic					0.255	Anderson-Darling Gamma GOF Test					
889	5% A-D Critical Value					0.746	Detected data appear Gamma Distributed at 5% Significance Level					
890	K-S Test Statistic					0.108	Kolmogorov-Smirnov Gamma GOF Test					
891	5% K-S Critical Value					0.186	Detected data appear Gamma Distributed at 5% Significance Level					
892	Detected data appear Gamma Distributed at 5% Significance Level											
893												
894	Gamma Statistics											
895	k hat (MLE)					4.79	k star (bias corrected MLE)					4.167
896	Theta hat (MLE)					13.27	Theta star (bias corrected MLE)					15.25
897	nu hat (MLE)					210.8	nu star (bias corrected)					183.4
898	MLE Mean (bias corrected)					63.57	MLE Sd (bias corrected)					31.14
899							Approximate Chi Square Value (0.05)					153
900	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					151
901												
902	Assuming Gamma Distribution											
903	95% Approximate Gamma UCL (use when n>=50))					76.16	95% Adjusted Gamma UCL (use when n<50)					77.2
904												
905	Lognormal GOF Test											
906	Shapiro Wilk Test Statistic					0.985	Shapiro Wilk Lognormal GOF Test					
907	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level					
908	Lilliefors Test Statistic					0.102	Lilliefors Lognormal GOF Test					
909	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level					
910	Data appear Lognormal at 5% Significance Level											
911												
912	Lognormal Statistics											
913	Minimum of Logged Data					3.018	Mean of logged Data					4.044
914	Maximum of Logged Data					5.017	SD of logged Data					0.478
915												
916	Assuming Lognormal Distribution											
917	95% H-UCL					78.61	90% Chebyshev (MVUE) UCL					83.74
918	95% Chebyshev (MVUE) UCL					92.86	97.5% Chebyshev (MVUE) UCL					105.5
919	99% Chebyshev (MVUE) UCL					130.4						
920												
921	Nonparametric Distribution Free UCL Statistics											
922	Data appear to follow a Discernible Distribution at 5% Significance Level											
923												
924	Nonparametric Distribution Free UCLs											
925	95% CLT UCL					74.54	95% Jackknife UCL					75.05
926	95% Standard Bootstrap UCL					74.21	95% Bootstrap-t UCL					77.77
927	95% Hall's Bootstrap UCL					78.43	95% Percentile Bootstrap UCL					74.66
928	95% BCA Bootstrap UCL					75.82						
929	90% Chebyshev(Mean, Sd) UCL					83.59	95% Chebyshev(Mean, Sd) UCL					92.66
930	97.5% Chebyshev(Mean, Sd) UCL					105.2	99% Chebyshev(Mean, Sd) UCL					130
931												
932	Suggested UCL to Use											
933	95% Student's-t UCL					75.05						
934												
935	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
936	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											

	A	B	C	D	E	F	G	H	I	J	K	L
937												
938	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
939	Recommendations are based upon data size, data distribution, and skewness.											
940	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
941	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
942												
943												
944	Co											
945												
946	General Statistics											
947	Total Number of Observations					22	Number of Distinct Observations					13
948							Number of Missing Observations					0
949	Minimum					3	Mean					18.09
950	Maximum					74	Median					11.5
951	SD					17.44	Std. Error of Mean					3.717
952	Coefficient of Variation					0.964	Skewness					2.322
953												
954	Normal GOF Test											
955	Shapiro Wilk Test Statistic					0.632	Shapiro Wilk GOF Test					
956	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level					
957	Lilliefors Test Statistic					0.365	Lilliefors GOF Test					
958	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level					
959	Data Not Normal at 5% Significance Level											
960												
961	Assuming Normal Distribution											
962	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
963	95% Student's-t UCL					24.49	95% Adjusted-CLT UCL (Chen-1995)					26.17
964							95% Modified-t UCL (Johnson-1978)					24.79
965												
966	Gamma GOF Test											
967	A-D Test Statistic					2.36	Anderson-Darling Gamma GOF Test					
968	5% A-D Critical Value					0.757	Data Not Gamma Distributed at 5% Significance Level					
969	K-S Test Statistic					0.31	Kolmogorov-Smirnov Gamma GOF Test					
970	5% K-S Critical Value					0.188	Data Not Gamma Distributed at 5% Significance Level					
971	Data Not Gamma Distributed at 5% Significance Level											
972												
973	Gamma Statistics											
974	k hat (MLE)					1.928	k star (bias corrected MLE)					1.696
975	Theta hat (MLE)					9.381	Theta star (bias corrected MLE)					10.67
976	nu hat (MLE)					84.85	nu star (bias corrected)					74.61
977	MLE Mean (bias corrected)					18.09	MLE Sd (bias corrected)					13.89
978							Approximate Chi Square Value (0.05)					55.72
979	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					54.5
980												
981	Assuming Gamma Distribution											
982	95% Approximate Gamma UCL (use when n>=50))					24.23	95% Adjusted Gamma UCL (use when n<50)					24.77
983												
984	Lognormal GOF Test											
985	Shapiro Wilk Test Statistic					0.843	Shapiro Wilk Lognormal GOF Test					
986	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level					
987	Lilliefors Test Statistic					0.259	Lilliefors Lognormal GOF Test					
988	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
989	Data Not Lognormal at 5% Significance Level											
990												
991	Lognormal Statistics											
992	Minimum of Logged Data				1.099	Mean of logged Data				2.614		
993	Maximum of Logged Data				4.304	SD of logged Data				0.704		
994												
995	Assuming Lognormal Distribution											
996	95% H-UCL				24.56	90% Chebyshev (MVUE) UCL				25.59		
997	95% Chebyshev (MVUE) UCL				29.36	97.5% Chebyshev (MVUE) UCL				34.6		
998	99% Chebyshev (MVUE) UCL				44.88							
999												
1000	Nonparametric Distribution Free UCL Statistics											
1001	Data do not follow a Discernible Distribution (0.05)											
1002												
1003	Nonparametric Distribution Free UCLs											
1004	95% CLT UCL				24.21	95% Jackknife UCL				24.49		
1005	95% Standard Bootstrap UCL				23.93	95% Bootstrap-t UCL				29.97		
1006	95% Hall's Bootstrap UCL				27.56	95% Percentile Bootstrap UCL				24.77		
1007	95% BCA Bootstrap UCL				27							
1008	90% Chebyshev(Mean, Sd) UCL				29.24	95% Chebyshev(Mean, Sd) UCL				34.29		
1009	97.5% Chebyshev(Mean, Sd) UCL				41.3	99% Chebyshev(Mean, Sd) UCL				55.08		
1010												
1011	Suggested UCL to Use											
1012	95% Chebyshev (Mean, Sd) UCL				34.29							
1013												
1014	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1015	Recommendations are based upon data size, data distribution, and skewness.											
1016	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1017	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1018												
1019												
1020	Fe											
1021												
1022	General Statistics											
1023	Total Number of Observations				22	Number of Distinct Observations				22		
1024						Number of Missing Observations				0		
1025	Minimum				6377	Mean				23348		
1026	Maximum				64483	Median				21381		
1027	SD				11534	Std. Error of Mean				2459		
1028	Coefficient of Variation				0.494	Skewness				2.17		
1029												
1030	Normal GOF Test											
1031	Shapiro Wilk Test Statistic				0.805	Shapiro Wilk GOF Test						
1032	5% Shapiro Wilk Critical Value				0.911	Data Not Normal at 5% Significance Level						
1033	Lilliefors Test Statistic				0.2	Lilliefors GOF Test						
1034	5% Lilliefors Critical Value				0.184	Data Not Normal at 5% Significance Level						
1035	Data Not Normal at 5% Significance Level											
1036												
1037	Assuming Normal Distribution											
1038	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1039	95% Student's-t UCL				27580	95% Adjusted-CLT UCL (Chen-1995)				28609		
1040						95% Modified-t UCL (Johnson-1978)				27769		

	A	B	C	D	E	F	G	H	I	J	K	L
1041												
1042	Gamma GOF Test											
1043	A-D Test Statistic					0.613	Anderson-Darling Gamma GOF Test					
1044	5% A-D Critical Value					0.746	Detected data appear Gamma Distributed at 5% Significance Level					
1045	K-S Test Statistic					0.171	Kolmogorov-Smirnov Gamma GOF Test					
1046	5% K-S Critical Value					0.186	Detected data appear Gamma Distributed at 5% Significance Level					
1047	Detected data appear Gamma Distributed at 5% Significance Level											
1048												
1049	Gamma Statistics											
1050	k hat (MLE)					5.197	k star (bias corrected MLE)					4.518
1051	Theta hat (MLE)					4493	Theta star (bias corrected MLE)					5167
1052	nu hat (MLE)					228.7	nu star (bias corrected)					198.8
1053	MLE Mean (bias corrected)					23348	MLE Sd (bias corrected)					10984
1054							Approximate Chi Square Value (0.05)					167.2
1055	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					165
1056												
1057	Assuming Gamma Distribution											
1058	95% Approximate Gamma UCL (use when n>=50)					27764	95% Adjusted Gamma UCL (use when n<50)					28128
1059												
1060	Lognormal GOF Test											
1061	Shapiro Wilk Test Statistic					0.935	Shapiro Wilk Lognormal GOF Test					
1062	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level					
1063	Lilliefors Test Statistic					0.194	Lilliefors Lognormal GOF Test					
1064	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level					
1065	Data appear Approximate Lognormal at 5% Significance Level											
1066												
1067	Lognormal Statistics											
1068	Minimum of Logged Data					8.76	Mean of logged Data					9.959
1069	Maximum of Logged Data					11.07	SD of logged Data					0.46
1070												
1071	Assuming Lognormal Distribution											
1072	95% H-UCL					28607	90% Chebyshev (MVUE) UCL					30476
1073	95% Chebyshev (MVUE) UCL					33692	97.5% Chebyshev (MVUE) UCL					38156
1074	99% Chebyshev (MVUE) UCL					46924						
1075												
1076	Nonparametric Distribution Free UCL Statistics											
1077	Data appear to follow a Discernible Distribution at 5% Significance Level											
1078												
1079	Nonparametric Distribution Free UCLs											
1080	95% CLT UCL					27393	95% Jackknife UCL					27580
1081	95% Standard Bootstrap UCL					27413	95% Bootstrap-t UCL					29512
1082	95% Hall's Bootstrap UCL					48829	95% Percentile Bootstrap UCL					27426
1083	95% BCA Bootstrap UCL					28707						
1084	90% Chebyshev(Mean, Sd) UCL					30725	95% Chebyshev(Mean, Sd) UCL					34067
1085	97.5% Chebyshev(Mean, Sd) UCL					38705	99% Chebyshev(Mean, Sd) UCL					47815
1086												
1087	Suggested UCL to Use											
1088	95% Adjusted Gamma UCL					28128						
1089												
1090	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1091	Recommendations are based upon data size, data distribution, and skewness.											
1092	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

	A	B	C	D	E	F	G	H	I	J	K	L
1093	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1094												
1095												
1096	Li											
1097												
1098		General Statistics										
1099	Total Number of Observations				22		Number of Distinct Observations				11	
1100							Number of Missing Observations				0	
1101	Minimum				1		Mean				6.905	
1102	Maximum				15		Median				6	
1103	SD				4.21		Std. Error of Mean				0.898	
1104	Coefficient of Variation				0.61		Skewness				0.35	
1105												
1106	Normal GOF Test											
1107	Shapiro Wilk Test Statistic				0.934		Shapiro Wilk GOF Test					
1108	5% Shapiro Wilk Critical Value				0.911		Data appear Normal at 5% Significance Level					
1109	Lilliefors Test Statistic				0.131		Lilliefors GOF Test					
1110	5% Lilliefors Critical Value				0.184		Data appear Normal at 5% Significance Level					
1111	Data appear Normal at 5% Significance Level											
1112												
1113	Assuming Normal Distribution											
1114	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1115	95% Student's-t UCL				8.449		95% Adjusted-CLT UCL (Chen-1995)				8.453	
1116							95% Modified-t UCL (Johnson-1978)				8.461	
1117												
1118	Gamma GOF Test											
1119	A-D Test Statistic				0.929		Anderson-Darling Gamma GOF Test					
1120	5% A-D Critical Value				0.756		Data Not Gamma Distributed at 5% Significance Level					
1121	K-S Test Statistic				0.201		Kolmogorov-Smirnov Gamma GOF Test					
1122	5% K-S Critical Value				0.188		Data Not Gamma Distributed at 5% Significance Level					
1123	Data Not Gamma Distributed at 5% Significance Level											
1124												
1125	Gamma Statistics											
1126	k hat (MLE)				1.976		k star (bias corrected MLE)				1.737	
1127	Theta hat (MLE)				3.495		Theta star (bias corrected MLE)				3.976	
1128	nu hat (MLE)				86.94		nu star (bias corrected)				76.42	
1129	MLE Mean (bias corrected)				6.905		MLE Sd (bias corrected)				5.239	
1130							Approximate Chi Square Value (0.05)				57.28	
1131	Adjusted Level of Significance				0.0386		Adjusted Chi Square Value				56.05	
1132												
1133	Assuming Gamma Distribution											
1134	95% Approximate Gamma UCL (use when n>=50))				9.212		95% Adjusted Gamma UCL (use when n<50)				9.415	
1135												
1136	Lognormal GOF Test											
1137	Shapiro Wilk Test Statistic				0.826		Shapiro Wilk Lognormal GOF Test					
1138	5% Shapiro Wilk Critical Value				0.911		Data Not Lognormal at 5% Significance Level					
1139	Lilliefors Test Statistic				0.242		Lilliefors Lognormal GOF Test					
1140	5% Lilliefors Critical Value				0.184		Data Not Lognormal at 5% Significance Level					
1141	Data Not Lognormal at 5% Significance Level											
1142												
1143	Lognormal Statistics											
1144	Minimum of Logged Data				0		Mean of logged Data				1.658	

	A	B	C	D	E	F	G	H	I	J	K	L
1145	Maximum of Logged Data					2.708	SD of logged Data					0.88
1146												
1147	Assuming Lognormal Distribution											
1148	95% H-UCL				12.32	90% Chebyshev (MVUE) UCL					12.25	
1149	95% Chebyshev (MVUE) UCL				14.38	97.5% Chebyshev (MVUE) UCL					17.33	
1150	99% Chebyshev (MVUE) UCL				23.13							
1151												
1152	Nonparametric Distribution Free UCL Statistics											
1153	Data appear to follow a Discernible Distribution at 5% Significance Level											
1154												
1155	Nonparametric Distribution Free UCLs											
1156	95% CLT UCL				8.381	95% Jackknife UCL					8.449	
1157	95% Standard Bootstrap UCL				8.351	95% Bootstrap-t UCL					8.539	
1158	95% Hall's Bootstrap UCL				8.408	95% Percentile Bootstrap UCL					8.36	
1159	95% BCA Bootstrap UCL				8.364							
1160	90% Chebyshev(Mean, Sd) UCL				9.598	95% Chebyshev(Mean, Sd) UCL					10.82	
1161	97.5% Chebyshev(Mean, Sd) UCL				12.51	99% Chebyshev(Mean, Sd) UCL					15.84	
1162												
1163	Suggested UCL to Use											
1164	95% Student's-t UCL				8.449							
1165												
1166	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1167	Recommendations are based upon data size, data distribution, and skewness.											
1168	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1169	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1170												
1171												
1172	Mn											
1173												
1174	General Statistics											
1175	Total Number of Observations				22	Number of Distinct Observations					22	
1176						Number of Missing Observations					0	
1177	Minimum				62.6	Mean					437.1	
1178	Maximum				1026	Median					404.5	
1179	SD				218.7	Std. Error of Mean					46.63	
1180	Coefficient of Variation				0.5	Skewness					1.017	
1181												
1182	Normal GOF Test											
1183	Shapiro Wilk Test Statistic				0.932	Shapiro Wilk GOF Test						
1184	5% Shapiro Wilk Critical Value				0.911	Data appear Normal at 5% Significance Level						
1185	Lilliefors Test Statistic				0.169	Lilliefors GOF Test						
1186	5% Lilliefors Critical Value				0.184	Data appear Normal at 5% Significance Level						
1187	Data appear Normal at 5% Significance Level											
1188												
1189	Assuming Normal Distribution											
1190	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1191	95% Student's-t UCL				517.3	95% Adjusted-CLT UCL (Chen-1995)					524.6	
1192						95% Modified-t UCL (Johnson-1978)					519	
1193												
1194	Gamma GOF Test											
1195	A-D Test Statistic				0.365	Anderson-Darling Gamma GOF Test						
1196	5% A-D Critical Value				0.747	Detected data appear Gamma Distributed at 5% Significance Level						

	A	B	C	D	E	F	G	H	I	J	K	L	
1197	K-S Test Statistic					0.124	Kolmogorov-Smirnov Gamma GOF Test						
1198	5% K-S Critical Value					0.186	Detected data appear Gamma Distributed at 5% Significance Level						
1199	Detected data appear Gamma Distributed at 5% Significance Level												
1200													
1201	Gamma Statistics												
1202	k hat (MLE)					3.826	k star (bias corrected MLE)					3.334	
1203	Theta hat (MLE)					114.2	Theta star (bias corrected MLE)					131.1	
1204	nu hat (MLE)					168.3	nu star (bias corrected)					146.7	
1205	MLE Mean (bias corrected)					437.1	MLE Sd (bias corrected)					239.4	
1206							Approximate Chi Square Value (0.05)					119.7	
1207	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					117.9	
1208													
1209	Assuming Gamma Distribution												
1210	95% Approximate Gamma UCL (use when n>=50))					535.6	95% Adjusted Gamma UCL (use when n<50)					543.9	
1211													
1212	Lognormal GOF Test												
1213	Shapiro Wilk Test Statistic					0.906	Shapiro Wilk Lognormal GOF Test						
1214	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level						
1215	Lilliefors Test Statistic					0.155	Lilliefors Lognormal GOF Test						
1216	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level						
1217	Data appear Approximate Lognormal at 5% Significance Level												
1218													
1219	Lognormal Statistics												
1220	Minimum of Logged Data					4.137	Mean of logged Data					5.944	
1221	Maximum of Logged Data					6.933	SD of logged Data					0.586	
1222													
1223	Assuming Lognormal Distribution												
1224	95% H-UCL					590.6	90% Chebyshev (MVUE) UCL					625.5	
1225	95% Chebyshev (MVUE) UCL					705.5	97.5% Chebyshev (MVUE) UCL					816.7	
1226	99% Chebyshev (MVUE) UCL					1035							
1227													
1228	Nonparametric Distribution Free UCL Statistics												
1229	Data appear to follow a Discernible Distribution at 5% Significance Level												
1230													
1231	Nonparametric Distribution Free UCLs												
1232	95% CLT UCL					513.8	95% Jackknife UCL					517.3	
1233	95% Standard Bootstrap UCL					513.1	95% Bootstrap-t UCL					533.7	
1234	95% Hall's Bootstrap UCL					545.1	95% Percentile Bootstrap UCL					513.7	
1235	95% BCA Bootstrap UCL					523							
1236	90% Chebyshev(Mean, Sd) UCL					577	95% Chebyshev(Mean, Sd) UCL					640.3	
1237	97.5% Chebyshev(Mean, Sd) UCL					728.3	99% Chebyshev(Mean, Sd) UCL					901.1	
1238													
1239	Suggested UCL to Use												
1240	95% Student's-t UCL					517.3							
1241													
1242	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1243	Recommendations are based upon data size, data distribution, and skewness.												
1244	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1245	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
1246													
1247													
1248	V												

	A	B	C	D	E	F	G	H	I	J	K	L
1249												
1250	General Statistics											
1251	Total Number of Observations					22	Number of Distinct Observations					16
1252							Number of Missing Observations					0
1253	Minimum					10	Mean					27.48
1254	Maximum					65	Median					25
1255	SD					16.39	Std. Error of Mean					3.494
1256	Coefficient of Variation					0.596	Skewness					0.918
1257												
1258	Normal GOF Test											
1259	Shapiro Wilk Test Statistic					0.894	Shapiro Wilk GOF Test					
1260	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level					
1261	Lilliefors Test Statistic					0.167	Lilliefors GOF Test					
1262	5% Lilliefors Critical Value					0.184	Data appear Normal at 5% Significance Level					
1263	Data appear Approximate Normal at 5% Significance Level											
1264												
1265	Assuming Normal Distribution											
1266	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1267	95% Student's-t UCL					33.49	95% Adjusted-CLT UCL (Chen-1995)					33.95
1268							95% Modified-t UCL (Johnson-1978)					33.6
1269												
1270	Gamma GOF Test											
1271	A-D Test Statistic					0.454	Anderson-Darling Gamma GOF Test					
1272	5% A-D Critical Value					0.749	Detected data appear Gamma Distributed at 5% Significance Level					
1273	K-S Test Statistic					0.16	Kolmogorov-Smirnov Gamma GOF Test					
1274	5% K-S Critical Value					0.187	Detected data appear Gamma Distributed at 5% Significance Level					
1275	Detected data appear Gamma Distributed at 5% Significance Level											
1276												
1277	Gamma Statistics											
1278	k hat (MLE)					3.116	k star (bias corrected MLE)					2.722
1279	Theta hat (MLE)					8.817	Theta star (bias corrected MLE)					10.1
1280	nu hat (MLE)					137.1	nu star (bias corrected)					119.8
1281	MLE Mean (bias corrected)					27.48	MLE Sd (bias corrected)					16.66
1282							Approximate Chi Square Value (0.05)					95.48
1283	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					93.87
1284												
1285	Assuming Gamma Distribution											
1286	95% Approximate Gamma UCL (use when n>=50))					34.46	95% Adjusted Gamma UCL (use when n<50)					35.05
1287												
1288	Lognormal GOF Test											
1289	Shapiro Wilk Test Statistic					0.941	Shapiro Wilk Lognormal GOF Test					
1290	5% Shapiro Wilk Critical Value					0.911	Data appear Lognormal at 5% Significance Level					
1291	Lilliefors Test Statistic					0.141	Lilliefors Lognormal GOF Test					
1292	5% Lilliefors Critical Value					0.184	Data appear Lognormal at 5% Significance Level					
1293	Data appear Lognormal at 5% Significance Level											
1294												
1295	Lognormal Statistics											
1296	Minimum of Logged Data					2.303	Mean of logged Data					3.144
1297	Maximum of Logged Data					4.174	SD of logged Data					0.6
1298												
1299	Assuming Lognormal Distribution											
1300	95% H-UCL					36.57	90% Chebyshev (MVUE) UCL					38.67

	A	B	C	D	E	F	G	H	I	J	K	L
1301	95% Chebyshev (MVUE) UCL					43.72	97.5% Chebyshev (MVUE) UCL					50.72
1302	99% Chebyshev (MVUE) UCL					64.48						
1303												
1304	Nonparametric Distribution Free UCL Statistics											
1305	Data appear to follow a Discernible Distribution at 5% Significance Level											
1306												
1307	Nonparametric Distribution Free UCLs											
1308	95% CLT UCL					33.22	95% Jackknife UCL					33.49
1309	95% Standard Bootstrap UCL					33.08	95% Bootstrap-t UCL					34.9
1310	95% Hall's Bootstrap UCL					34.17	95% Percentile Bootstrap UCL					33.02
1311	95% BCA Bootstrap UCL					33.36						
1312	90% Chebyshev(Mean, Sd) UCL					37.96	95% Chebyshev(Mean, Sd) UCL					42.71
1313	97.5% Chebyshev(Mean, Sd) UCL					49.3	99% Chebyshev(Mean, Sd) UCL					62.24
1314												
1315	Suggested UCL to Use											
1316	95% Student's-t UCL					33.49						
1317												
1318	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1319	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1320												
1321	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1322	Recommendations are based upon data size, data distribution, and skewness.											
1323	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1324	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1325												
1326												
1327	Zr											
1328												
1329	General Statistics											
1330	Total Number of Observations					22	Number of Distinct Observations					13
1331							Number of Missing Observations					0
1332	Minimum					0.5	Mean					2.214
1333	Maximum					5.8	Median					1.9
1334	SD					1.682	Std. Error of Mean					0.359
1335	Coefficient of Variation					0.76	Skewness					1.026
1336												
1337	Normal GOF Test											
1338	Shapiro Wilk Test Statistic					0.855	Shapiro Wilk GOF Test					
1339	5% Shapiro Wilk Critical Value					0.911	Data Not Normal at 5% Significance Level					
1340	Lilliefors Test Statistic					0.209	Lilliefors GOF Test					
1341	5% Lilliefors Critical Value					0.184	Data Not Normal at 5% Significance Level					
1342	Data Not Normal at 5% Significance Level											
1343												
1344	Assuming Normal Distribution											
1345	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1346	95% Student's-t UCL					2.831	95% Adjusted-CLT UCL (Chen-1995)					2.887
1347							95% Modified-t UCL (Johnson-1978)					2.844
1348												
1349	Gamma GOF Test											
1350	A-D Test Statistic					0.744	Anderson-Darling Gamma GOF Test					
1351	5% A-D Critical Value					0.757	Detected data appear Gamma Distributed at 5% Significance Level					
1352	K-S Test Statistic					0.18	Kolmogorov-Smirnov Gamma GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
1353	5% K-S Critical Value					0.188	Detected data appear Gamma Distributed at 5% Significance Level						
1354	Detected data appear Gamma Distributed at 5% Significance Level												
1355													
1356	Gamma Statistics												
1357	k hat (MLE)					1.781	k star (bias corrected MLE)					1.569	
1358	Theta hat (MLE)					1.243	Theta star (bias corrected MLE)					1.411	
1359	nu hat (MLE)					78.38	nu star (bias corrected)					69.02	
1360	MLE Mean (bias corrected)					2.214	MLE Sd (bias corrected)					1.767	
1361							Approximate Chi Square Value (0.05)					50.9	
1362	Adjusted Level of Significance					0.0386	Adjusted Chi Square Value					49.74	
1363													
1364	Assuming Gamma Distribution												
1365	95% Approximate Gamma UCL (use when n>=50)					3.002	95% Adjusted Gamma UCL (use when n<50)					3.072	
1366													
1367	Lognormal GOF Test												
1368	Shapiro Wilk Test Statistic					0.885	Shapiro Wilk Lognormal GOF Test						
1369	5% Shapiro Wilk Critical Value					0.911	Data Not Lognormal at 5% Significance Level						
1370	Lilliefors Test Statistic					0.191	Lilliefors Lognormal GOF Test						
1371	5% Lilliefors Critical Value					0.184	Data Not Lognormal at 5% Significance Level						
1372	Data Not Lognormal at 5% Significance Level												
1373													
1374	Lognormal Statistics												
1375	Minimum of Logged Data					-0.693	Mean of logged Data					0.488	
1376	Maximum of Logged Data					1.758	SD of logged Data					0.847	
1377													
1378	Assuming Lognormal Distribution												
1379	95% H-UCL					3.62	90% Chebyshev (MVUE) UCL					3.64	
1380	95% Chebyshev (MVUE) UCL					4.255	97.5% Chebyshev (MVUE) UCL					5.108	
1381	99% Chebyshev (MVUE) UCL					6.784							
1382													
1383	Nonparametric Distribution Free UCL Statistics												
1384	Data appear to follow a Discernible Distribution at 5% Significance Level												
1385													
1386	Nonparametric Distribution Free UCLs												
1387	95% CLT UCL					2.803	95% Jackknife UCL					2.831	
1388	95% Standard Bootstrap UCL					2.793	95% Bootstrap-t UCL					2.937	
1389	95% Hall's Bootstrap UCL					2.871	95% Percentile Bootstrap UCL					2.805	
1390	95% BCA Bootstrap UCL					2.895							
1391	90% Chebyshev(Mean, Sd) UCL					3.289	95% Chebyshev(Mean, Sd) UCL					3.777	
1392	97.5% Chebyshev(Mean, Sd) UCL					4.453	99% Chebyshev(Mean, Sd) UCL					5.782	
1393													
1394	Suggested UCL to Use												
1395	95% Adjusted Gamma UCL					3.072							
1396													
1397	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1398	Recommendations are based upon data size, data distribution, and skewness.												
1399	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1400	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
1401													

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Background Soil Data											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.123/01/2019 4:07:55 PM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	AI											
12												
13	General Statistics											
14	Total Number of Observations				10		Number of Distinct Observations				10	
15							Number of Missing Observations				0	
16	Minimum				5925		Mean				7464	
17	Maximum				10618		Median				7098	
18	SD				1334		Std. Error of Mean				422	
19	Coefficient of Variation				0.179		Skewness				1.51	
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic				0.878		Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value				0.842		Data appear Normal at 5% Significance Level					
24	Lilliefors Test Statistic				0.176		Lilliefors GOF Test					
25	5% Lilliefors Critical Value				0.262		Data appear Normal at 5% Significance Level					
26	Data appear Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL				8238		95% Adjusted-CLT UCL (Chen-1995)				8374	
31							95% Modified-t UCL (Johnson-1978)				8271	
32												
33	Gamma GOF Test											
34	A-D Test Statistic				0.363		Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value				0.724		Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic				0.155		Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value				0.266		Detected data appear Gamma Distributed at 5% Significance Level					
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)				38.65		k star (bias corrected MLE)				27.12	
42	Theta hat (MLE)				193.1		Theta star (bias corrected MLE)				275.2	
43	nu hat (MLE)				773		nu star (bias corrected)				542.4	
44	MLE Mean (bias corrected)				7464		MLE Sd (bias corrected)				1433	
45							Approximate Chi Square Value (0.05)				489.4	
46	Adjusted Level of Significance				0.0267		Adjusted Chi Square Value				480.7	
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))				8273		95% Adjusted Gamma UCL (use when n<50)				8424	
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic				0.932		Shapiro Wilk Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
53	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level						
54	Lilliefors Test Statistic					0.147	Lilliefors Lognormal GOF Test						
55	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level						
56	Data appear Lognormal at 5% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data					8.687	Mean of logged Data					8.905	
60	Maximum of Logged Data					9.27	SD of logged Data					0.166	
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL					8276	90% Chebyshev (MVUE) UCL					8637	
64	95% Chebyshev (MVUE) UCL					9171	97.5% Chebyshev (MVUE) UCL					9911	
65	99% Chebyshev (MVUE) UCL					11365							
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data appear to follow a Discernible Distribution at 5% Significance Level												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL					8158	95% Jackknife UCL					8238	
72	95% Standard Bootstrap UCL					8118	95% Bootstrap-t UCL					8654	
73	95% Hall's Bootstrap UCL					11530	95% Percentile Bootstrap UCL					8154	
74	95% BCA Bootstrap UCL					8294							
75	90% Chebyshev(Mean, Sd) UCL					8730	95% Chebyshev(Mean, Sd) UCL					9304	
76	97.5% Chebyshev(Mean, Sd) UCL					10099	99% Chebyshev(Mean, Sd) UCL					11663	
77													
78	Suggested UCL to Use												
79	95% Student's-t UCL					8238							
80													
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
82	Recommendations are based upon data size, data distribution, and skewness.												
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
85													
86													
87	Sb												
88													
89	General Statistics												
90	Total Number of Observations					10	Number of Distinct Observations					6	
91							Number of Missing Observations					0	
92	Minimum					0.4	Mean					0.64	
93	Maximum					0.9	Median					0.65	
94	SD					0.165	Std. Error of Mean					0.0521	
95	Coefficient of Variation					0.257	Skewness					0.127	
96													
97	Normal GOF Test												
98	Shapiro Wilk Test Statistic					0.938	Shapiro Wilk GOF Test						
99	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level						
100	Lilliefors Test Statistic					0.202	Lilliefors GOF Test						
101	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level						
102	Data appear Normal at 5% Significance Level												
103													
104	Assuming Normal Distribution												

	A	B	C	D	E	F	G	H	I	J	K	L	
105	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
106	95% Student's-t UCL					0.735	95% Adjusted-CLT UCL (Chen-1995)						0.728
107							95% Modified-t UCL (Johnson-1978)						0.736
108													
109	Gamma GOF Test												
110	A-D Test Statistic					0.383	Anderson-Darling Gamma GOF Test						
111	5% A-D Critical Value					0.725	Detected data appear Gamma Distributed at 5% Significance Level						
112	K-S Test Statistic					0.209	Kolmogorov-Smirnov Gamma GOF Test						
113	5% K-S Critical Value					0.266	Detected data appear Gamma Distributed at 5% Significance Level						
114	Detected data appear Gamma Distributed at 5% Significance Level												
115													
116	Gamma Statistics												
117	k hat (MLE)					16.36	k star (bias corrected MLE)					11.52	
118	Theta hat (MLE)					0.0391	Theta star (bias corrected MLE)					0.0556	
119	nu hat (MLE)					327.3	nu star (bias corrected)					230.4	
120	MLE Mean (bias corrected)					0.64	MLE Sd (bias corrected)					0.189	
121							Approximate Chi Square Value (0.05)					196.3	
122	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					190.8	
123													
124	Assuming Gamma Distribution												
125	95% Approximate Gamma UCL (use when n>=50))					0.751	95% Adjusted Gamma UCL (use when n<50)					0.773	
126													
127	Lognormal GOF Test												
128	Shapiro Wilk Test Statistic					0.936	Shapiro Wilk Lognormal GOF Test						
129	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level						
130	Lilliefors Test Statistic					0.193	Lilliefors Lognormal GOF Test						
131	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level						
132	Data appear Lognormal at 5% Significance Level												
133													
134	Lognormal Statistics												
135	Minimum of Logged Data					-0.916	Mean of logged Data					-0.477	
136	Maximum of Logged Data					-0.105	SD of logged Data					0.265	
137													
138	Assuming Lognormal Distribution												
139	95% H-UCL					0.763	90% Chebyshev (MVUE) UCL					0.802	
140	95% Chebyshev (MVUE) UCL					0.875	97.5% Chebyshev (MVUE) UCL					0.977	
141	99% Chebyshev (MVUE) UCL					1.176							
142													
143	Nonparametric Distribution Free UCL Statistics												
144	Data appear to follow a Discernible Distribution at 5% Significance Level												
145													
146	Nonparametric Distribution Free UCLs												
147	95% CLT UCL					0.726	95% Jackknife UCL					0.735	
148	95% Standard Bootstrap UCL					0.721	95% Bootstrap-t UCL					0.738	
149	95% Hall's Bootstrap UCL					0.721	95% Percentile Bootstrap UCL					0.72	
150	95% BCA Bootstrap UCL					0.72							
151	90% Chebyshev(Mean, Sd) UCL					0.796	95% Chebyshev(Mean, Sd) UCL					0.867	
152	97.5% Chebyshev(Mean, Sd) UCL					0.965	99% Chebyshev(Mean, Sd) UCL					1.158	
153													
154	Suggested UCL to Use												
155	95% Student's-t UCL					0.735							
156													

	A	B	C	D	E	F	G	H	I	J	K	L
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	Recommendations are based upon data size, data distribution, and skewness.											
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
161												
162												
163	As											
164												
165	General Statistics											
166	Total Number of Observations				10		Number of Distinct Observations				10	
167							Number of Missing Observations				0	
168	Minimum				8		Mean				16.83	
169	Maximum				37		Median				14.75	
170	SD				8.241		Std. Error of Mean				2.606	
171	Coefficient of Variation				0.49		Skewness				1.786	
172												
173	Normal GOF Test											
174	Shapiro Wilk Test Statistic				0.834		Shapiro Wilk GOF Test					
175	5% Shapiro Wilk Critical Value				0.842		Data Not Normal at 5% Significance Level					
176	Lilliefors Test Statistic				0.206		Lilliefors GOF Test					
177	5% Lilliefors Critical Value				0.262		Data appear Normal at 5% Significance Level					
178	Data appear Approximate Normal at 5% Significance Level											
179												
180	Assuming Normal Distribution											
181	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
182	95% Student's-t UCL				21.61		95% Adjusted-CLT UCL (Chen-1995)				22.69	
183							95% Modified-t UCL (Johnson-1978)				21.85	
184												
185	Gamma GOF Test											
186	A-D Test Statistic				0.338		Anderson-Darling Gamma GOF Test					
187	5% A-D Critical Value				0.729		Detected data appear Gamma Distributed at 5% Significance Level					
188	K-S Test Statistic				0.157		Kolmogorov-Smirnov Gamma GOF Test					
189	5% K-S Critical Value				0.267		Detected data appear Gamma Distributed at 5% Significance Level					
190	Detected data appear Gamma Distributed at 5% Significance Level											
191												
192	Gamma Statistics											
193	k hat (MLE)				5.798		k star (bias corrected MLE)				4.125	
194	Theta hat (MLE)				2.903		Theta star (bias corrected MLE)				4.08	
195	nu hat (MLE)				116		nu star (bias corrected)				82.5	
196	MLE Mean (bias corrected)				16.83		MLE Sd (bias corrected)				8.287	
197							Approximate Chi Square Value (0.05)				62.57	
198	Adjusted Level of Significance				0.0267		Adjusted Chi Square Value				59.56	
199												
200	Assuming Gamma Distribution											
201	95% Approximate Gamma UCL (use when n>=50))				22.19		95% Adjusted Gamma UCL (use when n<50)				23.31	
202												
203	Lognormal GOF Test											
204	Shapiro Wilk Test Statistic				0.964		Shapiro Wilk Lognormal GOF Test					
205	5% Shapiro Wilk Critical Value				0.842		Data appear Lognormal at 5% Significance Level					
206	Lilliefors Test Statistic				0.134		Lilliefors Lognormal GOF Test					
207	5% Lilliefors Critical Value				0.262		Data appear Lognormal at 5% Significance Level					
208	Data appear Lognormal at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
209												
210	Lognormal Statistics											
211	Minimum of Logged Data					2.079	Mean of logged Data					2.734
212	Maximum of Logged Data					3.611	SD of logged Data					0.429
213												
214	Assuming Lognormal Distribution											
215	95% H-UCL					22.87	90% Chebyshev (MVUE) UCL					23.61
216	95% Chebyshev (MVUE) UCL					26.73	97.5% Chebyshev (MVUE) UCL					31.06
217	99% Chebyshev (MVUE) UCL					39.57						
218												
219	Nonparametric Distribution Free UCL Statistics											
220	Data appear to follow a Discernible Distribution at 5% Significance Level											
221												
222	Nonparametric Distribution Free UCLs											
223	95% CLT UCL					21.12	95% Jackknife UCL					21.61
224	95% Standard Bootstrap UCL					20.91	95% Bootstrap-t UCL					24.99
225	95% Hall's Bootstrap UCL					40.41	95% Percentile Bootstrap UCL					21.55
226	95% BCA Bootstrap UCL					22.74						
227	90% Chebyshev(Mean, Sd) UCL					24.65	95% Chebyshev(Mean, Sd) UCL					28.19
228	97.5% Chebyshev(Mean, Sd) UCL					33.1	99% Chebyshev(Mean, Sd) UCL					42.76
229												
230	Suggested UCL to Use											
231	95% Student's-t UCL					21.61						
232												
233	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
234	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
235												
236	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
237	Recommendations are based upon data size, data distribution, and skewness.											
238	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
239	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
240												
241												
242	Ba											
243												
244	General Statistics											
245	Total Number of Observations					10	Number of Distinct Observations					9
246							Number of Missing Observations					0
247	Minimum					77	Mean					142.5
248	Maximum					295	Median					123.5
249	SD					59.57	Std. Error of Mean					18.84
250	Coefficient of Variation					0.418	Skewness					2.093
251												
252	Normal GOF Test											
253	Shapiro Wilk Test Statistic					0.776	Shapiro Wilk GOF Test					
254	5% Shapiro Wilk Critical Value					0.842	Data Not Normal at 5% Significance Level					
255	Lilliefors Test Statistic					0.243	Lilliefors GOF Test					
256	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level					
257	Data appear Approximate Normal at 5% Significance Level											
258												
259	Assuming Normal Distribution											
260	95% Normal UCL						95% UCLs (Adjusted for Skewness)					

	A	B	C	D	E	F	G	H	I	J	K	L
261	95% Student's-t UCL					177	95% Adjusted-CLT UCL (Chen-1995)					186.8
262							95% Modified-t UCL (Johnson-1978)					179.1
263												
264	Gamma GOF Test											
265	A-D Test Statistic				0.625	Anderson-Darling Gamma GOF Test						
266	5% A-D Critical Value				0.727	Detected data appear Gamma Distributed at 5% Significance Level						
267	K-S Test Statistic				0.207	Kolmogorov-Smirnov Gamma GOF Test						
268	5% K-S Critical Value				0.267	Detected data appear Gamma Distributed at 5% Significance Level						
269	Detected data appear Gamma Distributed at 5% Significance Level											
270												
271	Gamma Statistics											
272	k hat (MLE)				8.238	k star (bias corrected MLE)					5.833	
273	Theta hat (MLE)				17.3	Theta star (bias corrected MLE)					24.43	
274	nu hat (MLE)				164.8	nu star (bias corrected)					116.7	
275	MLE Mean (bias corrected)				142.5	MLE Sd (bias corrected)					59	
276						Approximate Chi Square Value (0.05)					92.73	
277	Adjusted Level of Significance				0.0267	Adjusted Chi Square Value					89.02	
278												
279	Assuming Gamma Distribution											
280	95% Approximate Gamma UCL (use when n>=50))				179.3	95% Adjusted Gamma UCL (use when n<50)					186.7	
281												
282	Lognormal GOF Test											
283	Shapiro Wilk Test Statistic				0.911	Shapiro Wilk Lognormal GOF Test						
284	5% Shapiro Wilk Critical Value				0.842	Data appear Lognormal at 5% Significance Level						
285	Lilliefors Test Statistic				0.187	Lilliefors Lognormal GOF Test						
286	5% Lilliefors Critical Value				0.262	Data appear Lognormal at 5% Significance Level						
287	Data appear Lognormal at 5% Significance Level											
288												
289	Lognormal Statistics											
290	Minimum of Logged Data				4.344	Mean of logged Data					4.897	
291	Maximum of Logged Data				5.687	SD of logged Data					0.354	
292												
293	Assuming Lognormal Distribution											
294	95% H-UCL				181.3	90% Chebyshev (MVUE) UCL					189.7	
295	95% Chebyshev (MVUE) UCL				211.4	97.5% Chebyshev (MVUE) UCL					241.6	
296	99% Chebyshev (MVUE) UCL				300.9							
297												
298	Nonparametric Distribution Free UCL Statistics											
299	Data appear to follow a Discernible Distribution at 5% Significance Level											
300												
301	Nonparametric Distribution Free UCLs											
302	95% CLT UCL				173.5	95% Jackknife UCL					177	
303	95% Standard Bootstrap UCL				171.5	95% Bootstrap-t UCL					213.3	
304	95% Hall's Bootstrap UCL				332.1	95% Percentile Bootstrap UCL					173.9	
305	95% BCA Bootstrap UCL				186.7							
306	90% Chebyshev(Mean, Sd) UCL				199	95% Chebyshev(Mean, Sd) UCL					224.6	
307	97.5% Chebyshev(Mean, Sd) UCL				260.1	99% Chebyshev(Mean, Sd) UCL					329.9	
308												
309	Suggested UCL to Use											
310	95% Student's-t UCL				177							
311												
312	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											

	A	B	C	D	E	F	G	H	I	J	K	L
313	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
314												
315	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
316	Recommendations are based upon data size, data distribution, and skewness.											
317	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
318	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
319												
320												
321	B											
322												
323	General Statistics											
324	Total Number of Observations				10		Number of Distinct Observations				1	
325							Number of Missing Observations				0	
326	Minimum				3		Mean				3	
327	Maximum				3		Median				3	
328												
329	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
330	ProUCL (or any other software) should not be used on such a data set!											
331	The data set for variable B was not processed!											
332												
333	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
334	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
335												
336												
337												
338	Cd											
339												
340	General Statistics											
341	Total Number of Observations				10		Number of Distinct Observations				9	
342							Number of Missing Observations				0	
343	Minimum				0.14		Mean				0.326	
344	Maximum				0.52		Median				0.32	
345	SD				0.117		Std. Error of Mean				0.0371	
346	Coefficient of Variation				0.36		Skewness				-0.1	
347												
348	Normal GOF Test											
349	Shapiro Wilk Test Statistic				0.952		Shapiro Wilk GOF Test					
350	5% Shapiro Wilk Critical Value				0.842		Data appear Normal at 5% Significance Level					
351	Lilliefors Test Statistic				0.179		Lilliefors GOF Test					
352	5% Lilliefors Critical Value				0.262		Data appear Normal at 5% Significance Level					
353	Data appear Normal at 5% Significance Level											
354												
355	Assuming Normal Distribution											
356	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
357	95% Student's-t UCL				0.394		95% Adjusted-CLT UCL (Chen-1995)				0.386	
358							95% Modified-t UCL (Johnson-1978)				0.394	
359												
360	Gamma GOF Test											
361	A-D Test Statistic				0.453		Anderson-Darling Gamma GOF Test					
362	5% A-D Critical Value				0.727		Detected data appear Gamma Distributed at 5% Significance Level					
363	K-S Test Statistic				0.226		Kolmogorov-Smirnov Gamma GOF Test					
364	5% K-S Critical Value				0.267		Detected data appear Gamma Distributed at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
365	Detected data appear Gamma Distributed at 5% Significance Level											
366												
367	Gamma Statistics											
368	k hat (MLE)				7.319		k star (bias corrected MLE)				5.19	
369	Theta hat (MLE)				0.0445		Theta star (bias corrected MLE)				0.0628	
370	nu hat (MLE)				146.4		nu star (bias corrected)				103.8	
371	MLE Mean (bias corrected)				0.326		MLE Sd (bias corrected)				0.143	
372							Approximate Chi Square Value (0.05)				81.29	
373	Adjusted Level of Significance				0.0267		Adjusted Chi Square Value				77.83	
374												
375	Assuming Gamma Distribution											
376	95% Approximate Gamma UCL (use when n>=50))				0.416		95% Adjusted Gamma UCL (use when n<50)				0.435	
377												
378	Lognormal GOF Test											
379	Shapiro Wilk Test Statistic				0.891		Shapiro Wilk Lognormal GOF Test					
380	5% Shapiro Wilk Critical Value				0.842		Data appear Lognormal at 5% Significance Level					
381	Lilliefors Test Statistic				0.255		Lilliefors Lognormal GOF Test					
382	5% Lilliefors Critical Value				0.262		Data appear Lognormal at 5% Significance Level					
383	Data appear Lognormal at 5% Significance Level											
384												
385	Lognormal Statistics											
386	Minimum of Logged Data				-1.966		Mean of logged Data				-1.191	
387	Maximum of Logged Data				-0.654		SD of logged Data				0.416	
388												
389	Assuming Lognormal Distribution											
390	95% H-UCL				0.444		90% Chebyshev (MVUE) UCL				0.46	
391	95% Chebyshev (MVUE) UCL				0.52		97.5% Chebyshev (MVUE) UCL				0.602	
392	99% Chebyshev (MVUE) UCL				0.765							
393												
394	Nonparametric Distribution Free UCL Statistics											
395	Data appear to follow a Discernible Distribution at 5% Significance Level											
396												
397	Nonparametric Distribution Free UCLs											
398	95% CLT UCL				0.387		95% Jackknife UCL				0.394	
399	95% Standard Bootstrap UCL				0.383		95% Bootstrap-t UCL				0.392	
400	95% Hall's Bootstrap UCL				0.394		95% Percentile Bootstrap UCL				0.387	
401	95% BCA Bootstrap UCL				0.384							
402	90% Chebyshev(Mean, Sd) UCL				0.437		95% Chebyshev(Mean, Sd) UCL				0.488	
403	97.5% Chebyshev(Mean, Sd) UCL				0.557		99% Chebyshev(Mean, Sd) UCL				0.695	
404												
405	Suggested UCL to Use											
406	95% Student's-t UCL				0.394							
407												
408	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
409	Recommendations are based upon data size, data distribution, and skewness.											
410	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
411	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
412												
413	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
414	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
415												
416												

	A	B	C	D	E	F	G	H	I	J	K	L
417	Cr											
418												
419	General Statistics											
420	Total Number of Observations					10	Number of Distinct Observations					8
421							Number of Missing Observations					0
422	Minimum					16	Mean					24.1
423	Maximum					37	Median					23
424	SD					5.705	Std. Error of Mean					1.804
425	Coefficient of Variation					0.237	Skewness					1.156
426												
427	Normal GOF Test											
428	Shapiro Wilk Test Statistic					0.91	Shapiro Wilk GOF Test					
429	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level					
430	Lilliefors Test Statistic					0.207	Lilliefors GOF Test					
431	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level					
432	Data appear Normal at 5% Significance Level											
433												
434	Assuming Normal Distribution											
435	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
436	95% Student's-t UCL					27.41	95% Adjusted-CLT UCL (Chen-1995)					27.77
437							95% Modified-t UCL (Johnson-1978)					27.52
438												
439	Gamma GOF Test											
440	A-D Test Statistic					0.344	Anderson-Darling Gamma GOF Test					
441	5% A-D Critical Value					0.725	Detected data appear Gamma Distributed at 5% Significance Level					
442	K-S Test Statistic					0.179	Kolmogorov-Smirnov Gamma GOF Test					
443	5% K-S Critical Value					0.266	Detected data appear Gamma Distributed at 5% Significance Level					
444	Detected data appear Gamma Distributed at 5% Significance Level											
445												
446	Gamma Statistics											
447	k hat (MLE)					21.44	k star (bias corrected MLE)					15.08
448	Theta hat (MLE)					1.124	Theta star (bias corrected MLE)					1.599
449	nu hat (MLE)					428.8	nu star (bias corrected)					301.5
450	MLE Mean (bias corrected)					24.1	MLE Sd (bias corrected)					6.207
451							Approximate Chi Square Value (0.05)					262.3
452	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					255.9
453												
454	Assuming Gamma Distribution											
455	95% Approximate Gamma UCL (use when n>=50))					27.7	95% Adjusted Gamma UCL (use when n<50)					28.39
456												
457	Lognormal GOF Test											
458	Shapiro Wilk Test Statistic					0.958	Shapiro Wilk Lognormal GOF Test					
459	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level					
460	Lilliefors Test Statistic					0.182	Lilliefors Lognormal GOF Test					
461	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level					
462	Data appear Lognormal at 5% Significance Level											
463												
464	Lognormal Statistics											
465	Minimum of Logged Data					2.773	Mean of logged Data					3.159
466	Maximum of Logged Data					3.611	SD of logged Data					0.226
467												
468	Assuming Lognormal Distribution											

	A	B	C	D	E	F	G	H	I	J	K	L
469	95% H-UCL					27.87	90% Chebyshev (MVUE) UCL					29.27
470	95% Chebyshev (MVUE) UCL					31.61	97.5% Chebyshev (MVUE) UCL					34.87
471	99% Chebyshev (MVUE) UCL					41.27						
472												
473	Nonparametric Distribution Free UCL Statistics											
474	Data appear to follow a Discernible Distribution at 5% Significance Level											
475												
476	Nonparametric Distribution Free UCLs											
477	95% CLT UCL					27.07	95% Jackknife UCL					27.41
478	95% Standard Bootstrap UCL					26.91	95% Bootstrap-t UCL					28.28
479	95% Hall's Bootstrap UCL					34.29	95% Percentile Bootstrap UCL					26.9
480	95% BCA Bootstrap UCL					27.5						
481	90% Chebyshev(Mean, Sd) UCL					29.51	95% Chebyshev(Mean, Sd) UCL					31.96
482	97.5% Chebyshev(Mean, Sd) UCL					35.37	99% Chebyshev(Mean, Sd) UCL					42.05
483												
484	Suggested UCL to Use											
485	95% Student's-t UCL					27.41						
486												
487	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
488	Recommendations are based upon data size, data distribution, and skewness.											
489	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
490	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
491												
492												
493	Co											
494												
495	General Statistics											
496	Total Number of Observations					10	Number of Distinct Observations					4
497							Number of Missing Observations					0
498	Minimum					7	Mean					8.3
499	Maximum					10	Median					8
500	SD					0.823	Std. Error of Mean					0.26
501	Coefficient of Variation					0.0992	Skewness					0.806
502												
503	Normal GOF Test											
504	Shapiro Wilk Test Statistic					0.841	Shapiro Wilk GOF Test					
505	5% Shapiro Wilk Critical Value					0.842	Data Not Normal at 5% Significance Level					
506	Lilliefors Test Statistic					0.342	Lilliefors GOF Test					
507	5% Lilliefors Critical Value					0.262	Data Not Normal at 5% Significance Level					
508	Data Not Normal at 5% Significance Level											
509												
510	Assuming Normal Distribution											
511	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
512	95% Student's-t UCL					8.777	95% Adjusted-CLT UCL (Chen-1995)					8.799
513							95% Modified-t UCL (Johnson-1978)					8.788
514												
515	Gamma GOF Test											
516	A-D Test Statistic					0.966	Anderson-Darling Gamma GOF Test					
517	5% A-D Critical Value					0.724	Data Not Gamma Distributed at 5% Significance Level					
518	K-S Test Statistic					0.342	Kolmogorov-Smirnov Gamma GOF Test					
519	5% K-S Critical Value					0.266	Data Not Gamma Distributed at 5% Significance Level					
520	Data Not Gamma Distributed at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
521												
522	Gamma Statistics											
523	k hat (MLE)				116.5	k star (bias corrected MLE)				81.65		
524	Theta hat (MLE)				0.0712	Theta star (bias corrected MLE)				0.102		
525	nu hat (MLE)				2331	nu star (bias corrected)				1633		
526	MLE Mean (bias corrected)				8.3	MLE Sd (bias corrected)				0.919		
527						Approximate Chi Square Value (0.05)				1540		
528	Adjusted Level of Significance				0.0267	Adjusted Chi Square Value				1524		
529												
530	Assuming Gamma Distribution											
531	95% Approximate Gamma UCL (use when n>=50))				8.8	95% Adjusted Gamma UCL (use when n<50)				8.891		
532												
533	Lognormal GOF Test											
534	Shapiro Wilk Test Statistic				0.851	Shapiro Wilk Lognormal GOF Test						
535	5% Shapiro Wilk Critical Value				0.842	Data appear Lognormal at 5% Significance Level						
536	Lilliefors Test Statistic				0.331	Lilliefors Lognormal GOF Test						
537	5% Lilliefors Critical Value				0.262	Data Not Lognormal at 5% Significance Level						
538	Data appear Approximate Lognormal at 5% Significance Level											
539												
540	Lognormal Statistics											
541	Minimum of Logged Data				1.946	Mean of logged Data				2.112		
542	Maximum of Logged Data				2.303	SD of logged Data				0.0971		
543												
544	Assuming Lognormal Distribution											
545	95% H-UCL				N/A	90% Chebyshev (MVUE) UCL				9.064		
546	95% Chebyshev (MVUE) UCL				9.411	97.5% Chebyshev (MVUE) UCL				9.892		
547	99% Chebyshev (MVUE) UCL				10.84							
548												
549	Nonparametric Distribution Free UCL Statistics											
550	Data appear to follow a Discernible Distribution at 5% Significance Level											
551												
552	Nonparametric Distribution Free UCLs											
553	95% CLT UCL				8.728	95% Jackknife UCL				8.777		
554	95% Standard Bootstrap UCL				N/A	95% Bootstrap-t UCL				N/A		
555	95% Hall's Bootstrap UCL				N/A	95% Percentile Bootstrap UCL				N/A		
556	95% BCA Bootstrap UCL				N/A							
557	90% Chebyshev(Mean, Sd) UCL				9.081	95% Chebyshev(Mean, Sd) UCL				9.435		
558	97.5% Chebyshev(Mean, Sd) UCL				9.926	99% Chebyshev(Mean, Sd) UCL				10.89		
559												
560	Suggested UCL to Use											
561	95% Student's-t UCL				8.777	or 95% Modified-t UCL				8.788		
562												
563	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
564	Recommendations are based upon data size, data distribution, and skewness.											
565	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
566	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
567												
568												
569	Fe											
570												
571	General Statistics											
572	Total Number of Observations				10	Number of Distinct Observations				10		

	A	B	C	D	E	F	G	H	I	J	K	L
573							Number of Missing Observations					0
574	Minimum					16560	Mean					19084
575	Maximum					22472	Median					18748
576	SD					2090	Std. Error of Mean					660.9
577	Coefficient of Variation					0.11	Skewness					0.511
578												
579	Normal GOF Test											
580	Shapiro Wilk Test Statistic					0.923	Shapiro Wilk GOF Test					
581	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level					
582	Lilliefors Test Statistic					0.158	Lilliefors GOF Test					
583	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level					
584	Data appear Normal at 5% Significance Level											
585												
586	Assuming Normal Distribution											
587	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
588	95% Student's-t UCL					20295	95% Adjusted-CLT UCL (Chen-1995)					20285
589							95% Modified-t UCL (Johnson-1978)					20313
590												
591	Gamma GOF Test											
592	A-D Test Statistic					0.335	Anderson-Darling Gamma GOF Test					
593	5% A-D Critical Value					0.724	Detected data appear Gamma Distributed at 5% Significance Level					
594	K-S Test Statistic					0.167	Kolmogorov-Smirnov Gamma GOF Test					
595	5% K-S Critical Value					0.266	Detected data appear Gamma Distributed at 5% Significance Level					
596	Detected data appear Gamma Distributed at 5% Significance Level											
597												
598	Gamma Statistics											
599	k hat (MLE)					94.75	k star (bias corrected MLE)					66.39
600	Theta hat (MLE)					201.4	Theta star (bias corrected MLE)					287.4
601	nu hat (MLE)					1895	nu star (bias corrected)					1328
602	MLE Mean (bias corrected)					19084	MLE Sd (bias corrected)					2342
603							Approximate Chi Square Value (0.05)					1244
604	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					1230
605												
606	Assuming Gamma Distribution											
607	95% Approximate Gamma UCL (use when n>=50))					20366	95% Adjusted Gamma UCL (use when n<50)					20600
608												
609	Lognormal GOF Test											
610	Shapiro Wilk Test Statistic					0.932	Shapiro Wilk Lognormal GOF Test					
611	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level					
612	Lilliefors Test Statistic					0.155	Lilliefors Lognormal GOF Test					
613	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level					
614	Data appear Lognormal at 5% Significance Level											
615												
616	Lognormal Statistics											
617	Minimum of Logged Data					9.715	Mean of logged Data					9.851
618	Maximum of Logged Data					10.02	SD of logged Data					0.108
619												
620	Assuming Lognormal Distribution											
621	95% H-UCL					20376	90% Chebyshev (MVUE) UCL					21037
622	95% Chebyshev (MVUE) UCL					21922	97.5% Chebyshev (MVUE) UCL					23151
623	99% Chebyshev (MVUE) UCL					25564						
624												

	A	B	C	D	E	F	G	H	I	J	K	L
625	Nonparametric Distribution Free UCL Statistics											
626	Data appear to follow a Discernible Distribution at 5% Significance Level											
627												
628	Nonparametric Distribution Free UCLs											
629	95% CLT UCL				20171	95% Jackknife UCL						20295
630	95% Standard Bootstrap UCL				20139	95% Bootstrap-t UCL						20498
631	95% Hall's Bootstrap UCL				20294	95% Percentile Bootstrap UCL						20108
632	95% BCA Bootstrap UCL				20246							
633	90% Chebyshev(Mean, Sd) UCL				21066	95% Chebyshev(Mean, Sd) UCL						21965
634	97.5% Chebyshev(Mean, Sd) UCL				23211	99% Chebyshev(Mean, Sd) UCL						25660
635												
636	Suggested UCL to Use											
637	95% Student's-t UCL				20295							
638												
639	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
640	Recommendations are based upon data size, data distribution, and skewness.											
641	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
642	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
643												
644												
645	Li											
646												
647	General Statistics											
648	Total Number of Observations				10	Number of Distinct Observations						4
649						Number of Missing Observations						0
650	Minimum				7	Mean						8.1
651	Maximum				10	Median						8
652	SD				1.197	Std. Error of Mean						0.379
653	Coefficient of Variation				0.148	Skewness						0.738
654												
655	Normal GOF Test											
656	Shapiro Wilk Test Statistic				0.824	Shapiro Wilk GOF Test						
657	5% Shapiro Wilk Critical Value				0.842	Data Not Normal at 5% Significance Level						
658	Lilliefors Test Statistic				0.233	Lilliefors GOF Test						
659	5% Lilliefors Critical Value				0.262	Data appear Normal at 5% Significance Level						
660	Data appear Approximate Normal at 5% Significance Level											
661												
662	Assuming Normal Distribution											
663	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
664	95% Student's-t UCL				8.794	95% Adjusted-CLT UCL (Chen-1995)						8.817
665						95% Modified-t UCL (Johnson-1978)						8.809
666												
667	Gamma GOF Test											
668	A-D Test Statistic				0.748	Anderson-Darling Gamma GOF Test						
669	5% A-D Critical Value				0.724	Data Not Gamma Distributed at 5% Significance Level						
670	K-S Test Statistic				0.24	Kolmogorov-Smirnov Gamma GOF Test						
671	5% K-S Critical Value				0.266	Detected data appear Gamma Distributed at 5% Significance Level						
672	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
673												
674	Gamma Statistics											
675	k hat (MLE)				53.2	k star (bias corrected MLE)						37.31
676	Theta hat (MLE)				0.152	Theta star (bias corrected MLE)						0.217

	A	B	C	D	E	F	G	H	I	J	K	L
677	nu hat (MLE)					1064	nu star (bias corrected)					746.1
678	MLE Mean (bias corrected)					8.1	MLE Sd (bias corrected)					1.326
679							Approximate Chi Square Value (0.05)					683.7
680	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					673.3
681												
682	Assuming Gamma Distribution											
683	95% Approximate Gamma UCL (use when n>=50))					8.839	95% Adjusted Gamma UCL (use when n<50)					8.976
684												
685	Lognormal GOF Test											
686	Shapiro Wilk Test Statistic					0.833	Shapiro Wilk Lognormal GOF Test					
687	5% Shapiro Wilk Critical Value					0.842	Data Not Lognormal at 5% Significance Level					
688	Lilliefors Test Statistic					0.23	Lilliefors Lognormal GOF Test					
689	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level					
690	Data appear Approximate Lognormal at 5% Significance Level											
691												
692	Lognormal Statistics											
693	Minimum of Logged Data					1.946	Mean of logged Data					2.082
694	Maximum of Logged Data					2.303	SD of logged Data					0.143
695												
696	Assuming Lognormal Distribution											
697	95% H-UCL					8.849	90% Chebyshev (MVUE) UCL					9.201
698	95% Chebyshev (MVUE) UCL					9.7	97.5% Chebyshev (MVUE) UCL					10.39
699	99% Chebyshev (MVUE) UCL					11.75						
700												
701	Nonparametric Distribution Free UCL Statistics											
702	Data appear to follow a Discernible Distribution at 5% Significance Level											
703												
704	Nonparametric Distribution Free UCLs											
705	95% CLT UCL					8.723	95% Jackknife UCL					8.794
706	95% Standard Bootstrap UCL					N/A	95% Bootstrap-t UCL					N/A
707	95% Hall's Bootstrap UCL					N/A	95% Percentile Bootstrap UCL					N/A
708	95% BCA Bootstrap UCL					N/A						
709	90% Chebyshev(Mean, Sd) UCL					9.236	95% Chebyshev(Mean, Sd) UCL					9.75
710	97.5% Chebyshev(Mean, Sd) UCL					10.46	99% Chebyshev(Mean, Sd) UCL					11.87
711												
712	Suggested UCL to Use											
713	95% Student's-t UCL					8.794						
714												
715	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
716	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
717												
718	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
719	Recommendations are based upon data size, data distribution, and skewness.											
720	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
721	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
722												
723												
724	Mn											
725												
726	General Statistics											
727	Total Number of Observations					10	Number of Distinct Observations					10
728							Number of Missing Observations					0

	A	B	C	D	E	F	G	H	I	J	K	L	
729	Minimum					285						Mean	400.8
730	Maximum					793						Median	345.5
731	SD					145.7						Std. Error of Mean	46.06
732	Coefficient of Variation					0.363						Skewness	2.591
733													
734	Normal GOF Test												
735	Shapiro Wilk Test Statistic					0.658						Shapiro Wilk GOF Test	
736	5% Shapiro Wilk Critical Value					0.842						Data Not Normal at 5% Significance Level	
737	Lilliefors Test Statistic					0.313						Lilliefors GOF Test	
738	5% Lilliefors Critical Value					0.262						Data Not Normal at 5% Significance Level	
739	Data Not Normal at 5% Significance Level												
740													
741	Assuming Normal Distribution												
742	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
743	95% Student's-t UCL					485.2						95% Adjusted-CLT UCL (Chen-1995)	516.9
744												95% Modified-t UCL (Johnson-1978)	491.5
745													
746	Gamma GOF Test												
747	A-D Test Statistic					1.127						Anderson-Darling Gamma GOF Test	
748	5% A-D Critical Value					0.725						Data Not Gamma Distributed at 5% Significance Level	
749	K-S Test Statistic					0.278						Kolmogorov-Smirnov Gamma GOF Test	
750	5% K-S Critical Value					0.267						Data Not Gamma Distributed at 5% Significance Level	
751	Data Not Gamma Distributed at 5% Significance Level												
752													
753	Gamma Statistics												
754	k hat (MLE)					11.82						k star (bias corrected MLE)	8.341
755	Theta hat (MLE)					33.91						Theta star (bias corrected MLE)	48.05
756	nu hat (MLE)					236.4						nu star (bias corrected)	166.8
757	MLE Mean (bias corrected)					400.8						MLE Sd (bias corrected)	138.8
758												Approximate Chi Square Value (0.05)	138
759	Adjusted Level of Significance					0.0267						Adjusted Chi Square Value	133.4
760													
761	Assuming Gamma Distribution												
762	95% Approximate Gamma UCL (use when n>=50))					484.7						95% Adjusted Gamma UCL (use when n<50)	501.2
763													
764	Lognormal GOF Test												
765	Shapiro Wilk Test Statistic					0.774						Shapiro Wilk Lognormal GOF Test	
766	5% Shapiro Wilk Critical Value					0.842						Data Not Lognormal at 5% Significance Level	
767	Lilliefors Test Statistic					0.257						Lilliefors Lognormal GOF Test	
768	5% Lilliefors Critical Value					0.262						Data appear Lognormal at 5% Significance Level	
769	Data appear Approximate Lognormal at 5% Significance Level												
770													
771	Lognormal Statistics												
772	Minimum of Logged Data					5.652						Mean of logged Data	5.951
773	Maximum of Logged Data					6.676						SD of logged Data	0.285
774													
775	Assuming Lognormal Distribution												
776	95% H-UCL					481.9						90% Chebyshev (MVUE) UCL	506.7
777	95% Chebyshev (MVUE) UCL					555.9						97.5% Chebyshev (MVUE) UCL	624.1
778	99% Chebyshev (MVUE) UCL					758							
779													
780	Nonparametric Distribution Free UCL Statistics												

	A	B	C	D	E	F	G	H	I	J	K	L
781	Data appear to follow a Discernible Distribution at 5% Significance Level											
782												
783	Nonparametric Distribution Free UCLs											
784	95% CLT UCL				476.6	95% Jackknife UCL				485.2		
785	95% Standard Bootstrap UCL				475.6	95% Bootstrap-t UCL				657.7		
786	95% Hall's Bootstrap UCL				815.9	95% Percentile Bootstrap UCL				480.6		
787	95% BCA Bootstrap UCL				515							
788	90% Chebyshev(Mean, Sd) UCL				539	95% Chebyshev(Mean, Sd) UCL				601.6		
789	97.5% Chebyshev(Mean, Sd) UCL				688.4	99% Chebyshev(Mean, Sd) UCL				859.1		
790												
791	Suggested UCL to Use											
792	95% Student's-t UCL				485.2	or 95% Modified-t UCL				491.5		
793	or 95% H-UCL				481.9							
794												
795	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
796	Recommendations are based upon data size, data distribution, and skewness.											
797	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
798	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
799												
800	ProUCL computes and outputs H-statistic based UCLs for historical reasons only.											
801	H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.											
802	It is therefore recommended to avoid the use of H-statistic based 95% UCLs.											
803	Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.											
804												
805												
806	Hg											
807												
808	General Statistics											
809	Total Number of Observations				10	Number of Distinct Observations				1		
810						Number of Missing Observations				0		
811	Minimum				0.03	Mean				0.03		
812	Maximum				0.03	Median				0.03		
813												
814	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
815	ProUCL (or any other software) should not be used on such a data set!											
816	The data set for variable Hg was not processed!											
817												
818	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
819	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
820												
821												
822												
823	Mo											
824												
825	General Statistics											
826	Total Number of Observations				10	Number of Distinct Observations				6		
827						Number of Missing Observations				0		
828	Minimum				0.7	Mean				1.49		
829	Maximum				2.5	Median				1.45		
830	SD				0.538	Std. Error of Mean				0.17		
831	Coefficient of Variation				0.361	Skewness				0.111		
832												

	A	B	C	D	E	F	G	H	I	J	K	L
833	Normal GOF Test											
834	Shapiro Wilk Test Statistic					0.927	Shapiro Wilk GOF Test					
835	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level					
836	Lilliefors Test Statistic					0.182	Lilliefors GOF Test					
837	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level					
838	Data appear Normal at 5% Significance Level											
839												
840	Assuming Normal Distribution											
841	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
842	95% Student's-t UCL					1.802	95% Adjusted-CLT UCL (Chen-1995)					1.776
843							95% Modified-t UCL (Johnson-1978)					1.803
844												
845	Gamma GOF Test											
846	A-D Test Statistic					0.538	Anderson-Darling Gamma GOF Test					
847	5% A-D Critical Value					0.727	Detected data appear Gamma Distributed at 5% Significance Level					
848	K-S Test Statistic					0.204	Kolmogorov-Smirnov Gamma GOF Test					
849	5% K-S Critical Value					0.267	Detected data appear Gamma Distributed at 5% Significance Level					
850	Detected data appear Gamma Distributed at 5% Significance Level											
851												
852	Gamma Statistics											
853	k hat (MLE)					7.508	k star (bias corrected MLE)					5.322
854	Theta hat (MLE)					0.198	Theta star (bias corrected MLE)					0.28
855	nu hat (MLE)					150.2	nu star (bias corrected)					106.4
856	MLE Mean (bias corrected)					1.49	MLE Sd (bias corrected)					0.646
857							Approximate Chi Square Value (0.05)					83.64
858	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					80.13
859												
860	Assuming Gamma Distribution											
861	95% Approximate Gamma UCL (use when n>=50))					1.896	95% Adjusted Gamma UCL (use when n<50)					1.979
862												
863	Lognormal GOF Test											
864	Shapiro Wilk Test Statistic					0.875	Shapiro Wilk Lognormal GOF Test					
865	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level					
866	Lilliefors Test Statistic					0.233	Lilliefors Lognormal GOF Test					
867	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level					
868	Data appear Lognormal at 5% Significance Level											
869												
870	Lognormal Statistics											
871	Minimum of Logged Data					-0.357	Mean of logged Data					0.331
872	Maximum of Logged Data					0.916	SD of logged Data					0.408
873												
874	Assuming Lognormal Distribution											
875	95% H-UCL					2.012	90% Chebyshev (MVUE) UCL					2.087
876	95% Chebyshev (MVUE) UCL					2.353	97.5% Chebyshev (MVUE) UCL					2.722
877	99% Chebyshev (MVUE) UCL					3.447						
878												
879	Nonparametric Distribution Free UCL Statistics											
880	Data appear to follow a Discernible Distribution at 5% Significance Level											
881												
882	Nonparametric Distribution Free UCLs											
883	95% CLT UCL					1.77	95% Jackknife UCL					1.802
884	95% Standard Bootstrap UCL					1.759	95% Bootstrap-t UCL					1.811

	A	B	C	D	E	F	G	H	I	J	K	L
885	95% Hall's Bootstrap UCL					1.815	95% Percentile Bootstrap UCL					1.76
886	95% BCA Bootstrap UCL					1.75						
887	90% Chebyshev(Mean, Sd) UCL					2.001	95% Chebyshev(Mean, Sd) UCL					2.232
888	97.5% Chebyshev(Mean, Sd) UCL					2.553	99% Chebyshev(Mean, Sd) UCL					3.184
889												
890	Suggested UCL to Use											
891	95% Student's-t UCL					1.802						
892												
893	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
894	Recommendations are based upon data size, data distribution, and skewness.											
895	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
896	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
897												
898												
899	Ni											
900												
901	General Statistics											
902	Total Number of Observations					10	Number of Distinct Observations					7
903							Number of Missing Observations					0
904	Minimum					18	Mean					30.1
905	Maximum					41	Median					30
906	SD					7.031	Std. Error of Mean					2.223
907	Coefficient of Variation					0.234	Skewness					0.216
908												
909	Normal GOF Test											
910	Shapiro Wilk Test Statistic					0.931	Shapiro Wilk GOF Test					
911	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level					
912	Lilliefors Test Statistic					0.193	Lilliefors GOF Test					
913	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level					
914	Data appear Normal at 5% Significance Level											
915												
916	Assuming Normal Distribution											
917	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
918	95% Student's-t UCL					34.18	95% Adjusted-CLT UCL (Chen-1995)					33.92
919							95% Modified-t UCL (Johnson-1978)					34.2
920												
921	Gamma GOF Test											
922	A-D Test Statistic					0.354	Anderson-Darling Gamma GOF Test					
923	5% A-D Critical Value					0.725	Detected data appear Gamma Distributed at 5% Significance Level					
924	K-S Test Statistic					0.163	Kolmogorov-Smirnov Gamma GOF Test					
925	5% K-S Critical Value					0.266	Detected data appear Gamma Distributed at 5% Significance Level					
926	Detected data appear Gamma Distributed at 5% Significance Level											
927												
928	Gamma Statistics											
929	k hat (MLE)					19.7	k star (bias corrected MLE)					13.86
930	Theta hat (MLE)					1.528	Theta star (bias corrected MLE)					2.172
931	nu hat (MLE)					394.1	nu star (bias corrected)					277.2
932	MLE Mean (bias corrected)					30.1	MLE Sd (bias corrected)					8.085
933							Approximate Chi Square Value (0.05)					239.6
934	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					233.6
935												
936	Assuming Gamma Distribution											

	A	B	C	D	E	F	G	H	I	J	K	L
937	95% Approximate Gamma UCL (use when n>=50))					34.82	95% Adjusted Gamma UCL (use when n<50)					35.72
938												
939	Lognormal GOF Test											
940	Shapiro Wilk Test Statistic					0.933	Shapiro Wilk Lognormal GOF Test					
941	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level					
942	Lilliefors Test Statistic					0.166	Lilliefors Lognormal GOF Test					
943	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level					
944	Data appear Lognormal at 5% Significance Level											
945												
946	Lognormal Statistics											
947	Minimum of Logged Data					2.89	Mean of logged Data					3.379
948	Maximum of Logged Data					3.714	SD of logged Data					0.242
949												
950	Assuming Lognormal Distribution											
951	95% H-UCL					35.28	90% Chebyshev (MVUE) UCL					37.08
952	95% Chebyshev (MVUE) UCL					40.23	97.5% Chebyshev (MVUE) UCL					44.6
953	99% Chebyshev (MVUE) UCL					53.2						
954												
955	Nonparametric Distribution Free UCL Statistics											
956	Data appear to follow a Discernible Distribution at 5% Significance Level											
957												
958	Nonparametric Distribution Free UCLs											
959	95% CLT UCL					33.76	95% Jackknife UCL					34.18
960	95% Standard Bootstrap UCL					33.58	95% Bootstrap-t UCL					35.03
961	95% Hall's Bootstrap UCL					35.72	95% Percentile Bootstrap UCL					33.6
962	95% BCA Bootstrap UCL					33.4						
963	90% Chebyshev(Mean, Sd) UCL					36.77	95% Chebyshev(Mean, Sd) UCL					39.79
964	97.5% Chebyshev(Mean, Sd) UCL					43.98	99% Chebyshev(Mean, Sd) UCL					52.22
965												
966	Suggested UCL to Use											
967	95% Student's-t UCL					34.18						
968												
969	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
970	Recommendations are based upon data size, data distribution, and skewness.											
971	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
972	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
973												
974												
975	Se											
976												
977	General Statistics											
978	Total Number of Observations					10	Number of Distinct Observations					6
979							Number of Missing Observations					0
980	Minimum					0.3	Mean					0.56
981	Maximum					0.8	Median					0.6
982	SD					0.178	Std. Error of Mean					0.0562
983	Coefficient of Variation					0.317	Skewness					-0.428
984												
985	Normal GOF Test											
986	Shapiro Wilk Test Statistic					0.906	Shapiro Wilk GOF Test					
987	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level					
988	Lilliefors Test Statistic					0.189	Lilliefors GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
989	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level						
990	Data appear Normal at 5% Significance Level												
991													
992	Assuming Normal Distribution												
993	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
994	95% Student's-t UCL				0.663	95% Adjusted-CLT UCL (Chen-1995)						0.644	
995						95% Modified-t UCL (Johnson-1978)						0.662	
996													
997	Gamma GOF Test												
998	A-D Test Statistic				0.577	Anderson-Darling Gamma GOF Test							
999	5% A-D Critical Value				0.725	Detected data appear Gamma Distributed at 5% Significance Level							
1000	K-S Test Statistic				0.227	Kolmogorov-Smirnov Gamma GOF Test							
1001	5% K-S Critical Value				0.267	Detected data appear Gamma Distributed at 5% Significance Level							
1002	Detected data appear Gamma Distributed at 5% Significance Level												
1003													
1004	Gamma Statistics												
1005	k hat (MLE)				9.527	k star (bias corrected MLE)						6.735	
1006	Theta hat (MLE)				0.0588	Theta star (bias corrected MLE)						0.0831	
1007	nu hat (MLE)				190.5	nu star (bias corrected)						134.7	
1008	MLE Mean (bias corrected)				0.56	MLE Sd (bias corrected)						0.216	
1009						Approximate Chi Square Value (0.05)						108.9	
1010	Adjusted Level of Significance				0.0267	Adjusted Chi Square Value						104.9	
1011													
1012	Assuming Gamma Distribution												
1013	95% Approximate Gamma UCL (use when n>=50))				0.693	95% Adjusted Gamma UCL (use when n<50)						0.719	
1014													
1015	Lognormal GOF Test												
1016	Shapiro Wilk Test Statistic				0.865	Shapiro Wilk Lognormal GOF Test							
1017	5% Shapiro Wilk Critical Value				0.842	Data appear Lognormal at 5% Significance Level							
1018	Lilliefors Test Statistic				0.233	Lilliefors Lognormal GOF Test							
1019	5% Lilliefors Critical Value				0.262	Data appear Lognormal at 5% Significance Level							
1020	Data appear Lognormal at 5% Significance Level												
1021													
1022	Lognormal Statistics												
1023	Minimum of Logged Data				-1.204	Mean of logged Data						-0.633	
1024	Maximum of Logged Data				-0.223	SD of logged Data						0.359	
1025													
1026	Assuming Lognormal Distribution												
1027	95% H-UCL				0.723	90% Chebyshev (MVUE) UCL						0.756	
1028	95% Chebyshev (MVUE) UCL				0.844	97.5% Chebyshev (MVUE) UCL						0.966	
1029	99% Chebyshev (MVUE) UCL				1.205								
1030													
1031	Nonparametric Distribution Free UCL Statistics												
1032	Data appear to follow a Discernible Distribution at 5% Significance Level												
1033													
1034	Nonparametric Distribution Free UCLs												
1035	95% CLT UCL				0.652	95% Jackknife UCL						0.663	
1036	95% Standard Bootstrap UCL				0.649	95% Bootstrap-t UCL						0.654	
1037	95% Hall's Bootstrap UCL				0.639	95% Percentile Bootstrap UCL						0.64	
1038	95% BCA Bootstrap UCL				0.63								
1039	90% Chebyshev(Mean, Sd) UCL				0.729	95% Chebyshev(Mean, Sd) UCL						0.805	
1040	97.5% Chebyshev(Mean, Sd) UCL				0.911	99% Chebyshev(Mean, Sd) UCL						1.119	

	A	B	C	D	E	F	G	H	I	J	K	L
1041												
1042	Suggested UCL to Use											
1043	95% Student's-t UCL					0.663						
1044												
1045	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1046	Recommendations are based upon data size, data distribution, and skewness.											
1047	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1048	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1049												
1050	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
1051	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
1052												
1053												
1054	V											
1055												
1056		General Statistics										
1057	Total Number of Observations					10	Number of Distinct Observations					8
1058							Number of Missing Observations					0
1059	Minimum					22	Mean					29
1060	Maximum					47	Median					26
1061	SD					7.318	Std. Error of Mean					2.314
1062	Coefficient of Variation					0.252	Skewness					1.89
1063												
1064	Normal GOF Test											
1065	Shapiro Wilk Test Statistic					0.799	Shapiro Wilk GOF Test					
1066	5% Shapiro Wilk Critical Value					0.842	Data Not Normal at 5% Significance Level					
1067	Lilliefors Test Statistic					0.259	Lilliefors GOF Test					
1068	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level					
1069	Data appear Approximate Normal at 5% Significance Level											
1070												
1071	Assuming Normal Distribution											
1072	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1073	95% Student's-t UCL					33.24	95% Adjusted-CLT UCL (Chen-1995)					34.28
1074							95% Modified-t UCL (Johnson-1978)					33.47
1075												
1076	Gamma GOF Test											
1077	A-D Test Statistic					0.657	Anderson-Darling Gamma GOF Test					
1078	5% A-D Critical Value					0.725	Detected data appear Gamma Distributed at 5% Significance Level					
1079	K-S Test Statistic					0.262	Kolmogorov-Smirnov Gamma GOF Test					
1080	5% K-S Critical Value					0.266	Detected data appear Gamma Distributed at 5% Significance Level					
1081	Detected data appear Gamma Distributed at 5% Significance Level											
1082												
1083	Gamma Statistics											
1084	k hat (MLE)					20.97	k star (bias corrected MLE)					14.74
1085	Theta hat (MLE)					1.383	Theta star (bias corrected MLE)					1.967
1086	nu hat (MLE)					419.3	nu star (bias corrected)					294.9
1087	MLE Mean (bias corrected)					29	MLE Sd (bias corrected)					7.553
1088							Approximate Chi Square Value (0.05)					256.1
1089	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					249.8
1090												
1091	Assuming Gamma Distribution											
1092	95% Approximate Gamma UCL (use when n>=50))					33.39	95% Adjusted Gamma UCL (use when n<50)					34.23

	A	B	C	D	E	F	G	H	I	J	K	L
1093												
1094	Lognormal GOF Test											
1095	Shapiro Wilk Test Statistic					0.873	Shapiro Wilk Lognormal GOF Test					
1096	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level					
1097	Lilliefors Test Statistic					0.25	Lilliefors Lognormal GOF Test					
1098	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level					
1099	Data appear Lognormal at 5% Significance Level											
1100												
1101	Lognormal Statistics											
1102	Minimum of Logged Data					3.091	Mean of logged Data					3.343
1103	Maximum of Logged Data					3.85	SD of logged Data					0.222
1104												
1105	Assuming Lognormal Distribution											
1106	95% H-UCL					33.39	90% Chebyshev (MVUE) UCL					35.05
1107	95% Chebyshev (MVUE) UCL					37.82	97.5% Chebyshev (MVUE) UCL					41.67
1108	99% Chebyshev (MVUE) UCL					49.21						
1109												
1110	Nonparametric Distribution Free UCL Statistics											
1111	Data appear to follow a Discernible Distribution at 5% Significance Level											
1112												
1113	Nonparametric Distribution Free UCLs											
1114	95% CLT UCL					32.81	95% Jackknife UCL					33.24
1115	95% Standard Bootstrap UCL					32.58	95% Bootstrap-t UCL					36.9
1116	95% Hall's Bootstrap UCL					48.7	95% Percentile Bootstrap UCL					32.9
1117	95% BCA Bootstrap UCL					33.9						
1118	90% Chebyshev(Mean, Sd) UCL					35.94	95% Chebyshev(Mean, Sd) UCL					39.09
1119	97.5% Chebyshev(Mean, Sd) UCL					43.45	99% Chebyshev(Mean, Sd) UCL					52.03
1120												
1121	Suggested UCL to Use											
1122	95% Student's-t UCL					33.24						
1123												
1124	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1125	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1126												
1127	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1128	Recommendations are based upon data size, data distribution, and skewness.											
1129	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1130	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1131												
1132												
1133	Zn											
1134												
1135	General Statistics											
1136	Total Number of Observations					10	Number of Distinct Observations					9
1137							Number of Missing Observations					0
1138	Minimum					47	Mean					65.2
1139	Maximum					83	Median					63.5
1140	SD					12.69	Std. Error of Mean					4.013
1141	Coefficient of Variation					0.195	Skewness					-0.0675
1142												
1143	Normal GOF Test											
1144	Shapiro Wilk Test Statistic					0.938	Shapiro Wilk GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
1145	5% Shapiro Wilk Critical Value					0.842	Data appear Normal at 5% Significance Level						
1146	Lilliefors Test Statistic					0.156	Lilliefors GOF Test						
1147	5% Lilliefors Critical Value					0.262	Data appear Normal at 5% Significance Level						
1148	Data appear Normal at 5% Significance Level												
1149													
1150	Assuming Normal Distribution												
1151	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
1152	95% Student's-t UCL					72.56	95% Adjusted-CLT UCL (Chen-1995)					71.71	
1153							95% Modified-t UCL (Johnson-1978)					72.54	
1154													
1155	Gamma GOF Test												
1156	A-D Test Statistic					0.312	Anderson-Darling Gamma GOF Test						
1157	5% A-D Critical Value					0.725	Detected data appear Gamma Distributed at 5% Significance Level						
1158	K-S Test Statistic					0.174	Kolmogorov-Smirnov Gamma GOF Test						
1159	5% K-S Critical Value					0.266	Detected data appear Gamma Distributed at 5% Significance Level						
1160	Detected data appear Gamma Distributed at 5% Significance Level												
1161													
1162	Gamma Statistics												
1163	k hat (MLE)					28.36	k star (bias corrected MLE)					19.92	
1164	Theta hat (MLE)					2.299	Theta star (bias corrected MLE)					3.273	
1165	nu hat (MLE)					567.3	nu star (bias corrected)					398.4	
1166	MLE Mean (bias corrected)					65.2	MLE Sd (bias corrected)					14.61	
1167							Approximate Chi Square Value (0.05)					353.1	
1168	Adjusted Level of Significance					0.0267	Adjusted Chi Square Value					345.7	
1169													
1170	Assuming Gamma Distribution												
1171	95% Approximate Gamma UCL (use when n>=50))					73.56	95% Adjusted Gamma UCL (use when n<50)					75.14	
1172													
1173	Lognormal GOF Test												
1174	Shapiro Wilk Test Statistic					0.93	Shapiro Wilk Lognormal GOF Test						
1175	5% Shapiro Wilk Critical Value					0.842	Data appear Lognormal at 5% Significance Level						
1176	Lilliefors Test Statistic					0.164	Lilliefors Lognormal GOF Test						
1177	5% Lilliefors Critical Value					0.262	Data appear Lognormal at 5% Significance Level						
1178	Data appear Lognormal at 5% Significance Level												
1179													
1180	Lognormal Statistics												
1181	Minimum of Logged Data					3.85	Mean of logged Data					4.16	
1182	Maximum of Logged Data					4.419	SD of logged Data					0.201	
1183													
1184	Assuming Lognormal Distribution												
1185	95% H-UCL					74.12	90% Chebyshev (MVUE) UCL					77.68	
1186	95% Chebyshev (MVUE) UCL					83.32	97.5% Chebyshev (MVUE) UCL					91.15	
1187	99% Chebyshev (MVUE) UCL					106.5							
1188													
1189	Nonparametric Distribution Free UCL Statistics												
1190	Data appear to follow a Discernible Distribution at 5% Significance Level												
1191													
1192	Nonparametric Distribution Free UCLs												
1193	95% CLT UCL					71.8	95% Jackknife UCL					72.56	
1194	95% Standard Bootstrap UCL					71.32	95% Bootstrap-t UCL					72.75	
1195	95% Hall's Bootstrap UCL					71.31	95% Percentile Bootstrap UCL					71.4	
1196	95% BCA Bootstrap UCL					71.1							

	A	B	C	D	E	F	G	H	I	J	K	L
1197	90% Chebyshev(Mean, Sd) UCL					77.24	95% Chebyshev(Mean, Sd) UCL					82.69
1198	97.5% Chebyshev(Mean, Sd) UCL					90.26	99% Chebyshev(Mean, Sd) UCL					105.1
1199												
1200	Suggested UCL to Use											
1201	95% Student's-t UCL					72.56						
1202												
1203	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1204	Recommendations are based upon data size, data distribution, and skewness.											
1205	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1206	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1207												
1208	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
1209	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
1210												

Appendix C
HHRA Supporting Information

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Antimony
Soil concentration	24.41
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	24.41	mg/kg
Chronic Daily Intake	3.01E-05	mg/kg bw-day
SSTL	66	mg/kg
Hazard Quotient	7.52E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	4.00E-04	mg CoPC/kg bw - day	US EPA IRIS
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	3.61E-06	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	8.40E-01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{4.00\text{E-}04 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 0.84$$

$$\text{SSTL (mg/kg)} = 66$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Chromium
Soil concentration	1400.42
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	1400.42	mg/kg
Chronic Daily Intake	1.86E-03	mg/kg bw-day
SSTL	45240	mg/kg
Hazard Quotient	6.20E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.23E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.1 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 45240$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Chromium
Soil concentration	28.58
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	28.58	mg/kg
Chronic Daily Intake	3.79E-05	mg/kg bw-day
SSTL	186	mg/kg
Hazard Quotient	3.79E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.23E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.1 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 186$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Camping-Toddler	Lifetime Average Daily Dose	5.66E-06	mg/kg bw-day
Receptor	Lifetime Composite		SSTL	642	mg/kg
CoPC	Chromium		ILCR	4.71E-07	
Soil concentration	28.58		where: ILCR = $\frac{C_{\text{soil}}}{\text{SSTL} - \text{BSC}} \times \text{TR}$		
Target risk	1.E-05				
Age-adjustment?	TRUE				

SSTL (mg CoPC/kg soil) =

TR x ATc

+ BSC

((EF x SFo x AFG x SIRadj) + (EF x SFo x AFS x SRadj) + (EF x SFi x AFI x IRs adj x ET2))

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =		kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =		kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =		kg soil/day	calculated
Soil Inhalation Rate	IR _s =		kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =	4.72E-05	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =	1.56E-04	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =	1.63E-08	kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =	9.20E+01	days/year	Health Canada (2006)
Exposure Term	ET ₁ =		unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Averaging Time (non-carcinogens)	ATn =		days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

Example Calculation =

1.00E-05 x 29200

+ 35

((92 x 0 x 1 x 4.72E-05) + (92 x 0 x 0.1 x 1.56E-04) + (92 x 320 x 1 x 1.63E-08 x 1.00E+00))

SSTL (mg/kg) = 642

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Cobalt
Soil concentration	93.8
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	93.8	mg/kg
Chronic Daily Intake	1.16E-04	mg/kg bw-day
SSTL	172	mg/kg
Hazard Quotient	1.16E-01	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.74E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 9.5$$

$$\text{SSTL (mg/kg)} = 172$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Manganese
Soil concentration	635.7
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	635.7	mg/kg
Chronic Daily Intake	7.84E-04	mg/kg bw-day
SSTL	22774	mg/kg
Hazard Quotient	5.76E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.36E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	1.00E-01	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.36\text{E-}01 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 709$$

$$\text{SSTL (mg/kg)} = 22774$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Nickel
Soil concentration	2013
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	2013	mg/kg
Chronic Daily Intake	2.65E-03	mg/kg bw-day
SSTL	1710	mg/kg
Hazard Quotient	2.41E-01	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	9.99E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.091 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 40.7$$

$$\text{SSTL (mg/kg)} = 1710$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Antimony
Soil concentration	24.41
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	24.41	mg/kg
Chronic Daily Intake	2.23E-06	mg/kg bw-day
SSTL	878	mg/kg
Hazard Quotient	5.56E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	4.00E-04	mg CoPC/kg bw - day	US EPA IRIS
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	4.78E-07	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	8.40E-01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{4.00\text{E-}04 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 0.84$$

$$\text{SSTL (mg/kg)} = 878$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Chromium
Soil concentration	1400.42
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	1400.42	mg/kg
Chronic Daily Intake	1.85E-04	mg/kg bw-day
SSTL	454910	mg/kg
Hazard Quotient	6.16E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.85E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 454910$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Chromium
Soil concentration	28.58
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	28.58	mg/kg
Chronic Daily Intake	3.77E-06	mg/kg bw-day
SSTL	1551	mg/kg
Hazard Quotient	3.77E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.85E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 1551$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Hunter/Gatherer	Lifetime Average Daily Dose	3.20E-06	mg/kg bw-day
Receptor	Lifetime Composite		SSTL	1109	mg/kg
CoPC	Chromium		ILCR	2.66E-07	
Soil concentration	28.58		where: ILCR = $\frac{C_{\text{soil}}}{\text{SSTL} - \text{BSC}}$ x TR		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	TRUE				

SSTL (mg CoPC/kg soil) =

TR x ATc

+ BSC

((EF x SFo x AFG x SIRadj) + (EF x SFo x AFs x SRadj) + (EF x SFi x AFI x IRs adj x ET2))

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =		kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =		kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =		kg soil/day	calculated
Soil Inhalation Rate	IR _s =		kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =	4.72E-05	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =	1.56E-04	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =	1.63E-08	kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =	5.20E+01	days/year	Health Canada (2006)
Exposure Term	ET ₁ =		unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Averaging Time (non-carcinogens)	ATn =		days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

Example Calculation =

1.00E-05 x 29200

+ 35

((52 x 0 x 1 x 4.72E-05) + (52 x 0 x 0.1 x 1.56E-04) + (52 x 320 x 1 x 1.63E-08 x 1.00E+00))

SSTL (mg/kg) = 1109

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Cobalt
Soil concentration	93.8
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	93.8	mg/kg
Chronic Daily Intake	8.55E-06	mg/kg bw-day
SSTL	2203	mg/kg
Hazard Quotient	8.55E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	$\text{TDI}_{\text{oral}} =$	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	$\text{TDI}_{\text{inh}} =$		mg CoPC/kg bw - day	
Estimated Daily Intake	$\text{EDI} =$	4.64E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	$\text{EDI}_{\text{inh}} =$		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	$\text{SAF} =$	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	$\text{BW} =$	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	$\text{AF}_g =$	1.00E+00	unitless	Default
Absorption Factor - skin	$\text{AF}_s =$	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	$\text{AF}_i =$	1.00E+00	unitless	Default
Soil Ingestion Rate	$\text{SIR} =$	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	$\text{SR} =$	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	$\text{IR}_s =$	1.10E-08	kg soil/day	calculated
Exposure Term	$\text{ET}_1 =$	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	$\text{ET}_2 =$	1.00E+00	unitless	calculated
Background Soil Concentration	$\text{BSC} =$	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 9.5$$

$$\text{SSTL (mg/kg)} = 2203$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Manganese
Soil concentration	635.7
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	635.7	mg/kg
Chronic Daily Intake	5.80E-05	mg/kg bw-day
SSTL	268317	mg/kg
Hazard Quotient	4.75E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.22E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	8.37E-02	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.22\text{E-}01 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 709$$

$$\text{SSTL (mg/kg)} = 268317$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Nickel
Soil concentration	2013
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	2013	mg/kg
Chronic Daily Intake	2.57E-04	mg/kg bw-day
SSTL	17251	mg/kg
Hazard Quotient	2.34E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	7.59E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.091 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 40.7$$

$$\text{SSTL (mg/kg)} = 17251$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Antimony
Soil concentration	24.41
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	24.41	mg/kg
Chronic Daily Intake	2.72E-07	mg/kg bw-day
SSTL	7190	mg/kg
Hazard Quotient	6.79E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	4.00E-04	mg CoPC/kg bw - day	US EPA IRIS
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.66E-07	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	8.40E-01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{4.00\text{E-}04 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 0.84$$

$$\text{SSTL (mg/kg)} = 7190$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Chromium
Soil concentration	1400.42
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	1400.42	mg/kg
Chronic Daily Intake	2.26E-05	mg/kg bw-day
SSTL	3724926	mg/kg
Hazard Quotient	7.52E-05	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	5.93E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 35$$

$$\text{SSTL (mg/kg)} = 3724926$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Chromium
Soil concentration	28.58
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	28.58	mg/kg
Chronic Daily Intake	4.60E-07	mg/kg bw-day
SSTL	12451	mg/kg
Hazard Quotient	4.60E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	5.93E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 35$$

$$\text{SSTL (mg/kg)} = 12451$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Occasional Visitor	Lifetime Average Daily Dose	2.59E-07	mg/kg bw-day
Receptor	Adult - Female		SSTL	22311	mg/kg
CoPC	Chromium		ILCR	1.28E-08	
Soil concentration	28.58		where: ILCR = $\frac{C_{\text{soil}}}{\text{SSTL} - \text{BSC}}$ x TR		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	FALSE				

SSTL (mg _{CoPC}/kg _{soil}) =

TR x BW

+ BSC

((ET1 x SFo x AFg x SIR) + (ET1 x SFo x AFs x SR) + (ET1 x ET2 x SFi x AFI x IRs)) x (ATn / ATc)

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =		kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =		kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =		kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =		days/year	Health Canada (2006)
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Averaging Time (non-carcinogens)	ATn =	1.64E+04	days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5 th ile (2016)

Example Calculation =

1.00E-05 x 62.2

+ 35

((3.29E-02 x 0 x 1 x 0.00002) + (3.29E-02 x 0 x 0.1 x 1.05E-04) + (3.29E-02 x 4.17E-01 x 320 x 1 x 1.13E-08)) x (16425 / 29200)

SSTL (mg/kg) = 22311

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Cobalt
Soil concentration	93.8
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	93.8	mg/kg
Chronic Daily Intake	1.04E-06	mg/kg bw-day
SSTL	17983	mg/kg
Hazard Quotient	1.04E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	$\text{TDI}_{\text{oral}} =$	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	$\text{TDI}_{\text{inh}} =$		mg CoPC/kg bw - day	
Estimated Daily Intake	$\text{EDI} =$	2.30E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	$\text{EDI}_{\text{inh}} =$		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	$\text{SAF} =$	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	$\text{BW} =$	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	$\text{AF}_g =$	1.00E+00	unitless	Default
Absorption Factor - skin	$\text{AF}_s =$	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	$\text{AF}_i =$	1.00E+00	unitless	Default
Soil Ingestion Rate	$\text{SIR} =$	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	$\text{SR} =$	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	$\text{IR}_s =$	1.13E-08	kg soil/day	calculated
Exposure Term	$\text{ET}_1 =$	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	$\text{ET}_2 =$	4.17E-01	unitless	calculated
Background Soil Concentration	$\text{BSC} =$	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 9.5$$

$$\text{SSTL (mg/kg)} = 17983$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Manganese
Soil concentration	635.7
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	635.7	mg/kg
Chronic Daily Intake	7.07E-06	mg/kg bw-day
SSTL	2804651	mg/kg
Hazard Quotient	4.53E-05	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.56E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	5.67E-02	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.56\text{E-}01 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 709$$

$$\text{SSTL (mg/kg)} = 2804651$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Nickel
Soil concentration	2013
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	2013	mg/kg
Chronic Daily Intake	3.14E-05	mg/kg bw-day
SSTL	140978	mg/kg
Hazard Quotient	2.86E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	$\text{TDI}_{\text{oral}} =$	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	$\text{TDI}_{\text{inh}} =$		mg CoPC/kg bw - day	
Estimated Daily Intake	$\text{EDI} =$	4.08E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	$\text{EDI}_{\text{inh}} =$		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	$\text{SAF} =$	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	$\text{BW} =$	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	$\text{AF}_g =$	1.00E+00	unitless	Default
Absorption Factor - skin	$\text{AF}_s =$	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	$\text{AF}_l =$	1.00E+00	unitless	Default
Soil Ingestion Rate	$\text{SIR} =$	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	$\text{SR} =$	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	$\text{IR}_s =$	1.13E-08	kg soil/day	calculated
Exposure Term	$\text{ET}_1 =$	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	$\text{ET}_2 =$	4.17E-01	unitless	calculated
Background Soil Concentration	$\text{BSC} =$	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.091 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 40.7$$

$$\text{SSTL (mg/kg)} = 140978$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Antimony
Soil concentration	17.89
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	17.89	mg/kg
Chronic Daily Intake	2.21E-05	mg/kg bw-day
SSTL	66	mg/kg
Hazard Quotient	5.51E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	4.00E-04	mg CoPC/kg bw - day	US EPA IRIS
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	3.61E-06	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	8.40E-01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{4.00\text{E-}04 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 0.84$$

$$\text{SSTL (mg/kg)} = 66$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Chromium
Soil concentration	642.488
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	642.488	mg/kg
Chronic Daily Intake	8.53E-04	mg/kg bw-day
SSTL	45240	mg/kg
Hazard Quotient	2.84E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.23E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.1 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 45240$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Chromium
Soil concentration	13.112
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	13.112	mg/kg
Chronic Daily Intake	1.74E-05	mg/kg bw-day
SSTL	186	mg/kg
Hazard Quotient	1.74E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.23E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.1 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 186$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Camping-Toddler	Lifetime Average Daily Dose	2.60E-06	mg/kg bw-day
Receptor	Lifetime Composite		SSTL	642	mg/kg
CoPC	Chromium		ILCR	2.16E-07	
Soil concentration	13.112		where: ILCR = $\frac{C_{soil}}{SSTL - BSC} \times TR$		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	TRUE				

SSTL (mg CoPC/kg soil) = $\frac{TR \times ATc}{((EF \times SF_o \times AF_g \times SIR_{adj}) + (EF \times SF_o \times AF_s \times SR_{adj}) + (EF \times SF_i \times AFI \times IR_s \times adj \times ET_2))}$ + BSC

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =		kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =		kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =		kg soil/day	calculated
Soil Inhalation Rate	IR _s =		kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =	4.72E-05	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =	1.56E-04	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =	1.63E-08	kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =	9.20E+01	days/year	Health Canada (2006)
Exposure Term	ET ₁ =		unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Averaging Time (non-carcinogens)	ATn =		days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5 th ile (2016)

Example Calculation = $\frac{1.00E-05 \times 29200}{((92 \times 0 \times 1 \times 4.72E-05) + (92 \times 0 \times 0.1 \times 1.56E-04) + (92 \times 320 \times 1 \times 1.63E-08 \times 1.00E+00))}$ + 35

SSTL (mg/kg) = 642

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Cobalt
Soil concentration	54.61
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	54.61	mg/kg
Chronic Daily Intake	6.73E-05	mg/kg bw-day
SSTL	172	mg/kg
Hazard Quotient	6.73E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.74E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 9.5$$

$$\text{SSTL (mg/kg)} = 172$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Manganese
Soil concentration	563.5
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	563.5	mg/kg
Chronic Daily Intake	6.95E-04	mg/kg bw-day
SSTL	22774	mg/kg
Hazard Quotient	5.11E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.36E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	1.00E-01	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.36\text{E-}01 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 709$$

$$\text{SSTL (mg/kg)} = 22774$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Nickel
Soil concentration	981.9
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	981.9	mg/kg
Chronic Daily Intake	1.29E-03	mg/kg bw-day
SSTL	1710	mg/kg
Hazard Quotient	1.18E-01	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	9.99E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.091 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 40.7$$

$$\text{SSTL (mg/kg)} = 1710$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Antimony
Soil concentration	17.89
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	17.89	mg/kg
Chronic Daily Intake	1.63E-06	mg/kg bw-day
SSTL	878	mg/kg
Hazard Quotient	4.08E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	4.00E-04	mg CoPC/kg bw - day	US EPA IRIS
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	4.78E-07	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	8.40E-01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{4.00\text{E-}04 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 0.84$$

$$\text{SSTL (mg/kg)} = 878$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Chromium
Soil concentration	642.488
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	642.488	mg/kg
Chronic Daily Intake	8.47E-05	mg/kg bw-day
SSTL	454910	mg/kg
Hazard Quotient	2.82E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.85E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 454910$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Chromium
Soil concentration	13.112
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	13.112	mg/kg
Chronic Daily Intake	1.73E-06	mg/kg bw-day
SSTL	1551	mg/kg
Hazard Quotient	1.73E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.85E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 1551$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Hunter/Gatherer	Lifetime Average Daily Dose	1.47E-06	mg/kg bw-day
Receptor	Lifetime Composite		SSTL	1109	mg/kg
CoPC	Chromium		ILCR	1.22E-07	
Soil concentration	13.112		where: ILCR = $\frac{C_{soil}}{SSTL - BSC} \times TR$		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	TRUE				

SSTL (mg _{CoPC}/kg _{soil}) =

TR x ATc

+ BSC

((EF x SFo x AFG x SIRadj) + (EF x SFo x AFs x SRadj) + (EF x SFi x AFI x IRs adj x ET2))

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =		kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =		kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =		kg soil/day	calculated
Soil Inhalation Rate	IR _s =		kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =	4.72E-05	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =	1.56E-04	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =	1.63E-08	kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =	5.20E+01	days/year	Health Canada (2006)
Exposure Term	ET ₁ =		unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Averaging Time (non-carcinogens)	ATn =		days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5 th ile (2016)

Example Calculation =

1.00E-05 x 29200

+ 35

((52 x 0 x 1 x 4.72E-05) + (52 x 0 x 0.1 x 1.56E-04) + (52 x 320 x 1 x 1.63E-08 x 1.00E+00))

SSTL (mg/kg) = 1109

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Cobalt
Soil concentration	54.61
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	54.61	mg/kg
Chronic Daily Intake	4.98E-06	mg/kg bw-day
SSTL	2203	mg/kg
Hazard Quotient	4.98E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	4.64E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 9.5$$

SSTL (mg/kg) = 2203

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

SSTL (mg/kg) = EDI does not exceed TDI, SSTL calculated above

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

SSTL (mg/kg) = EDI does not exceed TDI, SSTL calculated above

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Manganese
Soil concentration	563.5
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	563.5	mg/kg
Chronic Daily Intake	5.14E-05	mg/kg bw-day
SSTL	268317	mg/kg
Hazard Quotient	4.21E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.22E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	8.37E-02	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.22\text{E-}01 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 709$$

$$\text{SSTL (mg/kg)} = 268317$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Nickel
Soil concentration	981.9
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	981.9	mg/kg
Chronic Daily Intake	1.26E-04	mg/kg bw-day
SSTL	17251	mg/kg
Hazard Quotient	1.14E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	$\text{TDI}_{\text{oral}} =$	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	$\text{TDI}_{\text{inh}} =$		mg CoPC/kg bw - day	
Estimated Daily Intake	$\text{EDI} =$	7.59E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	$\text{EDI}_{\text{inh}} =$		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	$\text{SAF} =$	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	$\text{BW} =$	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	$\text{AF}_g =$	1.00E+00	unitless	Default
Absorption Factor - skin	$\text{AF}_s =$	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	$\text{AF}_l =$	1.00E+00	unitless	Default
Soil Ingestion Rate	$\text{SIR} =$	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	$\text{SR} =$	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	$\text{IR}_s =$	1.10E-08	kg soil/day	calculated
Exposure Term	$\text{ET}_1 =$	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	$\text{ET}_2 =$	1.00E+00	unitless	calculated
Background Soil Concentration	$\text{BSC} =$	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.091 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 40.7$$

$$\text{SSTL (mg/kg)} = 17251$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Antimony
Soil concentration	17.89
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	17.89	mg/kg
Chronic Daily Intake	1.99E-07	mg/kg bw-day
SSTL	7190	mg/kg
Hazard Quotient	4.98E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	4.00E-04	mg CoPC/kg bw - day	US EPA IRIS
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.66E-07	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	8.40E-01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{4.00\text{E-}04 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 0.84$$

$$\text{SSTL (mg/kg)} = 7190$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Chromium
Soil concentration	642.488
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	642.488	mg/kg
Chronic Daily Intake	1.03E-05	mg/kg bw-day
SSTL	3724926	mg/kg
Hazard Quotient	3.45E-05	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	5.93E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 35$$

$$\text{SSTL (mg/kg)} = 3724926$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Chromium
Soil concentration	13.112
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	13.112	mg/kg
Chronic Daily Intake	2.11E-07	mg/kg bw-day
SSTL	12451	mg/kg
Hazard Quotient	2.11E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	5.93E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 35$$

$$\text{SSTL (mg/kg)} = 12451$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Occasional Visitor	Lifetime Average Daily Dose	1.19E-07	mg/kg bw-day
Receptor	Adult - Female		SSTL	22311	mg/kg
CoPC	Chromium		ILCR	5.89E-09	
Soil concentration	13.112		where: ILCR = $\frac{C_{\text{soil}}}{\text{SSTL} - \text{BSC}}$ x TR		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	FALSE				

SSTL (mg _{CoPC}/kg _{soil}) =

TR x BW

+ BSC

((ET1 x SFo x AFg x SIR) + (ET1 x SFo x AFs x SR) + (ET1 x ET2 x SFi x AFi x IRs)) x (ATn / ATc)

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =		kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =		kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =		kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =		days/year	Health Canada (2006)
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Averaging Time (non-carcinogens)	ATn =	1.64E+04	days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

Example Calculation =

1.00E-05 x 62.2

+ 35

((3.29E-02 x 0 x 1 x 0.00002) + (3.29E-02 x 0 x 0.1 x 1.05E-04) + (3.29E-02 x 4.17E-01 x 320 x 1 x 1.13E-08)) x (16425 / 29200)

SSTL (mg/kg) = 22311

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Cobalt
Soil concentration	54.61
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	54.61	mg/kg
Chronic Daily Intake	6.08E-07	mg/kg bw-day
SSTL	17983	mg/kg
Hazard Quotient	6.08E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.30E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 9.5$$

SSTL (mg/kg) = 17983

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

SSTL (mg/kg) = EDI does not exceed TDI, SSTL calculated above

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

SSTL (mg/kg) = EDI does not exceed TDI, SSTL calculated above

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Manganese
Soil concentration	563.5
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	563.5	mg/kg
Chronic Daily Intake	6.27E-06	mg/kg bw-day
SSTL	2804651	mg/kg
Hazard Quotient	4.02E-05	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.56E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	5.67E-02	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.56\text{E-}01 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 709$$

$$\text{SSTL (mg/kg)} = 2804651$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Nickel
Soil concentration	981.9
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	981.9	mg/kg
Chronic Daily Intake	1.53E-05	mg/kg bw-day
SSTL	140978	mg/kg
Hazard Quotient	1.39E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	4.08E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.091 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 40.7$$

$$\text{SSTL (mg/kg)} = 140978$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Chromium
Soil concentration	385.532
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	385.532	mg/kg
Chronic Daily Intake	5.12E-04	mg/kg bw-day
SSTL	45240	mg/kg
Hazard Quotient	1.71E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.23E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.1 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 45240$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Chromium
Soil concentration	7.868
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	7.868	mg/kg
Chronic Daily Intake	1.04E-05	mg/kg bw-day
SSTL	186	mg/kg
Hazard Quotient	1.04E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	2.23E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.1 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 186$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Camping-Toddler	Lifetime Average Daily Dose	1.56E-06	mg/kg bw-day
Receptor	Lifetime Composite		SSTL	642	mg/kg
CoPC	Chromium		ILCR	1.30E-07	
Soil concentration	7.868		where: ILCR = $\frac{C_{\text{soil}}}{\text{SSTL} - \text{BSC}} \times \text{TR}$		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	TRUE				

SSTL (mg CoPC/kg soil) = $\frac{\text{TR} \times \text{ATc}}{(\text{EF} \times \text{SFo} \times \text{AFg} \times \text{SIRadj}) + (\text{EF} \times \text{SFo} \times \text{AFs} \times \text{SRadj}) + (\text{EF} \times \text{SFi} \times \text{AFI} \times \text{IRs adj} \times \text{ET2})}$ + BSC

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =		kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =		kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =		kg soil/day	calculated
Soil Inhalation Rate	IR _s =		kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =	4.72E-05	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =	1.56E-04	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =	1.63E-08	kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =	9.20E+01	days/year	Health Canada (2006)
Exposure Term	ET ₁ =		unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Averaging Time (non-carcinogens)	ATn =		days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

Example Calculation = $\frac{1.00\text{E-}05 \times 29200}{((92 \times 0 \times 1 \times 4.72\text{E-}05) + (92 \times 0 \times 0.1 \times 1.56\text{E-}04) + (92 \times 320 \times 1 \times 1.63\text{E-}08 \times 1.00\text{E+}00))}$ + 35

SSTL (mg/kg) = 642

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Cobalt
Soil concentration	34.3
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	34.3	mg/kg
Chronic Daily Intake	4.23E-05	mg/kg bw-day
SSTL	172	mg/kg
Hazard Quotient	4.23E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.74E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 9.5$$

$$\text{SSTL (mg/kg)} = 172$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Manganese
Soil concentration	517.3
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	517.3	mg/kg
Chronic Daily Intake	6.38E-04	mg/kg bw-day
SSTL	22774	mg/kg
Hazard Quotient	4.69E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.36E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	1.00E-01	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.36\text{E-}01 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.01 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 709$$

$$\text{SSTL (mg/kg)} = 22774$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Camping-Toddler
Receptor	Toddler
CoPC	Nickel
Soil concentration	545.5
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	545.5	mg/kg
Chronic Daily Intake	7.19E-04	mg/kg bw-day
SSTL	1710	mg/kg
Hazard Quotient	6.54E-02	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	9.99E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	1.65E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	8.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	6.88E-05	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	7.07E-09	kg soil/day	calculated
Exposure Term	ET ₁ =	2.52E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 16.5}{(1 \times 0.00008) + (0.091 \times 6.88\text{E-}05) + (1 \times 7.07\text{E-}09) \times 1.00\text{E+}00} \times 2.52\text{E-}01 + 40.7$$

$$\text{SSTL (mg/kg)} = 1710$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined	- Hunter/Gatherer
Receptor	Child	
CoPC	Chromium	
Soil concentration	385.532	
Target risk	1.E-05	
Age-adjustment?	FALSE	

Results Summary

Soil Concentration (C _{soil})	385.532	mg/kg
Chronic Daily Intake	5.09E-05	mg/kg bw-day
SSTL	454910	mg/kg
Hazard Quotient	1.70E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.85E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 454910$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Chromium
Soil concentration	7.868
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	7.868	mg/kg
Chronic Daily Intake	1.04E-06	mg/kg bw-day
SSTL	1551	mg/kg
Hazard Quotient	1.04E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	6.85E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 35$$

$$\text{SSTL (mg/kg)} = 1551$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Hunter/Gatherer	Lifetime Average Daily Dose	8.80E-07	mg/kg bw-day
Receptor	Lifetime Composite		SSTL	1109	mg/kg
CoPC	Chromium		ILCR	7.33E-08	
Soil concentration	7.868		where: ILCR = $\frac{C_{soil}}{SSTL - BSC} \times TR$		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	TRUE				

SSTL (mg CoPC/kg soil) =

TR x ATc

+ BSC

((EF x SFo x AFG x SIRadj) + (EF x SFo x AFS x SRadj) + (EF x SFi x AFI x IRs adj x ET2))

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =		kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =		kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =		kg soil/day	calculated
Soil Inhalation Rate	IR _s =		kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =	4.72E-05	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =	1.56E-04	kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =	1.63E-08	kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =	5.20E+01	days/year	Health Canada (2006)
Exposure Term	ET ₁ =		unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Averaging Time (non-carcinogens)	ATn =		days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

Example Calculation =

1.00E-05 x 29200

+ 35

((52 x 0 x 1 x 4.72E-05) + (52 x 0 x 0.1 x 1.56E-04) + (52 x 320 x 1 x 1.63E-08 x 1.00E+00))

SSTL (mg/kg) = 1109

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Cobalt
Soil concentration	34.3
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	34.3	mg/kg
Chronic Daily Intake	3.13E-06	mg/kg bw-day
SSTL	2203	mg/kg
Hazard Quotient	3.13E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	4.64E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 9.5$$

SSTL (mg/kg) = 2203

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

SSTL (mg/kg) = EDI does not exceed TDI, SSTL calculated above

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

SSTL (mg/kg) = EDI does not exceed TDI, SSTL calculated above

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Manganese
Soil concentration	517.3
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	517.3	mg/kg
Chronic Daily Intake	4.72E-05	mg/kg bw-day
SSTL	268317	mg/kg
Hazard Quotient	3.87E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.22E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	8.37E-02	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.22\text{E-}01 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 709$$

$$\text{SSTL (mg/kg)} = 268317$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Hunter/Gatherer
Receptor	Child
CoPC	Nickel
Soil concentration	545.5
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	545.5	mg/kg
Chronic Daily Intake	6.97E-05	mg/kg bw-day
SSTL	17251	mg/kg
Hazard Quotient	6.34E-03	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	7.59E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	3.29E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.10E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	1.42E-01	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	1.00E+00	unitless	calculated
Background Soil Concentration	BSC =	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 32.9}{(1 \times 0.00002) + (0.091 \times 1.05\text{E-}04) + (1 \times 1.10\text{E-}08) \times 1.00\text{E+}00} \times 1.42\text{E-}01 + 40.7$$

$$\text{SSTL (mg/kg)} = 17251$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Chromium
Soil concentration	385.532
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	385.532	mg/kg
Chronic Daily Intake	6.21E-06	mg/kg bw-day
SSTL	3724926	mg/kg
Hazard Quotient	2.07E-05	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	3.00E-01	mg CoPC/kg bw - day	EFSA (2014)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	5.93E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{3.00\text{E-}01 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 35$$

$$\text{SSTL (mg/kg)} = 3724926$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Chromium
Soil concentration	7.868
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	7.868	mg/kg
Chronic Daily Intake	1.27E-07	mg/kg bw-day
SSTL	12451	mg/kg
Hazard Quotient	1.27E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.00E-03	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	
Estimated Daily Intake	EDI =	5.93E-05	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _l =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.1 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 35$$

$$\text{SSTL (mg/kg)} = 12451$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model			Results Summary		
Exposure Scenario	User Defined	- Occasional Visitor	Lifetime Average Daily Dose	7.13E-08	mg/kg bw-day
Receptor	Adult - Female		SSTL	22311	mg/kg
CoPC	Chromium		ILCR	3.53E-09	
Soil concentration	7.868		where: ILCR = $\frac{C_{\text{soil}}}{\text{SSTL} - \text{BSC}}$ x TR		
Target risk	1.E-05		SSTL - BSC		
Age-adjustment?	FALSE				

SSTL (mg _{CoPC}/kg _{soil}) =

TR x BW

+ BSC

((ET1 x SFo x AFg x SIR) + (ET1 x SFo x AFs x SR) + (ET1 x ET2 x SFi x AFi x IRs)) x (ATn / ATc)

where:		Value	Units	Reference
Oral Slope Factor	SF _o =		1/ (mg CoPC/kg bw - day)	
Inhalation Slope Factor	SF _i =	3.20E+02	1/ (mg CoPC/kg bw - day)	Health Canada (2010)
Target Risk	TR =	1.00E-05	unitless	
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-01	unitless	Health Canada (2010)
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Age-adjusted Soil Ingestion Rate	SIR _{adj} =		kg soil - year/kg bw-d	calculated
Age-adjusted Soil Dermal Contact Rate	SR _{adj} =		kg soil - year/kg bw-d	calculated
Age-adjusted Soil Inhalation Rate	IRs _{adj} =		kg soil - year/kg bw-d	calculated
Exposure Frequency	EF =		days/year	Health Canada (2006)
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Averaging Time (non-carcinogens)	ATn =	1.64E+04	days	Health Canada (2006)
Averaging Time (carcinogens)	ATc =	2.92E+04	days	Health Canada (2006)
Background Soil Concentration	BSC =	3.50E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

Example Calculation =

1.00E-05 x 62.2

+ 35

((3.29E-02 x 0 x 1 x 0.00002) + (3.29E-02 x 0 x 0.1 x 1.05E-04) + (3.29E-02 x 4.17E-01 x 320 x 1 x 1.13E-08)) x (16425 / 29200)

SSTL (mg/kg) = 22311

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Cobalt
Soil concentration	34.3
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	34.3	mg/kg
Chronic Daily Intake	3.82E-07	mg/kg bw-day
SSTL	17983	mg/kg
Hazard Quotient	3.82E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	$\text{TDI}_{\text{oral}} =$	1.00E-03	mg CoPC/kg bw - day	OMOE (2011)
Tolerable Daily Intake inhaled	$\text{TDI}_{\text{inh}} =$		mg CoPC/kg bw - day	
Estimated Daily Intake	$\text{EDI} =$	2.30E-04	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	$\text{EDI}_{\text{inh}} =$		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	$\text{SAF} =$	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	$\text{BW} =$	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	$\text{AF}_g =$	1.00E+00	unitless	Default
Absorption Factor - skin	$\text{AF}_s =$	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	$\text{AF}_l =$	1.00E+00	unitless	Default
Soil Ingestion Rate	$\text{SIR} =$	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	$\text{SR} =$	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	$\text{IR}_s =$	1.13E-08	kg soil/day	calculated
Exposure Term	$\text{ET}_1 =$	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	$\text{ET}_2 =$	4.17E-01	unitless	calculated
Background Soil Concentration	$\text{BSC} =$	9.50E+00	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.00\text{E-}03 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 9.5$$

$$\text{SSTL (mg/kg)} = 17983$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_l \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Manganese
Soil concentration	517.3
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	517.3	mg/kg
Chronic Daily Intake	5.76E-06	mg/kg bw-day
SSTL	2804651	mg/kg
Hazard Quotient	3.69E-05	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	TDI _{oral} =	1.56E-01	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	TDI _{inh} =		mg CoPC/kg bw - day	US EPA IRIS
Estimated Daily Intake	EDI =	5.67E-02	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	EDI _{inh} =		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	SAF =	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	BW =	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	AF _g =	1.00E+00	unitless	Default
Absorption Factor - skin	AF _s =	1.00E-02	unitless	US EPA RAGS E default
Absorption Factor - lung	AF _i =	1.00E+00	unitless	Default
Soil Ingestion Rate	SIR =	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	SR =	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	IR _s =	1.13E-08	kg soil/day	calculated
Exposure Term	ET ₁ =	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	ET ₂ =	4.17E-01	unitless	calculated
Background Soil Concentration	BSC =	7.09E+02	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.56\text{E-}01 \times 0.2 \times 62.2}{(1 \times 0.00002) + (0.01 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01} \times 3.29\text{E-}02 + 709$$

$$\text{SSTL (mg/kg)} = 2804651$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Example Calculation Worksheet

Tier II Metals Toolkit, v1.01

Non-Carcinogenic CoPC

Site Name: Clinton Creek, Yukon
Project No.: VE52705D.100.1

Conceptual Model

Exposure Scenario	User Defined - Occasional Visitor
Receptor	Adult - Female
CoPC	Nickel
Soil concentration	545.5
Target risk	1.E-05
Age-adjustment?	FALSE

Results Summary

Soil Concentration (C _{soil})	545.5	mg/kg
Chronic Daily Intake	8.52E-06	mg/kg bw-day
SSTL	140978	mg/kg
Hazard Quotient	7.74E-04	

$$\text{SSTL (mg CoPC/kg soil)} = \frac{(\text{TDI}_{\text{oral}} - \text{EDI}) \times \text{SAF} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

where:

		Value	Units	Reference
Tolerable Daily Intake oral	$\text{TDI}_{\text{oral}} =$	1.10E-02	mg CoPC/kg bw - day	Health Canada (2010)
Tolerable Daily Intake inhaled	$\text{TDI}_{\text{inh}} =$		mg CoPC/kg bw - day	
Estimated Daily Intake	$\text{EDI} =$	4.08E-03	mg CoPC/kg bw - day	calculated ** EDI data incomplete - not used in calculation **
Estimated Daily Intake inhaled	$\text{EDI}_{\text{inh}} =$		mg CoPC/kg bw - day	calculated
Soil Allocation Factor	$\text{SAF} =$	2.00E-01	unitless	EDI data incomplete - Soil allocation set at default 20%
Body Weight	$\text{BW} =$	6.22E+01	kg bw	Health Canada (2006)
Absorption Factor - gut	$\text{AF}_g =$	1.00E+00	unitless	Default
Absorption Factor - skin	$\text{AF}_s =$	9.10E-02	unitless	Health Canada (2010)
Absorption Factor - lung	$\text{AF}_i =$	1.00E+00	unitless	Default
Soil Ingestion Rate	$\text{SIR} =$	2.00E-05	kg soil/day	Health Canada (2006)
Soil Dermal Contact Rate	$\text{SR} =$	1.05E-04	kg soil/day	calculated
Soil Inhalation Rate	$\text{IR}_s =$	1.13E-08	kg soil/day	calculated
Exposure Term	$\text{ET}_1 =$	3.29E-02	unitless	calculated
Exposure Term (inhalation only)	$\text{ET}_2 =$	4.17E-01	unitless	calculated
Background Soil Concentration	$\text{BSC} =$	4.07E+01	mg CoPC/kg soil	AmecFW 97.5%ile (2016)

$$\text{Example Calculation} = \frac{1.10\text{E-}02 \times 0.2 \times 62.2}{((1 \times 0.00002) + (0.091 \times 1.05\text{E-}04) + (1 \times 1.13\text{E-}08) \times 4.17\text{E-}01) \times 3.29\text{E-}02} + 40.7$$

$$\text{SSTL (mg/kg)} = 140978$$

If EDI > TDI, calculate SSTL as lowest of 10% EDI or 20% TDI

$$\text{SSTL (mg CoPC/kg soil)} = \frac{\text{TDI}_{\text{oral}} \times 0.2 \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

$$\text{SSTL (mg CoPC/kg soil)} = \frac{0.1 \times \text{EDI} \times \text{BW}}{(\text{AF}_g \times \text{SIR}) + (\text{AF}_s \times \text{SR}) + (\text{AF}_i \times \text{IR}_s) \times \text{ET}_2} \times \text{ET}_1 + \text{BSC}$$

Example Calculation =

$$\text{SSTL (mg/kg)} = \text{EDI does not exceed TDI, SSTL calculated above}$$

Appendix D
ERA Supporting Information

Table D.1
Exposure Parameters – American Robin (Small Invertivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	0.079	Average of male and female	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.0956	Calculated from the published value of 1.21 kg wet food/kg wet body weight/day.	FCSAP, 2012
Dietary Composition					
Plants	P _{plants}	Unitless	60%		
Terrestrial Invertebrates	P _{invert}	Unitless	40%	Earthworms are one of the most important food sources when summering in northern habitats, and insects are fed to young.	FCSAP, 2012
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.000589	4% of dry food ingestion rate	FCSAP, 2012.
Water Ingestion Rate	IR _{water}	L/day	0.011	Converted to L/day from published value of 0.14 L/kg wet body weight/day.	FCSAP, 2012
Foraging Range	FR	hectares	0.7	Foraging range size varies from 0.7 ha in deciduous forests to 28.3 ha in poor habitats. 0.7 recommended by FCSAP.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	TUF set to 1 per the FCSAP Guidance.	FCSAP, 2012

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Fuller, P., 1977. Fall robin migration. Loon 49: 239-240.

Howell, J.C., 1942. Notes on the nesting habits of the American Robin (*Turdus migratorius* L.) Am. Midl. Nat. 28: 529-603.

USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

Young, H., 1951. Territorial behavior of the eastern robin. Proc. Linnean Soc. NY 58-62: 1-37.

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

Table D.2
Exposure Parameters – Spruce Grouse (Medium/Large Herbivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	0.6	Average. Recommended value adopted.	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.28	Calculated from the published value of 0.07 kg dry food/kg wet body weight/day recommended by FCSAP for all birds (based on Nagy 1987 in US EPA 1993) and adjusted for average dietary moisture content [a].	FCSAP, 2012; USEPA, 1993
Dietary Composition				Principally plants, with some invertebrates.	FCSAP, 2012
Plants	P _{plants}	Unitless	95%	Pine needles are main component of diet.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	5%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.00126	3% of dry food ingestion rate.	Beyer <i>et al.</i> , 1994.
Water Ingestion Rate	IR _{water}	L/day	0.042	Converted to L/day from published value of 0.07 L/kg wet body weight/day.	FCSAP, 2012
Foraging Range	FR	ha	3	Foraging range size varies from 3 to 24 ha. Recommended value adopted.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Non-migratory	Cornell Ornithology Lab, 2010.

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

Notes:

[a] Adjusted for average dietary moisture content assuming 84% moisture for invertebrates and 85% moisture for plants (Sample & Suter, 1994)

References:

Beyer W.N., E. Connor, and S. Gerould 1994. Estimates of soil ingestion by wildlife. *Journal of Wildlife Management*. 58(2):375-382.
 Cornell Ornithology Lab, 2010. References to the spruce grouse for dietary information. Available at www.allaboutbirds.org. Accessed June 11, 2010.
 Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.
 Sample, B.E., and G.W. Suter II, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. U.S. Department of Energy, Office of Environmental Restoration and Waste Management. ES/ER/TM-125.

Table D.3
Exposure Parameters - Red Tailed Hawk (Medium Predator)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	1.1	Males: 1.0 kg Females: 1.2 kg Average of 1.1 kg recommended by FCSAP.	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.11	Calculated from the FCSAP recommended value of 0.10 kg wet food/kg wet body weight/day based on average (0.099g/g per day) of 3 values (adult male and female in winter, adult male in summer) for adults, both sexes (US EPA, 1993).	FCSAP, 2012
Dietary Composition					
Plants	P _{plants}	Unitless	0%	Consumes primarily rodents and small birds. May also consume amphibians when available. Food chain model assumes a terrestrial exposure and therefore amphibian consumption is not included.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	0%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	100%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.00035	1% of dry food ingestion rate (none identified by FCSAP)	USEPA, 1999
Water Ingestion Rate	IR _{water}	L/day	0.066	Base on FCSAP recommended value of 0.06 L/ kg BW-day, calculated using regression equation for birds: IR _{water} (L/day) = 0.059 * BW ^{0.67} (kg).	USEPA, 1993 (as cited in FCSAP, 2012)
Foraging Range	FR	Hectares	20	0.2 to 50 hectares	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Migratoy in northern portion of species range. TUF is set to 1 per the FCSAP Guidance.	USEPA, 1993

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

USEPA, 1999. Data Collection for the Hazardous Waste Identification Rule. Office of Solid Waste. October 1999

Table D.4
Exposure Parameters - Masked Shrew (Small Invertivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	0.0041	Average	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.0087	Calculated using the allometric equation for total dry food intake for rodents: IR _{food} (g/day) = 0.621* BW ^{0.564} and adjusted for average dietary moisture content [a].	FCSAP, 2012; Sample & Suter, 1994.
Dietary Composition					
Plants	P _{plants}	Unitless	5%	Miscellaneous vegetation.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	95%	Consumes insects, earthworms, and other soil and litter invertebrates	FCSAP, 2012
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.00018	13% of dry food ingestion rate. Note FCSAP recommends no incidental soil ingestion.	Sample & Suter, 1994.
Water Ingestion Rate	IR _{water}	L/day	0.00070	FCSAP recommended value of 0.17 L/kg BW-day. Calculated using regression equation for mammals: IR _{water} (L/day) = 0.099 * BW ^{0.90} (kg).	USEPA, 1993 (as cited in FCSAP, 2012)
Foraging Range	FR	Hectares	0.6	FCSAP recommended. Average value.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Active all year round.	Kirkland & Schmidt, 1982.

Prepared by: SFR 8/13/12

Checked by: AMR 8/13/2012

Notes:

[a] Adjusted for average dietary moisture content assuming 85% moisture for plants and 84% moisture for invertebrates (Sample and Suter, 1994)

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Kirkland, G.L., and D.F. Schmidt, 1982. Abundance, habitat, reproduction, and morphology of forest dwelling small mammals of Nova Scotia and southeastern New Brunswick. Canadian Field Naturalist. 96:156-162.

Sample, B.E., & G.W. Suter II, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. U.S. Department of Energy, Office of Environmental Restoration and Waste Management. ES/ER/TM-125.

USEPA, 1993. Wildlife Exposure Factors Handbook. Vol.1. EPA/600/R-93/187a. Office of Research and Development. Washington, DC.

Table D.5
Exposure Parameters - Meadow Vole (Small Herbivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	0.0349	FCSAP recommended value. Average	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.012	Calculated from the published value of 0.33 kg wet food/kg wet body weight/day.	FCSAP, 2012
Dietary Composition					
Plants	P _{plants}	Unitless	100%	Berries, seeds, grasses.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	0%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.00004	2.4% of dry food ingestion rate.	FCSAP, 2012
Water Ingestion Rate	IR _{water}	L/day	0.0073	Converted to L/day from published value of 0.21 L/kg wet body weight/day.	FCSAP, 2012
Foraging Range	FR	Hectares	0.17755	FCSAP recommends 69 square metres. Average range of 69 and 3,480 square metres selected for use.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Active all year round.	Kirkland & Schmidt, 1982.

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Checked by: AMR 8/13/2012

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Kirkland, G.L., and D.F. Schmidt, 1982. Abundance, habitat, reproduction, and morphology of forest dwelling small mammals of Nova Scotia and southeastern New Brunswick. Canadian Field Naturalist. 96:156-162.

Table D.6
Exposure Parameters - Deer Mouse (Small Omnivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	0.0217	Average	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.0059	Calculated from the published value of 0.27 kg wet food/kg wet body weight/day.	FCSAP, 2012
Dietary Composition				Deer mouse is omnivorous.	FCSAP, 2012
Plants	P _{plants}	Unitless	50%	Berries, seeds, grasses, mushrooms	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	50%	Ground insects, earthworms	FCSAP, 2012
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.0000091	FCSAP recommended <2% of dry food ingestion rate.	FCSAP, 2012
Water Ingestion Rate	IR _{water}	L/day	0.0041	Converted to L/day from published value of 0.19 L/kg wet body weight/day.	FCSAP, 2012
Foraging Range	FR	Hectares	0.206	FCSAP recommends 120 m ² . Average range of 120 and 4,000 m ² selected for use.	Cranford, 1984 (as cited in USEPA, 1993)
Temporal Use Factor	TUF	days	365	Generally active year round although temporary hibernation occurs in winter in the northern part of the species range.	USEPA, 1993

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Checked by: AMR 8/13/2012

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Cranford, J. A., 1984. Population ecology and home range utilizations of two subalpine meadow rodents (*Microtus longicaudus* and *Peromyscus maniculatus*). In: Merrit, J. F., ed. Winter ecology of small mammals: v. 10. Spec. Publ. Carnegie Mus. Nat. Hist.; pp. 1-380.

USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

Table D.7
Exposure Parameters - Snowshoe Hare (Medium Herbivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	1.3	Average	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.52	Calculated from the published value of 0.06 kg dry food/kg wet body weight/day and adjusted for average dietary moisture content [a].	FCSAP, 2012; Sample & Suter, 1994.
Dietary Composition					
Plants	P _{plants}	Unitless	100%	Snowshoe hares feed on a variety of shrubs, grasses, and berries.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	0%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.0049140	FCSAP recommended 6.3% of dry food ingestion rate.	FCSAP, 2012
Water Ingestion Rate	IR _{water}	L/day	0.13	FCSAP recommended value, calculated using regression equation for mammals: IR _{water} (L/day) = 0.099 * BW ^{0.90} (kg), unadjusted for body weight.	FCSAP, 2012
Foraging Range	FR	Hectares	1.6	Foraging range varies from 1.6 to 10.2 ha according to season and population cycle. FCSAP recommended value of 1.6 selected.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Active year round	NL DEC, 2012

Notes:

[a] Adjusted for average dietary moisture content assuming 85% moisture for plants (Sample and Suter, 1994)

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Newfoundland and Labrador Department of Environmental Conservation (NL DEC), 2012. Salmonier Nature Park, Animal Facts: Snowshoe hare. August 10, 2012.

Sample, B.E., and G.W. Suter II, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. U.S. Department of Energy, Office of Environmental Restoration and Waste Management. ES/ER/TM-125.

USEPA,1993. Wildlife Exposure Factors Handbook. Vol.1. EPA/600/R-93/187a. Office of Research and Development. Washington, DC.

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Table D.8
Exposure Parameters - Red Fox (Medium/Large Carnivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	3.8	Average	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	0.34	Calculated from the published value of 0.09 kg wet food/kg wet body weight/day.	FCSAP, 2012
Dietary Composition				Red fox is omnivorous and consumes a variety of plant and animal material	FCSAP, 2012
Plants	P _{plants}	Unitless	15%	Fruits and plant material.	
Terrestrial Invertebrates	P _{invert}	Unitless	25%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	20%		
Mammals	P _{mammal}	Unitless	40%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.0024371	FCSAP recommended 2.8 % of dry food ingestion rate.	FCSAP, 2012
Water Ingestion Rate	IR _{water}	L/day	0.34	FCSAP recommended value, calculated using regression equation for mammals: IR _{water} (L/day) = 0.099 * BW ^{0.90} (kg), unadjusted for body weight.	USEPA, 1993 (as cited in FCSAP, 2012)
Foraging Range	FR	Hectares	280	Foraging range size varies from 2.8 to 3.4 km ² . FCSAP recommended 2.8 selected.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Active all year round.	USEPA, 1993

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.
USEPA,1993. Wildlife Exposure Factors Handbook. Vol.1. EPA/600/R-93/187a. Office of Research and Development. Washington, DC.

Table D.9
Exposure Parameters - Caribou (Large Herbivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	150	Average of male and female.	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	30	Calculated from the published value of 0.06 kg dry food/kg wet body weight/day and adjusted for average dietary moisture content [a].	FCSAP, 2012; Sample & Suter, 1994.
Dietary Composition				Browsing herbivore	FCSAP, 2012
Plants	P _{plants}	Unitless	100%	Buds and twigs, plants, leaves, fruit, mushroom, grasses, lichens.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	0%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.0450000	FCSAP recommended <2% of dietary ingestion.	FCSAP, 2012
Water Ingestion Rate	IR _{water}	L/day	9	FCSAP recommended value, calculated using regression equation for mammals: IR _{water} (L/day) = 0.099 * BW ^{0.90} (kg), unadjusted for body weight.	FCSAP, 2012
Foraging Range	FR	Hectares	30	30 to 2435 ha. FCSAP recommended value of 30 selected.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Active year round.	NL DEC, 2012

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

Notes:

[a] Adjusted for average dietary moisture content assuming 85% moisture for plants (Sample and Suter, 1994)

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Newfoundland and Labrador Department of Environmental Conservation (NL DEC), 2012. Salmonier Nature Park, Animal Facts: Moose. August 10, 2012.

Sample, B.E., and G.W. Suter II, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. U.S. Department of Energy, Office of Environmental Restoration and Waste Management. ES/ER/TM-125.

USEPA, 1993. Wildlife Exposure Factors Handbook. Vol.1. EPA/600/R-93/187a. Office of Research and Development. Washington, DC.

Table D.10
Exposure Parameters - Moose (Large Herbivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	400	Average of male and female.	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	53	Calculated from the published value of 0.02 kg dry food/kg wet body weight/day and adjusted for average dietary moisture content [a].	FCSAP, 2012; Sample & Suter, 1994.
Dietary Composition				Moose are generalist herbivores, may ingest 20% aquatic plants but to be conservative, have assumed 100% terrestrial exposure.	
Plants	P _{plants}	Unitless	100%	Leaves, shrubs, trees, twigs, woody vegetation.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	0%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	0%		
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.0800000	FCSAP recommended <2% of dietary ingestion.	FCSAP, 2012
Water Ingestion Rate	IR _{water}	L/day	20	FCSAP recommended value, calculated using regression equation for mammals: IR _{water} (L/day) = 0.099 * BW ^{0.90} (kg), unadjusted for body weight.	FCSAP, 2012
Foraging Range	FR	Hectares	460	4.6 to 262 km ² . FCSAP recommended value of 4.6 selected.	FCSAP, 2012
Temporal Use Factor	TUF	days	365	Active year round.	NL DEC, 2012

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

Notes:

[a] Adjusted for average dietary moisture content assuming 85% moisture for plants (Sample and Suter, 1994)

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Newfoundland and Labrador Department of Environmental Conservation (NL DEC), 2012. Salmonier Nature Park, Animal Facts: Moose. August 10, 2012.

Sample, B.E., and G.W. Suter II, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. U.S. Department of Energy, Office of Environmental Restoration and Waste Management. ES/ER/TM-125.

USEPA,1993. Wildlife Exposure Factors Handbook. Vol.1. EPA/600/R-93/187a. Office of Research and Development. Washington, DC.

Table D.11
Exposure Parameters - Black Bear (Large Omnivore)

Exposure Parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference
Body Weight	BW	kg	68	Average	FCSAP, 2012
Food Ingestion Rate	IR _{food}	kg ww/day	12	0.03 kg dry food/ kg BW-day, based on FCSAP recommended allometric equation (Nagy 1987 in US EPA 1993) for total dry food intake for all mammals (g/day;(0.235*BW ^{0.822}) divided by BW adjusted for average dietary moisture content [a].	FCSAP, 2012; Sample & Suter, 1994.
Dietary Composition				Can include 5% fish, but have assumed only terrestrial diet components to be conservative.	
Plants	P _{plants}	Unitless	80%	Berries, seeds, grasses, and leaves.	FCSAP, 2012
Terrestrial Invertebrates	P _{invert}	Unitless	0%		
Amphibians	P _{amphib}	Unitless	0%		
Birds	P _{bird}	Unitless	0%		
Mammals	P _{mammal}	Unitless	20%	Carrion and small mammals (can be 5% fish).	FCSAP, 2012
Aquatic Plants	P _{aq_plant}	Unitless	0%		
Marine Invertebrates	P _{benthic}	Unitless	0%		
Fish	P _{fish}	Unitless	0%		
Soil Ingestion Rate	IR _{soil}	kg dw/day	0.0571200	2.8% dry food ingestion rate.	USEPA, 1999
Water Ingestion Rate	IR _{water}	L/day	4.08	FCSAP recommended value, calculated using regression equation for mammals: IR _{water} (L/day) = 0.099 * BW ^{0.90} (kg), unadjusted for body weight.	FCSAP, 2012
Foraging Range	FR	Hectares	300	3 to 1147 km ² . FCSAP recommended 3 km ² selected.	FCSAP, 2012
Temporal Use Factor	TUF	days	365		

Prepared by: SFR 8/13/12
Checked by: AMR 8/13/2012

Notes:

[a] Adjusted for average dietary moisture content assuming 85% moisture for plants, 84% moisture for invertebrates, and 68% moisture for mammals (Sample and Suter, 1994)

References:

Federal Contaminated Sites Action Plan (FCSAP). 2012. Ecological Risk Assessment Guidance Module C: Standardization of Wildlife Receptor Characteristics. Azimuth Consulting Group Inc. March, 2012.

Sample, B.E., and G.W. Suter II, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. U.S. Department of Energy, Office of Environmental Restoration and Waste Management. ES/ER/TM-125.

USEPA. 1999. Data collection for the Hazardous Waste Identification Rule. Office of Solid Waste. October 1999.

Table D.12: Soil Exposure Concentrations for Terrestrial Receptors (mg/kg)
Project VE52705D, Clinton Creek - Tailings

COPC	Soil Concentration (mg/kg dw)	EPC
Trace Metals		
Antimony	24.4	UCLM
Arsenic	70.5	UCLM
Barium	269.4	UCLM
Chromium	1429	UCLM
Mercury	0.15	UCLM
Molybdenum	6.2	Max
Nickel	2013	UCLM
Selenium	0.9	UCLM
Zinc	39.9	UCLM

Background Soil Concentration (mg/kg dw)	
Trace Metals	
0.73	UCLM
21.6	UCLM
177	UCLM
27.4	UCLM
0.03	UCLM
1.8	UCLM
34.2	UCLM
0.66	UCLM
72.6	UCLM

EPC = Exposure Point Concentration

UCLM = Upper Confidence Limit on the Mean

Max = Maximum measured concentration

LMW PAHs = Low molecular weight PAHs

HMW PAHs = High molecular weight PAHs

EC = Environment Canada (2006 - 2008)

A = Assumed

Table D.13: Uptake Equations (dry weight)
Project VE52705D, Clinton Creek - Tailings

COPC	Soil to Plants ¹	Soil to Invertebrates ²	Soil to Mammals ¹
Trace Metals			
Antimony	$\ln(C_p)=0.938*\ln(C_s)+(-3.233)$	$C_e=1*C_s$	$C_m=0.05*C_s$
Arsenic	$C_p=0.03752*C_s$	$\ln(C_e)=0.706*\ln(C_s)+(-1.421)$	$\ln(C_m)=0.8188*\ln(C_s)+(-4.8471)$
Barium	$C_p=0.156*C_s$	$C_e=0.091*C_s$	$C_m=0.0075*C_s$
Chromium	$C_p=0.041*C_s$	$C_e=0.306*C_s$	$\ln(C_m)=0.7338*\ln(C_s)+(-1.4599)$
Mercury	$\ln(C_p)=0.544*\ln(C_s)+(-0.996)$	$\ln(C_e)=0.118*\ln(C_s)+(-0.684)$	$\ln(C_m)=-2.2764*\ln(C_s)+(-4.8666)$
Molybdenum	$C_p=0.25*C_s$	$C_e=0.953*C_s$	$\ln(C_m)=-*\ln(C_s)+(-)$
Nickel	$\ln(C_p)=0.748*\ln(C_s)+(-2.223)$	$C_e=0.7778*C_s$	$\ln(C_m)=0.4658*\ln(C_s)+(-0.2462)$
Selenium	$\ln(C_p)=1.104*\ln(C_s)+(-0.677)$	$\ln(C_e)=0.733*\ln(C_s)+(-0.075)$	$\ln(C_m)=0.3764*\ln(C_s)+(-0.4158)$
Zinc	$\ln(C_p)=0.554*\ln(C_s)+(1.575)$	$\ln(C_e)=0.328*\ln(C_s)+(4.449)$	$\ln(C_m)=0.0706*\ln(C_s)+(4.3632)$

Notes:

1 = Sources used in order of preference: US EPA (2007), Baes et al. (1984), Bechtel Jacobs (1998), Travis & Arms (1988)

2 = Sources used in order of preference: US EPA (2007), Sample et al. (1998), Jager (1998)

C_p = Concentration in plant

C_s = Concentration in soil

C_e = Concentration in earthworm

C_m = Concentration in mammal

Table D.14: Tissue Concentrations - Site (wet weight)
Project VE52705D, Clinton Creek - Tailings

SITE				
COPC		Concentration in Foliage ¹ (mg/kg)	Concentration in Earthworms ¹ (mg/kg)	Concentration in Mammals ¹ (mg/kg)
Trace Metals				
Antimony		1.18E-01	3.90E+00	3.90E-01
Arsenic		3.97E-01	7.79E-01	8.19E-02
Barium		6.30E+00	3.92E+00	6.47E-01
Chromium		8.79E+00	7.00E+01	1.54E+01
Mercury		1.97E-02	6.45E-02	1.85E-01
Molybdenum		2.33E-01	9.45E-01	9.45E-01
Nickel		4.81E+00	2.51E+02	8.65E+00
Selenium		6.79E-02	1.37E-01	2.03E-01
Zinc		5.59E+00	4.59E+01	3.26E+01
Water Content ¹		85%	84%	68%

Notes:

N/A = not available

¹ = Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants.

Based on the water content provided in Sample and Suter, conversion factors of 0.15, 0.16, and 0.32 were applied for plants, earthworms, and mammals respectively.

Table D.15: Tissue Concentrations - Background (wet weight)
Project VE52705D, Clinton Creek - Tailings

BACKGROUND			
COPC	Concentration in Foliage ¹ (mg/kg)	Concentration in Earthworms ¹ (mg/kg)	Concentration in Mammals ¹ (mg/kg)
Trace Metals			
Antimony	4.40E-03	1.17E-01	1.17E-02
Arsenic	1.22E-01	3.38E-01	3.11E-02
Barium	4.14E+00	2.58E+00	4.25E-01
Chromium	1.69E-01	1.34E+00	8.44E-01
Mercury	8.22E-03	5.34E-02	7.22E+00
Molybdenum	6.75E-02	2.74E-01	2.74E-01
Nickel	2.28E-01	4.26E+00	1.30E+00
Selenium	4.82E-02	1.09E-01	1.81E-01
Zinc	7.78E+00	5.58E+01	3.40E+01
Water Content ¹	85%	84%	68%

Notes:

N/A = not available

¹ = Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants.

Based on the water content provided in Sample and Suter, conversion factors of 0.15, 0.16, and 0.32 were applied for plants, earthworms, and mammals respectively.

Table D.16: Exposure Estimates for ROCs - Site (mg/kg-day)
Project VE52705D, Clinton Creek - Tailings

COPC	RECEPTORS OF CONCERN							RECEPTORS OF CONCERN		
	Meadow Vole	Masked Shrew	Deer Mouse	Red Fox	White Tailed Deer	Moose	Black Bear	American Robin	Spruce Grouse	Red Tailed Hawk
					Trace Metals					
Antimony	6.81E-02	9.00E+00	5.53E-01	8.87E-03	2.03E-02	8.85E-04	3.37E-03	2.16E+00	1.94E-01	4.61E-02
Arsenic	2.15E-01	4.74E+00	1.88E-01	5.10E-03	6.60E-02	2.87E-03	7.80E-03	1.19E+00	3.42E-01	3.03E-02
Barium	2.40E+00	2.05E+01	1.49E+00	2.68E-02	8.81E-01	3.83E-02	7.55E-02	8.48E+00	3.44E+00	1.49E-01
Chromium	4.60E+00	2.06E+02	1.12E+01	2.42E-01	1.43E+00	6.24E-02	1.97E-01	5.09E+01	8.51E+00	1.96E+00
Mercury	6.69E-03	1.39E-01	1.14E-02	8.30E-04	2.62E-03	1.14E-04	6.28E-04	4.67E-02	1.05E-02	1.83E-02
Molybdenum	8.41E-02	2.21E+00	1.62E-01	5.59E-03	3.17E-02	1.38E-03	4.74E-03	6.73E-01	1.38E-01	9.50E-02
Nickel	3.98E+00	5.97E+02	3.53E+01	5.25E-01	1.03E+00	4.47E-02	1.76E-01	1.40E+02	1.22E+01	1.49E+00
Selenium	2.35E-02	3.25E-01	2.81E-02	1.09E-03	9.08E-03	3.95E-04	1.16E-03	1.22E-01	3.51E-02	2.03E-02
Zinc	1.89E+00	9.52E+01	6.96E+00	2.03E-01	7.41E-01	3.22E-02	1.31E-01	2.65E+01	3.62E+00	3.22E+00

Exposure Dose_{ing} =

$$\left[\left(\frac{C_p \cdot IR_p}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_m \cdot IR_m}{BW} \right) + \left(\frac{C_b \cdot IR_b}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_{bi} \cdot IR_{bi}}{BW} \right) + \left(\frac{C_f \cdot IR_f}{BW} \right) + \left(\frac{C_w \cdot IR_w}{BW} \right) \right] \times TUF$$

Table D.17: Exposure Estimates for ROCs - Background (mg/kg-day)
Project VE52705D, Clinton Creek - Tailings

COPC	RECEPTORS OF CONCERN							RECEPTORS OF CONCERN		
	Meadow Vole	Masked Shrew	Deer Mouse	Red Fox	White Tailed Deer	Moose	Black Bear	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals										
Antimony				3.52E-03	3.78E-04	7.02E-04	1.55E-03			2.17E-05
Arsenic				2.30E-02	1.06E-02	1.96E-02	3.42E-02			1.55E-04
Barium				2.33E-01	3.03E-01	5.62E-01	7.07E-01			1.54E-03
Chromium				8.89E-02	1.44E-02	2.68E-02	7.22E-02			1.44E-03
Mercury				3.63E-01	5.68E-04	1.06E-03	2.42E-01			1.12E-02
Molybdenum				2.14E-02	4.83E-03	8.96E-03	1.96E-02			4.34E-04
Nickel				1.77E-01	1.92E-02	3.57E-02	1.01E-01			2.18E-03
Selenium				1.24E-02	3.38E-03	6.28E-03	1.30E-02			2.83E-04
Zinc				3.02E+00	5.42E-01	1.01E+00	2.23E+00			5.31E-02

$$Exposure\ Dose_{ing} = \left[\left(\frac{C_p \cdot IR_p}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_m \cdot IR_m}{BW} \right) + \left(\frac{C_b \cdot IR_b}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_{bi} \cdot IR_{bi}}{BW} \right) + \left(\frac{C_f \cdot IR_f}{BW} \right) + \left(\frac{C_w \cdot IR_w}{BW} \right) \right] \times TUF$$

Table D.18: Toxicological Benchmarks and TRVs
Project VE52705D, Clinton Creek - Tailings

COPC	Birds (mg/kg/day)	Reference	SAR _B (mg/kg/day)	Reference	Mammals (mg/kg/day)	Reference
Trace Metals						
Antimony	---	---	---	---	7.60	Geometric mean of LOAELs* from Eco-SSL ¹
Arsenic	4.50	Geometric mean of LOAELs* from Eco-SSL ¹	3.7	Geometric mean of NOAELs* from Eco-SSL ¹	5.70	Geometric mean of LOAELs* from Eco-SSL ¹
Barium	420	Sample et al., 1996 ²	210	Sample et al., 1996 ²	119	Geometric mean of LOAELs* from Eco-SSL ¹
Chromium	11.1	Geometric mean of LOAELs* from Eco-SSL ¹	3.04	Geometric mean of NOAELs* from Eco-SSL ¹	35.1	Geometric mean of LOAELs* from Eco-SSL ¹
Mercury	0.90	Sample et al., 1996 ²	0.45	Sample et al., 1996 ²	1.9	NTP, 1993 as cited in ATSDR, 1999 ⁶
Molybdenum	35.3	Sample et al., 1996 ²	---	---	2.6	Sample et al., 1996 ²
Nickel	21.7	Geometric mean of LOAELs* from Eco-SSL ¹	9.52	Geometric mean of NOAELs* from Eco-SSL ¹	13.3	Geometric mean of LOAELs* from Eco-SSL ¹
Selenium	1.17	Geometric mean of LOAELs* from Eco-SSL ¹	0.85	Geometric mean of NOAELs* from Eco-SSL ¹	0.79	Geometric mean of LOAELs* from Eco-SSL ¹
Zinc	187	Geometric mean of LOAELs* from Eco-SSL ¹	82.8	Geometric mean of NOAELs* from Eco-SSL ¹	292	Geometric mean of LOAELs* from Eco-SSL ¹

Notes:

SAR_B = Species at Risk (Birds)

SAR_M = Species at Risk (Mammals)

¹ Eco-SSL = Ecological Soil Screening Levels - data from individual supporting documents

² Sample et al. 1996. Toxicological Benchmarks for Wildlife. 1996 Revision. Oak Ridge National Laboratory.

³ Chronic LOAEL adapted from Szaro et al. (1978), Coon and Dieter (1981) and Stubblefield et al. (1995).

⁴ ATSDR. 2010. Toxicological Profile for Ethylbenzene. November 2010

⁵ Chronic LOAEL - Weight of Evidence from ATSDR (1999), TPHCWG (1997), MADEP (2003) and CWS (2000)

⁶ NTP. 1993. Toxicology and carcinogenesis studies of mercuric chloride (CAS no. 7487-94-7) in F344/N rats and B6C3F1 mice (gavage studies). National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, Research Triangle Park, NC. NTP TR 408.

⁷ Eisler, R. 1989. Tin hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol.Rep. 85(1.15).

* LOAELs for reproduction, growth, and survival

--- = No TRV available, no suitable study identified

Table D.19: Hazard Quotients for Mammals - Site
Project VE52705D, Clinton Creek - Tailings

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony	8.96E-03	1.18E+00	7.28E-02	1.84E-02	1.17E-03	2.68E-03	1.16E-04	4.44E-04
Arsenic	3.8E-02	8.3E-01	3.30E-02	7.5E-02	8.9E-04	1.16E-02	5.03E-04	1.37E-03
Barium	2.0E-02	1.7E-01	1.3E-02	3.0E-02	2.3E-04	7.4E-03	3.2E-04	6.3E-04
Chromium	1.3E-01	5.9E+00	3.2E-01	2.5E-01	6.9E-03	4.1E-02	1.8E-03	5.6E-03
Mercury	3.5E-03	7.3E-02	6.0E-03	4.5E-03	4.4E-04	1.4E-03	6.0E-05	3.3E-04
Molybdenum	3.2E-02	8.5E-01	6.2E-02	4.5E-02	2.1E-03	1.2E-02	5.3E-04	1.8E-03
Nickel	3.0E-01	4.5E+01	2.7E+00	7.2E-01	3.9E-02	7.7E-02	3.4E-03	1.3E-02
Selenium	3.0E-02	4.1E-01	3.6E-02	3.9E-02	1.4E-03	1.1E-02	5.0E-04	1.5E-03
Zinc	6.5E-03	3.3E-01	2.4E-02	8.2E-03	7.0E-04	2.5E-03	1.1E-04	4.5E-04

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.20: Hazard Quotients for Mammals - Background
Project VE52705D, Clinton Creek - Tailings

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
Trace Metals								
Antimony					4.63E-04	4.97E-05	9.23E-05	2.04E-04
Arsenic					4.04E-03	1.86E-03	3.45E-03	6.01E-03
Barium					2.0E-03	2.5E-03	4.7E-03	5.9E-03
Chromium					2.5E-03	4.1E-04	7.6E-04	2.1E-03
Mercury					1.9E-01	3.0E-04	5.6E-04	1.3E-01
Molybdenum					8.2E-03	1.9E-03	3.4E-03	7.5E-03
Nickel					1.3E-02	1.4E-03	2.7E-03	7.6E-03
Selenium					1.6E-02	4.3E-03	7.9E-03	1.6E-02
Zinc					1.0E-02	1.9E-03	3.4E-03	7.6E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.21: Hazard Quotients for Mammals - Total
Project VE52705D, Clinton Creek - Tailings

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony	8.96E-03	1.18E+00	7.28E-02	1.84E-02	1.63E-03	2.73E-03	2.09E-04	6.48E-04
Arsenic	3.8E-02	8.3E-01	3.3E-02	7.5E-02	4.9E-03	1.34E-02	3.95E-03	7.38E-03
Barium	2.0E-02	1.7E-01	1.3E-02	3.0E-02	2.2E-03	9.9E-03	5.0E-03	6.6E-03
Chromium	1.3E-01	5.9E+00	3.2E-01	2.5E-01	9.4E-03	4.1E-02	2.5E-03	7.7E-03
Mercury	3.5E-03	7.3E-02	6.0E-03	4.5E-03	1.9E-01	1.7E-03	6.2E-04	1.3E-01
Molybdenum	3.2E-02	8.5E-01	6.2E-02	4.5E-02	1.0E-02	1.4E-02	4.0E-03	9.4E-03
Nickel	3.0E-01	4.5E+01	2.7E+00	7.2E-01	5.3E-02	7.9E-02	6.0E-03	2.1E-02
Selenium	3.0E-02	4.1E-01	3.6E-02	3.9E-02	1.7E-02	1.6E-02	8.4E-03	1.8E-02
Zinc	6.5E-03	3.3E-01	2.4E-02	8.2E-03	1.1E-02	4.4E-03	3.6E-03	8.1E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.22: Hazard Quotients for Birds - Site
Project VE52705D, Clinton Creek - Tailings

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic	2.6E-01	7.6E-02	6.7E-03
Barium	2.0E-02	8.2E-03	3.5E-04
Chromium	4.6E+00	7.7E-01	1.8E-01
Mercury	5.2E-02	1.2E-02	2.0E-02
Molybdenum	1.9E-02	3.9E-03	2.7E-03
Nickel	6.4E+00	5.6E-01	6.8E-02
Selenium	1.0E-01	3.0E-02	1.7E-02
Zinc	1.4E-01	1.9E-02	1.7E-02

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.23: Hazard Quotients for Birds - Background
Project VE52705D, Clinton Creek - Tailings

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic			3.45E-05
Barium			3.7E-06
Chromium			1.3E-04
Mercury			1.2E-02
Molybdenum			1.2E-05
Nickel			1.0E-04
Selenium			2.4E-04
Zinc			2.8E-04

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.24: Hazard Quotients for Birds - Total
Project VE52705D, Clinton Creek - Tailings

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic	2.6E-01	7.6E-02	6.8E-03
Barium	2.0E-02	8.2E-03	3.6E-04
Chromium	4.6E+00	7.7E-01	1.8E-01
Mercury	5.2E-02	1.2E-02	3.3E-02
Molybdenum	1.9E-02	3.9E-03	2.7E-03
Nickel	6.4E+00	5.6E-01	6.9E-02
Selenium	1.0E-01	3.0E-02	1.8E-02
Zinc	1.4E-01	1.9E-02	1.8E-02

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.25: Soil Exposure Concentrations for Terrestrial Receptors (mg/kg)
Project VE52705D, Clinton Creek - Waste Rock

COPC	Soil Concentration (mg/kg dw)	EPC
Trace Metals		
Antimony	17.8	UCLM
Arsenic	37.8	UCLM
Barium	198.7	UCLM
Chromium	655.6	UCLM
Mercury	0.3	UCLM
Molybdenum	14.1	Max
Nickel	981.9	UCLM
Selenium	4.81	UCLM
Zinc	175.6	UCLM

Background Soil Concentration (mg/kg dw)	
Trace Metals	
0.73	UCLM
21.6	UCLM
177	UCLM
27.4	UCLM
0.03	UCLM
1.8	UCLM
34.2	UCLM
0.66	UCLM
72.6	UCLM

EPC = Exposure Point Concentration

UCLM = Upper Confidence Limit on the Mean

Max = Maximum measured concentration

LMW PAHs = Low molecular weight PAHs

HMW PAHs = High molecular weight PAHs

EC = Environment Canada (2006 - 2008)

A = Assumed

Table D.26: Uptake Equations (dry weight)
Project VE52705D, Clinton Creek - Waste Rock

COPC	Soil to Plants ¹	Soil to Invertebrates ²	Soil to Mammals ¹
Trace Metals			
Antimony	$\ln(C_p)=0.938*\ln(C_s)+(-3.233)$	$C_e=1*C_s$	$C_m=0.05*C_s$
Arsenic	$C_p=0.03752*C_s$	$\ln(C_e)=0.706*\ln(C_s)+(-1.421)$	$\ln(C_m)=0.8188*\ln(C_s)+(-4.8471)$
Barium	$C_p=0.156*C_s$	$C_e=0.091*C_s$	$C_m=0.0075*C_s$
Chromium	$C_p=0.041*C_s$	$C_e=0.306*C_s$	$\ln(C_m)=0.7338*\ln(C_s)+(-1.4599)$
Mercury	$\ln(C_p)=0.544*\ln(C_s)+(-0.996)$	$\ln(C_e)=0.118*\ln(C_s)+(-0.684)$	$\ln(C_m)=-2.2764*\ln(C_s)+(-4.8666)$
Molybdenum	$C_p=0.25*C_s$	$C_e=0.953*C_s$	$\ln(C_m)=-*\ln(C_s)+(-)$
Nickel	$\ln(C_p)=0.748*\ln(C_s)+(-2.223)$	$C_e=0.7778*C_s$	$\ln(C_m)=0.4658*\ln(C_s)+(-0.2462)$
Selenium	$\ln(C_p)=1.104*\ln(C_s)+(-0.677)$	$\ln(C_e)=0.733*\ln(C_s)+(-0.075)$	$\ln(C_m)=0.3764*\ln(C_s)+(-0.4158)$
Zinc	$\ln(C_p)=0.554*\ln(C_s)+(1.575)$	$\ln(C_e)=0.328*\ln(C_s)+(4.449)$	$\ln(C_m)=0.0706*\ln(C_s)+(4.3632)$

Notes:

1 = Sources used in order of preference: US EPA (2007), Baes et al. (1984), Bechtel Jacobs (1998), Travis & Arms (1988)

2 = Sources used in order of preference: US EPA (2007), Sample et al. (1998), Jager (1998)

C_p = Concentration in plant

C_s = Concentration in soil

C_e = Concentration in earthworm

C_m = Concentration in mammal

Table D.27: Tissue Concentrations - Site (wet weight)
Project VE52705D, Clinton Creek - Waste Rock

SITE				
COPC		Concentration in Foliage ¹ (mg/kg)	Concentration in Earthworms ¹ (mg/kg)	Concentration in Mammals ¹ (mg/kg)
Trace Metals				
Antimony		8.81E-02	2.85E+00	2.85E-01
Arsenic		2.13E-01	5.02E-01	4.92E-02
Barium		4.65E+00	2.89E+00	4.77E-01
Chromium		4.03E+00	3.21E+01	8.67E+00
Mercury		2.88E-02	7.00E-02	3.82E-02
Molybdenum		5.29E-01	2.15E+00	2.15E+00
Nickel		2.81E+00	1.22E+02	6.19E+00
Selenium		4.32E-01	4.69E-01	3.81E-01
Zinc		1.27E+01	7.46E+01	3.62E+01
Water Content ¹		85%	84%	68%

Notes:

N/A = not available

¹ = Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants.

Based on the water content provided in Sample and Suter, conversion factors of 0.15, 0.16, and 0.32 were applied for plants, earthworms, and mammals respectively.

Table D.28: Tissue Concentrations - Background (wet weight)
Project VE52705D, Clinton Creek - Waste Rock

BACKGROUND			
COPC	Concentration in Foliage ¹ (mg/kg)	Concentration in Earthworms ¹ (mg/kg)	Concentration in Mammals ¹ (mg/kg)
Trace Metals			
Antimony	4.40E-03	1.17E-01	1.17E-02
Arsenic	1.22E-01	3.38E-01	3.11E-02
Barium	4.14E+00	2.58E+00	4.25E-01
Chromium	1.69E-01	1.34E+00	8.44E-01
Mercury	8.22E-03	5.34E-02	7.22E+00
Molybdenum	6.75E-02	2.74E-01	2.74E-01
Nickel	2.28E-01	4.26E+00	1.30E+00
Selenium	4.82E-02	1.09E-01	1.81E-01
Zinc	7.78E+00	5.58E+01	3.40E+01
Water Content ¹	85%	84%	68%

Notes:

N/A = not available

¹ = Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants.

Based on the water content provided in Sample and Suter, conversion factors of 0.15, 0.16, and 0.32 were applied for plants, earthworms, and mammals respectively.

Table D.29: Exposure Estimates for ROCs - Site (mg/kg-day/
Project VE52705D, Clinton Creek - Waste Rock

COPC	RECEPTORS OF CONCERN								RECEPTORS OF CONCERN		
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear	American Robin	Spruce Grouse	Red Tailed Hawk
	Trace Metals										
Antimony	5.02E-02	6.56E+00	4.04E-01	1.03E-01	1.58E-02	2.30E-02	1.60E-03	6.06E-03	1.58E+00	1.43E-01	3.42E-02
Arsenic	1.15E-01	2.71E+00	1.12E-01	2.28E-01	7.06E-03	5.39E-02	3.76E-03	1.03E-02	6.79E-01	1.85E-01	1.70E-02
Barium	1.77E+00	1.51E+01	1.10E+00	2.61E+00	4.83E-02	9.90E-01	6.91E-02	1.36E-01	6.26E+00	2.54E+00	1.11E-01
Chromium	2.11E+00	9.44E+01	5.15E+00	4.09E+00	2.86E-01	1.00E+00	7.00E-02	2.31E-01	2.33E+01	3.91E+00	1.08E+00
Mercury	9.85E-03	1.58E-01	1.35E-02	1.26E-02	7.26E-04	5.85E-03	4.08E-04	9.20E-04	5.70E-02	1.50E-02	3.91E-03
Molybdenum	1.91E-01	5.03E+00	3.68E-01	2.65E-01	3.11E-02	1.10E-01	7.68E-03	2.64E-02	1.53E+00	3.13E-01	2.20E-01
Nickel	2.09E+00	2.91E+02	1.73E+01	4.84E+00	6.45E-01	8.57E-01	5.98E-02	2.32E-01	6.85E+01	6.15E+00	9.34E-01
Selenium	1.48E-01	1.21E+00	1.24E-01	1.91E-01	6.89E-03	8.78E-02	6.13E-03	1.27E-02	5.76E-01	2.12E-01	3.97E-02
Zinc	4.40E+00	1.60E+02	1.19E+01	5.74E+00	6.73E-01	2.59E+00	1.81E-01	5.23E-01	4.66E+01	7.71E+00	3.67E+00

$$Exposure\ Dose_{ing} = \left[\left(\frac{C_p \cdot IR_p}{BW} \right) + \left(\frac{C_g \cdot IR_g}{BW} \right) + \left(\frac{C_m \cdot IR_m}{BW} \right) + \left(\frac{C_b \cdot IR_b}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_{bi} \cdot IR_{bi}}{BW} \right) + \left(\frac{C_f \cdot IR_f}{BW} \right) + \left(\frac{C_w \cdot IR_w}{BW} \right) \right] \times TUF$$

Table D.30: Exposure Estimates for ROCs - Background (mg/kg-day)
Project VE52705D, Clinton Creek - Waste Rock

COPC	RECEPTORS OF CONCERN								RECEPTORS OF CONCERN		
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals											
Antimony					3.14E-03		6.56E-04	1.39E-03			
Arsenic					2.05E-02		1.84E-02	3.08E-02			
Barium					2.07E-01		5.26E-01	6.35E-01			
Chromium					7.91E-02		2.50E-02	6.49E-02			
Mercury					3.24E-01		9.87E-04	2.18E-01			
Molybdenum					1.91E-02		8.38E-03	1.76E-02			
Nickel					1.58E-01		3.34E-02	9.04E-02			
Selenium					1.10E-02		5.87E-03	1.17E-02			
Zinc					2.69E+00		9.42E-01	2.01E+00			

$$Exposure\ Dose_{ing} = \left[\left(\frac{C_p \cdot IR_p}{BW} \right) + \left(\frac{C_g \cdot IR_g}{BW} \right) + \left(\frac{C_m \cdot IR_m}{BW} \right) + \left(\frac{C_b \cdot IR_b}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_{bi} \cdot IR_{bi}}{BW} \right) + \left(\frac{C_f \cdot IR_f}{BW} \right) + \left(\frac{C_w \cdot IR_w}{BW} \right) \right] \times TUF$$

Table D.31: Hazard Quotients for Mammals - Site
Project VE52705D, Clinton Creek - Waste Rock

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony	6.61E-03	8.64E-01	5.31E-02	1.35E-02	2.08E-03	3.02E-03	2.11E-04	7.97E-04
Arsenic	2.0E-02	4.8E-01	1.97E-02	4.0E-02	1.2E-03	9.45E-03	6.60E-04	1.80E-03
Barium	1.5E-02	1.3E-01	9.3E-03	2.2E-02	4.1E-04	8.3E-03	5.8E-04	1.1E-03
Chromium	6.0E-02	2.7E+00	1.5E-01	1.2E-01	8.2E-03	2.9E-02	2.0E-03	6.6E-03
Mercury	5.2E-03	8.3E-02	7.1E-03	6.7E-03	3.8E-04	3.1E-03	2.1E-04	4.8E-04
Molybdenum	7.4E-02	1.9E+00	1.4E-01	1.0E-01	1.2E-02	4.2E-02	3.0E-03	1.0E-02
Nickel	1.6E-01	2.2E+01	1.3E+00	3.6E-01	4.9E-02	6.4E-02	4.5E-03	1.7E-02
Selenium	1.9E-01	1.5E+00	1.6E-01	2.4E-01	8.7E-03	1.1E-01	7.8E-03	1.6E-02
Zinc	1.5E-02	5.5E-01	4.1E-02	2.0E-02	2.3E-03	8.9E-03	6.2E-04	1.8E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.32: Hazard Quotients for Mammals - Background
Project VE52705D, Clinton Creek - Waste Rock

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony					4.13E-04		8.64E-05	1.83E-04
Arsenic					3.60E-03		3.22E-03	5.40E-03
Barium					1.7E-03		4.4E-03	5.3E-03
Chromium					2.3E-03		7.1E-04	1.8E-03
Mercury					1.7E-01		5.2E-04	1.1E-01
Molybdenum					7.3E-03		3.2E-03	6.8E-03
Nickel					1.2E-02		2.5E-03	6.8E-03
Selenium					1.4E-02		7.4E-03	1.5E-02
Zinc					9.2E-03		3.2E-03	6.9E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.33: Hazard Quotients for Mammals - Total
Project VE52705D, Clinton Creek - Waste Rock

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony	6.61E-03	8.64E-01	5.31E-02	1.35E-02	2.50E-03	3.02E-03	2.97E-04	9.80E-04
Arsenic	2.02E-02	4.75E-01	1.97E-02	4.00E-02	4.84E-03	9.45E-03	3.88E-03	7.20E-03
Barium	1.49E-02	1.27E-01	9.26E-03	2.19E-02	2.15E-03	8.32E-03	5.00E-03	6.48E-03
Chromium	6.01E-02	2.69E+00	1.47E-01	1.17E-01	1.04E-02	2.86E-02	2.71E-03	8.42E-03
Mercury	5.19E-03	8.33E-02	7.09E-03	6.66E-03	1.71E-01	3.08E-03	7.34E-04	1.15E-01
Molybdenum	7.36E-02	1.94E+00	1.41E-01	1.02E-01	1.93E-02	4.23E-02	6.18E-03	1.69E-02
Nickel	1.57E-01	2.19E+01	1.30E+00	3.64E-01	6.04E-02	6.44E-02	7.00E-03	2.43E-02
Selenium	1.88E-01	1.53E+00	1.57E-01	2.42E-01	2.27E-02	1.11E-01	1.52E-02	3.09E-02
Zinc	1.51E-02	5.48E-01	4.06E-02	1.97E-02	1.15E-02	8.87E-03	3.85E-03	8.66E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.34: Hazard Quotients for Birds - Site
Project VE52705D, Clinton Creek - Waste Rock

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic	1.5E-01	4.1E-02	3.8E-03
Barium	1.5E-02	6.0E-03	2.6E-04
Chromium	2.1E+00	3.5E-01	9.7E-02
Mercury	6.3E-02	1.7E-02	4.3E-03
Molybdenum	4.3E-02	8.9E-03	6.2E-03
Nickel	3.2E+00	2.8E-01	4.3E-02
Selenium	4.9E-01	1.8E-01	3.4E-02
Zinc	2.5E-01	4.1E-02	2.0E-02

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.35: Hazard Quotients for Birds - Background
Project VE52705D, Clinton Creek - Waste Rock

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic			
Barium			
Chromium			
Mercury			
Molybdenum			
Nickel			
Selenium			
Zinc			

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.36: Hazard Quotients for Birds - Total
Project VE52705D, Clinton Creek - Waste Rock

COPC	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic	1.51E-01	4.11E-02	3.78E-03
Barium	1.49E-02	6.05E-03	2.65E-04
Chromium	2.10E+00	3.52E-01	9.70E-02
Mercury	6.34E-02	1.66E-02	4.35E-03
Molybdenum	4.33E-02	8.88E-03	6.22E-03
Nickel	3.16E+00	2.83E-01	4.30E-02
Selenium	4.93E-01	1.81E-01	3.39E-02
Zinc	2.49E-01	4.12E-02	1.97E-02

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.37: Soil Exposure Concentrations for Terrestrial Receptors (mg/kg)
Project VE52705D, Clinton Creek - Remainder of Site

COPC	Soil Concentration (mg/kg dw)	EPC
Trace Metals		
Antimony	3.8	UCLM
Arsenic	15.2	UCLM
Barium	420.6	UCLM
Chromium	393.4	UCLM
Mercury	0.17	UCLM
Molybdenum	2.7	Max
Nickel	545.6	UCLM
Selenium	2.6	UCLM
Zinc	75.5	UCLM

Background Soil Concentration (mg/kg dw)	
Trace Metals	
0.73	UCLM
21.6	UCLM
177	UCLM
27.4	UCLM
0.03	UCLM
1.8	UCLM
34.2	UCLM
0.66	UCLM
72.6	UCLM

EPC = Exposure Point Concentration

UCLM = Upper Confidence Limit on the Mean

Max = Maximum measured concentration

LMW PAHs = Low molecular weight PAHs

HMW PAHs = High molecular weight PAHs

EC = Environment Canada (2006 - 2008)

A = Assumed

Table D.38: Uptake Equations (dry weight)
Project VE52705D, Clinton Creek - Remainder of Site

COPC	Soil to Plants ¹	Soil to Invertebrates ²	Soil to Mammals ¹
Trace Metals			
Antimony	$\ln(C_p)=0.938*\ln(C_s)+(-3.233)$	$C_e=1*C_s$	$C_m=0.05*C_s$
Arsenic	$C_p=0.03752*C_s$	$\ln(C_e)=0.706*\ln(C_s)+(-1.421)$	$\ln(C_m)=0.8188*\ln(C_s)+(-4.8471)$
Barium	$C_p=0.156*C_s$	$C_e=0.091*C_s$	$C_m=0.0075*C_s$
Chromium	$C_p=0.041*C_s$	$C_e=0.306*C_s$	$\ln(C_m)=0.7338*\ln(C_s)+(-1.4599)$
Mercury	$\ln(C_p)=0.544*\ln(C_s)+(-0.996)$	$\ln(C_e)=0.118*\ln(C_s)+(-0.684)$	$\ln(C_m)=-2.2764*\ln(C_s)+(-4.8666)$
Molybdenum	$C_p=0.25*C_s$	$C_e=0.953*C_s$	$\ln(C_m)=-*\ln(C_s)+(-)$
Nickel	$\ln(C_p)=0.748*\ln(C_s)+(-2.223)$	$C_e=0.7778*C_s$	$\ln(C_m)=0.4658*\ln(C_s)+(-0.2462)$
Selenium	$\ln(C_p)=1.104*\ln(C_s)+(-0.677)$	$\ln(C_e)=0.733*\ln(C_s)+(-0.075)$	$\ln(C_m)=0.3764*\ln(C_s)+(-0.4158)$
Zinc	$\ln(C_p)=0.554*\ln(C_s)+(1.575)$	$\ln(C_e)=0.328*\ln(C_s)+(4.449)$	$\ln(C_m)=0.0706*\ln(C_s)+(4.3632)$

Notes:

1 = Sources used in order of preference: US EPA (2007), Baes et al. (1984), Bechtel Jacobs (1998), Travis & Arms (1988)

2 = Sources used in order of preference: US EPA (2007), Sample et al. (1998), Jager (1998)

C_p = Concentration in plant

C_s = Concentration in soil

C_e = Concentration in earthworm

C_m = Concentration in mammal

Table D.39: Tissue Concentrations - Site (wet weight)
Project VE52705D, Clinton Creek - Remainder of Site

SITE				
COPC		Concentration in Foliage ¹ (mg/kg)	Concentration in Earthworms ¹ (mg/kg)	Concentration in Mammals ¹ (mg/kg)
Trace Metals				
Antimony		2.07E-02	6.08E-01	6.08E-02
Arsenic		8.55E-02	2.64E-01	2.33E-02
Barium		9.84E+00	6.12E+00	1.01E+00
Chromium		2.42E+00	1.93E+01	1.70E-01
Mercury		2.11E-02	6.55E-02	1.39E-01
Molybdenum		1.01E-01	4.12E-01	4.12E-01
Nickel		1.81E+00	6.79E+01	4.71E+00
Selenium		2.19E-01	2.99E-01	3.03E-01
Zinc		7.95E+00	5.65E+01	3.41E+01
Water Content ¹		85%	84%	68%

Notes:

N/A = not available

¹ = Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants.

Based on the water content provided in Sample and Suter, conversion factors of 0.15, 0.16, and 0.32 were applied for plants, earthworms, and mammals respectively.

Table D.40: Tissue Concentrations - Background (wet weight)
Project VE52705D, Clinton Creek - Remainder of Site

BACKGROUND			
COPC	Concentration in Foliage ¹ (mg/kg)	Concentration in Earthworms ¹ (mg/kg)	Concentration in Mammals ¹ (mg/kg)
Trace Metals			
Antimony	4.40E-03	1.17E-01	1.17E-02
Arsenic	1.22E-01	3.38E-01	3.11E-02
Barium	4.14E+00	2.58E+00	4.25E-01
Chromium	1.69E-01	1.34E+00	1.20E-01
Mercury	8.22E-03	5.34E-02	7.22E+00
Molybdenum	6.75E-02	2.74E-01	2.74E-01
Nickel	2.28E-01	4.26E+00	1.30E+00
Selenium	4.82E-02	1.09E-01	1.81E-01
Zinc	7.78E+00	5.58E+01	3.40E+01
Water Content ¹	85%	84%	68%

Notes:

N/A = not available

¹ = Sample and Suter, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants.

Based on the water content provided in Sample and Suter, conversion factors of 0.15, 0.16, and 0.32 were applied for plants, earthworms, and mammals respectively.

Table D.41: Exposure Estimates for ROCs - Site (mg/kg-day)
Project VE52705D, Clinton Creek - Remainder of Site

COPC	RECEPTORS OF CONCERN							RECEPTORS OF CONCERN		
	Meadow Vole	Masked Shrew	Deer Mouse	Red Fox	White Tailed Deer	Moose	Black Bear	American Robin	Spruce Grouse	Red Tailed Hawk
					Trace Metals					
Antimony	1.13E-02	1.40E+00	8.65E-02	1.38E-03	3.46E-03	1.51E-04	5.46E-04	3.38E-01	3.13E-02	7.18E-03
Arsenic	4.63E-02	1.22E+00	5.35E-02	1.27E-03	1.42E-02	6.18E-04	1.70E-03	3.03E-01	7.59E-02	7.08E-03
Barium	3.75E+00	3.20E+01	2.33E+00	4.18E-02	1.37E+00	5.98E-02	1.18E-01	1.32E+01	5.38E+00	2.32E-01
Chromium	1.27E+00	5.67E+01	3.09E+00	5.12E-02	3.95E-01	1.72E-02	4.48E-02	1.40E+01	2.34E+00	1.41E-01
Mercury	7.17E-03	1.42E-01	1.18E-02	6.60E-04	2.81E-03	1.22E-04	5.34E-04	4.83E-02	1.12E-02	1.38E-02
Molybdenum	3.66E-02	9.64E-01	7.04E-02	2.43E-03	1.38E-02	6.01E-04	2.07E-03	2.93E-01	6.00E-02	4.14E-02
Nickel	1.25E+00	1.62E+02	9.64E+00	1.52E-01	3.45E-01	1.50E-02	5.81E-02	3.82E+01	3.53E+00	6.36E-01
Selenium	7.53E-02	7.44E-01	7.10E-02	1.95E-03	2.92E-02	1.27E-03	2.91E-03	3.23E-01	1.09E-01	3.06E-02
Zinc	2.71E+00	1.19E+02	8.74E+00	2.30E-01	1.06E+00	4.60E-02	1.59E-01	3.37E+01	4.99E+00	3.38E+00
	1.27E+00	5.67E+01	3.09E+00	7.31E-02	3.95E-01	1.72E-02	5.84E-02	14.01099608	2.343408931	

$$Exposure\ Dose_{ing} = \left[\left(\frac{C_p \cdot IR_p}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_m \cdot IR_m}{BW} \right) + \left(\frac{C_b \cdot IR_b}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_{bi} \cdot IR_{bi}}{BW} \right) + \left(\frac{C_f \cdot IR_f}{BW} \right) + \left(\frac{C_w \cdot IR_w}{BW} \right) \right] \times TUF$$

Table D.42: Exposure Estimates for ROCs - Background (mg/kg-day)
Project VE52705D, Clinton Creek - Remainder of Site

COPC	RECEPTORS OF CONCERN							RECEPTORS OF CONCERN		
	Meadow Vole	Masked Shrew	Deer Mouse	Red Fox	White Tailed Deer	Moose	Black Bear	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals										
Antimony				3.52E-03	3.78E-04	7.02E-04	1.55E-03			2.17E-05
Arsenic				2.30E-02	1.06E-02	1.96E-02	3.42E-02			1.55E-04
Barium				2.33E-01	3.03E-01	5.62E-01	7.07E-01			1.54E-03
Chromium				5.25E-02	1.44E-02	2.68E-02	4.80E-02			3.22E-04
Mercury				3.63E-01	5.68E-04	1.06E-03	2.42E-01			1.12E-02
Molybdenum				2.14E-02	4.83E-03	8.96E-03	1.96E-02			4.34E-04
Nickel				1.77E-01	1.92E-02	3.57E-02	1.01E-01			2.18E-03
Selenium				1.24E-02	3.38E-03	6.28E-03	1.30E-02			2.83E-04
Zinc				3.02E+00	5.42E-01	1.01E+00	2.23E+00			5.31E-02

$$Exposure\ Dose_{ing} = \left[\left(\frac{C_p \cdot IR_p}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_m \cdot IR_m}{BW} \right) + \left(\frac{C_b \cdot IR_b}{BW} \right) + \left(\frac{C_s \cdot IR_s}{BW} \right) + \left(\frac{C_{bi} \cdot IR_{bi}}{BW} \right) + \left(\frac{C_f \cdot IR_f}{BW} \right) + \left(\frac{C_w \cdot IR_w}{BW} \right) \right] \times TUF$$

Table D.43: Hazard Quotients for Mammals - Site
Project VE52705D, Clinton Creek - Remainder of Site

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony	1.49E-03	1.84E-01	1.14E-02	2.98E-03	1.82E-04	4.56E-04	1.98E-05	7.19E-05
Arsenic	8.1E-03	2.1E-01	9.39E-03	1.6E-02	2.2E-04	2.50E-03	1.08E-04	2.97E-04
Barium	3.1E-02	2.7E-01	2.0E-02	4.6E-02	3.5E-04	1.2E-02	5.0E-04	9.9E-04
Chromium	3.6E-02	1.6E+00	8.8E-02	7.0E-02	1.5E-03	1.1E-02	4.9E-04	1.3E-03
Mercury	3.8E-03	7.5E-02	6.2E-03	4.8E-03	3.5E-04	1.5E-03	6.4E-05	2.8E-04
Molybdenum	1.4E-02	3.7E-01	2.7E-02	2.0E-02	9.4E-04	5.3E-03	2.3E-04	7.9E-04
Nickel	9.4E-02	1.2E+01	7.2E-01	2.1E-01	1.1E-02	2.6E-02	1.1E-03	4.4E-03
Selenium	9.5E-02	9.4E-01	9.0E-02	1.2E-01	2.5E-03	3.7E-02	1.6E-03	3.7E-03
Zinc	9.3E-03	4.1E-01	3.0E-02	1.2E-02	7.9E-04	3.6E-03	1.6E-04	5.4E-04

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.44: Hazard Quotients for Mammals - Background
Project VE52705D, Clinton Creek - Remainder of Site

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
Trace Metals								
Antimony					4.63E-04	4.97E-05	9.23E-05	2.04E-04
Arsenic					4.04E-03	1.86E-03	3.45E-03	6.01E-03
Barium					2.0E-03	2.5E-03	4.7E-03	5.9E-03
Chromium					1.5E-03	4.1E-04	7.6E-04	1.4E-03
Mercury					1.9E-01	3.0E-04	5.6E-04	1.3E-01
Molybdenum					8.2E-03	1.9E-03	3.4E-03	7.5E-03
Nickel					1.3E-02	1.4E-03	2.7E-03	7.6E-03
Selenium					1.6E-02	4.3E-03	7.9E-03	1.6E-02
Zinc					1.0E-02	1.9E-03	3.4E-03	7.6E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.45: Hazard Quotients for Mammals - Total
Project VE52705D, Clinton Creek - Remainder of Site

COPC	Mammals							
	Meadow Vole	Masked Shrew	Deer Mouse	Snowshoe Hare	Red Fox	White Tailed Deer	Moose	Black Bear
	Trace Metals							
Antimony	1.49E-03	1.84E-01	1.14E-02	2.98E-03	6.45E-04	5.06E-04	1.12E-04	2.76E-04
Arsenic	8.1E-03	2.1E-01	9.4E-03	1.6E-02	4.3E-03	4.35E-03	3.56E-03	6.30E-03
Barium	3.1E-02	2.7E-01	2.0E-02	4.6E-02	2.3E-03	1.4E-02	5.2E-03	6.9E-03
Chromium	3.6E-02	1.6E+00	8.8E-02	7.0E-02	3.0E-03	1.2E-02	1.3E-03	2.6E-03
Mercury	3.8E-03	7.5E-02	6.2E-03	4.8E-03	1.9E-01	1.8E-03	6.2E-04	1.3E-01
Molybdenum	1.4E-02	3.7E-01	2.7E-02	2.0E-02	9.2E-03	7.2E-03	3.7E-03	8.3E-03
Nickel	9.4E-02	1.2E+01	7.2E-01	2.1E-01	2.5E-02	2.7E-02	3.8E-03	1.2E-02
Selenium	9.5E-02	9.4E-01	9.0E-02	1.2E-01	1.8E-02	4.1E-02	9.6E-03	2.0E-02
Zinc	9.3E-03	4.1E-01	3.0E-02	1.2E-02	1.1E-02	5.5E-03	3.6E-03	8.2E-03

Notes:

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.46: Hazard Quotients for Birds - Site
Project VE52705D, Clinton Creek - Remainder of Site

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic	6.7E-02	1.7E-02	1.6E-03
Barium	3.2E-02	1.3E-02	5.5E-04
Chromium	1.3E+00	2.1E-01	1.3E-02
Mercury	5.4E-02	1.2E-02	1.5E-02
Molybdenum	8.3E-03	1.7E-03	1.2E-03
Nickel	1.8E+00	1.6E-01	2.9E-02
Selenium	2.8E-01	9.3E-02	2.6E-02
Zinc	1.8E-01	2.7E-02	1.8E-02

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.47: Hazard Quotients for Birds - Background
Project VE52705D, Clinton Creek - Remainder of Site

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic			3.45E-05
Barium			3.7E-06
Chromium			2.9E-05
Mercury			1.2E-02
Molybdenum			1.2E-05
Nickel			1.0E-04
Selenium			2.4E-04
Zinc			2.8E-04

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Table D.48: Hazard Quotients for Birds - Total
Project VE52705D, Clinton Creek - Remainder of Site

COPC			
	American Robin	Spruce Grouse	Red Tailed Hawk
Trace Metals			
Antimony	NC	NC	NC
Arsenic	6.7E-02	1.7E-02	1.6E-03
Barium	3.2E-02	1.3E-02	5.6E-04
Chromium	1.3E+00	2.1E-01	1.3E-02
Mercury	5.4E-02	1.2E-02	2.8E-02
Molybdenum	8.3E-03	1.7E-03	1.2E-03
Nickel	1.8E+00	1.6E-01	2.9E-02
Selenium	2.8E-01	9.3E-02	2.6E-02
Zinc	1.8E-01	2.7E-02	1.8E-02

Notes:

SAR_B = Species at Risk (birds)

NC=Not calculated, No TRV available

Bold=Hazard Quotient is greater than 1, potential risk to the ecological receptor exists.

Appendix E
Limitations

Limitations

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
 - a. The Standard Terms and Conditions which form a part of our Professional Services Contract;
 - b. The Scope of Services;
 - c. Time and Budgetary limitations as described in our Contract; and
 - d. The Limitations stated herein.
2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in Wood's opinion, for direct observation.
4. The environmental conditions at the Site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the Site with any applicable local, provincial or federal bylaws, orders-in-council, legislative enactments and regulations was not performed.
5. The Site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.
6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on-site and may be revealed by different or other testing not provided for in our contract.
7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Wood must be notified in order that it may determine if modifications to the conclusions in the report are necessary.
8. The utilization of Wood's services during the implementation of any remedial measures will allow Wood to observe compliance with the conclusions and recommendations contained in the report. Wood's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.
9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.
10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of Wood.
11. Provided that the report is still reliable, and less than 12 months old, Wood will issue a third-party reliance letter to parties that the client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on Wood's report, by such reliance agree to be bound by our proposal and Wood's standard reliance letter. Wood's standard reliance letter indicates that in no event shall Wood be liable for any damages, howsoever arising, relating to third-party reliance on Wood's report. No reliance by any party is permitted without such agreement.