BACKGROUND CONCENTRATIONS OF TRACE ELEMENTS IN SURFICIAL SOILS OF ARCTIC CANADA

CONCENTRATION DE FOND PAR DES OLIGO-ELEMENTS DANS LES SOLS SUPERFICIELS DE L'ARCTIQUE CANADIEN

A Thesis Submitted to the
Division of Graduate Studies of the Royal Military College of Canada

By

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B.Sc.H in Environmental Chemistry

In Partial Fulfillment of the Requirements for the Degree of Master of Science

September 2019

Acknowledgements

I would like to thank my supervisors Dr. Daniela Loock and Dr. Kela Weber for their guidance and support throughout my research career. Daniela, thank you for providing so many opportunities and I appreciate the time you have dedicated to the development of my career. I am very fortunate to have you as a supervisor. Kela, I appreciate the time and effort you have dedicated to the development of my research project.

Thank you to all the current members of the Environmental Sciences Group for providing a productive and enjoyable work environment for me to grow and learn in this career.

Lastly, I would like to thank my parents, David and Christine Garrett for their support that has allowed me to succeed in my career.

Abstract

Environmental soil quality guidelines represent acceptable numerical threshold values for trace metal concentrations that safeguard human and ecological health. These guidelines take into account background soil concentrations to avoid the remediation of areas erroneously identified as contaminated based on a simple guideline comparison. The majority of the background concentration data used to derive the Canadian Soil Quality Guidelines (CSQGs) was collected from soil surveys performed in southern provinces. However, as Canada is a vast country with many unique geological regions, the application of a single guideline value to the entire country is not realistic. If background concentrations are above guidelines, provisional guidelines in the form of Background Threshold Values (BTVs) should be established based on the background soil concentrations at the site (CCME, 2006). With limited background concentration data in Arctic Canada, Environmental Site Assessors are required to determine BTVs at many northern sites at significant cost. Several approaches to determining local background concentrations by performing high resolution background sampling programs have been proposed, but they vary greatly and guidance on best practices does not exist.

As part of the environmental site assessment of over 61 federal contaminated sites across Arctic Canada, over 2100 background soil samples were collected by the Environmental Sciences Group at the Royal Military College of Canada (ESG-RMC) between 1989 and 2016. Background soil data was manually compiled and analyzed to understand the natural variability across the continent. Trace element concentrations were found to be highly variable across Arctic Canada, with many of the sites having measured background concentrations above the CSQGs. This study provides the first longitudinal reference data set for background concentrations of trace elements (As, Cd, Co, Cu, Cr, Pb, Ni, Zn) in Arctic Canada along the 69th parallel North. The extensive data set generated in this study was compared to those generated in other areas of the world, highlighting the need for high resolution background sampling programs across other continents.

Additionally, background soil data from three case studies in Northern Canada was used to develop recommendations for performing high resolution background sampling programs in Arctic and remote sites in Canada. Recommendations were based on the influence of sampling strategy, sample size, and identification of outliers were evaluated during the calculation of BTVs. These recommendations include; collecting between 10-25 samples/km^2 from a minimum of 40 discrete sample locations, and the use of the interquartile rule to remove outliers. Additionally, each BTV calculation method was ranked by conservativeness and accuracy to guide decisions during data analysis and site management.

Résumé

Les recommandations environnementales sur la qualité des sols proposent les valeurs seuils numériques acceptables des concentrations de métaux traces qui protègent l'environnement et la santé humaine. Ces recommandations sont calculées d'après les concentrations de fond pour éviter que des zones ne soient déclarées contaminées et assainies à tort par suite d'une simple comparaison avec les recommandations. La majorité des données sur les concentrations de fond utilisées pour calculer les Recommandations canadiennes pour la qualité de l'environnement (RCQE) ont été recueillies lors de prospections pédologiques réalisées dans les provinces du Sud. Toutefois, dans un pays de l'immensité du Canada où l'on trouve de nombreuses régions géologiques uniques en leur genre, l'application d'une seule recommandation à tout le pays n'est pas réaliste. Dans les cas où les concentrations de fond sont supérieures aux recommandations, il faudrait des recommandations provisoires sous la forme de valeurs seuils des concentrations de fond (VSCF) calculées à partir des concentrations de fond spécifiques au terrain étudié (CCME, 2006). Le manque de données sur les concentrations de fond dans l'Arctique canadien fait que, bien souvent, les évaluateurs environnementaux de sites qui doivent déterminer les valeurs seuils des concentrations de fond dans des régions nordiques le font à grands frais. Plusieurs méthodes ont été proposées pour évaluer les concentrations de fond locales au moyen de programmes d'échantillonnage de concentrations de fond à haute résolution, mais elles sont très variables et il n'existe pas de pratiques exemplaires.

Dans le cadre d'une évaluation environnementale de plus de 61 lieux contaminés fédéraux répartis dans l'ensemble de l'Arctique canadien, le Groupe des sciences de l'environnement du Collège militaire royal du Canada a recueilli plus de 2 100 échantillons de concentrations de fond entre 1989 et 2016. Les données sur les concentrations de fond dans le sol ont été compilées et analysées manuellement afin de permettre une meilleure compréhension de la variabilité naturelle d'un bout à l'autre du continent. Il est ressorti de cette étude que les concentrations d'éléments traces varient énormément d'une région de l'Arctique canadien à l'autre, bon nombre des lieux analysés présentant des concentrations de fond supérieures aux RCQE. La présente étude fournit le premier ensemble de données longitudinales de référence sur les concentrations de fond d'éléments traces (As, Cd, Co, Cu, Cr, Pb, Ni, Zn) dans l'Arctique canadien le long du 69e parallèle nord. Une comparaison du riche ensemble de données qui a résulté de l'étude et des ensembles de données recueillis dans d'autres régions du monde a mis en évidence la nécessité d'établir des programmes d'échantillonnage des concentrations de fond à haute résolution dans les autres continents.

En outre, nous nous sommes servis des données sur les concentrations de fond de trois études de cas menées dans le Nord canadien pour calculer des recommandations en vue de l'exécution de programmes d'échantillonnage de

concentrations de fond à haute résolution dans des lieux éloignés et arctiques du Canada. Les recommandations tenaient compte de l'influence de la stratégie d'échantillonnage, de la taille des échantillons et du repérage des cas déviants dans l'élaboration des VSCF. Ces recommandations comprennent : la collecte de 10 à 25 échantillons par kilomètre carré d'au moins 40 lieux d'échantillonnage distincts et l'utilisation de la règle d'intervalle interquartile pour éliminer les cas déviants. En outre, chaque méthode de calcul des VSCF a été classée en fonction de la prudence et de l'exactitude de son approche dans l'orientation des décisions pendant l'analyse des données et la gestion des lieux. La limite supérieure de l'intervalle de confiance à 95 % s'est révélée être la VSCF la plus prudente tandis que la limite extrême de déviance a correspondu à la valeur la moins prudente.

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Acronyms

AHC	Agglomerative Hierarchical Clustering
BTV	Background Threshold Value
CCME	Canadian Council of Ministers of the Environment
COPC	Contaminant of Potential Concern
CSQG	Canadian Soil-Quality Guidelines
EOL	Extreme Outlier Limit
ESA	Environmental Site Assessment
ESG	Environmental Sciences Group
FCSAP	Federal Contaminated Sites Action Plan
GSC	Geological Survey of Canada
IQR	Interquartile Range
KM	Kaplan Meier
MAD	Median Absolute Deviation
PH	Public Health
RMC	Royal Military College of Canada
SQG	Soil Quality Guideline
SD	Standard Deviation
US EPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UPL	Upper Prediction Limits
US EPA	United States Environmental Protection Agency
U.S.A	United States of America
USL	Upper Simultaneous Limits
UTL	Upper Tolerance Limits

Chapter 1 **Introduction**

Soil is a mixture of organic material, minerals, gases and liquids that support life. All material included within this mixture originates from parent material, such as rocks, minerals, organisms and plant matter. Soil is formed through biological and geological processes that deposit soil material on the Earth's surface over time. Soil formation processes occurring at the Earth's surface are dependent on a variety of factors, including the disintegration of the rock; topography; climate; accumulation of plants and their transformation into humus; activity of microorganisms; soil fauna; and the weather. Depending on the processes that occur, and the parent material involved, a natural concentration of inorganic elements will exist in soil; referred to as background soil concentrations. In literature, background soil concentrations may also be described as 'ambient background', 'background levels', 'geochemical background', 'baseline concentrations', or simply just 'background concentrations' (Mikkonen *et al.*, 2017; Santos-Francés *et al.*, 2017; Tepanosyan *et al.*, 2017). However, providing a singular definition for 'background concentrations' has been a subject of discussion between environmental scientists and geologists for many years (Gałuszka, 2007; Reimann *et al.*, 2005). A variety of definitions can be found in literature, but often professionals provide their own definition or do not provide a definition at all (Gałuszka, 2007).

Background concentrations exist in all soil and at all depths of the soil profile. As soil near the Earth's surface is more heavily influenced by factors such as climate, organism, and plant matter, surficial soil varies by physical and chemical composition more dramatically compared to soil at depth (Rencz *et al.*, 2011). Within the uppermost layer of soil there are variations in the textural, mineralogical, moisture, and the organic composition that are expressed as soil horizons (Rencz *et al.*, 2011). As a result, background concentrations are much more variable in surficial soil and are the focus of this thesis. As defined by the Canadian Council of Ministers of the Environment (CCME), surficial soil is the soil ranging from the ground surface to 1.0 meter in depth (CCME, 2006).

Examining the distribution of background concentrations in surficial soil allows for the identification of anomaly conditions, which may be of interest to either environmental scientists or geologists. Concentrations of inorganic elements that exceed background conditions may indicate point-source contamination from anthropogenic input, or the presence of unique geochemical processes in the area. Therefore, understanding background concentrations in soil can aid in contaminated site investigations, geological explorations, or other studies related to geochemistry and soil science.

Background concentrations were originally introduced by exploration geochemists to differentiate between positive and negative anomalies of chemical elements in a rock matrix (Matschullat *et al.*, 2000). Background soil concentrations are examined during geochemical surveys in addition to rocks, to provide information on local enrichments of inorganic elements (Hosking, 1961). The goal is to discover source material containing higher-than-average amount of the element which can be related to an ore deposit (Hosking, 1961). The focus of these studies is on the natural origin of the variations in background soil concentrations that are directly related to parent material and certain geochemical processes (Tepanosyan *et al.*, 2017). As a result, geologists commonly describe background soil concentrations as a range rather than a single value.

However, more recently, background concentration data has been used extensively by environmental site assessors; a group of environmental scientists interested in characterizing pollution in the environment from anthropogenic activity. For a professional to decide whether a site is contaminated, they need to have a strong understanding of the site and its natural state prior to human activity. As inorganic elements exist naturally in soil in trace levels, and can also be contaminants released by anthropogenic activity, background concentrations need to be measured in order to quantity contamination of soil at a site (Kushwaha *et al.*, 2018). Therefore, background concentrations can be treated as a threshold value for contaminated site investigations.

To quantify contamination in soil, environmental soil quality guidelines (SQG) are developed and serve as an initial screening tool to determine whether management action may be required to safeguard human and ecological health. SQGs represent acceptable numerical threshold values for chemical concentrations that support the intended land-use. In Canada, the Canadian Soil Quality Guidelines (CSQGs) for inorganic elements are used (CCME, 2006). CSQGs incorporate Canadian background soil concentration data collected from multiple sources, however, much of the background soil data was collected from southern provinces. CSQGs were derived using background soil data mainly from Canadian provinces, and therefore these generic guidelines are not always applicable in regions of elevated background soil concentrations, which was the case at serval sites in Arctic Canada (ESG 2007a, 2007b, 2014).

During contaminated site investigation, a background sampling program is generally not required, as generic SQGs can be used to quantify the extent of contamination. However, when natural levels of inorganic elements exceed SQGs, environmental site assessors are required to generate Background Threshold Values (BTVs) to use in replacement of SQGs. BTVs equate to the highest background concentration at a given site where any concentration exceeding this value is considered a result of input from anthropogenic activity. BTVs represent the 'clean up' levels for inorganic element concentrations in soil and used to guide management and minimize costly and unnecessary disturbance of an area during site remediation.

In literature, determination of background soil concentrations is often performed on continental scale with low sampling density (Riemann *et al.*, 2017; Gambashidze *et al*., 2014; C. Reimann *et al*., 2014; Tóth *et al*., 2016; Cheng et al., 2014; Smith et al., 2012); however, high resolution soil data is required to understand local variability of background concentrations at a contaminated site. Sample collection strategies and statistical tools to determine background soil concentrations have been discussed in the scientific literature (Birch, 2017; Hofweber, 2010; Mikkonen *et al.*, 2017; Reimann *et al.*, 2005) while a comparison of sampling strategies and statistical methods for high resolution background sampling programs at Arctic and remote sites has never been performed in one study. Environmental site assessors require best practices on the selection of the approaches for the collection and interpretation of background data for the purpose of developing appropriate BTVs.

Background soil concentration data in Canada is not readily available for Arctic Canada, leaving much of Northern Canada uncharacterized. Without publicly available data, background soil concentrations are determined on a case-by-case basis. In Canada alone, the federal government is responsible for 20,000 historically contaminated sites of which 3,400 are in the North (Government of Canada, 2019). Future economic development in the Arctic through natural resource exploration and the development of shipping routes will increase the potential of contamination in this region, therefore increasing the need for background soil data.

1.1. Objectives

Through previous Arctic site ESAs, the Environmental Sciences Group at the Royal Military College of Canada (ESG-RMC) have shown that natural levels of inorganic elements in Arctic

Canada often exceed CSQGs, thus requiring extensive high resolution background soil sampling programs (ESG, 2004, 2007, 2014). As a result, ESG-RMC collected over 2100 background soil samples from 61 across Arctic Canada. From these individual site investigations, an extensive data set of background trace element (As, Cd, Co, Cr, Cu, Ni, Pb, Zn) concentrations in Arctic surficial soil was extracted and analyzed in this thesis.

This thesis provides the analysis of a large data set provided by ESG-RMC consisting of background soil concentrations at 61 sites in Arctic Canada. Additionally, three remote and Arctic sites were selected to compare and evaluate both sampling strategies and statistical methods for the calculation of BTVs and recommendations on how to perform high resolution background sampling programs.

To address the knowledge gaps described above, the purpose of this thesis was twofold: i) calculate and develop the first longitudinal background soil concentration data set in Arctic Canada at approximately the 69^{th} parallel North, and ii) provide recommendations for performing high resolution background sampling programs at remote and Arctic sites using larger background soil data sets from three unique case studies.

1.2. Organization

This thesis includes six chapters organized as follows:

Chapter 1 provides a brief introduction of the topic of the thesis, objectives, and organizational structure.

Chapter 2 provides additional background information about the current approach to contaminated site investigation in Canada, the Canadian Soil Quality Guidelines (CSQG), and an in-depth literature review that focuses on how background soil concentration data is interpreted and published in literature.

Chapter 3 describes the methodology utilized in this thesis.

Chapter 4 provides the first longitudinal background soil concentration data set in Arctic Canada at the 69^{th} parallel North. This chapter has been prepared as a manuscript for submission to the Journal of Science of the Total Environment.

Chapter 5 provides the recommendations for sample strategies and statistical methods for the calculation of BTVs during high resolution background soil programs in remote and Arctic sites. This chapter has been prepared as a manuscript for submission to the Canadian Journal of Soil Science.

Chapter 6 concludes the findings of this thesis and provides recommendations for further study.

Appendix A Supporting information for Chapter 2

Appendix B Supporting information for Chapter 4

Appendix C Supporting information for Chapter 5

Chapter 2 **Literature Review**

2.1 Introduction

2.1.1. Environmental Site Assessment

In Canada, federally contaminated sites are managed by the federal government through the integrated risk management process (CCME, 2016a, 2016b). This process consists of three main components, which are i) investigation and remediation, ii) human health and ecological risk assessment and iii) risk management (CCME, 2016a, 2016b). This process is further illustrated in Figure 2.1.

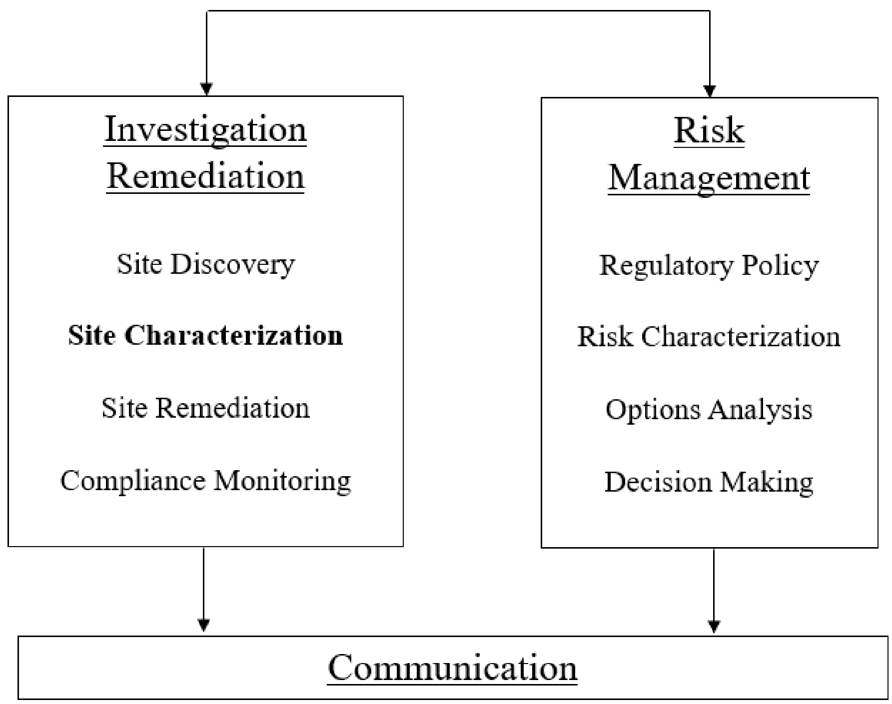

Figure 2.1: The Canadian integrated risk management process for contaminated sites. Figure modified from CCME (2012).

Site characterization is a crucial component of this process as many of the decisions made regarding site management hinge on an accurate understanding of the site conditions. Site characterizations follow a risked-based approach through a process referred to as an Environmental Site Assessment (ESA). The objectives of an environmental site assessment are to identify Contaminants of Potential Concern (COPCs), receptors and pathways of exposure, and to estimate the risk to the receptors.

For the purpose of this study, surficial soil is the medium of focus, which is defined by the Canadian Council of Ministers of the Environment (CCME) as the soil ranging in depth “grade” to 1.0 meters (CCME, 2006). This zone was chosen as it is most accessible to human and ecological receptors.

2.1.2. Soil Quality Guidelines

During ESAs, soil samples from the site are analyzed for suspected COPCs. Concentrations of COPCs are compared to Soil Quality Guidelines (SQGs). SGQs are generic numerical concentration limits for contaminants in soil that are recommended to maintain designated uses of the soil environment (CCME, 2006). Guidelines are derived to protect human and ecological receptors that sustain normal activities on the land. Because land uses can vary, Canadian guidelines are derived for four different land use categories: agricultural, residential/parkland, commercial, and industrial. Using SQGs, environmental site assessors can delineate the spatial extent of contamination at a site using simple guideline comparison.

In Canada, these guidelines are calculated for human and ecological receptors, and consider the toxicological effects of the contaminant (CCME, 1991, 2006; Health Canada, 2012). For metals/metalloids, the final derived SQG is compared to background soil concentrations in Canada to ensure the SQGs are not below the background concentrations (CCME, 1991). The derivation of Canadian SQGs considered background data collected from the following sources:

- British Columbia Ministry of Environment. 2010. Protocol for determining background soil quality, Table 1: Regional background soil quality estimates for inorganic substances;
- Ontario Ministry of the Environment (OMOE), 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario;
- Ministère de la Santé et des Services sociaux du Québec (MSSS), 2002. Ministère du développement durable, de l'environnement et des parcs, Québec. 2002. Politique de protection des sols et de réhabilitation des terrains contaminés – Teneurs de fond (critères A) pour les métaux et métalloïdes;
- Geological Survey of Canada. Canadian Geochemical Surveys. See also: (Spirito & Adcock, 2009a, 2009b), (Matschullat *et al*., 2000), (Adcock, 2009a, 2009b), (Garrett & Chen, 2007), (Spirito, Rencz, Kettles, Adcock, & Stacey, 2004, 2006); and
- Environmental site assessments and/or risk assessment reports for other sites in the same general vicinity, as and where available and appropriate (if the data in those reports have background information compiled, not affected by other anthropogenic activities). Data and locations of assessments are not often publicly available.

These guidelines are referred to as the Canadian Soil-Quality Guidelines (CSQGs) and are applicable to all contaminated sites in Canada (CCME, 2012). These guidelines are intended to provide a high level of protection for designated land uses and are considered broadly applicable to Canadian soils (CCME, 2006). If background concentrations are above guidelines, provisional guidelines in the form of Background Threshold Values (BTVs) should be established based on the background soil concentrations at the site (CCME, 2006).

Other jurisdictions have developed their own SQGs that are applicable to private or provincially governed land on which they are located. Provincial SQGs may be developed by following CCME guidance (CCME, 2006) or a justified alternative method.

2.1.3. Background Threshold Values (BTVs)

Detailed characterization of background soil at a contaminated site is generally not required for contaminated site investigations, as generic SQGs can be used to quantify the spatial extent of contamination. However, when natural levels of inorganic elements exceed SQGs, the development of BTVs is required.

If background soil concentration data already exists through other geochemical surveys or site investigations, then that data can be used if justifiable (CCME, 2006). In Canada, background soil concentration data is not readily available for remote areas, such as the Arctic. Without publicly available data, background soil concentrations are determined on a case-by-case basis through a high resolution background sampling program.

The purpose of background sampling programs is to determine local background soil concentrations that can be used to derive BTVs for soil at a specific contaminated site. The design of a background sampling program takes into account the spatial distribution of samples as well as the number of samples required to adequately characterize the background concentrations. A background unit is an area of soil surrounding the site but that is not influenced by the site activities or releases (US EPA, 1995). This unit should be geologically similar to the contaminated site, and should have similar biological, physical, and chemical characteristics (US EPA, 1995). Generally, these sites should be upstream, upgradient, and upwind of the site in order to ensure there are no influences from the contaminated site (US EPA, 1995).

To characterize background concentrations, the data is often described by its central tendency and the range to describe its distribution. The derivation of BTVs requires further statistical exploration. The calculated threshold values are highly influenced by the data analysis techniques adopted during BTV derivation. Although there is guidance for selecting appropriate locations of background soil sampling programs in Canada, there are no specific recommendations regarding statistical techniques as these techniques could be misused or have policy implications (CCME, 1991; US EPA, 1995). As a result, the approach to analyzing background sample data is widely varied, and best practices do not currently exist in Canada. In Section 2.2, the approaches used in current literature to execute background soil sampling programs and derive BTVs are reviewed.

2.1.4. Naturally Elevated Inorganic Elements in Arctic Soil

Northern regions of Canada are dominated by cryosolic soils, as shown in Figure 2.2 (Rencz *et al*., 2011). Cyrosolic soils are identified as having permafrost within either 1 m of the surface or within 2 m of the surface if the soil profiles shows evidence of cryoturbation; the subsequent freezing and melting of ice lenses in the active layer (Feisthauer, 2012; Rencz *et al*., 2011). Previous and ongoing geological events in Arctic Canada give rise to irregular soil horizons consisting of till or glacial till deposits, and marine sediments in coastal regions. Although, surface material in arctic regions could more appropriately be described as till material, generic soil quality guidelines only consider grain size of material, and therefore are applicable to till material as well (CCME, 1991). Therefore, determining background concentration in surficial soil at contaminated sites becomes more complex as soil is more heterogeneous in nature.

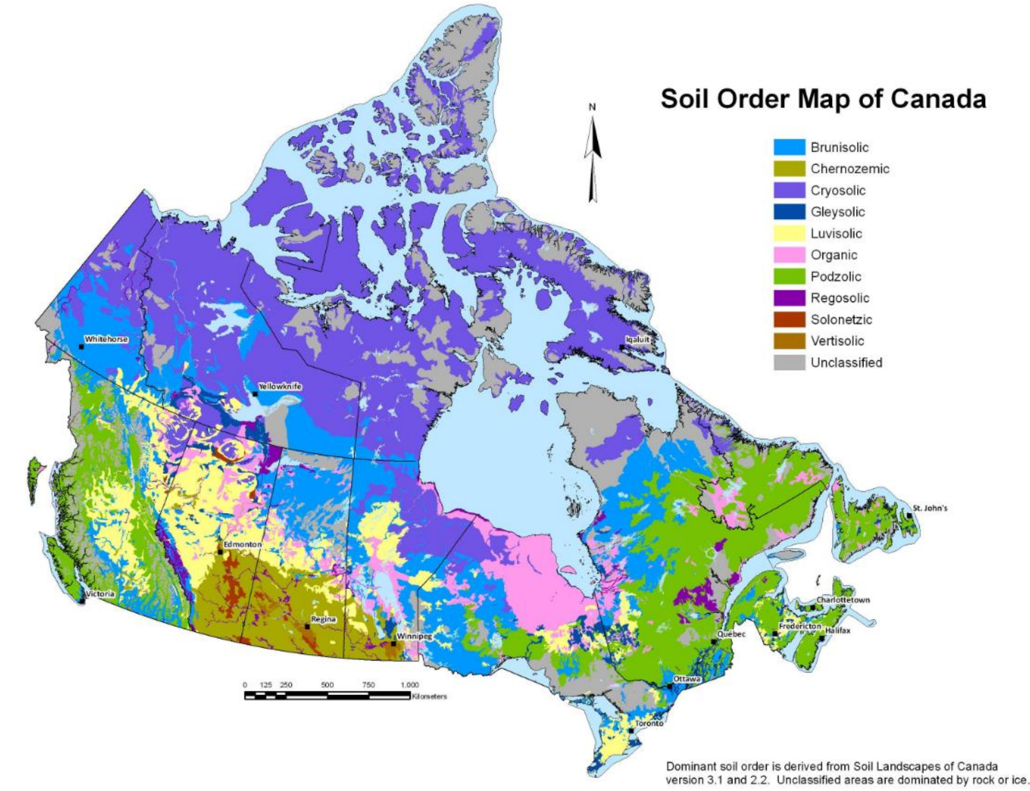

Figure 2.2: Soil order map of Canada. Figure taken from (Rencz *et al*., 2011).

Contaminated sites that contain irregular soil horizons can have several distinct soil types in one region, often referred to as terrain units. For example, the images provided in Figure 2.3 illustrate the irregularities in Arctic surficial soil that were found at one Arctic site on Baffin Island, NU. Environmental Site Assessors have to consider each terrain unit, as natural variability of background concentrations can be large. Past arctic studies (ESG, 2004, 2007) have shown that natural levels of, for example, nickel exceeded the national soil-quality guidelines by an order of magnitude in one terrain unit on site, and not another. As CSQGs were derived using background soil data mainly from Canadian provinces, these generic guidelines are not always applicable to northern regions of Canada. Additionally, as there is a lack of background soil data in Arctic Canada, determining background soil concentrations on a site-specific basis is commonly required as inorganic elements are often naturally elevated (ESG, 2004, 2007). There is a need for the development of a background soil data set in Arctic Canada as future economic development in the Arctic through natural resource exploration and the development of shipping routes will increase the potential of contamination in this region.

Figure 2.3: Two separate terrain units sampled at an Arctic site on Baffin Island (photographs taken by ESG-RMC in 2006).

2.2 Literature Review

Many researchers have discussed the definition of “background soil concentrations” and have explored the statistical methods used to determine BTVs (Birch, 2017; Hofweber, 2010; Mikkonen *et al*., 2017; Reimann *et al.* 2005); However, there are a variety of approaches to executing background soil sampling programs and deriving background soil concentrations. In the following sections, current literature regarding background soil sampling programs and the determination of background concentrations is summarized.

A literature review was performed to explore the current research regarding the determination of background soil concentrations. A variety of terms are used to describe background soil concentrations in the literature. An initial web search using the search term “background soil concentration” yielded over 4200 results, therefore requiring more specific search terms. All articles found were manually screened to determine their relevance to this study. Articles were deemed relevant if they discussed the definition of background soil concentrations, any approaches for collecting background soil data, or statistical techniques that can be used for the determination of background soil concentrations. Literature review search results are provided in Appendix A.

As shown in Figure 2.4, four categories were chosen to separate articles by focus of study. Out of 62 articles, only two described the concept and definition of background soil concentrations (Matschullat *et al.*, 2000; Clemens Reimann *et al.*, 2005). The majority of the relevant articles found were case studies. The last two categories shown in Figure 2.4 are for articles that discuss the statistical approach to determining background soil concentrations. These types of investigations were typically performed using a case study to demonstrate the results of the statistical approaches used. Seven articles reviewed the statistical approaches commonly used for determining background concentrations without the use of a case study. Of the 54 relevant case studies, Table 2.1 shows the locations where these studies were performed. Over half of the relevant case studies were performed in Europe, while only three were performed in Canada.

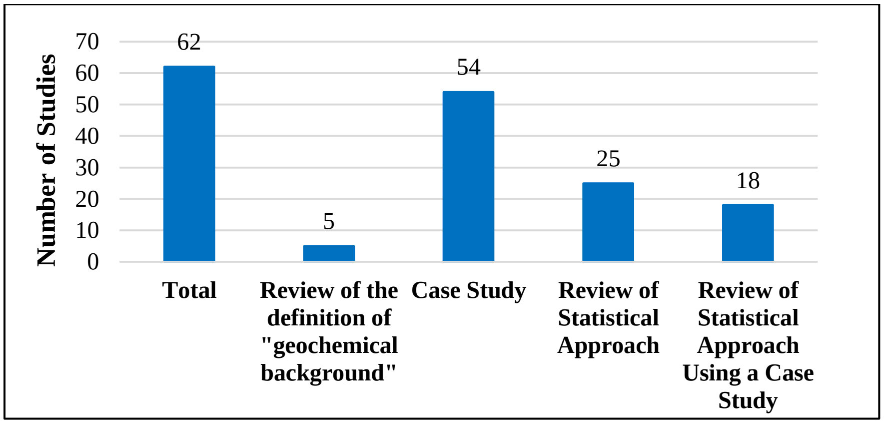

Figure 2.4: The focus of the relevant articles selected during the literature review.

Table 2.1: Locations of case studies found in literature.

Location of Study	Number of Case Studies
Canada	3
United States	7
South America	6
Africa	2
Asia	11
Australia	2
Europe (includes Greenland. UK)	30
Military Site - Army, Navy, Airforce	2

2.1.5. Performing a Background Sampling Program

2.1.5.1. *Scale of Background Sampling Programs*

Before background soil concentrations can be determined, selecting the sampling approach in terms of spatial distribution and number of samples is crucial. Spatial variability of inorganic elements is important to consider when defining the geographical boundaries of a sampling program. Depending on the scale of the study area, different soil types could be present, and the variability of background concentrations could increase. Natural variability in background soil concentrations can produce false negative or false positive errors when performing guideline comparisons during environmental site assessments.

Background sampling programs have been executed on a local, regional and even continental scale (Clemens Reimann, Matschullat, Birke, & Salminen, 2009). Scale, or area, of a sampling program can influence the representativeness of a soil data set in two ways; i) sample density will change if sample size remains constant, and ii) large scale programs can incorporate more unique geochemical patterns that will ultimately increase the variability of background concentrations in a dataset. A sampling program that covers between 0.5 to 500 km^2 in area is defined as local-scale, where as regional-scale is considered cover between 500-500,000 km^2 in area (Clemens Reimann *et al.*, 2009). Continental scale covers an area between 500,000-50,000,000 km^2 in area (Reimann *et al.*, 2009). The relevant case studies were separated based on the size of the sampling program used to determine background soil concentrations, shown in Figure 2.5.

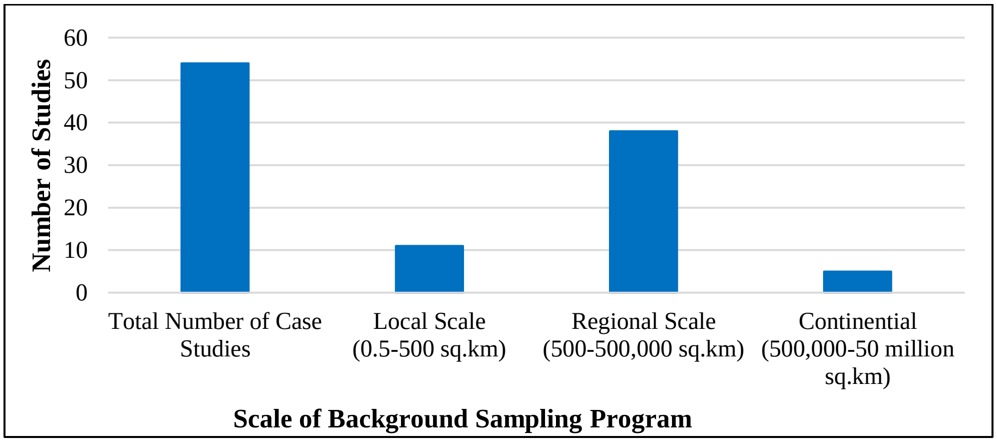

Figure 2.5: The scale of the background programs used in the case studies found in literature.

Most of the case studies use a regional-scale approach in order to determine background soil concentrations. Meanwhile, 11 case studies used a local scale to determine background soil concentrations. Of these 11 local-scale studies, the majority were found to be greater than 200 square kilometers. In geographical regions that have soil influenced by a variety of geochemical processes, a study that covers an area this large can have significant variability in the data set or may also mask some local variability, depending on how it is performed. In past studies (ESG, 2004, 2007) high resolution background soil sampling programs performed in Arctic Canada identified several different terrain units with background concentrations that varied by orders of magnitude. Therefore, increasing the area of a background sampling program can increase the variability of a data set. Large variability in a data set due to the inclusion of different terrain unit can disguise important geochemical information unique to different soil types.

2.1.5.2. *Sampling Approaches*

After geographical boundaries of a study area are determined, several soil sampling approaches can be used to collect representative samples. Because this study only involves surficial soil, the approaches described are limited to the soil in the upper 1.0 meter of soil. However, these sampling approaches can be adopted to investigate subsurface soil. As the entire area of the site is important to a background soil sampling program, meaning all areas of the site contribute to the natural variation in background concentrations, a strategy must be set in place that collects samples that represent the entire site. Canadian guidance on designing sampling strategies for contaminated sites can be adapted to a background sampling program to collect representative data (CCME, 2016a). These two-dimensional designs are shown in Figure 2.6. Soil samples can be collected at fixed depth intervals (e.g. 0-10 cm) or can be collected from specific soil horizons.

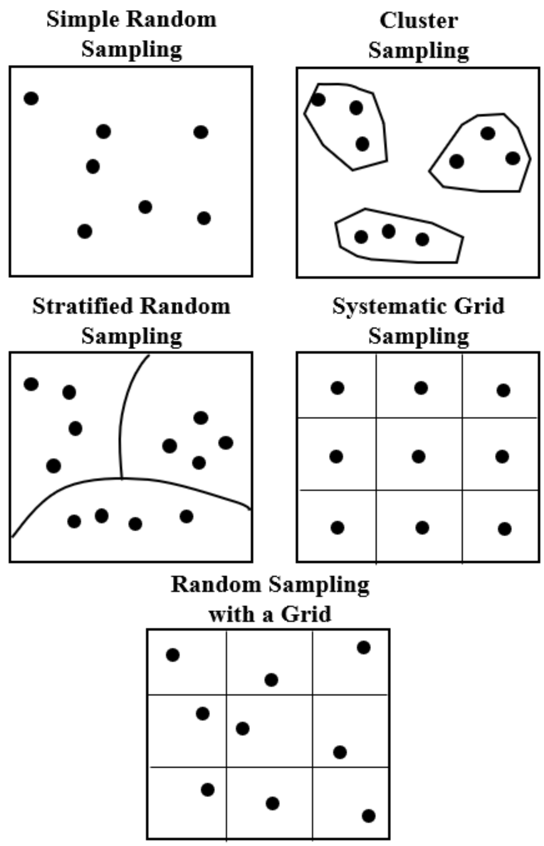

Figure 2.6: Common two-dimensional sampling designs. Figure adapted from CCME (2016a).

Random sampling strategies select sampling locations using random numbers (CCME, 2016a). Simple random sampling involves selecting a sample location at random using an equal probability for the entire site. Stratified random sampling and nested random sampling divides the area into strata or primary units, respectively, relying on historical information or prior historical results (CCME, 2016a). Cluster sampling design selects sampling locations based on observations, site history or other rationale and each cluster is measured independently of one another. Systematic grid sampling divides the entire area into even subunits or blocks, where one sample is collected from the center of each subunit. Within a systematic grid design, the sample locations can also be randomly selected within each block, referred to as random sampling within blocks.

When background units contain one surficial soil type, a systematic sampling grid could efficiently provide representative background data for the entire site. However, when background soil units contain more than one terrain unit, the design of the sampling program must address these strata because these distinct terrain units could have different background concentrations. Therefore, to understand the local variability of background concentrations, all soil types need to be identified prior to sampling, and a sampling program should be developed that will collect representative samples from all soil types. For example, using aerial photographs to identify different terrain units on the site, followed by a site visit to classify soil in each terrain unit and soil horizon down to 1.0 meter in depth can be an effective strategy when developing a background soil sampling program.

There are a few case studies in literature that identify terrain units and design a background soil sampling program that aims to characterize each terrain unit (Abbaslou, Martin, Abtahi, & Moore, 2014; Elberling, Breuning-Madsen, Hinge, & Asmund, 2010; Esmaeili, Moore, Keshavarzi, Jaafarzadeh, & Kermani, 2014; Gambashidze et al., 2014; Horckmans, Swennen, Deckers, & Maquil, 2005). However, since many of these case studies are on a regional-scale (500-500,000 km^2 in area), distinct soil types within each terrain unit on a local-scale could be overlooked. With low resolution background sampling programs, it is difficult to obtain meaningful local or regional information on soil variation.

Guidance in Canada recommends decreasing the spacing between samples as the soil layer becomes more heterogeneous in nature (CCME, 2016a). For example, if the background soil units have a homogenous surficial soil layer, the samples can be widely spread to be more cost-effective. However, if the soil at the site is more heterogeneous, the sample locations should be more spatially dense. Increasing sample density can be achieved by decreasing size of the clusters, blocks or strata in the background soil units or by increasing sample size.

2.1.5.3. *Sample Size*

Sample size is important to consider when formulating an approach. The sample size needs to be large enough to provide representative data of the entire site but from the practical perspective, needs to be balanced with the cost of obtaining this information. Sample size directly relates to the sampling designs, as discussed in the previous section. If a site is complex, containing more than one terrain unit, a larger sample size for the entire program may be required to allow the characterization of each terrain unit. The number of samples collected should increase with the heterogeneity of the system (CCME, 2016a).

In background soil units, the United States Environmental Protection Agency (US EPA) recommends collecting a minimum of four samples from the same soil type to establish background concentrations (US EPA, 1995). However, more recent US EPA guidance documents (Singh & Singh, 2013; US EPA, 2009) recommend at least 8-10 observations to allow statistical inferences. The US EPA endorsed ProUCL 5.0 software will not perform statistical tests on data sets with less than 8 observations, as decisions derived based upon smaller data sets may not be reliable enough to draw important decisions about human health and the environment (Singh & Singh, 2013). The Geological Survey of Canada (GSC) suggest collecting at least 30 samples when using univariate statistical methods (Rencz *et al*., 2011). GSC also suggests collecting samples from 0-10 centimeters in depth as well as soil horizon C (Rencz *et al*., 2011).

Figure 2.7 illustrates the sample sizes of the background soil sampling programs used in the case studies found in literature. Although sample sizes are commonly greater than 50 samples, one also needs to consider the area of the sampling programs. Sample density (sample/km^2) is often used to describe the coverage of sample programs and the spacing between sample locations. Shown in Figure 2.8, the average sample densities of the 54 case studies are plotted based on location of study. With respect to studies performed in Canada, sample densities range from one sample collected every 0.5 km^2 to one sample every 2300 km^2. For example, the background sample programs performed in Ontario and British Columbia that were used to derive SQGs, had sample densities of one sample per 2218 km^2 and 2228 km^2, respectively (Hofweber, 2010; OMOE, 2011)

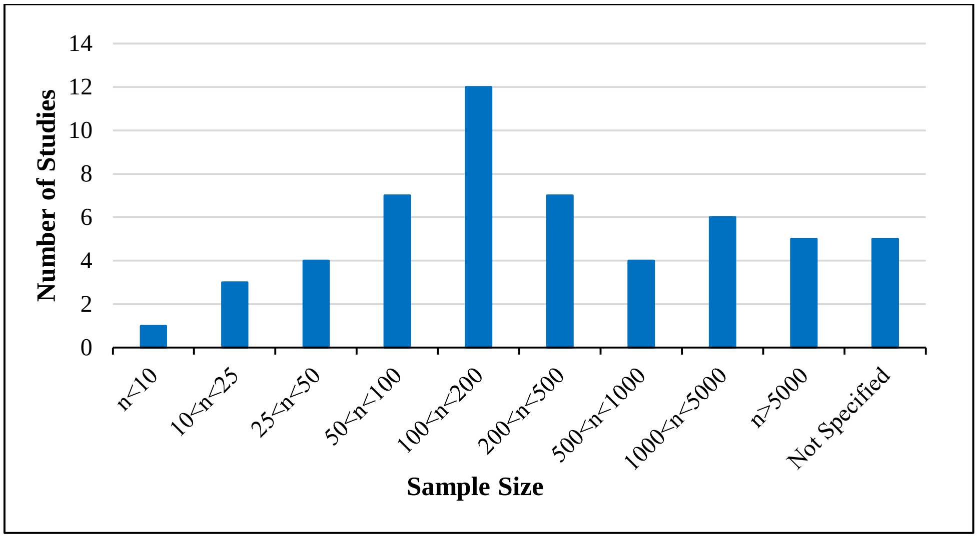

Figure 2.7: Sample size ranges for case studies found in the literature.

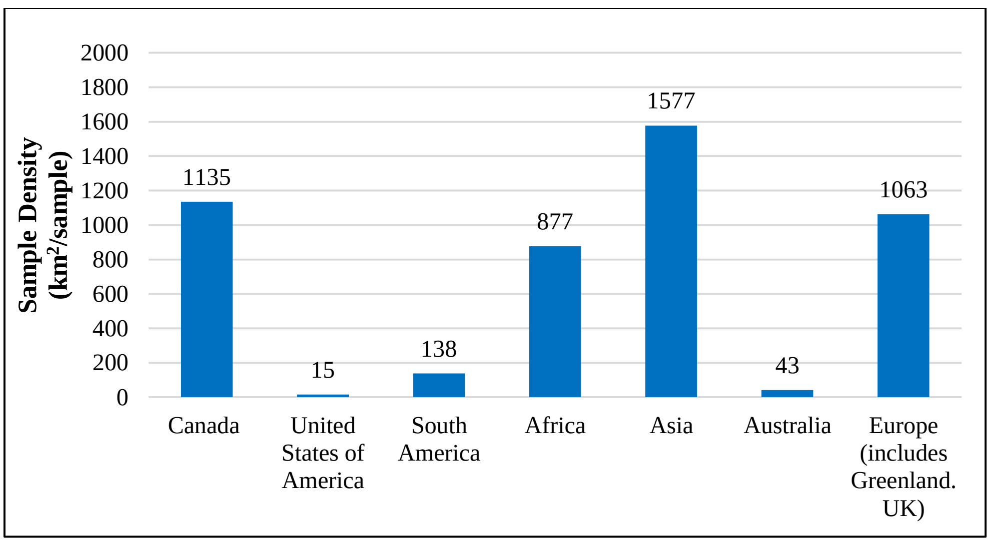

Figure 2.8: Average sample density (km^2/sample) of case studies found in the literature.

2.1.6. Statistical Analysis of Background Soil Data

Researchers have described the statistical approaches to the analysis of background soil data and determining background concentrations (Birch, 2017; Mikkonen *et al.*, 2017; Reimann *et al.*, 2005). Each case study used different approaches for deriving background concentrations which can lead to different numerical values. As background soil data is often used to generate BTVs, it is important to understand how different statistical approaches will influence the final BTV value.

2.1.6.1. *Outlier Detection Methods*

Outliers are observations within a data set that lie at an abnormal distance from the rest of the population and originate from different distributions. Reimann *et al.*, (2005) discussed several threshold levels that can be used to identify outliers. These methods include a boxplot inner fence technique, mean +/- a designated number of standard deviations, or elimination of the upper and lower 2.5 percent of data. Shown in Figure 2.9, it was found that many of the case studies in the literature did not specify which techniques for outlier identification were employed. When outlier identification was performed, the majority used the boxplot inner fence method, as recommended by Reimann *et al.,* (2005).

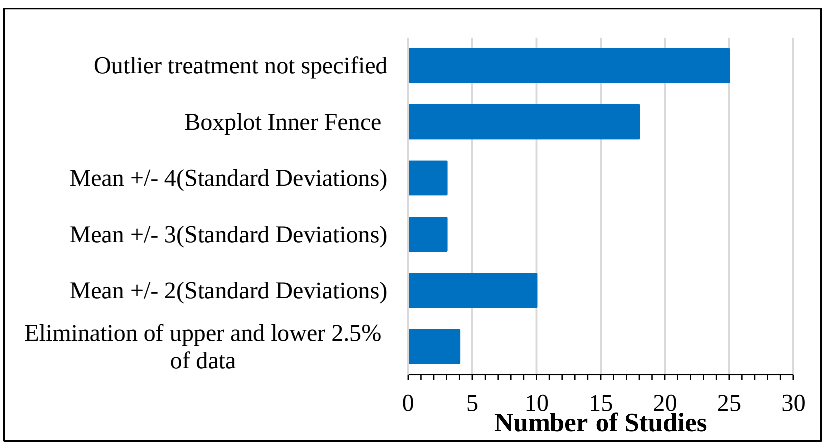

Figure 2.9: Methods used in the literature for the detection of outliers in background soil data.

2.1.6.2. *BTV Calculation Methods*

Depending on the applications of the data set, there are different statistical approaches to consider. If the purpose of the background soil data set is to provide background soil concentration ranges, summary statistics (min, max, mean, etc.) could be used to describe the data ranges and distributions. However, to derive a BTV value, a method that estimates the upper limit of the data set is used. Methods commonly used in literature to describe BTVs include median+2MAD (MAD: median absolute deviation), mean+2MAD, boxplot inner fence values, 95% upper confidence limit (95UCL), percentile rankings, mean+n(stdev) (stdev: standard deviation), or median+n(stdev), upper tolerance limits (UTL), upper prediction limits (UPL); upper simultaneous limits (USL), or extreme outlier limits (EOL) (CCME, 1991; Hofweber, 2010; Love *et al.*, 2005; Singh & Singh, 2013; US EPA, 1995). Most often, the case studies use summary statistics to represent background concentrations rather than providing a BTV, as shown in Figure 2.10.

If the goal is to develop new SQGs based on background concentrations, then BTVs need to be derived to properly quantify the spatial extent of soil contamination. In these cases, it is not appropriate to compare individual site observations to simple measures of the central tendency of background concentrations such as the mean or the upper confidence levels of the mean that do not take the range of the data into account, as this would result in false positive errors during delineation of contamination.

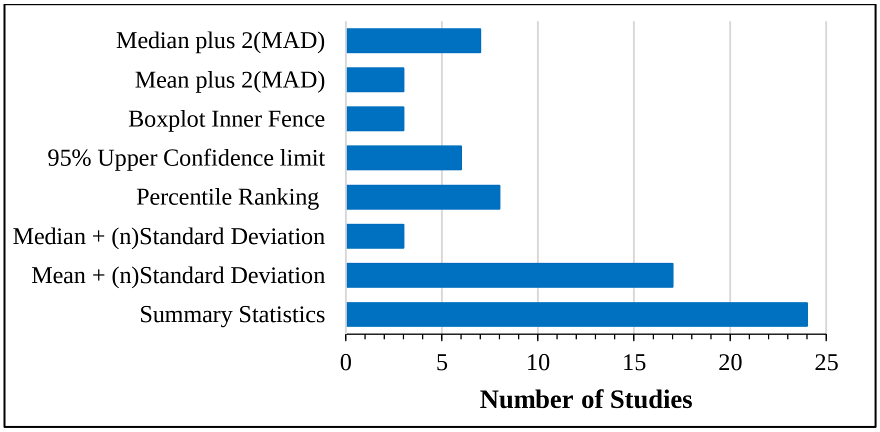

Figure 2.10: Methods used in literature for the determination of background soil concentration values.

2.3 Knowledge Gaps

Although trace metal concentrations vary in magnitude across geographic regions, there is no comprehensive data set characterizing the local variability of surficial soils in Arctic Canada. Past studies conducted by the Environmental Sciences Group (ESG) of the Royal Military College of Canada have shown that natural levels of inorganic elements in Arctic Canada exceed CSQGs, thus requiring extensive background soil sampling programs (ESG, 2004, 2007). As there are over 3400 known federally contaminated sites in the Canadian territories with the potential for additional sites as a result of future economic development, numerous background soil sampling programs will need to be performed, depleting a large amount of resources. A publicly available data set of background soil concentrations in Arctic Canada would support Environmental Site Assessors during site characterization of Arctic sites, and this data set could be used to develop soil quality guidelines and remediation targets for contaminants in Arctic Canada.

As evident in the wide variety of approaches found in literature, there is no guidance for what sample strategies or statistical methods to choose when performing high resolution background sampling programs. There is a need for best practices to provide environmental site assessors with guidance for the development of background sampling strategies and statistical analysis of background soil data. Given the number of contaminated sites across Canada, a thorough understanding of background soil sampling programs and how these methods will apply to contaminated sites in Arctic regions will help Environmental Site Assessors to derive background concentrations and adequately delineate contaminated soils in areas of naturally elevated inorganic element concentrations.

Chapter 3 Background Trace Element Concentrations in Surficial Soil of Arctic Canada

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Will be submitted to *Science of the Total Environment*

Main contributions of each co-author:

[1] Contributed to original ideas, compilation and analysis of background soil data, and manuscript preparation.

[2] Contributed to original ideas and revised manuscript.

Abstract

Trace metals/metalloids in surficial soils vary in concentration across Arctic Canada, however the quantitative differences across the longitudinal length of Canada have not been previously described. As part of the environmental site assessment of over 61 federal contaminated sites across Arctic Canada, 2143 background soil samples were collected between 1989 and 2016. These sites span approximately 5000 kilometers along the 69th parallel, from northwest Yukon, across the Canadian Arctic to Baffin Island and along the northern coast of Labrador. ESG-RMC performed high resolution background sampling programs, varying in complexity, at each site to characterize trace element concentrations in surficial soil (0-100 cm depth) of undisturbed areas surrounding the sites.

The background soil data sets from these sites were manually screened and analyzed to calculate trace element (As, Cd, Co, Cu, Cr, Pb, Ni, Zn) concentrations in surficial soil. Each background data set was evaluated using several outlier detection methods, distribution analysis tests, and population tests. Background concentrations were described using descriptive statistics as well as the 95 percent upper confidence limit of the mean (95UCL). The variability in background concentrations across Arctic Canada and were shown to be related to the bedrock geology found at each site. Trace element concentrations were found to be highly variable across Arctic Canada, with many of the sites having measured background concentrations above the soil-quality guidelines developed for all regions of Canada. This study provides the first longitudinal reference data set for background concentrations of trace elements in Arctic Canada. The extensive data set generated in this study was compared to those generated in other areas of the world, highlighting the need for high resolution background sampling programs across other continents.

Keywords: Soil, Background Concentrations, Trace Element, Inorganic Elements, Arctic, Canada, Metals, Metalloids.

Highlights

- Analysis of 2143 background soil samples collected from 61 sites across the 69th parallel of Arctic Canada.
- Background trace element concentrations in surficial soils of Arctic Canada varied across the longitudinal length
- Variability of background soil concentrations along the Arctic Canada at the 69th parallel was related to bedrock
- Many sites with background surficial soil concentrations above the Canadian soil-quality guidelines

3.1 Introduction

Worldwide, sites contaminated through human activities continue to pose environmental and economic challenges. In Canada alone, the federal government is responsible for 20,000 historically contaminated sites of which 3,400 are in the North (Government of Canada, 2019). Future economic development in the Arctic through natural resource exploration and the development of shipping routes will increase the potential of contamination in this region.

Trace metals and metalloids can be present in soils naturally or through anthropogenic activities such as agriculture or industrial operations. Distinguishing between background and elevated concentrations is important to assess whether there has been an impact to the environment. Environmental soil quality guidelines (SQG) serve as an initial screening tool to determine whether management action may be required to safeguard human and ecological health and represent acceptable numerical threshold values for chemical concentrations that support the intended land-use. In many countries, the development of these numerical guidelines considers background or ambient levels that are not attributable to point source pollution as well as factors related to toxicological effects of these chemicals (CCME, 2012; DEFRA, 2012; US EPA, 2019; NEPC, 2013). The background concentrations used for the development of the Canadian Soil-Quality Guidelines (CSGQs) were collected from soil surveys performed in southern provinces (CCME, 1991). However, trace metals vary in concentrations across geographic regions and no comprehensive data set characterizing surficial soils (0-100 cm below ground surface) in Arctic Canada exists. With limited background soil data in Arctic Canada, environmental site assessors are required to determine local background concentrations at sites with naturally elevated trace metals. These site-specific background soil assessment programs represent significant efforts, which require time and resources.

The consideration of regional and local background concentrations is now included in guidance for environmental risk assessments in several areas of the world, such as Australia (NEPC, 2013), England (DEFRA, 2012), Finland (Tarvainen & Jarva, 2011), and the United States of America (US EPA, 1995). Extensive soil surveys have been performed in Australia (Reimann *et al.*, 2017), Europe (Gambashidze *et al*., 2014; C. Reimann *et al.*, 2014; Tóth *et al.*, 2016), Asia (Cheng, Yao, Feng, Zhang, & Fang, 2014), and the United States of America (U.S.A) (Smith *et al.*, 2012) providing support to environmental site assessors during site investigation. In Canada, considering background concentrations is part of risk assessment guidance (Health Canada, 2012), however in Northern Canada there is a lack of background soil data to reference. In 2007, the Geological Survey of Canada joined a low-density continental scale geochemical survey project with the United States Geological Survey, and the Mexican Geological Survey (Smith *et al.*, 2012). However, after completing sampling in the Maritime provinces and portions of other provinces (472 sites, 7.6% of the total area of Canada), Canada withdrew from the project in 2010 (Smith *et al*., 2012), leaving many regions of Northern Canada uncharacterized.

Northern remote and Arctic regions of Canada are dominated by cryosolic soil, where either permafrost exists within 1 meter of the surface or within 2 m of the surface if the soil profiles shows evidence of cryoturbation (Feisthauer, 2012; Rencz *et al*., 2011). Previous and ongoing geological events in Arctic Canada give rise to irregular soil horizons consisting of till or glacial till deposits, and marine sediments in coastal regions (Rencz, Garrett, Adcock, & Bonham-Carter, 2006; Rencz et al., 2011). High resolution background sample coverage is required to understand the local variability of background concentrations across the Arctic.

With increasing economic development in the Arctic through natural resource exploration and the development of shipping routes, the risk of anthropogenic inputs of trace metals and metalloids will increase. To develop realistic soil-quality guidelines for the arctic region, detailed knowledge of natural background levels is required. The objectives of this study are to address the knowledge gaps pertaining to background soil concentrations in Arctic Canada. As part of the environmental site assessment of over 61 federal contaminated sites across Arctic Canada, 2143 background soil samples were collected by the Environmental Sciences Group at the Royal Military College of Canada (ESG-RMC) between 1989 and 2016. This study is intended to compare local background concentrations of trace elements (As, Cd, Co, Cu, Cr, Pb, Ni, Zn) to the CSQGs and understand how variable background concentrations are across Arctic. This study will highlight the importance of understanding the local natural variability of background trace metal concentrations prior to evaluating soil contamination, especially in regions with highly heterogeneous soil, such as Arctic Canada.

3.2 Methods

3.1.1. Defining Background Concentrations

In the literature, background soil concentrations may also be described as 'ambient background', 'geochemical background', 'baseline concentrations', or simply just 'background concentrations' (Mikkonen *et al*., 2017; Santos-Francés *et al*., 2017; Tepanosyan *et al*., 2017). However, providing a singular definition for 'background concentrations' has been a subject of discussion between environmental scientists and geologists for many years (Gałuszka, 2007; Reimann & Garrett, 2005)'. A variety of definitions can be found in literature, but often professionals provide their own definition or do not provide a definition at all (Gałuszka, 2007). For example, in many background studies performed in Europe, soil influenced by contributions from human inputs from agricultural practices is considered background soil (Mikkonen *et al*., 2017; Ottesen *et al*., 2013; Saaltink, Griffioen, Mol, Birke, & Team, 2014). Meanwhile, policy in Canada (CCME, 2016b), U.S.A (US EPA, 1995), and Australia (NEPC, 2013) does not consider land influenced by agricultural activity to be natural background.

In this study, background soil concentrations do not include soil that has been physically disturbed through site activity, such as landfilling, facility development, or roadway development and use. Additionally, soil that is within 50 meters of any site activity is not considered background and was excluded from this data set. However, soil that could potentially be influenced by contributions from diffuse anthropogenic inputs, such as atmospheric deposition of trace elements was considered background soil.

3.1.2. Project Background

From 1989 to 2016, ESG-RMC performed environmental site assessments of many sites in Arctic Canada. During site investigations, background soil samples were collected as many of sites had soils with naturally high inorganic element concentrations. Although soil samples were collected to characterize surficial soil at specific sites in Arctic Canada, the span of 61 sites across Arctic Canada provides the first longitudinal data set of background concentrations in Arctic Canada.

All analyses were conducted by the Analytical Services Unit at Queen's University (accredited by the Canadian Association for Laboratory Accreditation Incorporated to the International Organization for Standardization (ISO) 17025 standard). Soil samples were dry sieved to generate a <2mm grain size fraction subsample and were analyzed by inductively coupled plasma (ICP) – Optical Emission Spectroscopy (OES) after the dissolution of trace elements in Aqua Regia solution.

3.1.3. Study Areas and Scope

For the purpose of this study, the study area was limited to surficial soil at 0 to 100 centimeters depth from the surface. A total of 61 sites were included in this study and are shown in Table 3.1 and Figure 3.1.

Background soil data was collected within a 500-meter inclusion zone extending from soil disturbed by site activity. Background soil data was not collected within a 50-meter exclusion to avoid influence of background concentrations from site activity. As these sites span approximately 80 kilometers apart across arctic Canada, local background concentrations at each site can provide insight into regional background concentrations along the 69th parallel. The current study included the calculation of summary statistics and the 95 percent Upper Confidence Limit (95UCL) for As, Co, Cd, Cr, Cu, Pb, Ni, and Zn.

Figure 3.1: Location of sites included in this study.

Table 3.1: Number of background soil samples collected at each site and included in this study.

SITE ID	Latitude/Longitude	Sample Size							
		Cu	Ni	Co	Cd	Pb	Zn	Cr	As
1	69°35′41″N 140°10′41″W	22	22	22	22	22	22	22	21
2	69°10'05"N 140°08'34"W	10	10	10	10	9	10	10	10
3	69°19′49″N 138°44′13″W	57	58	57	58	57	57	56	57
4	68°55′22″N 137°15′38″W	2	2	2	2	2	2	2	2
5	69°00′21″N 134°40′05″W	9	9	9	9	9	9	9	8
6	68°53′39″N 133°56′31″W	26	25	25	26	26	26	26	26
7	69°26′35″N 132°59′55″W	18	18	18	18	16	17	18	18
8	69°55′59″N 131°25′54″W	5	5	5	5	5	5	5	5
9	69°36′15″N 130°53′37″W	26	26	26	26	26	26	26	26
10	69°55′27″N 128°58′24″W	20	20	20	20	20	20	20	20
11	70°00′59″N 126°56′35″W	26	26	25	26	25	25	25	25
12	70°10′17″N 124°43′30″W	9	9	6	5	5	8	5	9
13	69°48′55″N 122°43′02″W	4	4	4	4	4	4	4	4

SITE ID	Latitude/Longitude	Sample Size							
		Cu	Ni	Co	Cd	Pb	Zn	Cr	As
14	69°40′22″N 121°40′19″W	26	24	26	26	26	26	26	26
15	69°35′00″N 120°44′46″W	24	26	25	27	27	23	25	27
16	69°16′00″N 119°13′00″W	25	25	25	25	25	25	25	25
17	69°12′56″N 118°38′11″W	5	5	5	5	5	3	5	5
18	68°56′08″N 116°56′10″W	95	96	96	96	96	96	96	93
19	68°50′10″N 116°58′05″W	25	25	25	25	25	25	25	25
20	68°46′55″N 114°50′01″W	5	5	5	5	5	5	5	5
21	68°45′19″N 114°56′21″W	26	26	26	26	26	26	26	26
22	68°28′45″N 113°13′32″W	13	14	14	14	14	11	13	11
23	68°32′10″N 111°11′55″W	102	94	104	104	104	104	104	104
24	68°29′09″N 110°51′50″W	17	26	23	26	26	25	24	24
25	68°45′35″N 109°05′16″W	48	48	48	48	48	48	48	46
26	69°02′11″N 107°49′18″W	24	26	26	26	26	26	26	24
27	69°06′58″N 105°07′08″W	8	8	8	8	8	8	7	8
28	68°57′47″N 103°45′34″W	26	24	26	26	26	26	26	24
29	68°44′31″N 101°51′17″W	20	20	20	20	20	20	20	19
30	68°39′25″N 101°44′19″W	6	6	6	6	6	6	6	6
31	68°19′02″N 100°04′09″W	14	14	14	14	14	14	14	14
32	68°40′48″N 097°48′38″W	26	26	26	26	26	26	26	26
33	68°38′39″N 095°52′10″W	26	26	26	26	26	26	26	26
34	68°52′09″N 095°09′27″W	4	4	4	4	4	4	4	4
35	68°47′34″N 093°26′25″W	6	6	6	6	6	6	6	6
36	68°35′41″N 091°57′24″W	25	26	25	27	27	27	27	27
37	68°26′13″N 089°43′34″W	48	47	46	48	48	48	48	48
38	68°18′03″N 085°40′29″W	4	4	4	4	4	4	4	4
39	69°39′13″N 085°31′04″W	22	23	23	24	24	23	24	24
40	68°34′04″N 083°28′53″W	5	5	5	5	5	5	5	5
41	69°06′38″N 083°32′23″W	18	18	18	18	18	18	18	18
42	68°45′39″N 081°13′35″W	4	4	4	4	4	4	4	4
43	69°04′01″N 079°03′55″W	50	50	50	50	50	50	50	50
44	69°13′26″N 077°13′48″W	63	64	64	64	64	64	64	61
45	68°53′56″N 075°08′20″W	104	104	103	109	109	103	107	106
46	68°37′10″N 073°12′45″W	80	79	80	83	83	81	83	79
47	68°39′02″N 071°13′58″W	112	111	112	112	112	111	111	109
48	68°28′21″N 066°48′01″W	114	115	115	115	115	113	113	104
49	67°57′58″N 064°54′28″W	73	74	74	74	74	74	72	72
50	67°32′05″N 063°47′10″W	5	7	5	7	7	5	7	7
51	67°02′00″N 062°44′00″W	54	55	55	56	56	55	54	56
52	67°05′00″N 062°12′59″W	109	110	112	112	112	112	109	112
53	66°39′52″N 061°21′21″W	118	120	121	121	121	118	118	121
54	64°57′17″N 063°33′38″W	29	29	29	30	30	30	30	30
55	62°30′22″N 064°31′06″W	60	63	64	65	65	64	65	65
56	61°35′47″N 064°38′20″W	67	67	67	67	67	67	67	67
57	59°59′15″N 064°09′55″W	19	18	18	19	19	17	18	19
58	57°08′07″N 061°28′32″W	15	17	17	17	17	17	17	17
59	55°44′30″N 060°25′42″W	12	12	12	12	12	12	12	12
60	54°42′53″N 058°21′30″W	20	23	23	23	23	22	23	22
61	53°33′04″N 056°49′48″W	43	43	43	43	43	43	43	43
	Total	2078	2096	2102	2129	2124	2097	2104	2087

3.1.4. Background Soil Data Analysis

All background data sets were analyzed separately by site. A detailed summary of data analysis of background soil data at each site is provided in the Appendix B, Section B.2. Surface soil at each site was described as terrain units. A terrain unit refers to a physiogeographic unit that is defined by surface geology, vegetation, surface drainage, and relief.

The methods used for the identification of terrain units varied and are described in Table 1 of Appendix B, Section B.3. All terrain units were identified during the implementation of the background sampling program and were outline in the individual reports for each site. If more than one surface terrain unit was identified during the background sampling program, samples collected within areas of different terrain unit were kept separate until they were statistically proven to be from the same data population.

Data analysis was not performed on data sets with more than 50 percent of the concentrations below the analytical detection limit. Additionally, data analysis was not performed on data sets with less than eight samples.

3.1.4.1. *Outlier Detection*

Initial univariate outlier analysis was completed for each soil data set. The outlier tests chosen were i) the removal of outliers using the interquartile range (3×IQR) rule, ii) the removal of outliers four standard deviations above or below the mean (Mean+/-4SD) iii), the removal of outliers three standard deviations above or below the mean (Mean+/-3SD), and iv) the removal of outliers two standard deviations above or below the mean (Mean+/-2SD). Additionally, raw data sets without the removal of any outliers were also carried forward through analysis for comparison purposes. Each outlier test was applied to all data sets separately to identify the influence of omitting outliers from the data set. Each resulting data set was carried forward through distribution analysis.

3.1.4.2. *Distribution analysis*

The distribution of each data set available after removing outliers was tested using ProUCL 5.0 software (Singh & Singh, 2013). Distribution analysis began by first testing if the data fit a normal distribution, evaluated using the Shapiro-Wilk test. If the sample size was greater than 50, a Lilliefors test was employed. The Lilliefors test has been identified as more applicable than the Shapiro-Wilk test for larger data sets (Conover, 1999; Dudewicz & Misra, 1988). If the data did not fit a normal distribution, ProUCL 5.0 also tests for lognormal and gamma distributions. To test for lognormality, ProUCL 5.0 performs the Shapiro-Wilk test and the Lillifors test on log-transformed data. To test for gamma distributions, a Kolmogorov-Smirnov (K-S) test was employed to test the fit. If the data set did not fit any of the above data distributions, the data set was treated as nonparametric.

3.1.4.3. *Derivation of Background Summary Statistics*

Summary statistics for each data set were derived using ProUCL 5.0 software. Additionally, the 95 percent upper confidence limit (95UCL) was calculated using ProUCL 5.0 software. The appropriate outlier method was chosen for each data set separately by comparing both distribution analysis results and summary statistics values along with graphical analysis. The outlier method chosen for each data set is detailed and justified in the Supplementary Information, Section S2.

Where concentrations were below the analytical detection limit, the Kaplan-Meier (KM) estimation method was used. If more than 50 percent of the data set was below the detection limit, only the maximum concentration was provided.

1.1.1 Population Analysis

If more than one terrain unit was identified at a site, population analysis was performed to determine whether terrain units at the site could be combined to create a larger data set. Following investigation of each terrain separately, background data from each terrain unit was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units were significantly different. All tests were performed without replacement of values below the detection limit to avoid misinterpretation of population distributions involving significant quantities of substitution. If population analysis concluded that the terrain units were not significantly different, the background soil data sets were combined, and summary statistics were recalculated.

1.1.2 Geological Unit Comparison Analysis

Background soil data sets from sites that resided in the same surface geological unit according to the Geological Map of Canada (Wheeler *et al*., 1996), were combined into one data set. Once sites were categorized by geological units, Agglomerative Hierarchical Clustering (AHC) analysis was performed to identify possible relationships between the background concentrations found at the sites and the bedrock geology on which the sites reside. AHC was performed by comparing bedrock groups based on combined background As, Co, Cd, Cr, Cu, Pb, Ni, and Zn concentrations.

3.3 Results and Discussion

3.1.5. Collation of Background Soil Data

Background soil data collected during the environmental site assessment of 61 separate sites across Northern Canada was analyzed. Sixty-one separate environmental site assessment reports were reviewed, and surficial soil samples (0-100 meters) that were collected in the background soil units surrounding the site were collated into one data base. As a result, a total of 2143 surface soil samples with analytical results for As, Co, Cd, Cr, Cu, Pb, Ni, and Zn were extracted from environmental site assessments. The background soil sample size for each site is reported in Table 4.1.

3.1.6. Data Distribution

As shown in Figure 3.2, data distribution differed by element. Distribution analysis results are not presented for Cd and Pb as the number of values below the detection limit was greater than 50% for all background data sets.

Generally, it was found that the data distribution of background concentration often conform to a normal distribution for all elements studied. However, as sample size varies for each data set, sample size would impact the percentage of data sets that fit a normal distribution. In a study performed by Zhang *et al*. (2005), the effect of sample size on data distribution was investigated using large background soil data sets (>16,000 samples) collected during large regional surveys by the U.S. Geological Survey. When testing the distribution of data sets of varied sizes, departure from normality was rare when the sample size was reduced to 50 (Zhang, Manheim, Hinde, & Grossman, 2005). Therefore, a sample size below 50 could potentially increase the number of normally distributed data sets reported in Figure 3.2.

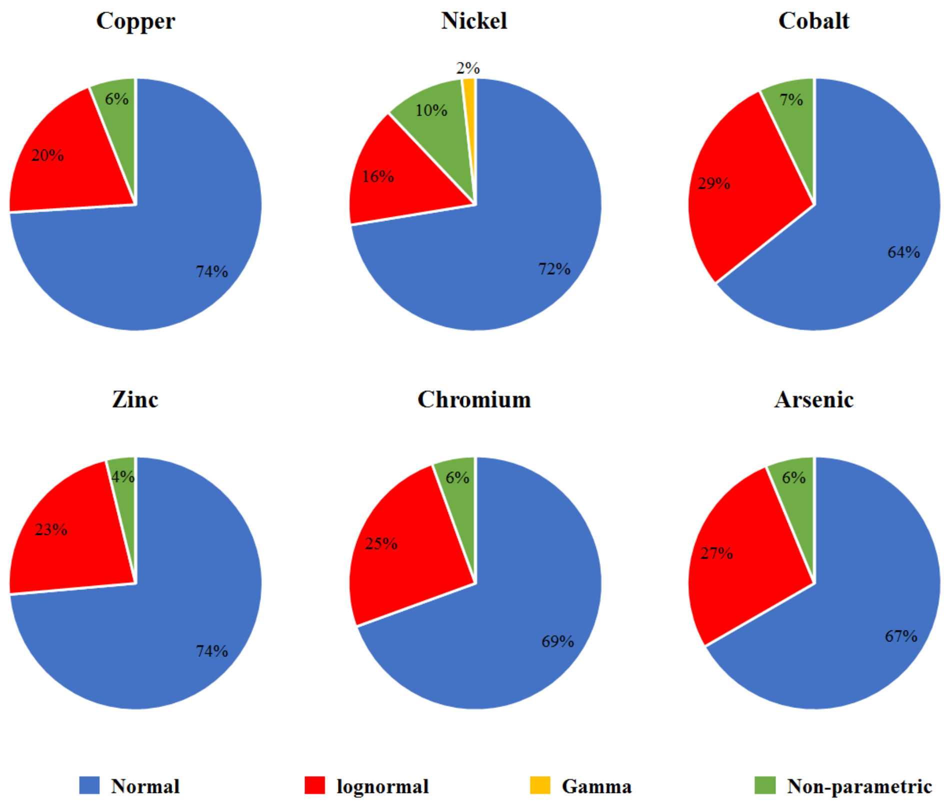

Figure 3.2: A summary of the distribution results for each element for all sites included in this analysis. Distribution analysis was performed for each data set separately.

3.1.7. Calculated Background Concentrations

Summary statistics for As, Co, Cu, Cr, Ni, and Zn at each site are presented in Figure 3.3 to Figure 3.8. Background concentrations for Cd and Pb were close to the analytical detection limit across the Canadian Arctic, and therefore are presented in the Appendix B, Section B.4 Figure 1-2. Descriptive statistics for each site are tabulated and are provided in the Appendix B, Section B.2.

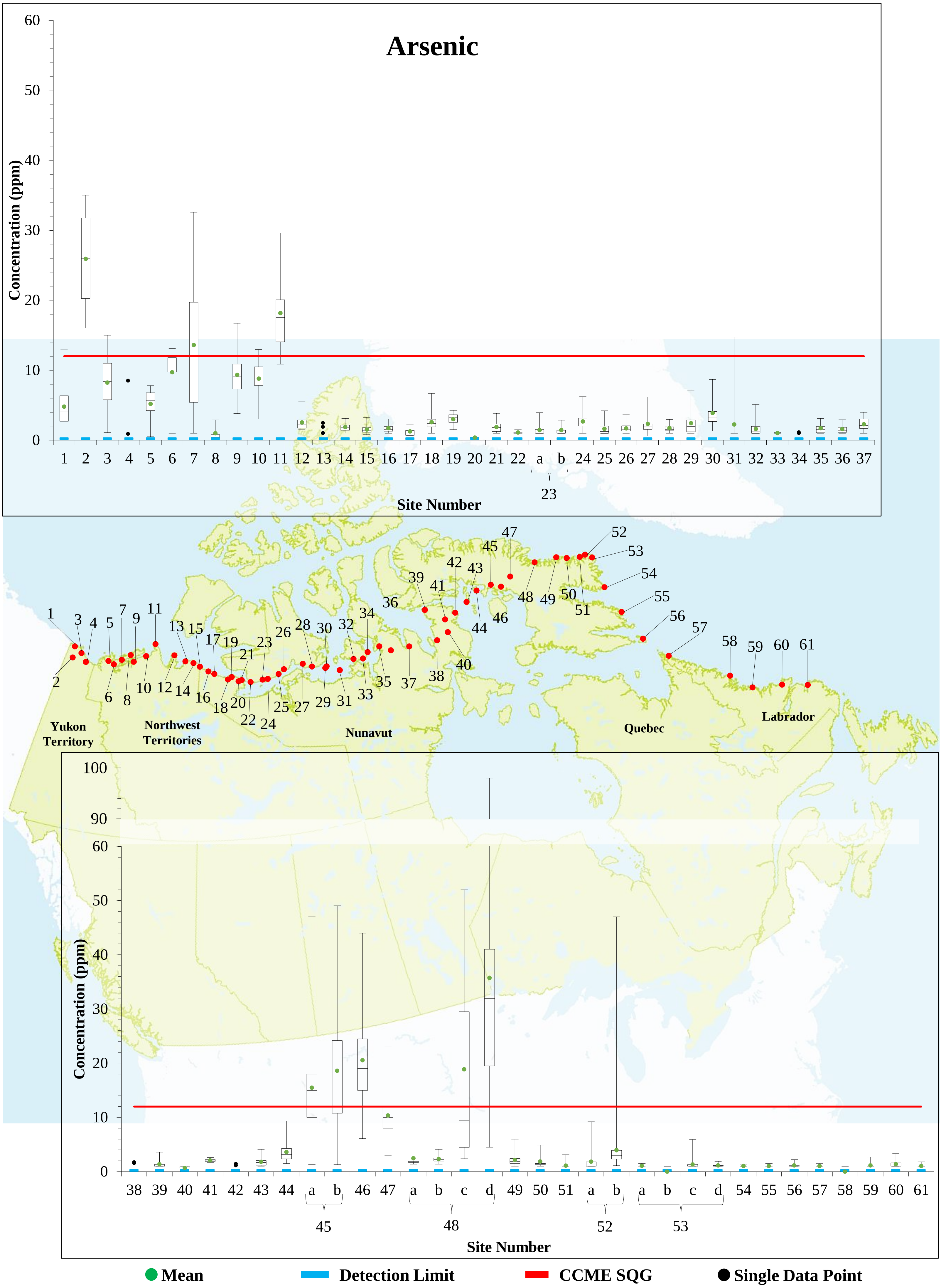

Figure 3.3: Background arsenic concentrations in surficial soil of Arctic Canada. Sites with terrain units that were found to have statistically different concentrations were plotted separately and labeled using letters. The center box line represents the median (50%), with the lower box line identifying the lower quartile (25%), and the upper box line identifying the upper quartile (75%). The top extended horizontal line representing the upper mild outlier limit, and the lower extended horizontal line representing the lower mild outlier limit. Data sets with less than 5 background samples were expressed as singular data points for each sample.

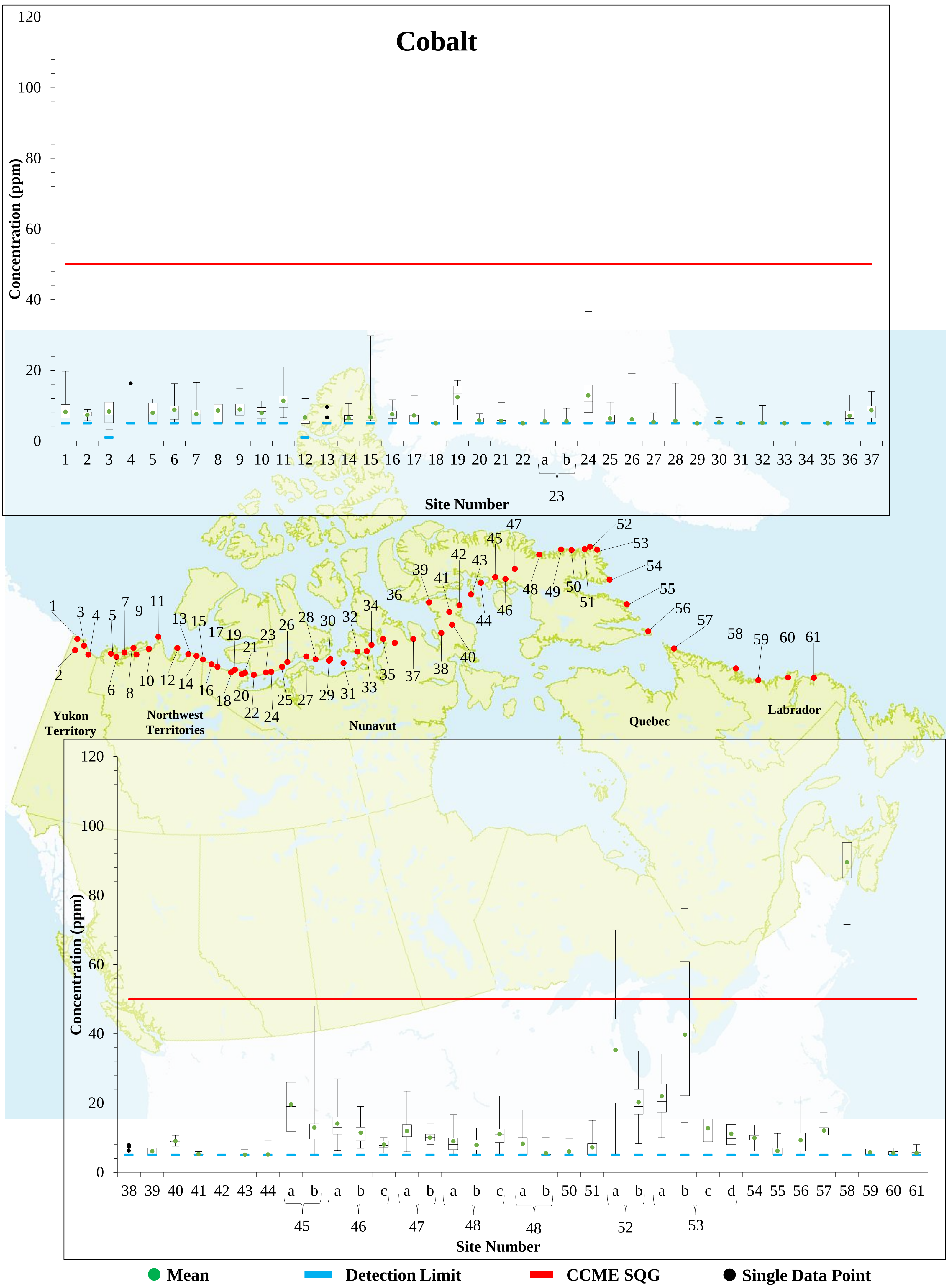

Figure 3.4: Background cobalt concentrations in surficial soil of Arctic Canada. Sites with terrain units that were found to have statistically different concentrations were plotted separately and labeled using letters. The center box line represents the median (50%), with the lower box line identifying the lower quartile (25%), and the upper box line identifying the upper quartile (75%). The top extended horizontal line representing the upper mild outlier limit, and the lower extended horizontal line representing the lower mild outlier limit. Data sets with less than 5 background samples were expressed as singular data points for each sample.

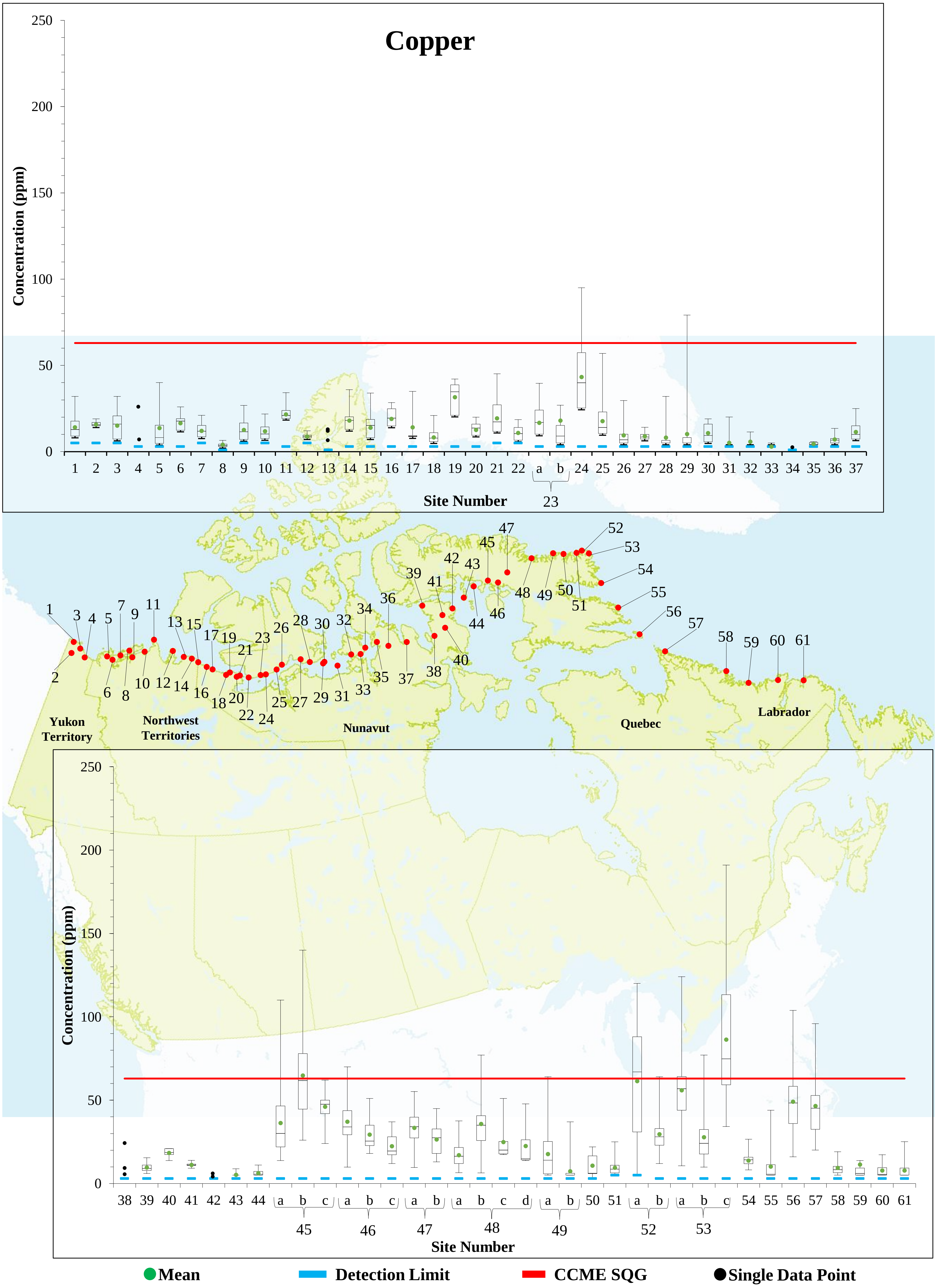

Figure 3.5: Background copper concentrations in surficial soil of Arctic Canada. Sites with terrain units that were found to have statistically different concentrations were plotted separately and labeled using letters. The center box line represents the median (50%), with the lower box line identifying the lower quartile (25%), and the upper box line identifying the upper quartile (75%). The top extended horizontal line representing the upper mild outlier limit, and the lower extended horizontal line representing the lower mild outlier limit. Data sets with less than 5 background samples were expressed as singular data points for each sample.

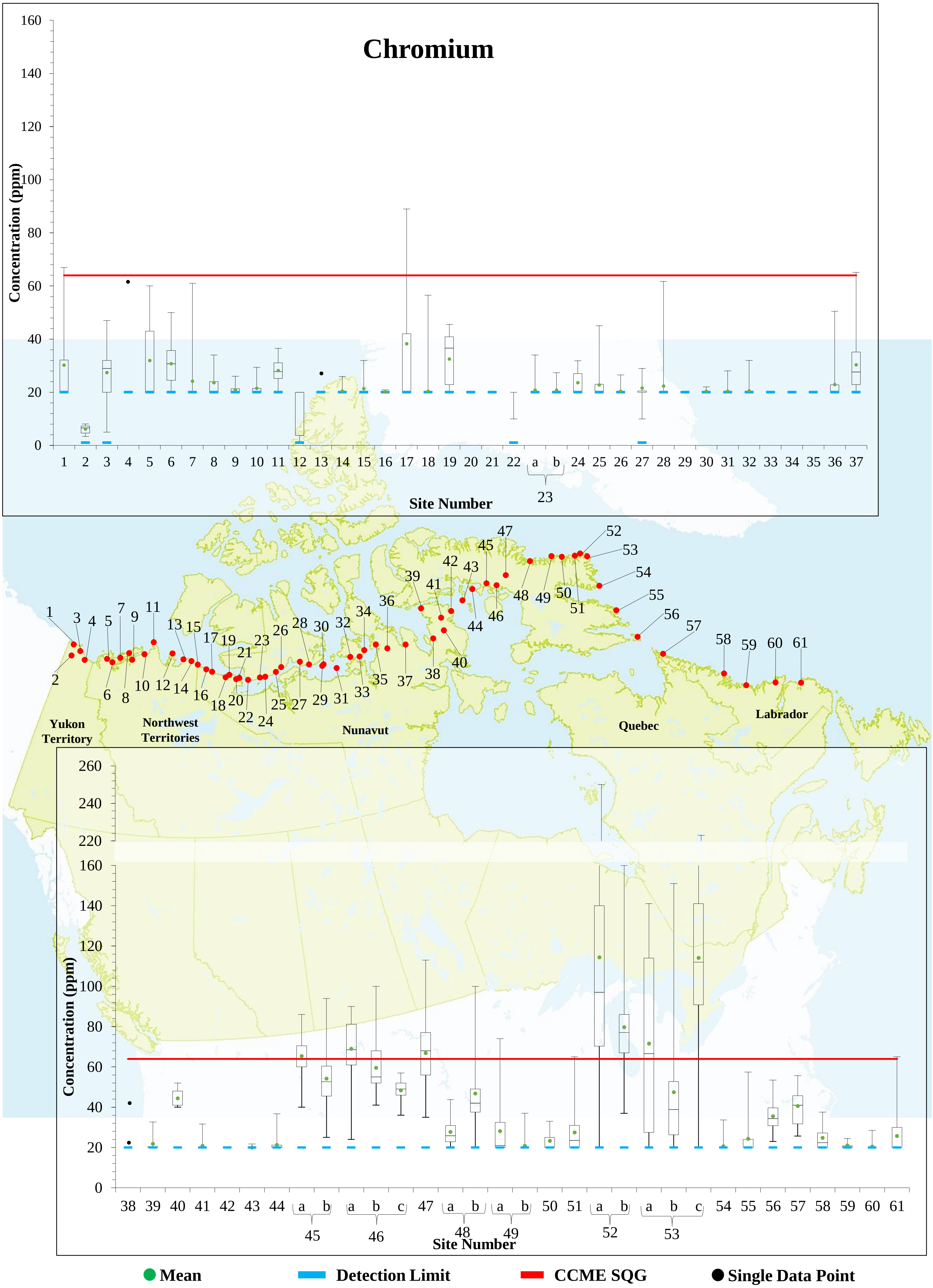

Figure 3.6: Background chromium concentrations in surficial soil of Arctic Canada. Sites with terrain units that were found to have statistically different concentrations were plotted separately and labeled using letters. The center box line represents the median (50%), with the lower box line identifying the lower quartile (25%), and the upper box line identifying the upper quartile (75%). The top extended horizontal line representing the upper mild outlier limit, and the lower extended horizontal line representing the lower mild outlier limit. Data sets with less than 5 background samples were expressed as singular data points for each sample.

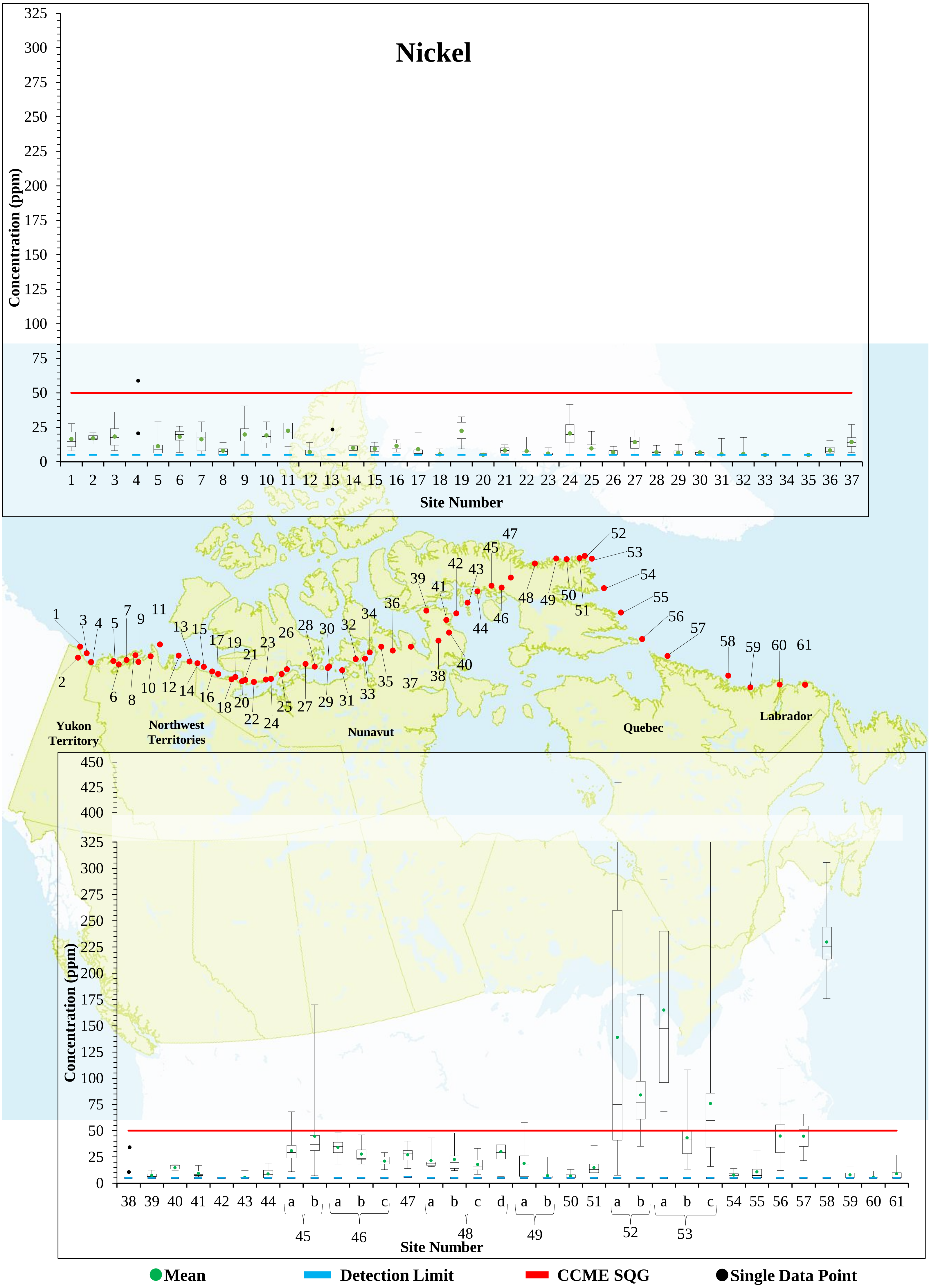

Figure 3.7: Background nickel concentrations in surficial soil of Arctic Canada. Sites with terrain units that were found to have statistically different concentrations were plotted separately and labeled using letters. The center box line represents the median (50%), with the lower box line identifying the lower quartile (25%), and the upper box line identifying the upper quartile (75%). The top extended horizontal line representing the upper mild outlier limit, and the lower extended horizontal line representing the lower mild outlier limit. Data sets with less than 5 background samples were expressed as singular data points for each sample.

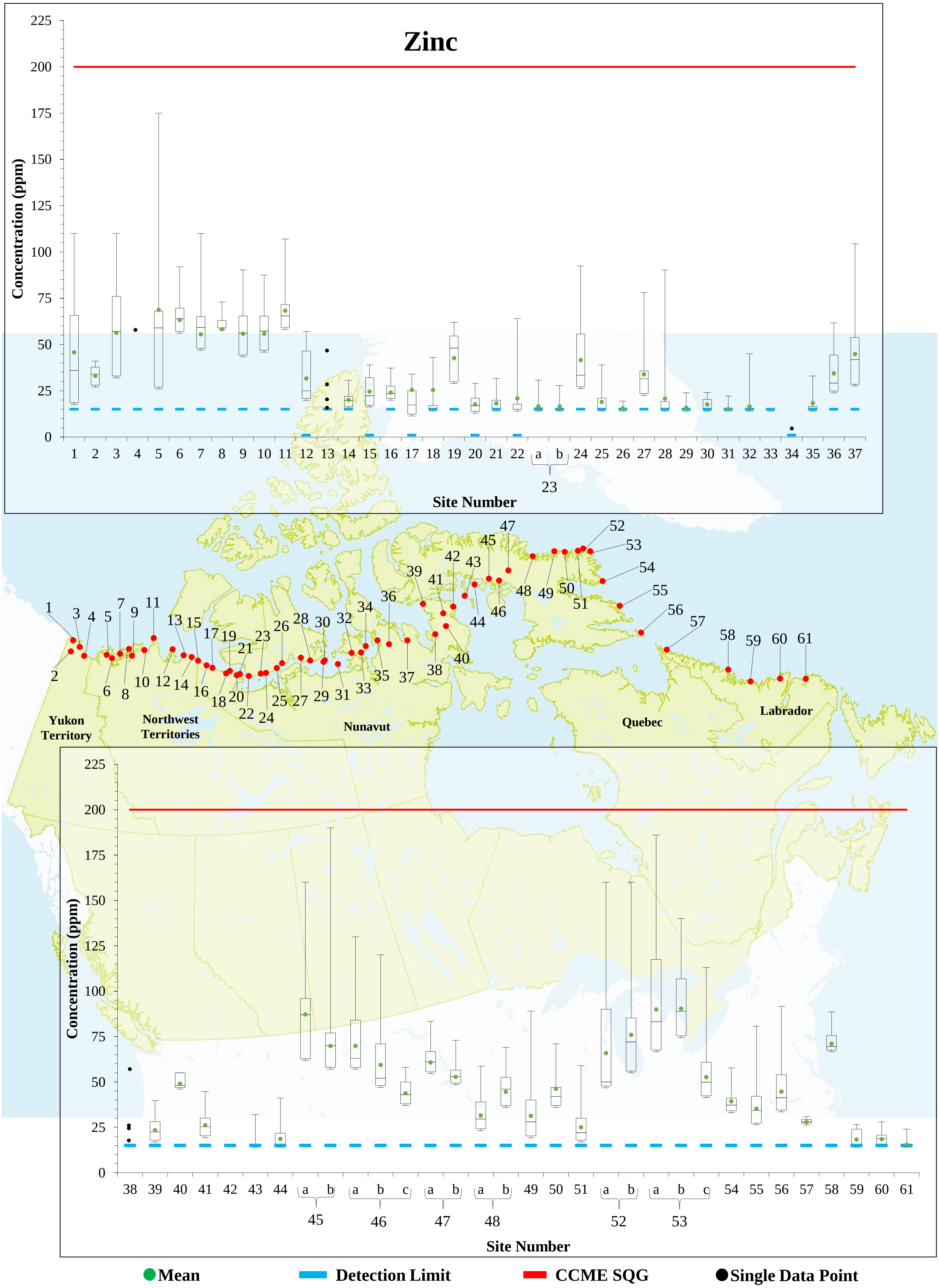

Figure 3.8: Background zinc concentrations in surficial soil of Arctic Canada. Sites with terrain units that were found to have statistically different concentrations were plotted separately and labeled using letters. The center box line represents the median (50%), with the lower box line identifying the lower quartile (25%), and the upper box line identifying the upper quartile (75%). The top extended horizontal line representing the upper mild outlier limit, and the lower extended horizontal line representing the lower mild outlier limit. Data sets with less than 5 background samples were expressed as singular data points for each sample.

3.1.7.1. *Variability of Background Soil Concentrations*

Background soil data for trace metals/metalloids were found to be highly variable longitudinally across the Canadian Arctic at the 69th parallel. Analysis of background concentrations site-specifically across the continent highlights the importance of understanding background concentrations on a local level and applying that knowledge to a broader, continental context. Without interrogating the data site-by-site, heterogeneities within the data set would be masked within a large range of background concentrations. This is problematic for contaminated site investigation, as soil contamination cannot be appropriately quantified without a detailed understanding of the natural variability of background concentrations locally in relation to a contaminated site. Even if the background soil data was interrogated from a regional-scale perspective, enrichments of trace elements would create a data set with a large data range. Ultimately, this will mask local variability, making it difficult to locate heterogeneities across the continent.

Arsenic concentrations varied widely across the Arctic with a total data range from the analytical detection limit (0.2 ppm) to 98 ppm, well above the Canadian Soil Quality Guideline (CSQG) of 12 ppm for agricultural land-use (CCME, 1991). It is apparent that arsenic concentrations in specific regions of Arctic Canada are elevated, specifically on the northern coast of Yukon Territory and Baffin Island.

Cadmium concentrations were found to be low in surface soil across Arctic Canada, with a total of 9 out of 2129 samples with detectable concentrations (>0.5 ppm). The maximum concentration of 19 ppm was found at Site 47 on Baffin Island, however only three detectable concentrations were found at this site.

Background cobalt concentrations varied less across Arctic Canada in comparison to arsenic. However, similar to arsenic, Baffin Island, Nunavut, had background cobalt concentrations ranging from below the analytical detection limit of 5.0 ppm to 114.1 ppm; well above the CSQG of 50 ppm for agricultural land-use (CCME, 1991). Additionally, Site 58 on the northern coast of Labrador, shown in Figure 3.4, had cobalt concentrations ranging from 71.5 ppm to 114.1 ppm.

Chromium concentrations were found to be highly variable across Arctic soil with some sites having concentrations elevated well above the CSQG of 64 ppm for agricultural land-use (CCME, 1991). A detection limit of 20 ppm was typically used for most sites studied; however, at sites were background sampling programs were performed in later years, a lower detection limit of 1.0 ppm was achievable with advances in analytical technology. As a result, it is evident that many sites have concentrations below 20 ppm and therefore regions with lower chromium concentrations could not be appropriately characterized.

Copper concentrations in surface soil were similar to cobalt, in that a majority of the elevated background concentrations were found at sites located on Baffin Island and the northern point of Labrador with median concentrations greater than the CSQG of 63 ppm (agricultural land-use) and a maximum concentration of 191 ppm found at Site 53 (CCME, 1991). Site 24, 25, and 29, located in central Nunavut, also had background concentrations close to and above the CSQG (CCME, 1991) However, in the eastern arctic region and sites located on the Labrador coast, median background copper concentrations typically ranged from below the detection limit of 3.0 ppm to 31.6 ppm.

Across Arctic Canada background concentrations of lead were typically reported below the analytical detection limit of 10 ppm. Similar to chromium, sites that were sampled later were analyzed with a detection limit of 1.0 ppm. That being the case, only 4% of the total 2124 samples had detectable concentrations of lead. The detectable concentrations reported were well below the CSQG of 140 ppm (agricultural land-use) (CCME, 1991).

Concentrations of Nickel were found to be elevated on Baffin Island and on the northern coast of Labrador. The concentrations reported in this region are well above the CSQG of 45 ppm (agricultural land-use) (CCME, 1991).

Zinc concentrations varied greatly across Arctic Canada with no samples with background concentrations exceeding the CSQG of 200 ppm (CCME, 1991).

3.1.7.2. *Arctic Bedrock Geological Comparison Analysis*

In order to use the background soil data sets within this study as a reference for other contaminated site investigations, Agglomerative Hierarchical Clustering (AHC) analysis was performed to identify possible relationships between the background concentrations found at the sites and the bedrock geology on which the sites reside. By linking elevated background soil concentrations to bedrock geology across Arctic Canada, soil that is expected to have elevated background concentrations can be located by using the Geological Map of Canada (Wheeler *et al*., 1996). The definition for each bedrock unit discussed in this section is provided in Appendix B, Section B.5.

All 61 sites were classified by the bedrock geological unit underlying the site as illustrated in Figure 3.9. Using AHC analysis, a resulting dendrogram was produced that illustrates the relationship between bedrock geological units and the concentrations of trace elements found in the surface soil, shown in Figure 3.10 and summarized in Table 3.2.

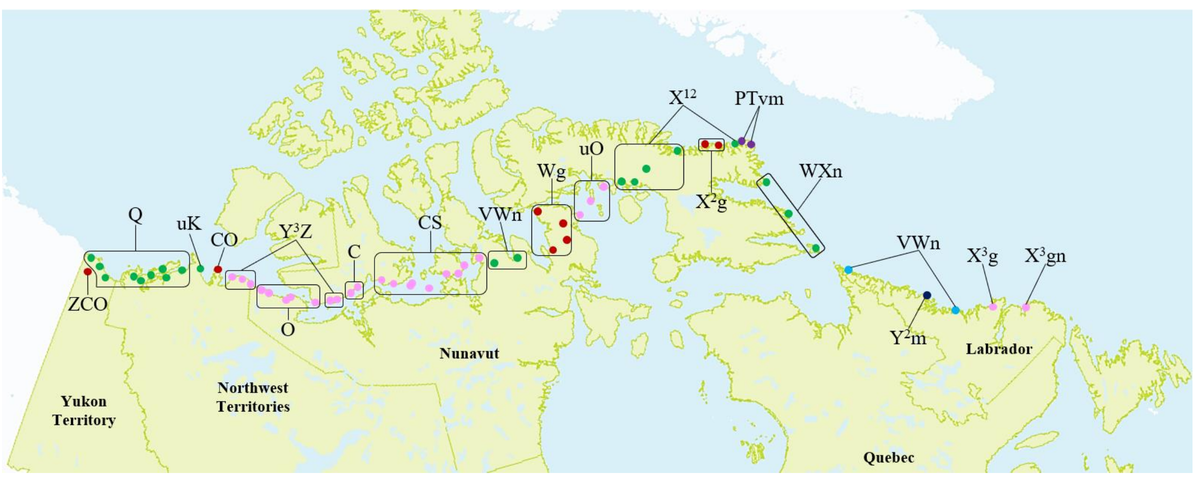

Figure 3.9: Sites classified by the bedrock geological unit found at the site. Any sites with the same marker colour were found to be related as a result of the AHC analysis performed.

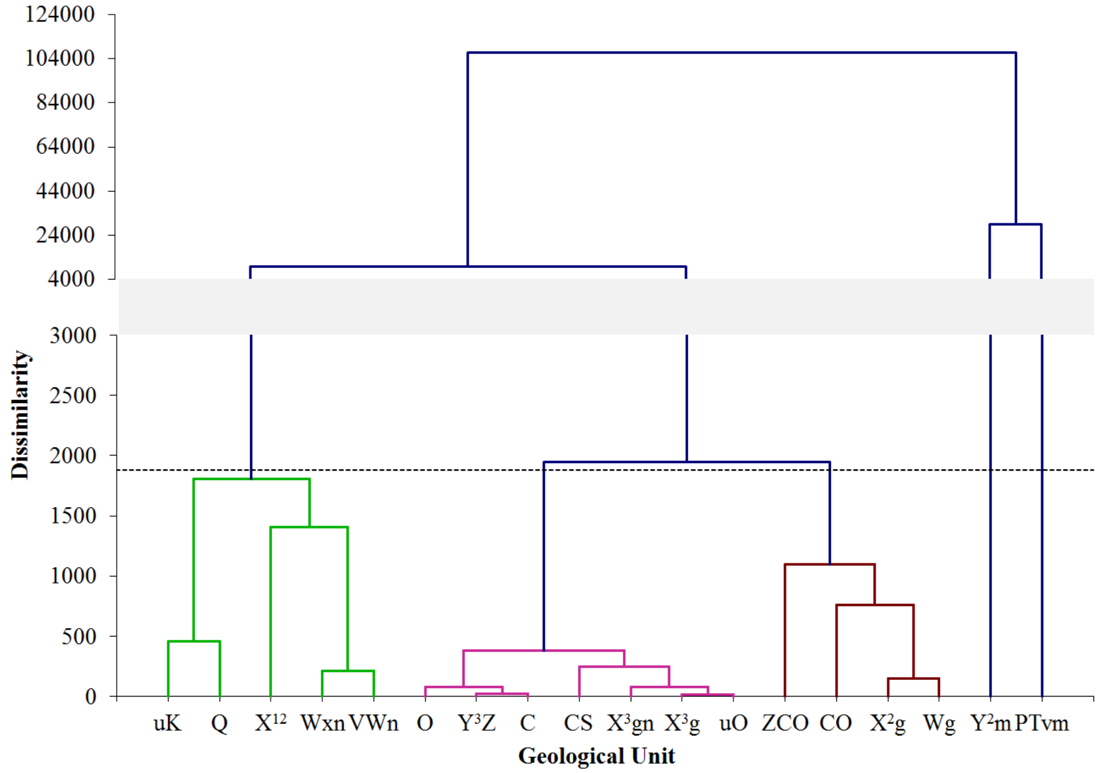

Figure 3.10: A dendrogram summarizing the AHC analysis by comparing bedrock geological units by surficial background trace element concentrations.

Table 3.2: A summary of the AHC analysis results. Bedrock units were grouped and site locations within each bedrock group are listed. Elements that are expected to be elevated within each group are also listed.

Bedrock Geological Unit	Rock Type	Era	Site Numbers Found in Bedrock Geological Unit	Elevated Trace Elements Expected
Q	Sedimentary	Cenozoic	1, 3-11, 36, 37, 45-48, 51, 54-56	Cu, Ni, Co*, Zn*, Cr, As, Cd
uK	Sedimentary	Mesozoic		
VWn	Metamorphic	Precambrian		
X^{12}	Sedimentary	Precambrian		
WXn	Metamorphic	Precambrian		
$Y^{3}Z$	Sedimentary	Precambrian	13-35, 42-44, 60, 61	Cu, Ni*, Zn*, Cr, As
O	Sedimentary	Paleozoic		
C	Sedimentary	Paleozoic		
CS	Sedimentary	Paleozoic		
uO	Sedimentary	Paleozoic		
$X^{3}g$	Igenous	Precambrian		
$X^{3}gn$	Metamorphic	Precambrian		
Wg	Igneous	Precambrian	2, 12, 38-41, 49, 50	Cu*, Ni, Zn*, Cr, As
$X^{2}g$	Igenous	Precambrian		
CO	Sedimentary	Paleozoic		
ZCO	Sedimentary	Precambrian		
PTvm	Volcanic	Cenozoic	52, 53	Cu, Ni, Co, Zn*, Cr, As
$Y^{2}m$	Igenous	Precambrian	58	Ni, Co, Zn*, As

* All samples were below CCME SQG, but the maximum concentrations were close to guideline values.

The resulting relationship between background soil concentrations and bedrock geology across Arctic Canada highlights the regions with potentially elevated background concentrations, as discussed in Section 3.1.7.1. Table 3.2 lists the trace elements that are expected to be elevated above or close to their respective CSQGs.

Relating the surface soil to the bedrock geology does not consider all factors that influence soil geochemistry in Arctic Canada, as there may be additional influence from climate, vegetation, topography, and biological activity. Additionally, soil influence through long range transport and atmosphere deposition of trace elements from anthropogenic activity was not considered. This may alter background concentrations in undisturbed soils, as was found in surface soil in the Norwegian Arctic (Halbach, Mikkelsen, Berg, & Steinnes, 2017).

The potential relationship between surface soil geochemistry and parent material is intended to provide insight into the possible background soil conditions that may impact contaminated site investigations. Considering the highly heterogeneous soil conditions and local variability in Canadian Arctic soil, this study should not replace a background sampling program in Arctic Canada, but rather justify the requirement of a high resolution background sampling program in complex geological landscapes. However, this study can be used to support findings and/or provide justification for the complexity of the background sampling program performed. In regions where local background soil concentrations are not expected to be highly variable and terrain at the contaminated site is homogeneous, a less complex background soil sampling program can be executed.

3.1.7.3. *Comparison to International Background Soil Data*

Background soil data is expected to vary widely across each continent as soil is formed in different geological settings and is influenced by different environmental forces. Table 3.3 lists the background soil concentrations from surveys performed in other areas of the world. As shown in Table 3.3, background concentrations from all large scale background soil surveys have large data ranges, in some cases varying in orders of magnitude in the following sections, each trace element is discussed in further detail.

Table 3.3: Compiled background surface soil concentrations in other areas of the world.

Element	Location	Depth (cm)	Fraction Size (µm)	N	Min	Med	Max
As	Canada	0-10	< 63	12477	<0.25	5.8	1800
	U.S.A	0-5	<150	4813	<0.6	5.2	1110
	Australia	0-10	< 200	1313	<0.1	1.6	218
	Europe	0-20	< 200	2108	<0.05	5.5	666
Cd	Canada	0-10	< 63	N/A	N/A	N/A	N/A
	U.S.A	0-5	<150	4813	<0.1	0.2	46.6
	Australia	0-10	< 200	1313	<0.01	0.04	5.09
	Europe	0-20	< 200	2108	<0.01	0.18	7.5
Co	Canada	0-10	< 63	7398	<0.25	7	95
	U.S.A	0-5	<150	4813	<0.1	7.8	184
	Australia	0-10	< 200	1313	<0.1	6.3	70.1
	Europe	0-20	< 200	2108	<0.1	7.5	126
Cr	Canada	0-10	< 63	12477	<0.5	62	2300
	U.S.A	0-5	<150	4813	<1.0	31	3850
	Australia	0-10	< 200	1313	<0.5	23.6	1660
	Europe	0-20	< 200	2108	0.4	20	696
Cu	Canada	0-10	< 63	7398	<0.5	19	3113
	U.S.A	0-5	<150	4813	<0.5	14.8	5090
	Australia	0-10	< 200	1313	<0.01	11.2	150
	Europe	0-20	< 200	2108	0.3	15	395
Ni	Canada	0-10	< 63	7398	<0.5	16	881
	U.S.A	0-5	<150	4813	<0.5	13.8	2310
	Australia	0-10	< 200	1313	<0.1	9.8	387
	Europe	0-20	< 200	2108	<0.1	15	2475
Pb	Canada	0-10	< 63	7398	<1.0	8	152
	U.S.A	0-5	<150	4813	<0.5	17.8	2200
	Australia	0-10	< 200	1313	<0.01	7.22	1090
	Europe	0-20	< 200	2108	1.6	16	1309
Zn	Canada	0-10	< 63	7398	<1.0	34	1770
	U.S.A	0-5	<150	4813	<1.0	59	2130
	Australia	0-10	< 200	1313	<0.1	26.3	262
	Europe	0-20	< 200	2108	2.8	45	1396

Data referenced: Canada (Rencz *et al*., 2006), U.S.A (Smith *et al.*, 2014), Australia (Clemens Reimann & de Caritat, 2017), Europe (Fabian *et al*., 2018). cm = centimeters; µm = micrometer; N= sample size; Min = minimum; Med = median; Max = maximum.

3.3.1.1.1 Arsenic

The median background concentration of arsenic was found to be 5.8 ppm in 12,477 surface soil samples collected across the continent by the Geological Survey of Canada (GSC) (Rencz *et al*., 2006; Spirito *et al.*, 2006). Many of these samples were collected in southern provinces, with a few major soil surveys performed in Northern Canada (Rencz *et al*., 2006; Spirito *et al.*, 2006). On Baffin Island, a survey performed by GSC reported a mean concentration of 21 ppm with strongly anomalous data greater than 150 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). In a survey performed in the southern region of Northwest Territories, a mean background concentration was reported to be 84 ppm, supporting the conclusion that concentrations in Northern Canada are highly variable (Rencz *et al*., 2006; Spirito *et al.*, 2006). However, in southern provinces, mean background concentrations were most often reported below 10 ppm, such as southern Saskatchewan and Ontario (Ontario Ministry of Environment, n.d.; Rencz *et al*., 2006; Spirito *et al.*, 2006). It is apparent that arsenic concentrations in specific regions of Arctic Canada are elevated in comparison to what is typically found in southern provinces.

In a nation-wide low density soil survey performed in the United States of America (U.S.A), background concentrations of arsenic were reported at similar concentrations found in Southern Canada, with a median value of 5.2 ppm (Smith *et al*., 2014). However, enrichments of arsenic were also reported at 1110 ppm which could have inflated the median concentration reported (Smith *et al.*, 2014). In a study of geochemical background in European agricultural soils, the median background concentration of arsenic was reported at 5.5 ppm, with a maximum of 666 ppm (Fabian *et al*., 2018). Australia's surface soil was reported to have a median concentration of 2 ppm, with a maximum of 218 ppm (Clemens Reimann & de Caritat, 2017). In all reports it was found that background concentrations of arsenic were found to be highly variable across the continents surveyed.

3.3.1.1.2 Cadmium

Soil surveys performed by the GSC didn't report any detectable concentrations of cadmium across Canada (Rencz *et al*., 2006; Spirito *et al*., 2006). In the U.S, approximately 22% of 4841 samples analyzed were below the analytical detection limit (Smith *et al.*, 2014). However, the analytical detection limit was lower at <0.1 ppm (Smith *et al.*, 2014). The median within the U.S. was reported at 0.2 ppm, which was below the detection limit (0.5 ppm) within this study. Similarly in Australia and European agricultural soils, the median cadmium concentrations were reported at 0.04 ppm and 0.18 ppm, respectively (Fabian *et al*., 2018; Reimann *et al.*, 2017).

3.3.1.1.3 Cobalt

In previous studies of Canadian soil and till, background cobalt concentrations ranged from <0.25 to 95 ppm, with a median concentration of 7 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). In a survey performed in southern British Columbia, cobalt concentrations were reported at having a mean concentration value of 19.4 ppm and ranged from 11-34 ppm (Rencz *et al*., 2006; Spirito *et al*., 2006). In addition, mean cobalt concentrations were reported below 15 ppm in other southern provinces; 11.8 ppm in southern Saskatchewan, 6.0 ppm in mid-central Manitoba, 13.3 ppm in mid-central New Brunswick, and 7.5 ppm in southern Ontario (Rencz *et al*., 2006; Spirito *et al*., 2006). Therefore, a majority of the western sites in this study were found to have background cobalt concentrations in a range similar to those found in southern provinces. However, sites in the Eastern Arctic, specifically on Baffin Island and the northern coast of Labrador were found to have elevated background concentrations of cobalt. In comparison to the U.S., cobalt concentrations ranged from <0.1 ppm to 216 ppm, with a median concentration of 7.8 ppm (Smith *et al*., 2014). Australia and European surface soil surveys reported a median of 70.1 ppm and 126 ppm, respectively, which is similar to the range of concentrations found in Arctic Canada (Fabian *et al*., 2018; Reimann *et al.*, 2017). However, with a median concentration of 6.3 ppm for Australia and 7.5 ppm for Europe, all median concentrations were found to be similar to Canadian soils, with the exception of elevated regions.

3.3.1.1.4 Chromium

The GSC has reported chromium concentrations with three different detection limits in the past (1.0, 5.0, and 20 ppm) (Rencz *et al*., 2006; Spirito *et al.*, 2006). This is similar to other Canadian surveys that reported a median chromium concentration of 62 ppm, with a maximum concentration of 310 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). However, it was noted that in surface soil derived from ultramafic rock, a few highly anomalous samples exceeding 1000 ppm were reported (Rencz *et al*., 2006; Spirito *et al.*, 2006). Compared to other low density surveys, the median concentrations found in Canada tend to be higher than the U.S. (30ppm), Australia (23.6 ppm), and European agricultural soil (20 ppm) (Fabian *et al*., 2018; Reimann, 2017; Smith *et al*., 2014). However, with all other studies, high anomalous data was reported exceeding 650 ppm in Australia and Europe, and some data points exceeding 4000 ppm (Fabian *et al*., 2018; Reimann, 2017; Smith *et al*., 2014).

3.3.1.1.5 Copper

The GSC reported a median value 19 ppm and outliers present at greater than 400 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). Suggesting cooper-rich source material increases copper concentrations into soil resulting in highly variable background soil data sets. Background copper concentrations were also found to be highly variable across the U.S. as well with a reported median concentration of 14.8 ppm and anomalies greater than 5000 ppm (Smith *et al*., 2014). Australia and European soil was reported to have similar median values of 11.2 ppm and 15 ppm, respectively (Fabian *et al.*, 2018; Reimann *et al.*, 2017). However, maximum concentrations reported were much less than those found in the U.S., at 150 ppm for Australia and 395 ppm in Europe (Fabian *et al.*, 2018; Reimann *et al.*, 2017).

3.3.1.1.6 Lead

In other Canadian surveys, an upper limit of natural background was reported as 33 ppm, however, soil influenced by lead enriched igneous rock may increase that upper limit to 80 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). This may explain the presence of anomaly concentrations above 30 ppm. Similarly in the U.S., the median concentration of lead was reported as 18.1 ppm, with upper limit concentrations near 45 ppm (Smith *et al*., 2014). However lower median concentrations in Australia and Europe were found, at 7.22 ppm and 16 ppm, respectively (Fabian *et al.*, 2018; Reimann *et al.*, 2017). In these studies, high anomaly concentrations were noted with relation to soil in the presence of lead enriched igneous rock (Fabian *et al*., 2018; Reimann, 2017; Smith *et al*., 2014). As these studies typically used analytical detection limits below 20 ppm, it is suggested that a much lower detection limit be used in order to appropriately quantify background lead concentrations in surface soil in Arctic Canada.

3.3.1.1.7 Nickel

The GSC has reported an upper limit of 214 ppm, however this does not represent nickel-enriched rocks or nickel bearing mineral occurrences that produce soil concentrations greater than 400 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). The median and 95 percentile nickel concentrations published in the U.S., which were 13.5 ppm and 38.5 ppm respectively. These concentrations were found to be similar to European agriculture soil, with a median value of 15 ppm (Fabian *et al*., 2018). Australian surface soils were found to have lower nickels concentrations at 9.8 ppm. Similar to the concentrations reported in this study, high reported maximum concentrations in these surveys allude to the fact that nickel-bearing parent material will elevate nickel concentrations in soil and will increase natural variability across a continent.

3.3.1.1.8 Zinc

Canadian soils are reported by the GSC to have a median concentration of 34 ppm and a positively skewed data set near 200 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). However, these surveys also measured outlier concentrations above 400 ppm (Rencz *et al*., 2006; Spirito *et al.*, 2006). These outlier concentrations were suspected to be related to mafic igneous rock, while the lower background concentrations resulted from carbonate and course clastic sediments and felsic igneous rocks (Rencz *et al*., 2006; Spirito *et al.*, 2006). The background concentrations reported in this study were very similar to the concentrations found in other nation-wide surveys in the U.S., Australia, and Europe (Fabian *et al*., 2018; Reimann, 2017; Smith *et al*., 2014).

3.1.7.4. *Comparison to Canadian Soil Quality Guidelines*

The background soil concentrations analyzed in this study were compared to their respective CSQG (CCME, 1991). Table 3.4 lists the percentage of sites across Arctic Canada that have measured trace element concentrations greater than the CSQG for agricultural land-use. No sites across the Arctic had background Zn or Pb concentrations greater than their respective CSQGs of 250 ppm and 70 ppm, respectively. Cu, Ni, Cr, and As had a higher percentage of sites with background concentrations greater than the CSQG, whereas fewer sites had elevated Co concentrations above the guideline.

Table 3.4: Percentage of Arctic sites with background concentrations above the CCME CSQG (Agriculture).

Element	CCME CSQG (ppm)	% of Sites Above CCME CSQG (Agricultural)			
		95UCL	Mean	Median	Max
As	12	23%	23%	20%	39%
Cd	1.4	0%	3%	8%	8%
Co	40	5%	2%	2%	8%
Cr	64	23%	16%	18%	44%
Cu	63	10%	7%	7%	30%
Ni	45	18%	15%	13%	36%
Pb	70	0%	0%	0%	0%
Zn	250	0%	0%	0%	0%

CCME CSQG: Canadian Council of Ministers of the Environment Canadian Soil Quality Guidelines. The CCME CSQG is for agricultural land-use; ppm: parts per million; 95UCL: 95 upper confidence limits of the mean; Mean: mean concentration; Median: median concentration; Max; maximum concentration.

Table 3.4 demonstrates that chosen CSQGs are often well within the range of background concentrations found in Arctic sites, with the exception of Pb and Zn. As the derivation of the CSQGs incorporated background concentrations (CCME, 1991), it is apparent that the background concentrations used do not reflect the geochemical variation often found in the Arctic region. In many cases, the CSQG is not applicable as background concentrations are elevated well above the guideline, therefore forcing environmental site assessors to characterized local background concentrations.

3.4 Implications

This study provides a reference for background soil concentrations of trace elements when performing contaminated site investigation in Arctic Canada. Due to the highly heterogeneous terrain in the Arctic, the findings of this study support the use of high resolution background sampling programs when performing contaminated site investigation in the Arctic Canada rather than low density, regional scale sampling programs. Trace element concentrations vary by site and therefore requires environmental site assessors to thoroughly understand background concentrations prior to screening contaminated soil using generic CSQGs in Arctic Canada.

Collecting background soil samples at high density is required in many regions of the Canadian Arctic as cryosolic soil creates complex and heterogeneous terrain. However, the methods for performing high resolution sampling programs can also be applied to other continents, as large-scale, low resolution surveys are often performed. If a low density background sampling program is performed, there is a risk of misrepresentation of the local variability of background concentrations. Understanding the local variability of background concentrations is critical when quantifying soil contamination and calculating site-specific background threshold values. As background trace element concentrations are significantly variable across Arctic Canada, the use of CSQGs seems unrealistic for most areas of Arctic Canada.

Thus, it should be standard practice to perform high resolution background sampling programs when performing contaminated site investigation in the Arctic, following best practices when performing high resolution background sampling programs in remote and Arctic sites (See

Chapter 4). An alternative option is to develop regional-specific soil quality guidelines for Arctic Canada, by dividing the Arctic into several regions based on background soil concentrations. However, this approach would require a more significant amount of resources to provide total sample coverage of each region to characterize all soil units present. Without complete sample coverage, this approach risks the misrepresentation of soil units that are elevated or well below the average background concentration in comparison to the rest of the region. Therefore, developing larger background soil data sets from high resolution background sampling programs should be a priority.

Chapter 4 Developing Background Threshold Values at Remote and Arctic Sites

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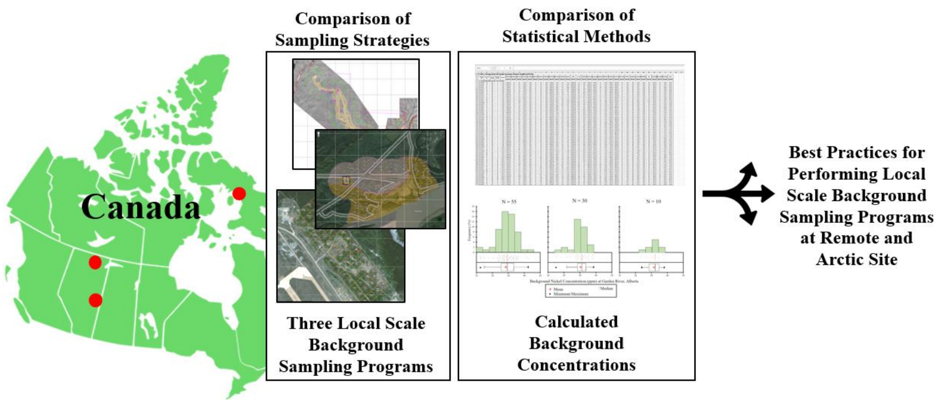
Will be submitted to *Science of the Total Environment*

Main contributions of each co-author:

[1] Contributed to original ideas, compilation and analysis of background soil data, and manuscript preparation.

[2] Contributed to original ideas and revised manuscript.

4.1 Graphical Abstract



4.2 Abstract

Environmental soil quality guidelines represent acceptable numerical threshold values for trace metal concentrations that support the intended land use. At contaminated sites where background soil data is unavailable, performing a local-scale background soil sampling program is an essential component of environmental site assessments and delineation of contaminated soils, particularly in areas where concentrations are naturally elevated above generic soil quality guidelines, such as in Northern Canada. Background soil data for metals/metalloids from two remote sites in Northern Alberta, Canada, and one site on Baffin Island in Nunavut, Canada were used to illustrate best practices for designing sampling programs with the purpose of developing background threshold values. Sampling strategies used at each site were compared to highlight the challenges associated with performing high resolution background sampling programs in remote and Arctic regions of Canada. Background soil data from each site were manually investigated and compared to understand the influence of sample size, outlier detection methods, and statistical methods for the calculation background threshold values (BTVs). Outlier detection methods chosen in this study include the interquartile range rule, and the removal of outliers a designated number (N) of standard deviations above and below the mean concentration, where N is equal to two, three, and four. Statistical methods investigated for the calculation of BTVs were the Mean plus Two Standard Deviations, Median plus Two Median Absolute Deviations, 95th Percentile Ranking, 95 Percent Upper Confidence Limit, Upper Prediction Limit, Upper Tolerance Limit, Upper Simultaneous Limit, Three Standard Deviations above the Mean, and the Extreme Outlier Limit. Background sampling strategies and statistical methods were compared to identify and develop recommendations for performing high resolution background sampling programs in remote and Arctic sites. These recommendations include; collecting between 10-25 samples/km^2 from a minimum of 40 discrete sample locations, and the use of the interquartile rule to remove outliers. Additionally, each BTV calculation method was ranked by conservativeness and accuracy to guide decisions during data analysis.

Keywords: Soil, Background Concentrations, Arctic, Background Threshold Values, Outliers, Metals, Metalloids, Local-scale, Soil Quality Guideline

Highlights

- Best practice for performing local-scale background sampling programs at remote and Arctic sites were identified.
- Statistical methods for outlier detection and calculation of background threshold values were evaluated and compared

4.3 Introduction

Trace metals and metalloids can be present in soils naturally or through anthropogenic activities such as agriculture or industrial operations. Distinguishing between the two is important to assess whether there has been an impact to the environment. Environmental soil quality guidelines (SQG) represent acceptable numerical threshold values for chemical concentrations that support the intended land use. Guideline values tend to be higher for industrial than for agricultural land uses (CCME, 1991; Environmental Agency, 2009). The development of these numerical guidelines considers background or ambient levels that are not attributable to point source pollution as well as factors related to effects of these chemicals (CCME, 2012; DEFRA, 2012; US EPA, 2019; NEPC, 2013).

Several jurisdictions have conducted background or ambient soil surveys on regional scales (500 to 500,000 km^2) or continental scales (500,000 – 50,000,000 km^2) where samples are collected in low densities, including Australia (Reimann & de Caritat, 2017), Europe (Gambashidze *et al.*, 2014; Reimann *et al.* 2014; Tóth *et al.*, 2016), Asia (Cheng *et al.*, 2014), and the United States of America (U.S.A) (Smith *et al.*, 2012). In Europe, researchers have discussed the need to perform local-scale (0.5 – 500 km^2) programs to provide information on local variability in background concentrations (Mikkonen *et al.* 2017). In Canada, soil survey data is readily available from the southern provinces (Rencz, *et al.* 2011; Rencz *et al.* 2006) but there is a lack of data for northern and remote regions even though local background concentrations of metals and metalloids are known to be elevated above the Canadian Soil Quality Guidelines (CSQGs) (ESG, 2007a, 2007b; Rencz *et al*., 2011). Some background soil data is available in northern regions, however data is mostly available in areas related to extensive mining activities (Rencz *et al*., 2006).

With an increase of future economic development in Northern Canada through natural resource exploration and the development of shipping routes, the potential of anthropogenic inputs of trace metals and metalloids will increase. Sample collection strategies and statistical tools to determine background soil concentrations have been discussed in the scientific literature (Birch, 2017; Hofweber, 2010; Mikkonen *et al*., 2017; Clemens Reimann *et al*., 2005); however a comparison of sampling strategies and statistical methods have never been performed in one study. Environmental site assessors require best practices on the selection of the best approaches for the collection and interpretation of background data for the purpose of developing background threshold values (BTVs) to quantify soil contamination. BTVs equate to the highest background concentration at a given site where any concentration exceeding this value is considered a result of input from anthropogenic activity. BTVs represent the ‘clean up’ levels for inorganic element concentrations in soil and used to guide management of sites with soil contamination.

Northern remote and Arctic regions of Canada are dominated by cryosolic soil, where either permafrost exists within 1 meter of the surface or within 2 m of the surface if the soil profiles shows evidence of cryoturbation (Feisthauer, 2012; Rencz *et al*., 2011). Previous and ongoing geological events in Arctic Canada give rise to irregular soil horizons consisting of till or glacial till deposits, and marine sediments in coastal regions (Rencz *et al*., 2006; Rencz *et al*., 2011). Contaminated sites that contain irregular soil horizons can have several distinct soil types on the local-scale and designing a sampling program with appropriate spatial coverage and sample size is critical to calculate representative BTVs. Several sampling strategies can be used to collect representative background soil samples at a site with irregular soil horizons, such as simple random sampling, cluster sampling, stratified random sampling, systematic grid sampling, nested random sampling, random sampling within block, or incremental sampling methodology (CCME, 2016a; US EPA, 2018).

Statistical analysis of background soil concentration data is required to determine representative conditions and to develop BTVs (Love *et al.* 2005; Matschullat *et al.* 2000; Reimann *et al.*, 2005; Reimann *et al.* 2013). A simple mean plus a designated number of standard deviations is often used to calculate BTVs (Matschullat *et al.* 2000) but because soil data rarely conforms to a normal distribution, this approach should be applied with caution (Reimann *et al.* 2000). Non-parametric methods and methods that are less sensitive to positively skewed datasets have been described in the more recent literature (Mikkonen *et al*., 2017; Reimann *et al*., 2005, 2009; Zhao *et al.*, 2007). In a critical review by Reimann *et al.* (2005), three statistical methods were recommended for deriving BTVs and the identification of outliers (the upper whisker of a Tukey boxplot, the median plus two median absolute standard deviation and the point of inflection on a cumulative frequency plot). In addition to these methods, governing bodies recommend using the upper confidence limits, upper tolerance limits, upper prediction limits, or upper simultaneous limit as BTVs (Singh & Singh, 2013).

The objectives of this study were to; (1) evaluate sampling strategies for determining high resolution reference conditions with respect to spatial coverage; sample density; minimum number of samples; and outlier detection methods using data from three remote and Arctic field sites; (2) validate parametric and non-parametric statistical methods for calculation of BTVs; and (3) develop recommendations for selecting sampling strategies and statistical tools for use by environmental site assessment professionals. Several trace elements, including arsenic (As), chromium (Cr), cobalt (Co), copper (Cu), zinc (Zn), and nickel (Ni) were evaluated in this study.

4.4 Methods

Soil data collected during local-scale background sampling programs at three sites in Northern Canada were used to evaluate the influence of sample size on data distribution, incidence of outliers and calculated background threshold values. Additionally, four outlier detection methods were evaluated to investigate the importance of removing outliers for the calculation of BTVs. Lastly; statistical methods for the calculation of BTVs were compared and evaluated based on their ease of application, accuracy and conservatism. The methods used in this study are described in the following sections. Additional information regarding methods is provided in Appendix C, Section C.2.

4.1.1. Study Areas and Raw Data Sets

Background soil data collected as part of environmental site assessment activities from three Canadian sites was available from previous work conducted by the authors and used with permission for this study:

- Site A, Baffin Island, Nunavut (ESG, 2007a);
- Site B, Alberta (ESG, 2014); and,
- Site C, Alberta (ESG, 2017)

Background soil samples were collected at each site and were analyzed for a suite of inorganic elements (total concentrations). All analyses were conducted by a Laboratory accredited by the Canadian Association for Laboratory Accreditation Incorporated to the International Organization for Standardization (ISO) 17025 standard. Soil samples were dry sieved to generate a <75µm grain size fraction subsample and were analyzed by inductively coupled plasma (ICP) and atomic absorption spectrometry (AAS) after the dissolution of trace elements in Aqua Regia solution.

Each site had unique terrain features that required different sampling designs. A total of 114 background soil samples (0-50 cm below ground surface (bgs)) were collected at Site A, 102 background soil samples (0-50 cm bgs) were collected at Site B, and, 60 soil samples (0-10 cm bgs) were collected at Site C. Site A contained seven unique terrain units, while two terrain units were identified at Site B. One terrain unit was identified at Site C. The locations and sampling designs of each site are illustrated in Figure 4.1. Site characteristics and sample sizes are also listed in Table 4.1. More detailed information of each site is provided in Appendix C, Section C.2.

Surface soil at each site was described using terrain units. A terrain unit refers to a physiogeographic unit that is defined by surface geology, vegetation, surface drainage, and relief. At each site, terrain units were identified using air photos prior to site visit and then confirmed during the field program. Soil within each terrain unit was then classified using the Canadian system of soil classification (NRC, 1998).

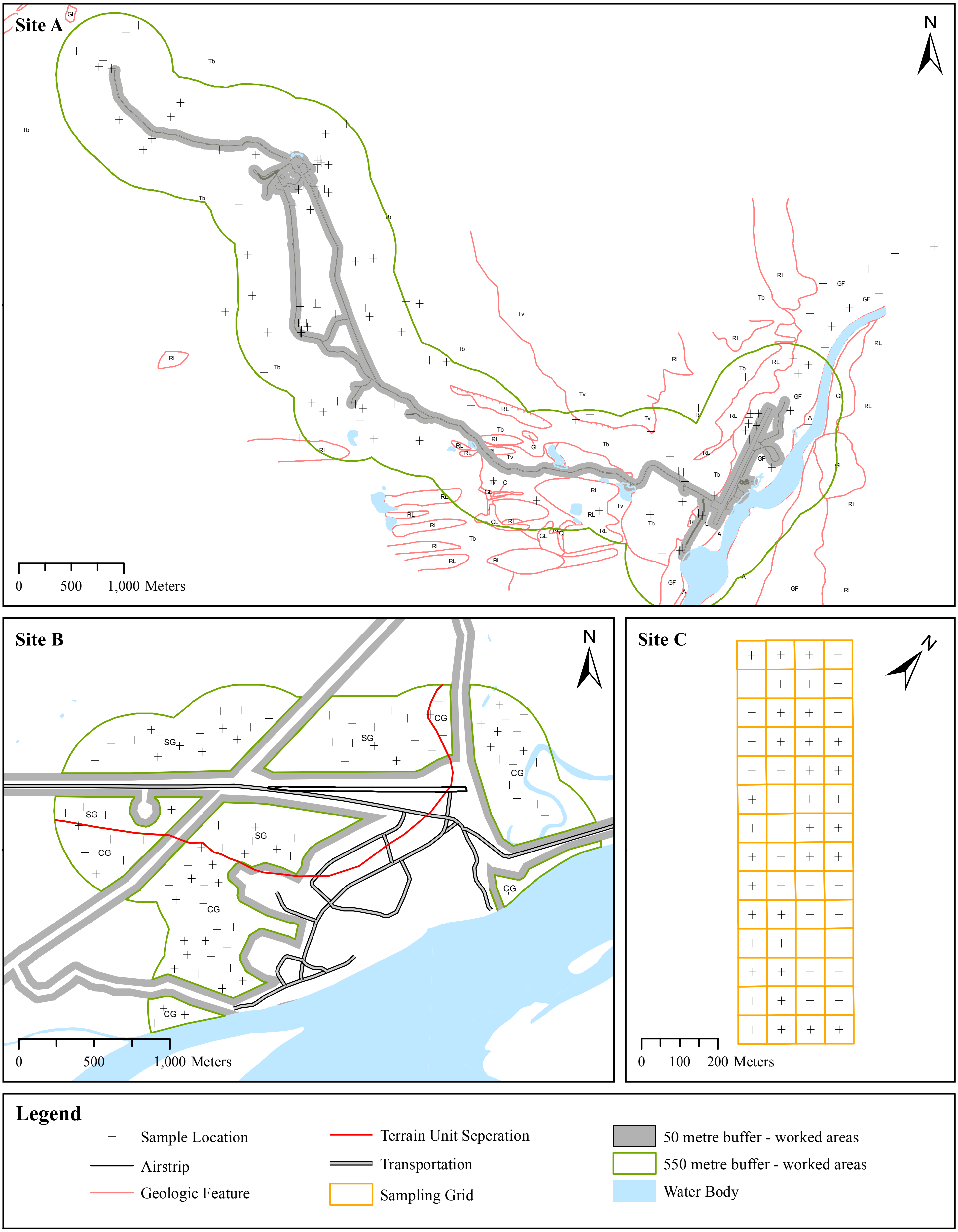


Figure 4.1: The locations and sampling designs for each site. Terrain units are identified using abbreviation for the terrain unit within the site map. A = alluvium; C = colluvium; GF = glaciofluvial; GL = glaciolacustrine; RL = exposed bedrock; TB = till blanket; TV = till veneer; SG = sandy glaciolacustrine; CG = silty/clayey glaciolacustrine.

Table 4.1: Site characteristics of the sites used in this study.

	Terrain Unit	Area (km^2)	Area (%)	Sample Size (0-50 cm)
Site A	A	0.47	4.4	1
	C	0.01	0.1	0
	GF	0.52	4.9	16
	GL	0.18	1.7	3
	RL	0.82	7.6	2
	TB	8.05	75.3	84
	TV	0.65	6.1	8
	Total	**10.7**	**100**	**114**
Site B	SG	2.60	52	47
	CG	2.36	48	55
	Total	**4.96**	**100**	**102**
Site C	Entire Site	0.27	100	60
	Total	**0.27**	**100**	**60**

Note: 14 duplicate samples were collected at 10% frequency for quality assurance/quality control (QA/QC) purposes. A terrain unit refers to a physiogeographic unit that is defined by surface geology, vegetation, surface drainage, and relief. At each site, terrain units were identified using high resolution air photos prior to site visit and then confirmed during the field program. All terrain units were identified during the implementation of the background sampling program and were outline in the individual reports for each site. A = alluvium; C = colluvium; GF = glaciofluvial; GL = glaciolacustrine; RL = exposed bedrock; TB = till blanket; TV = till veneer; SG = sandy glaciolacustrine; CG = silty/clayey glaciolacustrine.

4.1.2. Data Screening

Only background soil data from the TB terrain unit (84 samples) at Site A were analyzed to facilitate the comparison of results between each site. The sample size of the TB terrain unit was comparable to the sample size from Sites B and C. Background soil data from the two terrain units at the Site B were kept separate throughout the analysis. This yielded 4 separate data sets.

Only inorganic elements with 100% detectable concentrations were carried forward for statistical analysis to avoid influence of values below analytical detection limits on the calculation of background concentrations.

Only soil samples collected within 50 cm below ground surface were included to have consistent sampling depths between all three sites.

Inorganic elements that followed the previous criteria for all three sites were carried forward in the analysis: As, Cr, Co, Cu, Zn, and Ni.

4.1.3. Varying Sample Size for Statistical Analysis

To investigate the influence of sample size, the original data sets were resampled by random data sampling (without replacement) using XLSTAT 2018 (Addinsoft, 2019). New raw data sets were generated for each site by decreasing the sample size. For example, within the CG terrain unit of Site B, 55 samples were collected. From the entire data set (N=55), soil samples were randomly selected (without replacement) to generate a new data set with N equal to 40, 30, 20, and 10, as shown in Table 4.2. Soil samples were randomly selected by the designated soil sample number to simulate a decrease in sample locations at each site. The elements chosen and the sample size for each site are listed in Table 4.2. To assess the consistency of the methods chosen for the selection of sample sets, data sets listed in Table 4.2 were recreated seven additional times using the method described above for a total of eight trials. This resulted in 164 raw data sets of varying sample size for each element. The site-specific data sets carried forward were generated by averaging the results of trials 1-8 for each sample size.

Table 4.2: Summary of all available soil data sets from each case study.

Site Name	Terrain Unit	Depth (cm)	Inorganic Elements	Number of Samples Collected	Varying Sample Size of Raw Data Sets	Number of Trials
Site A	TB	0-50	As, Cr, Co, Cu, Zn, Ni	84	84, 70, 60, 50, 40, 30, 20, 10	8
Site B	SG	0-50		47	55, 40, 30, 20, 10	8
	CG	0-50		55	47, 40, 30, 20, 10	8
Site C	Entire Site	0-10		60	60, 50, 40, 30, 20, 10	8

Note: All resampled data sets in this table were generated a total of 8 times for each sample size using random resampling techniques.

4.1.4. Background Soil Data Analysis

4.1.4.1. *Outlier Detection*

Four univariate outlier tests were applied to all data sets listed in Table 4.2 to identify the influence of outlier tests on varying sample size. The outlier tests chosen were i) the removal of outliers three times the interquartile range (IQR) above and below the third and first quartiles, respectively; referred to as the interquartile rule (3×IQR) ii) the removal of outliers four standard deviations (SD) above or below the mean (Mean+/-4SD) iii), the removal of outliers three standard deviations above or below the mean (Mean+/-3SD), and iv) the removal of outliers two standard deviations above or below the mean (Mean+/-2SD).

4.1.4.2. *Distribution analysis*

The data distribution of each element listed in Table 4.2 was analyzed for each data set individually; including data sets generated after outliers were removed. ProUCL 5.0 software (endorsed by United States Environmental Protection Agency, Singh and Singh, 2013) was used for all distribution analysis. Data sets were tested for a normal distribution using the Shapiro-Wilk test and a Lilliefors test. To test for lognormality, ProUCL 5.0 performs the Shapiro-Wilk test and the Lillifors test on log-transformed data. To test for gamma distributions, a Kolmogorov-Smirnov (K-S) test was employed.

4.1.4.3. *Background Threshold Concentration (BTV) Derivation*

BTVs were calculated using ProUCL5.0 (Singh & Singh, 2013). The statistical methods chosen included: i) Mean+2(SD), ii) Median+2Median Absolute Deviations (MAD), iii) 95th percentile ranking, iv) 95% upper confidence limit (95UCL), v) Extreme Outlier Limit (EOL), equivalent to 3 times the interquartile range above the third quartile vi) Upper Prediction Limit (UPL), vii) Upper Tolerance Limit (UTL), and viii) Upper Simultaneous Limit (USL). For each site, the BTVs from each of the 8 trials were averaged for each sample size and outlier detection method.

4.1.4.4. *Evaluation of Statistical Methods Chosen*

To test whether there is a significant difference between the BTVs calculated using each method, a post hoc test in the Analysis of Variance (ANOVA) was performed. The Tukey Test, also called Tukey's Honest Significant Difference (HSD) test, was chosen to compare methods for calculating BTVs to determine whether there are significant differences between the values calculated. A non-parametric Kruskal-Wallis one-way analysis of variance was performed to compare to Tukey Test results. Dunnett's multiple comparison tests were performed using the raw data sets without the removal of any outliers as the control group. The tests were performed for each inorganic element, sample size, and each outlier test individually to determine whether these factors would influence the results of the method chosen.

4.1.5. Summary of Approach

Background soil data sets (As, Cr, Co, Cu, Zn, Ni) collected from two remote sites in Northern Alberta and one site on Baffin Island, Nunavut, were used to evaluate sampling designs, sample size, and statistical methods used for background soil data analysis. A total of 4 soil data sets created from 251 unique sampling locations were analyzed in this study. Analysis was performed for a total of 1230 iterations per data set. Figure 4.2 outlines the process applied for evaluation of statistical methods chosen for background soil data analysis.

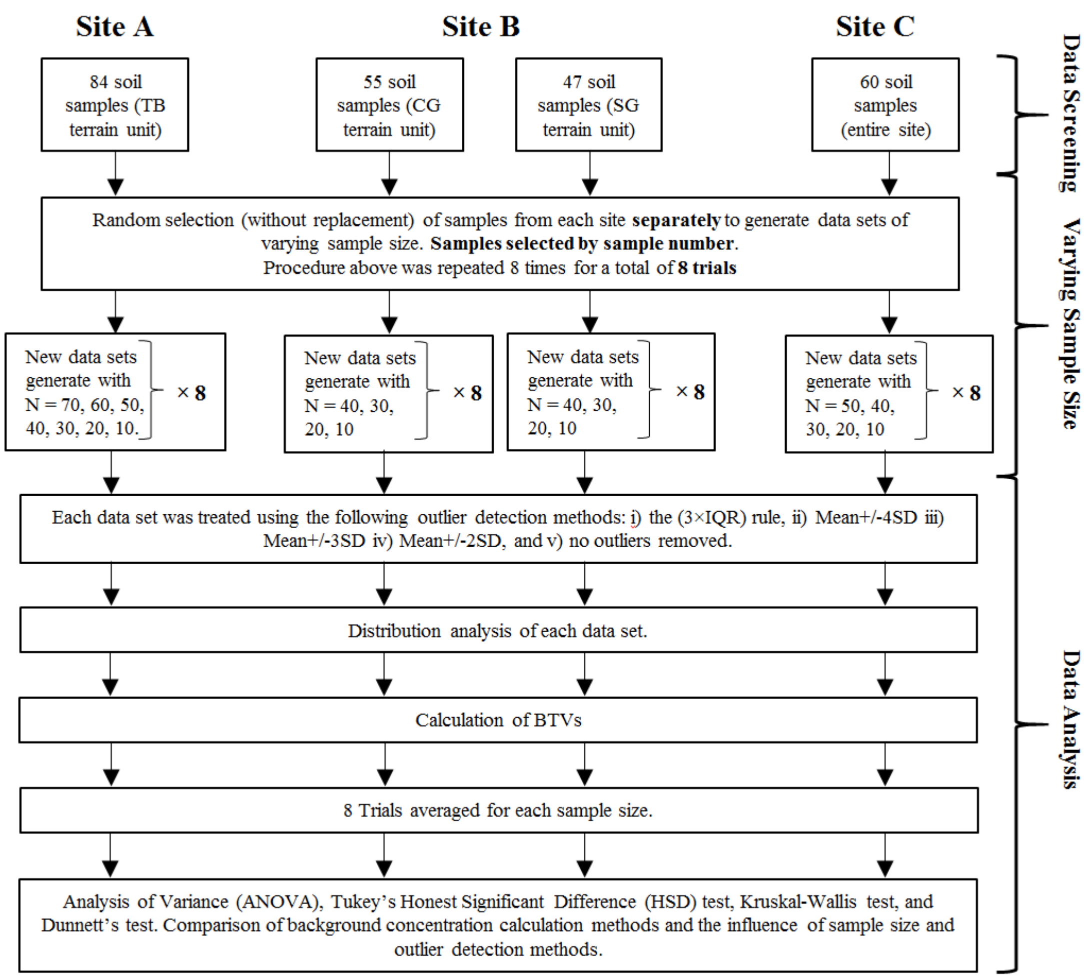


Figure 4.2: Summary of the process applied for evaluation of statistical methods chosen for background soil data analysis.

4.5 Results and Discussion

4.1.6. Sample Density

Northern regions of Canada are dominated by cryosolic soils that have irregular soil horizons consisting of till or glacial till deposits of varying thickness. Therefore, terrain is highly heterogeneous compared to more southern sites, resulting in a higher density of different terrain units. In the context of environmental site assessment, this means that areas beyond the boundaries of a contaminated site are likely representative of soil from a separate terrain unit and therefore background programs should be conducted on a local rather than regional scale. All terrain units present at a study property need to be characterized. Emphasis should be placed on terrain units that are involved in site operations or infrastructure such as gravel pads need to be characterized to properly identify contaminated soil at the site.

The complexity of the sampling strategy used in the three environmental site assessments varied due to the site characteristics. The objectives of the sampling campaigns at sites A and B were to determine representative background concentrations and to develop BTVs for further assessment of contaminated soil at the site. The aim of the sampling campaign at Site C was to determine representative ambient concentrations of inorganic elements in an area with localized point sources of contamination. Hence, the purpose of this program was to detect and remove outliers prior to calculating the ambient reference concentrations.

Both Site A and Site B are remote sites with known naturally elevated background concentrations of inorganic elements (ESG, 2007a, 2014). Surrounding soils were considered representative of background units within a 500-meter inclusion zone that extended from all areas with evidence of previous site activity. Sample sites were randomly selected inside a 500 by 500-meter grid using a stratified random sampling strategy, overlaying the area. Any samples that were within 50 meters of another sample and/or within 50 meters of a potentially contaminated area were removed from the sample set.

Site A includes 7 distinct terrain units that are not uniformly distributed across the site. A total of 114 samples were collected from the 7 terrain units, resulting in a sample density of 10 samples/km^2, shown in Figure 4.1.

Site B is located at the convergence of two terrain units that have distinctively different background concentrations. Each terrain unit covered approximately 50 percent of Site B, therefore simplifying the sampling strategy with respect to sample density. Approximately 50% of the samples were allocated to the CG terrain unit, while the other 50% were collected in the SG terrain unit. A total of 102 surface soil samples were collected within a 500-meter inclusion zone, keeping a distance of 50 meters from areas of potential contamination. This resulted in a sample density of 21 samples/km^2. Sample density was approximately twice that of Site A.

The surface soil stratigraphy across Site C is homogeneous and the study area is relatively small in comparison to sites A and B. To develop ambient reference conditions and identify areas of extreme concentrations at the tail of the distribution (“hot spots”), the sampling approach used at Site C consisted of a uniform random sampling grid. A total of 60 surface samples were collected across the entire site, resulting in a sample density of 222 samples/km^2 (Figure 4.1), appropriate for the detection and delineation of point source contamination.

The sample density required for Site C was much greater compared to the local-scale background sampling programs performed at Site A and Site B to detect potential hot spots.

Sample density depends on the total area of the site, as well as the number of terrain units within the site. Based on the sampling campaign of Site A and B, to appropriately characterize background concentrations on a local scale, sample density should be between 10-25 samples/ km^2 within a 5 to 10 km^2 area. A minimum sample size of 10 observations should be collected to allow for statistical inferences (Singh & Singh, 2013). The influence of sample size on the statistical methods used in background soil data analysis is investigated in the following sections.

4.1.7. Evaluation and Comparison of Statistical Methods

Soil concentration data for select inorganic elements collected during local-scale background sampling programs at three unique sites in Northern Canada were used to evaluate the influence of sample size on distribution analysis, outlier detection methods, and calculation of background thresholds (BTVs). Figure 4.2 summarizes the process applied for evaluation of statistical methods chosen for background soil data analysis.

4.1.7.1. *The Influence of Sample Size on Distribution Analysis*

Distribution analysis was performed on all 4920 soil data sets individually and the frequency in which the soil data sets conformed to a specific data distribution for each inorganic element is illustrated in Figure 4.3. The individual results were then pooled by element and sample size and aggregated for all sites. A sample size of 50 was selected as a cut off, as this was the maximum sample size that was common between all sites.

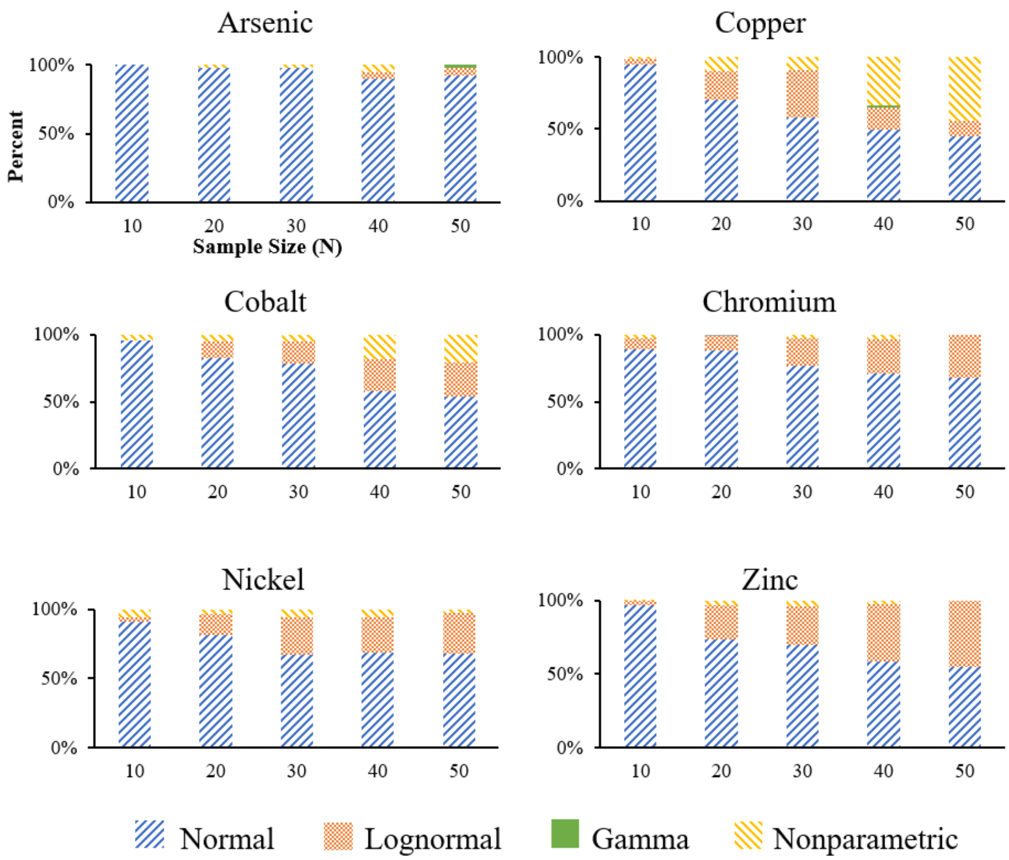


Figure 4.3: Summary of distribution analysis results for soil data at different sample size for all sites combined. Percent value indicates the frequency in which the data sets conformed to normal, lognormal, or gamma distributions or were considered nonparametric.

Figure 4.3 illustrates that increasing the sample size decreases the frequency in which the data fit a normal distribution. With the exception of arsenic, the frequency in which the data fit a lognormal distribution or were considered nonparametric increased closer to 50% by increasing the sample size to 50. These results are consistent with the results obtained by site (see Supplementary Information).

Larger data sets increase the representativeness of the background soil concentrations and the statistical methods applied to larger data sets have greater statistical power compared to smaller data sets (CCME, 2016a; US EPA, 2006). In a study performed by Zhang *et al.* (2005), the effect of sample size on data distribution was investigated using large background soil data sets (>16,000 samples) collected during large regional surveys by the U.S. Geological Survey. When testing the distribution of data sets of varied sizes, departure from normality was rare when the sample size was 50 (Zhang *et al.* 2005). However, when random samples of 100, 200, 500, 1000, 2000, and 5000 were chosen from declustered data sets, the statistical tests gain power and none of the elements passed tests for normality or lognormality (Zhang *et al.*, 2005). Because the data is no longer normal or lognormal, this suggests that larger data sets can distinguish the heterogeneities in the system. These results were found to be true even for local-scale background soil data sets where sample size was lowered below 50. Although soil samples were collected from one terrain unit, lowering the sample size below 50 increased the potential for masking heterogeneities in the background soil data set. This may also suggest that the soil at these Arctic sites is more heterogenous than the soil studied by Zhang *et al.* (2005) as not all data sets fit a normal distribution when the sample size was 50.

Larger data variability may result in improper distribution analysis conclusions and can lead to skewed background threshold calculations or outlier identification. To illustrate how data variability is influenced by sample size, the standard deviation of each data set was calculated for each sample size. This calculation was performed for all 8 data sets that were randomly generated. From the standard deviations calculated from the 8 randomly generated data sets, a ratio of the maximum and minimum standard deviation was calculated for each sample size and plotted, as shown in Figure 4.4.

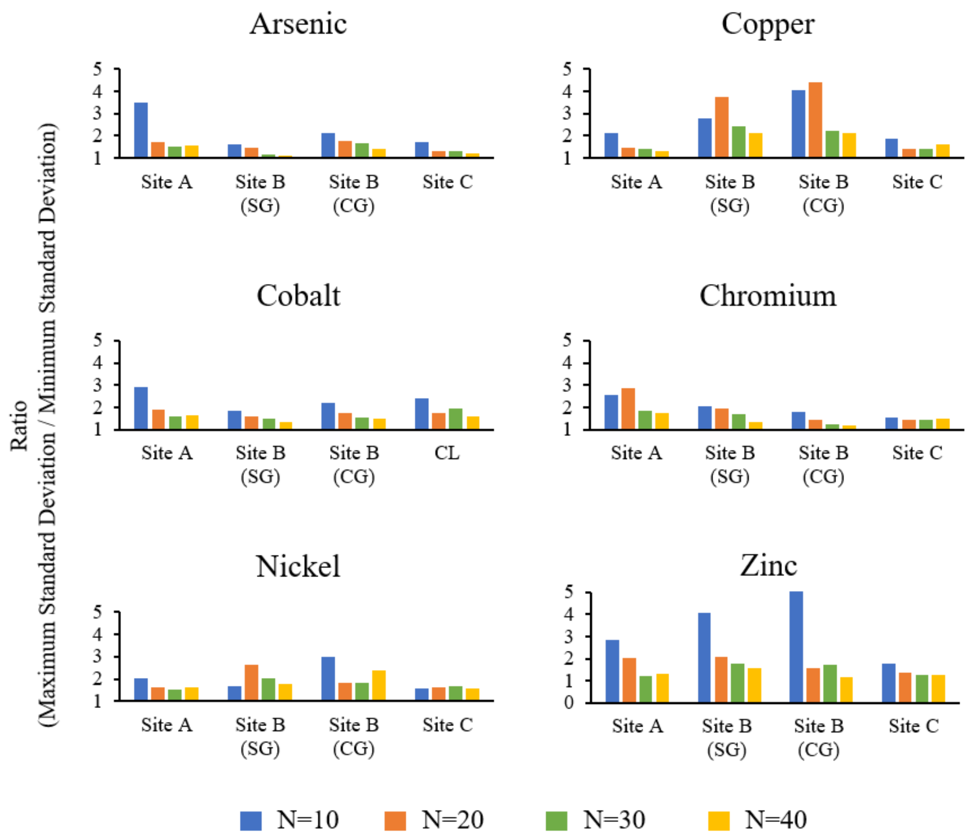


Figure 4.4: Ratio of maximum and minimum standard deviation of soil data sets separated by sample size.

For most elements and most sites, a smaller samples size results in an increased ratio. The larger the ratio, the larger the variability between data sets that were generated from the same original data set. This suggests if the sample size is too small when performing a local background sampling program, there is a greater possibility that the data set does not provide the best representation of the background concentrations. Currently, regulators in Canada suggest collecting a minimum of 8-10 discrete background samples for an environmental site assessment (CCME, 2016b), although this will not be large enough to detect heterogeneities in background concentrations.

4.1.7.2. *The Influence of Sample Size on Outlier Detection*

Choosing an appropriate outlier detection method for the calculation of BTVs is critical to ensure outliers are not distorting the calculated BTV. Outliers in a background soil data set provide insight into site characteristics that otherwise cannot be observed during site visits. As extreme outliers represent values that originate from other populations, the location of the sample where the outlier concentration was detected may be of significance to site. Extreme outliers can represent locations of unique mineral deposits or geochemical processes, separate terrain units, the extremes of natural variation in background concentrations for a specific soil type or they can represent, or they can represent a previously unknown impacted area.

The influence of sample size on different methods of identifying outliers was investigated by determining the total number of outliers detected at each sample size by the different methods employed, keeping element-specific results separate. The total number of outliers detected is shown in Figure 4.5. Site-specific results are presented in the Appendix C, Section C.3, Figure 2.

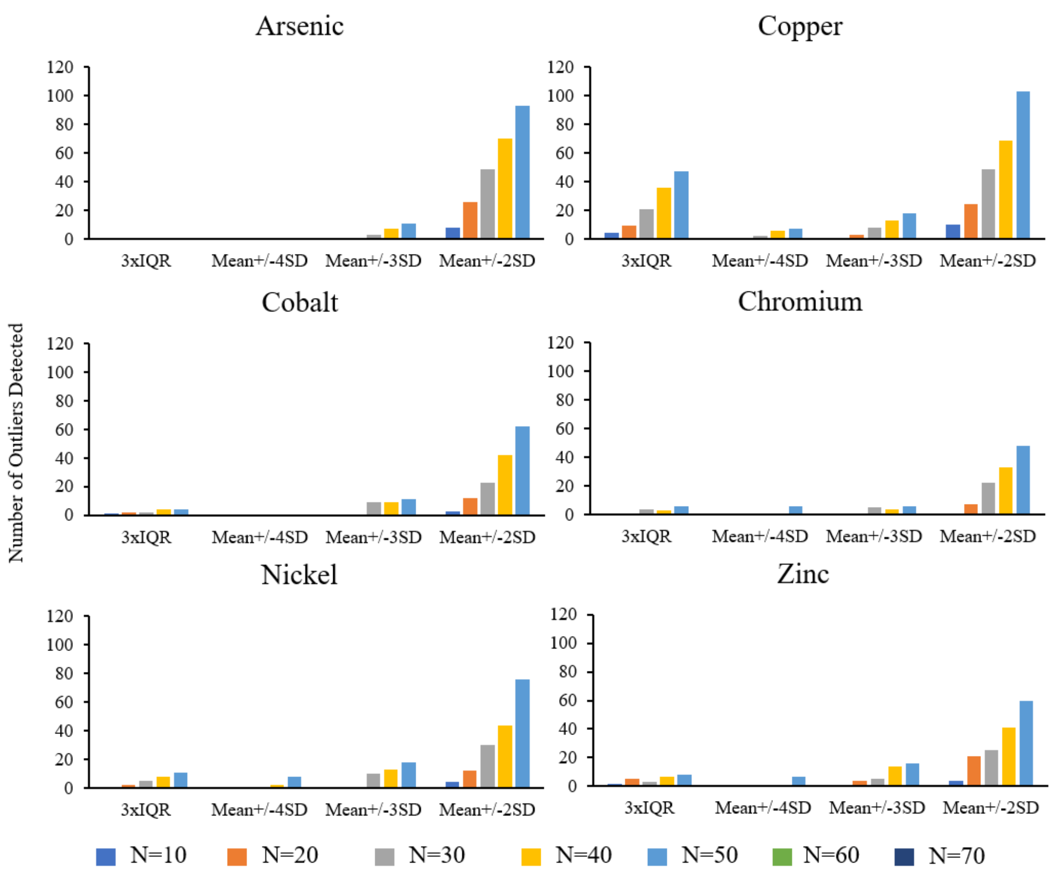


Figure 4.5: Total number of outliers detected by each outlier detection method.

All outlier methods are found to be heavily influenced by sample size as the number of outliers detected at lower sample sizes is significantly lower than larger sample sizes. This trend was also observed in the site-specific results (Appendix C, Section C.3, Figure 2). This is expected for two reasons; i) if a data set has a larger sample size, there is a greater probability of including data values from other populations that are represented as outliers, and ii) if the sample size is larger, the methods chosen gain statistical power and adds confidence to the decisions made regarding inclusion or exclusion of an outlier in the data set.

4.1.7.3. *Comparison of Outlier Detection Methods*

Four different outlier detection methods were evaluated to determine their influence on the calculated BTVs. First, BTVs were calculated for the entire data set without removal of outliers. Tukey's test was then used to compare the BTV values calculated after data sets were subject to each outlier removal method. Following the Tukey's test, a percentage value was calculated that indicated the frequency of significantly different BTVs from values (as defined within the 95% confidence interval) calculated without the removal of outliers. A summary of Tukey's test results are presented in Table 4.3. A Dunnett's multiple comparison analysis was also performed which yielded similar results (provided in the Appendix C, Section C.3, Table 12).

Table 4.3: Summary of Tukey's test results for outlier removal method comparison. Percentage value indicated the frequency that the methods are significantly different (within the 95% confidence interval) from the results with no outliers removed.

Site A (TB Terrain Unit)				
Sample Size	**3×IQR**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=70	2%	9%	13%	41%
N=60	2%	11%	11%	35%
N=50	13%	15%	19%	48%
N=40	2%	2%	2%	11%
N=30	2%	2%	2%	6%
N=20	2%	2%	2%	2%
N=10	2%	2%	2%	2%
Site B (SG Terrain Unit)				
Sample Size	**3×IQR**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=40	22%	33%	35%	48%
N=30	2%	13%	4%	9%
N=20	7%	0%	4%	13%
N=10	0%	0%	4%	2%
Site B (CG Terrain Unit)				
Sample Size	**3×IQR**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=40	7%	7%	7%	30%
N=30	6%	6%	0%	9%
N=20	0%	0%	0%	0%
N=10	2%	2%	2%	2%
Site C				
Sample Size	**3×IQR**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=50	2%	2%	9%	83%
N=40	0%	0%	2%	50%
N=30	0%	0%	2%	15%
N=20	0%	0%	2%	4%
N=10	0%	0%	2%	6%

For most cases, as samples size increases, the frequency of significantly different BTVs for each outlier detection method chosen increased. Larger sample size did not always result in a larger frequency value, as extreme values in the original data sets may have been selected for certain data sets and not others based on the random selection method. However, the general trend described is consistent.

Removing outlier's two standard deviations above and below the mean value had the highest frequency of significant difference, while the EOL had the least. At Site B and Site C, the

3×IQR rule and the Mean+4SD had comparable results; however, at Site A the 3×IQR rule had lower frequencies of significantly different results. Also, the sensitivity of each outlier method increased with sample size, as more outliers were detected in larger data sets. Similar results were observed using Dunnett's test to compare outlier methods (Appendix C, Section C.3, Table 12).

4.1.7.4. *Ranking Background Threshold Values (BTVs)*

Statistical methods for calculating BTVs were evaluated by ranking methods according to calculated concentration values and the associated standard deviations. Initially, BTVs were calculated for each data set using several statistical methods as described in the methods section. For each of the 8 trials, an average BTV and standard deviation was calculated. For each sample size, the BTV calculation method was ranked from highest to lowest concentration and standard deviation, separately. Using the method ranking results, a percent value was calculated to indicate the frequency in which each method ranked from 1st (highest) to 9th (lowest) based on the average BTV concentration and the standard deviation of the average BTV. BTVs, standard deviations, and ranking frequency data is provided in the Appendix C, Section C.2.1, Table 8-11. A summary of the ranking result is provided in Table 4.4.

Table 4.4: Each background concentration method ranked from highest (1st) to lowest (9th) by concentration and standard deviation of the BTV.

Rank by Concentration	**Method**	**Rank by Standard Deviation**	**Method**
1st	EOL	1st	EOL
2nd – 4th	Mean+3SD, USL, UTL	2nd	Mean+3SD
5th – 6th	Mean+2SD, UPL	3rd – 7th	UTL, USL, Mean+2SD, 95%tile, Med+2MAD
7th	95%tile	8th	UPL
8th	Med+2MAD	9th	95UCL
9th	95UCL		

Generally, a higher BTV resulted in a higher standard deviation. The EOL ranked the highest for both concentration and standard deviation, whereas the 95UCL ranked the lowest for both concentration and standard deviation. At all sites, the EOL is considered the least conservative method to use when developing a BTV that is to be used to identify or delineate anthropogenic contamination, as this method most often resulted in the highest concentration value. On the other hand, the 95UCL is considered the most conservative because it most often ranked as the lowest BTV. The ranking pattern is consistent for all case studies.

The higher a method ranks by concentration, the less conservative the method is regarding quantifying contamination at a site. If the threshold value is intended to replace the soil quality guideline, a larger value is more likely to generate false negative results when comparing to soil sample concentrations from the contaminated site, i.e. a sample is classified as background when in fact it is not. On the other hand, if a lower threshold value is chosen, a false positive conclusion of incorrectly classifying a sample as contaminated is more likely to occur.

Standard deviation is used to measure the confidence of statistical conclusions and therefore can be used to evaluate each statistical method applied. More confidence is given to methods with a smaller standard deviation, such as the 95UCL or the UPL. Standard deviation is important to consider when calculating background threshold values, as a larger standard deviation increases the range of possible conclusions for a given method. Because the purpose of a background sampling program is to determine background concentrations that are representative of the site of interest, accuracy of background threshold concentrations is important to consider when selecting the statistical method.

4.1.7.5. *Minimum Recommended Sample Size for BTV Calculations*

Sample size was explored further by performing an additional Tukey test to determine the influence of sample size on each method for calculating BTVs. To summarize the results, the frequency in which each sample size resulted in a significantly different concentrations value was calculated and is listed in Table 4.5.

Table 4.5: Summary of Tukey test results to determine influence of sample size on each background concentrations calculation method. The frequency (%) in which sample size resulted in a significantly different average concentration value at the 95% confidence level.

Site A (TB Terrain Unit)		Site B (SG Terrain Unit)		Site B (CG Terrain Unit)		Site C	
Sample Size	**Frequency (%)**	**Sample Size**	**Frequency (%)**	**Sample Size**	**Frequency (%)**	**Sample Size**	**Frequency (%)**
84	0%	-	-	-	-	-	-
70	0%	-	-	-	-	-	-
60	0%	-	-	-	-	**60**	0%
50	0%	**47**	0%	**55**	0%	**50**	0%
40	0%	**40**	0%	**40**	0%	**40**	0%
30	1%	**30**	0%	**30**	3%	**30**	5%
20	7%	**20**	6%	**20**	6%	**20**	8%
10	28%	**10**	30%	**10**	29%	**10**	29%

Reducing the sample size to 10 samples produced a significantly different concentration value at a frequency of 28% at Site A, 30% at the SG terrain unit at Site B, 29% at the CG terrain unit at Site B, and 29% at Site C. However, increasing the sample size from 10 to 20 samples decreased the frequency for all sites. The sample size where no calculations resulted in significantly different results from the complete data occurred at a sample size of 30 at the SG terrain unit at Site C. Site A, the CG terrain unit at Site B, and Site C were found to have larger data ranges in background concentrations compared to the SG terrain unit at Site B which is reflected in the higher number of samples (40) required to detect no significant differences in the concentrations calculated. This finding is likely a result of data distributions normalizing when a smaller sample size was used. Prior to performing a background sampling program, the variability of background concentrations cannot be estimated, and therefore to ensure accurate background concentrations, a minimum sample size of 40 is suggested.

4.1.8. Recommendations for Background Sampling Programs

In order to collect representative background soil data at a contaminated site, background soil units should conform to the following criteria:

- Extend background soil units into areas surrounding the site that are free from any disturbance associated with site activity. Extending into regions that vary based physical soil characteristics and terrain is not advised as the background concentrations may not be representative of the site. A 500 meter boundary around the site was used as Site A and Site B as the physical characteristics of the soil and terrain were found to be similar to the sites. Establishing a 500 meter boundary for background unit may be an appropriate starting point for developing a program, however extending beyond this distance may be required depending on the scenario.

- Establish an exclusion zone between any area that is influenced by site activity and the background soil units to avoid any influence on the background soil data collected. A 50 meter exclusion zone is an appropriate starting point for an exclusion zone; however this may need to be adjusted depending on site characteristics (ground and surface water dynamic, topography, etc.). Areas that require exclusion zones around, include:
    - Areas used for site access (i.e. roads, off-road trails) and any other areas that have been influenced by anthropogenic activity;
    - Agricultural land;
    - Soil that has been tilled or excavated; and
    - Areas containing non-native materials

For selecting appropriate background soil units, terrain mapping for the site is critical. The result of the terrain mapping would identify any distinct physical changes of soil at the site and the surrounding area. If possible, a site visit can be valuable for confirming the physical characteristics of the soil and any changes in surface conditions identified during terrain mapping. However, for many remote and Arctic sites, multiple trips to the site are not always feasible, and therefore selection of background soil units will heavily rely on air photos and satellite images.

Sample locations in the background soil units can be selected using digital maps and a stratified random sampling strategy targeting subunits of the site or a systematic grid pattern. Sample density depends on the total area of the site, as well as number of terrain units within the site. Based on the success of the high resolution sampling programs performed at Site A and B, a sample density between 10-25 samples/km^2 within a 5-10 km^2 area provided a reliable background data set. Sample density and sample size may need to be adjusted to meet minimum sample size requirements for each terrain unit. Depending on the site characteristics, some terrain units may be more dominant than others by covering a larger area of the contaminated site or were more functional for infrastructure. In that case, extending beyond the 500-meter boundary may be necessary. Increasing sample density beyond the recommended to achieve a larger sample size is not appropriate as there is a risk of misrepresenting local variability of background concentrations if sample locations are too close to one another.

To minimize the risk of significantly different background concentrations, the collection of at least 40 discrete surface samples within each terrain unit is recommended. However, a sample size of 40 within each terrain unit may increase sample density beyond the recommendation if the area of the terrain unit is too small. Extending the 500-meter boundary to increase the sample size in a specific unit may be required.

Figure 4.6 provides guidance on selection outlier detection methods and methods for calculating BTVs based on their sensitivity, conservatism, and accuracy.

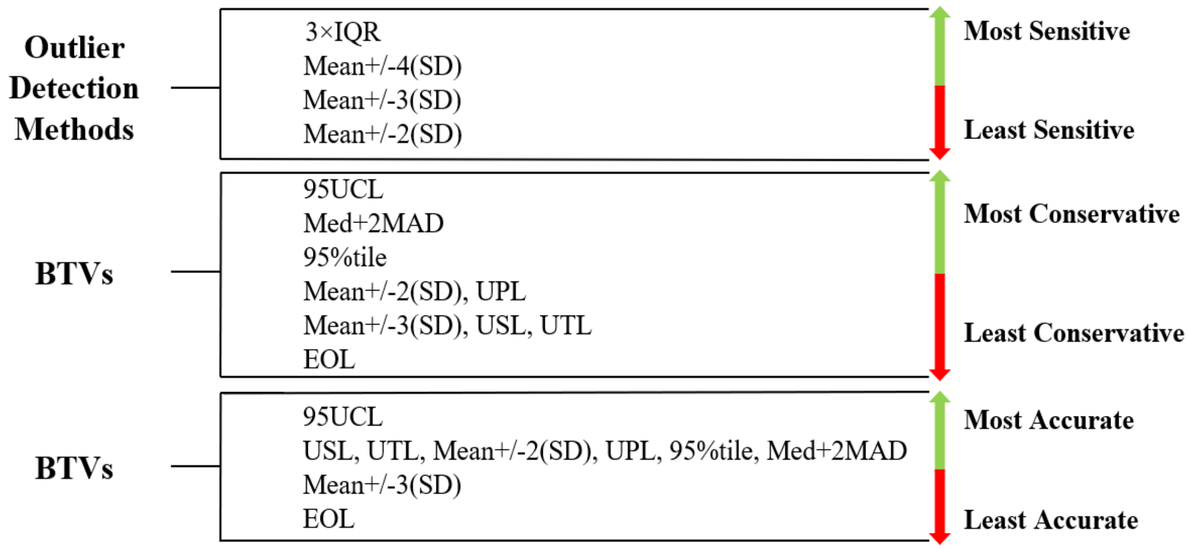


Figure 4.6: Summary of in-depth comparison analysis results. Outlier Detection methods and BTV calculation methods ranked by their sensitivity, conservatism, and accuracy to guide selection process.

If background soil units chosen are known to be undisturbed by site activity, the 3×IQR should be used to avoid removing the values that represent the extremes of the natural variation of local background concentrations. If there is concern that areas used for background soil sampling are influenced by anthropogenic input, a more sensitive outlier method should be chosen in order to locate areas within the site that are potentially influenced by site activity, such as the Mean+/-n(SD).

In the determination of BTVs, if a method produced the highest concentration, it was considered least conservative if used to guide remedial efforts. Additionally, the standard deviation associated with each method was used to rank the method by their accuracy.

During the development of BTVs for the purpose of guiding remedial efforts at contaminated sites, it is good practice to apply all outlier detection methods to the background data set separately. This will help in striking a balance between conservatism and accuracy when choosing an appropriate BTV. Background threshold values should be calculated with and without removing any outliers. All end results should be compared, and the outlier method chosen for the program should be appropriately justified.

The EOL calculation most often resulted in the highest BTV of all the methods, and therefore is least conservative if used as a threshold value. Additionally, the standard deviation associated with this method was largest compared to all other methods, and therefore was least accurate. The potential error associated with this method is important to consider, especially when sample size is below 40. However, as this method does not assume that the data conform to a specific distribution, the use of the interquartile range is less influenced by outliers in the population. As a result, this method is less sensitive to the outlier method chosen during data analysis and can be applied to all data distributions.

The Mean+3SD or Mean+2SD methods can be easily applied, however assume that the data fit a normal distribution. These methods were found to be least sensitive to the outlier methods chosen, however these methods are limited as they shouldn't be applied to lognormally distributed data sets. The Mean+3SD method most often resulted in a higher concentration and standard deviation, while the Mean+2SD had comparable concentrations and standard deviations to the Med+2MAD and the 95 percentile. The Med+2MAD most often produced a background concentration lower than the 95 percentile and the Med+2MAD had the highest sensitivity to the outlier detection methods.

The 95UCL always produced the lowest concentration and standard deviation values for the background calculations. Both the 95 percentile and the 95UCL produced significantly different values when the Mean+/-2SD outlier method was used. Because ProUCL5.0 calculates the 95UCL based on the distribution of the data, the 95UCL tends to be less skewed by data sets that do not fit a normal distribution, whereas the other methods mentioned above can produce skewed results when used on a skewed data set.

The USL, UTL, and UPL are calculated based on the underlying distribution of the data set and this can be beneficial as not all inorganic elements are normally distributed. However, these methods were found to be most sensitive to outliers at the tails of the distribution.

4.6 Conclusions

Background soil data from two remote sites in Northern Alberta, Canada, and one site on Baffin Island in Nunavut, Canada were used to illustrate best practices for designing sampling programs with the purpose of developing background threshold values. Soil sampling strategies were compared, and the best practices for executing a sampling program were outlined. Background soil data from each site were manually investigated and compared to understand the influence of sample size, outlier detection methods, and statistical methods for the calculation background threshold values (BTVs). The methods evaluated and compared in this study were shown to have an influence on the final conclusions of a local-scale background sampling program.

Sample density depends on the total area of the site, as well as number of terrain units within the site. Based on the success of the high resolution sampling programs performed at Site A and B, a sample density between 10-25 samples/km^2 in a 5-10 km^2 area provided a reliable background data set. Sample density and sample size may need to be adjusted to meet minimum sample size requirements for each terrain unit.

To minimize the risk of significantly different background concentrations, the collection of at least 40 discrete surface samples within each terrain unit is recommended. However, a sample size of 40 within each terrain unit may increase sample density beyond the recommendation if the area of the terrain unit is too small. Extending beyond the recommended 500-meter site boundary to increase the sample size in a specific unit may be required.

During outlier analysis, if background soil units chosen are known to be undisturbed by site activity, the 3×IQR outlier rule should be used to avoid removing the values that represent the extremes of the natural variation of local background concentrations. If there is concern that areas used for background soil sampling are influenced by anthropogenic input, a more sensitive outlier method should be chosen in order to locate areas within the site that are potentially influenced by site activity, such as the Mean+/-n(SD).

The EOL calculation was found to be the most conservative method when used as a BTV, however was also considered to be least accurate. The Mean+3SD method most often resulted in a higher concentration and standard deviation, while the Mean+2SD had comparable concentrations and standard deviations to the Med+2MAD and the 95 percentile. The Med+2MAD most often produced a background concentration lower than the 95 percentile and the Med+2MAD had the highest sensitivity to the outlier detection methods. The 95UCL always produced the lowest concentration and standard deviation values for the background calculations. The USL, UTL, and UPL are calculated based on the underlying distribution of the data set and this can be beneficial as not all inorganic elements are normally distributed. However, these methods were found to be most sensitive to outliers at the tails of the distribution.

Chapter 5 **Principle Outcomes and Recommendations**

5.1 Research Objectives

The main objectives of this thesis were as follows;

1) Compile and analyse background soil data collected from ESG-RMC to develop the first longitudinal background soil data set in Arctic Canada at the 69th parallel North.
2) Use background soil data sets from three case studies in Northern Canada to;
    a. evaluate sampling strategies for determining high resolution reference conditions with respect to spatial coverage; sample density; minimum number of samples; and outlier detection methods
    b. Validate parametric and non-parametric statistical methods for calculation of BTVs.
    c. Provide recommendations for performing high resolution background sampling programs.

5.1.1. Objective 1: Creating a background soil data set for Arctic Canada

Background soil data sets from 61 sites across Arctic Canada were compiled and analyzed to provide the first longitudinal background soil data set in Arctic Canada. Background soil data for trace metals/metalloids were found to be highly variable longitudinally across the Canadian Arctic at the 69th parallel.

Specific regions of Canada were found to have more variable background concentrations than others. As was found to be variable on the northern coast of the Yukon Territory and on Baffin Island in Nunavut. Co, Cr, copper, and Ni we also found to be highly variable on Baffin Island. Additionally, Co, Cu, and Ni were also found to be variable on the northern coast of Labrador. Zn was variable all across the 69th parallel North. Cd and Pb were often found to be below the detection limit used in the analysis of these background samples. From the background soil data used in this study, AHC analysis was performed to determine a potential relationship between surface soil geochemistry and bedrock geology across Arctic Canada. Specific bedrock geological units were linked to elevated trace element concentrations to indicate where trace element concentrations may be elevated in comparison to CSQGs.

In comparison to the CSQGs, no sites across the Arctic had background Zn or Pb concentrations greater than their respective CSQGs of 250 ppm and 70 ppm, respectively. Cu, Ni, Cr, and As had a significant percentage of sites with background concentrations greater than the CSQG, whereas fewer sites had elevated Co and Cd concentrations above the guideline.

5.1.2. Objective 2: Recommendations for High Resolution Background Sampling Programs in Arctic Canada

Background soil data sets from three case studies were used to develop recommendations for sample strategies and statistical methods used when performing high resolution background sampling programs at remote and Arctic sites. Based on the success of the high resolution sampling programs performed at Site A and B, a sample density between 10-25 samples/km^2 in a 5-10 km^2 area provided a reliable background data set. Sample density and sample size may need to be adjusted to meet minimum sample size requirements for each terrain unit. Depending on the site characteristics, some terrain units may be more dominant than others by covering a larger area of the contaminated site or were more functional for infrastructure. Establishing a 500-meter inclusion zone is an appropriate starting point for determining the size of background soil units, however, extending beyond the 500-meter boundary may be necessary depend on site characteristics. Increasing sample density beyond the recommended to achieve a larger sample size is not appropriate as there is a risk of misrepresenting local variability of background concentrations if sample locations are too close to one another.

To minimize the risk of significantly different background concentrations, the collection of at least 40 discrete surface samples within each terrain unit is recommended. However, a sample size of 40 within each terrain unit may increase sample density beyond the recommendation if the area of the terrain unit is too small. Extending the 500-meter boundary to increase the sample size in a specific unit may be required.

During outlier analysis, if background soil units chosen are known to be undisturbed by site activity, the 3×IQR outlier rule should be used to avoid removing the values that represent the extremes of the natural variation of local background concentrations. If there is concern that areas used for background soil sampling are influenced by anthropogenic input, a more sensitive outlier method should be chosen in order to locate areas within the site that are potentially influenced by site activity, such as the Mean+/-n(SD).

In the determination of BTVs, if a method produced the highest concentration, it was considered least conservative if used to guide remedial efforts. Additionally, the standard deviation associated with each method was used to rank the method by their accuracy. During the development of BTVs for the purpose of guiding remedial efforts at contaminated sites, it is good practice to apply all outlier detection methods to the background data set separately. This will help in striking a balance between conservatism and accuracy when choosing an appropriate BTV. Background threshold values should be calculated with and without removing any outliers. All end results should be compared, and the outlier method chosen for the program should be appropriately justified.

The EOL calculation most often resulted in the highest BTV of all the methods, and therefore is least conservative if used as a threshold value. Additionally, the standard deviation associated with this method was largest compared to all other methods, and therefore was least accurate. The potential error associated with this method is important to consider, especially when sample size is below 40. However, as this method does not assume that the data conform to a specific distribution, the use of the interquartile range is less influenced by outliers in the population. As a result, this method is less sensitive to the outlier method chosen during data analysis and can be applied to all data distributions. The Mean+3SD or Mean+2SD methods can be easily applied, however assume that the data fit a normal distribution. These methods were found to be least sensitive to the outlier methods chosen, however these methods are limited as they shouldn't be applied to lognormally distributed data sets. The Mean+3SD method most often resulted in a higher concentration and standard deviation, while the Mean+2SD had comparable concentrations and standard deviations to the Med+2MAD and the 95 percentile.

The Med+2MAD most often produced a background concentration lower than the 95 percentile and the Med+2MAD had the highest sensitivity to the outlier detection methods. The 95UCL always produced the lowest concentration and standard deviation values for the background calculations. Both the 95 percentile and the 95UCL produced significantly different values when the Mean+/-2SD outlier method was used. Because ProUCL5.0 calculates the 95UCL based on the distribution of the data, the 95UCL tends to be less skewed by data sets that do not fit a normal distribution, whereas the other methods mentioned above can produce skewed results when used on a skewed data set. The USL, UTL, and UPL are calculated based on the underlying distribution of the data set and this can be beneficial as not all inorganic elements are normally distributed. However, these methods were found to be most sensitive to outliers at the tails of the distribution.

5.2. Scientific Contribution

This thesis contributes to the first longitudinal background soil data set in Arctic Canada along the 69^{th} parallel North. This data set provides a reference for background soil concentrations of trace elements when performing contaminated site investigation in Arctic Canada. Due to the highly heterogeneous terrain in the Arctic, the findings of this study support the use of high resolution background sampling programs when performing contaminated site investigation in the Arctic Canada. Trace element concentrations can vary dramatically by site forcing environmental site assessors to thoroughly understand background concentrations prior to screening contaminated soil using generic CSQGs in Arctic Canada. Additionally, when compared to background soil data sets generated for other continents of the world, this data set highlights the need to thoroughly understand the local variability of background soil concentration prior to understanding the characteristics across an entire continent.

In addition, this thesis provides recommendations for how to perform high resolution background sampling programs in remote and Arctic regions. Environmental site assessors can use these recommendations to guide the design of sample strategies as well as decisions regarding which statistical methods to use during background soil data analysis. Implementation of a well-planned sampling event at remote and arctic sites can reduce project costs by reducing logistical burden associated with additional site visits. As the statistical methods used for outlier analysis and BTV calculations have an influence on the final BTV calculation, these recommendations can be used to justify the use of one method over another and guide management decisions during contaminated site investigation.

5.3. Future Research

Based on the findings in this thesis, recommendations for future research include:

1) Collect more background soil samples at the Arctic Canada sites that are characterized with samples sizes smaller than 10 samples.
2) Characterization of background cadmium and lead concentrations in Arctic Canada using analytical methods with lower detection limits.
3) Continue to assess background soil concentrations in Arctic Canada and determine the influence of atmospheric deposition, active layer water, and vegetation on the distribution of trace elements in surface soil.
4) Resample at background sample locations to better understand how trace element distributions vary temporally.

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Appendix A

Supplementary Information for Chapter 2: Literature Review

A.1 Literature Search

A literature review was performed in September 2017 and updated annually until submission of this thesis. Literature search was performed using JSTOR research platform. Results from the literature review are summarized in Table 1-2

Table 1: Search Criteria and results.

Search Criteria (Key word(s) & Field)	Controlled Vocabulary	Date of Search (mm-yy)	Total Number of Articles Found (prior to screening)	Number of Relevant Articles (may include duplicates)	Duplicates
background soil concentrations	-	09-2017	4269	Too Broad	0
background soil concentrations	refine to "Soil Science" category	09-2017	455	12	0
Baseline soil concentrations	-	09-2017	779	Too Broad	0
Baseline soil concentrations	refine to "Soil Science" category	09-2017	74	4	2
Ambient background soil	-	09-2017	283	4	1
Natural soil concentration	-	09-2017	10718	Too Broad	0
Natural soil concentration	refine to "Soil Science" category	09-2017	1239	Too Broad	0
Trace element concetrations in soil	-	09-2017	5156	Too Broad	0
Trace element concetrations in soil	refine to "Soil Science" category	09-2017	368	16	7
Inorganic elements in soil	-	09-2017	1150	Too Broad	0
Inorganic elements in soil		09-2017	137	1	0
Trace metals in soil	-	09-2017	7,926	Too Broad	0
Trace metals in soil	refine to "Soil Science" category	09-2017	843	Too Broad	0
Heavy metals in soil	-	09-2017	24906	Too Broad	0
Heavy metals in soil	refine to "Soil Science" category	09-2017	2719	Too Broad	0
Reference soil concentrations	-	09-2017	3087	Too Broad	0
Reference soil concentrations	refine to "Soil Science" category	09-2017	374	2	2
Geochemical background soil	refine to "Soil Science" category	09-2017	76	4	4
Statistical approaches	background soil data	09-2017	65	6	1
Statistical approaches	background environmental data, refine to "environmental science"	09-2017	52	5	3
Statistical analysis	Ambient soil	09-2017	74	0	0
Geochemical background	statistical analysis	09-2017	130	8	2
Determining background soil concentrations	statistical analysis	09-2017	69	5	2
Background and thresholds	Soil data	09-2017	125	5	4
Outlier tests	Soil data	09-2017	61	1	0
Values below detection limit	Soil data	09-2017	50	1	0
Censored data	soil data	09-2017	44	3	1
Upper confidence limit	Background soil data	09-2017	3	2	0
Site specific target levels	Background soil data	09-2017	2	1	0
Geochemical background	-	09-2017	-	6	0

Table 2: List of articles found from literature search

ID	Search Number	Year	Title	Journal
1	2	2014	Trace element concentrations and background values in the arid soils of Hormozgan Province of southern Iran	Archives of Agronomy and Soil Science
2	2	2010	Heavy metals in 3300-year-old agricultural soils used to assess present soil contamination	European Journal of Soil Science
3	2,9	2013	Heavy Metals in some soils of western georgia	Eurasian Soil Science
4	2,18,24	2014	A geochemcial survey of heavy metals in agricultural and background soils of the Isfahan industrial zone, Iran	Elsevier
5	2	2005	Local background concentrations of trace elements in soils: case study in the grand Duchy of Luxemburg	Elsevier
6	2	2005	Assessment of background concentrations of heavy metals in soils opf the northeastern part of European Russia	Eurasian Soil Science
7	2	2012	Identification of sources of heavy metals in agricultural soils using multivariate analysis and GIS	Journal of Soils and Sediments
8	2,5,9,18	2013	Modelling trace metal background to evaluate anthropogenic contamination in arable soils of south-western France	Geoderma
9	2	2012	background levels of potentially toxic elements in soils: a case study in Catamarca (a semiarid region in Argentina)	Catena
10	2,4,9,18	2006	Trace elements in soils developed in sedimentary materials from northern France	Geoderma
11	2,9	2006	Trace element distributions in soils developed in loess deposits from northern france	European Journal of Soil Science
12	2,4,9	2010	Defining soil geochemical baselines at small scales using geochemcial common factors and soil organic matter as normalizers	Journal of Soils and Sediments
13	4,9,17	2010	Baseline concentrations of heavy metals in native soils of the salamanca and valladolid provinces, spain	arid land research and management
14	4,9	2007	baselines for trace elements and evaluation of environmental risk in soils of Almeria (SE Spain)	Geoderma
15	5	2006	Estimates of ambient background concentrations of trace metals in soil for risk assessment	Envrionmental Pollution
16	5,19,20,25	2017	Assessment of ambient background concentrations of elements in soil using combined survey and open-source data	Science and total environment
17	5	2009	Ambient trace element background concentrations in soils and their use in risk assessment	Science and total environment
18	9	2012	Trace element in Benchmark Soils of Oklahoma	Soil science society of america
19	9	2011	Permissible and Background Concentrations of pollutants in environmental regulation (heavy metals and other chemcial elements)	Eurasian Soil Science
20	9,17	2016	Background and reference values of metals in soils from Paraiba State, Brazil	Revista Brasileira de ciencia do solo
21	9	2015	Naturally elevated metal contents of soils in northeastern north dakota, USA, with a focus on cadmium	Journal of Soils and Sediments
22	9	2010	Geochemistry and spatial distribution of heavy metals in oxisols in a mineralized region of the brazilian central plateau	Geoderma
23	9	2009	Trace elements in Ontario soils- mobility, concetration profiles, and evidence of non-point source pollution	Canadian Journal of Soil Science
24	9,18	2008	Geochemical background levels of zinc, cadmium and mercury in anthropically influenced soils located in a semi -arid zone (SE, Spain)	Geoderma
25	9	2005	Heavy metal content in soils of Reunion (Indian Ocean)	Geoderma
26	9	2006	Concentrations of Ag, In, Sn, Sb, and Bi, and their chemcial fractionation in typical soils in japan	European Journal of Soil Science
27	11	2013	Geochemical assessment of agricultural soil: a case study in Songnen-Plain (Northeastern China)	Catena
28	19,22,23	2016	Integrated Approach to Determine Background Concentrations of chemical elements in soils	Geochemistry International
29	19	2011	Heavy metals in urban soils of Bristol (UK). Initial screening for contaminated land	Journal of Soils and Sediments
30	19,20,22,23	2009	Geochemical background in soils: a linear process domain ? An example from (Croatia)	Environmental Earth Sciences
31	19,20,22	2006	Different approaches in using and understanding the term "geochemical background"	Polish Journal of Environmental Studies
32	19	2004	Identifying metals contaminated in soil: a geochemical approach	Soil & Sediment Contamination
33	20	2007	A review of geochemcial background concepts and an example using data from Poland	Environmental Geology
34	20	2004	Robust principle component analysis and outlier detection with ecologiocal data	Envrionmetrics
35	22	2017	Assessing background values of chloride, sulfate and fluoride in groundwater: a geochemcial-statistical approach at a regional scale	Journal of Geochemcial Exploration
36	22	2015	Background values for evaluation of heavy metal contamination in sediments in the Parnaiba River Delta Estuary.NE/Brazil	Marine Pollution Bulletin
37	22	2011	Background levels of trace elements and soil geochemistry at regional levels in NE Italy	Journal of Geochemcial Exploration
38	22,23,24	2010	Surface soil geochemistry for environmental assessment in Kavala Area, Northern Greece	Water, Air, & Soil Pollution
39	22	2011	Geochemical and statistical approach to evaluate background concentrations of Cd, Cu, Pb, and Zn (case study: Eastern Poland)	Environmental Earth Sciences
40	22	2005	Background and threshold: critical comparison of methods of determination	Science and total environment
41	23,24	2017	Determination of sediment metal background concentrations and enrichment in marine environments - a critical review	Science and total environment

ID	**Search Number**	**Year**	**Title**	**Journal**
42	23,24	2014	Comparison of methods used to calculate typical threshold values for potentially toxic elements in soil	Environmental Geochemistry and health
43	23	2008	Multivariate geostatistical analysis of heavy metals in topsoils from Beijing China	Journals of Soils and Sediments
44	23	2005	Geochemcial Background - concept versus reality	Science and total environment
45	24	2005	Baseline concentration of Cd, Co, Cr, Cu, Pb, Ni, and Zn in surface soils of south africa	South African Journal of Science
46	25	2005	Statistical Characterization of a large geochemical database and effect of sample size	Applied Geochemistry
47	26,27	2015	Estimating the mean and standard deviation of environmental data with below detection limit observations: considering highly skewed data and model misspecification	Chemosphere
48	27	2016	An investigation of the impact of left-censored soil contamination data on the uncertainty of descriptive statistical parameters	Environmental Toxicology and Chemistry
49	27	2014	On estimating population parameters in the presence of censored data: Overview if available methods	Hacettepe Journal of Mathematics and Statistics
50	28	2013	methodology for the determination of normal background concentrations of contaminants in english soil	Science and total environment
51	28	2008	trace element distribution in topsoils in catalonia: Background and reference values and relationship with regional geology	Environmental Engineering Science
52	29	2015	A comparison of methods used to calculate normal background concentrations of potentially toxic elements of urban soil	Science and total environment
53	30	2000	Normal and lognormal data distribution in geochemistry: death of a myth. Consequences for the statistical treatment of geochemical and environmental data	Environmental Geology
54	30	2006	maximum likelihood mixture estimation to determine metal background values in estuarine and coastal sediments within the european water framework directive	Science and total environment
55	30	2000	Geochemical background - can we calculate it ?	Environmental Geology
56	30	2011	Geochemical Background - an environmental perspective	Mineralogia
57	30	2017	Geochemical background and baseline values determination and spatial distribution of heavy metal pollution in soils of the Andes Mountain range (Cajamarca-Hunacavelica, Peru)	Envrionmental Research and Public Health
58	30	2017	Establishing Geochemical background of elements present in soil and its application in the evaluation of soils pollution based on data collected in the beskid sadecki region	Geoinformation Polonica
59	30	2005	Multivariate outlier detection in exploration gechemistry	computer & Geosciences
60	30	2008	Evaluation of Statistical treatment of Left-censored Environmental Data using Coincident uncensored data sets: I. Summary Statistics	Environmental Science and Technology
61	30	2005	Distinguishing between naturally and anthropogencially elevated arsenic at an abandoned arctic military site	Environmental Forensics
62	30	2013	Analysis of worldwide regualtory guidance values for the most commonly regulated elemental surface soil contamination	Journal of Environmental Management
63	30	2018	Establishing geochemical background and threshold for 53 chemical elements in European agricultural soil	Applied Geochemistry
64	30	2017	Establishing geochemical background variation and threshold values for 59 elements in Australian surface soil	Science and the Total Environment
65	30	2017	Assessment of ambient background concentrations of elements in soil using combined survey and open-source data	Science and the Total Environment

Appendix B

Supplementary Information for Chapter 4: Arctic Canada Background Inorganic Element Concentration Data Set

Table of Contents

List of Tables

B.1 Introduction

From 1989 to 2016, the Environmental Sciences Group of the Royal Military College of Canada (RMCC-ESG) collected background soil data from 61 former and current early warning radar stations. The soil samples collected were analyzed for eight inorganic elements; Copper (Cu), Nickel (Ni), Cobalt (Co), Cadmium (Cd), Lead (Pb), Zinc (Zn), Chromium (Cr), and Arsenic (As). During the collection of all background soil samples, a strict quality assurance/quality control program was implemented.

All analysis was conducted by a Laboratory accredited by the Canadian Association for Laboratory Accreditation Incorporated to the International Organization for Standardization (ISO) 17025 standard. Soil samples were dry sieved to generate a <2mm grain size fraction subsample and were analyzed by inductively coupled plasma (ICP) – Optical Emission Spectroscopy (OES) after the dissolution of trace elements in Aqua Regia solution..

B.2 Methods

Data compilation

Background soil data collected from each of the 61 sites was extracted from separate contaminated site investigation reports. Each report was read to understand the approach used to perform the background sampling programs at each site. For the purpose of this study, the data selected was limited to surficial soil at 0 to 100 centimeters depth from the surface.

Background soil data sets from each site were kept separate for analysis. Additionally, if a site encompassed more than one terrain unit, the terrain units were investigated separately. If data sets had a sample size smaller than 8 or had a percentage of non-detect values greater than 50% of the data set, data analysis was not performed.

Analysis of Arctic Background Soil Data

All data analysis was performed in Microsoft XLSTAT 2018 software (Addinsoft, 2019) and ProUCL 5.0 software (Singh & Singh, 2013). All boxplots and tables were generated in Microsoft XLSTAT 2018.

Outlier Detection

Initial univariate outlier analysis was completed for each soil data set. The outlier tests chosen were i) the removal of outliers three times the interquartile range (IQR) above and below the third and first quartiles, respectively; referred to as the interquartile rule (3×IQR), ii) the removal of outliers four standard deviations above or below the mean (Mean+/-4SD) iii), the removal of outliers three standard deviations above or below the mean (Mean+/-3SD), and iv) the removal of outliers two standard deviations above or below the mean (Mean+/-2SD). Additionally, raw data sets without the removal of any outliers were also carried forward through analysis for comparison purposes. Each outlier test was applied to all data sets separately to identify the influence of omitting outliers from the data set. Each resulting data set was carried forward through distribution analysis to determine whether identified outliers influenced distribution results.

Distribution analysis

The distribution of each data set available after removing outliers was tested using ProUCL 5.0 software (Singh & Singh, 2013). Distribution analysis began by first testing if the data fit a normal distribution, evaluated using the Shapiro-Wilk test. If the sample size was greater than 50, a Lilliefors test was employed. The Lilliefors test has been identified as more applicable than the Shapiro-Wilk test for larger data sets (Conover, 1999; Dudewicz & Misra, 1988). If the data did not fit a normal distribution, ProUCL 5.0 also tests for lognormal and gamma distributions. To test for lognormality, ProUCL 5.0 performs the Shapiro-Wilk test and the Lillifors test on log-transformed data. To test for gamma distributions, a Kolmogorov-Smirnov (K-S) test was employed to test the fit. If the data set did not fit any of the above data distributions, the data set was treated as nonparametric. Distribution results of the data sets with and without the outliers identified during outlier analysis were compared.

Derivation of Background Summary Statistics

Summary statistics for each data set were derived using ProUCL 5.0 software. Additionally, the 95 percent upper confidence limit (95UCL) was calculated using ProUCL 5.0 software.

The appropriate outlier method was chosen for each data set separately by comparing both distribution analysis results and summary statistics values along with graphical analysis. The outlier method was chosen by determining whether the outlier heavily distorted distribution results or the 95UCL. If it was evident that the outlier influenced distribution results, the outlier was removed and the resulting distribution was reported. The 3×IQR outlier method was chosen if the final distribution was non-normal as it is considered a non-parametric test. A Mean+/-nSD method was chosen if the final distribution was normal. The final outlier method chosen for each data set at each site is detailed and justified in the Supplementary Information, Section S2.

Where concentrations were below the analytical detection limit, the Kaplan-Meier (KM) estimation method was used. The KM method is incorporated into the ProUCL 5.0 software. If more than 50 percent of the data set was below the detection limit, only the maximum concentration was provided.

Population Analysis

If more than one terrain unit was identified at a site, population analysis was performed to determine whether terrain units at the site could be combined to create a larger data set. Following investigation of each terrain separately, background data from each terrain unit was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units were significantly different. All tests were performed without replacement of values below the detection limit to avoid misinterpretation of population distributions involving significant quantities of substitution. If population analysis concluded that the terrain units were not significantly different, the background soil data sets were combined, and summary statistics were recalculated.

B.3 Terrain Unit Identification

The method for terrain unit identification at each site is outlined in the table below.

Table 1: A description of the terrain unit identification methods used at each site.

Site ID	Year	Number of Terrain Units	Terrain Unit Identification
1	2012	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
2	2013	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.

Site ID	Year	Number of Terrain Units	Terrain Unit Identification
3	2006	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
4	1991	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
5	1994	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
6	2008	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
7	1990	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
8	1992	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
9	2008	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
10	2011	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
11	2006	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
12	1990	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
13	1992	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
14	2011	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
15	1999	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
16	2011	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
17	1994	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
18	2004	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
19	2012	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
20	2012	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
21	1992	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
22	2000	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
23	2009	2	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
24	2012	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
25	2003	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
26	2012	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
27	1990	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
28	2012	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
29	2009	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
30	2002	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
31	2010	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the

Site ID	Year	Number of Terrain Units	Terrain Unit Identification
			raised station area and the low lying beach area that interacts with the ocean.
32	2001	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
33	2012	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
34	1992	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
35	2000	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
36	2010	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
37	2003	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
38	2000	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
39	2007	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
40	1993	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
41	2007	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
42	2001	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
43	2010	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
44	2010	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
45	2005	5	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
46	2009	4	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
47	2006	6	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
48	2011	5	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
49	1990	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
50	1993	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.
51	2009	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
52	2009	2	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
53	2003	4	Terrain units were identified using high resolution air photographs and satellite imagery. Terrain units identified were confirmed during the field program.
54	2010	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
55	2009	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
56	2009	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
57	2008	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
58	2008	1	One terrain unit identified at the site during site visit based on soil characteristics. All surrounding background areas were considered to be the same as the site.
59	2007	1	Terrain units were not considered and were not identified. All surrounding background areas were considered to be the same as the site.

Site ID	Year	Number of Terrain Units	Terrain Unit Identification
60	2008	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.
61	2012	2	Background soil units were divided into two terrain units during site visit. The two areas identified were the raised station area and the low lying beach area that interacts with the ocean.

B.3 Description of Data Analysis by Site

B.3.1 SITE 1, Komakuk Beach, Yukon Territory

A background sampling program was carried out for the site in 2012 and all samples were collected from the only terrain unit in the 500 meters background radius of the Station. 22 background samples were collected from random locations within 50 to 500 meters of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 2: SITE 1 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G1617	1992	0	23.0	26.0	16.0	1.0	10.0	86.0	78.0	7.4
G1618	1992	0	18.0	24.0	13.0	1.0	10.0	81.0	67.0	7.9
G1619	1992	0	17.0	20.0	6.2	1.0	10.0	65.0	47.0	2.0
00-3016	2000	0	16.0	19.0	10.0	1.0	10.0	66.0	35.0	24.0
00-3023	2000	0	32.0	22.0	14.0	1.0	10.0	110.0	44.0	13.0
9803	2011	0	13.2	13.2	<5.0	<1.0	<10	35.7	<20	3.2
9804	2011	0	20.3	27.6	8.6	<1.0	<10	66.5	22.7	6.2
9805	2011	20-30	16.9	24.5	7.5	<1.0	<10	55.7	20.9	4.8
9806	2011	0	7.5	10.8	6.9	<1.0	<10	18.2	<20	1.7
9807	2011	0	9.6	9.8	<5.0	<1.0	<10	32.2	<20	2.4
9810	2011	0	12.5	12.9	<5.0	<1.0	<10	<15	<20	2.9
9811	2011	0	16.4	14.5	<5.0	<1.0	<10	<15	<20	2.7
9812	2011	0	22.7	17.4	5.0	<1.0	<10	31.7	23.3	6.3
9813	2011	0	<5.0	8.0	<5.0	<1.0	<10	31.2	<20	1.2
9814	2011	0	7.7	14.6	19.8	<1.0	<10	19.6	<20	4.0
9815	2011	0	9.6	11.4	10.5	<1.0	<10	36.3	<20	2.7
9816	2011	0	10.5	17.4	5.0	<1.0	11.5	55.2	29.7	7.8
9817	2011	0	5.5	9.6	7.6	<1.0	<10	<15	<20	1.1
9818	2011	0	21.1	25.4	12.1	<1.0	15.3	96.0	44.4	6.1
9819	2011	0	8.6	10.2	<5.0	<1.0	<10	17.1	<20	4.2
9820	2011	0	9.2	14.4	<5.0	<1.0	10.6	42.6	32.1	9.6
9821	2011	0	9.0	8.7	<5.0	<1.0	<10	15.8	<20	3.4

SQG = CCME Soil Quality Guidelines for residential/parkland land use; ppm = parts per million.

Table 3: SITE 1 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	22	22	22	22	22	22	22	22
%ND	5	0	41	100	86	14	50	0
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 4: SITE 1 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	43.9	53.1	26.4	N/A	N/A	207.3	N/A	20.4
# of Outliers	0	0	0	0	3	0	1	1
Mean+/-4SD (ppm)	41.2	42.6	24.9	N/A	N/A	156.5	N/A	24.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	34.1	35.8	20.6	N/A	N/A	126.7	N/A	19.3
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-2SD (ppm)	26.9	28.9	16.2	N/A	N/A	96.9	N/A	14.3
# of Outliers	1	0	1	0	1	1	2	1
Lower Limit								
3×IQR (ppm)	-17.1	-20.6	-11.0	N/A	N/A	-123.0	N/A	-10.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-15.9	-12.0	-10.1	N/A	N/A	-82.0	N/A	-15.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-8.8	-5.1	-5.7	N/A	N/A	-52.2	N/A	-10.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-1.6	1.7	-1.3	N/A	N/A	-22.4	N/A	-5.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 5: SITE 1 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. All methods returned identical results, except Mean+/-2SD. The Mean+/-2SD method detected one outlier above the upper limit, however, the outlier did not visually appear to be from a separate population and did not distort distribution results.
Ni	Method chosen: No outlier removed. No outliers were detected with all methods.
Co	Method chosen: No outlier removed. All methods returned identical results, except Mean+/-2SD. The Mean+/-2SD method detected one outlier above the upper limit, however, the outlier did not visually appear to be from a separate population and did not distort distribution results.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outlier removed. All methods returned identical results, except Mean+/-2SD. The Mean+/-2SD method detected one outlier above the upper limit, however, the outlier did not visually appear to be from a separate population and did not distort distribution results.
Cr	Not analysed
As	Method chosen: 3×IQR. One outlier found distant from the rest of the data set. The Mean+/-3SD and Mean+/-2SD also detected this outlier. This outlier distorted the 95UCL results, making concentration seem greater by ~2ppm.

SD = standard deviation; IQR = interquartile range

Table 6: SITE 1 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	21	22	22	22	22	22	22	21
ND	1	0	9	22	22	3	11	0
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	8.0	5.0	1.0	10	15	20	1.1
Max (ppm)	32	28	20	1.0	10	110	78	13
Mean (ppm)	14	16	8.3	1.0	10	46	30	4.8
Med (ppm)	13	15	6.6	1.0	10	36	35	4.0
SD (ppm)	6.8	6.3	4.3	N/A	N/A	29	N/A	3.1
95%tile (ppm)	23	26	16	N/A	N/A	95	N/A	9.5
95UCL (ppm)	17	19	9.9	N/A	N/A	56	N/A	5.9
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.2 SITE 2, Yukon Territory

A background sampling program was carried out for the site in 2013, and all soil samples were collected from the only terrain unit in the 500 meters background radius of the operation facility and any areas of anthropogenic impact. 10 background samples were collected from random locations within 50 to 500 meters of the site. All samples were analyzed for a large suite of inorganic elements, however, only the Arctic suite was investigated in this report to remain consistent with other background sampling programs.

Table 7: SITE 2 (all terrain) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**5**	**1**	**15**	**1**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
6990	2013	20	18	21	8.9	<0.50	10	40	7.4	32
6991	2013	20	17	19	8.2	<0.50	9.4	37	6.9	31
6992	2013	20	19	19	8.4	<0.50	22	41	8.1	35
6993	2013	20	15	19	8.2	<0.50	8.8	38	7.8	35
6994	2013	20	15	17	7.2	<0.50	7.9	34	6.9	24
6995	2013	20	12	14	6.0	<0.50	6.8	27	5.4	21
6996	2013	20	17	17	7.2	<0.50	8.7	28	3.4	16
6997	2013	20	14	13	5.8	<0.50	6.9	24	4.2	17
6998	2013	20	16	16	7.0	<0.50	8.8	28	4.4	20
6999	2013	20	15	17	7.6	<0.50	8.5	34	6.3	28

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 8: SITE 2 (all terrain) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	10	10	10	10	10	10	10	10
%ND	0	0	0	100	0	0	0	0
Analysed?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 9: SITE 2 (all terrain) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	23.0	27.3	11.7	0.5	12.9	67.0	15.2	66.3
# of Outliers	0	0	0	0	1	0	0	0
Mean+/-4SD (ppm)	34.0	37.6	15.0	2.3	28.4	76.5	13.8	64.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	29.4	32.4	13.1	1.9	23.6	65.5	11.8	54.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	24.9	27.3	11.2	1.4	18.8	54.5	9.8	44.9
# of Outliers	0	0	0	0	1	0	0	0
Lower Limit								
3×IQR (ppm)	9.0	8.0	3.6	0.5	4.5	-1.3	-3.2	-14.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-2.7	-3.5	-0.2	-1.3	-10.0	-11.3	-2.1	-14.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	1.9	1.6	1.7	-0.9	-5.2	-0.3	-0.1	-4.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	6.5	6.8	3.6	-0.4	-0.4	10.7	1.9	5.0
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 10: SITE 2 (all terrain) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers were detected with all methods.
Ni	Method chosen: No outlier removed. No outliers were detected with all methods.
Co	Method chosen: No outlier removed. No outliers were detected with all methods.
Cd	Not analysed
Pb	Method chosen: 3×IQR. One outlier found distant from the rest of the data set. The Mean+/-2SD method also detected this outlier. This outlier distorted the 95UCL results and the distribution analysis results, making concentration seem greater by ~2ppm.
Zn	Method chosen: No outlier removed. No outliers were detected with all methods.
Cr	Method chosen: No outlier removed. No outliers were detected with all methods.
As	Method chosen: No outlier removed. No outliers were detected with all methods.

SD = standard deviation; IQR = interquartile range.

Table 11: SITE 2 (all terrain) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	10	10	10	10	9	10	10	10
ND	0	0	0	10	0	0	0	0
DL (ppm)	5.0	5.0	5.0	1.0	1.0	15	1.0	0.2
Min (ppm)	12	13	5.8	1	6.8	24	3.4	16
Max (ppm)	19	21	8.9	1	10	41	8.1	35
Mean (ppm)	16	17	7.5	1	8.4	33	6.1	26
Med (ppm)	16	17	7.4	1	8.7	34	6.6	26
SD (ppm)	2.0	2.4	1.0	N/A	1.1	6.0	1.6	7.2
95%tile (ppm)	18	20	8.7	N/A	9.8	40	8.0	35
95UCL (ppm)	17	19	8.0	N/A	9.1	37	7.0	30
Distribution	norm	norm	norm	N/A	norm	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.3 SITE 3, Stokes Point, Yukon Territory

A background sampling program was carried out for the site in 2006, and all soil samples were collected from the only terrain unit in the 500 meters background radius of the station area. 58 background samples were collected from random locations within 50 to 500 meters of the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 12: SITE 3 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
26401	2006	25	13.0	18.0	13.0	<1.0	<10	52.0	31.0	8.6
26402	2006	20	17.0	16.0	<5.0	<1.0	12.0	57.0	29.0	8.6
26403	2006	35	24.0	24.0	8.1	<1.0	<10	67.0	24.0	3.8
26404	2006	20	29.0	25.0	7.5	<1.0	12.0	98.0	33.0	5.7
26405	2006	20	22.0	29.0	9.9	<1.0	13.0	96.0	43.0	3.8
26406	2006	10	11.0	15.0	12.0	<1.0	10.0	58.0	32.0	11.0
26407	2006	20	16.0	19.0	14.0	<1.0	10.0	61.0	29.0	11.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
26408	2006	10	16.0	19.0	12.0	<1.0	10.0	73.0	30.0	11.0
26409	2006	20	29.0	33.0	9.8	<1.0	12.0	100.0	34.0	15.0
06-26410/11	2006	20	28.0	25.0	7.6	<1.0	11.0	82.0	34.0	4.2
26412	2006	20	18.0	24.0	14.0	<1.0	12.0	82.0	31.0	12.0
26413	2006	30	20.0	26.0	12.0	<1.0	12.0	84.0	30.0	12.0
26414	2006	20	18.0	24.0	10.0	<1.0	11.0	72.0	57.0	8.7
26415	2006	15	18.0	25.0	12.0	<1.0	11.0	86.0	33.0	14.0
26419	2006	20	14.0	17.0	6.6	<1.0	<10	48.0	29.0	5.8
06-26420/21	2006	20	12.0	10.0	<5.0	<1.0	<10	<15	<20	1.6
26422	2006	10	15.0	16.0	8.0	<1.0	<10	64.0	30.0	8.4
26423	2006	35	28.0	24.0	9.2	<1.0	11.0	82.0	29.0	5.2
26424	2006	15	18.0	22.0	12.0	<1.0	12.0	75.0	34.0	10.0
06-26430/31	2006	25	24.0	23.0	5.5	<1.0	14.0	76.0	34.0	3.1
26432	2006	20	7.9	11.0	<5.0	<1.0	<10	41.0	29.0	6.2
26433	2006	20	16.0	16.0	11.0	<1.0	<10	73.0	31.0	6.2
26434	2006	20	9.4	12.0	12.0	<1.0	<10	56.0	28.0	11.0
26435	2006	30	20.0	19.0	12.0	<1.0	<10	49.0	25.0	20.0
26436	2006	15	16.0	10.0	<5.0	<1.0	<10	31.0	26.0	1.9
26437	2006	30	19.0	21.0	5.8	<1.0	<10	47.0	<20	6.8
06-26440/41	2006	20	32.0	28.0	7.2	<1.0	14.0	98.0	42.0	3.4
26444	2006	20	22.0	21.0	6.2	<1.0	<10	59.0	23.0	8.1
26445	2006	5	14.0	18.0	5.6	<1.0	<10	54.0	<20	6.0
26449	2006	40	9.4	14.0	5.9	<1.0	<10	40.0	<20	9.4
06-26450/51	2006	30	<5.0	9.8	<5.0	<1.0	<10	30.0	<20	8.8
26452	2006	15	18.0	21.0	15.0	<1.0	11.0	66.0	33.0	11.0
26453	2006	40	19.0	23.0	9.7	<1.0	13.0	67.0	35.0	12.0
26454	2006	15	29.0	36.0	17.0	<1.0	17.0	150.0	41.0	13.0
26455	2006	15	7.1	11.0	3.3	<1.0	<2.0	19.0	5.0	3.0
26456	2006	10	7.4	12.0	<5.0	<1.0	<10	29.0	<20	7.6
26457	2006	55	5.5	11.0	<5.0	<1.0	<10	34.0	<20	8.2
26458	2006	0	7.2	13.0	6.1	<1.0	<10	39.0	<20	14.0
26459	2006	0	6.7	13.0	6.1	<1.0	<10	39.0	<20	14.0
06-26460/61	2006	40	<5.0	9.6	<5.0	<1.0	<10	28.0	<20	8.4
26462	2006	70	6.3	14.0	6.8	<1.0	<10	43.0	<20	13.0
26463	2006	20	5.1	8.1	<5.0	<1.0	<10	23.0	<20	6.8
26466	2006	0	6.9	14.0	6.4	<1.0	<10	38.0	<20	14.0
26467	2006	50	7.3	8.7	<5.0	<1.0	<10	24.0	<20	6.3
26468	2006	30	5.7	11.0	5.1	<1.0	<10	31.0	<20	8.0
26469	2006	0	5.2	8.4	<5.0	<1.0	<10	22.0	<20	6.6
06-26470/71	2006	5	6.6	9.8	<5.0	<1.0	<10	27.0	<20	7.6
26472	2006	15	6.8	14.0	6.8	<1.0	<10	33.0	<20	5.8
26473	2006	10	21.0	23.0	11.0	<1.0	11.0	77.0	33.0	12.0
26474	2006	25	21.0	21.0	9.9	<1.0	10.0	62.0	33.0	8.9
26477	2006	20	16.0	11.0	<5.0	<1.0	<10	<15	<20	1.1
26478	2006	20	11.0	9.7	5.4	<1.0	<10	20.0	<20	1.7
26479	2006	15	24.0	27.0	7.9	<1.0	15.0	110.0	47.0	5.0
26722	2006	20	13.0	17.0	11.0	<1.0	11.0	69.0	25.0	11.0
26723	2006	10	19.0	25.0	13.0	<1.0	11.0	76.0	30.0	11.0
26724	2006	30	23.0	29.0	8.8	<1.0	10.0	84.0	31.0	9.8
26725	2006	20	26.0	35.0	13.0	<1.0	13.0	100.0	31.0	13.0
26728	2006	50	5.7	12.0	5.5	<1.0	<10	30.0	<20	5.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use; ppm = parts per million.

Table 13: SITE 3 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	58	58	58	58	58	58	58	58
%ND	0	0	22	100	62	3	36	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 14: SITE 3 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	61.0	60.0	28.5	1.0	14.0	204.3	71.0	26.6
# of Outliers	0	0	0	0	2	0	0	0
Mean+/-4SD (ppm)	44.6	46.7	21.3	1.5	19.2	166.2	62.3	23.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	36.8	39.3	17.9	1.4	17.0	137.4	53.2	19.3
# of Outliers	0	0	0	0	1	1	1	1
Mean+/-2SD (ppm)	29.0	31.8	14.5	1.3	14.8	108.6	44.2	15.3
# of Outliers	1	3	2	0	2	2	2	1
Lower Limit								
3×IQR (ppm)	-33.0	-24.0	-12.3	1.0	7.0	-95.0	-18.3	-9.8
# of Outliers	0	0	0	0	1	0	0	0
Mean+/-4SD (ppm)	-17.9	-12.9	-5.9	0.5	1.8	-64.4	-10.1	-8.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-10.1	-5.4	-2.5	0.6	3.9	-35.6	-1.1	-4.6
# of Outliers	0	0	0	0	1	0	0	0
Mean+/-2SD (ppm)	-2.2	2.0	0.9	0.7	6.1	-6.8	8.0	-0.7
# of Outliers	0	0	0	0	1	0	1	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 15: SITE 3 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. The Mean+/-2SD method was the only method that identified outliers. The removal of outliers had a minor influence on calculated background concentration and no influence on distribution analysis results.
Ni	Method chosen: No outlier removed. Outliers only detected using the Mean+/-2SD method, however, as the data fit a gamma distribution with and without the outliers, the Mean+/-2SD is not an appropriate outlier detection method for this data set.
Co	Method chosen: No outlier removed. Two outliers found using the Mean+/-2SD method. However, these outliers did not distort calculated background concentrations or distribution results, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: Mean+/-3SD. One outlier found distant from the rest of the data set. The Mean+/-2SD method also detected this outlier. This outlier distorted the calculated background concentrations, however, did not influence distribution analysis results.
Cr	Method chosen: Mean+/-3SD. One outlier found distant from the rest of the data set. The Mean+/-2SD method also detected this outlier. Data set fit a normal distribution when using ROS methods for the treatment of non-detect values, therefore, the Mean+/-3SD methods is appropriate for the data set. Removal of outlier has a minor impact on calculated background concentrations.
As	Method chosen: Mean+/-3SD. One outlier found distant from the rest of the data set. The Mean+/-2SD method also detected this outlier. This outlier had minor influence on background concentration, however was removed after graphical representation.

SD = standard deviation; IQR = interquartile range.

Table 16: SITE 3 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	57	58	57	58	58	57	57	57
ND	0	0	13	58	36	2	21	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	5.0	8.1	5.0	1	10	15	5.0	1.1
Max (ppm)	32	36	17	1	17	110	47	15
Mean (ppm)	15	18	8.4	1	11	56	27	8.2
Med (ppm)	16	18	9.4	1	12	58	29	8.4
SD (ppm)	7.4	7.2	3.3	N/A	N/A	25	7.0	3.6
95%tile (ppm)	29	30	14	N/A	N/A	98	41	14
95UCL (ppm)	20	20	9.1	N/A	N/A	62	29	9.0
Distribution	non-p	gamma	norm	N/A	N/A	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.4 SITE 4, Shingle Point, Yukon Territory

In 1991 background soil data was collected from the area surrounding the station area. However, only two background soil samples were collected from random locations surrounding the station. These samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 17: SITE 4 (station area) background soil data.

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G637	1990	0	29.0	25.0	17.0	<1.0	<10	54.0	61.0	9.1
G634	1990	0	15.0	8.9	<5.0	<1.0	11.0	15.0	<20	0.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 18: SITE 4 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	0	50	100	50	0	50	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 19: SITE 4 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	2	2	2	2	2	2	2	2
ND	0	0	1	2	1	0	1	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Max (ppm)	29	25	17	1.0	11	54	61	9.1
Mean (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Med (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
SD (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95%tile (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95UCL (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.5 SITE 5, Tununuk Point, Northwest Territories

A background sampling program was carried out for the site in 1994, and all soil samples were collected from the only terrain unit in the 500 meters background radius of the Station. Nine background samples were collected within 50 to 500 meters of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 20: SITE 5 (station area) background soil data.

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G5053	1994	0	15.3	12.1	10.7	<1.0	<10	59.0	45.0	3.4
G5054	1994	0	26.0	29.0	11.9	<1.0	10.8	122.0	39.0	6.3

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G5055	1994	0	15.2	15.4	11.3	<1.0	<10	63.0	43.0	7.3
G5056	1994	0	8.2	8.7	7.2	<1.0	<10	68.0	<20	5.1
G5049	1994	0	7.5	<5.0	<5.0	<1.0	<10	175.0	<20	0.5
G5050A	1994	0	3.2	6.4	<5.0	<1.0	<10	27.0	<20	6.6
G5050B	1994	0	3.1	9.1	7.7	<1.0	<10	25.0	<20	7.8
G5051	1994	0	4.8	<5.0	<5.0	<1.0	<10	21.0	<20	4.5
G5052	1994	0	40.0	11.8	8.2	<1.0	11.7	58.0	60.0	29.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 21: SITE 5 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	9	9	9	9	9	9	9	9
%ND	0	22	33	100	78	0	56	0
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 22: SITE 5 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	46.8	29.2	27.8	1.0	10.0	191.0	112.0	15.7
# of Outliers	0	0	0	0	2	0	0	1
Mean+/-4SD (ppm)	58.5	40.3	20.5	2.3	21.0	262.6	97.6	37.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	46.3	32.7	17.2	1.9	18.3	210.7	80.4	29.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	34.0	25.0	14.0	1.6	15.6	158.7	63.3	21.2
# of Outliers	1	1	0	0	0	1	0	1
Lower Limit								
3×IQR (ppm)	-26.7	-10.7	-12.1	1.0	10.0	-96.0	-49.0	-3.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-39.2	-20.8	-5.3	-0.3	-0.4	-153.1	-39.6	-26.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-27.0	-13.2	-2.1	0.1	2.2	-101.1	-22.5	-18.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-14.8	-5.5	1.1	0.4	4.9	-49.2	-5.3	-10.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 23: SITE 5 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified.
Ni	Method chosen: No outlier removed. Outliers only detected using the Mean+/-2SD method, however, this outlier had minor impact on background concentrations and did not change the distribution analysis results.
Co	Method chosen: No outlier removed. Outliers only detected using the Mean+/-2SD method, however, this outlier had minor impact on background concentrations and did not change the distribution analysis results.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outlier removed. No outliers identified.
Cr	Not analysed
As	Method chosen: 3×IQR. One outlier found distant from the rest of the data set. The Mean+/-2SD method also detected this outlier. This outlier influenced background concentrations and distribution analysis, making the data set appear lognormal

SD = standard deviation; IQR = interquartile range.

Table 24: SITE 3 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	9	9	9	9	9	9	9	8
ND	0	2	3	9	7	0	5	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	3.1	5.0	5.0	1.0	10	21	20	0.5
Max (ppm)	40	29	11.9	1.0	12	175	60	7.8
Mean (ppm)	14	11	8.0	1.0	11	69	32	5.2
Med (ppm)	8.2	12	9.4	1.0	10	59	44	5.7
SD (ppm)	12	7.0	2.6	N/A	N/A	50	N/A	2.4
95%tile (ppm)	34	24	12	N/A	N/A	154	N/A	7.6
95UCL (ppm)	21	16	9.8	N/A	N/A	100	N/A	6.8
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.6 SITE 6, Storm Hills, Northwest Territory

A background sampling program was carried out for the site in 2008, and all soil samples were collected from the only terrain unit in the 500 meters background radius of the Station, referred to as the moraine surficial geological terrain unit. 26 background samples were collected within 50 to 500 meters of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 25: SITE 6 (moraine terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
15240	2008	10	11.0	13.9	11.1	<1.0	11.0	53.0	33.0	10.1

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
15241	2008	10	11.2	13.3	11.9	<1.0	11.0	53.0	30.0	10.3
15242	2008	10	26.0	25.8	10.0	<1.0	13.0	83.0	39.0	9.3
15243	2008	10	10.9	11.8	<5.0	<1.0	<10	38.0	<20	3.5
15244	2008	10	21.3	22.1	15.7	<1.0	12.4	71.1	37.9	10.7
15245	2008	30	21.1	24.2	9.0	<1.0	11.8	70.2	38.9	10.7
15246	2008	10	15.6	33.8	75.6	1.0	<10	91.9	<20	1.2
15247	2008	10	7.3	7.6	<5.0	<1.0	<10	41.4	<20	<1.0
15248	2008	10	18.8	21.9	7.9	<1.0	12.0	63.7	50.0	11.1
15249	2008	35	17.3	19.8	9.6	<1.0	11.9	64.1	37.3	11.2
15250	2008	10	17.2	16.4	5.4	<1.0	10.2	58.3	35.4	9.4
15251	2008	10	17.7	15.6	5.9	<1.0	12.2	58.8	25.9	11.2
15252	2008	10	5.9	6.8	<5.0	<1.0	<10	46.8	<20	<1.0
15253	2008	10	15.1	16.5	8.6	<1.0	11.0	56.7	24.0	9.6
15254	2008	30	17.5	22.4	16.3	<1.0	12.3	72.8	28.6	13.1
15255	2008	10	20.4	23.1	11.0	<1.0	11.6	63.1	29.5	11.7
15256	2008	10	18.9	21.0	14.2	<1.0	12.8	67.3	31.8	11.9
15257	2008	30	19.0	20.8	9.3	<1.0	13.5	69.0	30.6	12.2
15258	2008	10	20.9	21.4	6.2	<1.0	13.6	66.0	29.7	10.7
15336	2008	10	19.4	19.2	7.9	<1.0	13.6	70.9	35.8	12.0
15337	2008	45	17.9	19.7	8.4	<1.0	12.9	69.0	34.1	10.9
15338	2008	10	11.5	17.4	9.7	<1.0	11.9	69.8	24.0	12.4
15339	2008	10	11.1	13.3	5.7	<1.0	11.6	53.6	23.7	11.8
15340	2008	10	18.4	20.1	7.5	<1.0	12.7	63.6	30.9	11.9
15341	2008	10	17.8	19.9	6.7	<1.0	13.5	61.4	32.3	11.7
15342	2008	10	19.2	22.7	8.2	<1.0	13.9	68.1	36.3	11.7

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 26: SITE 6 (moraine terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	0	0	12	100	15	0	15	8
Analysed?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 27: SITE 6 (moraine terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	39.3	40.7	24.0	1.0	18.5	107.1	69.6	17.9
# of Outliers	0	0	1	0	0	0	0	0
Mean+/-4SD (ppm)	37.3	43.8	62.4	1.8	21.0	127.9	66.0	23.6
# of Outliers	0	0	1	0	0	0	0	0
Mean+/-3SD (ppm)	31.9	37.3	49.0	1.6	18.7	111.5	57.0	19.7
# of Outliers	0	0	1	0	0	0	0	0
Mean+/-2SD (ppm)	26.5	30.8	35.7	1.4	16.4	95.0	48.0	15.8
# of Outliers	0	1	1	0	0	0	1	0
Lower Limit								
3×IQR (ppm)	-7.8	-2.8	-7.0	1.0	5.4	19.6	-9.4	3.6
# of Outliers	0	0	0	0	0	0	0	4
Mean+/-4SD (ppm)	-5.9	-8.0	-44.2	0.2	2.8	-3.6	-6.3	-7.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-0.5	-1.5	-30.9	0.4	5.1	12.8	2.7	-3.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	4.9	4.9	-17.6	0.6	7.3	29.3	11.8	0.4
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 28: SITE 6 (moraine terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified.
Ni	Method chosen: Mean+/-2SD. One outlier found distant from the rest of the data set. This outlier had minor impact on background concentrations and did not change the distribution analysis results.
Co	Method chosen: 3×IQR. All outlier methods detected this outlier. This outlier significantly influenced background concentrations and distribution analysis.
Cd	Not analysed
Pb	Method chosen: No outlier removed. No outliers identified.
Zn	Method chosen: No outlier removed. No outliers identified.
Cr	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
As	Method chosen: No outlier removed. No outliers identified.

SD = standard deviation; IQR = interquartile range.

Table 29: SITE 6 (moraine terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	25	25	26	26	26	26	26
ND	0	0	3	26	4	0	4	2
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1
Min (ppm)	5.9	6.8	5.0	1.0	10	38	20	1.0
Max (ppm)	26	26	16	1.0	14	92	50	13
Mean (ppm)	16.5	18	8.8	1.0	12	63	31	9.7
Med (ppm)	17	20	8.7	1.0	12	64	32	11
SD (ppm)	4.7	4.9	3.1	N/A	1.2	12	7.2	3.6
95%tile (ppm)	21	24	15	N/A	14	80	39	12
95UCL (ppm)	18	20	9.9	N/A	12	67	33	13
Distribution	norm	norm	norm	N/A	norm	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.7 SITE 7, Tuktoyaktuk, Northwest Territory

Table 30: SITE 7 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G915	1990	0	21.1	29.0	16.6	1.0	10.0	64.0	35.0	4.7
G916	1990	0	21.0	16.2	11.1	1.0	15.0	99.0	37.0	14.9
G917	1990	0	11.3	5.0	5.0	1.0	10.0	154.0	20.0	7.6
G918	1990	0	15.4	27.6	9.9	1.0	10.0	110.0	61.0	13.7
9440	2011	0	11.3	14.5	5.4	1.0	26.0	54.1	20.0	12.9
9441	2011	0	10.9	14.5	5.7	1.0	30.9	59.8	20.0	11.8
9442	2011	0	13.9	21.2	7.6	1.0	11.8	59.2	20.0	15.6
9443	2011	0	15.6	21.5	8.2	1.0	15.5	67.4	20.0	25.9
9444	2011	20-30	14.5	20.8	8.2	1.0	12.6	65.1	20.0	17.4
9445	2011	0	9.5	15.7	6.2	1.0	11.1	47.9	20.0	16.5
9446	2011	0	16.5	23.0	9.0	1.0	16.0	76.0	20.0	20.5
9447	2011	0	8.3	18.2	7.7	1.0	15.5	55.5	21.1	20.8

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
9448	2011	0	14.9	25.0	9.4	1.0	15.0	64.1	20.0	32.6
9449	2011	20-30	12.4	20.5	8.0	1.0	13.1	58.3	20.0	23.2
9450	2011	0	5.0	5.0	5.0	1.0	10.0	15.0	20.0	1.0
9451	2011	0	5.0	5.0	5.0	1.0	10.0	15.0	20.0	1.0
9452	2011	0	5.0	5.0	5.0	1.0	10.0	15.0	20.0	1.0
9453	2011	0	5.0	5.8	5.0	1.0	10.0	18.2	20.0	3.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 31: SITE 7 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	18	18	18	18	18	18	18	18
%ND	22	22	28	100	39	17	78	17
Analysed?	Yes	Yes	Yes	No	Yes	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 32: SITE 7 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	35.3	61.7	19.9	1.0	31.4	119.1	20.0	62.6
# of Outliers	0	0	0	0	0	1	4	0
Mean+/-4SD (ppm)	32.8	48.0	19.8	1.9	38.2	197.9	68.5	46.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	27.3	39.5	16.7	1.7	32.0	161.0	57.1	36.9
# of Outliers	0	0	0	0	0	0	1	0
Mean+/-2SD (ppm)	21.8	30.9	13.5	1.5	25.7	124.1	45.7	27.6
# of Outliers	0	0	1	0	2	1	1	1
Lower Limit								
3×IQR (ppm)	-11.4	-32.4	-6.0	1.0	-6.0	-2.8	20.0	-37.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-11.0	-20.5	-5.4	0.1	-11.8	-97.4	-23.0	-28.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-5.6	-12.0	-2.2	0.3	-5.6	-60.5	-11.5	-18.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-0.1	-3.4	0.9	0.5	0.7	-23.6	-0.1	-9.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 33: SITE 7 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified.
Ni	Method chosen: No outlier removed. No outliers identified.
Co	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Cd	Not analysed
Pb	Method chosen: Mean+/-2SD. Two outliers identified by the Mean+/-2SD method. These outliers distorted the calculated background concentrations and distribution analysis results and therefore were removed.
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results.
Cr	Not analysed
As	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 34: SITE 7 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	18	18	18	18	16	17	18	18
ND	4	4	5	18	7	3	14	3
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	21	29	17	1.0	16	110	61	33
Mean (ppm)	12	16	7.7	1.0	12	55	24	14
Med (ppm)	14	21	8.2	1.0	15	62	36	16
SD (ppm)	5.0	7.9	2.9	N/A	2.3	27	N/A	8.9
95%tile (ppm)	21	28	12	N/A	16	101	N/A	27
95UCL (ppm)	14	20	8.9	N/A	13	67	N/A	17
Distribution	norm	norm	norm	N/A	norm	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.8 SITE 8 , Atkinson Point, Northwest Territory

Background soil data was collected from the area surrounding the station area in 1992. However, only five background soil samples were collected from random locations surrounding the station. These samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 35: SITE 8 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm

Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G2738	1992	0	<3.0	7.4	<5.0	<1.0	<10	63	24	0.6
G2739	1992	0	6.5	9.4	10.4	<1.0	<10	73	<20	0.4
G2740	1992	0	4.4	13.9	<5.0	<1.0	<10	37	34	2.9
G2741	1992	0	<3.0	<5.0	17.8	<1.0	<10	59	<20	<0.2
G2734	1992	0	3.5	<5.0	<5.0	<1.0	<10	59	<20	0.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 36: SITE 8 (station area) data summary.

	Cu	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
N	5	5	5	5	5	5	5	5
%ND	40	40	60	100	100	0	60	20
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.9 SITE 9, Liverpool Bay, Northwest Territory

A background sampling program was carried out for the site in 2008, and all soil samples were collected a 500-meter background radius of the station. A total of 26 background samples were collected within 50 to 500 meters of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 37: SITE 9 (station area) background soil data.

Sample #	**Date**	**Depth**	**Cu**	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
		cm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
15346	2008	10	15.7	25.1	9.8	<1.0	10.9	64.5	20.4	10.0
15347	2008	10	19.3	24.7	9.7	<1.0	11.1	64.3	22.8	10.8
15348	2008	10	12.6	15.0	<5.0	<1.0	<10	46.0	<20	6.0
15349	2008	50	16.9	23.5	8.2	<1.0	<10	58.8	<20	11.0
15350	2008	10	10.0	19.5	10.3	<1.0	<10	44.2	<20	7.5
15351	2008	10	10.5	19.9	7.9	<1.0	<10	44.8	<20	6.6
15352	2008	10	19.1	30.2	12.4	<1.0	10.5	65.6	22.3	10.4
15353	2008	10	15.3	21.3	7.3	<1.0	<10	62.4	<20	8.8
15366	2008	10	22.0	22.1	12.0	<1.0	10.5	81.6	22.4	16.7
15367	2008	10	26.8	29.7	11.7	<1.0	10.6	76.3	21.7	14.3
15368	2008	10	21.8	27.5	10.5	<1.0	<10	72.7	<20	10.9
15369	2008	10	14.6	21.7	11.1	<1.0	<10	60.4	22.1	11.4
15370	2008	10	8.6	15.7	8.5	<1.0	<10	55.3	<20	9.2
15371	2008	10	9.1	16.3	8.4	<1.0	<10	57.0	<20	10.0
15372	2008	10	7.9	19.5	7.6	<1.0	<10	48.9	<20	8.1
15373	2008	10	7.2	18.5	7.6	<1.0	<10	48.5	<20	7.6
15374	2008	10	22.3	40.4	14.9	<1.0	12.4	90.3	26.0	12.6
15375	2008	10	<5.0	5.7	<5.0	<1.0	<10	30.8	<20	3.8
15376	2008	10	<5.0	13.1	7.2	<1.0	<10	33.0	<20	6.8
15377	2008	10	7.0	14.2	7.5	<1.0	<10	46.8	<20	8.9
15378	2008	10	6.3	15.0	6.3	<1.0	<10	40.2	<20	7.2
15379	2008	10	6.2	15.5	6.3	<1.0	<10	39.7	<20	6.5
15380	2008	10	<5.0	10.3	6.1	<1.0	<10	37.9	<20	7.6
15381	2008	10	<5.0	11.5	8.8	<1.0	<10	37.7	<20	7.3
15382	2008	10	14.8	16.2	12.2	<1.0	10.5	73.4	25.1	12.3

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
15383	2008	10	13.3	24.2	9.1	<1.0	<10	69.4	<20	10.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 38: SITE 9 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	15	0	8	100	73	0	69	0
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 39: SITE 9 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	45.4	50.7	19.9	1.0	11.4	128.3	25.4	21.6
# of Outliers	0	0	0	0	1	0	1	0
Mean+/-4SD (ppm)	37.5	50.2	19.6	1.8	16.9	128.0	36.7	21.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	30.9	42.3	16.9	1.6	15.3	109.4	32.8	18.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	24.3	34.4	14.1	1.4	13.6	90.8	28.8	15.1
# of Outliers	1	1	1	0	0	0	0	1
Lower Limit								
3×IQR (ppm)	-21.7	-11.5	-2.1	1.0	9.0	-18.6	15.9	-3.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-15.5	-13.2	-2.5	0.2	3.5	-20.8	4.9	-3.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-8.9	-5.3	0.3	0.4	5.2	-2.2	8.9	-0.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-2.2	2.7	3.1	0.6	6.9	16.4	12.9	2.7
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 40: SITE 9 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Ni	Method chosen: No outlier removed. No outliers identified. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Co	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outlier removed. No outliers identified.
Cr	Not analysed
As	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 41: SITE 9 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	26	26	26	26	26	26	26
ND	4	0	2	26	19	0	18	0
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	5.0	5.7	5.0	1.0	10	31	20	3.8
Max (ppm)	27	40	15	1.0	12	90	26	17
Mean (ppm)	13	20	8.9	1.0	10	56	21	9.3
Med (ppm)	14	19	8.7	1.0	11	56	22	9.1
SD (ppm)	6.3	7.3	2.4	N/A	N/A	16	N/A	2.8
95%tile (ppm)	22	30	12	N/A	N/A	80	N/A	14
95UCL (ppm)	15	22	9.7	N/A	N/A	61	N/A	10
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.10 SITE 10, Nicholson Peninsula, Northwest Territory

A background sampling program was carried out for the site in 2011, and all soil samples were collected from the only terrain unit in the 500 meters background radius of the Station. 30 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 42: SITE 10 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm

Detection Limit (ppm)			5	5	5	1	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
10164	2011	0	12.6	17.6	8.9	<1.0	10.4	47.4	<20	10.0
10165	2011	0	<5.0	9.8	5.2	<1.0	11.0	57.9	23.5	13.0
10166	2011	0	7.6	12.0	6.4	<1.0	<10	57.5	<20	9.4
10167	2011	20-30	7.0	13.4	7.4	<1.0	<10	38.1	<20	10.6
10168	2011	0	12.3	18.3	8.9	<1.0	10.5	56.6	<20	9.9
10169	2011	0	6.9	13.1	10.2	<1.0	<10	47.7	<20	11.6
10170	2011	0	9.5	17.5	7.8	<1.0	<10	63.8	<20	10.5
10171	2011	0	11.2	18.5	8.2	<1.0	<10	58.9	<20	11.7
10172	2011	0	21.0	28.9	11.5	<1.0	12.8	74.7	25.5	9.2
10173	2011	0	10.5	20.6	9.5	<1.0	<10	55.7	<20	8.4
10174	2011	20-30	14.2	27.6	9.1	<1.0	<10	57.0	22.9	8.5
10175	2011	0	21.8	28.4	10.1	<1.0	13.0	87.5	26.5	10.1
10176	2011	0	10.0	16.8	7.1	<1.0	<10	69.8	<20	7.9
10177	2011	20-30	14.8	22.0	8.6	<1.0	<10	59.0	<20	9.2
10178	2011	0	21.7	28.3	10.9	<1.0	13.6	71.5	29.4	11.5
10179	2011	0	7.6	19.5	6.1	<1.0	<10	<15	<20	3.0
10180	2011	0	9.8	18.9	<5.0	<1.0	<10	38.6	<20	5.8
10181	2011	0	7.3	13.7	<5.0	<1.0	<10	45.3	<20	4.1
10182	2011	20-30	8.7	13.5	<5.0	<1.0	<10	40.9	<20	4.1
10183	2011	0	18.3	25.7	9.5	<1.0	10.5	72.9	21.0	7.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 43: SITE 10 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	20	20	20	20	20	20	20	20
%ND	5	0	15	100	65	5	70	0
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 44: SITE 10 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	34.5	50.8	19.0	1.0	11.9	120.6	25.8	18.5
# of Outliers	0	0	0	0	3	0	2	0
Mean+/-4SD (ppm)	33.0	45.9	17.3	1.9	19.2	131.3	41.3	20.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	27.5	39.0	14.9	1.7	17.1	111.7	36.3	17.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	21.9	32.1	12.5	1.4	14.9	92.1	31.3	14.4
# of Outliers	0	0	0	0	0	0	0	0
Lower Limit								
3×IQR (ppm)	-12.6	-14.2	-3.2	1.0	8.6	-8.4	15.6	-0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-11.2	-9.3	-1.8	0.1	1.8	-25.5	1.3	-3.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-5.7	-2.4	0.6	0.3	4.0	-5.9	6.3	-0.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-0.1	4.5	3.0	0.6	6.2	13.7	11.3	2.2
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 45: SITE 10 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified.
Ni	Method chosen: No outlier removed. No outliers identified.
Co	Method chosen: No outlier removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outlier removed. No outliers identified.
Cr	Not analysed
As	Method chosen: No outlier removed. No outliers identified.

SD = standard deviation; IQR = interquartile range**.**

Table 46: SITE 10 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	20	20	20	20	20	20	20	20
ND	1	0	3	20	13	1	14	0
DL (ppm)	5	5	5	1.0	10	15	20	0.2
Min (ppm)	5.0	9.8	5.0	1.0	10	15	20	3.0
Max (ppm)	22	29	11	1.0	14	87	29	13
Mean (ppm)	12	19	8.0	1.0	11	56	21	8.8
Med (ppm)	11	18	8.9	1.0	11	57	24	9.3
SD (ppm)	5.1	5.9	2.0	N/A	N/A	16	N/A	2.7
95%tile (ppm)	22	28	11	N/A	N/A	75	N/A	12
95UCL (ppm)	14	21	8.8	N/A	N/A	62	N/A	9.9
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.11 SITE 11, Horton River, Northwest Territory

A background sampling program was carried out for the site in 2008, and all soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 47: SITE 11 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
15444	2008	10	30.4	16.2	11.1	<1.0	12.5	68.1	31.4	26.3
15445	2008	10	34.1	17.6	8.4	<1.0	18.3	64.2	28.5	29.1
15446	2008	10	21.3	12.6	7.7	<1.0	14.6	51.7	30.0	20.8
15447	2008	10	25.1	27.7	20.9	<1.0	11.9	107.0	28.4	26.0
15448	2008	40	29.7	29.0	32.3	<1.0	16.3	153.3	31.7	83.2
15449	2008	10	17.7	11.1	6.6	<1.0	13.1	53.5	27.6	10.9
15450	2008	10	19.8	15.6	8.2	<1.0	14.8	58.6	34.6	14.7
15451	2008	10	19.4	14.7	9.6	<1.0	13.8	55.7	31.1	12.7
15464	2008	10	24.0	33.6	13.2	<1.0	13.0	80.3	25.2	18.8

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
15465	2008	10	21.0	25.7	12.7	<1.0	13.4	87.7	27.8	20.8
15466	2008	40	24.0	32.1	12.7	<1.0	13.3	84.1	25.8	19.1
15467	2008	10	23.7	29.8	12.8	<1.0	13.6	71.3	26.8	20.1
15468	2008	10	21.0	17.9	9.7	<1.0	12.3	60.5	28.2	13.7
15469	2008	10	25.3	31.1	12.8	<1.0	12.5	84.5	24.8	17.7
15470	2008	40	23.6	22.2	10.8	<1.0	14.6	65.1	26.1	19.2
15471	2008	40	20.5	18.0	9.1	<1.0	13.5	54.0	23.5	29.6
15472	2008	10	19.4	14.8	12.3	<1.0	13.1	59.5	36.6	19.3
15473	2008	10	19.2	47.8	18.0	<1.0	13.1	71.6	52.3	15.1
15474	2008	30	18.7	22.4	9.8	<1.0	10.7	59.0	26.0	13.6
15475	2008	10	15.0	19.6	10.5	<1.0	11.3	89.6	22.7	14.0
15476	2008	10	19.2	23.0	13.2	<1.0	13.5	68.5	33.1	16.1
15477	2008	10	10.4	16.9	7.3	<1.0	<10	51.1	<20	13.8
15478	2008	30	17.6	23.6	10.8	<1.0	10.8	60.8	24.4	11.7
15479	2008	10	19.8	28.2	15.9	<1.0	12.6	68.0	24.2	16.3
15480	2008	10	21.5	17.3	10.6	<1.0	13.1	68.0	33.8	17.6
15481	2008	10	21.9	16.4	10.0	<1.0	13.1	65.5	30.4	16.7

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 48: SITE 11 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	0	0	0	100	4	0	4	0
Analysed?	Yes	Yes	Yes	Mo	Yes	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 49: SITE 11 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	37.8	62.9	22.2	1.0	16.9	135.1	49.4	39.8
# of Outliers	0	0	1	0	1	1	1	1
Mean+/-4SD (ppm)	45.4	57.2	33.3	1.8	24.0	169.0	60.5	74.3
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	39.3	48.2	27.9	1.6	21.3	144.1	52.5	60.4
# of Outliers	0	0	1	0	0	1	0	1
Mean+/-2SD (ppm)	33.3	39.2	22.4	1.4	18.5	119.2	44.5	46.4
# of Outliers	1	1	1	0	0	1	1	1
Lower Limit								
3×IQR (ppm)	5.4	-18.3	0.2	1.0	9.3	2.2	7.2	-5.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-3.1	-14.8	-10.5	0.2	2.2	-30.5	-3.5	-37.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	2.9	-5.8	-5.0	0.4	4.9	-5.6	4.5	-23.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	9.0	3.2	0.5	0.6	7.6	19.4	12.5	-9.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 50: SITE 11 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Ni	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Co	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results.
Cd	Not analysed
Pb	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results.
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results.
Cr	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results.
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results. Outlier detected by all outlier detection methods.

SD = standard deviation; IQR = interquartile range.

Table 51: SITE 11 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	26	25	26	26	26	25	25
ND	0	0	0	26	1	0	1	0
DL (ppm)	5	5	5	1.0	10	15	20	0.2
Min (ppm)	10	11	6.6	1.0	10	51	20	11
Max (ppm)	34	48	32	1.0	16	107	37	27
Mean (ppm)	22	22	12	1.0	13	68	28	18
Med (ppm)	21	21	11	1.0	13	65	28	18
SD (ppm)	4.8	8.3	5.2	N/A	1.4	14	4.0	5.1
95%tile (ppm)	30	33	20	N/A	15	89	34	29
95UCL (ppm)	23	25	14	N/A	13	73	29	20
Distribution	norm	norm	norm	N/A	norm	log	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.12 SITE 12, Cape Perry, Northwest Territory

A background sampling program was carried out for the site in 1990 and 1998. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 9 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 52: SITE 12 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As

		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5**	**5**	**5**	**1**	**10**	**15**	**1.0**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G730	1990	0	9.2	<5.0	<5.0	<1.0	<10	57.0	<20	5.5
G729	1990	0	9.6	13.9	12.0	<1.0	<10	46.0	<20	3.1
G719	1990	0	6.9	<5.0	<5.0	<1.0	<10	27.0	<20	1.5
G718	1990	0	12.1	<5.0	<5.0	<1.0	<10	48.0	<20	1.7
G716	1990	0	8.0	<5.0	7.6	<1.0	<10	164.0	<20	1.7
98-1262	1998	0	8.9	8.4	4.9	<0.1	4.9	23.0	3.7	2.9
98-1260	1998	0	8.3	7.4	3.9	<0.1	3.3	17.0	2.0	2.2
98-1258	1998	0	10.5	10.2	5.6	<0.1	5.3	22.0	3.9	2.7
98-1256	1998	0	5.7	5.2	3.5	<0.1	2.5	13.0	1.4	1.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 53: SITE 12 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	9	9	9	9	9	9	9	9
%ND	0	44	67	100	100	0	100	0
Analysed?	Yes	No	No	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 54: SITE 12 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	14.4	18.5	7.9	3.7	25.3	126.0	68.9	6.5
# of Outliers	0	0	1	0	0	1	0	0
Mean+/-4SD (ppm)	19.8	20.3	16.3	2.9	20.6	218.9	44.8	7.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	17.0	16.9	13.6	2.2	17.1	172.7	35.6	5.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	14.2	13.5	10.9	1.6	13.5	126.5	26.4	4.7
# of Outliers	0	1	1	0	0	1	0	1
Lower Limit								
3×IQR (ppm)	3.2	-5.1	2.6	-2.6	-10.4	-56.0	-45.2	-1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-2.6	-6.8	-5.4	-2.2	-7.5	-150.7	-28.8	-2.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	0.2	-3.4	-2.7	-1.6	-4.0	-104.5	-19.6	-1.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	3.0	0.0	0.0	-0.9	-0.5	-58.3	-10.4	-0.1
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 55: SITE 12 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results.
Cr	Not analysed
As	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 56: SITE 12 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	9	9	9	9	9	9	9	9
ND	0	4	4	9	9	0	5	0
DL (ppm)	5.0	5.0	5.0	1.0	10	15	1.0	0.2
Min (ppm)	5.7	5.0	5.0	1.0	10	13	1.4	1.5
Max (ppm)	12	14	12	1.0	10	57	3.9	5.5
Mean (ppm)	8.8	7.2	6.7	1.0	10	32	2.7	2.5
Med (ppm)	8.9	8.4	7.6	1.0	10	25	2.8	2.2
SD (ppm)	1.9	N/A	N/A	N/A	N/A	16	N/A	1.3
95%tile (ppm)	11	N/A	N/A	N/A	N/A	54	N/A	4.5
95UCL (ppm)	10	N/A	N/A	N/A	N/A	43	N/A	3.3
Distribution	norm	N/A	N/A	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.13 SITE 13, Pearce Point, Northwest Territory

A background sampling program was carried out for the site in 1990 and 1992. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 9 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 57: SITE 13 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G2950	1992	0	15.9	<5.0	<5.0	<1.0	<10	38.0	<20	2.0
G2951	1992	0	<3.0	<5.0	6.7	<1.0	<10	23.0	<20	0.9
G2952	1992	0	<3.0	<5.0	<5.0	<1.0	<10	21.0	<20	0.9
G2953	1992	0	18.8	11.2	13.0	<1.0	<10	49.0	27.0	2.9

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 58: SITE 13 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	4	4	4	4	4	4	4	4
%ND	50	75	50	100	100	0	75	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.14 SITE 14, Keats Point, Northwest Territory

A background sampling program was carried out for the site in 1990 and 2011. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 9 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 59: SITE 14 (station area) background soil data.

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
9991	2011	0	23.2	10.3	7.2	<1.0	<10	22.1	<20	2.8
9992	2011	0	27.2	14.4	8.2	<1.0	<10	24.3	<20	2.2
9993	2011	0	16.4	19.8	6.0	<1.0	<10	19.1	<20	1.8
9994	2011	20-30	18.5	9.6	5.9	<1.0	<10	17.8	<20	2.0
9995	2011	0	19.1	11.4	7.4	<1.0	<10	21.6	<20	2.0
9996	2011	0	20.1	10.6	6.3	<1.0	<10	20.3	<20	1.4
9997	2011	20-30	19.8	11.9	6.9	<1.0	<10	21.9	<20	2.1
9998	2011	0	24.6	13.1	7.8	<1.0	<10	28.3	<20	2.3
9999	2011	0	19.1	11.0	6.7	<1.0	<10	19.9	<20	1.8
10000	2011	0	18.5	11.6	6.8	<1.0	<10	22.7	<20	1.8
10001	2011	0	20.3	12.8	7.3	<1.0	<10	23.8	<20	2.0
10002	2011	0	17.5	11.3	6.4	<1.0	<10	18.9	<20	1.9
10003	2011	20-30	22.9	12.8	7.8	<1.0	<10	22.1	<20	2.2
10004	2011	0	17.8	9.3	5.9	<1.0	<10	19.6	<20	2.0
10005	2011	0	13.2	7.4	5.1	<1.0	<10	16.2	<20	2.7
10006	2011	0	9.2	5.8	<5.0	<1.0	<10	<15	<20	1.6
10007	2011	0	7.1	5.4	<5.0	<1.0	<10	<15	<20	1.1
10008	2011	0	12.6	8.6	<5.0	<1.0	<10	<15	<20	1.4
10009	2011	20-30	15.0	8.7	5.3	<1.0	<10	19.1	<20	1.5
10010	2011	0	35.9	19.6	10.6	<1.0	<10	30.6	25.9	3.1
10011	2011	0	30.2	18.1	9.5	<1.0	<10	27.5	25.6	2.5
10012	2011	0	9.1	6.2	<5.0	<1.0	<10	<15	<20	1.3
10013	2011	0	9.6	6.9	<5.0	<1.0	<10	<15	<20	1.2
10014	2011	0	17.4	8.8	5.8	<1.0	<10	20.3	<20	1.6
10015	2011	0	12.4	7.5	<5.0	<1.0	<10	<15	<20	1.0
10016	2011	20-30	12.9	8.8	5.1	<1.0	<10	16.4	<20	1.3

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 60: SITE 14 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	0	0	23	100	100	23	92	0
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 61: SITE 14 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	42.1	24.4	13.9	1.0	10.0	39.4	20.0	4.4
# of Outliers	0	0	0	0	0	0	2	0
Mean+/-4SD (ppm)	46.0	26.9	13.0	1.8	16.2	41.7	35.9	3.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	38.7	22.7	11.3	1.6	14.6	36.2	32.0	3.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	31.4	18.5	9.7	1.4	13.1	30.7	28.1	2.8
# of Outliers	1	2	1	0	0	0	0	1
Lower Limit								
3×IQR (ppm)	-8.9	-3.2	-1.6	1.0	10.0	-1.0	20.0	-0.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-12.3	-6.4	-0.4	0.2	3.8	-2.4	4.9	-0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-5.0	-2.3	1.3	0.4	5.4	3.1	8.8	0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	2.3	1.9	3.0	0.6	6.9	8.6	12.7	0.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 62: SITE 14 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Ni	Method chosen: Mean+/-2SD. Two outliers found distant from the rest of the population that distorted the background concentrations, however, had no influence on the conclusion of distribution results.
Co	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified.
Cr	Not analysed
As	Method chosen: No outlier removed. One outlier identified by the Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 63: SITE 14 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	26	26	26	26	26	26	26
ND	0	0	6	26	26	6	24	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	7.1	5.4	5.0	1.0	10	15	20	1.0
Max (ppm)	36	18	11	1.0	10	31	26	3.1
Mean (ppm)	18	10	6.5	1.0	10	20	20	1.9
Med (ppm)	18	9.9	6.7	1.0	10	21	26	1.9
SD (ppm)	6.7	3.0	1.4	N/A	N/A	4.3	N/A	0.5
95%tile (ppm)	29	14	9.2	N/A	N/A	28	N/A	2.7
95UCL (ppm)	20	11	7.0	N/A	N/A	22	N/A	2.1
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.15 SITE 15 , Clinton Point, Northwest Territory

A background sampling program was carried out for the site in 1999, however, background soil samples were also collected in 1990 (2 samples) and 1992 (3 samples) as part of previous investigations. An additional 25 background samples were collected in 1999 within 50 to 500 m of the station area. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. All samples were analyzed for the Arctic suite of inorganic elements with the exception of samples P1-046 and P1-001 that were not analyzed for Cu, Co, and Zn concentrations.

Table 64: SITE 15 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3	5	5	1	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
P1-046	1990	0		10.0		<1.0	<10		<20	1.7
P1-001	1990	0		11.0		<1.0	<10		<20	2.2
500-1836/37	1992	0	17.0	13.0	<5.0	<1.0	<10	36.0	22.0	1.3
500-1847	1992	0	18.2	10.6	6.6	<1.0	<10	23.0	<20	1.5
500-1848	1992	0	34.0	14.2	7.9	<1.0	<10	39.0	30.0	1.3
500-1865	1992	0	10.6	8.9	<5.0	<1.0	17.0	18.7	<20	1.4
99-24594	1999	0	8.6	9.2	5.1	<1.0	<10	31.5	<20	1.4
99-24595	1999	0	8.6	8.7	<5.0	<1.0	<10	22.7	<20	1.2
99-24597	1999	0	7.4	6.7	<5.0	<1.0	<10	29.0	<20	1.1
99-24598	1999	0	7.4	6.9	<5.0	<1.0	<10	13.8	<20	1.0
99-24599	1999	0	9.8	8.7	<5.0	<1.0	<10	15.8	<20	1.1
99-24600	1999	0	15.7	9.7	<5.0	<1.0	<10	18.6	<20	1.8
99-24637	1999	0	16.1	10.1	<5.0	<1.0	<10	19.3	<20	1.3
99-24638	1999	0	22.5	11.4	5.3	<1.0	<10	22.6	<20	1.8
99-24639	1999	0	15.2	10.3	<5.0	<1.0	<10	17.6	<20	1.8
99-24640	1999	0	16.1	9.8	<5.0	<1.0	<10	17.7	<20	2.0
99-24641	1999	0	15.1	10.9	<5.0	<1.0	<10	22.1	<20	1.4
99-24642	1999	0	3.8	<5.0	<5.0	<1.0	<10	<15	<20	0.8
99-24643	1999	0	5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
99-24644	1999	0	4.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
99-24645	1999	0	7.1	<5.0	<5.0	<1.0	<10	<15	<20	0.9
99-24646	1999	0	19.3	11.9	5.8	<1.0	<10	36.2	22.8	2.2
99-24647	1999	0	20.3	12.4	7.5	<1.0	<10	33.8	26.4	1.6
99-24648	1999	0	21.4	13.4	9.4	<1.0	<10	35.5	25.8	2.2
99-24649	1999	0	24.2	11.3	9.9	<1.0	<10	34.3	26.0	1.5
99-24682	1999	0	146.2	98.3	29.8	<1.0	<10	70.4	<20	0.9
99-24683	1999	0	6.7	5.4	<5.0	<1.0	20.6	31.3	<20	3.3

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 65: SITE 15 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	24	26	25	27	27	24	27	27
%ND	0	15	64	100	93	16	78	0
Analysed?	Yes	Yes	No	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 66: SITE 15 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	54.7	22.0	8.0	1.0	10.0	82.2	20.0	3.8
# of Outliers	1	1	3	0	2	0	6	0
Mean+/-4SD (ppm)	121.7	78.3	26.0	1.8	21.9	76.0	39.0	3.6
# of Outliers	1	1	1	0	0	0	0	0
Mean+/-3SD (ppm)	94.5	61.1	21.0	1.6	19.1	63.0	34.5	3.0
# of Outliers	1	1	1	0	1	1	0	1
Mean+/-2SD (ppm)	67.4	44.0	16.0	1.4	16.2	49.9	30.0	2.5
# of Outliers	1	1	1	0	2	1	1	1
Lower Limit								
3×IQR (ppm)	-28.0	-2.8	2.7	1.0	10.0	-30.8	20.0	-0.8
# of Outliers	0	0	0	0	0	0	2	0
Mean+/-4SD (ppm)	-95.3	-58.7	-14.1	0.2	-1.0	-28.4	3.0	-0.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-68.2	-41.6	-9.0	0.4	1.9	-15.4	7.5	-0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-41.1	-24.4	-4.0	0.6	4.7	-2.3	12.0	0.4
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 67: SITE 15 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results. All outlier detection methods identified the same outlier
Ni	Method chosen: 3×IQR. One outlier identified distant from the rest of the population that distorted the background concentrations and distribution results. All outlier detection methods identified the same outlier
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: Mean+/-3SD. One outlier identified by the Mean+/-3SD and the Mean+/-2SD method. This outlier distorted background concentrations and distribution analysis results and therefore was removed.
Cr	Not analysed
As	Method chosen: No outlier removed. One outlier identified by the Mean+/-3SD and Mean+/-2SD method, however this outlier had minor influence on background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 68: SITE 15 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	24	26	25	27	27	24	27	26
ND	0	4	16	27	25	4	21	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	3.8	5.0	5.0	1.0	10	14	20	0.8
Max (ppm)	34	14	30	1.0	21	39	30	3.3
Mean (ppm)	14	9.4	6.7	1.0	11	25	21	1.5
Med (ppm)	15	10	7.5	1.0	23	23	26	1.4
SD (ppm)	7.5	2.7	N/A	N/A	N/A	8.2	N/A	0.5
95%tile (ppm)	24	13	N/A	N/A	N/A	36	N/A	2.2
95UCL (ppm)	17	10	N/A	N/A	N/A	28	N/A	1.7
Distribution	norm	norm	N/A	N/A	N/A	log	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.16 SITE 16, Croker River, Nunavut Territory

A background sampling program was carried out for the site in 2011. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 25 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 69: SITE 16 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
9822	2011	0	15.7	13.7	10.1	<1.0	<10	32.5	<20	2.9

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
9823	2011	0	9.6	8.3	5.8	<1.0	<10	20.2	<20	2.5
9824	2011	0	19.7	15.7	11.7	<1.0	<10	37.2	<20	1.5
9825	2011	20-30	17.3	13.7	9.3	<1.0	<10	27.7	<20	1.7
9826	2011	0	12.9	10.8	8.2	<1.0	<10	27.5	<20	<1.0
9827	2011	0	14.0	11.8	8.8	<1.0	<10	27.8	<20	1.9
9828	2011	0	16.8	11.3	8.0	<1.0	<10	25.3	<20	1.7
9829	2011	0	15.4	9.4	7.1	<1.0	<10	23.5	<20	1.2
9830	2011	0	13.7	9.2	6.0	<1.0	<10	20.7	<20	<1.0
9831	2011	0	12.3	9.8	6.7	<1.0	<10	20.9	<20	1.1
9832	2011	20-30	15.6	9.4	6.6	<1.0	<10	21.9	<20	1.3
9833	2011	0	24.8	12.6	7.7	<1.0	<10	22.6	<20	3.1
9834	2011	0	28.4	13.2	8.4	<1.0	<10	24.5	<20	2.2
9835	2011	0	19.8	10.2	6.5	<1.0	<10	19.8	<20	1.7
9836	2011	20-30	19.4	10.4	6.5	<1.0	<10	21.0	<20	1.4
9837	2011	0	11.3	6.9	<5.0	<1.0	<10	<15	<20	1.3
9838	2011	0	22.4	11.3	7.2	<1.0	<10	21.3	<20	1.3
9839	2011	0	25.4	13.6	8.0	<1.0	<10	25.0	<20	1.9
9840	2011	20-30	25.0	13.7	8.0	<1.0	<10	26.0	<20	1.5
9841	2011	20-30	25.2	13.2	8.0	<1.0	<10	24.8	<20	1.8
9842	2011	0	19.4	8.9	5.7	<1.0	<10	17.6	<20	1.4
9843	2011	0	21.1	11.7	7.0	<1.0	<10	22.6	<20	1.5
9844	2011	0	28.2	15.9	9.1	<1.0	<10	29.2	20.9	2.2
9845	2011	20-30	27.4	15.7	9.0	<1.0	<10	29.4	20.4	2.5
9846	2011	0	14.9	8.7	5.4	<1.0	<10	18.6	<20	1.3

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 70: SITE 16 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	25	25	25	25	25	25	25	25
%ND	0	0	4	100	100	4	92	0
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 71: SITE 16 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	54.7	26.2	14.2	1.0	10.0	47.3	20.0	3.9
# of Outliers	0	0	0	0	0	0	2	0
Mean+/-4SD (ppm)	43.9	23.6	15.0	1.8	16.3	49.5	34.2	3.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	37.5	20.5	13.1	1.6	14.7	43.1	30.7	3.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	31.1	17.4	11.2	1.4	13.1	36.6	27.1	2.7
# of Outliers	0	0	1	0	0	1	0	2
Lower Limit								
3×IQR (ppm)	-15.1	-3.2	0.7	1.0	10.0	1.1	20.0	-0.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-7.5	-1.0	-0.1	0.2	3.7	-2.3	5.9	-0.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-1.1	2.1	1.8	0.4	5.3	4.2	9.4	0.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	5.4	5.2	3.7	0.6	6.9	10.7	13.0	0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 72: SITE 16 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outlier removed. No outliers identified.
Ni	Method chosen: No outlier removed. No outliers identified.
Co	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method. This outlier did not distorted background concentrations and distribution analysis results and therefore was not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method. This outlier did not distorted background concentrations and distribution analysis results and therefore was not removed.
Cr	Not analysed
As	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method. This outlier did not distorted background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 73: SITE 16 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	25	25	25	25	25	25	25	25
ND	0	0	1	25	25	1	23	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	9.6	6.9	5.0	1.0	10	15	20	1.0
Max (ppm)	28	16	12	1.0	10	37	21	3.1
Mean (ppm)	19	12	7.6	1.0	10	24	20	1.7
Med (ppm)	19	11	7.8	1.0	10	24	21	1.5
SD (ppm)	5.6	2.5	1.5	N/A	N/A	4.8	N/A	0.6
95%tile (ppm)	28	16	10	N/A	N/A	32	N/A	2.8
95UCL (ppm)	21	12	8.1	N/A	N/A	26	N/A	1.9
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.17 SITE 17, Clifton Point, Nunavut Territory

A background sampling program was carried out for the site in 1994 and 1992. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 5 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 74: SITE 17 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G5542	1994	0	9.3	8.7	5.0	<1.0	<10	12.4	42.0	1.3
G5543	1994	0	8.7	5.4	<5.0	<1.0	<10	9.7	<20	1.4
G5544	1994	0	35.0	21.0	12.9	<1.0	<10	34.0	89.0	2.2
G5545A	1994	0	8.9	<5.0	6.2	<1.0	<10	25.0	<20	0.7
G5545B	1994	0	8.7	5.9	7.3	<1.0	<10	17.3	<20	0.7

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 75: SITE 17 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	5	5	5	5	5	5	5	5
%ND	0	20	40	100	100	0	60	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.18 SITE 18, Cape Young, Nunavut Territory

A background sampling program was carried out for the site in 2004. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 96 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 76: SITE 18 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
04-3840	2004	0	11.3	5.4	<5.0	<1.0	<10	33.0	<20	2.0
04-3841	2004	0	10.9	5.5	<5.0	<1.0	<10	33.2	<20	1.9
04-3842	2004	25	8.3	6.4	<5.0	<1.0	<10	<15	<20	1.5
04-3843	2004	70	7.3	6.4	<5.0	<1.0	<10	<15	<20	1.1
04-3844	2004	0	15.0	5.2	<5.0	<1.0	<10	17.0	<20	1.5
04-3845	2004	55	11.0	7.5	<5.0	<1.0	<10	16.0	<20	2.0
04-3846	2004	20	12.0	<5.0	<5.0	<1.0	<10	<15	<20	2.7
04-3847	2004	50	9.0	5.3	<5.0	<1.0	<10	<15	<20	1.9
04-3848	2004	100	9.0	5.5	<5.0	<1.0	<10	<15	<20	1.3
04-3850	2004	0	14.3	5.9	<5.0	<1.0	<10	18.0	<20	2.1
04-3851	2004	0	13.2	5.4	<5.0	<1.0	<10	16.3	<20	1.5
04-3852	2004	50	7.8	<5.0	<5.0	<1.0	<10	<15	<20	1.5
04-3853	2004	90	7.6	<5.0	<5.0	<1.0	<10	<15	<20	1.3
04-3854	2004	20	21.0	8.0	6.3	<1.0	<10	26.0	<20	11.0
04-3855	2004	55	11.0	6.1	<5.0	<1.0	<10	19.0	<20	<1.0
04-3856	2004	80	13.0	7.5	<5.0	<1.0	<10	19.0	<20	1.3
04-3858	2004	0	33.0	<5.0	<5.0	<1.0	<10	20.0	<20	1.9
04-3859	2004	60	17.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
04-3862	2004	0	11.0	6.4	<5.0	3.0	<10	38.0	<20	2.8
04-3863	2004	10	6.4	<5.0	<5.0	<1.0	<10	25.0	<20	2.0
04-3864	2004	40	9.8	<5.0	<5.0	<1.0	<10	16.0	<20	2.8
04-3865	2004	20	5.9	<5.0	<5.0	<1.0	<10	<15	<20	2.6
04-3866	2004	50	6.7	<5.0	<5.0	<1.0	<10	<15	<20	2.3

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
04-3867	2004	100	7.2	<5.0	<5.0	<1.0	<10	<15	<20	1.7
04-3868	2004	20	9.6	<5.0	<5.0	<1.0	<10	<15	<20	2.5
04-3869	2004	75	7.5	<5.0	<5.0	<1.0	<10	<15	<20	4.8
04-3870	2004	0	5.0	<5.0	<5.0	<1.0	<10	<15	<20	4.0
04-3871	2004	0	6.5	<5.0	<5.0	<1.0	<10	<15	<20	3.5
04-3872	2004	10	12.0	5.4	<5.0	<1.0	<10	19.0	<20	3.0
04-3873	2004	35	9.3	6.3	<5.0	<1.0	<10	<15	<20	2.7
04-3874	2004	10	8.8	5.2	<5.0	<1.0	<10	<15	<20	3.2
04-3875	2004	35	12.0	<5.0	<5.0	<1.0	<10	<15	<20	3.7
04-3876	2004	10	5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.1
04-3877	2004	10	11.0	5.6	<5.0	<1.0	<10	43.0	<20	3.4
04-3878	2004	40	13.0	6.0	<5.0	<1.0	<10	20.0	<20	3.3
04-3879	2004	65	9.3	6.8	<5.0	<1.0	<10	23.0	<20	4.2
04-3880	2004	10	5.9	<5.0	<5.0	<1.0	<10	26.8	<20	2.3
04-3881	2004	10	7.0	<5.0	<5.0	<1.0	<10	17.0	<20	2.5
04-3882	2004	35	12.0	7.0	<5.0	<1.0	<10	17.0	<20	3.8
04-3883	2004	80	8.1	<5.0	<5.0	<1.0	<10	16.0	<20	2.7
04-3884	2004	5	17.0	8.3	<5.0	<1.0	<10	21.0	<20	3.4
04-3885	2004	30	6.3	<5.0	<5.0	<1.0	<10	<15	<20	2.7
04-3886	2004	80	8.2	<5.0	<5.0	<1.0	<10	<15	<20	1.3
04-3887	2004	10	5.4	<5.0	<5.0	<1.0	<10	<15	<20	1.8
04-3888	2004	30	8.7	<5.0	<5.0	<1.0	<10	<15	<20	3.7
04-3889	2004	10	13.0	5.4	<5.0	<1.0	<10	<15	<20	1.4
04-3890	2004	30	3.5	<5.0	<5.0	<1.0	<10	<15	<20	4.1
04-3891	2004	30	3.9	<5.0	<5.0	<1.0	<10	<15	<20	3.7
04-3892	2004	70	5.0	<5.0	<5.0	<1.0	<10	<15	<20	11.0
04-3893	2004	10	9.0	6.8	<5.0	<1.0	<10	<15	<20	2.8
04-3894	2004	60	11.0	5.8	<5.0	<1.0	<10	<15	<20	2.0
04-3895	2004	100	11.0	6.0	<5.0	<1.0	<10	<15	<20	2.0
04-3897	2004	15	6.7	<5.0	<5.0	<1.0	<10	<15	<20	3.8
04-3898	2004	10	4.9	<5.0	<5.0	<1.0	<10	<15	<20	2.2
04-3899	2004	30	3.9	<5.0	<5.0	<1.0	<10	<15	<20	3.0
04-3900	2004	5	5.9	<5.0	<5.0	<1.0	<10	<15	<20	2.3
04-3901	2004	35	5.9	<5.0	<5.0	<1.0	<10	<15	<20	2.3
04-3902	2004	35	7.1	<5.0	<5.0	<1.0	<10	<15	<20	2.3
04-3903	2004	5	11.0	5.5	<5.0	<1.0	<10	17.0	<20	1.9
04-3904	2004	25	8.9	<5.0	<5.0	<1.0	<10	15.0	<20	2.4
04-3905	2004	5	7.3	<5.0	<5.0	<1.0	<10	<15	<20	1.8
04-3906	2004	35	10.0	<5.0	<5.0	<1.0	<10	<15	<20	4.0
04-3907	2004	5	9.7	5.2	<5.0	<1.0	<10	21.0	<20	2.3
04-3908	2004	40	9.1	5.5	<5.0	<1.0	<10	19.0	<20	3.4
04-3909	2004	5	15.0	6.2	<5.0	<1.0	<10	17.0	<20	1.1
04-3910	2004	35	7.1	<5.0	<5.0	<1.0	<10	<15	<20	2.3
04-3911	2004	35	6.5	<5.0	<5.0	<1.0	<10	<15	<20	2.8
04-3912	2004	5	10.0	<5.0	<5.0	<1.0	<10	21.0	<20	2.1
04-3913	2004	10	8.1	<5.0	<5.0	<1.0	<10	21.0	<20	3.1
04-3914	2004	30	8.2	5.5	<5.0	<1.0	<10	<15	<20	2.3
04-3915	2004	55	5.6	<5.0	<5.0	<1.0	<10	<15	<20	2.4
04-3916	2004	5	4.8	<5.0	<5.0	<1.0	<10	<15	<20	2.6
04-3917	2004	30	5.2	<5.0	<5.0	<1.0	<10	<15	<20	3.0
04-3918	2004	65	9.9	<5.0	<5.0	<1.0	<10	<15	<20	5.3
04-3919	2004	10	4.1	<5.0	<5.0	<1.0	<10	<15	<20	2.5
04-3920	2004	45	3.7	<5.0	<5.0	<1.0	<10	<15	<20	2.3
04-3921	2004	45	3.2	8.8	<5.0	<1.0	<10	<15	56.5	2.4
04-3922	2004	75	3.5	<5.0	<5.0	<1.0	<10	16.0	<20	1.9

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**1**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
04-3923	2004	20	4.9	<5.0	<5.0	<1.0	<10	<15	<20	4.3
04-3924	2004	50	4.0	<5.0	<5.0	<1.0	<10	<15	<20	1.0
04-3925	2004	95	4.6	<5.0	<5.0	<1.0	<10	<15	<20	2.5
04-3926	2004	20	6.5	<5.0	<5.0	<1.0	<10	<15	<20	2.5
04-3927	2004	80	4.7	<5.0	<5.0	<1.0	<10	<15	<20	2.5
04-3928	2004	25	6.1	<5.0	<5.0	<1.0	<10	<15	<20	2.6
04-3929	2004	50	12.0	9.3	6.6	<1.0	<10	21.0	<20	4.0
04-3930	2004	85	7.5	<5.0	<5.0	<1.0	<10	<15	<20	1.4
04-3931	2004	85	7.5	<5.0	<5.0	<1.0	<10	<15	<20	2.1
04-3932	2004	50	4.5	<5.0	<5.0	<1.0	<10	<15	<20	2.6
04-3933	2004	100	7.8	<5.0	<5.0	<1.0	<10	<15	<20	1.7
04-3935	2004	10	6.0	<5.0	<5.0	<1.0	<10	<15	<20	4.7
04-3936	2004	10	4.3	<5.0	<5.0	<1.0	<10	<15	<20	1.7
04-3937	2004	10	8.4	<5.0	<5.0	<1.0	<10	<15	<20	8.5
04-3938	2004	10	5.7	<5.0	<5.0	<1.0	<10	<15	<20	3.8
04-3939	2004	10	4.1	<5.0	<5.0	<1.0	<10	<15	<20	1.8
04-3940	2004	10	5.4	<5.0	<5.0	<1.0	<10	<15	<20	6.7
04-3941	2004	10	11.8	5.6	<5.0	<1.0	<10	<15	<20	1.7

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 77: SITE 18 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	96	96	96	96	96	96	96	96
%ND	0	65	98	99	100	69	99	2
Analysed?	Yes	No	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 78: SITE 18 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	26.5	7.0	5.0	1.0	10.0	23.0	20.0	7.2
# of Outliers	1	6	2	1	0	7	1	3
Mean+/-4SD (ppm)	24.9	9.1	6.5	1.9	13.2	37.1	36.8	9.2
# of Outliers	1	1	1	1	0	2	1	2
Mean+/-3SD (ppm)	20.6	8.2	6.1	1.7	12.4	32.0	32.7	7.5
# of Outliers	2	3	2	1	0	4	1	3
Mean+/-2SD (ppm)	16.3	7.3	5.8	1.5	11.6	26.9	28.5	5.8
# of Outliers	4	6	2	1	0	4	1	4
Lower Limit								
3×IQR (ppm)	-9.7	3.5	5.0	1.0	10.0	9.0	20.0	-2.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-9.3	1.6	3.5	0.1	6.8	-3.9	3.6	-4.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-5.1	2.6	3.9	0.3	7.6	1.3	7.8	-2.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-0.8	3.5	4.3	0.6	8.4	6.4	11.9	-0.9
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 79: SITE 18 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: Mean+/-4SD. One outlier identified by the Mean+/-4SD. This outlier distorted background concentrations and distribution analysis results and therefore was removed. The 3×IQR method also detected the same outliers. One additional outlier was detected by the Mean+/-3SD method, and three additional outliers were detected by the Mean+/-2SD method, however, these outliers had a minor influence on background concentrations and did not change the distribution analysis results, therefore were not removed.
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: 3×IQR. Three outliers identified by the 3×IQR method. These outlier distorted background concentrations and therefore were removed. The data set conformed to a lognormal distribution before and after the removal of these outliers. As the data was found to be lognormal, the Mean+/-nSD methods were not chosen for this data set.

SD = standard deviation; IQR = interquartile range.

Table 80: SITE 18 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	95	96	96	96	96	96	96	93
ND	0	62	94	95	96	66	95	2
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	3.2	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	21	9.3	6.6	3.0	10	43	56	6.7
Mean (ppm)	8.3	5.4	5.0	1.0	10	17	20	2.6
Med (ppm)	7.8	6.0	5.0	3.0	10	19	20	2.4
SD (ppm)	3.4	N/A	N/A	N/A	N/A	N/A	N/A	1.0
95%tile (ppm)	14	N/A	N/A	N/A	N/A	N/A	N/A	4.2
95UCL (ppm)	8.9	N/A	N/A	N/A	N/A	N/A	N/A	2.7
Distribution	norm	N/A	N/A	N/A	N/A	N/A	N/A	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.19 SITE 19, Harding River, Nunavut Territory

A background sampling program was carried out for the site in 2012. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 25 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 81: SITE 19 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
16974	2012	0	16.7	10.8	6.1	<1.0	<10	17.8	<20	1.9

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
16975	2012	0	19.8	13.8	7.8	<1.0	<10	24.8	<20	1.7
16976	2012	0	24.3	19.6	11.9	<1.0	<10	35.3	25.9	1.9
16977	2012	0	39.3	32.6	17.2	<1.0	14.2	60.6	44.9	3.3
16978	2012	0	27.8	16.9	10.2	<1.0	<10	29.9	22.8	3.0
16979	2012	30	42.0	18.9	11.7	<1.0	<10	30.2	24.8	2.6
16980	2012	0	19.9	17.2	10.7	<1.0	<10	37.2	23.4	2.1
16981	2012	0	21.1	17.3	10.6	<1.0	<10	39.6	23.5	1.9
16982	2012	0	42.1	30.2	16.7	<1.0	12.5	57.0	43.6	3.6
16983	2012	0	40.1	28.2	15.5	<1.0	12.2	54.7	40.3	3.1
16984	2012	0	17.9	9.5	5.9	<1.0	<10	22.9	<20	1.5
16985	2012	30	20.9	10.8	6.4	<1.0	<10	23.5	<20	3.1
16986	2012	0	40.8	31.6	16.1	<1.0	12.8	61.9	44.8	3.8
16987	2012	0	34.0	27.6	14.7	<1.0	11.5	51.9	37.7	3.4
16988	2012	30	34.2	27.0	14.3	<1.0	11.5	51.1	39.3	3.2
16989	2012	0	34.9	27.8	14.1	<1.0	11.3	49.3	39.8	3.6
16990	2012	0	37.2	26.1	13.7	<1.0	10.7	48.0	36.7	3.7
16991	2012	0	35.8	26.1	13.5	<1.0	10.5	49.9	35.9	3.3
16992	2012	0	37.3	28.5	15.1	<1.0	11.9	53.8	40.9	3.7
16993	2012	0	38.7	29.4	15.8	<1.0	12.5	54.6	42.1	3.8
16994	2012	0	38.5	30.9	16.7	<1.0	12.7	57.2	44.5	4.1
16995	2012	0	41.5	31.5	16.2	<1.0	13.2	59.1	45.5	4.3
16996	2012	30	34.7	25.8	13.3	<1.0	11.0	47.0	36.6	3.3
16997	2012	0	21.1	11.9	7.6	<1.0	<10	23.5	<20	2.5
16998	2012	30	29.3	12.2	7.5	<1.0	<10	24.1	<20	2.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 82: SITE 19 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	25	25	25	25	25	25	25	25
%ND	0	0	0	100	44	0	24	0
Analysed?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 83: SITE 19 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	91.5	63.4	31.6	1.0	18.8	128.9	95.1	6.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	71.7	55.6	28.4	1.8	19.8	104.4	77.1	6.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	61.4	46.9	24.2	1.6	17.6	88.3	65.5	5.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	51.0	38.3	20.1	1.4	15.5	72.2	54.0	4.5
# of Outliers	0	0	0	0	0	0	0	0
Lower Limit								
3×IQR (ppm)	-31.7	-17.9	-5.8	1.0	3.4	-44.3	-31.4	-0.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-11.2	-13.7	-4.9	0.2	2.3	-24.5	-15.2	-0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-0.8	-5.0	-0.7	0.4	4.5	-8.4	-3.7	0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	9.6	3.6	3.4	0.6	6.7	7.7	7.8	1.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 84: SITE 19 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified.
Ni	Method chosen: No outliers removed. No outliers identified.
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Method chosen: No outliers removed. No outliers identified.
Zn	Method chosen: No outliers removed. No outliers identified.
Cr	Method chosen: No outliers removed. No outliers identified.
As	Method chosen: No outliers removed. No outliers identified.

SD = standard deviation; IQR = interquartile range.

Table 85: SITE 19 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	25	25	25	25	25	25	25	25
ND	0	0	0	25	11	0	6	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	17	9.5	5.9	1.0	10	18	20	1.5
Max (ppm)	42	33	17	1.0	14	62	45	4.3
Mean (ppm)	32	22	12	1.0	11	43	32	3.0
Med (ppm)	35	26	13	1.0	12	48	39	3.2
SD (ppm)	8.8	7.8	3.7	N/A	1.3	14	10	0.8
95%tile (ppm)	42	32	17	N/A	13	60	45	4.1
95UCL (ppm)	35	25	14	N/A	12	47	36	3.3
Distribution	non-p	non-p	norm	N/A	norm	non-p	non-p	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.20 SITE 20, Bernard Harbour, Nunavut Territory

A background sampling program was carried out for the site in 1992. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 5 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 86: SITE 20 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3**	**5**	**5**	**1**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G3031A	1992	0	9.5	6.0	6.5	<1.0	<10	21.0	<20	0.4
G3031 B	1992	0	13.7	<5.0	<5.0	<1.0	<10	16.9	<20	0.3
G3032	1992	0	16.0	<5.0	<5.0	<1.0	<10	13.9	<20	0.2
G3034	1992	0	3.8	<5.0	7.8	<1.0	<10	7.2	<20	0.3

G3035	1992	0	20.0	<5.0	<5.0	<1.0	<10	29.0	<20	0.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 87: SITE 20 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	5	5	5	5	5	5	5	5
%ND	0	80	60	100	100	0	100	20
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.21 SITE 21, Bernard Harbour, Nunavut Territory

A background sampling program was carried out for the site in 2012. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 88: SITE 21 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17060	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17061	2012	0	<5.0	5.1	<5.0	<1.0	<10	<15	<20	<1.0
17062	2012	30	13.9	10.4	5.5	<1.0	<10	19.9	<20	3.8
17063	2012	0	5.7	<5.0	<5.0	<1.0	<10	<15	<20	1.1
17064	2012	0	10.7	6.2	<5.0	<1.0	<10	<15	<20	1.7
17065	2012	0	32.4	<5.0	<5.0	<1.0	<10	16.9	<20	<1.0
17066	2012	0	17.2	7.5	<5.0	<1.0	<10	<15	<20	<1.0
17067	2012	0	28.5	10.7	5.9	<1.0	<10	<15	<20	2.5
17068	2012	30	21.3	7.1	5.0	<1.0	<10	<15	<20	3.0
17069	2012	0	11.7	8.5	6.3	<1.0	<10	31.7	<20	1.9
17070	2012	30	27.7	12.3	9.9	<1.0	<10	22.9	<20	2.3
17071	2012	30	38.5	12.1	10.9	<1.0	<10	28.8	<20	2.1
17072	2012	0	11.1	7.8	<5.0	<1.0	<10	18.5	<20	1.4
17073	2012	0	45.1	7.5	5.2	<1.0	<10	24.1	<20	1.7
17074	2012	0	7.9	5.9	<5.0	<1.0	<10	23.2	<20	1.2
17075	2012	0	33.0	11.0	6.6	<1.0	<10	19.8	<20	2.0
17076	2012	30	28.9	10.5	6.4	<1.0	<10	16.5	<20	2.1
17078	2012	0	25.5	11.8	7.0	<1.0	<10	18.5	<20	2.9
17079	2012	0	21.0	9.2	5.1	<1.0	<10	15.4	<20	2.8
17080	2012	0	19.2	9.5	<5.0	<1.0	<10	<15	<20	2.0
17081	2012	0	16.6	6.5	<5.0	<1.0	<10	<15	<20	2.2
17082	2012	0	20.1	8.5	<5.0	<1.0	<10	<15	<20	2.4
17083	2012	30	17.3	8.0	<5.0	<1.0	<10	<15	<20	1.4
17084	2012	0	14.5	5.3	<5.0	<1.0	<10	20.1	<20	1.3
17085	2012	0	14.0	8.3	<5.0	<1.0	<10	<15	<20	1.7
17086	2012	0	12.1	8.6	<5.0	<1.0	<10	<15	<20	1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 89: SITE 21 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	8	12	58	100	100	50	100	15
Analysed?	Yes	Yes	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 90: SITE 21 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	73.4	21.9	8.3	1.0	10.0	34.4	20.0	5.5
# of Outliers	0	0	2	0	0	0	0	0
Mean+/-4SD (ppm)	59.9	18.2	12.1	1.8	16.2	39.6	33.9	4.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	49.1	15.6	10.5	1.6	14.6	34.1	30.4	3.9
# of Outliers	0	0	1	0	0	0	0	0
Mean+/-2SD (ppm)	38.2	13.0	8.9	1.4	13.1	28.6	26.9	3.2
# of Outliers	2	0	2	0	0	2	0	1
Lower Limit								
3×IQR (ppm)	-34.4	-5.4	2.6	1.0	10.0	0.4	20.0	-1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-26.8	-2.4	-1.0	0.2	3.8	-4.3	6.1	-1.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-15.9	0.2	0.7	0.4	5.4	1.2	9.6	-0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-5.1	2.7	2.3	0.6	6.9	6.7	13.1	0.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 91: SITE 21 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method. This outlier did not distorted background concentrations and distribution analysis results and therefore was not removed.
Ni	Method chosen: No outliers removed. No outliers identified.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method. This outlier did not distorted background concentrations and distribution analysis results and therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 92: SITE 21 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	26	26	26	26	26	26	26
ND	2	3	15	26	26	13	26	4
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	45	12	11	1.0	10	32	20	3.8
Mean (ppm)	19	8.2	5.7	1.0	10	18	20	1.9
Med (ppm)	18	8.4	6.2	1.0	10	20	20	2.0
SD (ppm)	10	2.3	N/A	N/A	N/A	N/A	N/A	0.7
95%tile (ppm)	37	12	N/A	N/A	N/A	N/A	N/A	3.0
95UCL (ppm)	23	9.0	N/A	N/A	N/A	N/A	N/A	2.1
Distribution	norm	norm	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.22 SITE 22, Lady Franklin Point, Nunavut Territory

A background sampling program was carried out for the site in 2000 and 2001, however, background soil samples were also collected in 1989 (1 sample) and 1990 (3 samples) as part of previous investigations. 10 background samples were collected in 2000 and 2001 within 50 to 500 m of the station area for a total of 14 samples. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. All samples were analyzed for the Arctic suite of inorganic elements.

Table 93: SITE 22 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
BM500	1989	0	5.8	<5.0	<5.0	<1.0	<10	6.0	<20	<1.0
G527	1990	0	18.6	11.3	<5.0	<1.0	<10	11.0	<20	1.1
G528	1990	0	18.4	17.8	<5.0	<1.0	<10	10.0	<20	0.3
G529	1990	0	10.4	17.9	<5.0	<1.0	<10	64.0	<20	0.7
00-13890/91	2000	0	12.0	6.1	<5.0	<1.0	<10	18.0	<20	<1.0
00-14528	2000	0	35.0	5.7	<5.0	<1.0	<10	<15	<20	1.5
00-14529	2000	0	6.7	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
00-14530/31	2000	0	6.6	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
00-14532	2000	0	6.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
01-17947	2001	0	18.0	5.0	<5.0	<1.0	<10	23.0	<20	<1.0
01-17948	2001	60	6.7	<5.0	<5.0	<1.0	<10	15.0	<20	<1.0
01-17949	2001	0	7.5	<5.0	<5.0	<1.0	<10	15.0	<20	1.2
01-17950/51	2001	40	11.0	7.0	5.1	<1.0	<10	17.0	<20	1.2
01-17952	2001	40	14.0	8.0	5.1	<1.0	<10	18.0	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 94: SITE 22 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	14	14	14	14	14	14	14	14
%ND	0	50	86	100	100	71	93	50
Analysed?	Yes	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 95: SITE 22 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	47.9	16.0	5.0	1.0	10.0	26.0	20.0	1.3
# of Outliers	0	2	2	0	0	1	0	1
Mean+/-4SD (ppm)	43.6	25.7	8.1	2.0	18.3	71.0	38.6	2.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	35.4	21.0	7.4	1.8	16.2	57.7	33.9	1.9
# of Outliers	0	0	0	0	0	1	0	0
Mean+/-2SD (ppm)	27.2	16.3	6.6	1.5	14.1	44.4	29.3	1.6
# of Outliers	1	2	0	0	0	1	0	0
Lower Limit								
3×IQR (ppm)	-24.2	-3.3	5.0	1.0	10.0	6.8	20.0	0.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-21.9	-11.9	1.9	0.0	1.7	-35.4	1.4	0.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-13.7	-7.2	2.7	0.2	3.8	-22.1	6.1	0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-5.5	-2.5	3.5	0.5	5.9	-8.8	10.7	0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 96: SITE 22 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: Mean+/-2SD. One outlier identified distant from the population. This outlier distorted background concentrations and therefore was removed.
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 97: SITE 22 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	14	14	14	14	14	14	14	14
ND	0	7	12	14	14	10	13	7
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.8	5.0	5.0	1.0	10	15	20	0.3
Max (ppm)	18.6	18	5.0	1.0	10	64	20	1.5
Mean (ppm)	11	7.8	5.0	1.0	10	21	20	1.0
Med (ppm)	10	8.0	5.1	1.0	10	18	20	1.2
SD (ppm)	4.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95%tile (ppm)	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95UCL (ppm)	13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution	norm	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.23 SITE 23, Ross Point, Nunavut Territory

A background sampling program was carried out for the site in 2009. At SITE 23, the higher elevations of the north side of Johansen Bay, which include the main site, airstrips and the water supply lake, are underlain by subhorizontal Ordovician or Silurian Cass Fiord Formation (terrain unit Cc). At the lower elevations of the site, the sub-horizontal Neoproterozoic Nelson Head formation (unit Nnh) is exposed. A total of 100 background soil samples were collected within 50 to 500 m of the station area from the two terrain units at the site. 52 soil samples were collected from the Cc terrain unit and 48 samples were collected from the Nnh terrain unit. All samples were analyzed for the Arctic suite of inorganic elements. Data analysis began with investigation of each terrain unit separately.

Table 98: SITE 23 (Cc terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
30960	2009	20	24.3	14.0	8.4	<1.0	<10	26.3	21.8	2.5
30961	2009	20	23.7	13.5	8.2	<1.0	<10	21.1	20.0	1.7
30962	2009	10	26.5	10.6	7.6	<1.0	<10	19.6	<20	<1.0
30963	2009	10	14.2	6.0	<5.0	<1.0	<10	<15	<20	<1.0
30964	2009	0	33.6	11.2	<5.0	<1.0	<10	16.4	21.7	<1.0
30965	2009	0	11.7	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30966	2009	30	25.8	11.8	7.3	<1.0	<10	17.5	20.5	<1.0
30967	2009	10	29.5	8.0	5.9	<1.0	<10	<15	<20	1.5
30968	2009	10	6.5	7.7	<5.0	<1.0	<10	<15	<20	1.3
30969	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30970	2009	20	19.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30971	2009	20	21.4	5.1	<5.0	<1.0	<10	<15	<20	<1.0
30972	2009	10	20.8	7.9	5.3	<1.0	<10	<15	<20	<1.0
30973	2009	10	29.0	6.1	<5.0	<1.0	<10	19.4	<20	1.3
30974	2009	10	24.5	5.1	<5.0	<1.0	<10	<15	<20	1.4
30975	2009	20	18.8	7.7	5.2	<1.0	<10	<15	<20	1.5
30976	2009	20	16.8	8.0	5.1	<1.0	<10	<15	<20	1.2
30977	2009	10	5.9	5.8	5.2	<1.0	<10	16.7	<20	<1.0
30978	2009	10	18.5	7.5	5.6	<1.0	<10	<15	<20	2.3
30979	2009	10	8.5	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30980	2009	10	15.7	<5.0	<5.0	<1.0	<10	<15	<20	1.3
30981	2009	10	11.6	5.1	<5.0	<1.0	<10	<15	<20	1.4
30982	2009	10	10.3	5.1	<5.0	<1.0	<10	<15	<20	<1.0
30983	2009	0	20.6	5.4	<5.0	<1.0	<10	<15	<20	<1.0
30984	2009	10	49.5	10.3	5.7	<1.0	<10	16.7	<20	2.0
30985	2009	10	6.2	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30986	2009	20	8.4	5.3	<5.0	<1.0	<10	<15	<20	<1.0
30987	2009	10	39.6	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30988	2009	10	11.8	8.0	5.0	<1.0	<10	<15	<20	4.0
30989	2009	0	24.4	11.1	6.8	<1.0	<10	17.3	<20	2.4
30990	2009	10	5.6	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30991	2009	10	5.5	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30992	2009	20	10.1	<5.0	<5.0	<1.0	<10	<15	<20	1.1
30993	2009	10	5.2	5.2	<5.0	<1.0	<10	<15	<20	<1.0
30994	2009	0	16.0	7.6	<5.0	<1.0	<10	<15	<20	<1.0
30995	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
30996	2009	0	26.4	7.9	5.2	<1.0	<10	<15	<20	1.1
30997	2009	0	25.6	9.4	5.3	<1.0	<10	<15	<20	1.6
30998	2009	0	12.2	5.6	<5.0	<1.0	<10	15.5	<20	<1.0
30999	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31000	2009	0	28.1	16.8	9.1	<1.0	<10	30.8	29.5	3.0
31001	2009	0	24.8	15.8	8.5	<1.0	<10	28.9	29.8	2.8
31002	2009	10	16.3	6.4	<5.0	<1.0	<10	<15	<20	3.3
31003	2009	10	17.5	9.0	5.0	<1.0	<10	<15	<20	2.1
31004	2009	10	16.4	7.4	<5.0	<1.0	<10	<15	<20	1.4
31037	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31038	2009	20	17.2	13.0	7.0	<1.0	<10	21.7	24.5	2.3
31039	2009	10	18.1	13.5	9.1	<1.0	<10	<15	34.0	3.0
31040	2009	0	17.5	6.1	<5.0	<1.0	<10	<15	<20	<1.0
31041	2009	0	17.1	6.3	<5.0	<1.0	<10	15.6	<20	<1.0
31042	2009	0	11.1	<5.0	<5.0	<1.0	<10	19.4	<20	<1.0
31043	2009	10	52.0	7.4	5.8	<1.0	<10	<15	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 99: SITE 23 (Nnh terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
31005	2009	10	7.3	6.5	<5.0	<1.0	<10	<15	<20	1.7
31006	2009	10	12.4	6.0	<5.0	<1.0	<10	<15	<20	1.6
31007	2009	10	15.2	5.7	<5.0	<1.0	<10	<15	<20	1.1
31008	2009	20	5.5	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31009	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31010	2009	10	5.3	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31011	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.0
31012	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31013	2009	10	17.3	7.9	<5.0	<1.0	<10	<15	<20	1.7
31014	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
31015	2009	0	15.2	8.6	5.8	<1.0	<10	17.1	<20	2.1
31016	2009	10	12.6	7.1	<5.0	<1.0	<10	18.3	<20	2.7
31017	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31018	2009	10	23.2	9.4	7.0	<1.0	<10	17.0	<20	2.1
31019	2009	10	17.8	7.3	<5.0	<1.0	<10	<15	<20	1.4
31020	2009	0	10.9	6.4	<5.0	<1.0	<10	15.1	<20	1.3
31021	2009	0	10.3	5.9	<5.0	<1.0	<10	<15	<20	1.1
31022	2009	10	11.0	5.6	<5.0	<1.0	<10	<15	<20	1.3
31023	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31024	2009	10	7.8	<5.0	<5.0	<1.0	<10	16.1	<20	<1.0
31025	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31026	2009	10	18.4	7.1	<5.0	<1.0	<10	<15	<20	1.5
31027	2009	0	6.2	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31028	2009	0	8.8	5.7	<5.0	<1.0	<10	17.5	<20	<1.0
31029	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31030	2009	20	10.4	<5.0	<5.0	<1.0	<10	<15	<20	1.1
31031	2009	20	11.2	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31032	2009	20	21.5	5.0	<5.0	<1.0	<10	<15	<20	<1.0
31033	2009	10	14.1	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31034	2009	0	9.0	5.5	<5.0	<1.0	<10	15.5	<20	<1.0
31035	2009	0	15.0	<5.0	<5.0	<1.0	<10	15.5	<20	1.1
31036	2009	0	6.4	5.1	<5.0	<1.0	<10	<15	<20	<1.0
31044	2009	0	26.9	9.5	6.3	<1.0	<10	27.8	<20	2.6
31045	2009	0	6.5	8.1	<5.0	<1.0	<10	<15	<20	1.8
31046	2009	0	6.5	5.9	<5.0	<1.0	<10	<15	<20	<1.0
31047	2009	20	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31048	2009	0	15.9	15.9	9.3	<1.0	<10	26.5	27.3	1.4
31049	2009	0	<5.0	5.5	<5.0	<1.0	<10	<15	<20	<1.0
31050	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31051	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31052	2009	0	21.1	<5.0	<5.0	<1.0	<10	<15	<20	2.3
31053	2009	10	24.6	8.9	5.8	<1.0	<10	<15	<20	1.3
31054	2009	20	9.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31055	2009	20	12.4	5.5	<5.0	<1.0	<10	<15	<20	<1.0
31056	2009	10	5.4	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31057	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
31058	2009	10	22.6	9.5	6.2	<1.0	<10	<15	<20	2.9
31059	2009	10	19.3	10.1	5.9	<1.0	<10	<15	<20	1.2

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 100: SITE 23 (Cc terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	52	52	52	52	52	52	52	52

%ND	8	27	60	100	100	71	85	54
Analysed?	Yes	Yes	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 101: SITE 23 (Nnh terrain unit) data summary.

	Cu	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
N	48	48	48	48	48	48	48	48
%ND	27	48	85	100	100	79	98	52
Analysed?	Yes	Yes	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 102: SITE 23 (Cc terrain unit) outlier results.

Outlier Method	**Cu**	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
Upper Limit								
3×IQR (ppm)	67.0	18.1	6.5	1.0	10.0	18.3	20.0	3.2
# of Outliers	0	0	9	0	0	8	8	2
Mean+/-4SD (ppm)	58.3	19.9	10.6	1.5	14.4	32.1	35.6	4.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	47.5	16.7	9.3	1.4	13.3	28.1	31.8	3.5
# of Outliers	2	1	0	0	0	2	1	1
Mean+/-2SD (ppm)	36.7	13.5	8.0	1.3	12.2	24.2	28.1	2.8
# of Outliers	3	4	5	0	0	3	3	4
Lower Limit								
3×IQR (ppm)	-32.3	-4.8	3.9	1.0	10.0	12.5	20.0	-0.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-28.1	-5.8	0.5	0.5	5.6	0.3	5.8	-1.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-17.3	-2.6	1.7	0.6	6.7	4.3	9.5	-0.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-6.5	0.6	3.0	0.7	7.8	8.3	13.2	-0.1
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 103: SITE 23 (Nnh terrain unit) outlier results.

Outlier Method	**Cu**	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
Upper Limit								
3×IQR (ppm)	45.7	11.5	5.0	1.0	10.0	15.0	20.0	2.6
# of Outliers	0	1	7	0	0	10	1	2
Mean+/-4SD (ppm)	35.2	14.5	8.6	1.6	14.6	28.3	31.3	3.2
# of Outliers	0	1	1	0	0	0	0	0
Mean+/-3SD (ppm)	28.7	12.4	7.7	1.4	13.4	25.1	28.5	2.7
# of Outliers	0	1	1	0	0	2	0	1
Mean+/-2SD (ppm)	22.3	10.3	6.9	1.3	12.3	21.9	25.7	2.2
# of Outliers	4	1	2	0	0	2	1	4
Lower Limit								
3×IQR (ppm)	-25.5	0.1	5.0	1.0	10.0	15.0	20.0	-0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-16.4	-2.6	1.8	0.4	5.4	3.0	8.9	-0.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-10.0	-0.4	2.6	0.6	6.6	6.1	11.7	-0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-3.5	1.7	3.5	0.7	7.7	9.3	14.5	0.2
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 104: SITE 23 (Cc) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: Mean+/-3SD. Two outliers identified distant from the population. These outliers distorted background concentrations and therefore were removed.
Ni	Method chosen: Mean+/-2SD. One outlier identified distant from the population. This outlier distorted background concentrations and therefore were removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 105: SITE 23 (Cc) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	50	51	52	52	52	52	52	52
ND	4	14	31	52	52	38	43	28
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5	5	5.0	1.0	10	15	20	1.0
Max (ppm)	40	16	9.1	1.0	10	31	34	4.0
Mean (ppm)	18	7.6	5.6	1.0	10	16	21	1.5
Med (ppm)	17	7.7	5.8	1.0	10	19	23	1.7
SD (ppm)	11	3.1	N/A	N/A	N/A	N/A	N/A	N/A
95%tile (ppm)	29.3	13	N/A	N/A	N/A	N/A	N/A	N/A
95UCL (ppm)	19	8.1	N/A	N/A	N/A	N/A	N/A	N/A
Distribution	norm	norm	N/A	N/A	N/A	N/A	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

Table 106: SITE 23 (Nnh) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. Four outliers identified by the Mean+/-2SD method. These outliers did not distorted background concentrations or distribution analysis results and therefore were not removed.
Ni	Method chosen: 3×IQR. One outlier found distant from the rest of the population that distorted background concentrations and distribution analysis and therefore was removed. All outlier methods detected this outlier.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 107: SITE 23 (Nnh) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	48	47	48	48	48	48	48	48
ND	13	23	41	48	48	38	47	25
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0

Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	27	10	9.3	1.0	10	28	27	2.9
Mean (ppm)	11	6.0	5.2	1.0	10	16	20	1.3
Med (ppm)	9.0	5.0	5.0	1.0	10	15	20	1.0
SD (ppm)	6.4	1.5	N/A	N/A	N/A	N/A	N/A	N/A
95%tile (ppm)	23	9.5	N/A	N/A	N/A	N/A	N/A	N/A
95UCL (ppm)	12	6.4	N/A	N/A	N/A	N/A	N/A	N/A
Distribution	norm	norm	N/A	N/A	N/A	N/A	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

Following investigation of each terrain separately, Cu and Ni background data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution.

Table 108: SITE 23 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	**Standardized Difference (ppm)**	**p-value**	**Significance Difference?**
Cc versus Nnh				
Cu	4.566	2.772	0.007	Yes
Ni	1.304	1.980	0.052	No

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 109: SITE 23 Kruskal Wallis test results.

	K (observed)	**K (critical value)**	**p-value**	**Significance Difference?**
Cc versus Nnh				
Cu	6.192	3.841	0.013	Yes
Ni	2.030	3.841	0.154	No

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 110: SITE 23 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	**Sum of Ranks**	**Mean of Ranks**	**Dunn's Groups**		**Conover-Iman Groups**	
Copper							
Cc	46	2147	46.674	A		A	
Nnh	35	1174	33.543		B		B
Nickel							
Cc	37	1243.5	33.608	A		A	
Nnh	24	647.5	26.979	A		A	

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

All tests conclude that the Cu data sets within the Cc unit and the Nnh unit do not come from the same population, meanwhile the Ni data sets within each unit were not found to be significantly different. Therefore, the Ni data sets from each terrain unit were combined and background concentrations were recalculated.

Table 111: SITE 23 (Cc and Nnh combined) background concentration results summary.

	Ni
SQG (ppm)	**50**
N	94
ND	46
DL (ppm)	5.0
Min (ppm)	5.0
Max (ppm)	10
Mean (ppm)	6.0
Med (ppm)	6.4
SD (ppm)	1.5
95%tile (ppm)	9.5
95UCL (ppm)	6.3
Distribution	non-p

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.24 SITE 24, Edinburgh Island, Nunavut Territory

A background sampling program was carried out for the site in 2012 All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 112: SITE 24 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17240	2012	0	188.7	27.1	47.1	<1.0	11.6	75.8	57.3	6.2
17241	2012	0	193.7	27.0	49.1	<1.0	12.0	74.6	56.7	6.1
17242	2012	0	57.4	25.7	16.9	<1.0	<10	36.7	28.0	4.5
17243	2012	0	108.9	16.1	9.4	<1.0	<10	153.3	<20	1.8
17244	2012	0	68.6	32.9	18.8	<1.0	<10	55.7	26.2	3.1
17245	2012	0	95.0	9.5	<5.0	<1.0	<10	51.3	<20	1.1
17246	2012	0	46.7	26.8	14.2	<1.0	<10	29.2	29.7	2.1

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17247	2012	0	34.2	20.5	10.4	<1.0	<10	37.4	<20	2.1
17248	2012	0	20.3	13.7	8.3	<1.0	<10	25.0	<20	2.0
17249	2012	30	24.0	13.9	7.9	<1.0	<10	29.3	20.1	2.8
17250	2012	0	345.2	<5.0	<5.0	<1.0	<10	18.0	<20	1.1
17251	2012	0	323.7	<5.0	5.2	<1.0	<10	16.5	<20	<1.0
17252	2012	30	263.9	7.5	21.3	<1.0	<10	56.6	<20	<1.0
17253	2012	0	394.6	20.5	14.9	<1.0	<10	58.3	<20	3.3
17254	2012	0	38.0	19.2	10.4	<1.0	<10	33.4	20.2	2.0
17255	2012	0	58.3	33.8	20.2	<1.0	<10	50.6	31.8	3.3
17256	2012	30	54.9	34.0	21.2	<1.0	<10	41.0	26.8	3.2
17257	2012	0	44.0	22.9	13.4	<1.0	<10	31.1	30.8	2.6
17258	2012	0	23.0	16.9	11.6	<1.0	<10	27.2	25.2	2.5
17259	2012	30	39.9	21.2	12.0	<1.0	<10	32.6	30.8	3.2
17260	2012	0	25.3	13.7	8.7	<1.0	<10	23.1	<20	2.5
17261	2012	0	21.1	13.3	7.8	<1.0	<10	21.8	<20	2.3
17262	2012	0	633.4	39.4	36.6	<1.0	<10	66.3	27.7	15.5
17263	2012	30	540.4	41.5	54.0	<1.0	<10	92.3	26.1	23.0
17264	2012	0	57.7	17.2	11.1	<1.0	<10	29.2	22.5	2.6
17265	2012	0	27.2	13.6	7.6	<1.0	<10	26.4	<20	2.1

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 113: SITE 24 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	0	8	8	100	92	0	42	26
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 114: SITE 24 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	664.4	66.6	54.1	1.0	10.0	142.3	51.8	6.9
# of Outliers	0	0	0	0	2	1	2	2
Mean+/-4SD (ppm)	758.2	60.0	69.3	1.8	16.7	159.9	68.3	21.7
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	588.3	49.5	55.3	1.6	15.1	129.8	57.4	17.0
# of Outliers	1	0	0	0	0	1	0	1
Mean+/-2SD (ppm)	418.4	39.0	41.4	1.4	13.4	99.7	46.6	12.3
# of Outliers	2	2	3	0	0	1	2	2
Lower Limit								
3×IQR (ppm)	-436.8	-25.9	-25.8	1.0	10.0	-58.3	-3.8	-1.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-601.1	-23.9	-42.2	0.2	3.6	-80.9	-18.5	-16.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-431.2	-13.4	-28.3	0.4	5.2	-50.8	-7.7	-11.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-261.3	-2.9	-14.3	0.6	6.8	-20.7	3.2	-6.7
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 115: SITE 24 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: Nine outliers removed. No outliers identified using the 3×IQR method or the Mean+/-4SD method, one outlier identified using the Mean+/-3SD method, and two outliers identified using the Mean+/-2SD method. After removal of outliers, the distribution analysis results remained the same and because the data doesn't conform to a date distribution, use of the Mean+/-nSD methods is not appropriate. Larger range of data may indicate that more than one terrain unit was sampled during the background sampling program. Nine samples were found to have very elevated concentrations (>200 ppm). These concentrations may be attributed to anthropogenic activity, or a unique terrain unit that was not identified during site investigation. As these samples most likely represent a unique population, these samples were removed as they are unrepresentative of the site as a whole.
Ni	Method chosen: No outliers removed. Two outliers identified using the Mean+/-2SD method. These outliers had minor influence on the calculated background concentration and did not change the distribution analysis results, therefore were not removed.
Co	Method chosen: Mean+/-2SD. Three outliers identified distant from the rest of the population. These outliers distorted the calculated background concentrations and distribution analysis, therefore were removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier found distant from the rest of the population. This outlier distorted the calculated background concentrations and distribution analysis, therefore was removed. Outlier also identified using the Mean+/-3SD and Mean+/-2SD method.
Cr	Method chosen: 3×IQR. Two outliers found distant from the rest of the population. These outliers distorted the calculated background concentrations and distribution analysis, therefore were removed. Outliers also identified using the Mean+/-3SD and Mean+/-2SD method.
As	Method chosen: 3×IQR. Two outliers found distant from the rest of the population. These outliers distorted the calculated background concentrations and distribution analysis, therefore were removed. Outliers also identified using the Mean+/-2SD method.

SD = standard deviation; IQR = interquartile range.

Table 116: SITE 24 (station area) background concentration results summary.

	Cu	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	26	23	23	26	25	24	24
ND	0	2	2	23	24	0	11	2
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	20	5.0	5.0	1.0	10	16	20	1.0
Max (ppm)	633	42	37	1.0	12	92	32	6.2
Mean (ppm)	143	20	13	1.0	10	42	24	2.7
Med (ppm)	57	20	12	1.0	11	33	27	2.5
SD (ppm)	171	9.8	7.1	N/A	N/A	20	4.3	1.3
95%tile (ppm)	610	41	33	N/A	N/A	88	32	6.2
95UCL (ppm)	290	24	15	N/A	N/A	49	25	3.3
Distribution	non-p	norm	norm	N/A	N/A	norm	norm	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.25 SITE 25, Byron Bay, Nunavut Territory

A background sampling program was carried out for the site in 2003 All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 48 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 117: SITE 25 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11586	2003	0	23.0	10.0	7.0	<1.0	<10	20.0	<20	2.2
11587	2003	45	12.0	9.7	6.5	<1.0	<10	18.0	<20	1.1
11588	2003	0	57.0	8.0	<5.0	<1.0	<10	<15	<20	1.1
11589	2003	55	27.0	11.0	7.2	<1.0	<10	23.0	<20	<1.0
11606	2003	0	9.1	<5.0	<5.0	<1.0	<10	<15	<20	1.4
11607	2003	40	7.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
11608	2003	80	8.8	6.0	<5.0	<1.0	<10	<15	<20	2.4
11609	2003	0	11.0	<5.0	<5.0	<1.0	<10	19.0	<20	1.9
03-11610/611	2003	40	7.6	<5.0	<5.0	<1.0	<10	<15	<20	2.4
11612	2003	70	7.9	5.3	<5.0	<1.0	<10	<15	<20	2.0
03-12570/71	2003	70	12.5	7.0	<5.0	<1.0	<10	<15	<20	1.4
12748	2003	0	15.0	6.0	<5.0	<1.0	<10	<15	<20	1.7
12749	2003	40	8.1	10.0	6.4	<1.0	<10	17.0	<20	1.9
03-12775	2003	0	16.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
12776	2003	30	7.7	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
12777	2003	50	9.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
12778	2003	20	11.0	9.4	5.9	<1.0	<10	<15	<20	2.0
12779	2003	0	5.9	5.0	<5.0	<1.0	<10	<15	<20	1.1
03-12780/81	2003	50	15.0	12.0	7.3	<1.0	<10	20.5	<20	2.3
12752	2003	0	52.0	20.0	11.0	<1.0	<10	39.0	31.0	1.0
12753	2003	40	13.0	14.0	8.4	<1.0	<10	27.0	24.0	1.2
12754	2003	0	17.0	5.1	<5.0	<1.0	<10	19.0	<20	<1.0
12755	2003	50	11.0	22.0	10.0	<1.0	<10	37.0	45.0	<1.0
12756	2003	0	11.0	5.7	<5.0	<1.0	<10	28.0	<20	<1.0
12757	2003	50	5.0	8.8	<5.0	<1.0	<10	17.0	<20	<1.0
12758	2003	90	5.7	8.6	<5.0	<1.0	<10	<15	<20	<1.0
12759	2003	0	11.0	9.2	<5.0	<1.0	14.0	<15	23.0	2.9
03-12760/61	2003	30	18.0	13.0	7.3	<1.0	19.0	<15	35.0	4.2
12762	2003	70	18.0	12.0	7.6	<1.0	19.0	<15	33.0	5.5
12763	2003	0	14.0	7.1	<5.0	<1.0	<10	<15	<20	2.2
12764	2003	30	14.0	9.8	6.3	<1.0	12.0	<15	23.0	4.2
12765	2003	75	18.0	11.0	6.4	<1.0	12.0	<15	27.0	5.2
12766	2003	0	11.0	6.4	<5.0	<1.0	<10	<15	<20	2.7
12767	2003	40	16.0	11.0	6.5	<1.0	10.0	18.0	26.0	3.5
12768	2003	0	26.0	7.0	<5.0	<1.0	<10	<15	<20	<1.0
12769	2003	50	30.0	5.1	<5.0	<1.0	<10	<15	<20	<1.0
03-12770/71	2003	0	8.5	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
12772	2003	0	13.0	8.6	<5.0	<1.0	11.0	<15	<20	1.1
12773	2003	25	23.0	15.0	7.0	<1.0	15.0	<15	32.0	1.9
12774	2003	40	19.0	17.0	7.8	<1.0	14.0	<15	38.0	1.9
12783	2003	30	14.0	13.0	11.0	<1.0	<10	23.0	23.0	1.0
12784	2003	55	18.0	11.0	10.0	<1.0	<10	21.0	21.0	2.1
14179	2003	0	31.0	16.0	8.5	<1.0	<10	25.0	23.0	1.3
03-14180/01	2003	40	32.5	14.0	7.6	<1.0	<10	21.0	22.0	<1.0
14182	2003	100	28.0	15.0	8.3	<1.0	<10	27.0	23.0	1.2
14183	2003	0	33.0	16.0	9.1	<1.0	<10	34.0	21.0	1.1
14184	2003	30	34.0	13.0	7.7	<1.0	<10	29.0	<20	<1.0
14185	2003	95	37.2	11.2	7.0	<1.0	<10	22.8	<20	1.4

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 118: SITE 25 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	48	48	48	48	48	48	48	48
%ND	0	19	50	100	83	56	65	33
Analysed?	Yes	Yes	No	No	No	No	No	yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 119: SITE 25 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	60.4	32.2	14.5	1.0	10.0	39.0	32.0	5.5
# of Outliers	0	0	0	0	8	0	4	0
Mean+/-4SD (ppm)	61.2	26.5	13.6	1.6	20.2	44.5	46.9	5.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	49.6	22.1	11.7	1.4	17.8	37.9	40.7	4.8
# of Outliers	2	0	0	0	2	1	1	2
Mean+/-2SD (ppm)	38.1	17.6	9.9	1.3	15.4	31.4	34.6	3.7
# of Outliers	2	2	4	0	2	3	3	4
Lower Limit								
3×IQR (ppm)	-26.9	-14.4	-2.1	1.0	10.0	-3.0	11.0	-2.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-31.3	-8.9	-1.2	0.4	1.0	-8.1	-2.5	-2.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-19.7	-4.4	0.7	0.6	3.4	-1.5	3.7	-1.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-8.1	0.0	2.5	0.7	5.8	5.0	9.9	-0.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 120: SITE 25 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified using the 3×IQR method or the Mean+/-4SD method, two outliers identified using the Mean+/-3SD method and the Mean+/-2SD method. After removal of outliers, the distribution analysis results remained the same and because the data conforms to a lognormal distribution, use of the Mean+/-nSD methods is not appropriate.
Ni	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method. These outliers did not distorted background concentrations or distribution analysis results and therefore were not removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: Mean+/-3SD. Two outliers found distant found distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis results, therefore were removed.

SD = standard deviation; IQR = interquartile range.

Table 121: SITE 25 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	48	48	48	48	48	48	48	46
ND	0	9	24	48	40	27	31	16
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	57	22	11	1.0	19	39	45	4.2
Mean (ppm)	18	9.7	6.4	1.0	10.8	19	23	1.6
Med (ppm)	14	10	7.4	1.0	14	23	24	1.9
SD (ppm)	11	4.3	N/A	N/A	N/A	N/A	N/A	0.8
95%tile (ppm)	36	17	N/A	N/A	N/A	N/A	N/A	3.3
95UCL (ppm)	21	11	N/A	N/A	N/A	N/A	N/A	1.8
Distribution	log	norm	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.26 SITE 26, Cape Peel West, Nunavut Territory

A background sampling program was carried out for the site in 2012. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 122: SITE 26 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**<5.0**	**<5.0**	**<5.0**	**<1.0**	**10**	**15**	**20**	**<1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17430	2012	0	6.1	5.5	19.0	<1.0	<10.0	<1<5.0	<20.0	4.9
17431	2012	0	<5.0	<5.0	18.2	<1.0	<10.0	16.9	<20.0	4.8

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			<5.0	<5.0	<5.0	<1.0	10	15	20	<1.0
SQG (ppm)			63	50	50	10	140	200	64	12
17432	2012	0	9.1	7.1	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.9
17433	2012	0	8.1	5.3	<5.0	<1.0	<10.0	19.4	<20.0	1.3
17434	2012	0	<5.0	5.9	<5.0	<1.0	<10.0	<1<5.0	<20.0	<1.0
17435	2012	30	<5.0	<5.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.1
17436	2012	0	11.7	<5.0	<5.0	<1.0	<10.0	16.2	<20.0	1.4
17437	2012	0	<5.0	8.4	5.2	<1.0	<10.0	<1<5.0	<20.0	2.0
17438	2012	30	9.9	11.1	6.1	<1.0	<10.0	15.4	21.4	2.1
17439	2012	0	10.6	7.2	<5.0	<1.0	<10.0	17.9	<20.0	1.4
17440	2012	0	<5.0	<5.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.8
17441	2012	0	<5.0	<5.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.3
17442	2012	30	<5.0	<5.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.5
17443	2012	0	8.4	9.1	<5.0	<1.0	<10.0	<1<5.0	<20.0	2.1
17444	2012	0	5.7	8.1	<5.0	<1.0	<10.0	<1<5.0	<20.0	2.2
17445	2012	0	6.8	8.8	<5.0	<1.0	<10.0	<1<5.0	<20.0	2.1
17446	2012	0	5.6	7.1	<5.0	<1.0	<10.0	<1<5.0	<20.0	2.2
17447	2012	0	69.5	6.3	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.5
17448	2012	30	32.6	11.2	5.8	<1.0	<10.0	<1<5.0	21.1	3.7
17449	2012	0	8.5	<5.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.4
17450	2012	0	20.6	8.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.2
17451	2012	0	29.7	7.6	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.6
17452	2012	0	6.9	6.4	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.4
17453	2012	30	6.1	10.1	5.2	<1.0	<10.0	18.2	26.5	2.1
17454	2012	0	26.0	6.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	1.2
17455	2012	0	12.0	<5.0	<5.0	<1.0	<10.0	<1<5.0	<20.0	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 123: SITE 26 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	27	31	77	100	100	77	88	8
Analysed?	Yes	Yes	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 124: SITE 26 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	30.4	17.3	5.0	1.0	10.0	15.0	20.0	4.4
# of Outliers	2	0	6	0	0	6	3	2
Mean+/-4SD (ppm)	64.8	15.2	20.4	1.8	16.2	26.9	35.3	5.7
# of Outliers	1	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	50.9	13.1	16.7	1.6	14.6	24.0	31.6	4.7
# of Outliers	1	0	2	0	0	0	0	2
Mean+/-2SD (ppm)	37.0	10.9	13.0	1.4	13.1	21.2	27.8	3.7
# of Outliers	1	2	2	0	0	0	0	2
Lower Limit								
3×IQR (ppm)	-13.8	-4.2	5.0	1.0	10.0	15.0	20.0	-1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-46.3	-1.9	-9.2	0.2	3.8	4.1	5.3	-2.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-32.4	0.2	-5.5	0.4	5.4	6.9	9.0	-1.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-18.6	2.4	-1.8	0.6	6.9	9.8	12.8	-0.2
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 125: SITE 26 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Two outliers identified distant from the rest of the data. These outliers influence the calculated background concentrations and distribution analysis results, therefore were removed. Using detect values only, the data fit a lognormal data distribution, however, using ROS methods for non-detect values, the data appear to fit a normal distribution. As the 3×IQR doesn't assume a distribution is was chosen as most appropriate for this data set.
Ni	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method. These outliers did not distorted background concentrations or distribution analysis results and therefore were not removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: 3×IQR. Two outliers identified distant from the rest of the data. These outliers influence the calculated background concentrations and distribution analysis results, therefore were removed. The Mean+/-3SD method and Mean+/-2SD method identified the same outliers.

SD = standard deviation; IQR = interquartile range.

Table 126: SITE 26 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	24	26	26	26	26	26	26	24
ND	7	8	20	26	26	20	23	2
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	27	11	19	1.0	10	19	27	3.7
Mean (ppm)	9.5	6.9	6.1	1.0	10	15	20	1.7
Med (ppm)	8.5	7.4	5.9	1.0	10	17	21	1.5
SD (ppm)	6.5	1.9	N/A	N/A	N/A	N/A	N/A	0.6
95%tile (ppm)	25	11	N/A	N/A	N/A	N/A	N/A	2.2
95UCL (ppm)	13	7.6	N/A	N/A	N/A	N/A	N/A	1.9
Distribution	norm	norm	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.27 SITE 27, Cambridge Bay, Nunavut Territory

A background sampling program was carried out for the site in 1989 and 1990. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 8 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 127: SITE 27 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
BF106	1989	0	8.4	21.0	<5.0	<1.0	<10	38.0	<20	1.4

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G108	1989	0	9.0	17.0	<5.0	<1.0	15.0	16.0	29.0	2.0
G109	1989	0	8.5	10.1	<5.0	<1.0	<10	26.0	<10	1.8
G114	1989	0	7.9	12.5	<5.0	<1.0	<10	78.0	22.0	2.1
G118	1990	0	5.5	8.8	8.0	<1.0	14.0	33.0	<20	2.9
G140	1989	0	13.1	23.0	<5.0	<1.0	<10	30.0	<20	6.2
G153	1990	0	14.1	<5.0	<5.0	<1.0	<10	15.0	<20	1.6
BF102	1989	0	4.7	16.6	<5.0	<1.0	<10	35.0	<20	0.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 128: SITE 27 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	8	8	8	8	8	8	8	
%ND	0	13	88	100	75	13	63	0
Analysed?	Yes	No	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 129: SITE 26 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	18.2	42.7	5.0	1.0	14.0	72.5	22.0	4.6
# of Outliers	0	0	1	0	1	1	1	1
Mean+/-4SD (ppm)	23.7	41.3	11.3	2.3	25.5	115.0	50.3	8.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	19.9	34.2	9.8	2.0	21.8	93.7	42.6	6.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	16.0	27.1	8.3	1.7	18.2	72.5	34.9	5.1
# of Outliers	0	0	0	0	0	1	0	1
Lower Limit								
3×IQR (ppm)	-0.9	-14.9	5.0	1.0	7.0	-13.3	18.5	-0.7
# of Outliers	0	0	0	0	0	0	1	0
Mean+/-4SD (ppm)	-7.0	-15.6	-0.7	-0.3	-3.5	-55.2	-11.4	-4.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-3.1	-8.4	0.8	0.0	0.1	-33.9	-3.7	-2.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	0.7	-1.3	2.3	0.3	3.7	-12.6	4.0	-1.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 130: SITE 27 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified.
Ni	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method. These outliers did not distorted background concentrations or distribution analysis results and therefore were not removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: No outliers removed. One outlier identified using the 3×IQR and Mean+/-2SD methods, however, removal of this outlier would decrease the sample size below 8 samples, therefore the outlier was not removed.

SD = standard deviation; IQR = interquartile range.

Table 131: SITE 27 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	8	8	8	8	8	8	8	8
ND	0	1	7	8	8	1	5	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	4.7	5.0	5.0	1.0	10	15	20	0.6
Max (ppm)	14	23	8.0	1.0	10	78	29	6.2
Mean (ppm)	8.9	14	5.4	1.0	10	34	22	2.3
Med (ppm)	8.4	17	8.0	1.0	10	33	25	1.9
SD (ppm)	3.3	N/A	N/A	N/A	N/A	N/A	N/A	1.7
95%tile (ppm)	14	N/A	N/A	N/A	N/A	N/A	N/A	5.0
95UCL (ppm)	11	N/A	N/A	N/A	N/A	N/A	N/A	4.3
Distribution	norm	N/A	N/A	N/A	N/A	N/A	N/A	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.28 SITE 28, Sturt Point North, Nunavut Territory

A background sampling program was carried out for the site in 2012. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 132: SITE 28 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17620	2012	0	7.1	5.8	<5.0	<1.0	<10	17.0	<20	2.3
17621	2012	0	5.7	7.9	<5.0	<1.0	<10	16.3	<20	2.0
17622	2012	30	7.6	6.7	<5.0	<1.0	<10	<15	<20	2.5
17623	2012	0	31.8	11.4	<5.0	<1.0	<10	19.8	<20	2.7
17624	2012	0	<5.0	6.9	<5.0	<1.0	<10	23.8	<20	1.9

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17625	2012	0	5.8	<5.0	<5.0	<1.0	12.3	<15	<20	5.6
17626	2012	0	<5.0	5.5	<5.0	<1.0	<10	<15	<20	1.6
17627	2012	30	<5.0	10.7	6.5	<1.0	<10	20.3	<20	1.6
17628	2012	0	6.8	6.9	<5.0	<1.0	<10	<15	<20	4.9
17629	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.4
17630	2012	0	32.0	26.2	16.4	<1.0	<10	90.2	61.7	1.4
17631	2012	0	12.9	11.9	8.3	<1.0	<10	43.1	27.6	1.5
17632	2012	30	5.7	11.1	<5.0	<1.0	<10	<15	<20	1.4
17633	2012	0	<5.0	<5.0	<5.0	<1.0	<10	15.8	<20	1.4
17634	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17635	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
17636	2012	30	<5.0	6.7	<5.0	<1.0	<10	<15	<20	1.9
17637	2012	0	16.5	20.7	9.3	<1.0	<10	29.3	30.8	2.1
17638	2012	0	<5.0	7.6	<5.0	<1.0	<10	<15	<20	1.1
17639	2012	0	<5.0	5.1	<5.0	<1.0	<10	<15	<20	1.5
17640	2012	30	<5.0	7.9	<5.0	<1.0	<10	<15	<20	3.0
17641	2012	30	<5.0	6.6	<5.0	<1.0	<10	<15	<20	1.7
17642	2012	0	<5.0	5.1	<5.0	<1.0	<10	<15	<20	<1.0
17643	2012	0	<5.0	7.4	<5.0	<1.0	<10	16.5	<20	1.5
17644	2012	0	<5.0	<5.0	<5.0	<1.0	<10	17.3	<20	1.5
17645	2012	0	<5.0	5.9	<5.0	<1.0	<10	20.9	<20	1.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 133: SITE 28 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	62	23	85	100	96	54	88	8
Analysed?	No	Yes	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 134: SITE 28 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	11.3	16.2	5.0	1.0	10.0	31.7	20.0	4.0
# of Outliers	4	2	4	0	1	2	3	2
Mean+/-4SD (ppm)	36.4	27.6	15.4	1.8	16.6	80.7	58.1	6.1
# of Outliers	0	0	1	0	0	1	1	0
Mean+/-3SD (ppm)	28.9	22.6	12.9	1.6	14.9	65.2	48.9	5.0
# of Outliers	2	1	1	0	0	1	1	1
Mean+/-2SD (ppm)	21.5	17.5	10.5	1.4	13.3	49.6	39.8	3.9
# of Outliers	2	2	1	0	0	1	1	2
Lower Limit								
3×IQR (ppm)	0.3	-3.2	5.0	1.0	10.0	2.5	20.0	-0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-23.1	-12.9	-4.4	0.2	3.6	-43.8	-15.1	-2.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-15.7	-7.9	-1.9	0.4	5.2	-28.2	-5.9	-1.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-8.2	-2.8	0.6	0.6	6.8	-12.7	3.2	-0.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 135: SITE 28 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Not analysed
Ni	Method chosen: 3×IQR. Two outliers identified distant from the population. These outliers were also identified by the Mean+/-2SD method. These outliers distorted the calculated background concentrations and distribution analysis results and therefore were removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: 3×IQR. Two outliers identified distant from the population. These outliers were also identified by the Mean+/-2SD method. These outliers distorted the calculated background concentrations and distribution analysis results and therefore were removed.

SD = standard deviation; IQR = interquartile range.

Table 136: SITE 28 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	24	26	26	26	26	26	24
ND	16	6	22	26	25	14	23	2
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	6.5	1.0	10	15	28	1.0
Max (ppm)	32	12	16	1.0	12	90	62	3.0
Mean (ppm)	8.2	7.0	10	1.0	10	21	22	1.7
Med (ppm)	7.3	6.9	8.8	1.0	12	20	31	1.6
SD (ppm)	N/A	2.2	N/A	N/A	N/A	N/A	N/A	0.5
95%tile (ppm)	N/A	11	N/A	N/A	N/A	N/A	N/A	2.7
95UCL (ppm)	N/A	7.9	N/A	N/A	N/A	N/A	N/A	1.9
Distribution	N/A	norm	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.29 SITE 29, Jenny Lind Island, Nunavut Territory

A background sampling program was carried out for the site in 2009. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 20 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 137: SITE 29 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
29419	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.3
29420	2009	0	9.9	7.9	<5.0	<1.0	<10	<15	<20	6.2
29421	2009	0	10.9	10.5	<5.0	<1.0	<10	<15	<20	7.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
29433	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.2
29434	2009	0	13.4	12.5	5.3	<1.0	10.0	<15	<20	10.6
29435	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
29436	2009	0	<5.0	7.8	<5.0	<1.0	<10	<15	<20	<1.0
29437	2009	0	5.3	8.2	<5.0	<1.0	<10	<15	<20	1.3
29438	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
29439	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
29423	2009	0	<5.0	5.8	<5.0	<1.0	<10	<15	<20	2.0
29424	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.7
29425	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	3.2
29426	2009	0	7.2	<5.0	<5.0	<1.0	<10	20.6	<20	<1.0
29427	2009	0	79.2	8.3	<5.0	<1.0	<10	<15	<20	2.0
29428	2009	0	12.1	11.6	5.3	<1.0	<10	23.9	<20	4.2
29429	2009	0	7.7	<5.0	<5.0	<1.0	<10	17.2	<20	1.2
29430	2009	0	<5.0	5.0	<5.0	<1.0	<10	<15	<20	3.1
29431	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.6
29432	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 138: SITE 29 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	20	20	20	20	20	20	20	20
%ND	60	55	90	100	95	85	100	20
Analysed?	No	No	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 139: SITE 29 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	17.9	16.7	5.0	1.0	10.0	15.0	20.0	8.9
# of Outliers	1	0	2	0	1	3	0	1
Mean+/-4SD (ppm)	71.6	16.6	7.7	1.9	17.0	30.8	35.7	11.9
# of Outliers	1	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	55.5	14.1	7.0	1.7	15.2	27.0	31.8	9.5
# of Outliers	1	0	0	0	0	0	0	1
Mean+/-2SD (ppm)	39.3	11.5	6.4	1.4	13.5	23.2	27.9	7.1
# of Outliers	1	2	0	0	0	1	0	1
Lower Limit								
3×IQR (ppm)	-4.7	-3.8	5.0	1.0	10.0	15.0	20.0	-4.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-57.4	-4.1	2.4	0.1	3.0	0.6	4.3	-7.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-41.3	-1.5	3.0	0.3	4.8	4.4	8.2	-5.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-25.2	1.1	3.7	0.6	6.5	8.2	12.1	-2.7
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 140: SITE 29 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Not analysed
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: 3×IQR. One outlier identified distant from the population. This outlier was also identified by the Mean+/-3SD and Mean+/-2SD method. These outliers distorted the calculated background concentrations and distribution analysis results and therefore were removed.

SD = standard deviation; IQR = interquartile range.

Table 141: SITE 29 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	20	20	20	20	20	20	20	19
ND	12	11	18	20	19	17	20	4
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	79	12	5.3	1.0	10	24	20	7.0
Mean (ppm)	10.3	6.6	5.0	1.0	10	16	20	2.4
Med (ppm)	10	8.2	5.3	1.0	10	21	20	2.2
SD (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.7
95%tile (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.3
95UCL (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1
Distribution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.30 SITE 30, Jenny Lind Island, Nunavut Territory

A background sampling program was carried out for the site in 2002. All soil samples were collected from the three identified terrain units on the site within the 500 meters background radius of the station. Two background samples were collected in terrain unit 1, three within terrain unit 2, and two within terrain unit 3. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 142: SITE 30 (terrain unit 1) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
02-7752	2002	10	17.0	<5.0	<5.0	<1.0	11.0	22.0	<20	8.7

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 143: SITE 30 (terrain unit 2) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
02-7748	2002	10	4.4	<5.0	<5.0	<1.0	<10	<15	<20	1.3
02-7749	2002	40	13.0	13.0	6.7	<1.0	<10	24.0	22.0	2.9
02-7750/51	2002	65	19.0	7.4	<5.0	<1.0	<10	<15	<20	3.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 144: SITE 30 (terrain unit 3) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
02-7474	2002	0	5.7	<5.0	<5.0	<1.0	<10	<15	<20	2.6
02-7475	2002	30	5.8	<5.0	<5.0	<1.0	12.0	<15	<20	4.3

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 145: SITE 30 (terrain unit 1) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	1	1	1	1	1	1	1	1
%ND	0	100	100	100	0	0	100	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 146: SITE 30 (terrain unit 2) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	3	3	3	3	3	3	3	3
%ND	0	33	67	100	100	67	67	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 147: SITE 30 (terrain unit 3) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	100	100	100	50	100	100	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.31 SITE 31, Hat Island, Nunavut Territory

A background sampling program was carried out for the site in 2010. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 148: SITE 31 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
8600	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8601	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8602	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8603	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8604	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8605	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8606	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8607	2010	20-30	6.6	10.3	6.5	<1.0	11.5	16.1	25.2	2.5
8608	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	3.4
8609	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	14.7
8620	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8621	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8622	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8623	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8610	2010	0	12.6	12.3	7.0	<1.0	<10	22.1	28.1	2.8
8611	2010	0	12.7	12.8	7.5	<1.0	<10	20.9	28.0	3.4
8612	2010	0	<5.0	5.2	<5.0	<1.0	<10	<15	<20	<1.0
8613	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8614	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8615	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8616	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8617	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8618	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8619	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8598	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
8599	2010	0	20.1	16.9	<5.0	<1.0	<10	<15	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 149: SITE 31 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	85	81	88	100	96	88	88	77
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.32 SITE 32, Gladman Point, Nunavut Territory

A background sampling program was carried out for the site in 2012. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 150: SITE 32 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**

SQG (ppm)			63	50	50	10	140	200	64	12
17760	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.0
17761	2012	0	6.9	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17762	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.1
17763	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17764	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.3
17765	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17766	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
17767	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17768	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
17769	2012	0	11.1	17.7	10.1	<1.0	17.0	45.0	32.0	5.1
17770	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.1
17771	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.4
17772	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.1
17773	2012	0	9.1	8.5	<5.0	<1.0	<10	24.0	21.0	3.4
17774	2012	0	6.0	6.6	<5.0	<1.0	<10	<15	<20	3.1
17775	2012	0	11.4	6.7	<5.0	<1.0	<10	<15	<20	1.3
17776	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17777	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17778	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
17779	2012	0	5.7	<5.0	<5.0	<1.0	<10	<15	<20	2.6
17780	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17781	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17782	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17783	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.6
17784	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17785	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 151: SITE 32 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	77	85	96	100	96	92	92	42
Analysed?	No	No	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 152: SITE 32 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	5.0	5.0	5.0	1.0	10.0	15.0	20.0	4.9
# of Outliers	6	4	1	0	1	2	2	1
Mean+/-4SD (ppm)	13.4	15.9	9.8	1.8	18.5	42.2	37.4	5.3
# of Outliers	0	1	1	0	0	1	0	0
Mean+/-3SD (ppm)	11.4	13.3	8.6	1.6	16.5	35.7	33.1	4.3
# of Outliers	0	1	1	0	1	1	0	1
Mean+/-2SD (ppm)	9.5	10.7	7.5	1.4	14.4	29.1	28.9	3.4
# of Outliers	2	1	1	0	1	1	1	2
Lower Limit								
3×IQR (ppm)	5.0	5.0	5.0	1.0	10.0	15.0	20.0	-1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-2.2	-5.0	0.5	0.2	1.9	-10.4	3.4	-2.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-0.2	-2.4	1.7	0.4	4.0	-3.8	7.7	-1.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	1.7	0.2	2.8	0.6	6.0	2.8	11.9	-0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 153: SITE 32 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Not analysed
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Method chosen: No outliers removed. One outlier identified by the Mean+/-3SD and Mean+/-2SD method. These outliers did not distort the calculated background concentration or distribution analysis results, therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 154: SITE 32 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	26	26	26	26	26	26	26
ND	20	22	25	26	25	24	24	11
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	11	18	10.1	1.0	17	45	24	5.1
Mean (ppm)	5.8	5.8	5.2	1.0	10	16	20	1.6
Med (ppm)	8.0	7.6	10	1.0	17	34	26	1.6
SD (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0
95%tile (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.3
95UCL (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9
Distribution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.33 SITE 33, Gjoa Haven, Nunavut Territory

A background sampling program was carried out for the site in 2012. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 26 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 155: SITE 33 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17960	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17961	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17962	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17963	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17964	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17965	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17966	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17967	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17968	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17969	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17970	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17971	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17972	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17973	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17974	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17975	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17976	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17977	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17978	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17979	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17980	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17981	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17982	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17983	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
17984	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
17985	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 156: SITE 33 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	26	26	26	26	26	26	26	26
%ND	100	100	100	100	100	100	100	96
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.34 SITE 34, Matheson Point, Nunavut Territory

A background sampling program was carried out for the site in 1992. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. Four background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 157: SITE 34 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G3124	1992	0	<3.0	<5.0	<5.0	<1.0	<10	5.0	<20	0.4
G3126	1992	0	<3.0	<5.0	<5.0	<1.0	<10	4.8	<20	0.5
G3135A	1992	0	<3.0	<5.0	<5.0	<1.0	<10	5.4	<20	<0.2
G3135B	1992	0	<3.0	<5.0	<5.0	<1.0	17.0	<3	<20	<0.2

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 158: SITE 34 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	4	4	4	4	4	4	4	4
%ND	100	100	100	100	75	25	100	50
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.35 SITE 35, Shepherd Bay, Nunavut Territory

A background sampling program was carried out for the site in 2000. All soil samples were collected from the five identified terrain units on the site within the 500 meters background radius of the station. Two background samples were collected from terrain unit 3, 4, and 5, and no background samples were collected from terrain unit 1 and 2. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 159: SITE 35 (terrain unit 3) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
00-16700	2000	0	3.9	<5.0	<5.0	<1.0	<10	<15	<20	1.3
00-16702	2000	30	3.9	<5.0	<5.0	<1.0	<10	<15	<20	1.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 160: SITE 35 (terrain unit 4) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
00-16698	2000	3	5.6	<5.0	<5.0	<1.0	<10	33.0	<20	3.1
00-16699	2000	30	4.7	<5.0	<5.0	<1.0	<10	17.0	<20	2.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 161: SITE 35 (terrain unit 5) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
00-16699	2000	0	5.8	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
00-16699	2000	30	<3.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 162: SITE 35 (terrain unit 3) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	100	100	100	100	100	100	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 163: SITE 35 (terrain unit 4) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	100	100	100	100	0	100	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 164: SITE 35 (terrain unit 5) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	50	100	100	100	100	100	100	100
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.36 SITE 36, Simpson Lake, Nunavut Territory

A background sampling program was carried out for the site in 2010. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 27 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 165: SITE 36 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
8570	2010	0	<5.0	5.1	5.8	<1.0	<10	20.9	<20	1.2
8571	2010	0	<5.0	6.9	5.7	<1.0	<10	20.8	<20	1.3
8572	2010	0	10.3	15.5	13.0	<1.0	<10	60.0	32.9	2.6
8573	2010	20-30	10.4	14.3	12.6	<1.0	<10	52.9	28.9	2.5
8574	2010	0	<5.0	6.3	5.6	<1.0	<10	23.5	<20	1.4
8575	2010	0	<5.0	<5.0	<5.0	<1.0	<10	18.2	<20	<1.0
8576	2010	0	13.5	10.8	8.3	<1.0	<10	33.4	22.7	1.8
8577	2010	0	<5.0	5.3	5.2	<1.0	<10	17.5	<20	<1.0
8578	2010	0	17.1	10.0	18.2	<1.0	11.3	45.9	21.5	2.9
8579	2010	0	6.6	10.9	8.8	<1.0	<10	39.1	30.1	1.1
8580	2010	0	6.6	7.7	8.3	<1.0	<10	28.7	<20	1.1
8581	2010	20-30	7.2	8.0	8.5	<1.0	<10	31.7	<20	1.4
8582	2010	0	24.3	21.0	18.1	<1.0	<10	61.5	50.5	2.0
8583	2010	0	<5.0	<5.0	<5.0	<1.0	<10	20.2	<20	<1.0
8584	2010	0	<5.0	<5.0	<5.0	<1.0	<10	61.7	<20	<1.0
8585	2010	0	<5.0	7.9	6.8	<1.0	<10	47.5	<20	1.5
8586	2010	0	<5.0	5.1	<5.0	<1.0	<10	17.2	<20	1.6
8587	2010	20-30	5.7	8.1	6.2	<1.0	<10	29.1	<20	1.4
8588	2010	0	7.1	8.9	6.7	<1.0	<10	29.9	<20	1.6
8589	2010	0	10.9	10.7	9.7	<1.0	<10	42.8	22.9	2.6
8590	2010	0	<5.0	7.0	6.1	<1.0	<10	27.0	<20	1.3
8591	2010	0	<5.0	7.3	6.1	<1.0	<10	27.1	<20	1.5
8592	2010	0	7.6	6.3	5.2	<1.0	<10	27.6	<20	1.3
8593	2010	0	6.9	7.5	6.4	<1.0	<10	28.5	<20	1.8

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
8594	2010	20-30	10.4	10.8	8.5	<1.0	<10	42.9	23.1	1.9
8595	2010	0	6.7	7.0	6.5	<1.0	<10	26.3	<20	<1.0
8596	2010	20-30	11.1	12.6	9.2	<1.0	<10	46.5	25.2	1.9

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 166: SITE 36 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	27	27	27	27	27	27	27	27
%ND	41	11	15	100	96	0	67	19
Analysed?	Yes	Yes	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 167: SITE 36 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	26.4	24.1	17.7	1.0	10.0	102.8	31.3	4.0
# of Outliers	0	0	2	0	1	0	2	0
Mean+/-4SD (ppm)	25.5	23.7	22.4	1.8	16.2	91.4	52.3	3.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	20.9	19.8	18.6	1.6	14.7	76.5	44.8	3.1
# of Outliers	1	1	0	0	0	0	1	0
Mean+/-2SD (ppm)	16.4	15.9	14.9	1.4	13.1	61.6	37.3	2.6
# of Outliers	2	1	2	0	0	1	1	2
Lower Limit								
3×IQR (ppm)	-11.1	-7.0	-3.4	1.0	10.0	-33.6	11.5	-1.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-11.0	-7.5	-7.6	0.2	3.9	-27.6	-7.8	-0.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-6.4	-3.6	-3.8	0.4	5.4	-12.7	-0.3	-0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-1.9	0.3	-0.1	0.6	7.0	2.1	7.2	0.4
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 168: SITE 36 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: Mean+/-2SD. Two outliers found distant from the population that distorted calculated background concentrations and distribution analysis, therefore were removed.
Ni	Method chosen: Mean+/-3SD. One outlier found distant from the population that distorted calculated background concentrations and distribution analysis, therefore was removed.
Co	Method chosen: Mean+/-2SD. Two outliers found distant from the population that distorted calculated background concentrations and distribution analysis, therefore were removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method. This outlier did not distort calculated background concentrations or distribution analysis, therefore wasn't removed.
Cr	Not analysed
As	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method. These outliers did not distort the calculated background concentration or distribution analysis results, therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 169: SITE 36 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	25	26	25	26	27	27	27	27
ND	11	3	4	26	26	0	18	5
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	17	20	1.0
Max (ppm)	13	15	13	1.0	11	62	50	2.9
Mean (ppm)	7.0	8.3	7.2	1.0	10	34	23	1.6
Med (ppm)	7.4	7.9	6.7	1.0	11	29	25	1.5
SD (ppm)	2.5	2.9	2.2	N/A	N/A	14	N/A	0.5
95%tile (ppm)	11	14	12	N/A	N/A	61	N/A	2.6
95UCL (ppm)	7.9	9.2	8.1	N/A	N/A	40	N/A	1.7
Distribution	norm	norm	norm	N/A	N/A	log	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.37 SITE 37, Pelly Bay, Nunavut Territory

Background soil samples were collected from the site periodically in the years 2002, 2003, 2005, 2006, and 2011. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. A total of 48 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 170: SITE 37 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17277/78	2002	0	8.8	12.0	6.3	<1.0	<10	29.0	25.0	1.1

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
17279	2002	30	18.0	20.0	10.0	<1.0	<10	56.0	32.0	2.2
17295	2002	0	15.0	17.0	11.0	<1.0	<10	53.0	36.0	2.1
17297	2002	30	8.9	11.0	7.3	<1.0	<10	30.0	25.0	1.1
17981	2003	0	25.0	24.0	14.0	<1.0	12.0	84.0	45.0	2.2
17983	2003	30	15.0	15.0	9.0	<1.0	<10	44.0	35.0	1.7
17986	2003	0	19.0	22.0	13.0	<1.0	11.0	66.0	43.0	3.5
17988	2003	30	15.0	18.0	10.0	<1.0	<10	44.0	32.0	2.7
18029	2003	0	22.0	25.0	14.0	<1.0	13.0	77.0	46.0	2.1
18031	2003	30	12.0	14.0	8.3	<1.0	<10	38.0	27.0	1.2
21222	2005	0	14.0	16.0	9.8	<1.0	<10	56.0	31.0	3.1
21224	2005	30	10.0	13.0	8.1	<1.0	<10	35.0	25.0	1.4
21266	2005	30	11.0	18.0	8.9	<1.0	10.0	43.0	26.0	2.0
21268	2005	0	9.4	12.0	7.2	<1.0	<10	53.0	22.0	1.7
21358	2005	0	8.7	12.0	7.8	<1.0	<10	48.0	23.0	1.3
36000	2005	30	18.0	22.0	13.0	<1.0	10.0	77.0	44.0	3.3
11992	2006	0	12.0	11.0	8.6	<1.0	<10	44.0	24.0	3.2
11994	2006	30	16.0	17.0	11.0	<1.0	<10	53.0	34.0	2.6
12048	2006	0	16.0	18.0	10.0	<1.0	<10	53.0	39.0	4.0
12050	2006	30	11.0	15.0	8.8	<1.0	<10	39.0	30.0	2.9
12056	2006	0	10.0	12.0	6.9	<1.0	<10	34.0	27.0	3.2
12058	2006	30	13.0	14.0	8.3	<1.0	<10	39.0	29.0	3.5
10320	2011	0	20.3	27.0	22.9	<1.0	16.5	89.1	55.3	3.9
10321	2011	0	23.2	32.3	26.6	<1.0	19.4	104.4	65.2	3.8
10322	2011	0	9.3	14.0	9.9	<1.0	<10	42.2	28.7	2.0
10323	2011	20-30	8.0	13.0	8.6	<1.0	<10	36.5	28.0	2.0
10324	2011	0	5.4	8.9	5.8	<1.0	<10	26.4	<20	1.6
10325	2011	0	<5.0	6.6	<5.0	<1.0	<10	17.9	<20	<1.0
10326	2011	20-30	<5.0	7.6	<5.0	<1.0	<10	20.9	<20	<1.0
10327	2011	0	9.7	15.0	8.3	<1.0	<10	39.3	30.3	2.8
10328	2011	0	14.6	19.6	11.7	<1.0	12.0	65.5	40.6	2.9
10329	2011	0	5.3	8.6	5.2	<1.0	<10	24.4	<20	<1.0
10330	2011	20-30	5.5	10.8	5.5	<1.0	<10	21.6	<20	2.4
10331	2011	20-30	<5.0	7.9	5.0	<1.0	<10	19.2	<20	1.7
10332	2011	0	6.7	11.8	7.2	<1.0	<10	30.1	26.6	3.8
10333	2011	0	<5.0	7.6	5.2	<1.0	<10	22.4	21.7	1.6
10334	2011	20-30	<5.0	7.8	5.7	<1.0	<10	21.4	22.7	1.7
10335	2011	0	7.5	11.1	6.5	<1.0	<10	26.5	20.5	1.7
10336	2011	0	9.9	13.2	9.0	<1.0	<10	41.5	29.3	2.4
10337	2011	0	<5.0	14.0	6.5	<1.0	<10	25.0	22.6	1.5
10338	2011	0	<5.0	9.5	6.0	<1.0	<10	25.0	<20	2.1
10339	2011	0	19.8	21.3	13.3	<1.0	10.6	76.6	42.3	3.2
10340	2011	0	10.3	14.2	10.4	<1.0	<10	50.6	28.2	1.8
10341	2011	0	9.2	12.9	9.5	<1.0	<10	44.3	27.2	1.7
10342	2011	0	16.3	20.0	13.9	<1.0	10.8	70.2	42.1	3.0
10343	2011	20-30	13.8	16.9	12.8	<1.0	<10	57.8	35.6	3.1
10344	2011	0	<5.0	10.0	6.1	<1.0	<10	27.2	23.0	1.8
10345	2011	0	7.5	11.3	7.0	<1.0	<10	30.5	23.3	2.1

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 171: SITE 37 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	48	48	48	48	48	48	48	48
%ND	17	0	6	100	83	0	15	6
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 172: SITE 37 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	38.0	38.8	22.5	1.0	10.0	129.4	71.9	7.0
# of Outliers	0	0	2	0	8	0	0	0
Mean+/-4SD (ppm)	32.5	36.9	25.8	1.6	18.8	124.8	71.6	5.5
# of Outliers	0	0	1	0	1	0	0	0
Mean+/-3SD (ppm)	27.0	31.1	21.5	1.4	16.7	103.8	60.9	4.7
# of Outliers	0	1	2	0	1	1	1	0
Mean+/-2SD (ppm)	21.4	25.4	17.3	1.3	14.6	82.8	50.3	3.8
# of Outliers	3	2	2	0	2	3	2	2
Lower Limit								
3×IQR (ppm)	-15.7	-9.7	-5.4	1.0	10.0	-47.1	-13.9	-2.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-12.1	-9.1	-8.4	0.4	2.1	-43.5	-13.7	-1.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-6.5	-3.4	-4.1	0.6	4.2	-22.4	-3.1	-0.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-0.9	2.4	0.1	0.7	6.3	-1.4	7.6	0.4
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 173: SITE 37 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method. These outliers did not distort the calculated background concentration or distribution analysis results, therefore were not removed.
Ni	Method chosen: Mean+/-3SD. One outlier found distant from the population that distorted calculated background concentrations and distribution analysis, therefore was removed.
Co	Method chosen: 3×IQR. Two outliers found distant from the population that distorted calculated background concentrations and distribution analysis, therefore were removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier identified by the Mean+/-3SD method and three outliers identified by the Mean+/-2SD method. These outliers did not distort calculated background concentrations or distribution analysis, therefore were not removed.
Cr	Method chosen: No outliers removed. One outlier identified by the Mean+/-3SD method and two outliers identified by the Mean+/-2SD method. These outliers did not distort calculated background concentrations or distribution analysis, therefore were not removed.
As	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method. These outliers did not distort the calculated background concentration or distribution analysis results, therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 174: SITE 37 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	48	47	46	48	48	48	48	48
ND	8	0	3	48	40	0	7	3
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	18	20	1.0
Max (ppm)	25	27	14	1.0	13	104	65	4.0
Mean (ppm)	11	14	8.7	1.0	10	45	30	2.3
Med (ppm)	11	14	8.6	1.0	10	42	29	2.4
SD (ppm)	5.4	4.9	2.7	N/A	N/A	20	9.9	0.9
95%tile (ppm)	21	23	14	N/A	N/A	8.2	46	3.8
95UCL (ppm)	13	16	9.4	N/A	N/A	50	33	2.5
Distribution	norm	norm	norm	N/A	N/A	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.38 SITE 38, Mackar Inlet, Nunavut Territory

Background soil samples were collected from the site in 1992 (two samples) and 2000 (two samples). All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. A total of four background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 175: SITE 38 (station area) background soil data.

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
G2421	1992	0	25.0	35.0	22.0	2.8	<10	58.0	44.0	1.5
G2422	1992	0	8.3	8.0	6.6	<1.0	<10	24.0	23.0	<0.2
19896	2000	0-10	4.3	<5.0	<5.0	<1.0	<10	15.0	<20	1.2
19897	2000	0-10	4.2	10.4	6.8	<1.0	<10	27.0	<20	<0.2

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 176: SITE 38 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	4	4	4	4	4	4	4	4
%ND	0	25	25	75	100	0	50	50
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.39 SITE 39, Cape McLaughlin, Nunavut Territory

Background soil samples were collected from the site in 2007. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. A total of 24 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 177: SITE 39 (station area) background soil data.

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	1.0
SQG (ppm)			63	50	50	10	140	200	64	12
39029	2007	0	12.7	9.2	9.1	<1.0	<10	35.8	<20	1.9
39030	2007	0	8.8	6.1	6.1	<1.0	<10	22.4	<20	1.3
39031	2007	0	8.3	6.3	6.5	<1.0	<10	24.2	<20	1.3
39032	2007	0	6.1	<5.0	5.1	<1.0	<10	23.9	<20	<1.0
39033	2007	40	7.4	5.9	5.1	<1.0	<10	17.9	<20	<1.0
39034	2007	0	9.1	7.5	6.6	<1.0	<10	28.2	<20	1.4
39035	2007	0	9.3	6.7	<5.0	<1.0	<10	21.4	<20	1.3
39036	2007	0	37.1	5.2	<5.0	<1.0	<10	17.0	<20	<1.0
39037	2007	0	9.9	6.9	6.1	<1.0	<10	21.6	<20	1.1
39038	2007	0	9.0	6.9	5.9	<1.0	<10	19.9	<20	<1.0
39039	2007	40	7.9	6.2	<5.0	<1.0	<10	<15	<20	<1.0
39043	2007	0	9.7	12.2	7.4	<1.0	17.1	37.5	31.0	2.3
39044	2007	40	12.9	12.4	8.0	<1.0	19.6	39.7	32.0	2.5
39045	2007	0	6.6	6.4	<5.0	<1.0	<10	18.7	<20	<1.0
39046	2007	0	6.6	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
39047	2007	0	7.9	6.2	<5.0	<1.0	<10	<15	<20	<1.0
39048	2007	40	15.5	8.0	6.3	<1.0	<10	17.8	<20	<1.0
39049	2007	0	11.3	10.2	7.7	<1.0	<10	28.1	23.2	<1.0
39050	2007	40	12.3	11.1	7.7	<1.0	<10	30.1	23.5	1.3
39051	2007	40	14.7	10.4	7.3	<1.0	<10	30.1	21.7	1.2
39052	2007	0	10.4	6.1	5.9	<1.0	<10	22.4	<20	<1.0
39053	2007	0	6.9	<5.0	<5.0	<1.0	<10	24.3	<20	<1.0

39054	2007	0	8.3	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
39055	2007	0	38.3	19.6	15.3	<1.0	17.4	89.2	32.7	3.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 178: SITE 39 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	24	24	24	24	24	24	24	24
%ND	0	17	33	100	88	17	75	54
Analysed?	Yes	Yes	Yes	No	No	Yes	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 179:SITE 39 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	25.8	19.7	14.3	1.0	10.0	60.9	21.7	2.2
# of Outliers	2	0	1	0	3	1	5	3
Mean+/-4SD (ppm)	44.0	21.5	15.7	1.8	23.7	86.4	43.9	3.8
# of Outliers	0	0	0	0	0	1	0	0
Mean+/-3SD (ppm)	35.6	17.9	13.3	1.6	20.4	70.8	38.3	3.2
# of Outliers	2	1	1	0	0	1	0	1
Mean+/-2SD (ppm)	27.2	14.4	11.0	1.4	17.2	55.1	32.7	2.5
# of Outliers	2	1	1	0	2	1	0	1
Lower Limit								
3×IQR (ppm)	-5.5	-4.2	-2.0	1.0	10.0	-14.4	18.7	0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-23.1	-6.7	-3.2	0.2	-2.2	-38.8	-0.8	-1.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-14.7	-3.2	-0.8	0.4	1.1	-23.1	4.8	-0.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-6.3	0.3	1.5	0.6	4.3	-7.5	10.4	0.0
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 180: SITE 39 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Two outliers found distant from the population that distorted calculated background concentrations and distribution analysis, therefore were removed.
Ni	Method chosen: Mean+/-3SD. Two outliers found distant from the population that distorted calculated background concentrations and distribution analysis, therefore were removed.
Co	Method chosen: 3×IQR. One outlier found distant from the population that distorted calculated background concentrations and distribution analysis, therefore was removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier found distant from the population that distorted calculated background concentrations and distribution analysis, therefore was removed.
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 181: SITE 39 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	22	23	23	24	24	23	24	24
ND	0	4	8	24	21	4	18	13
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	6.1	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	15	12	9.1	1.0	20	40	33	3.6
Mean (ppm)	9.6	7.4	6.1	1.0	11	23	22	1.3
Med (ppm)	9.0	6.9	6.5	1.0	17	24	27	1.3
SD (ppm)	2.6	2.3	1.2	N/A	N/A	7.2	N/A	N/A
95%tile (ppm)	15	12	8.0	N/A	N/A	37	N/A	N/A
95UCL (ppm)	11	8.2	6.6	N/A	N/A	26	N/A	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.40 SITE 40, Sacrpa Lake, Nunavut Territory

Background soil samples were collected from the site in 1993. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. A total of five background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 182: SITE 40 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
G3555	1993	0	13.8	12.2	7.5	<1.0	<10	40.0	40.0	<0.2
G3556A	1993	0	17.4	17.0	10.7	<1.0	<10	48.0	52.0	0.9

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
G3556B	1993	0	18.6	17.3	9.0	<1.0	<10	47.0	48.0	0.9
G3757	1993	0	21.0	13.7	8.8	<1.0	<10	55.0	41.0	0.7
G3757	1993	0	21.0	13.7	8.8	<1.0	<10	55.0	41.0	0.7

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 183: SITE 40 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	5	5	5	5	5	5	5	5
%ND	0	0	0	100	100	0	0	20
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.41 SITE 41, Laylor River, Nunavut Territory

Background soil samples were collected from the site in 2007. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. A total of 18 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 184: SITE 41 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	12
38935	2007	0	13.5	8.4	5.1	<1.0	<10	27.4	<20	2.2
38936	2007	40	10.9	6.8	<5.0	<1.0	<10	19.7	<20	2.1
38937	2007	0	11.7	7.4	<5.0	<1.0	<10	22.0	<20	1.9
38938	2007	0	11.9	8.2	<5.0	<1.0	<10	22.9	<20	2.2
38939	2007	40	11.2	7.0	<5.0	<1.0	<10	18.6	<20	1.8
38940	2007	0	11.4	7.9	5.8	<1.0	<10	31.9	<20	2.1
38941	2007	0	13.9	11.7	<5.0	<1.0	<10	26.2	<20	1.7
38942	2007	0	11.0	7.6	<5.0	<1.0	<10	19.5	<20	2.6
38943	2007	0	11.2	9.1	5.3	<1.0	<10	29.0	<20	2.5
38944	2007	40	10.5	6.8	<5.0	<1.0	<10	19.6	<20	2.1
38945	2007	0	9.7	6.0	<5.0	<1.0	<10	20.3	<20	1.9
38946	2007	0	12.0	7.2	<5.0	<1.0	<10	20.4	<20	2.2
38947	2007	0	10.8	12.2	5.3	<1.0	<10	44.7	21.4	1.9
38948	2007	0	9.2	9.9	<5.0	<1.0	<10	24.4	<20	1.7
38949	2007	0	10.9	12.3	6.0	<1.0	10.9	33.6	21.4	2.2
38950	2007	40	10.5	11.8	5.3	<1.0	<10	30.2	20.0	2.0
38951	2007	40	11.1	16.8	5.4	<1.0	<10	31.0	31.6	2.1
38966	2007	0	11.1	10.7	5.6	<1.0	<10	29.6	<20	2.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 185: SITE 40 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	18	18	18	18	18	18	18	18
%ND	0	0	56	100	94	0	83	0

Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 186: SITE 41 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	14.0	24.1	6.2	1.0	10.0	59.2	20.0	3.1
# of Outliers	0	0	0	0	1	0	3	0
Mean+/-4SD (ppm)	20.7	21.7	8.4	1.9	17.5	59.8	40.9	3.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	18.4	18.5	7.6	1.7	15.6	51.2	35.9	2.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	16.0	15.3	6.8	1.5	13.8	42.6	30.8	2.5
# of Outliers	0	1	0	0	0	1	1	1
Lower Limit								
3×IQR (ppm)	8.4	-5.4	4.1	1.0	10.0	-8.9	20.0	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	1.6	-3.8	2.0	0.1	2.6	-9.0	0.4	1.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	4.0	-0.6	2.8	0.3	4.5	-0.4	5.5	1.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	6.4	2.6	3.6	0.5	6.3	8.2	10.5	1.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 187: SITE 41 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified.
Ni	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however this outlier did not distort calculated background concentrations or distribution results, therefore was not removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however this outlier did not distort calculated background concentrations or distribution results, therefore was not removed.
Cr	Not analysed
As	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however this outlier did not distort calculated background concentrations or distribution results, therefore was not removed.

SD = standard deviation; IQR = interquartile range.

Table 188: SITE 41 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	18	18	18	18	18	18	18	18
ND	0	0	10	18	17	0	15	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	9.2	6.0	5.0	1.0	10	19	20	1.7
Max (ppm)	14	17	6.0	1.0	11	45	32	2.6
Mean (ppm)	11	9.3	5.2	1.0	10	26	21	2.1
Med (ppm)	11	8.3	5.3	1.0	10	25	21	2.1
SD (ppm)	1.1	2.8	N/A	N/A	N/A	6.8	N/A	0.2
95%tile (ppm)	14	13	N/A	N/A	N/A	35	N/A	2.5
95UCL (ppm)	12	10	N/A	N/A	N/A	29	N/A	2.2
Distribution	norm	norm	N/A	N/A	N/A	norm	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.42 SITE 42, Hall Beach, Nunavut Territory

Background soil samples were collected from the site in 2001. Background soil samples were collected two terrain units identified within the 500 meters background radius of the station, called Terrain Unit 1 and Terrain Unit 2. Two background samples were collected from each terrain unit for a total of four samples in total. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 189: SITE 42 (terrain unit 1) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
01-22009	2001	0	6.6	<5.0	<5.0	<1.0	<10	<15	<20	1.3
01-22010/11	2001	40	4.8	<5.0	<5.0	<1.0	<10	<15	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 190: SITE 42 (terrain unit 2) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
01-22012	2001	0	6.2	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
01-22013	2001	50	7.7	7.6	<5.0	<1.0	<10	<15	<20	1.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 191: SITE 42 (terrain unit 1) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	100	100	100	100	100	100	50
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 192: SITE 42 (terrain unit 2) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	50	100	100	100	100	100	50
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.43 SITE 43, Rowley Island, Nunavut Territory

Background soil samples were collected from the site in 2001. Background soil samples were collected two terrain units identified within the 500 meters background radius of the station, called Terrain Unit 1 and Terrain Unit 2. Two background samples were collected from each terrain unit for a total of four samples in total. All samples were analyzed for the Arctic suite of inorganic elements.

Table 193: SITE 43 (station area) background soil data

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
8120	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
8121	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8122	2010	0	<5.0	5.4	<5.0	<1.0	<10	<15	<20	<1.0
8123	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	3.0
8124	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
8125	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			5.0	5.0	5.0	1.0	10	15	20	1.0
SQG (ppm)			63	50	50	10	140	200	64	12
8126	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.0
8127	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.4
8128	2010	0	<5.0	6.8	<5.0	<1.0	<10	<15	<20	1.7
8129	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8130	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.7
8131	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
8132	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
8133	2010	0	8.8	11.9	6.5	<1.0	<10	32.0	21.7	3.6
8134	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.2
8135	2010	0	6.4	8.5	<5.0	<1.0	<10	19.2	<20	2.4
8136	2010	20-30	7.3	9.4	<5.0	<1.0	<10	20.7	<20	2.4
8137	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.3
8138	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.6
8139	2010	0	8.4	10.8	5.2	<1.0	<10	25.6	<20	2.2
8140	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
8141	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
8142	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.7
8143	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.6
8144	2010	0	<5.0	5.1	<5.0	<1.0	<10	<15	<20	1.3
8145	2010	0	<5.0	5.3	<5.0	<1.0	<10	<15	<20	1.5
8146	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.0
8147	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
8148	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.4
8149	2010	20-30	8.2	<5.0	<5.0	<1.0	<10	<15	<20	1.0
8150	2010	0	<5.0	5.5	<5.0	<1.0	<10	<15	<20	4.1
8151	2010	0	<5.0	6.2	<5.0	<1.0	<10	<15	<20	3.4
8152	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8153	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
8154	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
8155	2010	0	6.7	9.7	<5.0	<1.0	<10	21.9	<20	2.8
8156	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.7
8100	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
8101	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
8102	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
8103	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8104	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
8105	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.2
8106	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.9
8107	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.9
8108	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.9
8109	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.7
8110	2010	0	<5.0	5.2	<5.0	<1.0	<10	<15	<20	1.8
8111	2010	0	<5.0	5.2	<5.0	<1.0	<10	<15	<20	3.0
8112	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 194: SITE 43 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	50	50	50	50	50	50	50	50
%ND	88	74	96	100	100	90	98	12
Analysed?	No	No	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 195: SITE 43 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	5.0	5.3	5.0	1.0	10.0	15.0	20.0	4.6
# of Outliers	6	9	2	0	0	5	1	0
Mean+/-4SD (ppm)	9.4	12.0	6.9	1.6	14.5	30.1	30.2	4.5
# of Outliers	0	0	0	0	0	1	0	0
Mean+/-3SD (ppm)	8.3	10.4	6.5	1.4	13.4	26.5	27.6	3.8
# of Outliers	2	2	1	0	0	1	0	1
Mean+/-2SD (ppm)	7.3	8.7	6.0	1.3	12.2	22.9	25.1	3.1
# of Outliers	4	4	1	0	0	2	0	3
Lower Limit								
3×IQR (ppm)	5.0	4.8	5.0	1.0	10.0	15.0	20.0	-1.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	1.1	-1.2	3.1	0.4	5.5	1.3	9.9	-1.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	2.2	0.5	3.6	0.6	6.6	4.9	12.4	-0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	3.2	2.1	4.1	0.7	7.8	8.5	15.0	0.2
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 196: SITE 43 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Not analysed
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed.
Cr	Not analysed
As	Method chosen: No outliers removed. One outlier identified by the Mean+/-3SD method and two outliers identified by the Mean+/-2SD method, however these outliers did not distort calculated background concentrations or distribution results, therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 197: SITE 43 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	50	50	50	50	50	50	50	50
ND	44	37	48	50	50	45	49	6
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	19	20	1.0
Max (ppm)	7.7	12	6.5	1.0	10	32	22	4.1
Mean (ppm)	5.3	5.6	5.0	1.0	10	16	20	1.8
Med (ppm)	1.0	6.2	5.9	1.0	10	22	22	1.7
SD (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.7
95%tile (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.2
95UCL (ppm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.0
Distribution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.44 SITE 44, Bray Island, Nunavut Territory

A background sampling program was carried out for the site in 2010. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. 64 background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements.

Table 198: SITE 44 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8500	2010	0	11.1	15.9	<5.0	<1.0	<10	28.2	24.5	4.8
8501	2010	0	9.0	14.4	<5.0	1.5	<10	25.1	23.2	3.5
8502	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.1
8503	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
8504	2010	0	7.2	12.5	<5.0	<1.0	<10	21.9	20.9	4.2
8505	2010	0	<5.0	5.8	<5.0	<1.0	<10	<15	<20	3.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8506	2010	0	<5.0	6.1	<5.0	<1.0	<10	<15	<20	2.6
8507	2010	0	5.2	6.1	<5.0	<1.0	<10	<15	<20	3.0
8508	2010	0	<5.0	5.3	<5.0	<1.0	<10	<15	<20	4.3
8509	2010	0	7.2	8.6	<5.0	<1.0	<10	18.9	<20	3.6
8510	2010	0	6.9	9.2	<5.0	<1.0	<10	<15	<20	15.5
8511	2010	0	6.0	8.3	<5.0	<1.0	<10	<15	<20	9.1
8512	2010	20-30	7.1	9.3	<5.0	<1.0	<10	<15	<20	13.0
8513	2010	0	7.7	12.9	<5.0	<1.0	<10	23.3	22.4	6.3
8514	2010	0	8.2	13.3	<5.0	<1.0	<10	25.1	25.1	5.2
8515	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.9
8516	2010	0	7.4	12.2	<5.0	<1.0	<10	21.6	21.0	3.2
8517	2010	0	8.6	13.2	<5.0	<1.0	<10	23.8	24.1	4.8
8518	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	3.2
8520	2010	0	5.6	6.9	<5.0	<1.0	<10	<15	<20	1.8
8521	2010	0	5.4	6.8	<5.0	<1.0	<10	<15	<20	3.3
8522	2010	20-30	6.5	15.2	<5.0	<1.0	<10	28.6	23.5	2.0
8523	2010	0	<5.0	11.8	<5.0	<1.0	<10	19.9	20.4	2.2
8524	2010	0	6.0	12.9	<5.0	<1.0	<10	<15	<20	6.6
8525	2010	0	5.4	10.3	<5.0	<1.0	<10	<15	<20	9.3
8526	2010	0	8.8	13.3	5.2	<1.0	<10	25.4	24.0	4.3
8527	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.4
8528	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.4
8529	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
8530	2010	0	6.1	9.4	<5.0	<1.0	<10	18.6	<20	2.9
8531	2010	0	6.6	10.5	<5.0	<1.0	<10	20.0	<20	2.8
8532	2010	20-30	5.9	9.3	<5.0	<1.0	<10	19.6	<20	3.6
8533	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.7
8534	2010	0	8.2	12.5	<5.0	<1.0	<10	22.4	22.1	4.2
8535	2010	0	7.9	12.2	<5.0	<1.0	<10	21.9	21.0	4.3
8536	2010	0	<5.0	7.6	<5.0	<1.0	<10	<15	<20	2.9
8537	2010	0	8.5	13.1	5.2	<1.0	<10	24.3	23.9	5.1
8538	2010	0	6.2	9.7	<5.0	<1.0	<10	18.1	<20	2.3
8539	2010	0	6.2	10.9	<5.0	<1.0	<10	19.7	<20	5.2
8540	2010	0	<5.0	7.5	<5.0	<1.0	<10	<15	<20	4.6
8541	2010	0	6.5	6.7	<5.0	<1.0	<10	<15	<20	5.0
8542	2010	0	8.3	8.4	<5.0	<1.0	<10	<15	<20	3.7
8543	2010	0	8.8	13.0	<5.0	<1.0	<10	23.6	23.3	4.0
8544	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.0
8545	2010	20-30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	3.6
8546	2010	0	7.9	10.2	<5.0	<1.0	<10	20.4	22.1	2.1
8547	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
8548	2010	0	<5.0	6.4	<5.0	<1.0	<10	<15	<20	2.9
8549	2010	0	<5.0	6.1	<5.0	<1.0	<10	<15	<20	2.8
8550	2010	0	7.3	12.3	<5.0	<1.0	<10	22.8	22.8	8.8
8551	2010	0	6.7	11.5	<5.0	<1.0	<10	21.7	21.6	3.8
8552	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.9
8553	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.5
8554	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	3.2
8555	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.7
8556	2010	0	5.8	<5.0	<5.0	<1.0	<10	<15	<20	2.0
8557	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.8
8558	2010	0	<5.0	8.2	<5.0	<1.0	<10	<15	<20	3.3
8559	2010	0	10.6	16.0	7.1	<1.0	<10	31.7	28.8	5.4
8560	2010	20-30	12.8	19.1	9.2	<1.0	<10	41.1	36.7	13.9
8561	2010	20-30	10.2	15.5	7.2	<1.0	<10	31.1	28.8	5.9

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8562	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.6
8563	2010	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	2.5
8564	2010	0	<5.0	5.9	<5.0	<1.0	<10	<15	<20	3.4

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 199: SITE 44 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	64	64	64	64	64	64	64	64
%ND	44	30	92	98	100	59	69	0
Analysed?	Yes	Yes	No	No	No	No	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 200: SITE 44 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	14.4	33.8	5.0	1.0	10.0	42.0	24.6	11.4
# of Outliers	0	0	5	1	0	0	4	3
Mean+/-4SD (ppm)	13.6	23.4	8.1	1.5	14.0	40.9	35.7	14.8
# of Outliers	0	0	1	0	0	1	1	1
Mean+/-3SD (ppm)	11.8	19.6	7.3	1.4	13.0	35.2	32.1	12.0
# of Outliers	1	0	1	1	0	1	1	3
Mean+/-2SD (ppm)	9.9	15.8	6.6	1.3	12.0	29.4	28.4	9.1
# of Outliers	4	3	3	1	0	3	3	4
Lower Limit								
3×IQR (ppm)	-2.1	-16.6	5.0	1.0	10.0	-5.2	16.5	-4.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-1.3	-7.2	2.2	0.5	6.0	-5.0	6.5	-7.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	0.6	-3.4	2.9	0.6	7.0	0.7	10.2	-5.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	2.5	0.4	3.6	0.7	8.0	6.5	13.8	-2.2
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 201: SITE 44 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: Mean+/-3SD. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and therefore was removed. Two additional outliers detected by the Mean+/-2SD method, however, these outliers didn't distort calculated background concentrations and therefore were not removed.
Ni	Method chosen: No outliers removed. Four outliers detected by the Mean+/-2SD method, however, these outliers didn't distort calculated background concentrations and therefore were not removed.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed.
Cr	Not analysed
As	Method chosen: 3×IQR. Three outliers identified that distorted calculated background concentrations. These outliers are from samples located in a similar area of the site within the beach area. As these samples were collected from a similar area and were all identified as outliers, these concentrations may represent a separate population with elevated As concentrations. However, as these outliers distort the calculated concentrations for the entire station area, they were removed. These outliers were also identified using the Mean+/-3SD and Mean+/-2SD methods, however as the data set conforms to a lognormal distribution before and after removal of these outliers, the non-parametric 3×IQR method was deemed most appropriate.

SD = standard deviation; IQR = interquartile range.

Table 202: SITE 44 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	63	64	64	64	64	64	64	61
ND	28	19	59	63	64	38	44	0
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	5.0	5.3	5.0	1.0	10	15	20	1.5
Max (ppm)	11	19	9.1	1.5	10	41	37	9.3
Mean (ppm)	6.3	8.9	5.1	1.0	10	19	21	3.6
Med (ppm)	7.2	10	7.1	1.5	10	23	23	3.2
SD (ppm)	1.6	3.7	N/A	N/A	N/A	N/A	N/A	1.8
95%tile (ppm)	9.0	15	N/A	N/A	N/A	N/A	N/A	6.6
95UCL (ppm)	6.6	9.6	N/A	N/A	N/A	N/A	N/A	4.0
Distribution	norm	norm	N/A	N/A	N/A	N/A	N/A	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.45 SITE 45, Longstaff Bluff, Nunavut Territory

A background sampling program was carried out for the site in 2005. Nine terrain units were identified at SITE 45 and are detailed below

1. Mr – Beach sediments: cobble, gravel and sand.
2. Mv – Marine veneer deposits: sand, gravel and cobble in varying proportions, trace silt, a discontinuous cover of littoral and off-shore sediment, including raised beach ridges and sea-

ice rafted debris, mimicking the surface of underlying till or bedrock with patches of exposed bedrock.

3. Mb – Marine blanket deposits: thick deposits of sand, gravel and cobble in varying proportions, trace silt, with some sea-ice rafted debris, forming a continuous cover of littoral and off-shore sediment.
4. GM – Glaciomarine deposits: diamictic stony sand and mud with ice-rafted dropstones, forming undulating terraces.
5. GL – Glaciolacustrine deposits: sand, silt and mud with ice-rafted dropstones, forming flat to undulating plains with patches of exposed bedrock.
6. Tv – Till veneer: glacial diamicton (silt, clay, gravel, and cobble in varying proportions, bouldery), discontinuous cover mimicking topography of underlying bedrock with patches of exposed bedrock.
7. RL – Exposed metasedimentary bedrock: psammite, pelite, wacke and quartzite of the Longstaff Bluff Formation.
8. RLg – Exposed metasedimentary bedrock with patches of felsenmeer or till veneer or marine veneer.
9. RLs – Steep bedrock slope.

The sampling program conducted in 2005 yielded a data set of 113 background samples. The number of background samples collected, and the area of each terrain unit is detailed in Table 203.

Table 203: Summary of SITE 45 terrain unit and sample coverage for the background sampling program.

Terrain unit	Area (km^2)	Area (%)	Sample Size (N)
GL	0.7528	5.12	0
GM	0.6146	4.18	3
Mb	6.0908	41.45	56
Mr	0.0792	0.54	0
Mv	0.4009	2.73	0
RL	0.7209	4.91	1
RLg	3.0665	20.87	23
RLs	0.0651	0.44	0
Tv	2.9033	19.76	30

As the Mb, RLg, and Tv terrain units are the most spatially extensive on the site, most of the background samples collected were from these units. All samples were analyzed for the Arctic suite of inorganic elements.

Table 204: SITE 45 (GM terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2

SQG (ppm)			63	50	50	10	140	200	64	23
11574	2005	0	28.0	35.0	16.0	<1.0	<10	90.0	70.0	9.1
11575	2005	20	45.0	56.0	20.0	<1.0	<10	96.0	82.0	11.0
11588	2005	0	18.0	25.0	8.6	<1.0	<10	44.0	70.0	5.3

Table 205: SITE 45 (Mb terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	23
11520	2005	0	27.5	37.0	18.6	<1.0	<10	81.3	71.3	10.1
11521	2005	0	30.1	36.0	17.8	<1.0	<10	82.6	74.4	8.0
11522	2005	25	40.0	44.0	22.0	<1.0	<10	100.0	88.0	11.0
11528	2005	0	20.0	26.0	10.0	<1.0	<10	57.0	53.0	9.9
11529	2005	0	29.0	29.0	11.0	<1.0	<10	64.0	47.0	18.0
11530	2005	0	87.9	102.0	57.6	<1.0	10.9	220.4	65.5	49.0
11531	2005	0	88.5	102.1	54.9	<1.0	10.5	205.2	59.7	76.8
11532	2005	30	30.0	35.0	24.0	<1.0	<10	76.0	45.0	17.0
11533	2005	0	24.0	25.0	9.3	<1.0	<10	48.0	42.0	20.0
11534	2005	35	38.0	30.0	12.0	<1.0	<10	75.0	55.0	25.0
11535	2005	0	27.0	34.0	12.0	<1.0	<10	67.0	59.0	15.0
11536	2005	30	32.0	30.0	11.0	<1.0	<10	70.0	63.0	15.0
11537	2005	70	49.0	32.0	12.0	<1.0	<10	74.0	54.0	27.0
11538	2005	0	45.0	37.0	14.0	<1.0	<10	79.0	61.0	32.0
11539	2005	30	55.0	38.0	14.0	<1.0	<10	71.0	57.0	25.0
11540	2005	50	49.1	34.6	13.9	<1.0	10.5	77.1	56.3	37.9
11541	2005	50	51.0	34.2	13.5	<1.0	<10	74.6	54.9	32.4
11542	2005	75	48.0	38.0	15.0	<1.0	<10	81.0	59.0	35.0
11543	2005	0	45.0	37.0	13.0	<1.0	<10	75.0	58.0	26.0
11544	2005	30	28.0	29.0	12.0	<1.0	<10	61.0	52.0	24.0
11545	2005	75	58.0	34.0	13.0	<1.0	<10	67.0	42.0	46.0
11546	2005	5	38.0	29.0	9.9	<1.0	<10	71.0	56.0	20.0
11547	2005	10	34.0	33.0	12.0	<1.0	<10	64.0	51.0	13.0
11548	2005	30	33.0	25.0	9.6	<1.0	<10	58.0	41.0	20.0
11549	2005	50	28.0	22.0	8.3	<1.0	<10	47.0	41.0	15.0
11550	2005	5	21.9	22.5	9.5	<1.0	<10	57.1	42.6	18.8
11551	2005	5	17.6	18.2	7.8	<1.0	<10	60.9	35.8	16.5
11552	2005	30	27.0	29.0	10.0	<1.0	<10	54.0	45.0	15.0
11553	2005	5	36.0	68.0	27.0	<1.0	<10	93.0	55.0	19.0
11554	2005	30	34.0	24.0	9.3	<1.0	<10	46.0	35.0	36.0
11555	2005	5	31.0	30.0	13.0	<1.0	<10	77.0	58.0	19.0
11556	2005	5	21.0	21.0	8.2	<1.0	<10	39.0	34.0	17.0
11557	2005	40	22.0	21.0	8.2	<1.0	<10	35.0	28.0	20.0
11558	2005	0	21.0	21.0	8.7	<1.0	<10	47.0	43.0	14.0
11559	2005	0	23.0	28.0	11.0	<1.0	<10	70.0	65.0	10.0
11560	2005	40	27.7	29.5	11.4	<1.0	<10	69.1	62.2	21.2
11561	2005	40	33.0	33.7	13.0	<1.0	<10	75.1	69.8	24.7
11563	2005	25	14.0	11.0	5.7	<1.0	<10	28.0	25.0	22.0
11564	2005	5	21.0	23.0	8.3	<1.0	<10	42.0	37.0	14.0
11565	2005	5	23.0	25.0	9.6	<1.0	<10	54.0	54.0	9.8
11566	2005	30	21.0	18.0	7.2	<1.0	<10	40.0	39.0	9.8
11570	2005	10	17.8	22.3	8.9	<1.0	<10	47.9	47.2	8.8
11571	2005	10	13.8	19.6	8.5	<1.0	<10	48.0	45.6	16.8
11572	2005	30	22.0	28.0	10.0	<1.0	<10	60.0	63.0	7.9
11578	2005	30	21.0	27.0	11.0	<1.0	<10	57.0	63.0	15.0
11582	2005	0	700.0	210.0	85.0	<1.0	33.0	280.0	47.0	26.0
11593	2005	30	19.0	24.0	9.9	<1.0	<10	58.0	58.0	7.6
11594	2005	5	23.0	36.0	14.0	<1.0	<10	78.0	89.0	10.0
11595	2005	40	44.0	38.0	16.0	<1.0	<10	79.0	75.0	18.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
11602	2005	5	61.0	56.0	20.0	<1.0	<10	99.0	68.0	36.0
11603	2005	40	49.0	47.0	17.0	<1.0	<10	97.0	73.0	26.0
11623	2005	0	64.0	14.0	9.3	<1.0	11.0	110.0	94.0	1.7
11624	2005	0	110.0	110.0	34.0	<1.0	17.0	190.0	120.0	6.8
11626	2005	0	17.0	27.0	9.9	<1.0	<10	64.0	51.0	6.3
11627	2005	5	53.0	49.0	29.0	<1.0	14.0	170.0	74.0	31.0
11628	2005	30	52.0	52.0	36.0	<1.0	13.0	160.0	76.0	32.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 206: SITE 45 (RLg terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
11523	2005	0	47.0	34.0	14.0	<1.0	<10	88.0	86.0	16.0
11524	2005	30	48.0	40.0	19.0	<1.0	<10	74.0	62.0	16.0
11525	2005	65	48.0	42.0	27.0	<1.0	<10	89.0	75.0	20.0
11526	2005	0	80.0	110.0	30.0	<1.0	<10	95.0	57.0	10.0
11527	2005	30	88.0	140.0	25.0	<1.0	<10	110.0	40.0	5.8
11562	2005	10	140.0	69.0	35.0	<1.0	15.0	120.0	68.0	18.0
11567	2005	5	60.0	49.0	17.0	<1.0	<10	82.0	62.0	29.0
11568	2005	30	26.0	29.0	13.0	<1.0	<10	60.0	58.0	14.0
11569	2005	60	41.0	39.0	15.0	<1.0	<10	70.0	59.0	21.0
11573	2005	0	35.0	11.0	6.3	<1.0	11.0	80.0	71.0	6.9
11579	2005	10	42.0	10.0	5.2	<1.0	<10	64.0	63.0	11.0
11580	2005	0	69.8	11.4	5.8	<1.0	58.4	61.6	61.1	80.4
11581	2005	0	72.9	11.2	10.6	<1.0	61.1	60.6	58.8	75.9
11583	2005	10	110.0	53.0	20.0	<1.0	26.0	90.0	71.0	47.0
11584	2005	0	73.0	18.0	9.5	<1.0	19.0	40.0	57.0	1.3
11596	2005	5	84.0	130.0	31.0	<1.0	<10	110.0	69.0	13.0
11597	2005	20	68.0	84.0	19.0	<1.0	<10	87.0	70.0	15.0
11598	2005	50	90.0	170.0	50.0	<1.0	<10	160.0	64.0	17.0
11599	2005	5	76.0	89.0	31.0	<1.0	11.0	160.0	69.0	22.0
11600	2005	20	42.3	47.1	19.1	<1.0	<10	90.6	76.7	6.7
11601	2005	20	61.7	54.0	21.1	<1.0	<10	97.0	77.8	7.4
11625	2005	0	42.0	26.0	10.0	<1.0	13.0	58.0	63.0	16.0
11632	2005	5	47.0	37.0	16.0	<1.0	<10	59.0	66.0	12.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 207: SITE 45 (Tv terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
11576	2005	5	29.0	34.0	14.0	<1.0	<10	74.0	66.0	10.0
11577	2005	30	24.0	33.0	13.0	<1.0	<10	72.0	65.0	13.0
11585	2005	5	36.0	7.0	<5.0	<1.0	11.0	71.0	54.0	2.5
11586	2005	25	36.0	7.0	<5.0	<1.0	13.0	74.0	60.0	8.6
11587	2005	10	150.0	96.0	48.0	<1.0	<10	190.0	80.0	11.0
11589	2005	20	46.0	35.0	13.0	<1.0	<10	60.0	46.0	31.0
11590	2005	10	49.5	32.9	10.8	<1.0	<10	62.5	46.4	35.8
11591	2005	10	54.9	33.8	11.0	<1.0	10.2	65.5	45.5	41.5
11592	2005	50	45.0	27.0	9.6	<1.0	<10	58.0	43.0	34.0
11604	2005	20	39.0	29.0	10.0	<1.0	<10	59.0	48.0	30.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
11605	2005	5	60.0	41.0	15.0	<1.0	11.0	80.0	51.0	37.0
11606	2005	30	58.0	41.0	14.0	<1.0	10.0	77.0	47.0	35.0
11607	2005	5	46.0	31.0	11.0	<1.0	<10	66.0	42.0	32.0
11608	2005	5	50.0	38.0	14.0	<1.0	<10	73.0	49.0	35.0
11609	2005	30	50.0	39.0	14.0	<1.0	<10	75.0	50.0	34.0
11610	2005	5	99.7	45.5	14.1	<1.0	21.2	102.1	60.4	62.8
11611	2005	5	98.6	45.5	14.5	<1.0	21.5	103.5	58.4	63.4
11612	2005	30	96.0	46.0	16.0	<1.0	21.0	100.0	57.0	63.0
11613	2005	0	41.0	36.0	14.0	<1.0	<10	74.0	51.0	29.0
11614	2005	30	48.0	40.0	14.0	<1.0	<10	78.0	52.0	31.0
11615	2005	5	62.0	41.0	16.0	<1.0	11.0	76.0	51.0	36.0
11616	2005	30	46.0	33.0	13.0	<1.0	<10	65.0	45.0	30.0
11617	2005	5	50.0	32.0	12.0	<1.0	12.0	65.0	47.0	55.0
11618	2005	0	47.0	36.0	13.0	<1.0	10.0	65.0	45.0	34.0
11619	2005	0	48.0	42.0	15.0	<1.0	<10	71.0	51.0	34.0
11620	2005	30	57.6	43.6	16.4	<1.0	13.2	82.5	53.1	39.5
11621	2005	30	49.4	35.7	13.9	<1.0	11.8	72.6	50.3	33.7
11629	2005	10	45.0	33.0	11.0	<1.0	<10	58.0	42.0	26.0
11630	2005	10	29.8	19.6	7.6	<1.0	<10	62.6	52.7	22.2
11631	2005	10	52.1	17.3	6.9	<1.0	<10	50.8	40.3	24.6

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 208: SITE 45 (RL terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
11622	2005	0	27.0	16.0	8.8	<1.0	<10	110.0	93.0	3.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 209: SITE 45 (GM terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	3	3	3	3	3	3	3	3
%ND	0	0	0	100	100	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 210: SITE 45 (Mb terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	56	56	56	56	56	56	56	56
%ND	0	0	0	100	86	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 211: SITE 45 (RLg terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	23	23	23	23	23	23	23	23
%ND	0	0	0	100	65	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 212: SITE 45 (Tv terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	30	30	30	30	30	30	30	30
%ND	0	0	7	100	63	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 213: SITE 45 (RL terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	1	1	1	1	1	1	1	1
%ND	0	0	0	100	100	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 214: SITE 45 (Mb terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	127.0	73.8	32.2	1.0	10.0	147.0	119.0	66.5
# of Outliers	1	4	5	0	8	6	1	1
Mean+/-4SD (ppm)	394.8	155.0	68.8	1.5	24.1	266.9	127.8	68.7
# of Outliers	1	1	1	0	1	1	0	1
Mean+/-3SD (ppm)	304.6	124.4	55.0	1.4	20.7	218.2	109.5	55.9
# of Outliers	1	1	2	0	1	2	1	1
Mean+/-2SD (ppm)	214.5	93.8	41.1	1.3	17.3	169.4	91.1	43.1
# of Outliers	1	4	3	0	1	5	2	3
Lower Limit								
3×IQR (ppm)	-56.8	-12.0	-7.4	1.0	10.0	-10.5	-10.5	-28.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-326.4	-89.8	-41.9	0.5	-3.2	-122.8	-19.0	-33.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-236.3	-59.2	-28.1	0.6	0.2	-74.1	-0.7	-20.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-146.1	-28.6	-14.3	0.7	3.7	-25.4	17.7	-8.1
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 215: SITE 45 (RLg terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	178.1	223.5	68.5	1.0	18.0	195.5	101.8	50.5
# of Outliers	0	0	0	0	4	0	0	2
Mean+/-4SD (ppm)	176.0	221.1	61.5	1.8	70.3	219.5	128.0	95.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	147.0	176.3	50.3	1.6	56.0	185.3	112.2	75.5
# of Outliers	0	0	0	0	2	0	0	2
Mean+/-2SD (ppm)	118.0	131.4	39.1	1.4	41.7	151.1	96.4	55.3
# of Outliers	1	2	1	0	2	2	0	2
Lower Limit								
3×IQR (ppm)	-55.5	-119.5	-30.7	1.0	4.0	-36.7	28.8	-19.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-55.7	-137.7	-28.0	0.2	-44.3	-54.1	1.5	-66.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-26.8	-92.9	-16.8	0.4	-30.0	-19.9	17.3	-45.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	2.2	-48.0	-5.6	0.6	-15.7	14.3	33.1	-25.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 216: SITE 45 (Tv terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	92.8	67.3	23.4	1.0	14.0	112.0	76.8	63.5
# of Outliers	4	1	1	0	3	1	1	0
Mean+/-4SD (ppm)	158.0	96.4	41.8	1.7	26.2	184.9	99.8	90.9
# of Outliers	0	0	1	0	0	1	0	0
Mean+/-3SD (ppm)	131.2	80.4	34.5	1.5	22.5	157.1	87.6	75.1
# of Outliers	1	1	1	0	0	1	0	0
Mean+/-2SD (ppm)	104.4	64.4	27.1	1.4	18.7	129.2	75.4	59.3
# of Outliers	1	1	1	0	3	1	1	3
Lower Limit								
3×IQR (ppm)	9.2	5.9	1.7	1.0	7.0	29.8	23.1	-0.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-56.6	-31.7	-17.1	0.3	-3.8	-37.8	2.3	-35.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-29.8	-15.7	-9.7	0.5	0.0	-10.0	14.5	-19.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-3.0	0.3	-2.4	0.6	3.7	17.9	26.7	-3.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 217: SITE 45 (Mb terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and therefore was removed. Outlier was also detected by all other outlier methods.
Ni	Method chosen: 3×IQR. Four outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis results, therefore were removed. Outliers were also detected by the Mean+/-2SD method, however the data appear to conform to a lognormal distribution, therefore the 3×IQR method was deemed most appropriate.
Co	Method chosen: 3×IQR. Five outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis results, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however the data appear to conform to a lognormal distribution, therefore the 3×IQR method was deemed most appropriate.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. Six outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis results, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however the data appear to conform to a lognormal distribution, therefore the 3×IQR method was deemed most appropriate.
Cr	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.

SD = standard deviation; IQR = interquartile range.

Table 218: SITE 45 (Mb terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	55	52	51	56	56	50	55	55
ND	0	0	0	56	48	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	14	11	5.7	1.0	10	28	25	1.7
Max (ppm)	110	68	29	1.0	33	110	94	49
Mean (ppm)	36	31	12	1.0	11	66	56	20
Med (ppm)	30	29	11	1.0	12	67	55	18
SD (ppm)	19	10	4.9	N/A	N/A	18	15	10
95%tile (ppm)	71	50	23	N/A	N/A	98	77	37
95UCL (ppm)	41	33	14	N/A	N/A	70	59	22
Distribution	log	log	log	N/A	N/A	norm	norm	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 219: SITE 45 (RLg terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method, however, this outlier didn't distort calculated background concentrations and therefore was not removed.
Ni	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method, however, these outliers didn't distort calculated background concentrations and therefore were not removed.
Co	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method, however,

	this outlier didn't distort calculated background concentrations and therefore was not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method, however, these outliers didn't distort calculated background concentrations and therefore were not removed.
Cr	Method chosen: No outliers removed. No outliers identified.
As	Method chosen: 3×IQR. Two outliers identified that distorted calculated background concentrations and distribution analysis. These outliers were also identified using the Mean+/-3SD and Mean+/-2SD methods.

SD = standard deviation; IQR = interquartile range.

Table 220: SITE 45 (RLg terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	23	23	23	23	23	23	23	21
ND	0	23	23	23	15	0	23	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	26	10	5.2	1.0	10	40	40	1.3
Max (ppm)	140	170	50	1.0	61	160	86	47
Mean (ppm)	65	57	20	1.0	16	87	65	15
Med (ppm)	62	42	19	1.0	17	87	64	15
SD (ppm)	27	44	11	N/A	N/A	30	9.3	9.6
95%tile (ppm)	108	139	35	N/A	N/A	156	78	29
95UCL (ppm)	74	78	23	N/A	N/A	98	69	19
Distribution	norm	log	norm	N/A	N/A	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 221: SITE 45 (Tv terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Four outliers identified that distorted calculated background concentrations.
Ni	Method chosen: 3×IQR. One outlier identified that distorted calculated background concentrations. The data set was found to be non-parametric before and after the removal of the outlier, therefore the 3×IQR was deemed most appropriate.
Co	Method chosen: 3×IQR. One outlier identified that distorted calculated background concentrations. The data set was found to be non-parametric before and after the removal of the outlier, therefore the 3×IQR was deemed most appropriate.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier identified that distorted calculated background concentrations and distribution analysis. All outlier methods identified this outlier.
Cr	Method chosen: 3×IQR. One outlier identified that distorted calculated background concentrations and distribution analysis. The Mean+/-2SD method also identified this outlier.
As	Method chosen: No outliers removed. Three outliers detected by the Mean+/-2SD method, however, these outliers didn't distort calculated background concentrations and therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 222: SITE 45 (Tv terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	26	29	29	30	30	29	29	30
ND	0	0	2	30	19	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	24	7.0	6.9	1.0	10	51	40	2.5
Max (ppm)	62	46	16	1.0	21	103	66	63
Mean (ppm)	46	34	12	1.0	12	72	51	32
Med (ppm)	47	35	14	1.0	12	72	50	34
SD (ppm)	9.5	10	3.0	N/A	N/A	13	6.6	15
95%tile (ppm)	59	45	16	N/A	N/A	101	53	63
95UCL (ppm)	49	37	13	N/A	N/A	76	29	45
Distribution	norm	non-p	non-p	N/A	N/A	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey’s post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution.

Table 223: SITE 45 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
Mb versus RLg				
Cu	28.568	5.922	<0.0001	Yes
Ni	25.690	4.528	<0.0001	Yes
Co	7.248	4.081	<0.0001	Yes
Zn	21.096	4.185	<0.0001	Yes
Cr	14.749	4.401	<0.0001	Yes
As	17.007	5.115	<0.0001	Yes
RLg versus Tv				
Cu	18.730	3.368	0.003	Yes
Ni	23.065	3.646	0.001	Yes
Co	7.013	4.390	<0.0001	Yes
Zn	15.036	2.692	0.023	Yes
Cr	9.804	3.289	0.004	Yes
As	12.704	4.789	<0.0001	Yes
Mb versus Tv				
Cu	9.838	2.128	0.089	No
Ni	2.625	0.500	0.871	No
Co	0.235	0.159	0.986	No
Zn	6.060	1.298	0.400	No
Cr	4.945	1.795	0.176	No
As	4.303	1.435	0.327	No

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 224: SITE 45 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
Mb versus RLg				
Cu	21.091	3.841	<0.0001	Yes
Ni	6.511	3.841	0.011	Yes
Co	9.055	3.841	0.003	Yes
Zn	9.246	3.841	0.002	Yes
Cr	10.599	3.841	0.001	Yes
As	3.394	3.841	0.065	No
RLg versus Tv				
Cu	5.884	3.841	0.015	Yes
Ni	3.534	3.841	0.060	No
Co	7.565	3.841	0.006	Yes
Zn	3.432	3.841	0.064	No
Cr	24.404	3.841	<0.0001	Yes
As	16.479	3.841	<0.0001	Yes
Mb versus Tv				
Cu	12.224	3.841	<0.0001	Yes
Ni	4.283	3.841	0.038	Yes
Co	1.583	3.841	0.208	No
Zn	2.207	3.841	0.137	No
Cr	2.791	3.841	0.095	No
As	15.978	3.841	<0.0001	Yes

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 225: SITE 45 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups		Conover-Iman Groups	
Copper							
Mb	55	2123	38.6	A		A	
RLg	23	1747.5	75.978		B		B
Tv	26	1589.5	61.135		B		B
Nickel							
Mb	52	2298	44.192	A		A	
RLg	23	1531.5	66.587		B		B
Tv	29	1630.5	66.587		B		B
Cobalt							
Mb	51	2269.0	44.490	A		A	
RLg	23	1602.5	69.674	A	B	A	B
Tv	29	1484.5	51.190		B		B
Zinc							
Mb	50	2173	43.460	A		A	
RLg	23	1541	67.0	A	B	A	B
Tv	29	1539.0	53.069		B		B
Chromium							
Mb	55	2850.5	51.827	A		A	
RLg	23	1807.0	78.565		B		B
Tv	29	1120.5	38.638	A		A	
Arsenic							
Mb	55	2666.5	48.482	A		A	
RLg	21	753.0	35.857	A		A	
Tv	30	2251.5	75.05		B		B

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed, otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 226: Summary of SITE 45 population analysis.

Element	Population analysis conclusion
Cu	Keep terrain units separate
Ni	Combine Rlg and Tv terrain units
Co	Combine Mb and Tv terrain units
Cd	Not analysed
Pb	Not analysed
Zn	Combine Mb and Tv
Cr	Combine Mb and Tv
As	Combine Mb and Tv

Table 227: SITE 45 (combined terrain units) background concentration results summary.

	Ni	Co	Zn	Cr	As
Terrain units	**Rlg + Tv**	**Mb + Tv**	**Mb + Tv**	**Mb + Tv**	**Mb + Tv**
SQG (ppm)	**50**	**50**	**200**	**64**	**12**
N	53	81	80	85	76
ND	0	0	0	0	0
DL (ppm)	5.0	5.0	15	20	0.2
Min (ppm)	7.0	5.	28	25	1.3
Max (ppm)	170	48	190	94	49
Mean (ppm)	45	13	70	54	18
Med (ppm)	37	12	70	53	17
SD (ppm)	33	5.8	21	13	10
95%tile (ppm)	118	22	100	76	36
95UCL (ppm)	64	14	74	57	21
Distribution	non-p	non-p	log	norm	non-p

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.46 SITE 46, Nadluardjuk Lake, Nunavut Territory

A background sampling program was carried out for the site in 2009. Four terrain units were identified within a 500 meter radius of the station and detailed below:

1. Mb – Marine blanket deposits: continuous deposits of sand and silt, greater than 2 m thick. Silt deposits commonly from wetlands. (40 background samples collected).
2. RL – Rock, Longstaff Bluff Formation, Pilling Group, deformed layered metasedimentary rock, generally ridges with rough or glacially polished surface. (1 background sample collected).
3. Tb – Till Blanket: thick units of till forming rolling plains. Materials are stony silt-sand till in areas of metasedimentary rock. (25 background samples collected).
4. Tv – Till veneer: thin, discontinuous till with rock outcrop having glacially polished surfaces. Terrain morphology determined by underlaying rock. (18 background samples collected).

All samples were analyzed for the Arctic suite of inorganic elements.

Table 228: SITE 46 (Mb terrain unit) background soil data.

Sample #	**Date**	**Depth**	**Cu**	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
		cm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**

SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
09-14338	2009	10	9.9	18.0	6.9	<1.0	<10	44.0	42.0	10.0
09-14339	2009	10	11.0	18.0	6.3	<1.0	<10	36.0	24.0	6.9
09-14340/41	2009	10	50.0	40.0	51.0	<1.0	<10	81.0	78.0	29.0
09-14342	2009	10	62.0	47.0	62.0	<1.0	<10	88.0	74.0	37.0
09-14343	2009	40	42.0	39.0	20.0	<1.0	<10	76.0	73.0	29.0
09-14344	2009	10	56.0	41.0	14.0	<1.0	<10	83.0	77.0	30.0
09-14345	2009	10	35.0	31.0	13.0	<1.0	<10	68.0	70.0	33.0
09-14346	2009	10	33.0	30.0	11.0	<1.0	<10	62.0	64.0	32.0
09-14347	2009	10	21.0	27.0	9.6	<1.0	<10	59.0	56.0	23.0
09-14348	2009	10	30.0	31.0	10.0	<1.0	<10	59.0	53.0	20.0
09-14349	2009	10	38.0	38.0	14.0	<1.0	<10	87.0	83.0	42.0
09-14370/71	2009	10	27.0	26.0	10.0	<1.0	<10	56.0	59.0	11.0
09-14372	2009	10	26.0	27.0	12.0	<1.0	<10	58.0	61.0	11.0
09-14373	2009	10	25.0	29.0	12.0	<1.0	<10	58.0	62.0	12.0
09-14374	2009	10	30.0	35.0	16.0	<1.0	<10	65.0	70.0	12.0
09-14375	2009	10	37.0	36.0	13.0	<1.0	<10	64.0	66.0	20.0
09-14376	2009	10	60.0	44.0	17.0	<1.0	<10	85.0	82.0	44.0
09-14377	2009	15	250.0	86.0	26.0	<1.0	19.0	130.0	81.0	99.0
09-14378	2009	10	52.0	32.0	11.0	<1.0	<10	63.0	61.0	26.0
09-14379	2009	15	310.0	78.0	22.0	<1.0	36.0	540.0	87.0	68.0
09-14380/81	2009	10	32.0	23.0	8.6	<1.0	<10	50.0	51.0	24.0
09-14382	2009	10	43.0	46.0	18.0	<1.0	<10	87.0	87.0	23.0
09-14383	2009	15	27.0	32.0	12.0	<1.0	<10	62.0	61.0	8.6
09-14384	2009	10	35.0	39.0	16.0	<1.0	<10	76.0	77.0	16.0
09-14385	2009	10	58.0	43.0	21.0	<1.0	<10	100.0	84.0	26.0
09-14386	2009	10	44.0	48.0	20.0	<1.0	11.0	62.0	88.0	11.0
09-14387	2009	40	36.0	35.0	12.0	<1.0	<10	55.0	66.0	14.0
09-14388	2009	10	26.0	27.0	12.0	<1.0	<10	51.0	55.0	19.0
09-14389	2009	10	45.0	39.0	17.0	<1.0	<10	85.0	86.0	24.0
09-14390/91	2009	10	39.0	45.0	16.0	<1.0	<10	86.0	90.0	6.1
09-14392	2009	10	70.0	75.0	27.0	<1.0	<10	120.0	84.0	13.0
09-14393	2009	10	31.0	35.0	13.0	<1.0	<10	63.0	68.0	17.0
09-14394	2009	10	62.0	38.0	13.0	<1.0	<10	63.0	69.0	15.0
09-14405	2009	10	29.0	28.0	10.0	<1.0	<10	52.0	59.0	18.0
09-14406	2009	10	30.0	31.0	11.0	<1.0	<10	58.0	65.0	21.0
09-14409	2009	10	31.0	37.0	15.0	<1.0	<10	91.0	82.0	18.0
09-14410/11	2009	10	31.0	34.0	14.0	<1.0	<10	68.0	68.0	16.0
09-14412	2009	10	24.0	21.0	8.3	<1.0	<10	41.0	50.0	16.0
09-14413	2009	40	33.0	39.0	14.0	<1.0	<10	62.0	79.0	24.0
09-14414	2009	10	38.0	37.0	13.0	<1.0	<10	70.0	68.0	23.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 229: SITE 46 (RL terrain unit) background soil data.

Sample #	**Date**	**Depth**	**Cu**	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
		cm	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
09-14403	2009	10	36.0	35.0	13.0	<1.0	<10	58.0	59.0	20.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 230: SITE 46 (Tb terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
09-14326	2009	10	22.0	23.0	9.0	<1.0	<10	47.0	52.0	17.0
09-14327	2009	10	22.0	23.0	11.0	<1.0	<10	52.0	53.0	20.0
09-14328	2009	10	41.0	27.0	11.0	<1.0	<10	54.0	58.0	28.0
09-14329	2009	40	23.0	21.0	9.4	<1.0	<10	48.0	55.0	16.0
09-14350/51	2009	10	35.0	29.0	13.0	<1.0	<10	84.0	70.0	37.0
09-14352	2009	10	110.0	78.0	26.0	<1.0	10.0	120.0	100.0	74.0
09-14353	2009	10	37.0	38.0	18.0	<1.0	<10	78.0	77.0	27.0
09-14354	2009	10	25.0	23.0	9.9	<1.0	<10	45.0	47.0	18.0
09-14355	2009	10	51.0	46.0	19.0	<1.0	<10	81.0	79.0	34.0
09-14356	2009	10	35.0	40.0	17.0	<1.0	<10	77.0	75.0	22.0
09-14357	2009	10	35.0	34.0	13.0	<1.0	<10	66.0	67.0	24.0
09-14358	2009	40	24.0	29.0	12.0	<1.0	<10	56.0	56.0	14.0
09-14359	2009	10	45.0	42.0	17.0	<1.0	<10	73.0	68.0	26.0
09-14360/61	2009	10	27.0	23.0	9.8	<1.0	<10	50.0	53.0	20.0
09-14362	2009	10	48.0	40.0	14.0	<1.0	<10	71.0	70.0	29.0
09-14363	2009	10	19.0	22.0	9.2	<1.0	<10	49.0	51.0	14.0
09-14364	2009	40	20.0	23.0	9.4	<1.0	<10	50.0	53.0	15.0
09-14365	2009	10	32.0	31.0	12.0	<1.0	<10	60.0	60.0	11.0
09-14366	2009	10	28.0	25.0	9.8	<1.0	<10	50.0	55.0	20.0
09-14367	2009	10	22.0	22.0	9.5	<1.0	<10	50.0	54.0	20.0
09-14368	2009	10	23.0	22.0	8.6	<1.0	<10	46.0	47.0	21.0
09-14369	2009	10	23.0	18.0	6.9	<1.0	<10	38.0	41.0	18.0
09-14415	2009	10	18.0	20.0	7.7	<1.0	<10	42.0	49.0	17.0
09-14416	2009	40	26.0	23.0	8.8	<1.0	<10	45.0	45.0	20.0
09-14425	2009	10	23.0	24.0	8.8	<1.0	<10	52.0	54.0	19.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 231: SITE 46 (Tv terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
09-14335	2009	10	19.0	19.0	7.2	<1.0	<10	38.0	48.0	40.0
09-14336	2009	10	25.0	23.0	9.1	<1.0	<10	53.0	55.0	29.0
09-14337	2009	10	33.0	25.0	9.1	<1.0	<10	58.0	57.0	18.0
09-14395	2009	10	16.0	17.0	7.3	<1.0	<10	35.0	39.0	14.0
SITE 46 (T^b	2009	10	12.0	13.0	5.6	<1.0	<10	30.0	36.0	15.0
09-14397	2009	10	20.0	24.0	9.6	<1.0	<10	52.0	46.0	13.0
09-14398	2009	10	23.0	25.0	9.5	<1.0	<10	47.0	53.0	18.0
09-14399	2009	10	17.0	21.0	8.2	<1.0	<10	41.0	50.0	15.0
09-14400/01	2009	40	36.0	29.0	9.0	<1.0	<10	91.0	52.0	53.0
09-14402	2009	10	37.0	27.0	10.0	<1.0	<10	50.0	57.0	29.0
09-14404	2009	10	29.0	25.0	9.1	<1.0	<10	52.0	51.0	16.0
09-14417	2009	10	16.0	17.5	6.9	<1.0	<10	36.3	41.4	12.2
09-14418	2009	40	29.0	18.0	7.6	<1.0	<10	42.0	46.0	25.0
09-14419	2009	10	17.0	16.0	6.1	<1.0	<10	36.0	42.0	18.0
09-14420/21	2009	10	18.0	18.0	7.5	<1.0	<10	41.0	48.0	15.0
09-14422	2009	10	19.0	18.0	7.0	<1.0	<10	43.0	48.0	16.0
09-14423	2009	10	18.0	21.0	7.8	<1.0	<10	44.0	50.0	21.0
09-14424	2009	45	20.0	22.0	7.8	<1.0	<10	45.0	52.0	21.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 232: SITE 46 (Mb terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	40	40	40	40	40	40	40	40
%ND	0	0	0	100	93	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 233: SITE 46 (RL terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	1	1	1	1	1	1	1	1
%ND	0	0	0	100	100	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 234: SITE 46 (Tb terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	25	25	25	25	25	25	25	25
%ND	0	0	0	100	100	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 235: SITE 46 (Tv terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	18	18	18	18	18	18	18	18
%ND	0	0	0	100	100	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 236: SITE 46 (Mb terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	95.8	71.8	35.0	1.0	10.0	166.0	142.0	65.8
# of Outliers	2	3	2	0	3	1	0	2
Mean+/-4SD (ppm)	260.1	96.2	56.8	1.6	28.4	378.5	137.0	88.3
# of Outliers	1	0	1	0	1	1	0	1
Mean+/-3SD (ppm)	204.7	81.0	46.2	1.5	24.0	301.6	119.6	71.2
# of Outliers	2	1	2	0	1	1	0	1
Mean+/-2SD (ppm)	149.2	65.9	35.6	1.3	19.5	224.7	102.1	54.1
# of Outliers	2	3	2	0	1	1	0	2
Lower Limit								
3×IQR (ppm)	-19.8	-1.8	-7.0	1.0	10.0	-23.0	0.3	-25.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-183.7	-25.2	-28.1	0.4	-7.4	-236.6	-2.5	-48.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-128.3	-10.0	-17.5	0.5	-2.9	-159.7	14.9	-31.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-72.8	5.2	-6.9	0.7	1.6	-82.8	32.4	-14.2
# of Outliers	0	0	0	0	0	0	1	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 237: SITE 46 (Tb terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	71.0	67.0	24.4	1.0	10.0	140.0	116.0	53.0
# of Outliers	1	1	1	0	0	0	0	1
Mean+/-4SD (ppm)	106.4	82.4	30.3	1.8	16.3	141.7	127.3	72.2
# of Outliers	1	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	87.2	68.8	25.6	1.6	14.7	120.6	110.1	59.5
# of Outliers	1	1	1	0	0	0	0	1
Mean+/-2SD (ppm)	68.0	55.2	20.9	1.4	13.1	99.4	92.8	46.8
# of Outliers	1	1	1	0	0	1	1	1
Lower Limit								
3×IQR (ppm)	-13.0	-10.0	-2.2	1.0	10.0	-21.0	4.0	-10.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-47.2	-26.3	-7.6	0.2	3.7	-27.4	-10.7	-29.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-28.0	-12.7	-2.9	0.4	5.3	-6.3	6.5	-16.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-8.8	0.9	1.9	0.6	6.9	14.9	23.8	-4.1
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 238: SITE 46 (Tv terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	60.3	45.0	14.7	1.0	10.0	89.8	70.0	51.0
# of Outliers	0	0	0	0	0	1	0	1
Mean+/-4SD (ppm)	55.7	44.7	15.3	1.9	17.3	110.8	96.4	64.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	47.1	38.7	13.5	1.7	15.5	94.3	84.4	53.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	38.5	32.7	11.6	1.5	13.7	77.9	72.3	42.2
# of Outliers	0	0	0	0	0	1	0	1
Lower Limit								
3×IQR (ppm)	-15.0	-2.3	1.6	1.0	10.0	0.5	28.0	-12.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-12.9	-3.5	0.6	0.1	2.7	-21.0	-0.3	-25.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-4.3	2.5	2.4	0.3	4.5	-4.5	11.8	-13.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	4.3	8.6	4.2	0.5	6.3	12.0	23.9	-2.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 239: SITE 46 (Mb terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and therefore were removed. Outliers were also detected by all other outlier methods.
Ni	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and therefore were removed. Outliers were also detected by all other outlier methods.
Co	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis results, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however the data appear to conform to a lognormal distribution, therefore the 3×IQR method was deemed most appropriate.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
Cr	Method chosen: No outliers removed. No outliers identified
As	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis results, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however the data appear to conform to a lognormal distribution, therefore the 3×IQR method was deemed most appropriate.

SD = standard deviation; IQR = interquartile range.

Table 240: SITE 46 (Mb terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	38	37	38	40	40	39	40	38
ND	0	0	0	40	37	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	9.9	18	6.3	1.0	10	36	24	6.1
Max (ppm)	70	48	27	1.0	11	130	90	44
Mean (ppm)	37	34	14	1.0	11	70	69	20
Med (ppm)	34	35	13	1.0	11	63	69	19
SD (ppm)	14	7.8	4.8	N/A	N/A	20	14	9.3
95%tile (ppm)	62	46	23	N/A	N/A	102	87	38
95UCL (ppm)	41	36	15	N/A	N/A	75	73	23
Distribution	norm	norm	log	N/A	N/A	log	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 241: SITE 46 (Tb terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-2SD methods.
Ni	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-2SD methods.
Co	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
Cd	Not analysed

Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier identified using the Mean+/-2SD method, however the data conform to a lognormal distribution, therefore this method was not deemed appropriate.
Cr	Method chosen: No outliers removed. One outlier identified using the Mean+/-2SD method, however the data conform to a lognormal distribution, therefore this method was not deemed appropriate.
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.

SD = standard deviation; IQR = interquartile range.

Table 242: SITE 46 (Tb terrain unit) background concentration results summary.

	Cu	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	24	24	24	25	25	25	25	24
ND	0	0	0	25	25	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	18	18	6.9	1.0	10	38	41	11
Max (ppm)	51	46	19	1.0	10	120	100	37
Mean (ppm)	29	28	11	1.0	10	59	60	21
Med (ppm)	25	23	9.8	1.0	10	52	55	20
SD (ppm)	9.5	7.9	3.4	N/A	N/A	18	13	6.3
95%tile (ppm)	48	42	18	N/A	N/A	83	79	33
95UCL (ppm)	33	31	13	N/A	N/A	66	65	23
Distribution	log	Non-p	log	N/A	N/A	log	log	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 243: SITE 46 (Tv terrain unit) justification for outlier method chosen.

Element	**Outlier Method Justification**
Cu	Method chosen: No outliers removed. No outliers identified
Ni	Method chosen: No outliers removed. No outliers identified
Co	Method chosen: No outliers removed. No outliers identified
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-2SD methods.
Cr	Method chosen: No outliers removed. No outliers identified
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-2SD methods.

SD = standard deviation; IQR = interquartile range.

Table 244: SITE 46 (Tv terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	18	18	18	18	18	17	18	17
ND	0	0	0	18	18	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	12	13	5.6	1.0	10	30	36	12
Max (ppm)	37	29	10	1.0	10	58	57	40
Mean (ppm)	22	21	8.0	1.0	10	44	48	20
Med (ppm)	19	21	7.8	1.0	10	43	49	18
SD (ppm)	7.4	4.3	1.3	N/A	N/A	7.5	5.9	7.3
95%tile (ppm)	36	27	9.7	N/A	N/A	54	57	31
95UCL (ppm)	26	23	8.5	N/A	N/A	47	51	23
Distribution	log	norm	norm	N/A	N/A	norm	norm	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution.

Table 245: SITE 46 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
Mb versus Tb				
Cu	7.743	2.600	0.03	Yes
Ni	6.383	3.383	0.003	Yes
Co	2.663	2.673	0.025	Yes
Zn	10.486	2.350	0.055	No
Cr	9.440	2.946	0.012	Yes
As	0.583	0.276	0.935	No
Mb versus Tv				
Cu	14.632	4.477	<0.0001	Yes
Ni	13.191	6.377	<0.0001	Yes
Co	6.051	5.535	<0.0001	Yes
Zn	26.123	5.161	<0.0001	Yes
Cr	20.589	5.771	<0.0001	Yes
As	1.407	0.548	0.848	No
Tb versus Tv				
Cu	6.889	1.934	0.136	No
Ni	6.808	3.033	0.009	Yes
Co	3.389	2.844	0.016	Yes
Zn	15.637	2.856	0.015	Yes
Cr	11.149	2.870	0.014	Yes
As	0.824	0.349	0.935	No

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 246: SITE 46 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
Mb versus Tb				
Cu	6.966	3.841	0.008	Yes
Ni	8.528	3.841	0.003	Yes
Co	6.535	3.841	0.011	Yes
Zn	7.208	3.841	0.007	Yes
Cr	9.421	3.841	0.002	Yes
As	0.327	3.841	0.568	No
Mb versus Tv				
Cu	16.511	3.841	<0.0001	Yes
Ni	26.100	3.841	<0.0001	Yes
Co	26.673	3.841	<0.0001	Yes
Zn	29.116	5.991	<0.0001	yes
Cr	9.421	3.841	0.002	Yes
As	0.327	3.841	0.568	No
Tb versus Tv				
Cu	6.878	3.841	0.009	Yes
Ni	8.095	3.841	0.004	Yes
Co	14.358	3.841	<0.0001	Yes
Zn	11.131	3.841	0.001	Yes
Cr	9.797	3.841	0.002	Yes
As	1.155	3.841	0.282	No

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 247: SITE 46 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups	Conover-Iman Groups
Copper					
Mb	38	1953	51.395	A	A
Tb	24	892.5	37.188	A B	B
Tv	18	394.5	21.917	B	B
Nickel					
Mb	37	1962	53.027	A	A
Tb	24	874	36.417	B	B
Tv	18	324	18	C	C
Cobalt					
Mb	38	2009.5	52.882	A	A
Tb	24	944.5	39.354	A	B
Tv	18	286	15.889	B	C
Zinc					
Mb	39	2077.5	53.269	A	A
Tb	25	960	38.4	B	B
Tv	17	235.5	16.676	C	C
Chromium					
Mb	40	2212.5	55.313	A	A
Tb	25	949.5	37.980	B	B
Tv	18	324	18	C	C
Arsenic					
Mb	38	1493	39.289	A	A
Tb	24	1040	43.33	A	A
Tv	17	627	36.882	A	A

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed, otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 248: Summary of SITE 46 population analysis.

Element	Population analysis conclusion
Cu	Keep terrain units separate
Ni	Keep terrain units separate
Co	Keep terrain units separate
Cd	Not analysed
Pb	Not analysed
Zn	Keep terrain units separate
Cr	Keep terrain units separate
As	Combine all terrain units

Table 249: SITE 46 (combined terrain units) background concentration results summary.

	As
Terrain units	**Mb + Tb + Tv**
SQG (ppm)	**12**
N	79
ND	0
DL (ppm)	0.2
Min (ppm)	6.1
Max (ppm)	44
Mean (ppm)	20
Med (ppm)	19
SD (ppm)	8.0
95%tile (ppm)	37
95UCL (ppm)	22
Distribution	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.47 SITE 47, Dewar Lakes, Nunavut Territory

A background sampling program was carried out for the site in 2006. Seven terrain units were identified within a 500-meter radius of the station and detailed below:

1. Alluvium (A) – gravel, sand and boulder layer (1-5 m thick) forming valley bottom deposits.
2. Colluvium (C) – rock debris.
3. Glaciofluvial (GF) – stratified gravel and sand layer (2-15 meters thick).
4. Glaciolacustrine (GL) – sand and mud layer with ice rafted dropstones (0.5-10 meters thick).
5. Till veneer (TV) – glacial diamicton layer (0.5-2 m thick), with silt, clay, gravel, cobbles and boulders in varying proportions, discontinuous cover mimicking topography of underlying bedrock with patches of exposed bedrock and areas of boulder fields.
6. Till blanket (TB) – glacial diamicton layer (2-10 m thick) forming undulating plains with fluted or drumlinized areas and areas of boulder fields.
7. Exposed bedrock (RL) – felsic gneiss and plutonic rocks; psammite, pelite, wacke and quartzite of the Longstaff Bluff Formation.

The sampling program yielded a data set of 114 background samples. The number of background samples collected, and the area of each terrain unit is detailed in Table 250.

Table 250: Summary of FOX- 3 terrain unit and sample coverage for the background sampling program.

Terrain unit	Area (km^2)	Area (%)	Sample Size (N)
A	0.47	4.4	1
C	0.00	0.0	0
GF	0.52	4.9	19
GL	0.18	1.7	4
RL	0.82	7.7	2
Tb	8.05	75.3	79
Tv	0.65	6.1	9

As the GF, Tb, and Tv terrain units are the most spatially extensive on the site, most of the background samples collected were from these units. All samples were analyzed for the Arctic suite of inorganic elements.

Table 251: SITE 47 (A terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	23
06-7025	2006	0	20.1	21.1	10.1	<1.0	<10.0	47.9	50.2	9.3

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 252: SITE 47 (GF terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	23
06-7026	2006	5	14.5	21.7	9.5	<1.0	<10	50.3	57.1	8.6
06-7027	2006	55	27.0	28.2	11.7	<1.0	<10	61.9	69.8	15.1
06-7057	2006	5	30.8	18.1	8.2	<1.0	<10	42.9	44.8	10.7
06-7058	2006	40	28.3	24.2	10.2	<1.0	<10	53.8	64.9	8.8
06-7059	2006	0	28.6	24.8	10.2	<1.0	<10	52.9	65.0	10.0
06-7060	2006	0	35.5	29.6	12.2	<1.0	<10	64.2	78.3	12.3
06-7061	2006	0	28.1	25.6	10.6	<1.0	<10	54.5	68.2	10.4
06-7062	2006	45	27.9	23.3	10.2	<1.0	<10	54.0	62.0	9.7
06-7063	2006	10	25.9	28.3	11.2	<1.0	<10	57.8	76.4	10.5
06-7064	2006	0	35.3	29.3	12.4	<1.0	<10	61.4	76.1	8.2
06-7065	2006	50	27.0	29.0	10.2	<1.0	<10	54.6	70.1	7.6
06-7068	2006	0	35.2	32.0	11.7	<1.0	<10	49.7	70.3	34.3
06-7069	2006	30	41.6	36.8	12.7	<1.0	12.6	49.8	60.3	13.5
06-7070	2006	0	13.2	20.6	8.6	<1.0	<10	41.8	45.0	6.2
06-7071	2006	0	13.4	19.2	7.9	<1.0	<10	39.1	44.2	5.4
06-7072	2006	30	17.6	20.1	8.6	<1.0	<10	40.7	41.9	8.8
06-7073	2006	5	21.1	24.5	10.2	<1.0	<10	52.3	49.9	7.2
06-7074	2006	40	21.3	22.0	8.0	<1.0	<10	46.3	47.1	6.0
06-7075	2006	70	14.8	22.9	9.7	<1.0	<10	44.2	51.2	6.2

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 253: SITE 47 (GL terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
06-6973	2006	0	17.9	19.0	7.8	<1.0	<10	45.9	52.5	3.6
06-6974	2006	50	27.4	25.3	10.8	<1.0	<10	57.3	63.5	5.6
06-7040	2006	10	88.1	47.0	12.7	<1.0	15.2	81.2	78.6	10.7
06-7041	2006	10	106.9	51.2	11.7	<1.0	17.7	80.8	75.1	8.1

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 254: SITE 47 (RL terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
06-6966	2006	0	17.5	17.7	7.9	<1.0	<10	42.8	50.6	5.8
06-6967	2006	40	34.7	28.7	10.2	<1.0	<10	51.3	72.7	4.9

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 255: SITE 47 (Tb terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
G414	1990	0	10.7	22.0	7.8	7.8	<10	54.0	59.0	5.3
G428	1990	0	27.8	28.1	19.0	19.0	<10	78.0	113.0	10.9
G429	1990	0	13.5	28.7	12.4	12.4	<10	73.0	98.0	4.3
06-6960	2006	10	32.2	21.6	7.6	<1.0	<10	50.3	52.7	7.6
06-6961	2006	10	41.2	23.4	9.4	<1.0	<10	54.6	58.0	16.0
06-6964	2006	0	32.3	25.1	12.6	<1.0	<10	56.9	56.7	7.0
06-6965	2006	40	39.2	24.8	9.8	<1.0	<10	65.4	75.5	5.4
06-6968	2006	20	28.9	21.9	9.6	<1.0	<10	52.8	63.4	10.5
06-6975	2006	0	16.0	17.3	7.0	<1.0	<10	39.7	50.9	3.1
06-6976	2006	30	26.4	21.3	8.4	<1.0	<10	53.6	66.3	3.1
06-6977	2006	0	37.2	29.5	11.6	<1.0	<10	67.7	84.4	6.2
06-6978	2006	0	37.7	28.7	11.0	<1.0	<10	58.6	84.4	21.6
06-6979	2006	50	48.0	27.4	11.9	<1.0	<10	64.3	76.7	14.4
06-6980	2006	10	38.7	27.5	11.5	<1.0	<10	67.6	76.7	11.4
06-6981	2006	10	32.9	23.6	10.0	<1.0	<10	59.1	66.9	10.9
06-6982	2006	10	47.4	33.5	14.7	<1.0	<10	74.9	82.5	7.7
06-6983	2006	50	39.6	30.9	14.9	<1.0	<10	72.9	77.2	12.7
06-6984	2006	10	38.7	28.5	23.4	<1.0	<10	66.0	62.6	14.4
06-6985	2006	10	46.6	34.2	15.3	<1.0	<10	76.3	83.9	18.5
06-6986	2006	10	33.6	57.0	15.6	<1.0	<10	61.9	157.2	8.2
06-6987	2006	10	35.5	35.5	13.3	<1.0	<10	61.3	77.5	8.8
06-6988	2006	10	36.1	28.4	11.3	<1.0	<10	56.9	65.5	11.6
06-6989	2006	40	38.4	30.6	12.5	<1.0	<10	58.8	70.9	13.6
06-6990	2006	10	49.6	39.6	14.1	<1.0	<10	63.6	77.2	11.3
06-6991	2006	10	50.1	37.3	14.2	<1.0	<10	66.7	74.0	13.5
06-6992	2006	40	52.5	38.2	15.0	<1.0	<10	67.0	69.5	16.8
06-6993	2006	10	23.7	22.0	9.5	<1.0	<10	47.3	52.4	4.9
06-6994	2006	0	29.1	27.6	10.3	<1.0	<10	59.2	67.8	5.4
06-6995	2006	40	42.9	31.7	12.1	<1.0	<10	63.1	80.5	9.8
06-6996	2006	0	39.9	29.2	11.7	<1.0	<10	58.9	69.9	11.0
06-6997	2006	50	43.0	31.4	14.1	<1.0	<10	64.2	71.7	11.5
06-6998	2006	0	44.8	33.9	13.8	<1.0	<10	66.8	92.7	18.7
06-6999	2006	40	44.1	30.9	12.2	<1.0	<10	62.6	86.2	16.5
06-7000	2006	5	39.7	26.9	12.7	<1.0	<10	64.3	76.3	11.2

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
06-7001	2006	5	45.2	29.1	13.8	<1.0	<10	66.8	80.7	15.6
06-7002	2006	30	45.9	28.6	12.7	<1.0	<10	65.9	75.5	10.6
06-7003	2006	0	16.8	17.4	8.0	<1.0	<10	40.7	36.9	3.6
06-7004	2006	40	20.1	21.5	8.4	<1.0	<10	51.5	44.0	2.7
06-7005	2006	10	18.7	21.6	8.8	<1.0	<10	52.4	55.9	3.2
06-7006	2006	0	22.9	25.4	11.4	<1.0	<10	60.8	55.9	3.6
06-7007	2006	40	31.1	32.3	12.9	<1.0	<10	59.8	64.7	5.4
06-7008	2006	0	16.7	20.3	9.0	<1.0	<10	44.7	48.6	7.7
06-7009	2006	0	22.3	16.7	7.7	<1.0	<10	37.0	42.8	9.6
06-7010	2006	5	32.6	24.6	12.5	<1.0	<10	60.3	62.2	8.3
06-7011	2006	5	31.6	23.8	11.7	<1.0	<10	59.4	60.5	7.9
06-7012	2006	45	35.3	25.8	11.9	<1.0	<10	60.5	61.6	7.8
06-7013	2006	0	45.0	32.5	13.8	<1.0	<10	67.7	77.6	14.6
06-7014	2006	40	55.2	32.7	12.5	<1.0	<10	67.5	76.5	20.6
06-7015	2006	5	34.1	33.2	13.8	<1.0	<10	64.4	88.7	21.2
06-7016	2006	40	36.9	37.0	14.8	<1.0	<10	73.1	91.4	23.0
06-7017	2006	5	36.9	27.9	11.8	<1.0	<10	63.3	70.2	14.2
06-7018	2006	5	30.9	25.8	10.6	<1.0	<10	58.8	63.7	9.5
06-7019	2006	30	45.8	30.6	12.5	<1.0	<10	66.5	65.4	19.3
06-7020	2006	5	36.2	27.3	12.1	<1.0	<10	62.0	74.9	14.6
06-7021	2006	5	34.1	24.7	10.8	<1.0	<10	57.3	67.7	12.4
06-7022	2006	5	24.3	24.3	10.6	<1.0	<10	55.4	67.5	9.4
06-7023	2006	30	36.0	36.1	14.7	<1.0	<10	81.9	97.6	19.3
06-7024	2006	5	42.8	35.7	14.8	<1.0	<10	82.5	83.9	14.9
06-7028	2006	0	22.4	26.8	11.6	<1.0	<10	58.7	62.9	8.1
06-7029	2006	50	23.7	26.9	11.7	<1.0	<10	56.3	57.9	8.1
06-7030	2006	0	20.3	27.4	9.5	<1.0	<10	52.5	50.3	10.1
06-7031	2006	0	20.0	34.6	10.9	<1.0	<10	55.7	54.0	11.0
06-7032	2006	30	26.0	29.9	10.8	<1.0	<10	57.6	55.9	8.9
06-7033	2006	60	47.3	36.9	12.5	<1.0	<10	70.1	64.0	14.4
06-7034	2006	0	27.6	28.5	13.0	<1.0	<10	68.3	69.2	9.2
06-7035	2006	50	34.7	36.2	15.9	<1.0	<10	75.2	78.0	10.5
06-7039	2006	10	24.8	16.8	7.7	<1.0	<10	43.4	48.8	57.9
06-7042	2006	0	33.8	33.0	14.5	<1.0	<10	83.3	82.7	11.6
06-7043	2006	40	39.2	34.5	14.0	<1.0	11.5	83.5	93.7	8.8
06-7044	2006	5	39.9	27.8	11.7	<1.0	<10	64.4	72.7	9.6
06-7045	2006	10	42.5	30.9	13.3	<1.0	<10	66.1	76.4	12.7
06-7046	2006	0	31.0	20.6	7.8	<1.0	<10	50.6	41.9	11.5
06-7047	2006	40	30.4	21.8	8.1	<1.0	<10	40.3	47.9	12.5
06-7048	2006	10	29.5	21.2	8.8	<1.0	<10	43.3	52.8	13.2
06-7049	2006	35	36.4	36.1	15.0	<1.0	<10	63.2	77.7	10.7
06-7050	2006	10	28.6	33.7	11.7	<1.0	<10	58.4	82.9	10.3
06-7051	2006	10	27.8	32.5	11.2	<1.0	<10	56.9	80.8	12.6
06-7052	2006	10	38.8	26.1	13.3	<1.0	<10	64.5	67.6	9.9
06-7053	2006	10	28.9	29.9	12.9	<1.0	<10	64.3	67.8	8.2
06-7054	2006	40	38.4	33.9	15.2	<1.0	<10	71.0	75.7	12.4
06-7055	2006	5	9.7	13.8	6.5	<1.0	<10	37.6	35.0	5.3
06-7056	2006	50	16.4	13.8	6.0	<1.0	<10	37.4	34.7	4.0
06-7066	2006	0	29.4	29.8	11.9	<1.0	<10	58.8	74.8	11.3
06-7067	2006	0	26.1	30.5	12.5	<1.0	<10	53.1	71.0	10.9

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 256: SITE 47 (Tv terrain unit) background soil data.

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	0.2
SQG (ppm)			63	50	50	10	140	200	64	23
06-6962	2006	10	13.5	20.2	8.3	<1.0	<10	49.7	51.1	4.2
06-6963	2006	35	18.3	18.1	8.2	<1.0	<10	49.4	51.8	4.5
06-6969	2006	10	27.7	21.7	9.2	<1.0	<10	52.7	56.4	8.4
06-6970	2006	0	32.5	27.2	9.9	<1.0	<10	54.6	77.2	7.3
06-6971	2006	0	39.0	27.8	10.5	<1.0	<10	58.7	74.5	8.5
06-6972	2006	50	44.7	29.9	13.5	<1.0	<10	72.6	87.4	10.3
06-7036	2006	10	15.6	20.3	8.8	<1.0	<10	54.0	49.7	9.0
06-7037	2006	40	18.6	18.5	8.7	<1.0	<10	97.9	51.9	10.7
06-7038	2006	5	43.0	22.1	9.9	<1.0	<10	60.1	65.6	22.3

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 257: SITE 47 (A terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	1	1	1	1	1	1	1	1
%ND	0	0	0	100	100	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 258: SITE 47 (GF terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	19	19	19	19	19	19	19	19
%ND	0	0	0	100	89	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 259: SITE 47 (GL terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	4	4	4	4	4	4	4	4
%ND	0	0	0	100	50	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 260: SITE 47 (RL) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	2	2	2	2	2	2	2	2
%ND	0	0	0	100	100	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 261: SITE 47 (Tb terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	84	84	84	84	84	84	84	84
%ND	0	0	0	96	98	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 262: SITE 47 (Tv terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	9	9	9	9	9	9	9	9
%ND	0	0	0	100	100	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 263: SITE 47 (GF terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	60.8	49.0	18.5	1.0	10.0	82.4	134.5	20.1
# of Outliers	0	0	0	0	2	0	0	1
Mean+/-4SD (ppm)	62.9	52.9	19.5	1.9	17.9	103.1	129.4	35.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	53.3	45.9	17.1	1.7	15.9	90.0	111.7	28.8
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-2SD (ppm)	43.6	38.9	14.8	1.4	14.0	76.9	94.1	22.3
# of Outliers	0	0	0	0	0	0	0	1
Lower Limit								
3×IQR (ppm)	-11.7	1.5	2.0	1.0	10.0	17.4	-16.0	-2.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-14.4	-3.2	0.7	0.1	2.5	-1.7	-11.5	-16.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-4.8	3.8	3.1	0.3	4.4	11.4	6.1	-9.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	4.9	10.8	5.4	0.6	6.3	24.5	23.7	-3.4
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 264: SITE 47 (Tb terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	77.1	56.6	24.2	1.0	10.0	100.1	134.1	30.2
# of Outliers	0	1	0	3	2	0	1	1
Mean+/-4SD (ppm)	73.8	56.2	23.5	10.7	13.6	108.4	144.5	37.7
# of Outliers	0	1	0	2	0	0	1	1
Mean+/-3SD (ppm)	63.3	49.1	20.5	8.3	12.7	96.3	125.3	30.8
# of Outliers	0	1	1	2	0	0	1	1
Mean+/-2SD (ppm)	52.7	42.0	17.5	5.9	11.8	84.1	106.1	23.8
# of Outliers	1	1	2	3	0	0	2	1
Lower Limit								
3×IQR (ppm)	-10.0	0.5	-0.2	1.0	10.0	22.2	2.2	-8.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-10.4	-0.9	-0.3	-8.5	6.4	11.2	-8.9	-17.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	0.1	6.2	2.6	-6.1	7.3	23.3	10.2	-10.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	10.6	13.4	5.6	-3.7	8.2	35.5	29.4	-3.9
# of Outliers	1	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 265: SITE 47 (Tv terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	100.9	48.2	13.5	1.0	10.0	82.5	142.4	19.5
# of Outliers	0	0	0	0	0	1	0	1
Mean+/-4SD (ppm)	82.3	53.6	21.1	2.3	20.1	154.6	154.7	30.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	68.2	45.8	18.2	1.9	17.6	130.8	131.4	25.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	54.0	38.1	15.3	1.6	15.1	107.1	108.1	19.5
# of Outliers	0	0	0	0	0	0	0	1
Lower Limit								
3×IQR (ppm)	-43.6	-0.7	5.1	1.0	10.0	30.3	-16.1	-1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-31.0	-8.5	-1.9	-0.3	-0.1	-35.3	-31.6	-13.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-16.8	-0.8	1.0	0.1	2.4	-11.5	-8.3	-8.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-2.7	7.0	3.8	0.4	4.9	12.2	15.0	-2.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 266: SITE 47 (GF terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified
Ni	Method chosen: No outliers removed. No outliers identified
Co	Method chosen: No outliers removed. No outliers identified
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified
Cr	Method chosen: No outliers removed. No outliers identified
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.

SD = standard deviation; IQR = interquartile range.

Table 267: SITE 47 (GF terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	19	19	19	19	19	19	19	18
ND	0	0	0	19	19	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	13	18	7.9	1.0	10	39	42	5.4
Max (ppm)	42	37	13	1.0	10	64	78	15
Mean (ppm)	26	25	10	1.0	10	51	60	9.2
Med (ppm)	27	24	10	1.0	10	52	62	8.8
SD (ppm)	8.3	4.8	1.5	N/A	N/A	7.3	12	2.7
95%tile (ppm)	36	32	12	N/A	N/A	62	77	14
95UCL (ppm)	29	27	11	N/A	N/A	54	65	10
Distribution	norm	norm	norm	norm	norm	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 268: SITE 47 (Tb terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. Two outliers detected using the Mean+/-2SD method, however these outliers do not distort background concentrations or distribution analysis, therefore were not removed.
Ni	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
Co	Method chosen: No outliers removed. Two outliers detected using the Mean+/-2SD method, however these outliers do not distort background concentrations or distribution analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified
Cr	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.

SD = standard deviation; IQR = interquartile range.

Table 269: SITE 47 (Tb terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	84	83	84	84	84	84	83	83
ND	0	0	0	81	82	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	9.7	14	5.9	1.0	10	37	35	2.7
Max (ppm)	55	40	23	13	11	83	113	23
Mean (ppm)	33	28	12	5.8	10	61	69	11
Med (ppm)	34	28	12	32	11	61	69	11
SD (ppm)	10	5.8	2.8	N/A	N/A	10	15	4.6
95%tile (ppm)	48	37	15	N/A	N/A	78	93	19
95UCL (ppm)	35	29	12	N/A	N/A	63	72	12
Distribution	norm	norm	norm	N/A	N/A	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 270: SITE 47 (Tv terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified.
Ni	Method chosen: No outliers removed. No outliers identified.
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
Cr	Method chosen: No outliers removed. No outliers identified
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.

SD = standard deviation; IQR = interquartile range.

Table 271: SITE 47 (Tv terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	9	9	9	9	9	8	9	8
ND	0	0	0	9	9	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	14	18	8.2	1.0	10	49	50	4.2
Max (ppm)	45	30	14	1.0	10	73	87	11
Mean (ppm)	28	23	9.7	1.0	10	57	14	7.9
Med (ppm)	28	22	9.2	1.0	10	54	63	8.4
SD (ppm)	12	4.3	1.6	N/A	N/A	7.5	56	2.4
95%tile (ppm)	44	29	12	N/A	N/A	68	83	11
95UCL (ppm)	36	26	11	N/A	N/A	62	71	9.5
Distribution	norm	norm	norm	N/A	N/A	norm	norm	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution.

Table 272: SITE 47 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
GF versus Tb				
Cu	7.804	3.090	0.007	Yes
Ni	2.799	1.977	0.123	No
Co	1.693	2.609	0.028	Yes
Zn	9.584	3.850	0.001	Yes
Cr	8.686	2.348	0.054	No
As	1.645	1.489	0.300	No
GF versus Tv				
Cu	2.464	0.613	0.813	No
Ni	2.380	1.057	0.543	No
Co	0.527	0.509	0.867	No
Zn	5.312	1.286	0.406	No
Cr	2.708	0.460	0.890	No
As	1.315	0.728	0.747	No
Tb versus Tv				
Cu	5.339	1.531	0.280	No
Ni	5.178	2.651	0.025	Yes
Co	2.220	2.478	0.039	Yes
Zn	4.272	1.178	0.469	No
Cr	5.977	1.171	0.473	No
As	2.960	1.882	0.149	No

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 273: SITE 47 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
GF versus Tb				
Cu	10.005	3.841	0.002	Yes
Ni	4.599	3.841	0.032	Yes
Co	8.407	3.841	0.004	Yes
Zn	15.498	3.841	<0.0001	Yes
Cr	5.366	3.841	0.021	Yes
As	2.439	3.841	0.118	No
GF versus Tv				
Cu	0.320	3.841	0.572	No
Ni	1.574	3.841	0.210	No
Co	0.920	3.841	0.337	No
Zn	1.624	3.841	0.203	No
Cr	0.320	3.841	0.572	No
As	0.790	3.841	0.374	No
Tb versus Tv				
Cu	1.689	3.841	0.194	No
Ni	6.806	3.841	0.009	Yes
Co	6.355	3.841	0.012	Yes
Zn	2.811	3.841	0.094	No
Cr	1.543	3.841	0.214	No
As	3.905	3.841	0.048	No

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 274: SITE 47 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups	Conover-Iman Groups
Copper					
GF	19	690	36.316	A	A
Tb	84	5218	62.119	B	B
Tv	9	420	46.667	A B	A B
Nickel					
GF	19	840	44.211	A B	A B
Tb	83	5096	61.398	A	A
Tv	9	280	31.111	B	B
Cobalt					
GF	19	752	39.579	A	A
Tb	84	5281	62.869	B	B
Tv	9	295	32.778	A	A
Zinc					
GF	19	577	30.368	A	A
Tb	84	5288	62.952	B	B
Tv	8	351	43.875	A B	A B
Chromium					
GF	19	783	41.211	A	A
Tb	83	5012	60.386	A	A
Tv	9	421	46.778	A	A
Arsenic					
GF	18	830	46.111	A	
Tb	83	4882	58.819	A	
Tv	8	283	35.375	A	

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed; otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 275: Summary of SITE 47 population analysis.

Element	Population analysis conclusion
Cu	Combine GF and Tv
Ni	Combine all terrain units
Co	Combine GF and Tv
Cd	Not analysed
Pb	Not analysed
Zn	Combine GF and Tv
Cr	Combine all terrain units
As	Combine all terrain units

Table 276: SITE 47 (combined terrain units) background concentration results summary.

	Cu	**Ni**	**Co**	**Zn**	**Cr**	**As**
Terrain units	**GF+Tv**	**GF+Tb+Tv**	**GF+Tv**	**GF+Tv**	**GF+Tb+Tv**	**GF+Tb+Tv**
SQG (ppm)	**63**	**50**	**50**	**200**	**64**	**12**
N	28	111	28	27	111	109
ND	0	0	0	0	0	0
DL (ppm)	3.0	5.0	5.0	15	20	0.2
Min (ppm)	13	14	79	39	35	2.7
Max (ppm)	45	40	14	73	113	23
Mean (ppm)	26	27	10	53	67	10
Med (ppm)	26	28	10	53	67	10
SD (ppm)	9.6	5.8	1.5	7.7	15	4.3
95%tile (ppm)	43	38	13	70	98	22
95UCL (ppm)	30	28	11	55	69	11
Distribution	norm	norm	norm	norm	norm	non-p

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.48 SITE 48, Cape Hooper, Nunavut Territory

A background sampling program was carried out for the site in 2011. Nine terrain units were identified within a 500-meter radius of the station and detailed below:

1. Beach sediments (Mr): Gravel and sand with trace cobble; 1–5 m thick; occasionally forms ridges with intervening swales.
2. Exposed bedrock (RL): Paleoproterozoic metasedimentary granulite-facies paragneiss.
3. Exposed bedrock and veneer (RLg): Metasedimentary rock with felsenmeer or till veneer or marine veneer.
4. Glaciolacustrine deposits (GL): Sand, silt, and mud with ice-rafted dropstones, forming flat to undulating plains with patches of exposed bedrock.
5. Glaciomarine deposits (GM): Diamictic stony sand and mud with ice-rafted dropstones, forming undulating terraces, reworked by marine processes; deposited in an ice-contact environment.
6. Marine blanket deposits (Mb): Gravel and sand with silt and trace cobble; possible icerafted debris; 2–10 m thick; forming continuous cover of sublittoral and offshore sediments.
7. Marine veneer deposits (Mv): Sand, gravel and silt with trace cobble in varying proportions; a discontinuous cover of littoral and offshore sediment, including raised beach ridges and sea-ice rafted debris, mimicking the surface of underlying till or bedrock with patches of exposed bedrock.
8. Steep bedrock slope (RLs): Steeply sloping Paleoproterozoic metasedimentary granulitefacies paragneiss.
9. Till veneer (Tv): Glacial diamicton (silt, clay, gravel, cobble, and boulder in varying proportions; discontinuous cover mimicking topography of underlying bedrock with patches of exposed bedrock.

The sampling program yielded a data set of 114 background samples. The number of background samples collected, and the area of each terrain unit is detailed in Table 277.

Table 277: Summary of SITE 48 terrain unit and sample coverage for the background sampling program.

Terrain unit	Area (%)	Sample Size (N)
Mr	2	0
RL	1.5	0
RLg	38	36
GL	9	8
GM	23	42
Mb	7.5	15
Mv	7.5	7
RLs	1.5	0
Tv	6	7

Table 278: SITE 48 (GL terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08526	2011	0-10	30.0	27.0	11.0	<1.0	<10	44.0	42.0	7.5
11-08539	2011	0-10	13.5	13.3	6.5	<1.0	<10	26.5	24.1	1.9
11-08540	2011	30-35	12.3	13.4	6.0	<1.0	<10	26.0	22.3	1.8
11-08541	2011	30-35	12.3	15.2	6.1	<1.0	<10	26.3	22.8	1.7
11-08560	2011	0-10	21.8	23.4	10.0	<1.0	<10	39.6	38.0	1.8
11-08561	2011	0-10	21.7	22.3	9.5	<1.0	<10	39.9	34.1	1.8
11-08570	2011	0-10	6.8	8.7	5.3	<1.0	<10	16.0	23.1	1.4
11-08571	2011	0-10	6.5	8.4	5.6	<1.0	<10	17.0	22.9	2.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 279: SITE 48 (GM terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08527	2011	0-10	12.0	12.2	7.1	<1.0	<10	25.6	24.0	1.5
11-08528	2011	0-10	20.2	18.0	8.6	<1.0	<10	37.9	30.0	2.5
11-08529	2011	30-35	22.3	18.9	9.5	<1.0	<10	39.3	32.5	2.4
11-08530	2011	0-10	28.3	31.8	10.1	<1.0	<10	42.3	27.2	2.4
11-08531	2011	0-10	27.0	31.4	9.4	<1.0	<10	41.4	28.8	99.0
11-08532	2011	0-10	18.4	22.0	9.1	<1.0	<10	31.5	26.8	3.5
11-08533	2011	0-10	14.2	14.2	6.5	<1.0	<10	27.7	22.9	2.2
11-08535	2011	0-10	11.3	11.7	6.5	<1.0	<10	23.4	22.0	2.0
11-08536	2011	0-10	10.2	10.7	6.0	<1.0	<10	23.6	21.9	1.7
11-08537	2011	30-35	13.2	13.7	7.3	<1.0	<10	28.0	27.3	2.3
11-08538	2011	0-10	17.7	16.3	8.6	<1.0	<10	32.5	29.0	2.6
11-08557	2011	0-10	15.9	15.5	7.1	<1.0	<10	29.5	28.3	2.2
11-08558	2011	40-50	19.6	15.7	6.8	<1.0	<10	29.6	27.7	1.9
11-08559	2011	0-10	21.8	24.5	10.1	<1.0	<10	41.3	37.5	2.0
11-08572	2011	0-10	16.3	16.0	7.7	<1.0	<10	29.5	26.0	2.3
11-08573	2011	40-50	31.6	29.4	11.8	<1.0	<10	55.0	43.7	4.1
11-08575	2011	0-10	10.6	12.4	6.4	<1.0	<10	24.4	22.8	2.5
11-08576	2011	0-10	25.6	29.5	11.4	<1.0	<10	49.2	34.7	5.5
11-08577	2011	40-50	16.8	24.0	7.7	<1.0	<10	35.0	21.1	2.2
11-08578	2011	0-10	19.1	21.7	9.1	<1.0	<10	40.0	33.0	3.6
11-08579	2011	0-10	10.6	11.4	6.2	<1.0	<10	22.0	23.0	2.2
11-08580	2011	0-10	10.4	10.7	5.3	<1.0	<10	17.9	<20	1.5
11-08581	2011	0-10	11.9	12.0	5.6	<1.0	<10	19.3	<20	1.4
11-08582	2011	40-50	15.1	19.7	7.6	<1.0	<10	23.2	25.1	2.8
11-08583	2011	0-10	7.5	9.0	5.5	<1.0	<10	18.5	21.1	1.4
11-08584	2011	0-10	17.5	21.8	8.5	<1.0	<10	38.2	31.0	2.2
11-08585	2011	0-10	10.1	11.9	6.1	<1.0	<10	23.9	22.6	1.9
11-08586	2011	40-50	12.6	14.0	7.3	<1.0	<10	29.3	25.4	2.2
11-08587	2011	0-10	18.3	17.0	8.0	<1.0	<10	30.9	26.2	2.1
11-08588	2011	0-10	19.7	22.2	8.7	<1.0	<10	37.9	28.7	2.5
11-08589	2011	0-10	21.8	25.2	9.5	<1.0	<10	34.4	25.6	2.1
11-08590	2011	40-50	19.1	20.3	8.1	<1.0	<10	30.0	25.6	31.1
11-08591	2011	40-50	21.8	21.5	8.6	<1.0	<10	32.9	30.5	3.6
11-08592	2011	0-10	7.2	8.5	5.2	<1.0	<10	16.8	<20	1.6
11-08593	2011	0-10	37.6	33.1	12.8	<1.0	<10	58.7	43.0	3.7
11-08594	2011	0-10	16.4	18.4	8.2	<1.0	<10	34.4	32.0	1.8
11-08595	2011	30-40	24.8	25.0	10.0	<1.0	<10	43.8	37.6	2.9
11-08596	2011	0-10	12.5	13.5	7.0	<1.0	<10	24.1	24.9	2.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08597	2011	0-10	13.8	14.5	6.4	<1.0	<10	25.0	23.9	2.3
11-08598	2011	0-10	21.6	21.6	9.5	<1.0	<10	44.4	39.8	2.1
11-08599	2011	0-10	11.1	13.8	6.5	<1.0	<10	26.8	24.1	2.1

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 280: SITE 48 (Mb terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08485	2011	30-35	6.4	6.3	<5.0	<1.0	<10	<15	<20	6.0
11-08486	2011	0-10	35.0	35.0	12.0	<1.0	<10	53.0	42.0	30.0
11-08487	2011	0-10	23.0	23.0	8.8	<1.0	<10	37.0	40.0	9.5
11-08488	2011	0-10	47.0	24.0	11.0	<1.0	<10	47.0	72.0	52.0
11-08489	2011	30-35	77.0	27.0	14.0	<1.0	<10	59.0	100.0	26.0
11-08490	2011	0-10	63.0	12.0	8.7	<1.0	<10	41.0	84.0	29.0
11-08491	2011	0-10	31.0	29.0	11.0	<1.0	<10	34.0	36.0	20.0
11-08492	2011	0-10	13.0	15.0	5.9	<1.0	<10	22.0	24.0	9.4
11-08519	2011	0-10	58.0	56.0	19.0	<1.0	<10	62.0	79.0	51.0
11-08520	2011	30-35	44.0	46.0	16.0	<1.0	<10	54.0	74.0	32.0
11-08521	2011	0-10	30.0	27.0	11.0	<1.0	<10	44.0	42.0	7.5
11-08542	2011	0-10	31.0	30.0	9.1	<1.0	<10	45.9	36.9	2.9
11-08543	2011	0-10	13.0	19.1	7.2	<1.0	<10	26.5	27.1	2.4
11-08544	2011	30-35	17.1	23.2	9.0	<1.0	<10	36.9	35.2	2.7
11-08545	2011	0-10	19.0	20.1	9.0	<1.0	<10	35.7	37.5	2.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 281: SITE 48 (Mv terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08483	2011	0-10	51.0	43.0	15.0	<1.0	<10	60.0	56.0	77.0
11-08548	2011	0-10	20.1	18.4	8.1	<1.0	<10	38.3	32.5	2.8
11-08549	2011	0-10	17.9	16.4	6.5	<1.0	<10	31.7	23.7	3.0
11-08562	2011	0-10	17.4	15.7	6.3	<1.0	<10	32.5	29.9	1.1
11-08563	2011	0-10	25.5	20.9	9.2	<1.0	<10	38.7	37.7	1.5
11-08564	2011	30-35	25.1	19.5	8.4	<1.0	<10	37.0	33.3	1.8
11-08565	2011	0-10	17.7	17.8	7.1	<1.0	<10	29.1	27.7	1.9

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 282: SITE 48 (RLg terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08480	2011	0-10	64.0	48.0	17.0	<1.0	12.0	106.0	59.0	55.0
11-08481	2011	30-35	92.0	65.0	22.0	<1.0	17.0	130.0	79.0	66.0
11-08482	2011	10-20	32.0	25.0	13.0	<1.0	<10	58.0	74.0	27.0
11-08484	2011	0-10	11.0	10.0	<5.0	<1.0	<10	19.0	<20	20.0
11-08493	2011	0-10	39.0	37.0	14.0	<1.0	<10	49.0	57.0	27.0
11-08494	2011	0-10	40.0	35.0	12.0	<1.0	<10	49.0	43.0	26.0
11-08495	2011	10-20	39.0	34.0	11.0	<1.0	<10	46.0	41.0	24.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08496	2011	0-10	37.0	33.0	12.0	<1.0	<10	47.0	42.0	18.0
11-08497	2011	30-35	35.0	32.0	11.0	<1.0	<10	48.0	44.0	19.0
11-08498	2011	0-10	28.0	18.0	7.1	<1.0	<10	35.0	38.0	35.0
11-08499	2011	0-10	25.0	15.0	6.2	<1.0	<10	26.0	31.0	41.0
11-08500	2011	30-35	32.0	19.0	11.0	<1.0	<10	31.0	37.0	70.0
11-08501	2011	0-10	28.0	23.0	8.3	<1.0	<10	32.0	40.0	20.0
11-08502	2011	0-10	23.0	24.0	9.4	<1.0	<10	37.0	36.0	13.0
11-08503	2011	10-20	31.0	29.0	12.0	<1.0	<10	46.0	48.0	15.0
11-08504	2011	0-10	40.0	44.0	15.0	<1.0	<10	56.0	48.0	41.0
11-08506	2011	0-10	44.0	30.0	10.0	<1.0	<10	49.0	49.0	34.0
11-08507	2011	0-10	35.0	27.0	9.8	<1.0	<10	48.0	48.0	33.0
11-08508	2011	30-35	29.0	23.0	8.5	<1.0	<10	42.0	40.0	28.0
11-08509	2011	0-10	33.0	37.0	11.0	<1.0	<10	46.0	39.0	98.0
11-08510	2011	0-10	41.0	36.0	11.0	<1.0	<10	51.0	49.0	43.0
11-08511	2011	30-35	39.0	34.0	10.0	<1.0	<10	50.0	47.0	40.0
11-08512	2011	0-10	72.0	42.0	13.0	<1.0	<10	60.0	46.0	150.0
11-08513	2011	0-10	62.0	41.0	13.0	<1.0	11.0	69.0	66.0	97.0
11-08514	2011	30-35	59.0	38.0	12.0	<1.0	10.0	66.0	62.0	96.0
11-08515	2011	0-10	17.0	12.0	5.5	<1.0	<10	26.0	23.0	7.4
11-08516	2011	0-10	13.0	18.0	6.4	<1.0	<10	31.0	32.0	30.0
11-08517	2011	0-10	39.0	32.0	12.0	<1.0	<10	49.0	47.0	17.0
11-08518	2011	0-10	24.0	25.0	8.2	<1.0	<10	45.0	40.0	4.5
11-08522	2011	0-10	39.0	32.0	12.0	<1.0	<10	49.0	47.0	17.0
11-08523	2011	0-10	24.0	25.0	8.2	<1.0	<10	45.0	40.0	4.5
11-08524	2011	0-10	58.0	56.0	19.0	<1.0	<10	62.0	79.0	51.0
11-08525	2011	30-35	44.0	46.0	16.0	<1.0	<10	54.0	74.0	32.0
11-08546	2011	0-10	32.1	26.3	8.4	<1.0	<10	44.5	41.9	31.9
11-08547	2011	30-35	35.7	30.7	10.7	<1.0	<10	52.5	48.4	33.5

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 283: SITE 48 (Tv terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10.0**	**15.0**	**20.0**	**0.2**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
11-08550	2011	0-10	13.8	12.0	5.2	<1.0	<10	23.2	<20	1.8
11-08551	2011	0-10	14.0	12.7	5.6	<1.0	<10	24.2	20.4	2.1
11-08552	2011	0-10	23.7	23.0	8.9	<1.0	<10	37.6	34.1	13.8
11-08553	2011	0-10	14.9	15.1	7.5	<1.0	<10	29.9	27.0	2.2
11-08554	2011	0-10	14.6	19.8	8.0	<1.0	<10	30.8	32.8	1.7
11-08555	2011	0-10	47.8	47.9	16.7	<1.0	11.8	75.1	59.1	6.4
11-08556	2011	0-10	28.8	28.8	10.8	<1.0	<10	46.5	43.7	2.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 284: SITE 48 (GL terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	8	8	8	8	8	8	8	8
%ND	0	0	0	100	100	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 285: SITE 48 (GM terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	42	42	42	42	42	42	42	42
%ND	0	0	0	100	100	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 286: SITE 48 (Mb terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	15	15	15	15	15	15	15	15
%ND	0	0	0	100	100	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 287: SITE 48 (Mv terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	7	7	7	7	7	7	7	7
%ND	0	0	0	100	100	0	0	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 288: SITE 48 (RLg terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	36	36	36	36	36	36	36	36
%ND	0	0	3	100	92	0	3	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 289: SITE 48 (Tv terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	7	7	7	7	7	7	7	7
%ND	0	0	0	100	86	0	14	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 290: SITE 48 (GL terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	54.1	53.7	20.8	1.0	10.0	87.5	71.5	2.5
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-4SD (ppm)	49.4	47.5	18.4	2.3	20.7	81.7	74.3	9.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	40.5	39.4	15.6	2.0	18.0	68.2	62.7	7.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	31.6	31.3	12.8	1.7	15.3	54.7	51.0	5.9
# of Outliers	0	0	0	0	0	0	0	1
Lower Limit								
3×IQR (ppm)	-21.4	-19.0	-5.3	1.0	10.0	-24.1	-13.6	1.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-21.9	-17.3	-4.0	-0.3	-0.7	-26.4	-18.9	-5.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-13.0	-9.2	-1.2	0.0	2.0	-12.9	-7.2	-3.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-4.1	-1.1	1.6	0.3	4.7	0.6	4.4	-1.7
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 291: SITE 48 (GM terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	49.3	50.0	16.9	1.0	10.0	80.0	52.7	4.4
# of Outliers	0	0	0	0	0	0	0	3
Mean+/-4SD (ppm)	43.8	45.0	15.7	1.6	14.9	73.2	55.6	63.8
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	36.9	38.1	13.7	1.5	13.7	62.6	48.5	48.5
# of Outliers	1	0	0	0	0	0	0	1
Mean+/-2SD (ppm)	30.0	31.1	11.7	1.3	12.4	51.9	41.3	33.2
# of Outliers	2	3	2	0	0	2	2	1
Lower Limit								
3×IQR (ppm)	-16.0	-15.4	-1.3	1.0	10.0	-17.7	0.5	0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-11.7	-10.7	-0.2	0.4	5.1	-12.0	-1.6	-58.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-4.7	-3.8	1.8	0.5	6.3	-1.4	5.6	-43.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	2.2	3.2	3.8	0.7	7.6	9.3	12.7	-28.0
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 292: SITE 48 (Mb terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	128.0	59.3	19.8	1.0	10.0	95.4	185.2	104.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	113.0	77.6	26.5	2.0	18.0	103.1	152.0	79.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	91.7	64.0	22.3	1.8	16.0	86.9	125.2	62.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	70.4	50.4	18.2	1.5	14.0	70.8	98.3	45.6
# of Outliers	1	1	1	0	0	0	1	2
Lower Limit								
3×IQR (ppm)	-64.5	-10.2	0.5	1.0	10.0	-10.5	-76.6	-70.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-57.3	-31.0	-6.8	0.0	2.0	-26.2	-62.6	-56.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-36.0	-17.5	-2.6	0.3	4.0	-10.1	-35.8	-39.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-14.7	-3.9	1.5	0.5	6.0	6.1	-8.9	-22.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 293: SITE 48 (RLg terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	74.8	74.8	26.5	1.0	10.0	85.4	76.0	106.8
# of Outliers	1	0	0	0	3	2	2	1
Mean+/-4SD (ppm)	103.7	80.0	26.3	1.7	17.5	133.0	107.8	152.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	86.5	67.4	22.4	1.5	15.7	111.5	92.2	122.1
# of Outliers	1	0	0	0	1	1	0	1
Mean+/-2SD (ppm)	69.4	54.8	18.5	1.3	13.8	90.0	76.6	91.3
# of Outliers	2	2	2	0	1	2	2	4
Lower Limit								
3×IQR (ppm)	-5.8	-12.8	-5.1	1.0	10.0	12.8	13.0	-45.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-33.6	-20.9	-4.9	0.3	3.0	-38.7	-17.2	-93.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-16.4	-8.3	-1.0	0.5	4.8	-17.2	-1.6	-62.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	0.7	4.3	2.9	0.7	6.6	4.2	14.0	-31.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 294: SITE 48 (GL terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. No outliers identified.
Ni	Method chosen: No outliers removed. No outliers identified.
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified.
Cr	Method chosen: No outliers removed. No outliers identified
As	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outliers was also detected by the Mean+/-2SD methods.

SD = standard deviation; IQR = interquartile range.

Table 295: SITE 48 (GL terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	8	8	8	8	8	8	8	8
ND	0	0	0	8	8	0	0	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	6.5	8.35	5.3	1.0	10	16	22	1.4
Max (ppm)	30	27	11	1.0	10	44	42	7.5
Mean (ppm)	16	16	7.5	1.0	10	29	29	2.5
Med (ppm)	13	14	6.3	1.0	10	26	24	1.8
SD (ppm)	8.2	7.0	2.3	N/A	N/A	11	8.1	N/A
95%tile (ppm)	27	26	11	N/A	N/A	43	41	N/A
95UCL (ppm)	21	21	9.0	N/A	N/A	36	34	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	non-p	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 296: SITE 48 (GM terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier identified by the Mean+/-3SD method and two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Ni	Method chosen: No outliers removed. Three outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Co	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Cr	Method chosen: No outliers removed. No outliers identified
As	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.

SD = standard deviation; IQR = interquartile range.

Table 297: SITE 48 (GM terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	42	42	42	42	42	42	42	39
ND	0	0	0	42	42	0	3	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	7.18	8.5	5.2	1.0	10	17	20	1.4
Max (ppm)	38	33	13	1.0	10	59	44	4.1
Mean (ppm)	17	18	8.0	1.0	10	32	28	2.3
Med (ppm)	17	17	3.2	1.0	10	30	27	2.3
SD (ppm)	6.6	6.6	1.8	N/A	N/A	9.7	6.0	0.7
95%tile (ppm)	28	31	11	N/A	N/A	49	40	3.6
95UCL (ppm)	19	20	8.4	N/A	N/A	34	29	2.5
Distribution	norm	norm	norm	N/A	N/A	norm	norm	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 298: SITE 48 (Mb terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Ni	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Co	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified
Cr	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
As	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 299: SITE 48 (Mb terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	15	15	15	15	15	14	14	15
ND	0	0	0	15	15	1	1	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	6.4	6.3	5.9	1.0	10	22	24	2.4
Max (ppm)	77	56	19	1.0	10	62	100	52
Mean (ppm)	34	26	10	1.0	10	41	50	19
Med (ppm)	31	24	10	1.0	10	42	41	19
SD (ppm)	20	13	3.6	N/A	N/A	13	24	17
95%tile (ppm)	67	49	174	N/A	N/A	60	89	51
95UCL (ppm)	43	32	12	N/A	N/A	47	61	33
Distribution	norm	norm	norm	N/A	N/A	norm	log	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 300: SITE 48 (RLg terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
Ni	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Co	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods.
Cr	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
As	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.

SD = standard deviation; IQR = interquartile range.

Table 301: SITE 48 (RLg terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	35	36	36	36	36	34	34	35
ND	0	0	1	36	33	0	1	0
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	0.2
Min (ppm)	11	10	5.0	1.0	10	19	23	4.5
Max (ppm)	72	65	22	1.0	17	69	74	98
Mean (ppm)	37	32	11	1.0	10	46	45	36
Med (ppm)	36	32	11	1.0	12	48	46	32
SD (ppm)	14	12	3.6	N/A	N/A	11	12	24
95%tile (ppm)	63	50	17	N/A	N/A	63	69	96
95UCL (ppm)	41	35	12	N/A	N/A	50	49	44
Distribution	norm	norm	norm	N/A	N/A	norm	log	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and

Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution.

Table 302: SITE 48 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
GL versus GM				
Cu	1.644	0.347	0.986	No
Ni	1.809	0.481	0.963	No
Co	0.450	0.400	0.978	No
Zn	2.555	0.602	0.931	No
Cr	1.035	0.212	0.997	No
As	0.549	0.093	1.00	No
GL versus Mb				
Cu	18.218	3.391	0.006	Yes
Ni	9.736	2.284	0.109	No
Co	2.944	2.307	0.104	No
Zn	11.468	2.382	0.088	No
Cr	21.331	3.844	0.001	Yes
As	17.110	2.904	0.023	Yes
GL versus RLg				
Cu	21.044	4.376	<0.0001	Yes
Ni	15.361	4.036	0.001	Yes
Co	3.739	3.282	0.008	Yes
Zn	16.865	3.902	0.001	Yes
Cr	16.742	3.361	0.006	Yes
As	33.991	5.768	<0.0001	Yes
GM versus Mb				
Cu	16.574	4.490	<0.0001	Yes
Ni	7.927	2.706	0.040	Yes
Co	2.494	2.845	0.027	Yes
Zn	8.913	2.694	0.041	Yes
Cr	22.366	5.866	<0.0001	Yes
As	16.561	2.810	0.030	Yes
GM versus RLg				
Cu	19.400	6.907	<0.0001	Yes
Ni	13.552	6.127	<0.0001	Yes
Co	3.289	4.968	<0.0001	Yes
Zn	14.310	5.640	<0.0001	Yes
Cr	17.777	6.079	<0.0001	Yes
As	33.441	5.675	<0.0001	Yes
Mb versus RLg				
Cu	2.826	0.746	0.878	No
Ni	5.625	1.880	0.244	No
Co	0.795	0.888	0.811	No
Zn	5.397	1.583	0.393	No
Cr	4.589	1.168	0.649	No
As	16.881	2.865	0.026	Yes

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 303: SITE 48 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
GL versus GM				
Cu	0.403	3.841	0.525	No
Ni	0.438	3.841	0.508	No
Co	0.717	3.841	0.397	No
Zn	0.309	3.841	0.578	No
Cr	0.000	3.841	0.989	No
As	7.492	3.841	0.006	Yes
GL versus Mb				
Cu	5.554	3.841	0.018	Yes
Ni	3.757	3.841	0.053	No
Co	2.941	3.841	0.086	No
Zn	3.628	3.841	0.057	No
Cr	5.114	3.841	0.024	Yes
As	13.696	3.841	<0.0001	Yes
GL versus RLg				
Cu	14.070	3.841	<0.0001	Yes
Ni	11.112	3.841	0.001	Yes
Co	7.966	3.841	0.005	Yes
Zn	10.699	3.841	0.001	Yes
Cr	11.224	3.841	0.001	Yes
As	17.100	3.841	<0.0001	Yes
GM versus Mb				
Cu	9.269	3.841	0.002	Yes
Ni	5.985	3.841	0.014	Yes
Co	6.530	3.841	0.011	Yes
Zn	5.636	3.841	0.018	Yes
Cr	13.274	3.841	<0.0001	Yes
As	24.731	3.841	<0.0001	Yes
GM versus RLg				
Cu	39.220	3.841	<0.0001	Yes
Ni	28.225	3.841	<0.0001	Yes
Co	20.089	3.841	<0.0001	Yes
Zn	24.945	3.841	<0.0001	Yes
Cr	38.329	3.841	<0.0001	Yes
As	54.605	3.841	<0.0001	Yes
Mb versus RLg				
Cu	0.930	3.841	0.335	No
Ni	2.912	3.841	0.088	No
Co	0.689	3.841	0.407	No
Zn	1.991	3.841	0.158	No
Cr	0.295	3.841	0.587	No
As	6.511	3.841	0.011	Yes

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 304: SITE 48 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups			Conover-Iman Groups			
Copper										
GL	8	223.50	27.938	A			A			
GM	42	1365.0	32.500	A			A			
Mb	15	916.50	61.10	A	B			B		
RLg	35	2545.0	72.714		B			B		
Nickel										
GL	8	243.50	30.438	A			A			
GM	42	1502.00	35.762	A			A			
Mb	15	847.50	56.500	A	B		A	B		
RLg	36	2558.00	71.056		B			B		
Cobalt										
GL	8	257.0	32.125	A			A			
GM	42	1586.0	37.762	A			A			
Mb	15	892.5	59.500	A	B		A	B		
RLg	36	2415.5	67.097		B			B		
Zinc										
GL	8	247.50	30.938	A			A			
GM	42	1512.0	36.00	A			A			
Mb	15	845.50	56.367	A	B		A	B		
RLg	34	2345.0	68.971		B			B		
Chromium										
GL	8	261.00	32.625	A			A			
GM	42	1306.00	31.095	A			A			
Mb	15	961.00	64.067		B	C		B		
RLg	34	2422.0	71.235			C		B		
Arsenic										
GL	7	75.00	10.714	A			A			
GM	39	1041.0	26.692	A				B		
Mb	15	917.0	61.133		B				C	
RLg	35	2623.0	74.943		B					D

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed; otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 305: Summary of SITE 48 population analysis.

Element	Population analysis conclusion
Cu	Combine GL and GM; Combine Mb and RLg
Ni	Combine GL and GM; Combine Mb and RLg
Co	Combine GL and GM; Combine Mb and RLg
Cd	Not analysed
Pb	Not analysed
Zn	Combine GL and GM; Combine Mb and RLg
Cr	Combine GL and GM; Combine Mb and RLg
As	Keel all terrain units separate

Table 306: SITE 48 (GL and GM terrain unit combined) background concentration results summary.

	Cu	Ni	Co	Zn	Cr
Terrain units	**GL + GM**	**GL + GM**	**GL + GM**	**GL + GM**	**GL + GM**
SQG (ppm)	**63**	**50**	**50**	**200**	**64**
N	50	50	50	50	50
ND	0	0	0	0	0
DL (ppm)	3.0	5.0	5.0	15	20
Min (ppm)	6.5	8.3	5.2	16	20
Max (ppm)	38	33	13	59	44
Mean (ppm)	16	18	7.9	32	28
Med (ppm)	17	16	7.7	30	26
SD (ppm)	6.8	12	3.6	9.8	6.3
95%tile (ppm)	29	31	11	47	41
95UCL (ppm)	19	19	8.3	34	29
Distribution	norm	norm	norm	norm	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

Table 307: SITE 48 (Mb and RLg terrain unit combined) background concentration results summary.

	Cu	Ni	Co	Zn	Cr
Terrain units	**Mb + RLg**	**Mb + RLg**	**Mb + RLg**	**Mb + RLg**	**Mb + RLg**
SQG (ppm)	**63**	**50**	**50**	**200**	**64**
N	50	51	51	49	49
ND	0	0	0	0	0
DL (ppm)	3.0	5.0	5.0	15	20
Min (ppm)	6.4	6.3	5	15	20
Max (ppm)	77	65	22	69	100
Mean (ppm)	36	30	11	45	47
Med (ppm)	35	29	11	46	42
SD (ppm)	16	12	3.6	12	17
95%tile (ppm)	64	52	18	62	77
95UCL (ppm)	40	33	12	48	51
Distribution	norm	norm	norm	norm	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.49 SITE 49, Kivitoo Point, Nunavut Territory

A background sampling program was performed in 2009 at the SITE 49 site. Background samples were collected from two identified terrain units within the 500 meters background radius of the station, till from the Cumberland Batholith (TCB) and emerged marine sediment (EM). 37 background samples were collected. All samples were analyzed for the Arctic suite of inorganic elements.

Table 308: SITE 49 (TCM terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
09-8213	2009	10	26.0	30.0	10.0	<1.0	<10	40.0	46.0	1.4
09-8214	2009	10	22.0	20.0	7.1	<1.0	<10	28.0	<20	1.6
09-8215	2009	15	16.0	25.0	7.6	<1.0	<10	24.0	31.0	1.6
09-8216	2009	10	16.0	26.0	8.4	<1.0	<10	25.0	34.0	2.1
09-8217	2009	10	22.0	18.0	7.5	<1.0	<10	21.0	21.0	1.5
09-8218	2009	10	25.0	24.0	8.8	<1.0	<10	33.0	31.0	1.5
09-8219	2009	10	29.0	28.0	10.0	<1.0	<10	29.0	21.0	1.2
09-8224	2009	10	27.0	24.0	15.0	<1.0	<10	57.0	36.0	2.2
09-8225	2009	10	40.0	34.0	14.0	<1.0	<10	37.0	33.0	1.7
09-8226	2009	10	31.0	27.0	10.0	<1.0	<10	29.0	26.0	2.7
09-8227	2009	10	12.0	20.0	6.7	<1.0	<10	22.0	30.0	2.2
09-8228	2009	10	12.0	16.0	6.2	<1.0	34.0	29.0	22.0	1.9
09-8229	2009	10	21.0	17.0	7.6	<1.0	<10	26.0	23.0	1.8
09-8230/31	2009	15	64.0	50.0	18.0	<1.0	<10	70.0	66.0	2.4
09-8232	2009	10	50.0	58.0	17.0	<1.0	<10	77.0	91.0	1.4
09-8233	2009	10	32.0	29.0	11.0	<1.0	<10	41.0	36.0	1.9
09-8234	2009	20	6.2	6.3	<5.0	<1.0	<10	19.0	<20	2.0
09-8235	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
09-8236	2009	20	<5.0	<5.0	<5.0	<1.0	<10	21.0	<20	1.7
09-8237	2009	20	<5.0	6.2	<5.0	<1.0	<10	22.0	<20	1.8
09-8238	2009	20	6.6	9.0	<5.0	<1.0	<10	24.0	<20	1.9
09-8239	2009	10	<5.0	5.1	<5.0	<1.0	<10	46.0	<20	6.9
09-8240/41	2009	10	8.0	8.0	<5.0	<1.0	<10	20.0	<20	1.7
09-8242	2009	10	13.0	12.0	5.4	<1.0	<10	23.0	21.0	<1.0
09-8243	2009	10	9.4	11.0	5.7	<1.0	<10	25.0	24.0	<1.0
09-8244	2009	10	24.0	25.0	8.5	<1.0	<10	34.0	36.0	<1.0
09-8245	2009	10	5.7	7.0	<5.0	<1.0	<10	17.0	<20	<1.0
09-8246	2009	10	31.0	39.0	13.0	<1.0	<10	52.0	74.0	<1.0
09-8247	2009	10	22.0	26.0	10.0	<1.0	<10	37.0	40.0	<1.0
09-8248	2009	10	15.0	18.0	7.7	<1.0	<10	27.0	32.0	<1.0
09-8249	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
09-8250/51	2009	10	7.1	7.4	<5.0	<1.0	<10	38.0	<20	1.8
09-8252	2009	10	89.0	38.0	18.0	<1.0	<10	89.0	100.0	4.8
09-8253	2009	10	5.9	5.6	<5.0	<1.0	<10	47.0	<20	2.1
09-8254	2009	10	<5.0	<5.0	<5.0	<1.0	<10	43.0	<20	4.7
09-8255	2009	10	<5.0	<5.0	<5.0	<1.0	<10	48.0	<20	4.1
09-8256	2009	10	<5.0	5.1	5.0	<1.0	<10	26.0	<20	5.9

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 309: SITE 49 (EM terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
09-8257	2009	10	<5.0	<5.0	<5.0	<1.0	<10	40.0	<20	3.1
09-8258	2009	10	<5.0	6.0	<5.0	<1.0	<10	40.0	<20	3.8
09-8259	2009	10	5.1	5.4	<5.0	<1.0	<10	31.0	<20	2.6
09-8260/61	2009	10	8.8	14.0	5.3	<1.0	<10	44.0	26.0	3.0
09-8262	2009	10	<5.0	<5.0	<5.0	<1.0	<10	49.0	<20	5.4
09-8263	2009	10	6.0	6.7	5.6	<1.0	<10	35.0	<20	3.3
09-8264	2009	10	<5.0	<5.0	<5.0	<1.0	<10	46.0	<20	3.7
09-8265	2009	10	<5.0	<5.0	<5.0	<1.0	<10	43.0	<20	3.4
09-8266	2009	10	<5.0	<5.0	<5.0	<1.0	<10	19.0	<20	1.9
09-8267	2009	10	<5.0	<5.0	<5.0	<1.0	<10	16.0	<20	2.1
09-8268	2009	30	<5.0	<5.0	<5.0	<1.0	<10	18.0	<20	2.2
09-8269	2009	10	<5.0	<5.0	<5.0	<1.0	<10	25.0	<20	2.3
09-8270/71	2009	10	12.0	8.6	<5.0	<1.0	<10	48.0	<20	4.8
09-8272	2009	10	16.0	17.0	9.4	<1.0	<10	60.0	37.0	3.3
09-8273	2009	15	<5.0	<5.0	<5.0	<1.0	<10	17.0	<20	1.5
09-8274	2009	10	8.3	5.5	<5.0	<1.0	<10	34.0	<20	1.7
09-8275	2009	10	<5.0	<5.0	<5.0	<1.0	<10	23.0	<20	2.0
09-8276	2009	10	<5.0	<5.0	<5.0	<1.0	<10	19.0	<20	2.0
09-8277	2009	10	<5.0	<5.0	<5.0	<1.0	<10	23.0	<20	1.4
06-8278	2009	10	6.6	8.2	5.7	<1.0	<10	32.0	<20	1.9
06-8279	2009	10	8.7	11.0	7.3	<1.0	10.0	45.0	25.0	2.3
09-8280/81	2009	10	<5.0	5.2	<5.0	<1.0	<10	30.0	<20	2.4
06-8282	2009	20	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.9
06-8283	2009	30	<5.0	5.9	<5.0	<1.0	<10	18.0	<20	1.9
06-8284	2009	10	<5.0	<5.0	<5.0	<1.0	<10	16.0	<20	1.3
06-8285	2009	10	9.9	14.0	5.7	<1.0	<10	28.0	<20	2.0
06-8286	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8
06-8287	2009	10	25.0	25.0	10.0	<1.0	<10	33.0	<20	6.0
06-8288	2009	0	5.0	<5.0	<5.0	<1.0	<10	18.0	<20	1.6
06-8289	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.2
06-8293	2009	10	6.2	6.7	5.6	<1.0	<10	34.0	<20	2.7
06-8294	2009	10	<5.0	<5.0	<5.0	<1.0	<10	19.0	<20	1.5
06-8295	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
06-8296	2009	10	<5.0	7.7	6.4	<1.0	<10	30.0	<20	2.3
06-8297	2009	10	<5.0	6.0	<5.0	<1.0	<10	22.0	<20	1.7
06-8298	2009	10	37.0	16.0	6.6	<1.0	<10	23.0	24.0	2.6
06-8299	2009	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 310: SITE 49 (TCB terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	37	37	37	37	37	37	37	37
%ND	22	14	38	100	97	5	41	22
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 311:SITE 49 (EB terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	37	37	37	37	37	37	37	37
%ND	68	54	73	100	100	14	89	5
Analysed?	No	No	No	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 312: SITE 49 (TCB terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	86.3	85.1	25.0	1.0	10.0	95.0	76.0	4.8
# of Outliers	1	0	0	0	1	0	2	2
Mean+/-4SD (ppm)	86.3	68.8	23.5	1.6	26.9	102.0	108.6	7.3
# of Outliers	1	0	0	0	1	0	0	0
Mean+/-3SD (ppm)	68.2	55.2	19.5	1.5	22.7	84.3	88.5	5.9
# of Outliers	1	1	0	0	1	1	2	1
Mean+/-2SD (ppm)	50.1	41.6	15.5	1.3	18.6	66.6	68.3	4.6
# of Outliers	2	2	3	0	1	3	3	4
Lower Limit								
3×IQR (ppm)	-54.4	-52.8	-10.0	1.0	10.0	-31.0	-22.0	-1.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-58.5	-40.0	-8.6	0.4	-6.2	-39.6	-52.5	-3.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-40.4	-26.4	-4.6	0.5	-2.1	-21.9	-32.4	-2.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-22.3	-12.8	-0.6	0.7	2.1	-4.2	-12.2	-1.0
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 313: SITE 49 (EM terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	9.8	11.8	6.2	1.0	10.0	86.0	20.0	6.9
# of Outliers	5	5	5	0	0	0	4	0
Mean+/-4SD (ppm)	31.6	24.4	10.5	1.6	15.2	77.1	37.9	6.8
# of Outliers	1	1	0	0	0	0	0	0
Mean+/-3SD (ppm)	25.3	19.9	9.2	1.5	13.9	64.4	33.6	5.6
# of Outliers	1	1	2	0	0	0	1	1
Mean+/-2SD (ppm)	18.9	15.4	7.9	1.3	12.6	51.6	29.3	4.5
# of Outliers	2	3	2	0	0	1	1	3
Lower Limit								
3×IQR (ppm)	1.4	-0.1	4.1	1.0	10.0	-33.0	20.0	-2.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-18.9	-11.4	0.3	0.4	4.8	-24.9	3.5	-2.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-12.6	-6.9	1.6	0.5	6.1	-12.2	7.8	-1.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-6.3	-2.5	2.9	0.7	7.4	0.6	12.1	0.0
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million

Table 314: SITE 49 (TCB terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outliers were also detected by the Mean+/-nSD methods.
Ni	Method chosen: No outliers removed. Two outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Co	Method chosen: No outliers removed. Three outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. Three outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.
Cr	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
As	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.

SD = standard deviation; IQR = interquartile range.

Table 315: SITE 49 (TCB terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	36	37	37	37	37	37	35	35
ND	8	5	14	37	36	2	15	8
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	64	58	18	1.0	34	89	74	4.8
Mean (ppm)	18	19	8.2	1.0	11	34	28	1.9
Med (ppm)	21	20	8.8	1.0	34	29	31	1.8
SD (ppm)	14	13	3.9	N/A	N/A	17	13	0.9
95%tile (ppm)	42	41	17	N/A	N/A	71	52	4.3
95UCL (ppm)	22	23	9.5	N/A	N/A	39	32	2.1
Distribution	norm	norm	log	N/A	N/A	log	log	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 316: SITE 49 (EM terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Not analysed
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier identified by the Mean+/-2SD method, however, this outlier didn't distort calculated background concentrations or distributional analysis, therefore was not removed.
Cr	Not analysed
As	Method chosen: No outliers removed. Three outliers identified by the Mean+/-2SD method, however, these outliers don't distort calculated background concentrations or distributional analysis, therefore were not removed.

SD = standard deviation; IQR = interquartile range.

Table 317: SITE 49 (EM terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	37	37	37	37	37	37	37	37
ND	25	20	27	37	37	5	33	2
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	37	25	10	1.0	10	60	37	6.0
Mean (ppm)	7.4	7.3	5.5	1.0	10	28	21	2.4
Med (ppm)	8.8	7.7	6.0	1.0	10	30	25	2.2
SD (ppm)	N/A	N/A	N/A	N/A	N/A	12	N/A	1.1
95%tile (ppm)	N/A	N/A	N/A	N/A	N/A	48	N/A	4.9
95UCL (ppm)	N/A	N/A	N/A	N/A	N/A	32	N/A	2.8
Distribution	N/A	N/A	N/A	N/A	N/A	norm	N/A	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution. Only Zinc and Arsenic were evaluated, as all other trace elements in the EM terrain unit were not analysed.

Table 318: SITE 49 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
TCB versus EM				
Zn	5.038	1.401	0.166	No
As	0.131	0.409	0.684	No

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 319: SITE 49 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
TCB versus EM				
Zn	1.306	3.841	0.253	No
As	1.714	3.841	0.190	No

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 320: SITE 49 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups	Conover-Iman Groups
Zinc					
TCB	32	997.0	31.156	A	A
EM	35	1281.0	36.60	A	A
Arsenic					
TCB	28	801.5	28.625	A	A
EM	35	1214.5	34.70	A	A

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed; otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 321: Summary of SITE 49 population analysis.

Element	Population analysis conclusion
Zn	Combine Units
As	Combine Units

Table 322: SITE 49 (terrain units combined) background concentration results summary.

	Zn	As
Terrain units	**TCB + EM**	**TCB + EM**
SQG (ppm)	**200**	**12**
N	74	72
ND	8	11
DL (ppm)	15	1.0
Min (ppm)	15	1.0
Max (ppm)	89	6.0
Mean (ppm)	31	2.2
Med (ppm)	29	2.0
SD (ppm)	15	1.1
95%tile (ppm)	58	4.7
95UCL (ppm)	34	2.4
Distribution	log	non-p

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.50 SITE 50, Qikiqtarjuaq, Nunavut Territory

Background soil samples were collected from the site in 1990. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station. A total of five background samples were collected within 50 to 500 m of the station area. All samples were analyzed for the Arctic suite of inorganic elements. As the background soil data sets have sample sizes less than 8 samples, background concentrations were not calculated.

Table 323: SITE 50 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**0.2**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
G1008	1990	0	22.0	<5.0	<5.0	<1.0	<10	37.0	<20	1.0
G1009	1990	0	6.2	<5.0	<5.0	<1.0	<10	47.0	<20	1.6
G1028	1990	0	<3.0	<5.0	<5.0	<1.0	<10	34.0	22.0	1.2
G1029	1990	0	16.6	8.9	9.8	<1.0	<10	71.0	28.0	1.5
G1030	1990	0	5.9	<5.0	<5.0	<1.0	<10	42.0	<20	1.4

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 324: SITE 50 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	5	5	5	5	5	5	5	5
%ND	20	80	80	100	100	0	60	0
Analysed?	No	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit.

B.3.51 SITE 51, Padloping Island, Nunavut Territory

A background sampling program was carried out for the site in 2009. All soil samples were collected from the only terrain unit in the 500 meters background radius of the station, referred to as the T(HB) terrain unit. A total of 56 background soil samples were collected within this terrain unit All samples were analyzed for the Arctic suite of inorganic elements.

Table 325: SITE 51 (T(HB) terrain unit) background soil data

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8153	2009	10	6.0	10.0	<5.0	<1.0	<10	19.0	<20	<1.0
8154	2009	10	11.0	6.2	<5.0	<1.0	<10	<15	<20	2.3
8155	2009	10	9.1	6.4	<5.0	<1.0	<10	<15	<20	1.1
8156	2009	10	<5.0	9.0	<5.0	<1.0	<10	17.0	<20	<1.0
8157	2009	10	11.0	18.0	8.8	<1.0	<10	32.0	36.0	<1.0
8158	2009	10	16.0	20.0	15.0	<1.0	<10	22.0	<20	<1.0
8159	2009	10	9.9	16.0	8.0	<1.0	<10	33.0	33.0	<1.0
8163	2009	10	7.7	14.0	6.6	<1.0	<10	22.0	24.0	<1.0
8164	2009	10	7.6	9.8	5.4	<1.0	<10	18.0	24.0	<1.0
8165	2009	0	15.0	35.0	9.7	<1.0	<10	34.0	72.0	<1.0
8166	2009	10	10.0	16.0	6.9	<1.0	<10	25.0	27.0	<1.0
8167	2009	10	10.0	15.0	6.8	<1.0	<10	27.0	26.0	<1.0
8168	2009	10	14.0	5.1	<5.0	<1.0	<10	<15	<20	<1.0
8169	2009	10	6.4	9.2	<5.0	<1.0	<10	19.0	<20	3.1
09-8170/71	2009	10	12.0	24.0	8.6	<1.0	<10	31.0	38.0	1.2
8172	2009	10	6.4	11.0	5.6	<1.0	<10	22.0	21.0	<1.0
8173	2009	10	30.0	36.0	13.0	<1.0	<10	59.0	65.0	1.1
8174	2009	10	12.0	18.0	8.4	<1.0	<10	26.0	31.0	<1.0
8175	2009	10	11.0	17.0	7.5	<1.0	<10	25.0	30.0	<1.0
8176	2009	10	23.0	29.0	15.0	<1.0	<10	48.0	49.0	<1.0
8177	2009	10	9.2	15.0	7.5	<1.0	<10	25.0	26.0	<1.0
8178	2009	10	11.0	18.0	7.2	<1.0	<10	25.0	31.0	<1.0
8179	2009	10	15.0	21.0	8.3	<1.0	<10	37.0	37.0	<1.0
09-8180/81	2009	10	<5.0	9.9	<5.0	<1.0	<10	20.0	<20	<1.0
8182	2009	10	13.0	22.0	9.3	<1.0	<10	36.0	39.0	<1.0
8183	2009	10	11.0	24.0	13.0	<1.0	<10	49.0	44.0	<1.0
8184	2009	10	6.5	10.0	<5.0	<1.0	<10	18.0	<20	<1.0
8185	2009	10	12.0	20.0	9.7	<1.0	<10	33.0	37.0	<1.0
8186	2009	10	7.4	11.0	6.1	<1.0	<10	18.0	21.0	<1.0
8187	2009	10	8.7	16.0	7.4	<1.0	<10	23.0	28.0	<1.0
8188	2009	10	8.5	18.0	8.2	<1.0	<10	29.0	32.0	<1.0
8189	2009	10	8.4	13.0	6.3	<1.0	<10	23.0	23.0	<1.0
09-8190/91	2009	10	8.3	18.0	6.4	<1.0	<10	20.0	26.0	<1.0
8192	2009	10	14.0	22.0	8.9	<1.0	<10	36.0	41.0	<1.0
8193	2009	20	7.2	13.0	5.3	<1.0	<10	22.0	27.0	<1.0
8194	2009	10	7.6	9.0	<5.0	<1.0	<10	<15	<20	<1.0
8195	2009	10	5.8	12.0	<5.0	<1.0	<10	17.0	20.0	<1.0
8196	2009	10	25.0	33.0	15.0	<1.0	<10	55.0	64.0	<1.0
8197	2009	10	<5.0	6.2	<5.0	<1.0	<10	<15	<20	<1.0
8198	2009	10	5.7	10.0	5.1	<1.0	<10	20.0	<20	1.0
8199	2009	10	5.4	8.3	<5.0	<1.0	<10	<15	<20	<1.0
09-8200/01	2009	10	18.0	22.0	8.7	<1.0	<10	34.0	38.0	1.1
8202	2009	10	6.6	11.0	5.5	<1.0	<10	20.0	<20	<1.0
8203	2009	10	11.0	18.0	8.0	<1.0	<10	32.0	31.0	<1.0
8204	2009	10	9.3	14.0	6.1	<1.0	<10	22.0	22.0	<1.0
8205	2009	10	9.4	13.0	6.2	<1.0	<10	25.0	24.0	<1.0
8206	2009	10	<5.0	8.0	<5.0	<1.0	<10	17.0	<20	<1.0
8207	2009	30	39.0	61.0	20.0	<1.0	10.0	97.0	110.0	2.6
8208	2009	10	<5.0	7.0	<5.0	<1.0	<10	<15	<20	<1.0
8209	2009	10	11.0	16.0	7.2	<1.0	<10	26.0	27.0	<1.0
09-8210/11	2009	10	7.0	10.0	<5.0	<1.0	<10	19.0	<20	<1.0
8212	2009	10	5.3	<5.0	6.7	<1.0	<10	<15	<20	1.4
8220	2009	20	5.2	9.7	<5.0	<1.0	<10	17.0	<20	<1.0
8221	2009	20	<5.0	9.2	<5.0	<1.0	<10	16.0	<20	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8222	2009	10	6.9	11.0	6.6	<1.0	<10	23.0	21.0	<1.0
8223	2009	10	6.9	11.0	5.4	<1.0	<10	23.0	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 326: SITE 51 (T(HB) terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	56	56	56	56	56	56	56	56
%ND	11	2	30	100	100	14	39	86
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 327: SITE 51 (T(HB) terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	25.6	42.4	18.3	1.0	10.0	71.0	69.0	1.0
# of Outliers	2	1	1	0	0	1	2	8
Mean+/-4SD (ppm)	34.8	51.9	19.8	1.5	14.2	80.7	92.8	2.7
# of Outliers	1	1	1	0	0	1	1	1
Mean+/-3SD (ppm)	28.4	42.4	16.6	1.4	13.2	66.5	76.4	2.3
# of Outliers	2	1	1	0	0	1	1	3
Mean+/-2SD (ppm)	22.0	32.8	13.4	1.3	12.1	52.4	60.0	1.9
# of Outliers	4	4	4	0	0	3	4	3
Lower Limit								
3×IQR (ppm)	-7.9	-14.5	-5.0	1.0	10.0	-21.8	-16.8	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-16.4	-24.4	-6.0	0.5	5.8	-32.5	-38.5	-0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-10.0	-14.9	-2.7	0.6	6.8	-18.4	-22.1	-0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-3.6	-5.4	0.5	0.7	7.9	-4.2	-5.7	0.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 328: SITE 51 (T(HB) terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods.
Ni	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
Co	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier also detected by the Mean+/-nSD methods.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier identified distant from the rest of the population. This outlier distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
Cr	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 329: SITE 51 (T(HB) terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	54	55	55	56	56	55	54	56
ND	6	1	17	56	56	8	22	48
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	25	36	15	1.0	10	59	65	3.1
Mean (ppm)	9.5	15	7.2	1.0	10	25	27	1.1
Med (ppm)	9.2	13	7.4	1.0	10	23	30	1.3
SD (ppm)	4.3	7.2	2.7	N/A	N/A	10	10	N/A
95%tile (ppm)	17	30	14	N/A	N/A	48	46	N/A
95UCL (ppm)	11	17	7.8	N/A	N/A	27	64	N/A
Distribution	norm	log	norm	N/A	N/A	log	norm	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.52 SITE 52, Durban Island, Nunavut Territory

A background sampling program was carried out for the site in 2009. All soil samples were collected from the two terrain units identified within the 500 meters background radius of the station, referred to as the R(CD) and the R(HB) terrain unit. 56 background soil samples were collected within each terrain unit for a total of 112 samples. All samples were analyzed for the Arctic suite of inorganic elements.

Table 330: SITE 52 (R(CD) terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
09-8030/31	2009	10	66.0	280.0	36.0	<1.0	<10	46.0	78.0	<1.0
8032	2009	10	83.0	310.0	40.0	<1.0	<10	47.0	81.0	<1.0
8033	2009	10	98.0	240.0	43.0	<1.0	<10	48.0	87.0	<1.0
8034	2009	10	110.0	220.0	38.0	<1.0	<10	45.0	90.0	<1.0
8035	2009	10	110.0	220.0	38.0	<1.0	<10	43.0	79.0	<1.0
8036	2009	10	69.0	1100.0	70.0	<1.0	<10	48.0	240.0	<1.0
8037	2009	10	79.0	870.0	56.0	<1.0	<10	42.0	190.0	<1.0
8038	2009	0	74.0	1100.0	66.0	<1.0	<10	49.0	240.0	<1.0
8039	2009	10	85.0	840.0	63.0	<1.0	<10	50.0	230.0	<1.0
09-8040/41	2009	10	72.0	970.0	65.0	<1.0	<10	50.0	230.0	<1.0
8042	2009	10	68.0	990.0	64.0	<1.0	<10	47.0	220.0	<1.0
8043	2009	10	72.0	970.0	67.0	<1.0	<10	52.0	220.0	<1.0
8044	2009	10	79.0	890.0	63.0	<1.0	<10	48.0	200.0	<1.0
8045	2009	10	98.0	430.0	51.0	<1.0	<10	54.0	130.0	<1.0
8046	2009	10	110.0	220.0	42.0	<1.0	<10	48.0	77.0	<1.0
8047	2009	10	110.0	260.0	42.0	<1.0	<10	48.0	100.0	<1.0
8048	2009	10	110.0	260.0	42.0	<1.0	<10	51.0	99.0	<1.0
8049	2009	0	100.0	270.0	41.0	<1.0	<10	48.0	95.0	<1.0
09-8050/51	2009	10	76.0	910.0	65.0	<1.0	<10	49.0	220.0	<1.0
8052	2009	10	75.0	900.0	65.0	<1.0	<10	50.0	230.0	<1.0
8053	2009	10	78.0	910.0	65.0	<1.0	<10	51.0	250.0	<1.0
8054	2009	10	110.0	290.0	45.0	<1.0	<10	48.0	110.0	<1.0
8055	2009	10	110.0	280.0	44.0	<1.0	<10	49.0	110.0	<1.0
8056	2009	10	120.0	280.0	44.0	<1.0	<10	49.0	110.0	<1.0
8057	2009	10	100.0	310.0	45.0	<1.0	<10	50.0	110.0	<1.0
8058	2009	10	28.0	72.0	24.0	<1.0	12.0	82.0	59.0	<1.0
8059	2009	10	17.0	21.0	16.0	<1.0	<10	90.0	38.0	<1.0
09-8060/61	2009	0	120.0	260.0	43.0	<1.0	<10	48.0	110.0	<1.0
8062	2009	0	97.0	350.0	44.0	<1.0	<10	50.0	130.0	<1.0
8063	2009	10	34.0	91.0	18.0	<1.0	<10	41.0	49.0	<1.0
8064	2009	10	31.0	110.0	18.0	<1.0	<10	43.0	52.0	<1.0
8065	2009	10	24.0	44.0	18.0	<1.0	13.0	110.0	51.0	<1.0
8066	2009	10	28.0	42.0	24.0	<1.0	10.0	100.0	110.0	1.8
8067	2009	10	48.0	61.0	28.0	<1.0	15.0	140.0	140.0	<1.0
8068	2009	10	32.0	96.0	28.0	<1.0	<10	160.0	190.0	2.6
8069	2009	10	34.0	120.0	20.0	<1.0	<10	37.0	49.0	<1.0
09-8070/71	2009	10	24.0	32.0	20.0	<1.0	<10	108.0	65.0	1.8
8072	2009	10	33.0	42.0	22.0	<1.0	<10	120.0	74.0	5.2
8073	2009	10	28.0	42.0	20.0	<1.0	<10	90.0	59.0	5.1
8074	2009	10	33.0	37.0	20.0	<1.0	<10	90.0	91.0	5.4
8075	2009	10	36.0	38.0	20.0	<1.0	<10	83.0	85.0	1.9
8076	2009	10	29.0	41.0	18.0	<1.0	<10	68.0	110.0	2.5
8077	2009	10	20.0	57.0	19.0	<1.0	12.0	110.0	140.0	2.6
8078	2009	10	23.0	30.0	19.0	<1.0	<10	64.0	65.0	1.8
8079	2009	10	36.0	55.0	21.0	<1.0	<10	100.0	130.0	1.0
09-8080/81	2009	0	<5.0	9.0	<5.0	<1.0	<10	<15	<20	<1.0
8082	2009	0	27.0	81.0	13.0	<1.0	<10	25.0	35.0	<1.0
8083	2009	10	31.0	37.0	21.0	<1.0	<10	88.0	93.0	1.2
8084	2009	10	51.0	66.0	26.0	<1.0	<10	110.0	140.0	5.8
8085	2009	10	35.0	41.0	21.0	<1.0	<10	110.0	80.0	2.0
8086	2009	10	25.0	19.0	11.0	<1.0	12.0	44.0	43.0	2.0
8087	2009	10	79.0	290.0	37.0	<1.0	<10	42.0	60.0	<1.0
09-8090/91	2009	10	74.0	75.0	30.0	<1.0	<10	120.0	140.0	9.2

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8092	2009	10	42.0	40.0	22.0	<1.0	<10	76.0	76.0	4.8
8093	2009	10	44.0	67.0	25.0	<1.0	<10	100.0	72.0	7.4
8094	2009	10	14.0	7.4	<5.0	<1.0	<10	18.0	26.0	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 331: SITE 52 (R(HB) terrain unit) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8088	2009	10	28.0	71.0	18.0	<1.0	11.0	76.0	67.0	3.3
8089	2009	10	42.0	150.0	26.0	<1.0	<10	77.0	88.0	3.0
8095	2009	10	64.0	160.0	30.0	<1.0	26.0	160.0	250.0	47.0
8096	2009	10	35.0	100.0	21.0	<1.0	12.0	85.0	84.0	3.9
8097	2009	10	34.0	130.0	23.0	<1.0	10.0	79.0	85.0	3.8
8098	2009	10	30.0	53.0	17.0	<1.0	13.0	82.0	86.0	3.9
8099	2009	10	32.0	82.0	20.0	<1.0	12.0	86.0	76.0	5.9
09-8100/01	2009	10	33.0	70.0	22.0	<1.0	<10	84.0	72.0	4.4
8102	2009	10	29.0	65.0	19.0	<1.0	<10	79.0	68.0	3.7
8103	2009	10	41.0	58.0	25.0	<1.0	14.0	120.0	93.0	5.5
8104	2009	10	24.0	110.0	17.0	<1.0	<10	59.0	65.0	2.3
8105	2009	10	32.0	250.0	31.0	<1.0	<10	75.0	99.0	2.5
8106	2009	10	27.0	170.0	22.0	<1.0	<10	63.0	75.0	4.3
8107	2009	10	27.0	110.0	19.0	<1.0	<10	59.0	67.0	2.6
8108	2009	0	12.0	51.0	13.0	<1.0	<10	37.0	37.0	1.6
8109	2009	10	31.0	60.0	19.0	<1.0	<10	74.0	74.0	3.8
09-8110/11	2009	10	38.0	59.0	22.0	<1.0	16.0	120.0	98.0	5.7
8112	2009	10	40.0	54.0	26.0	<1.0	14.0	100.0	81.0	5.0
8113	2009	10	26.0	65.0	17.0	<1.0	<10	72.0	74.0	3.4
8114	2009	0	29.0	52.0	19.0	<1.0	12.0	93.0	79.0	3.4
8115	2009	0	16.0	89.0	12.0	<1.0	<10	34.0	53.0	2.4
8116	2009	10	17.0	61.0	12.0	<1.0	<10	49.0	57.0	1.6
8117	2009	10	24.0	63.0	16.0	<1.0	<10	66.0	81.0	1.9
8118	2009	10	26.0	89.0	16.0	<1.0	<10	52.0	76.0	3.4
8119	2009	10	30.0	46.0	13.0	<1.0	<10	65.0	54.0	2.2
09-8120/21	2009	10	28.0	180.0	28.0	<1.0	<10	84.0	94.0	2.8
8122	2009	10	22.0	180.0	24.0	<1.0	<10	60.0	81.0	2.1
8123	2009	10	28.0	52.0	16.0	<1.0	<10	56.0	68.0	3.0
8124	2009	10	25.0	100.0	18.0	<1.0	<10	57.0	78.0	2.4
8125	2009	10	21.0	78.0	16.0	<1.0	<10	51.0	68.0	2.0
8126	2009	10	32.0	330.0	32.0	<1.0	<10	51.0	110.0	1.1
8127	2009	10	22.0	54.0	14.0	<1.0	<10	50.0	62.0	2.4
8128	2009	10	76.0	97.0	28.0	<1.0	<10	120.0	160.0	2.4
8129	2009	10	25.0	37.0	18.0	<1.0	<10	68.0	77.0	1.2
09-8130/31	2009	20	26.0	67.0	18.0	<1.0	<10	61.0	80.0	1.9
8132	2009	10	40.0	69.0	21.0	<1.0	<10	86.0	110.0	3.1
8133	2009	10	76.0	97.0	30.0	<1.0	<10	130.0	210.0	2.1
8134	2009	10	78.0	100.0	35.0	<1.0	18.0	160.0	200.0	5.8
8135	2009	10	48.0	76.0	24.0	<1.0	13.0	100.0	100.0	5.9
8136	2009	10	43.0	76.0	25.0	<1.0	<10	98.0	120.0	4.8
8137	2009	10	20.0	61.0	13.0	<1.0	<10	49.0	56.0	2.3
8138	2009	10	18.0	83.0	14.0	<1.0	<10	40.0	51.0	2.2
8139	2009	20	59.0	100.0	28.0	<1.0	<10	100.0	130.0	4.6
09-8140/41	2009	10	26.0	83.0	20.0	<1.0	<10	74.0	64.0	2.6

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8142	2009	10	30.0	60.0	18.0	<1.0	10.0	80.0	92.0	3.4
8143	2009	10	53.0	66.0	26.0	<1.0	15.0	130.0	150.0	3.4
8144	2009	10	14.0	35.0	8.3	<1.0	<10	54.0	38.0	3.8
8145	2009	10	29.0	78.0	21.0	<1.0	<10	68.0	81.0	3.4
8146	2009	10	22.0	95.0	16.0	<1.0	<10	52.0	66.0	1.9
8147	2009	10	25.0	110.0	18.0	<1.0	<10	72.0	66.0	2.3
8148	2009	10	22.0	67.0	17.0	<1.0	<10	55.0	77.0	2.4
8149	2009	10	23.0	84.0	18.0	<1.0	<10	56.0	80.0	2.3
09-8150/51	2009	0	34.0	81.0	20.0	<1.0	<10	72.0	77.0	4.2
8152	2009	10	20.0	97.0	17.0	<1.0	<10	56.0	69.0	4.3
09-8160/61	2009	10	16.0	74.0	14.0	<1.0	<10	42.0	49.0	1.2
8162	2009	10	30.0	90.0	21.0	<1.0	<10	74.0	84.0	2.4

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 332: SITE 52 (R(CB) terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	56	56	56	56	56	56	56	56
%ND	2	0	4	100	91	2	2	70
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 333: SITE 52 (R(HB) terrain unit) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	56	56	56	56	56	56	56	56
%ND	0	0	0	100	79	0	0	0
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	Yes

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 334: SITE 52 (R(CB) terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	259.0	1114.0	117.0	1.0	10.0	216.8	349.3	4.2
# of Outliers	0	0	0	0	5	0	0	7
Mean+/-4SD (ppm)	188.4	1513.5	104.5	1.5	15.8	188.1	358.2	8.5
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	154.0	1170.3	85.9	1.4	14.4	155.9	293.0	6.7
# of Outliers	0	0	0	0	1	1	0	2
Mean+/-2SD (ppm)	119.7	827.2	67.4	1.3	13.0	123.7	227.8	4.9
# of Outliers	2	11	1	0	1	2	6	6
Lower Limit								
3×IQR (ppm)	-140.0	-762.0	-52.8	1.0	10.0	-79.0	-139.0	-1.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-86.6	-1231.6	-44.0	0.5	4.6	-69.6	-163.1	-5.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-52.2	-888.5	-25.4	0.6	6.0	-37.4	-98.0	-3.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-17.8	-545.4	-6.9	0.7	7.4	-5.2	-32.8	-2.1
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 335: SITE 52 (R(HB) terrain unit) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	65.8	217.0	45.8	1.0	10.0	173.0	168.0	8.7
# of Outliers	3	2	0	0	12	0	3	1
Mean+/-4SD (ppm)	90.3	291.4	43.9	1.5	22.3	189.2	244.6	26.8
# of Outliers	0	1	0	0	1	0	1	1
Mean+/-3SD (ppm)	75.1	239.1	37.8	1.4	19.5	159.8	203.7	20.9
# of Outliers	3	2	0	0	1	2	2	1
Mean+/-2SD (ppm)	59.9	186.9	31.7	1.3	16.6	130.4	162.8	14.9
# of Outliers	4	2	2	0	2	2	3	1
Lower Limit								
3×IQR (ppm)	-7.8	-56.0	-5.0	1.0	10.0	-31.8	-8.8	-2.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-31.3	-126.8	-5.1	0.5	-0.8	-46.2	-82.5	-20.7
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-16.1	-74.5	1.1	0.6	2.1	-16.8	-41.6	-14.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-0.9	-22.3	7.2	0.7	5.0	12.6	-0.7	-8.8
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 336: SITE 52 (R(CB) terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Ni	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Co	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method but does not distort background concentrations or distribution analysis, therefore was not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Cr	Method chosen: No outliers removed. Six outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 337: SITE 52 (R(CB) terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	56	56	56	56	56	56	56	56
ND	1	0	2	56	51	1	1	39
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	14	7.4	11	1.0	10	15	20	1.0
Max (ppm)	120	1100	70	1.0	15	67	250	9.2
Mean (ppm)	61	298	35	1.0	10	66	114	1.8
Med (ppm)	68	170	36	1.0	12	50	99	2.6
SD (ppm)	34	344	18	N/A	N/A	31	63	N/A
95%tile (ppm)	110	975	65	N/A	N/A	12	232	N/A
95UCL (ppm)	81	498	40	N/A	N/A	73	130	N/A
Distribution	Non-p	Non-p	log	N/A	N/A	Non-p	log	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 338: SITE 52 (R(HB) terrain unit) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
Ni	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
Co	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Cr	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
As	Method chosen: No outliers removed. No outliers identified.

SD = standard deviation; IQR = interquartile range.

Table 339: SITE 52 (R(HB) terrain unit) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	50	54	56	56	56	56	53	56
ND	0	0	0	56	44	0	0	0
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	12	35	8.3	1.0	10	34	37	1.1
Max (ppm)	64	180	35	1.0	26	160	160	47
Mean (ppm)	30	84	20	1.0	11	76	80	3.9
Med (ppm)	28	77	19	1.0	13	72	77	3.9
SD (ppm)	10	34	5.7	N/A	N/A	28	24	6.0
95%tile (ppm)	50	163	30	N/A	N/A	130	124	5.8
95UCL (ppm)	32	92	21	N/A	N/A	82	85	4.1
Distribution	log	log	norm	N/A	N/A	log	log	log

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution. Only Zinc and Arsenic were evaluated, as all other trace elements in the EM terrain unit were not analysed.

Table 340: SITE 52 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
R(CB) versus R(HB)				
Cu	31.9125	6.586	<0.0001	Yes
Ni	213.930	4.549	<0.0001	Yes
Co	15.084	5.924	<0.0001	Yes
Zn	10.000	1.780	0.078	No
Cr	34.674	3.710	<0.0001	Yes

ANOVA Tukey's test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 341: SITE 52 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
R(CB) versus R(HB)				
Cu	26.832	3.841	<0.0001	Yes
Ni	4.073	3.841	0.044	Yes
Co	23.271	3.841	<0.0001	Yes
Zn	7.649	3.841	0.006	Yes
Cr	7.701	3.841	0.006	Yes

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 342: SITE 52 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups	Conover-Iman Groups
Copper					
R(CB)	56	3934.0	70.250	A	A
R(HB)	53	2061.0	38.887	B	B
Nickel					
R(CB)	56	3445.0	61.527	A	A
R(HB)	54	2659.5	49.250	B	B
Cobalt					
R(CB)	56	2336.0	41.714	A	A
R(HB)	56	3992.0	71.286	B	B
Zinc					
R(CB)	56	2689.0	48.018	A	A
R(HB)	56	3639.0	64.982	B	B
Chromium					
R(CB)	56	3537.5	63.170	A	A
R(HB)	53	2457.5	46.368	B	B

Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed; otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 343: Summary of SITE 52 population analysis.

Element	Population analysis conclusion
Cu	Keep all terrain units separate
Ni	Keep all terrain units separate
Co	Keep all terrain units separate
Zn	Keep all terrain units separate
Cr	Keep all terrain units separate

B.3.53 SITE 53, Cape Dyer, Nunavut Territory

A background sampling program was performed at SITE 53 in 2003. Background soil samples were collected from 4 identified terrain units at the site, described below:

1. Terrain unit 1 – The least extensive rock type at the upper site. It is dense, black, resistant mafic rock, which varied in compositions from ultramafic to mafic. Soils associated with this rock vary from dark rusty-brown associated with the ultramafic lenses, to brown-grey associated with the mafic lenses, to pale brown associated with the serpentinite lenses.
2. Terrain unit 2 – Thin veneer of much younger volcanic and associated rocks. The volcanic rocks are subdivided into pink and grey lavas that are both crumbly, very fine-grained, and may contain fine green or black phenocrystals and are variably pumice-like with 1-5mm diameter vesicles. The soil associated with terrain unit 2 is generally medium-brown, fine to medium grained, poorly sorted, contains pumice gravel, and its colour corresponds to that of the local lava, pink or grey.
3. Terrain unit 3 – A mica-rich variety of gneiss that occurs as a single continuous layer approximately 100 m wide. The soil associated with this unit is commonly darker brown and has higher mica content than other soil, but also contains coarse-grained quartz and feldspar from the disintegration of the associated granite.
4. Terrain unit 4 – banded gneiss is overall light grey, but in detail shows considerable diversity with changing proportions of interlayered white, light-grey, pink, and medium-grey bands that generally vary from 1 to 10 cm thick. The soil associated with terrain unit 4 is generally light brown, grey brown, or locally iron-stained orange-brown, and poorly sorted but on average medium to coarse-grained sand (0.25 - 1 mm).

A total of 121 background samples were collected during the background sampling program, with 17 samples collected in terrain unit 1, 23 samples in terrain unit 2, 34 samples in terrain unit 3, and 47 samples in terrain unit 4. All samples were analyzed for the Arctic suite of inorganic elements.

Table 344: SITE 53 (terrain unit 1) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
00-25505	2000	0	102.2	268.4	34.2	<1.0	<10	70.0	223.0	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
00-25506	2000	0	71.5	292.6	29.0	<1.0	<10	84.0	214.0	<1.0
00-25507	2000	0	59.6	182.6	24.3	<1.0	<10	69.0	132.0	<1.0
00-25508	2000	0	54.1	138.3	24.6	<1.0	<10	99.0	118.0	<1.0
00-25509	2000	0	72.6	**84.5**	23.6	<1.0	<10	114.0	128.0	<1.0
03-26160	2003	0	37.3	68.8	18.1	<1.0	11.3	92.7	85.5	1.4
03-26161	2003	0	34.2	57.6	16.1	<1.0	<10	82.3	77.0	1.1
03-26162	2003	0	69.6	99.1	16.6	<1.0	<10	79.6	108.0	1.0
03-26167	2003	0	115.0	92.8	18.5	<1.0	<10	40.0	121.0	<1.0
03-26193	2003	0	86.5	86.4	19.2	<1.0	25.5	186.0	382.0	<1.0
03-26194	2003	0	131.0	33.1	10.0	<1.0	10.1	137.0	177.0	<1.0
03-26200	2003	0	72.2	118.0	31.7	<1.0	12.5	150.0	146.0	<1.0
03-26201	2003	0	61.9	91.7	26.3	<1.0	12.0	128.0	137.0	1.5
03-26227	2003	0	66.0	56.1	14.0	<1.0	<10	63.6	51.5	<1.0
03-26235	2003	0	144.0	76.7	20.4	<1.0	<10	48.1	55.5	<1.0
03-26236	2003	0	56.3	325.0	31.9	<1.0	<10	31.9	185.0	<1.0
03-26242	2003	0	37.6	101.0	14.4	<1.0	<10	53.2	92.0	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 345: SITE 53 (terrain unit 2) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
03-26130	2003	0	65.4	943.0	68.5	<1.0	<10	61.1	118.0	<1.0
03-26131	2003	0	58.0	970.0	68.4	<1.0	<10	58.0	124.0	<1.0
03-26239	2003	0	147.0	93.3	19.7	<1.0	<10	46.0	28.0	<1.0
03-26240	2003	0	117.0	240.0	30.5	<1.0	<10	50.7	67.4	<1.0
03-26241	2003	0	113.5	**240.5**	31.0	<1.0	<10	49.1	66.6	<1.0
03-26243	2003	0	41.9	275.0	27.5	<1.0	<10	59.2	64.6	<1.0
03-26244	2003	0	63.9	171.0	22.0	<1.0	<10	44.7	61.5	<1.0
03-26246	2003	0	69.7	990.0	69.2	<1.0	<10	73.2	126.0	<1.0
03-26250	2003	0	49.2	1090.0	76.1	<1.0	<10	76.2	140.0	<1.0
03-26251	2003	0	50.6	1052.0	72.3	<1.0	<10	69.9	136.0	<1.0
03-26252	2003	0	120.0	95.4	18.3	<1.0	<10	41.9	24.7	<1.0
03-26253	2003	0	125.0	93.5	20.6	<1.0	<10	52.8	22.7	<1.0
03-26254	2003	0	57.7	1145.0	75.9	<1.0	<10	73.5	141.0	<1.0
03-26255	2003	0	77.5	715.0	60.9	<1.0	<10	72.1	110.0	<1.0
03-26256	2003	0	83.7	289.0	37.5	<1.0	<10	52.3	77.2	<1.0
03-26257	2003	0	113.0	199.0	33.5	<1.0	<10	62.1	103.0	<1.0
03-26258	2003	0	81.2	284.0	35.5	<1.0	<10	54.1	73.5	<1.0
03-26259	2003	0	103.0	167.0	27.5	<1.0	<10	49.2	34.8	<1.0
00-25513	2000	0	82.5	127.3	26.4	<1.0	<10	45.0	33.0	<1.0
00-25512	2000	0	109.7	99.0	21.5	<1.0	<10	37.0	27.0	<1.0
00-25514	2000	0	158.1	95.9	24.7	<1.0	<10	43.0	24.0	<1.0
00-25515	2000	0	103.2	68.4	22.1	<1.0	<10	45.0	<20	<1.0
00-25516	2000	0	191.0	97.1	23.4	<1.0	<10	39.0	24.0	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 346: SITE 53 (terrain unit 2) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
00-25519	2000	0	28.0	26.0	13.0	<1.0	<10	53.0	26.0	<1.0
00-25520	2000	0	14.0	18.0	7.0	<1.0	<10	28.0	<20	<1.0
00-25521	2000	0	16.0	19.0	8.5	<1.0	<10	41.0	<20	<1.0
03-26150	2003	0	44.0	60.5	12.6	<1.0	<10	88.5	115.0	<1.0
03-26152	2003	0	59.0	**59.6**	18.2	<1.0	10.4	84.3	159.0	<1.0
03-26153	2003	0	37.4	67.4	13.3	<1.0	10.8	74.9	86.2	<1.0
03-26163	2003	0	56.8	112.0	16.7	<1.0	<10	88.9	106.0	2.1
03-26165	2003	0	64.6	78.8	16.6	<1.0	<10	102.0	122.0	<1.0
03-26166	2003	0	56.9	84.8	19.7	<1.0	21.8	99.5	120.0	1.6
03-26168	2003	0	56.8	40.7	15.3	<1.0	<10	75.9	138.0	<1.0
03-26169	2003	0	38.2	57.6	16.0	<1.0	10.9	97.7	109.0	<1.0
03-26170	2003	0	59.3	27.8	10.1	<1.0	<10	100.0	97.6	1.8
03-26171	2003	0	55.7	25.8	9.1	<1.0	<10	93.2	93.4	1.6
03-26172	2003	0	59.3	33.8	7.1	<1.0	<10	88.8	94.4	<1.0
03-26173	2003	0	20.8	33.8	7.2	<1.0	<10	36.2	45.6	1.1
03-26174	2003	0	71.2	29.0	8.0	<1.0	11.0	105.6	119.5	1.4
03-26175	2003	0	76.3	26.8	8.7	<1.0	<10	117.0	119.0	<1.0
03-26192	2003	0	65.8	31.2	8.6	<1.0	<10	125.0	142.0	2.1
03-26195	2003	0	10.7	16.0	<5.0	<1.0	<10	22.9	25.1	<1.0
03-26196	2003	0	48.6	39.7	10.3	<1.0	<10	83.8	107.0	<1.0
03-26198	2003	0	88.1	25.6	13.7	<1.0	13.2	138.0	183.5	<1.0
03-26199	2003	0	57.8	49.6	15.4	<1.0	<10	116.0	144.0	<1.0
03-26205	2003	0	108.0	90.9	21.8	<1.0	10.0	126.5	147.0	<1.0
03-26206	2003	0	81.3	85.2	15.0	<1.0	<10	108.0	178.0	<1.0
03-26216	2003	0	62.2	72.8	22.0	<1.0	22.5	111.0	115.0	1.3
03-26218	2003	0	124.0	53.1	13.7	<1.0	12.8	140.0	167.0	<1.0
03-26219	2003	0	53.2	48.1	11.9	<1.0	<10	89.5	105.0	<1.0
03-26220	2003	0	44.0	34.4	8.4	<1.0	<10	74.0	82.2	<1.0
03-26221	2003	0	45.7	45.4	9.5	<1.0	<10	74.4	82.5	<1.0
03-26222	2003	0	62.7	59.3	13.7	<1.0	24.4	83.5	107.0	5.9
03-26228	2003	0	42.0	48.3	12.8	<1.0	12.5	95.8	106.0	<1.0
03-26230	2003	0	61.0	71.0	15.2	<1.0	12.4	88.4	94.5	1.4
03-26231	2003	0	55.7	63.6	13.3	<1.0	11.5	84.7	90.4	1.3
03-26268	2003	0	79.0	63.3	15.5	<1.0	12.1	135.0	186.0	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 347: SITE 53 (terrain unit 4) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
00-25524	2000	0	49.0	28.0	12.0	<1.0	12.0	98.0	94.0	<1.0
00-25525	2000	0	60.0	34.0	13.0	<1.0	21.0	125.0	126.0	<1.0
00-25526	2000	0	93.0	36.0	13.0	1.5	37.0	113.0	136.0	<1.0
00-25527	2000	0	74.0	29.0	13.0	1.3	13.0	145.0	151.0	<1.0
00-25528	2000	0	77.0	28.0	14.0	1.8	10.0	213.0	177.0	<1.0
03-26140	2003	0	16.3	52.7	8.5	<1.0	<10	31.9	23.9	<1.0
03-26141	2003	0	17.8	51.7	9.2	<1.0	<10	32.4	23.3	<1.0
03-26180	2003	0	12.4	15.7	<5.0	<1.0	<10	27.8	<20	1.1
03-26181	2003	0	18.9	23.9	5.6	<1.0	<10	42.4	46.0	1.1
03-26182	2003	0	32.4	74.4	14.9	<1.0	<10	43.3	38.6	<1.0
03-26183	2003	0	36.5	46.8	9.7	<1.0	20.4	69.0	66.2	1.2
03-26184	2003	0	17.6	50.5	8.0	<1.0	11.8	38.8	33.1	1.4
03-26185	2003	0	17.3	17.3	5.3	<1.0	<10	44.4	<20	<1.0
03-26186	2003	0	18.8	43.3	8.7	<1.0	<10	46.3	57.1	<1.0

Sample #	Date	Depth cm	Cu ppm	Ni ppm	Co ppm	Cd ppm	Pb ppm	Zn ppm	Cr ppm	As ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	1.0
SQG (ppm)			63	50	50	10	140	200	64	23
03-26187	2003	0	40.2	43.8	14.6	<1.0	<10	56.7	42.0	1.4
03-26188	2003	0	129.0	45.9	20.9	<1.0	<10	44.0	31.4	<1.0
03-26189	2003	0	107.0	38.9	14.4	<1.0	<10	37.9	38.4	<1.0
03-26190	2003	0	32.5	56.7	11.6	<1.0	10.2	63.8	73.2	1.5
03-26191	2003	0	30.8	55.6	13.7	<1.0	<10	59.8	59.7	1.5
03-26197	2003	0	25.5	41.1	10.9	<1.0	10.3	61.3	65.7	1.1
03-26202	2003	0	27.9	87.6	17.9	<1.0	15.0	59.8	45.8	<1.0
03-26203	2003	0	25.8	108.0	14.4	<1.0	<10	43.2	46.4	<1.0
03-26204	2003	0	29.4	93.0	17.3	<1.0	20.4	80.9	46.3	1.6
03-26212	2003	0	22.4	13.2	<5.0	<1.0	<10	47.2	<20	<1.0
03-26213	2003	0	15.4	39.8	7.8	<1.0	<10	32.2	23.8	<1.0
03-26214	2003	0	22.7	250.0	26.1	<1.0	12.0	69.8	588.0	<1.0
03-26215	2003	0	39.7	67.8	20.2	<1.0	11.2	77.1	119.0	<1.0
03-26217	2003	0	21.1	35.9	8.3	<1.0	<10	41.8	35.1	1.3
03-26223	2003	0	28.5	29.0	23.8	<1.0	<10	66.6	41.3	1.9
03-26224	2003	0	20.7	49.5	9.0	<1.0	<10	42.3	39.4	1.3
03-26225	2003	0	17.0	26.7	7.7	<1.0	<10	39.9	22.8	1.2
03-26226	2003	0	22.8	24.2	9.3	<1.0	<10	53.9	26.9	<1.0
03-26229	2003	0	22.1	23.2	7.3	<1.0	<10	29.7	21.2	<1.0
03-26232	2003	0	32.4	31.2	10.7	<1.0	<10	60.5	26.3	1.0
03-26233	2003	0	41.8	39.9	11.3	<1.0	<10	50.2	35.3	<1.0
03-26234	2003	0	28.8	50.8	10.0	<1.0	14.0	49.1	43.1	<1.0
03-26237	2003	0	29.1	48.8	8.0	<1.0	<10	52.2	52.7	<1.0
03-26238	2003	0	36.3	93.2	14.3	<1.0	<10	57.2	50.1	<1.0
03-26245	2003	0	27.8	41.5	9.6	<1.0	<10	49.9	38.9	1.7
03-26260	2003	0	13.1	21.3	<5.0	<1.0	<10	30.4	<20	1.0
03-26261	2003	0	15.7	28.9	5.3	<1.0	10.2	38.8	30.9	1.1
03-26262	2003	0	26.3	46.2	9.1	<1.0	11.2	60.6	41.1	1.3
03-26263	2003	0	17.1	42.7	9.9	<1.0	<10	50.6	32.1	<1.0
03-26264	2003	0	15.0	15.0	5.1	<1.0	<10	43.8	<20	<1.0
03-26265	2003	0	9.9	21.1	<5.0	<1.0	<10	29.2	20.4	<1.0
03-26266	2003	0	18.5	55.3	9.7	<1.0	<10	41.5	32.1	<1.0
03-26267	2003	0	21.8	41.5	9.0	<1.0	10.3	62.7	59.5	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 348: SITE 53 (terrain unit 1) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	17	17	17	17	17	17	17	17
%ND	0	0	0	100	71	0	0	82
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 349: SITE 53 (terrain unit 2) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	23	23	23	23	23	23	23	23
%ND	0	0	0	100	100	0	4	100
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 350: SITE 53 (terrain unit 3) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	34	34	34	34	34	34	34	34
%ND	0	0	3	100	62	0	6	62
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 351: SITE 53 (terrain unit 4) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	47	47	47	47	47	47	47	47
%ND	0	0	9	94	66	0	11	66
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit.

Table 352: SITE 53 (terrain unit 1) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	177.1	323.1	55.4	1.0	10.4	265.2	432.0	1.0
# of Outliers	0	1	0	0	4	0	0	3
Mean+/-4SD (ppm)	210.1	464.7	54.0	1.9	27.9	263.0	461.5	2.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	174.8	375.0	45.7	1.7	23.6	217.5	377.7	1.8
# of Outliers	0	0	0	0	1	0	1	0
Mean+/-2SD (ppm)	139.5	285.3	37.4	1.5	19.4	172.0	294.0	1.6
# of Outliers	1	2	0	0	1	1	1	0
Lower Limit								
3×IQR (ppm)	-34.3	-108.1	-12.5	1.0	9.7	-87.6	-163.0	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-72.3	-252.8	-12.3	0.1	-6.1	-100.8	-208.7	0.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-37.0	-163.1	-4.0	0.3	-1.8	-55.4	-124.9	0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-1.7	-73.4	4.3	0.5	2.4	-9.9	-41.1	0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 353: SITE 53 (terrain unit 2) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	267.1	3021.9	190.3	1.0	10.0	111.3	373.5	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	254.9	1858.0	124.0	1.8	16.5	116.8	239.2	1.8
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	213.2	1459.0	101.7	1.6	14.9	100.9	193.8	1.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	171.4	1060.0	79.4	1.4	13.3	85.1	148.4	1.4
# of Outliers	1	2	0	0	0	0	0	0
Lower Limit								
3×IQR (ppm)	-87.3	-2094.8	-102.9	1.0	10.0	-4.7	-232.0	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-79.1	-1333.8	-54.1	0.2	3.5	-10.0	-123.8	0.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-37.4	-934.8	-31.8	0.4	5.1	5.8	-78.4	0.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	4.4	-535.9	-9.6	0.6	6.7	21.7	-33.1	0.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 354: SITE 53 (terrain unit 3) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	124.5	165.5	35.1	1.0	15.5	196.2	262.6	2.2
# of Outliers	0	0	0	0	3	0	0	1
Mean+/-4SD (ppm)	151.8	143.3	30.4	1.7	27.2	214.0	282.1	4.7
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	126.3	118.6	25.8	1.5	23.2	181.5	235.2	3.8
# of Outliers	0	0	0	0	1	0	0	1
Mean+/-2SD (ppm)	100.9	93.9	21.2	1.3	19.2	149.0	188.2	2.9
# of Outliers	2	1	2	0	3	0	0	1
Lower Limit								
3×IQR (ppm)	-16.4	-72.4	-10.9	1.0	5.9	-11.0	-37.4	0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-52.0	-54.2	-6.4	0.3	-4.6	-45.9	-93.4	-2.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-26.5	-29.6	-1.8	0.5	-0.7	-13.4	-46.5	-1.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-1.1	-4.9	2.8	0.7	3.3	19.1	0.5	-0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 355: SITE 53 (terrain unit 4) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	83.2	119.6	31.4	1.0	13.0	123.1	153.4	1.6
# of Outliers	3	1	0	3	6	3	2	2
Mean+/-4SD (ppm)	127.8	188.3	30.4	1.8	30.4	189.1	387.8	2.1
# of Outliers	1	1	0	0	1	1	1	0
Mean+/-3SD (ppm)	102.8	151.2	25.3	1.6	25.6	155.0	301.9	1.8
# of Outliers	2	1	1	1	1	1	1	1
Mean+/-2SD (ppm)	77.7	114.2	20.3	1.4	20.8	120.9	216.0	1.6
# of Outliers	3	1	3	2	2	3	1	2
Lower Limit								
3×IQR (ppm)	-30.6	-39.9	-9.6	1.0	7.8	-19.4	-68.5	0.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-72.8	-107.9	-10.1	0.2	-8.0	-83.4	-299.6	0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-47.8	-70.9	-5.0	0.4	-3.2	-49.4	-213.7	0.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-22.7	-33.9	0.0	0.6	1.6	-15.3	-127.7	0.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 356: SITE 53 (terrain unit 1) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method, but does not distort background concentrations or distribution analysis, therefore was not removed.
Ni	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method, but does not distort background concentrations or distribution analysis, therefore was not removed.
Cr	Method chosen: Mean+3SD. One outlier detected by the Mean+/-3SD method that distorted background concentrations, therefore was removed.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 357: SITE 53 (terrain unit 1) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	17	17	17	17	17	17	16	17
ND	0	0	0	17	12	0	0	14
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	34	33	10	1.0	10	32	51	1.0
Max (ppm)	144	325	34	1.0	25	186	23	1.5
Mean (ppm)	75	128	22	1.0	11	90	128	1.1
Med (ppm)	70	93	20	1.0	12	82	124	1.4
SD (ppm)	32	87	7.0	N/A	N/A	42	52	N/A
95%tile (ppm)	134	299	32	N/A	N/A	157	216	N/A
95UCL (ppm)	88	174	25	N/A	N/A	108	151	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	log	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 358: SITE 53 (terrain unit 2) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method but does not distort background concentrations or distribution analysis, therefore was not removed.
Ni	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified.
Cr	Method chosen: No outliers removed. No outliers identified.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 359: SITE 53 (terrain unit 2) justification for outlier method chosen.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	23	23	23	23	23	23	23	23
ND	0	0	0	23	23	0	1	23
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0

Min (ppm)	42	68	18	1.0	10	37	23	1.0
Max (ppm)	191	1145	76	1.0	10	76	141	1.0
Mean (ppm)	35	415	40	1.0	10	55	72	1.0
Med (ppm)	84	240	30	1.0	10	52	67	1.0
SD (ppm)	38	399	21	N/A	N/A	12	43	N/A
95%tile (ppm)	157	1086	76	N/A	N/A	73	140	N/A
95UCL (ppm)	108	716	49	N/A	N/A	59	87	N/A
Distribution	norm	log	log	N/A	N/A	norm	norm	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 360: SITE 53 (terrain unit 3) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Ni	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method but does not distort background concentrations or distribution analysis, therefore was not removed.
Co	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified.
Cr	Method chosen: No outliers removed. No outliers identified.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 361: SITE 53 (terrain unit 3) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	34	34	34	34	34	34	34	34
ND	0	0	1	34	21	0	2	23
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	11	16	7.0	1.0	10	23	20	1.0
Max (ppm)	124	112	252	1.0	24	140	186	5.9
Mean (ppm)	56	50	13	1.0	12	90	107	1.3
Med (ppm)	57	48	13	1.0	12	89	108	1.6
SD (ppm)	24	24	4.2	N/A	N/A	29	43	N/A
95%tile (ppm)	95	87	20	N/A	N/A	136	180	N/A
95UCL (ppm)	63	57	14	N/A	N/A	99	120	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	norm	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Table 362: SITE 53 (terrain unit 4) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
Ni	Method chosen: 3×IQR. One outlier detected that distorts background concentrations and distribution analysis, therefore was removed. Outlier also detected by all other methods.

Co	Method chosen: No outliers removed. Three outliers detected by the Mean+/-2SD method but do not distort background concentrations or distribution analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. Three outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
Cr	Method chosen: 3×IQR. Two outliers identified distant from the rest of the population. These outliers distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-nSD methods, however as the data conforms to a lognormal distribution, the 3×IQR method was deemed most appropriate.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 363: SITE 53 (terrain unit 4) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	44	46	47	47	47	44	45	47
ND	0	0	4	44	31	0	5	31
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	9.9	13	5.0	1.0	10	29	20	1.0
Max (ppm)	77	108	26	1.8	37	113	151	1.9
Mean (ppm)	28	43	11	1.0	12	52	47	1.1
Med (ppm)	24	41	4.9	1.5	12	48	41	1.3
SD (ppm)	15	21	9.9	N/A	N/A	18	31	N/A
95%tile (ppm)	58	92	21	N/A	N/A	80	124	N/A
95UCL (ppm)	32	49	12	N/A	N/A	56	55	N/A
Distribution	log	log	norm	N/A	N/A	log	log	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

Following investigation of each terrain separately, background soil data was investigated using both a one-way analysis of variance (ANOVA) with Tukey's post hoc test, and a Kruskal-Wallis test followed by Dunn and Conover-Iman multiple comparison procedures to determine whether terrain units are significantly different. All tests were performed without replacement of values below the detection limit to avoid the dangers of misinterpreting population distributions involving significant quantities of substitution.

Table 364: SITE 53 terrain unit ANOVA with Tukey's post hoc test results.

	Difference (ppm)	Standardized Difference (ppm)	p-value	Significance Difference?
Terrain Unit 1 versus Terrain Unit 2				
Cu	20.059	2.422	0.079	No
Ni	286.994	5.052	<0.0001	Yes
Co	35.341	4.371	<0.0001	Yes
Zn	17.759	5.360	<0.0001	Yes
Cr	56.550	4.246	<0.0001	Yes
Terrain Unit 1 versus Terrain Unit 3				

Cu	18.787	2.444	0.075	No
Ni	77.843	1.476	0.456	No
Co	0.415	0.055	1.000	No
Zn	9.203	2.991	0.018	Yes
Cr	20.718	1.671	0.344	No
Terrain Unit 1 versus Terrain Unit 4				
Cu	46.935	6.347	<0.0001	Yes
Ni	84.578	1.678	0.340	No
Co	38.274	5.302	<0.0001	Yes
Zn	10.826	3.692	0.002	Yes
Cr	80.691	6.777	<0.0001	Yes
Terrain Unit 2 versus Terrain Unit 3				
Cu	38.857	5.558	<0.0001	Yes
Ni	364.837	7.609	<0.0001	Yes
Co	35.755	5.239	<0.0001	Yes
Zn	26.962	9.640	<0.0001	Yes
Cr	35.832	3.244	0.008	Yes
Terrain Unit 2 versus Terrain Unit 4				
Cu	66.994	10.055	<0.0001	Yes
Ni	371.572	8.193	<0.0001	Yes
Co	2.933	0.451	0.969	No
Zn	28.585	10.843	<0.0001	Yes
Cr	24.141	2.302	0.104	No
Terrain Unit 3 versus Terrain Unit 4				
Cu	28.138	4.759	<0.0001	Yes
Ni	6.735	0.168	0.998	No
Co	38.689	6.703	<0.0001	Yes
Zn	1.623	0.696	0.898	No
Cr	59.973	6.452	<0.0001	Yes

ANOVA Tukey’s test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. ppm = parts per million; p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 365: SITE 53 Kruskal Wallis test results.

	K (observed)	K (critical value)	p-value	Significance Difference?
Terrain Unit 1 versus Terrain Unit 2				
Cu	2.740	3.841	0.098	No
Ni	8.332	3.841	0.004	Yes
Co	9.307	3.841	0.002	Yes
Zn	9.475	3.841	0.002	Yes
Cr	9.075	3.841	0.003	Yes
Terrain Unit 1 versus Terrain Unit 3				
Cu	4.155	3.841	0.042	Yes
Ni	18.543	3.841	<0.0001	Yes
Co	19.066	3.841	<0.0001	Yes
Zn	0.462	3.841	0.497	No
Cr	1.406	3.841	0.236	No
Terrain Unit 1 versus Terrain Unit 4				
Cu	28.179	3.841	<0.0001	Yes
Ni	25.017	3.841	<0.0001	Yes
Co	24.644	3.841	<0.0001	Yes
Zn	14.291	3.841	<0.0001	Yes
Cr	25.020	3.841	<0.0001	Yes
Terrain Unit 2 versus Terrain Unit 3				
Cu	15.369	3.841	<0.0001	Yes
Ni	37.805	3.841	<0.0001	Yes
Co	38.514	3.841	<0.0001	Yes
Zn	21.793	3.841	<0.0001	Yes
Cr	6.440	3.841	0.011	Yes
Terrain Unit 2 versus Terrain Unit 4				
Cu	40.850	3.841	<0.0001	Yes
Ni	43.479	3.841	<0.0001	Yes
Co	42.373	3.8411	<0.0001	Yes
Zn	1.797	3.841	0.180	No
Cr	4.145	3.841	0.042	Yes
Terrain Unit 3 versus Terrain Unit 4				
Cu	25.794	3.841	<0.0001	Yes
Ni	1.688	3.841	0.194	No
Co	3.290	3.841	0.070	No
Zn	28.307	3.841	<0.0001	Yes
Cr	25.469	3.841	<0.0001	Yes

Kruskal Wallis test performed at the 95% confidence level. All statistical analyses were performed in Microsoft excel with the software add-in XLSTAT. p-value = probability value. If $p < 0.05$, reject the hypothesis that both soils come from one statistical population.

Table 366: SITE 53 multiple pairwise comparisons results using the Dunn's and Conover-Iman procedures.

	Frequency	Sum of Ranks	Mean of Ranks	Dunn's Groups	Conover-Iman Groups
Copper					
T1	17	1383.000	81.353	A B	A B
T2	23	2154.000	93.652	A	A
T3	34	2184.000	64.235	B	B
T4	44	1300.000	29.545	C	C
Nickel					
T1	17	1461.500	85.971	A	A
T2	23	2393.000	104.043	A	A
T3	34	1597.000	46.971	B	B
T4	46	1808.500	39.315	B	B
Cobalt					
T1	17	755.000	44.412	A	A
T2	23	1574.500	68.457	A C	A C
T3	34	675.000	19.853	B	B
T4	34	2881.500	84.750	C	C
Zinc					
T1	17	1325.000	77.941	A	A
T2	23	1070.500	46.543	B	B
T3	34	2872.000	84.471	A	A
T4	44	1753.500	39.852	B	B
Chromium					
T1	16	1419.500	88.719	A	A
T2	23	1264.000	54.957	B C	B C
T3	34	2631.500	77.397	A B	A B
T4	45	1706.000	37.911	C	C

T = Terrain Unit. Multiple pairwise comparisons performed in Microsoft excel with the software add-in XLSTAT. If the terrain unit is designated to a different group letter, the terrain units are significantly different as a result of the pairwise comparison procedure performed.

As all data sets were investigated using both parametric and non-parametric statistical tests, the conclusions of the analysis are based on the distribution of each data set. If the parametric and non-parametric procedures disagree, the ANOVA conclusions were only selected if both data sets were found to be normally distributed; otherwise, the non-parametric procedures were selected. Background concentrations were recalculated if terrain units were combined.

Table 367: Summary of SITE 53 population analysis.

Element	Population analysis conclusion
Cu	Combine terrain unit 1 and terrain unit 2
Ni	Combine terrain unit 1 and terrain unit 3
Co	Keep all terrain units seperate
Cd	Not analysed
Pb	Not analysed
Zn	Combine terrain unit 2 and terrain unit 4
Cr	Combine terrain unit 1 and terrain unit 3
As	Not analysed

Table 368: SITE 53 (terrain units combined) background concentration results summary.

	Cu	Ni	Zn	Cr
Terrain units	**T1 + T2**	**T1 + T3**	**T2 + T4**	**T1 + T3**
SQG (ppm)	**63**	**50**	**200**	**64**
N	40	51	67	50
ND	0	0	0	2
DL (ppm)	3.0	5.0	15	20
Min (ppm)	34	16	28	20
Max (ppm)	191	325	113	223
Mean (ppm)	86	76	53	114
Med (ppm)	75	57	50	118
SD (ppm)	36	65	16	47
95%tile (ppm)	148	225	77	186
95UCL (ppm)	97	90	56	125
Distribution	log	log	norm	norm

T = Terrain Unit; SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable

B.3.54 SITE 54, Cape Mercy, Nunavut Territory

A background sampling program was carried out for the site in 2010. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 30 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 369: SITE 54 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8070	2010	0	14.3	7.2	12.5	<1.0	<10	54.3	<20	<1.0
8071	2010	0	11.9	5.7	10.3	<1.0	<10	45.8	<20	<1.0
8072	2010	0	12.4	6.9	9.7	<1.0	<10	35.6	<20	<1.0
8073	2010	0	8.5	5.7	9.2	<1.0	<10	34.1	<20	<1.0
8074	2010	0	19.3	9.5	9.9	<1.0	<10	40.1	<20	<1.0
8075	2010	0	26.6	9.3	13.6	<1.0	<10	57.7	<20	<1.0
8076	2010	0	9.5	6.9	10.4	<1.0	<10	45.5	<20	<1.0
8077	2010	0	11.5	9.1	9.4	<1.0	<10	38.5	<20	<1.0
8078	2010	0	16.0	7.1	9.3	<1.0	<10	41.0	<20	<1.0
8079	2010	0	15.9	10.4	12.2	<1.0	<10	53.1	<20	1.4
8080	2010	0	12.6	8.1	9.4	<1.0	<10	32.3	<20	1.1
8081	2010	0	12.0	8.1	9.5	<1.0	<10	33.2	<20	1.1
8082	2010	0	15.2	7.4	9.7	<1.0	<10	36.5	<20	<1.0
8083	2010	20-30	14.2	6.5	8.7	<1.0	<10	34.1	<20	<1.0
8084	2010	0	12.2	5.5	7.8	<1.0	<10	33.2	<20	<1.0
8085	2010	0	19.3	13.9	11.5	<1.0	<10	37.3	25.3	<1.0
8086	2010	0	40.0	21.3	18.5	<1.0	<10	44.8	33.6	<1.0
8087	2010	0	16.3	9.5	11.3	<1.0	<10	40.8	<20	<1.0
8088	2010	0	16.2	8.4	10.3	<1.0	<10	33.9	<20	<1.0
8089	2010	0	14.3	7.5	10.8	<1.0	<10	37.3	<20	<1.0
8090	2010	0	15.5	7.8	9.5	<1.0	<10	34.2	<20	<1.0
8091	2010	0	12.7	7.4	10.5	<1.0	<10	33.5	<20	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
8092	2010	0	16.3	8.1	11.9	<1.0	<10	36.9	<20	<1.0
8093	2010	0	12.3	8.5	10.4	<1.0	<10	41.1	<20	<1.0
8094	2010	0	14.3	9.0	11.5	<1.0	<10	39.1	<20	<1.0
8095	2010	0	14.4	7.2	9.9	<1.0	<10	39.5	<20	<1.0
8096	2010	0	9.7	5.2	7.5	<1.0	<10	34.5	<20	<1.0
8097	2010	20-30	8.7	<5.0	6.2	<1.0	<10	31.0	<20	<1.0
8098	2010	0	8.2	<5.0	7.7	<1.0	<10	44.2	<20	<1.0
8099	2010	0	8.5	9.4	7.5	<1.0	<10	35.8	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 370: SITE 54 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	30	30	30	30	30	30	30	30
%ND	0	7	0	100	100	0	93	90
Analysed?	Yes	Yes	Yes	No	No	Yes	No	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 371: SITE 54 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR	28.1	15.6	16.6	1.0	10.0	62.0	20.0	1.0
# of Outliers	1	1	1	0	0	0	2	3
Mean+/-4SD	39.5	20.8	20.6	1.7	15.7	76.4	37.4	1.8
# of Outliers	1	1	0	0	0	0	0	0
Mean+/-3SD	33.1	17.6	18.0	1.5	14.3	67.0	33.2	1.6
# of Outliers	1	1	1	0	0	0	1	0
Mean+/-2SD	26.6	14.3	15.3	1.4	12.9	57.6	29.0	1.4
# of Outliers	1	1	1	0	0	1	1	0
Lower Limit								
3×IQR	-0.3	0.3	3.9	1.0	10.0	13.2	20.0	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD	-12.0	-5.1	-0.6	0.3	4.3	1.2	3.6	0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD	-5.6	-1.9	2.0	0.5	5.7	10.6	7.8	0.4
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD	0.8	1.3	4.7	0.6	7.1	20.0	12.0	0.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 372: SITE 54 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier detected by all methods.
Ni	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier detected by all methods.
Co	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier detected by all methods.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method, however this outlier didn't distort background concentrations or distribution analysis, therefore was not removed.
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 373: SITE 54 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	29	29	29	30	30	30	30	30
ND	0	2	0	30	30	0	28	27
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	8.1	5.1	6.2	1.0	10	31	20	1.0
Max (ppm)	27	14	14	1.0	10	58	34	1.4
Mean (ppm)	14	7.8	9.9	1.0	10	39	21	1.0
Med (ppm)	14	7.8	9.9	1.0	10	37	29	1.1
SD (ppm)	3.9	1.9	1.7	N/A	N/A	6.7	N/A	N/A
95%tile (ppm)	19	10	12	N/A	N/A	54	N/A	N/A
95UCL (ppm)	15	8.4	8.4	N/A	N/A	41	N/A	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.55 SITE 55, Loks Land Island, Nunavut Territory

A background sampling program was carried out for the site in 2010. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 65 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 374: SITE 55 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
29440	2009	0	<5.0	5.3	<5.0	<1.0	<10	35.6	<20	1.1

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
29441	2009	0	<5.0	5.4	<5.0	<1.0	<10	34.7	<20	<1.0
29442	2009	0	55.7	21.5	7.8	<1.0	<10	21.7	39.4	<1.0
29443	2009	50	94.3	29.8	9.0	<1.0	<10	19.4	34.6	<1.0
29444	2009	0	91.2	24.0	10.5	<1.0	<10	42.8	38.6	<1.0
29445	2009	0	30.8	15.3	8.6	<1.0	<10	40.8	<20	<1.0
29446	2009	0	<5.0	10.3	7.0	<1.0	<10	42.1	26.3	<1.0
29447	2009	0	10.0	9.3	6.6	<1.0	<10	46.8	<20	<1.0
29448	2009	0	57.6	40.4	10.0	<1.0	<10	33.6	57.4	<1.0
29449	2009	0	6.7	9.4	6.4	<1.0	<10	39.8	<20	<1.0
29450	2009	0	<5.0	5.0	<5.0	<1.0	<10	27.1	<20	<1.0
29451	2009	0	<5.0	6.3	<5.0	<1.0	<10	31.5	<20	<1.0
29452	2009	0	<5.0	5.3	<5.0	<1.0	<10	30.4	<20	<1.0
29453	2009	0	<5.0	<5.0	<5.0	<1.0	<10	32.2	<20	<1.0
29454	2009	0	<5.0	<5.0	<5.0	<1.0	<10	22.6	<20	<1.0
29455	2009	0	<5.0	<5.0	<5.0	<1.0	<10	19.5	<20	<1.0
29456	2009	0	5.3	6.2	5.5	<1.0	20.2	37.7	<20	<1.0
29457	2009	0	13.6	13.8	5.8	<1.0	<10	35.2	<20	<1.0
29458	2009	40	10.2	12.7	5.7	<1.0	<10	34.2	<20	<1.0
29459	2009	0	10.2	20.4	8.3	<1.0	<10	45.7	25.2	<1.0
29460	2009	0	<5.0	<5.0	<5.0	<1.0	<10	29.6	<20	<1.0
29461	2009	0	<5.0	<5.0	<5.0	<1.0	<10	30.6	<20	<1.0
29462	2009	0	5.7	<5.0	<5.0	<1.0	<10	27.0	<20	<1.0
29463	2009	0	8.8	7.2	<5.0	<1.0	<10	37.7	<20	<1.0
29464	2009	0	8.1	5.9	<5.0	<1.0	<10	31.6	<20	<1.0
29465	2009	0	16.9	7.3	6.8	<1.0	<10	50.6	<20	<1.0
29466	2009	0	7.5	5.8	<5.0	<1.0	<10	35.7	<20	<1.0
29467	2009	0	10.8	8.3	6.2	<1.0	<10	43.5	<20	<1.0
29468	2009	0	<5.0	<5.0	<5.0	<1.0	<10	30.6	<20	<1.0
29469	2009	40	<5.0	<5.0	<5.0	<1.0	<10	34.2	<20	<1.0
29470	2009	0	12.9	8.0	5.9	<1.0	<10	46.6	34.6	<1.0
29471	2009	0	16.9	9.8	7.0	<1.0	<10	58.8	44.5	<1.0
29472	2009	0	8.2	6.6	5.4	<1.0	<10	42.0	<20	<1.0
29473	2009	0	18.4	7.7	7.1	<1.0	<10	42.3	<20	<1.0
29474	2009	0	<5.0	5.5	<5.0	<1.0	<10	29.7	<20	<1.0
29475	2009	0	10.9	8.6	6.5	<1.0	<10	67.5	<20	<1.0
29476	2009	0	<5.0	<5.0	<5.0	<1.0	<10	22.1	<20	<1.0
29477	2009	0	44.0	20.8	<5.0	<1.0	<10	<15	23.9	<1.0
29478	2009	0	<5.0	<5.0	<5.0	<1.0	<10	29.8	<20	<1.0
29479	2009	0	<5.0	<5.0	<5.0	<1.0	<10	26.5	<20	<1.0
29480	2009	0	<5.0	6.5	<5.0	<1.0	<10	34.8	<20	<1.0
29481	2009	0	<5.0	5.9	<5.0	<1.0	<10	34.2	<20	<1.0
29482	2009	0	22.5	8.0	<5.0	<1.0	<10	36.0	<20	1.2
29483	2009	0	<5.0	7.1	<5.0	<1.0	<10	27.4	<20	<1.0
29484	2009	0	<5.0	10.5	7.1	<1.0	<10	42.7	<20	1.1
29485	2009	0	<5.0	<5.0	<5.0	<1.0	<10	15.6	<20	<1.0
29486	2009	0	6.0	11.7	<5.0	<1.0	<10	24.3	24.0	1.0
29487	2009	30	8.6	13.0	<5.0	<1.0	<10	24.2	22.9	<1.0
29488	2009	0	<5.0	9.5	5.1	<1.0	<10	22.7	<20	<1.0
29489	2009	0	12.4	15.5	7.9	<1.0	<10	42.5	25.3	<1.0
29490	2009	0	27.2	30.9	9.6	<1.0	<10	42.3	37.3	<1.0
29491	2009	0	27.3	30.6	9.5	<1.0	<10	41.5	36.3	<1.0
29492	2009	0	10.1	13.6	6.4	<1.0	<10	39.1	35.9	<1.0
29493	2009	0	29.8	28.6	11.2	<1.0	<10	80.7	39.2	<1.0
29494	2009	0	<5.0	22.6	10.0	<1.0	<10	64.2	46.0	1.1
29496	2009	0	16.3	13.8	6.8	<1.0	<10	37.8	24.1	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
29497	2009	0	<5.0	6.0	<5.0	<1.0	<10	17.8	<20	<1.0
29498	2009	0	55.5	106.3	43.6	<1.0	<10	95.3	43.0	1.5
29499	2009	0	11.0	11.5	5.5	<1.0	<10	28.2	<20	<1.0
29500	2009	0	5.4	6.4	<5.0	<1.0	<10	18.1	<20	<1.0
29501	2009	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
29502	2009	0	22.8	26.5	9.2	<1.0	<10	55.1	24.3	<1.0
29503	2009	0	19.5	20.8	7.3	<1.0	<10	42.6	22.2	<1.0
29504	2009	0	<5.0	5.1	6.2	<1.0	<10	33.1	<20	<1.0
29505	2009	0	<5.0	5.6	6.1	<1.0	<10	31.4	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 375: SITE 55 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	65	65	65	65	65	65	65	65
%ND	43	20	48	100	98	3	68	92
Analysed?	Yes	Yes	Yes	No	No	Yes	No	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 376: SITE 55 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	50.1	39.1	13.1	1.0	10.0	87.0	36.3	1.0
# of Outliers	5	2	1	0	1	1	9	5
Mean+/-4SD (ppm)	84.5	66.7	25.9	1.5	16.5	93.6	58.3	1.6
# of Outliers	2	1	1	0	1	1	0	0
Mean+/-3SD (ppm)	65.8	52.4	21.0	1.4	14.9	78.6	49.5	1.4
# of Outliers	2	1	1	0	1	2	1	1
Mean+/-2SD (ppm)	47.1	38.1	16.1	1.2	13.3	63.7	40.8	1.3
# of Outliers	5	2	1	0	1	4	4	1
Lower Limit								
3×IQR (ppm)	-28.8	-20.1	-1.1	1.0	10.0	-17.2	7.8	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-65.1	-47.8	-13.5	0.5	3.7	-26.1	-11.6	0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-46.4	-33.5	-8.5	0.6	5.3	-11.2	-2.8	0.6
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-27.7	-19.2	-3.6	0.8	6.9	3.8	5.9	0.7
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 377: SITE 55 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Five outliers detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-2SD method.
Ni	Method chosen: 3×IQR. Five outliers detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore were removed. Outliers were also detected by the Mean+/-2SD method, however, the data appear to conform to a lognormal distribution, therefore the 3×IQR method was deemed most appropriate.
Co	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier detected by all methods.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted calculated background concentrations and distribution analysis, therefore was removed. Outlier detected by all methods.
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 378: SITE 55 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	60	63	64	65	64	64	65	65
ND	28	13	31	65	64	2	44	60
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.5
Max (ppm)	44	31	11	1.0	20	81	57	1.0
Mean (ppm)	10	11	6.2	1.0	10	35	24	1.1
Med (ppm)	11	9.3	7.0	1.0	20	34	8.2	0.1
SD (ppm)	8.2	7.4	1.7	N/A	N/A	12	N/A	N/A
95%tile (ppm)	27	28	9.9	N/A	N/A	58	N/A	N/A
95UCL (ppm)	12	12	6.6	N/A	N/A	38	N/A	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.56 SITE 56, Resolution Island, Newfoundland and Labrador

A background sampling program was carried out for the site in 2009. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 67 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 379: SITE 56 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			3.0	5.0	5.0	1.0	10	15	20	1.0
SQG (ppm)			63	50	50	10	140	200	64	23
29514	2009	0	25.5	21.9	5.2	<1.0	<10	25.6	25.8	<1.0
29515	2009	0	25.4	17.7	<5.0	<1.0	<10	23.2	23.3	<1.0
29516	2009	0	23.3	52.0	19.6	<1.0	<10	<15	39.8	<1.0
29517	2009	0	28.7	21.2	5.2	<1.0	<10	23.5	28.4	<1.0
29518	2009	0	61.8	87.2	16.6	<1.0	<10	48.3	38.1	<1.0
29519	2009	0	49.0	33.0	9.5	<1.0	<10	31.6	35.4	<1.0
29520	2009	0	37.0	43.9	10.2	<1.0	<10	36.2	29.3	<1.0
29521	2009	0	40.5	48.0	11.4	<1.0	<10	37.9	32.1	<1.0
29522	2009	0	28.9	28.6	6.3	<1.0	<10	34.0	30.1	<1.0
29523	2009	50	65.9	66.0	13.8	<1.0	<10	49.8	38.9	1.4
29524	2009	0	40.6	52.5	9.8	<1.0	<10	38.0	38.5	1.6
29525	2009	0	37.1	50.7	10.0	<1.0	<10	37.4	34.1	<1.0
29526	2009	0	29.5	28.8	7.7	<1.0	<10	31.3	26.5	<1.0
29527	2009	0	15.6	12.0	<5.0	<1.0	<10	17.7	24.2	1.4
29528	2009	0	41.3	39.3	7.5	<1.0	<10	34.7	33.6	<1.0
29529	2009	0	61.5	55.0	9.5	<1.0	<10	54.1	43.0	<1.0
29530	2009	0	37.5	26.3	5.6	<1.0	<10	33.8	38.0	<1.0
29531	2009	0	50.0	33.5	6.7	<1.0	<10	35.2	43.5	<1.0
29532	2009	0	93.4	72.0	12.3	<1.0	<10	67.2	41.6	<1.0
29533	2009	0	34.9	30.5	6.1	<1.0	<10	33.0	33.4	<1.0
29534	2009	0	49.7	61.6	14.5	<1.0	<10	53.5	41.7	1.4
29535	2009	50	95.1	86.0	17.7	<1.0	<10	65.8	50.8	1.1
29536	2009	0	35.3	37.1	8.7	<1.0	<10	38.0	30.7	<1.0
29537	2009	0	21.3	24.2	5.5	<1.0	<10	27.5	31.9	<1.0
29538	2009	0	68.1	30.6	6.2	<1.0	<10	41.3	41.5	1.4
29539	2009	0	77.5	36.2	7.1	<1.0	<10	44.2	48.5	1.3
29540	2009	0	50.7	63.1	13.1	<1.0	<10	59.4	39.6	<1.0
29541	2009	0	47.9	60.9	12.4	<1.0	<10	56.1	39.4	<1.0
29542	2009	0	77.6	73.9	17.5	<1.0	<10	63.2	50.0	1.1
29543	2009	0	45.3	40.3	8.5	<1.0	<10	45.5	43.3	<1.0
29544	2009	0	59.4	54.7	11.4	<1.0	<10	54.4	45.8	1.1
29545	2009	0	36.7	34.1	7.7	<1.0	<10	40.0	36.1	<1.0
29546	2009	0	80.9	74.9	13.9	<1.0	<10	66.0	39.9	1.2
29547	2009	0	63.2	42.3	7.7	<1.0	<10	44.2	32.7	2.2
29548	2009	0	66.0	55.4	10.3	<1.0	<10	55.0	38.9	1.5
29549	2009	0	34.8	28.5	5.8	<1.0	<10	35.1	31.1	1.1
29550	2009	50	57.2	46.3	9.0	<1.0	<10	46.5	37.4	1.1
29551	2009	50	75.2	67.1	11.9	<1.0	<10	58.8	40.7	1.3
29552	2009	0	44.9	33.6	6.4	<1.0	<10	42.9	33.8	1.1
29553	2009	0	50.5	55.8	9.5	<1.0	<10	54.0	39.8	1.3
29554	2009	0	47.8	31.5	6.6	<1.0	<10	42.2	34.0	1.3
29555	2009	0	51.8	47.7	9.2	<1.0	<10	44.8	32.1	<1.0
29556	2009	0	27.1	28.2	6.1	<1.0	<10	37.1	30.9	1.0
29557	2009	0	56.5	16.5	<5.0	<1.0	<10	37.1	38.6	1.4
29558	2009	0	50.0	50.3	8.9	<1.0	<10	49.9	28.4	<1.0
29559	2009	0	43.0	29.2	6.8	<1.0	<10	31.4	25.5	<1.0
29775	2009	0	86.0	109.6	22.1	<1.0	<10	91.7	53.5	1.8
29776	2009	0	25.9	22.1	5.2	<1.0	<10	34.0	31.9	1.0
29777	2009	0	22.5	17.5	<5.0	<1.0	<10	24.6	24.5	<1.0
29778	2009	0	55.5	79.6	16.7	<1.0	<10	54.2	32.3	<1.0
29779	2009	0	48.4	69.1	12.8	<1.0	<10	79.1	38.2	<1.0
29780	2009	0	29.1	24.8	6.3	<1.0	<10	36.9	33.1	<1.0
29781	2009	0	26.7	23.6	5.4	<1.0	<10	32.8	26.4	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
SQG (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**23**
29782	2009	0	45.9	45.1	8.6	<1.0	<10	37.2	31.9	<1.0
29783	2009	0	71.2	32.0	6.1	<1.0	<10	37.3	37.0	<1.0
29784	2009	0	55.1	96.6	14.0	<1.0	<10	78.4	39.1	1.4
29785	2009	30	48.6	76.6	11.3	<1.0	<10	67.5	34.3	<1.0
29786	2009	0	37.7	16.9	5.1	<1.0	<10	33.0	35.1	<1.0
29787	2009	0	43.5	37.5	7.6	<1.0	<10	49.5	37.1	<1.0
29506	2009	0	50.3	15.1	<5.0	<1.0	<10	31.1	40.8	1.9
29507	2009	0	18.5	13.6	6.2	<1.0	<10	73.7	25.6	1.1
29508	2009	0	81.7	33.2	6.6	<1.0	<10	38.4	30.2	<1.0
29509	2009	0	49.9	48.2	7.1	<1.0	<10	50.2	34.2	1.1
29510	2009	0	48.4	43.7	7.0	<1.0	<10	45.2	27.8	<1.0
29511	2009	0	55.3	46.4	7.4	<1.0	<10	49.0	30.1	1.0
29512	2009	0	103.9	102.7	18.8	<1.0	<10	78.2	44.1	1.4
29513	2009	0	46.9	30.2	5.2	<1.0	<10	35.4	30.4	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 380: SITE 56 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	67	67	67	67	67	67	67	67
%ND	0	0	7	100	100	1	0	60
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 381: SITE 56 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	125.2	136.2	27.2	1.0	10.0	113.2	66.4	1.6
# of Outliers	0	0	0	0	0	0	0	3
Mean+/-4SD (ppm)	126.2	131.9	25.3	1.5	13.9	107.5	66.1	2.1
# of Outliers	0	0	0	0	0	0	0	1
Mean+/-3SD (ppm)	106.0	108.9	21.1	1.4	12.9	91.1	58.3	1.9
# of Outliers	0	1	1	0	0	1	0	1
Mean+/-2SD (ppm)	85.8	85.8	16.9	1.2	11.9	74.8	50.5	1.6
# of Outliers	4	5	5	0	0	4	2	3
Lower Limit								
3×IQR (ppm)	-30.9	-51.9	-9.7	1.0	10.0	-24.8	4.2	0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-35.5	-52.7	-8.4	0.5	6.1	-23.1	3.7	0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-15.3	-29.6	-4.1	0.6	7.1	-6.8	11.5	0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	4.9	-6.5	0.1	0.8	8.1	9.5	19.3	0.6
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 382: SITE 56 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. Four outliers detected by the Mean+/-2SD method, however, these outliers did not heavily distort calculated background soil concentrations, therefore were not removed.
Ni	Method chosen: No outliers removed. Five outliers detected by the Mean+/-2SD method and one outlier detected by the Mean+/-3SD method, however, these outliers did not heavily distort calculated background soil concentrations or distribution analysis, therefore were not removed.
Co	Method chosen: No outliers removed. Five outliers detected by the Mean+/-2SD method and one outlier detected by the Mean+/-3SD method, however, these outliers did not heavily distort calculated background soil concentrations or distribution analysis, therefore were not removed.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. Two outliers detected by the Mean+/-2SD method, however, these outliers did not heavily distort calculated background soil concentrations or distribution analysis, therefore were not removed.
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 383: SITE 56 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	67	67	67	67	67	67	67	67
ND	0	0	5	67	67	1	0	40
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	16	12	5.0	1.0	10	15	23	1.0
Max (ppm)	104	110	22	1.0	10	92	24	2.2
Mean (ppm)	49	45	9.2	1.0	10	45	36	1.1
Med (ppm)	48	40	8.6	1.0	10	42	34	1.3
SD (ppm)	20	23	4.1	N/A	N/A	15	6.7	N/A
95%tile (ppm)	85	87	18	N/A	N/A	77	48	N/A
95UCL (ppm)	53	50	10	N/A	N/A	48	37	N/A
Distribution	log	log	log	N/A	N/A	norm	norm	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.57 SITE 57, Cape Kakkiviak, Newfoundland and Labrador

A background sampling program was carried out for the site in 2008. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 19 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 384: SITE 57 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**3.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
26240	2008	10	32.4	31.2	11.2	<1.0	<10	28.1	29.2	1.5
26241	2008	10	31.6	30.0	10.6	<1.0	<10	26.3	25.7	<1.0
26242	2008	10	68.7	65.9	11.4	<1.0	<10	30.4	45.6	<1.0
26243	2008	50	48.4	58.2	13.0	<1.0	<10	27.9	55.7	<1.0
26244	2008	10	50.9	36.5	9.9	<1.0	<10	26.2	31.4	<1.0
26245	2008	10	70.9	58.1	17.4	<1.0	<10	51.0	40.7	<1.0
26246	2008	10	33.9	34.6	11.4	<1.0	<10	27.4	39.8	<1.0
26247	2008	50	32.4	35.8	11.2	<1.0	<10	29.3	41.1	<1.0
26248	2008	10	95.9	148.3	22.3	<1.0	<10	59.6	119.3	<1.0
26249	2008	10	45.7	52.8	12.0	<1.0	<10	29.1	53.0	<1.0
26250	2008	40	45.2	51.5	11.4	<1.0	<10	28.4	50.9	<1.0
26251	2008	40	50.5	54.7	12.8	<1.0	<10	30.6	54.2	<1.0
26252	2008	10	32.6	36.8	10.6	<1.0	<10	28.0	44.8	<1.0
26253	2008	10	20.0	21.6	10.0	<1.0	<10	22.4	26.4	<1.0
26254	2008	10	57.8	56.3	14.7	<1.0	<10	30.9	45.8	<1.0
26255	2008	40	54.7	51.3	12.4	<1.0	<10	25.4	32.7	<1.0
26256	2008	10	27.7	27.3	10.6	<1.0	<10	29.5	27.8	<1.0
26257	2008	10	44.5	53.8	13.4	<1.0	<10	27.3	40.8	<1.0
26258	2008	50	40.8	50.3	13.0	<1.0	<10	27.9	45.6	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 385: SITE 57 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	19	19	19	19	19	19	19	19
%ND	0	0	0	100	100	0	0	95
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 386: SITE 57 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	113.6	116.4	19.3	1.0	10.0	37.8	97.3	1.0
# of Outliers	0	1	1	0	0	2	1	1
Mean+/-4SD (ppm)	124.2	159.0	27.2	1.9	17.2	73.3	130.0	2.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	104.0	130.7	23.5	1.7	15.4	62.5	107.9	1.8
# of Outliers	0	1	0	0	0	0	1	0
Mean+/-2SD (ppm)	83.9	102.4	19.8	1.4	13.6	51.6	85.9	1.5
# of Outliers	1	1	1	0	0	1	1	0
Lower Limit								
3×IQR (ppm)	-28.3	-25.7	4.6	1.0	10.0	19.5	-16.9	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-37.0	-67.5	-2.6	0.1	2.8	-13.4	-46.4	0.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-16.9	-39.2	1.2	0.3	4.6	-2.6	-24.3	0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	3.3	-10.9	4.9	0.6	6.4	8.3	-2.3	0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 387: SITE 57 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: No outliers removed. One outlier detected by the Mean+/-2SD method, however, this outlier did not heavily distort calculated background soil concentrations, therefore was not removed.
Ni	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted background concentrations, and therefore was removed. Outlier also detected by the Mean+/-3SD and Mean+/-2SD method.
Co	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore was removed. Outlier also detected by the Mean+/-2SD method.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. Two outliers detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore were removed.
Cr	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted background concentrations, and therefore was removed. Outlier also detected by the Mean+/-3SD and Mean+/-2SD method.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 388: SITE 57 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	19	18	18	19	19	17	18	19
ND	0	0	0	19	19	0	0	18
DL (ppm)	3.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	20	22	9.9	1.0	10	22	26	1.0
Max (ppm)	96	66	17	1.0	10	31	56	1.5
Mean (ppm)	47	45	12	1.0	10	28	41	1.0
Med (ppm)	45	51	11	1.0	10	28	41	1.5
SD (ppm)	18	13	1.8	N/A	N/A	2.1	9.8	N/A
95%tile (ppm)	73	59	15	N/A	N/A	31	54	N/A
95UCL (ppm)	54	13	13	N/A	N/A	29	45	N/A
Distribution	norm	norm	norm	N/A	N/A	norm	norm	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.58 SITE 58, Cape Kiglapait, Nunavut Territory

A background sampling program was carried out for the site in 2008. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 17 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 389: SITE 58 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
26264	2008	10	17.6	234.7	87.8	<1.0	<10	69.6	21.8	<1.0
26265	2008	10	11.7	226.4	86.0	<1.0	<10	68.6	30.8	<1.0
26266	2008	30	13.2	195.5	75.2	<1.0	<10	58.5	21.3	<1.0
26267	2008	10	6.9	183.8	71.5	<1.0	<10	58.6	<20	<1.0
26268	2008	10	8.7	213.4	88.2	<1.0	<10	69.7	<20	<1.0
26269	2008	10	8.3	225.2	94.9	<1.0	<10	74.9	31.2	<1.0
26270	2008	10	39.3	305.5	114.1	<1.0	<10	88.6	22.4	<1.0
26271	2008	10	50.7	296.3	108.7	<1.0	<10	83.9	23.1	<1.0
26272	2008	40	19.1	257.3	97.5	<1.0	<10	78.3	27.2	<1.0
26273	2008	10	8.6	215.2	83.7	<1.0	<10	69.2	23.9	<1.0
26274	2008	10	6.4	244.1	95.2	<1.0	<10	75.5	37.5	<1.0
26275	2008	40	8.9	237.1	91.2	<1.0	<10	73.1	35.0	<1.0
26280	2008	10	5.9	216.4	85.5	<1.0	<10	67.6	22.2	<1.0
26281	2008	10	<5.0	215.0	86.0	<1.0	<10	67.5	<20	<1.0
26282	2008	30	7.9	175.8	71.7	<1.0	<10	51.6	<20	<1.0
26283	2008	10	6.6	209.5	85.0	<1.0	<10	68.4	25.4	<1.0
26284	2008	10	6.5	257.2	99.4	<1.0	<10	84.5	<20	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 390: SITE 58 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	17	17	17	17	17	17	17	17
%ND	6	0	0	100	100	0	29	100
Analysed?	Yes	Yes	Yes	No	No	Yes	Yes	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 391: SITE 58 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	33.0	336.3	125.7	1.0	10.0	99.2	48.9	1.0
# of Outliers	2	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	60.8	481.5	182.7	1.9	17.5	145.5	54.8	1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	48.2	418.0	159.3	1.7	15.7	126.7	47.2	1.7
# of Outliers	1	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	35.7	354.5	135.8	1.5	13.8	108.0	39.6	1.5
# of Outliers	2	0	0	0	0	0	0	0
Lower Limit								
3×IQR (ppm)	-13.2	121.2	54.5	1.0	10.0	43.9	-1.7	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-39.7	-26.4	-5.1	0.1	2.5	-4.6	-6.3	0.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-27.1	37.1	18.4	0.3	4.3	14.1	1.4	0.3
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-14.6	100.5	41.8	0.5	6.2	32.9	9.0	0.5
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 392: SITE 58 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Two outliers detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore were removed. Outliers were also detected by the Mean+/-2SD method.
Ni	Method chosen: No outliers removed. No outliers identified.
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: No outliers removed. No outliers identified.
Cr	Method chosen: No outliers removed. No outliers identified.
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 393: SITE 58 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	15	17	17	17	17	17	17	17
ND	1	0	0	17	17	0	5	17
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	176	72	1.0	10	52	20	1.0
Max (ppm)	19	305	114	1.0	10	89	38	1.0
Mean (ppm)	9.4	230	90	1.0	10	71	25	1.0
Med (ppm)	8.4	225	88	1.0	10	70	25	1.0
SD (ppm)	4.1	35	12	N/A	N/A	9.6	5.4	N/A
95%tile (ppm)	18	298	110	N/A	N/A	85	35	N/A
95UCL (ppm)	11	245	94	N/A	N/A	75	27	N/A
Distribution	log	norm	norm	N/A	N/A	norm	norm	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.59 SITE 59, Big Bay, Nunavut Territory

A background sampling program was carried out for the site in 2007. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 12 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 394: SITE 59 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
25922	2007	5	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
25923	2007	40	9.0	9.4	6.7	<1.0	<10	23.9	<20	<1.0
25924	2007	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
25925	2007	40	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
25926	2007	5	6.1	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
25927	2007	5	9.5	11.1	7.0	<1.0	<10	24.3	<20	<1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
25928	2007	0	54.1	<5.0	<5.0	<1.0	<10	<15	<20	2.7
25929	2007	15	<5.0	6.7	<5.0	<1.0	<10	<15	<20	<1.0
25930	2007	5	12.4	15.4	7.9	<1.0	<10	24.9	23.2	<1.0
25931	2007	5	5.9	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
25932	2007	40	6.9	7.8	<5.0	<1.0	<10	<15	24.4	<1.0
25933	2007	40	13.8	15.0	7.8	<1.0	<10	26.6	24.2	<1.0

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 395: SITE 59 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	12	12	12	12	12	12	12	12
%ND	33	50	67	100	100	67	75	92
Analysed?	Yes	No	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 396: SITE 59 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	25.9	24.2	12.0	1.0	10.0	50.9	23.2	1.0
# of Outliers	1	0	0	0	0	0	2	1
Mean+/-4SD (ppm)	62.1	23.7	11.9	2.1	18.9	43.9	43.1	3.2
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	48.7	19.6	10.3	1.8	16.7	37.3	37.5	2.7
# of Outliers	1	0	0	0	0	0	0	1
Mean+/-2SD (ppm)	35.3	15.4	8.8	1.6	14.4	30.8	32.0	2.1
# of Outliers	1	0	0	0	0	0	0	1
Lower Limit								
3×IQR (ppm)	-10.7	-9.4	-0.2	1.0	10.0	-11.9	17.6	1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-45.3	-9.3	-0.5	-0.1	1.1	-8.4	-1.2	-1.0
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-31.9	-5.1	1.0	0.2	3.3	-1.8	4.3	-0.5
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-18.5	-1.0	2.6	0.4	5.6	4.7	9.8	0.0
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 397: SITE 59 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. One oultier detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore was removed. Outlier was also detected by the Mean+/-2SD method.
Ni	Not analysed
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 398: SITE 59 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	12	12	12	12	12	12	12	12
ND	4	6	8	12	12	8	9	11
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	54	15	7.9	1.0	10	27	24	2.7
Mean (ppm)	11	7.9	5.8	1.0	10	18	21	1.1
Med (ppm)	9.2	10	7.4	1.0	10	45	24	2.7
SD (ppm)	13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95%tile (ppm)	13	N/A	N/A	N/A	N/A	N/A	N/A	N/A
95UCL (ppm)	9.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution	norm	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.60 SITE 60, Tukialik Bay, Nunavut Territory

A background sampling program was carried out for the site in 2008. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 23 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 399: SITE 60 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
26040	2008	10	<5.0	<5.0	5.4	<1.0	<10	16.7	<20	<1.0
26041	2008	10	<5.0	<5.0	5.3	<1.0	<10	19.2	<20	1.2
26042	2008	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
26043	2008	25	17.2	5.3	6.7	<1.0	<10	20.7	<20	1.7
26044	2008	10	12.4	<5.0	<5.0	<1.0	<10	18.7	<20	1.2
26045	2008	10	15.8	11.6	6.7	<1.0	<10	20.9	28.5	2.1

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			5.0	5.0	5.0	1.0	10	15	20	1.0
CCME Residential/Parkway (ppm)			63	50	50	10	140	200	64	12
26046	2008	10	<5.0	<5.0	5.7	<1.0	<10	18.9	<20	<1.0
26047	2008	40	6.0	5.5	6.7	<1.0	<10	20.8	21.2	1.7
26048	2008	10	5.0	<5.0	7.0	<1.0	<10	20.9	<20	1.0
26049	2008	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
26130	2008	50	<5.0	5.4	6.5	<1.0	<10	19.0	<20	<1.0
26131	2008	50	<5.0	5.4	6.3	<1.0	<10	18.7	<20	<1.0
26132	2008	10	56.5	<5.0	<5.0	<1.0	<10	<15	<20	2.4
26133	2008	10	<5.0	<5.0	5.3	<1.0	<10	20.4	<20	<1.0
26134	2008	10	8.3	<5.0	<5.0	<1.0	<10	17.2	<20	<1.0
26135	2008	10	11.2	6.6	5.8	<1.0	<10	17.6	<20	<1.0
26136	2008	50	11.7	5.1	5.1	<1.0	<10	17.3	<20	<1.0
26137	2008	10	7.1	<5.0	<5.0	<1.0	<10	<15	<20	1.1
26138	2008	35	7.5	<5.0	<5.0	<1.0	<10	<15	<20	1.2
26139	2008	10	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.4
26140	2008	10	52.5	<5.0	<5.0	<1.0	19.0	28.0	<20	3.3
26141	2008	10	58.7	<5.0	<5.0	<1.0	20.5	22.1	<20	4.1
26143	2008	10	9.0	<5.0	<5.0	<1.0	<10	37.0	<20	1.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 400: SITE 60 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	23	23	23	23	23	23	23	23
%ND	39	70	48	100	91	26	91	43
Analysed?	Yes	No	Yes	No	No	Yes	No	Yes

N = sample size; %ND = percentage of values below the analytical detection limit

Table 401: SITE 60 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	33.2	5.9	9.0	1.0	10.0	35.3	20.0	3.9
# of Outliers	3	2	0	0	2	1	2	1
Mean+/-4SD (ppm)	76.4	11.4	9.5	1.8	23.8	42.8	37.0	4.6
# of Outliers	0	1	0	0	0	0	0	0
Mean+/-3SD (ppm)	59.6	9.9	8.5	1.6	20.5	36.8	32.8	3.8
# of Outliers	0	1	0	0	1	1	0	1
Mean+/-2SD (ppm)	42.8	8.4	7.5	1.4	17.2	30.8	28.7	3.0
# of Outliers	3	1	0	0	2	1	0	2
Lower Limit								
3×IQR (ppm)	-16.1	4.4	2.0	1.0	10.0	1.3	20.0	-1.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-57.8	-0.8	1.5	0.2	-2.6	-5.1	3.8	-1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-41.1	0.8	2.5	0.4	0.7	0.9	7.9	-1.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-24.3	2.3	3.5	0.6	4.0	6.9	12.1	-0.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 402: SITE 60 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Method chosen: 3×IQR. Three outliers detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore were removed. Outlier was also detected by the Mean+/-2SD method.
Ni	Not analysed
Co	Method chosen: No outliers removed. No outliers identified.
Cd	Not analysed
Pb	Not analysed
Zn	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore was removed. Outlier was also detected by the Mean+/-3SD and Mean+/-2SD method.
Cr	Not analysed
As	Method chosen: 3×IQR. One outlier detected distant from the rest of the population that distorted background concentrations and distribution analysis, and therefore was removed. Outlier was also detected by the Mean+/-3SD and Mean+/-2SD method.

SD = standard deviation; IQR = interquartile range.

Table 403: SITE 60 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	20	23	23	23	23	22	23	22
ND	9	16	11	23	21	6	21	10
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	17.24	12	7.0	1.0	21	28	29	3.3
Mean (ppm)	7.8	5.4	5.5	1.0	11	18	20	1.4
Med (ppm)	9.02	5.4	6.0	1.0	20	19	25	1.5
SD (ppm)	3.8	N/A	0.7	N/A	N/A	3.1	N/A	0.6
95%tile (ppm)	16	N/A	6.7	N/A	N/A	22	N/A	2.4
95UCL (ppm)	9.3	N/A	5.8	N/A	N/A	20	N/A	16
Distribution	norm	N/A	N	N/A	N/A	log	N/A	norm

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.3.61 SITE 61, Tukialik Bay, Nunavut Territory

A background sampling program was carried out for the site in 2008. All soil samples were collected from the only terrain unit identified within the 500 meters background radius of the station. A total of 23 background soil samples were collected from the site. All samples were analyzed for the Arctic suite of inorganic elements.

Table 404: SITE 61 (station area) background soil data.

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
18360	2012	0	<5.0	<5.0	5.4	<1.0	<10	<15	<20	1.0

Sample #	Date	Depth	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
		cm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit (ppm)			**5.0**	**5.0**	**5.0**	**1.0**	**10**	**15**	**20**	**1.0**
CCME Residential/Parkway (ppm)			**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
18361	2012	0	<5.0	<5.0	6.4	<1.0	<10	<15	<20	1.0
18362	2012	0	16.5	8.5	<5.0	<1.0	<10	<15	23.0	<1.0
18363	2012	0	<5.0	10.0	5.3	<1.0	<10	<15	26.0	1.0
18364	2012	0	15.0	14.2	6.7	<1.0	<10	21.0	33.0	1.0
18365	2012	0	<5.0	9.5	<5.0	<1.0	<10	<15	65.0	<1.0
18366	2012	0	7.8	10.0	6.1	<1.0	<10	<15	31.0	1.1
18367	2012	30	6.0	7.2	5.4	<1.0	<10	<15	25.0	1.0
18368	2012	0	25.1	26.8	6.9	<1.0	<10	<15	29.0	<1.0
18369	2012	0	10.9	13.3	7.5	<1.0	<10	<15	34.0	1.6
18370	2012	0	15.8	8.9	<5.0	<1.0	<10	<15	37.0	<1.0
18371	2012	0	14.5	9.7	<5.0	<1.0	<10	<15	41.0	1.0
18372	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18373	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.1
18374	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18375	2012	30	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18376	2012	0	<5.0	11.0	<5.0	<1.0	<10	<15	<20	<1.0
18377	2012	0	<5.0	<5.0	7.8	<1.0	<10	15.0	<20	<1.0
18378	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18379	2012	0	11.4	15.3	6.1	<1.0	<10	<15	36.0	<1.0
18380	2012	0	9.9	20.7	7.8	<1.0	<10	<15	23.0	<1.0
18381	2012	0	12.3	20.7	7.7	<1.0	<10	<15	25.0	<1.0
18382	2012	0	17.4	17.5	8.0	<1.0	<10	19.0	37.0	1.1
18383	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18384	2012	30	<5.0	5.2	<5.0	<1.0	<10	<15	<20	<1.0
18385	2012	0	8.7	8	<5.0	<1.0	<10	<15	37	<1.0
18386	2012	0	8.3	9.1	<5.0	<1.0	<10	24	27	1
18387	2012	0	<5.0	16.6	<5.0	<1.0	<10	<15	<20	<1.0
18388	2012	0	14.8	24.4	6.5	<1.0	<10	<15	26	<1.0
18389	2012	0	7.1	<5.0	<5.0	<1.0	<10	<15	23	<1.0
18390	2012	0	<5.0	5.7	<5.0	<1.0	<10	<15	35	<1.0
18391	2012	0	7.9	7.7	<5.0	<1.0	<10	<15	32	<1.0
18392	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18393	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18394	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18395	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18396	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18397	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18398	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18399	2012	0	<5.0	<5.0	<5.0	<1.0	14	<15	<20	<1.0
18400	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18401	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	<1.0
18402	2012	0	<5.0	<5.0	<5.0	<1.0	<10	<15	<20	1.8

SQG = CCME Soil Quality Guidelines for residential/parkland land use.

Table 405: SITE 61 (station area) data summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
N	43	43	43	43	43	43	43	43
%ND	60	49	67	100	98	93	53	88
Analysed?	No	Yes	No	No	No	No	No	No

N = sample size; %ND = percentage of values below the analytical detection limit

Table 406: SITE 61 (station area) outlier results.

Outlier Method	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Upper Limit								
3×IQR (ppm)	33.2	5.9	9.0	1.0	10.0	35.3	20.0	3.9
# of Outliers	3	2	0	0	2	1	2	1
Mean+/-4SD (ppm)	76.4	11.4	9.5	1.8	23.8	42.8	37.0	4.6
# of Outliers	0	1	0	0	0	0	0	0
Mean+/-3SD (ppm)	59.6	9.9	8.5	1.6	20.5	36.8	32.8	3.8
# of Outliers	0	1	0	0	1	1	0	1
Mean+/-2SD (ppm)	42.8	8.4	7.5	1.4	17.2	30.8	28.7	3.0
# of Outliers	3	1	0	0	2	1	0	2
Lower Limit								
3×IQR (ppm)	-16.1	4.4	2.0	1.0	10.0	1.3	20.0	-1.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-4SD (ppm)	-57.8	-0.8	1.5	0.2	-2.6	-5.1	3.8	-1.9
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-3SD (ppm)	-41.1	0.8	2.5	0.4	0.7	0.9	7.9	-1.1
# of Outliers	0	0	0	0	0	0	0	0
Mean+/-2SD (ppm)	-24.3	2.3	3.5	0.6	4.0	6.9	12.1	-0.3
# of Outliers	0	0	0	0	0	0	0	0

SD = standard deviation; IQR = interquartile range; ppm = parts per million.

Table 407: SITE 61 (station area) justification for outlier method chosen.

Element	Outlier Method Justification
Cu	Not analysed
Ni	Method chosen: No outliers removed. Removal of outliers would result in over 50% of the data set to be values below the detection limit.
Co	Not analysed
Cd	Not analysed
Pb	Not analysed
Zn	Not analysed
Cr	Not analysed
As	Not analysed

SD = standard deviation; IQR = interquartile range.

Table 408: SITE 61 (station area) background concentration results summary.

	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
SQG (ppm)	**63**	**50**	**50**	**10**	**140**	**200**	**64**	**12**
N	43	43	43	43	43	43	43	43
ND	26	21	29	43	42	40	23	38
DL (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Min (ppm)	5.0	5.0	5.0	1.0	10	15	20	1.0
Max (ppm)	25	27	8.0	1.0	14	24	65	1.8
Mean (ppm)	7.9	9.0	5.5	1.0	10	15	26	1.0
Med (ppm)	11	10	6.6	1.0	14	21	31	1.1
SD (ppm)	N/A	5.7	N/A	N/A	N/A	N/A	N/A	N/A
95%tile (ppm)	N/A	21	N/A	N/A	N/A	N/A	N/A	N/A
95UCL (ppm)	N/A	11	N/A	N/A	N/A	N/A	N/A	N/A
Distribution	N/A	norm	N/A	N/A	N/A	N/A	N/A	N/A

SQG = CCME Soil Quality Guidelines for residential/parkland land use; N = sample size; ND = number of values below detection limit; DL = detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; Med = median; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; ppm = parts per million; norm = normal; log = lognormal; gam = gamma; non-p = non-parametric; N/A = not applicable.

B.4 Additional Background Concentration Figures

Figure 1

Figure 2

B.5 Surficial Geology Comparison Analysis

Following analysis of background soil data of each site individually, all 61 sites were categorized on the basis of their geological settings. Using the Geological Map of Canada available on the Natural Resource Canada GEOSCAN data base (Wheeler et al., 1996), sites were ordered based on the geological unit that the sites reside. As a result, sites were categorized as shown in Table 409. Summary statistics for each element are shown in Table 410 to Table 415. Cadmium and Lead were not included in this analysis, due to the larger number of values below the analytical detection limit.

Table 409: Sites categorized based on geological setting.

Geology Unit	Rock Type	Geological Era	Definition of Bedrock Unit	Sites
Q	Sedimentary	Cenozoic	Q = quaternary sedimentary rock	SITE 1, BAR-B, SITE 5, SITE 4, SITE 6, SITE 7, BAR-D, SITE 9, SITE 10
PTvm	Volcanic	Cenozoic	PTvm: PT = Paleogene volcanic rock, vm = mafic	SITE 52, SITE 53
uK	Sedimentary	Mesozoic	uK = Upper cretaceous sedimentary rock	SITE 11
CO	Sedimentary	Paleozoic	CO = Cambrian and Ordovician sedimentary rock	SITE 12
O	Sedimentary	Paleozoic	O = Ordovician sedimentary rock	SITE 16, SITE 17, SITE 18, SITE 19, SITE 20, SITE 21, SITE 22
C	Sedimentary	Paleozoic	C = Cambrian sedimentary	SITE 25, SITE 26
CS	Sedimentary	Paleozoic	CS = Cambrian to Silurian sedimentary rock	SITE 27, SITE 28, SITE 29, SITE 30, SITE 31, SITE 32, SITE 33, SITE 34, SITE 35
uO	Sedimentary	Paleozoic	uO = Upper ordovician sedimentary rock	SITE 42, SITE 43, SITE 44
VWn	Metamorphic	Precambrian	VWn: VW = Neoarchean metamorphic rock, n = undivided gneiss	SITE 36, SITE 37, SITE 57, SITE 59
Wg	Igneous	Precambrian	Wg : W = Neoarchean igneous rock, g = undivided granitoid	SITE 38, SITE 40, SITE 41, SITE 39
X^{12}	Sedimentary	Precambrian	X^{12} : X = paleoproterozoic sedimentary rock, ^{12} = impact structure 12	SITE 45, SITE 46, SITE 47, SITE 51, SITE 48
X^2g	Igneous	Precambrian	X^2 : X = paleoproterozoic igneous rock, ^{2} = impact structure 2, g = undivided granitoid	SITE 50, SITE 49
WXn	Metamorphic	Precambrian	WXn: WX = Neoarchean metamorphic rock, n = undivided gneiss	SITE 54, SITE 55, SITE 56
Y^2m	Igneous	Precambrian	Y^2m: Y = Mesoproterozoic igneous rock, ^{2} = impact structure 2, m = mafic intrusive-diorite, gabbro	SITE 58
X^3g	Igneous	Precambrian	X^3g: X = paleoproterozoic igneous rock, ^{2} = impact structure 2, g = undivided granitoid	SITE 60
X^3gn	Metamorphic	Precambrian	X^3gn: X = paleoproterozoic metamorphi rock, ^{2} = impact structure 2, gn = orthogneiss	SITE 61
ZCO	Sedimentary	Precambrian	ZCO = Neoproterozoic and lower Cambrian sedimentary rock	Site 2
Y^3Z	Sedimentary	Precambrian	Y^3Z = Mesoproterozoic and neoproterozoic sedimentary rock, ^{3} = impact structure 3,	SITE 13, SITE 14, SITE 15 , SITE 23, SITE 24

Table 410: Background copper concentrations in each geological unit.

	Geological Unit																	
	ZCO	**CO**	**Q**	**uK**	**Y^3Z**	**O**	**C**	**CS**	**VWn**	**X^2g**	**WXn**	**Wg**	**uO**	**X^3g**	**X^3gn**	**X^{12}**	**PTvm**	**Y^2m**
N	10	9	186	26	168	194	72	148	103	78	156	49	117	20	43	464	227	15
ND	0	0	14	0	19	4	8	101	23	34	28	0	72	9	26	6	1	1
Min	12	6	3.0	10	3.0	5.0	5.0	3.0	5.0	3.0	5.0	4.2	5.0	5.0	5.0	5.0	5.0	5.0
Max	19	12	40	34	95	45	57	79	96	64	104	25	11	25	17	140	191	19
Mean	16	8.8	14	22	17	15	15	6.1	16	12	28	11	5.8	7.8	7.9	31	51	9.4
SD	2.0	1.9	7.2	4.8	13	10	11	7.6	17	12	23	4.1	1.5	3.8	4.7	18	33	4.1
95%tile	19	11	27	30	40	38	33	14	51	33	76	20	8.8	16	16	62	115	18
95UCL	17	10	16	23	19	16	17	6.2	24	14	36	12	6.0	9.3	9.1	32	61	12
Dist.	NM	NM	NM	NM	L	L	L	NM	L	NM	NM	L	NM	NM	NM	G	NP	NM

All concentration values are in parts per million (ppm). N = sample size; ND = number of values below detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; NM = normal; L= lognormal; G = gamma; NP = non-parametric.

Table 411: Background nickel concentrations in each geological unit.

	Geological Unit																	
	ZCO	**CO**	**Q**	**uK**	**Y^3Z**	**O**	**C**	**CS**	**VWn**	**X^2g**	**WXn**	**Wg**	**uO**	**X^3g**	**X^3gn**	**X^{12}**	**PTvm**	**Y^2m**
N	10	9	185	26	174	196	74	145	103	81	159	50	118	23	43	465	212	17
ND	0	4	8	0	55	77	17	101	9	29	16	5	59	16	21	1	0	0
Min	13	5.0	5.0	11	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	7.4	176
Max	21	14	40	48	41	33	22	23	66	58	110	35	19	12	27	170	430	306
Mean	17	7.2	18	22	9.3	9.0	8.7	6.5	17	13	25	9.4	7.4	5.4	9.0	28	91	230
SD	2.4	3.0	7.1	8.3	6.6	6.5	3.9	3.3	14	11	23	4.9	3.4	1.4	5.7	16	79	35
95%tile	20	12	29	33	24	27	16	13	54	34	74	17	13	6.5	21	47	280	298
95UCL	19	9.3	18	25	10	11	9.5	6.5	24	18	33	10	7.9	6.0	11	29	115	245
Dist.	NM	NM	NM	NM	L	L	NM	NM	L	NM	NP	L	NM	NM	NM	NP	NP	NM

All concentration values are in parts per million (ppm). N = sample size; ND = number of values below detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; NM = normal; L= lognormal; G = gamma; NP = non-parametric.

Table 412: Background cobalt concentrations in each geological unit.

	Geological Unit																	
	ZCO	**CO**	**Q**	**uK**	**Y^3Z**	**O**	**C**	**CS**	**VWn**	**X^2g**	**WXn**	**Wg**	**uO**	**X^3g**	**X^3gn**	**X^{12}**	**PTvm**	**Y^2m**
N	10	9	185	25	178	196	74	148	101	79	158	50	118	23	43	459	233	17
ND	0	3	42	0	98	127	45	136	15	45	36	19	111	11	29	21	7	0
Min	5.8	3.5	3.3	6.6	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	71
Max	8.9	12	20	21	37	17	19	16	17	18	22	22	9.2	7.0	8.0	50	76	114
Mean	7.5	5.5	8.0	11	6.8	6.5	6.3	5.2	8.6	6.8	8.2	6.4	5.1	5.5	5.5	11	23	90
SD	1.0	2.6	3.7	3.3	4.1	2.9	2.6	1.2	2.9	3.1	3.4	2.6	0.5	0.7	1.0	5.2	16	12
95%tile	8.7	10	15	18	14	14	10	6.6	13	14	14	9.1	5.2	6.7	7.8	19	65	110
95UCL	8.0	7.3	8.5	12	7.3	6.8	6.8	5.4	9.1	7.4	8.7	6.9	5.2	5.8	5.8	12	27	94
Dist.	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	L	NM	NM	NM	L	NP	NM

All concentration values are in parts per million (ppm). N = sample size; ND = number of values below detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; NM = normal; L= lognormal; G = gamma; NP = non-parametric.

Table 413: Background zinc concentrations in each geological unit.

	Geological Unit																	
	ZCO	**CO**	**Q**	**uK**	**Y^3Z**	**O**	**C**	**CS**	**VWn**	**X^2g**	**WXn**	**Wg**	**uO**	**X^3g**	**X^3gn**	**X^{12}**	**PTvm**	**Y^2m**
N	10	8	184	25	179	196	74	148	104	79	161	50	118	22	43	449	230	17
ND	0	0	10	0	85	86	47	114	8	7	3	5	87	6	40	9	1	0
Min	24	13	15	51	14	6.0	15	3.0	15	15	15	15	15	15	15	15	15	52
Max	41	574	175	107	92	64	39	90	104	89	92	58	41	28	24	190	186	89
Mean	33	32	56	68	21	19	18	9.4	36	32	40	28	17	19	15	54	70	71
SD	6.0	16	24	14	13	13	5.2	12	18	15	14	11	4.6	3.1	1.7	23	31	9.6
95%tile	41	54	98	89	49	51	28	32	76	61	67	52	26	22	19	90	129	85
95UCL	37	43	59	73	23	21	19	14	39	36	41	30	18	20	16	56	69	75
Dist.	NM	NM	NM	L	NM	L	NM	NM	L	NM	L	L	NM	NM	NM	NP	L	NM

All concentration values are in parts per million (ppm). N = sample size; ND = number of values below detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; NM = normal; L= lognormal; G = gamma; NP = non-parametric.

Table 414: Background chromium concentrations in each geological unit.

	Geological Unit																	
	ZCO	**CO**	**Q**	**uK**	**Y^3Z**	**O**	**C**	**CS**	**VWn**	**X^2g**	**WXn**	**Wg**	**uO**	**X^3g**	**X^3gn**	**X^{12}**	**PTvm**	**Y^2m**
N	10	9	184	25	181	196	74	148	105	79	162	51	118	23	43	454	227	17
ND	0	5	91	1	148	171	54	137	34	52	72	35	97	21	23	27	9	5
Min	3.4	1.4	5.0	20	18	10	20	10	20	20	20	20	20	20	20	20	20	20
Max	8.1	20	67	37	34	898	45	62	65	74	57	52	37	28	65	113	250	37
Mean	6.1	2.8	19	28	20	13	22	11	29	24	28	24	21	20	26	52	89	25
SD	1.6	1.1	15	4.0	3.2	11	4.6	5.9	11	9.4	9.2	8.2	2.1	1.7	8.8	20	52	5.4
95%tile	8.0	20	44	34	28	40	32	24	51	37	44	43	24	21	37	84	197	35
95UCL	7.0	3.9	21	29	21	15	23	12	31	26	29	26	21	21	28	54	95	27
Dist.	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	G	NM

All concentration values are in parts per million (ppm). N = sample size; ND = number of values below detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; NM = normal; L= lognormal; G = gamma; NP = non-parametric.

Table 415: Background arsenic concentrations in each geological unit.

	Geological Unit																	
	ZCO	**CO**	**Q**	**uK**	**Y^3Z**	**O**	**C**	**CS**	**VWn**	**X^2g**	**WXn**	**Wg**	**uO**	**X^3g**	**X^3gn**	**X^{12}**	**PTvm**	**Y^2m**
N	10	9	183	25	157	193	70	163	137	116	297	81	72	79	43	276	209	73
ND	0	0	6	0	53	16	18	66	89	0	189	19	8	56	38	0	70	17
Min	16	1.5	0.2	10.9	0.8	0.2	1.0	0.2	1.0	1.4	1.0	0.2	1.0	1.0	1.0	1.3	1.0	1.0
Max	35	5.5	33	27	4.0	6.7	6.2	15	9.2	23	6.0	4.0	4.1	5.9	1.8	49	98	47
Mean	26	2.5	8.4	18	1.5	2.2	2.0	1.5	1.5	9.8	1.4	1.8	1.8	1.2	1.0	13	9.1	3.2
SD	7.2	1.3	4.9	5.1	0.7	1.1	1.1	1.7	1.2	4.7	0.8	1.0	0.6	0.7	0.2	11	17	5.3
95%tile	35	4.5	15	29	2.8	4.0	4.2	3.6	3.4	19	2.8	3.6	3.0	2.1	1.1	33	42	5.7
95UCL	30	3.3	10	20	1.5	2.3	2.2	2.1	2.0	12	1.4	2.0	2.0	1.3	1.1	16	14	3.5
Dist.	NM	NM	NP	NM	NM	NM	NM	L	NM	NP	NM	NM	NM	NM	NM	NP	L	L

All concentration values are in parts per million (ppm). N = sample size; ND = number of values below detection limit; Min = minimum concentration; Max = maximum concentration; SD = standard deviation; 95%tile = 95 percentile; 95UCL = 95% upper confidence limit; NM = normal; L= lognormal; G = gamma; NP = non-parametric.

Table 416: Sites categorized based on geological setting.

Colour ID	Geology Unit	Rock Type	Geological Era	Sites
	Q	Sedimentary	Cenozoic	SITE 1, BAR-B, SITE 5, SITE 4, SITE 6, SITE 7, BAR-D, SITE 9, SITE 10
	uK	Sedimentary	Mesozoic	SITE 11
	CO	Sedimentary	Paleozoic	SITE 12
	ZCO	Sedimentary	Precambrian	Site 2
	WXn	Metamorphic	Precambrian	SITE 54, SITE 55, SITE 56
	VWn	Metamorphic	Precambrian	SITE 36, SITE 37, SITE 57, SITE 59
	X^2g	Igneous	Precambrian	SITE 50, SITE 49
	CS	Sedimentary	Paleozoic	SITE 27, SITE 28, SITE 29, SITE 30, SITE 31, SITE 32, SITE 33, SITE 34, SITE 35
	Wg	Igneous	Precambrian	SITE 38, SITE 40, SITE 41, SITE 39
	uO	Sedimentary	Paleozoic	SITE 42, SITE 43, SITE 44
	X^3g	Igneous	Precambrian	SITE 60
	X^3gn	Metamorphic	Precambrian	SITE 61
	X^{12}	Sedimentary	Precambrian	SITE 45, SITE 46, SITE 47, SITE 51, SITE 48
	PTvm	Volcanic	Cenozoic	SITE 52, SITE 53
	O	Sedimentary	Paleozoic	SITE 16, SITE 17, SITE 18, SITE 19, SITE 20, SITE 21, SITE 22
	C	Sedimentary	Paleozoic	SITE 25, SITE 26
	Y^3Z	Sedimentary	Precambrian	SITE 13, SITE 14, SITE 15 , SITE 23, SITE 24
	Y^2m	Igneous	Precambrian	SITE 58

Appendix C

Supplementary Information for Chapter 5: Developing Background Threshold Values at Remote and Arctic Sites

C.1 Project Background

Background soil data collected from three Canadian sites was provided by ESG-RMC, which includes:

- Site A, Baffin Island, Nunavut (ESG, 2007a);
- Site B, Alberta (ESG, 2014); and,
- Site C, Alberta (ESG, 2017)

In 2006, ESG-RMC conducted a local scale background sampling program as part of the site investigation of Site A on Baffin Island, Nunavut, Canada. Seven terrain units were identified at the site. The site is primarily covered in till deposits of varying thickness (between 0 and 20 m), with some minor areas of glaciofluvial (GF) and glaciolacustrine (GL) deposits, as well as some modern-day alluvium (A) and colluvium (C) deposits (ESG, 2007a). The till deposits on site have been classified into two terrain units based on thickness: till blanket (TB) deposits represent 2 to 10 m of overburden; and till veneer (TV) deposits are 0.5 to 2 m of overburden, atop the bedrock. Several areas of exposed bedrock (RL) occur at the site, particularly at the lower site where the topography flattens out adjacent to the river (ESG, 2007a). The study area was limited to surficial soil (1 meter in depth) within an inclusion zone that avoided characterization of areas that have been influenced by anthropogenic activity. The inclusion zone did not extend 500 meters beyond the area of current or past human activity for a total area of 11 km^2.

In 2006, ESG-RMC performed a local scale background sampling program as part of an environmental site assessment (ESA) of Site B in Alberta, Canada. ESG-RMC conducted a review of air photos, available soil descriptions and surficial mapping (Mougeot & Fenton, 2010) prior to the 2014 field season to identify two terrain units in the study area at Site B. Both terrain units identified as being from the same surficial deposit, a glaciolacustrine deposit from the Pleistocene deposited in or along the margins of glacial lakes (ESG, 2014). These deposits typically consist of laminated or massively deposited fine sand, silt and clay and/or massive stratified well-sorted silty sand, pebbly sand and minor gravel (ESG, 2014). The description of these deposits is consistent with the soil observed in Site B. The two terrain units represent the well-sorted silty sand (Sandy Glaciolacustrine, SG) and the fine sand, silt and clay (Silty/Clayey Glaciolacustrine, CG), respectively (ESG, 2014). The study area was limited to surficial soil (1 meter in depth) within an inclusion zone that avoided characterization of areas that have been influenced by anthropogenic activity. The inclusion zone did not extend 500 meters beyond the area of current or past human activity for a total area of 5 km^2.

In 2016, ESG-RMC performed a Phase II ESA of a former landfill site at Site C in Alberta, Canada was completed (ESG, 2017). Information on the surficial geology at Site C indicates that the area is underlain by Pleistocene-aged sandy glaciofluvial deposits, overlying eroded moraines (Fenton & Andriashek, 1983). Top soil layer consisted of a mixture of sands and clays, and ranged in depth from 0.3 m to approximately 1.0 m (ESG, 2017). The objective of this assessment was to determine whether the former landfill was impacting surrounding areas of the site. Soil samples were collected in and around the landfill and were analyzed for inorganic elements. The study area was limited to surficial soil (1 meter in depth) for a total area of 0.03 km^2.

Background soil samples were collected at each site and were analyzed for a suite of inorganic elements. All analysis was conducted by a Laboratory accredited by the Canadian Association for Laboratory

Accreditation Incorporated to the International Organization for Standardization (ISO) 17025 standard. Soil samples were dry sieved to generate a <2mm grain size fraction subsample and were analyzed by inductively coupled plasma (ICP) and Optical Emission Spectroscopy (OES) after the dissolution of trace elements in Aqua Regia solution.

C.2 Methods

C.2.1 Data Compilation

Background soil data collected from each site was extracted from separate contaminated site investigation reports. Each report was read to understand the approach used to perform the background sampling programs at each site.

C.2.2 Data Screening

Only background soil data from the TB terrain unit (84 samples) at Site A were analyzed to facilitate the comparison of results between each site. The sample size of the TB terrain unit was comparable to the sample size from Sites B and C. Background soil data from each terrain unit (two in total) at the Site B was kept separate throughout the analysis. This yielded 4 separate data sets.

Only inorganic elements with 100% detectable concentrations were carried forward for statistical analysis to avoid influence of values below analytical detection limits on the calculation of background concentrations.

Only soil samples collected within 50 cm below ground surface were included to have consistent sampling depths between all three sites.

Inorganic elements that followed the previous criteria for all three sites were carried forward in the analysis: As, Cr, Co, Cu, Zn, and Ni.

C.2.3 Varying Sample Size for Statistical Analysis

To investigate the influence of sample size, the original data sets were resampled by random data sampling (without replacement) using XLSTAT 2018 (Addinsoft, 2019). New raw data sets were generated for each site by decreasing the sample size. For example, within the CG terrain unit of Site C, 55 samples were collected. From the entire data set (N=55), soil samples were randomly selected (without replacement) to generate a new data set with N equal to 40, 30, 20, and 10, as shown in Table 5.2. Soil samples were randomly selected by the designated soil sample number to simulate a decrease in sample locations at each site. The elements chosen and the sample size for each site are listed in Table 5.2. To assess the consistency of the methods chosen for the selection of sample sets, data sets listed in Table 5.2 were recreated seven additional times using the method described above for a total of eight trials. This resulted in 164 raw data sets of varying sample size for each element.

Table 3.1: Summary of all available soil data sets from each case study.

Site Name	Terrain Unit	Depth (cm)	Inorganic Elements	Number of Samples Collected	Varying Sample Size of Raw Data Sets	Number of Trials
Site A	TB	0-50	As, Cr, Co, Cu, Zn, Ni	84	84, 70, 60, 50, 40, 30, 20, 10	8
Site B	CG	0-50		55	55, 40, 30, 20, 10	8
	SG	0-50		47	47, 40, 30, 20, 10	8
Site C	Entire Site	0-10		60	60, 50, 40, 30, 20, 10	8

Note: All resampled data sets in this table were generated a total of 8 times for each sample size using random resampling techniques.

The site-specific data sets carried forward were generated by averaging the results of trials 1-8 for each sample size.

C.2.4 Background Soil Data Analysis

Outlier Detection

Four univariate outlier tests were applied to all data sets listed in Table 2 to identify the influence of outlier tests on varying sample size. The outlier tests chosen were i) the removal of outliers three times the interquartile range (IQR) above and below the third and first quartiles, respectively; referred to as the interquartile rule (3×IQR) ii) the removal of outliers four standard deviations (SD) above or below the mean (Mean+/-4SD) iii), the removal of outliers three standard deviations above or below the mean (Mean+/-3SD), and iv) the removal of outliers two standard deviations above or below the mean (Mean+/-2SD).

Distribution analysis

The data distribution of each element listed in Table 5.2 was analyzed for each data set individually; including data sets generated after outliers were removed. ProUCL 5.0 software (endorsed by United States Environmental Protection Agency, Singh and Singh, 2013) was used for all distribution analysis. Data sets were tested for a normal distribution using the Shapiro-Wilk test and a Lilliefors test. To test for lognormality, ProUCL 5.0 performs the Shapiro-Wilk test and the Lillifors test on log-transformed data. To test for gamma distributions, a Kolmogorov-Smirnov (K-S) test was employed.

Background Threshold Concentration (BTV) Derivation

BTVs were calculated using ProUCL5.0 (Singh & Singh, 2013). The statistical methods chosen included: i) Mean+2(SD), ii) Median+2Median Absolute Deviations (MAD), iii) 95th percentile ranking, iv) 95% upper confidence limit (95UCL), v) Extreme Outlier Limit (EOL), equivalent to 3 times the interquartile range above the third quartile vi) Upper Prediction Limit (UPL), vii) Upper Tolerance Limit (UTL), and viii) Upper Simultaneous Limit (USL). For each site, the BTVs from each of the 8 trials were averaged for each sample size and outlier detection method.

Evaluation of Statistical Methods Chosen

To test whether there is a significant difference between the BTVs calculated using each method, a post hoc test in the Analysis of Variance (ANOVA) was performed. The Tukey Test, also called Tukey's Honest Significant Difference (HSD) test, was chosen to compare methods for calculating BTVs to determine whether there are significant differences between the values calculated. A non-parametric Kruskal-Wallis one-way analysis of variance was performed to compare to Tukey Test results. Dunnett's multiple comparison tests were performed using the raw data sets without the removal of any outliers as the control group. The tests were performed for each inorganic element, sample size, and each outlier test individually to determine whether these factors would influence the results of the method chosen.

Summary of Approach

Background soil data sets (As, Cr, Co, Cu, Zn, Ni) collected from two remote sites in Northern Alberta and one site on Baffin Island, Nunavut, were used to evaluate sampling designs, sample size, and statistical methods used for background soil data analysis. A total of 4 soil data sets created from 251 unique sampling locations were analyzed in this study. Analysis was performed for a total of 1230 iterations per data set. Figure 5.2 outlines the process applied for evaluation of statistical methods chosen for background soil data analysis.

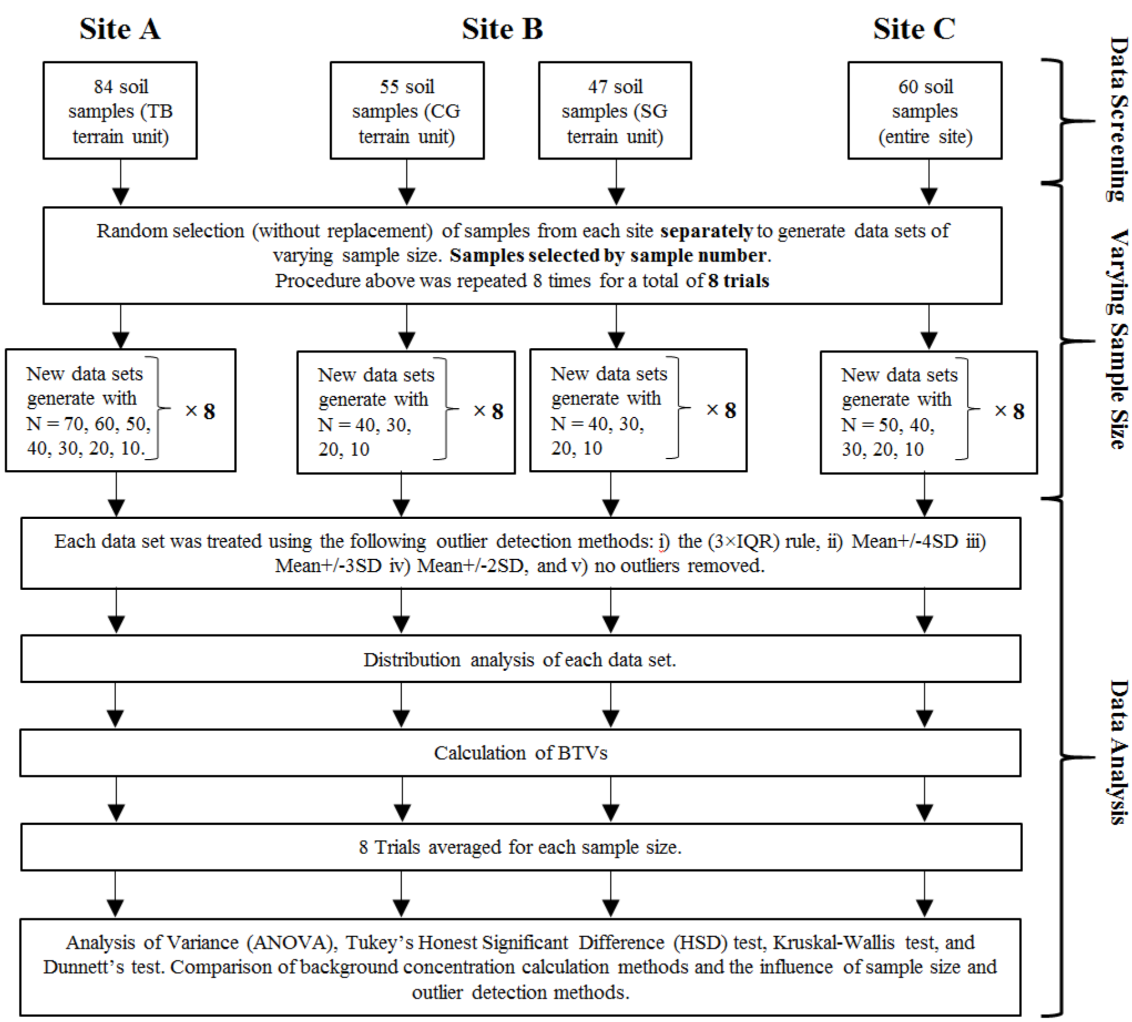

Figure 3.1: Summary of the process applied for evaluation of statistical methods chosen for background soil data analysis.

Example Analysis

Table 2: Site A Background Soil Data.

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.2	20.0	5.0	3.0	5.0	15
G414	1990	0-50	5.3	59.0	7.8	10.7	22.0	54.0
G428	1990	0-50	10.9	113.0	19.0	27.8	28.1	78.0
G429	1990	0-50	4.3	98.0	12.4	13.5	28.7	73.0
06-6960	2006	0-50	7.6	52.7	7.6	32.2	21.6	50.3
06-6961	2006	0-50	16.0	58.0	9.4	41.2	23.4	54.6
06-6964	2006	0-50	7.0	56.7	12.6	32.3	25.1	56.9
06-6965	2006	0-50	5.4	75.5	9.8	39.2	24.8	65.4
06-6968	2006	0-50	10.5	63.4	9.6	28.9	21.9	52.8
06-6975	2006	0-50	3.1	50.9	7.0	16.0	17.3	39.7
06-6976	2006	0-50	3.1	66.3	8.4	26.4	21.3	53.6
06-6977	2006	0-50	6.2	84.4	11.6	37.2	29.5	67.7
06-6978	2006	0-50	21.6	84.4	11.0	37.7	28.7	58.6
06-6979	2006	0-50	14.4	76.7	11.9	48.0	27.4	64.3
06-6980	2006	0-50	11.4	76.7	11.5	38.7	27.5	67.6
06-6981	2006	0-50	10.9	66.9	10.0	32.9	23.6	59.1
06-6982	2006	0-50	7.7	82.5	14.7	47.4	33.5	74.9
06-6983	2006	0-50	12.7	77.2	14.9	39.6	30.9	72.9
06-6984	2006	0-50	14.4	62.6	23.4	38.7	28.5	66.0
06-6985	2006	0-50	18.5	83.9	15.3	46.6	34.2	76.3
06-6986	2006	0-50	8.2	157.2	15.6	33.6	57.0	61.9
06-6987	2006	0-50	8.8	77.5	13.3	35.5	35.5	61.3
06-6988	2006	0-50	11.6	65.5	11.3	36.1	28.4	56.9
06-6989	2006	0-50	13.6	70.9	12.5	38.4	30.6	58.8
06-6990	2006	0-50	11.3	77.2	14.1	49.6	39.6	63.6
06-6991	2006	0-50	13.5	74.0	14.2	50.1	37.3	66.7
06-6992	2006	0-50	16.8	69.5	15.0	52.5	38.2	67.0
06-6993	2006	0-50	4.9	52.4	9.5	23.7	22.0	47.3
06-6994	2006	0-50	5.4	67.8	10.3	29.1	27.6	59.2
06-6995	2006	0-50	9.8	80.5	12.1	42.9	31.7	63.1
06-6996	2006	0-50	11.0	69.9	11.7	39.9	29.2	58.9
06-6997	2006	0-50	11.5	71.7	14.1	43.0	31.4	64.2
06-6998	2006	0-50	18.7	92.7	13.8	44.8	33.9	66.8
06-6999	2006	0-50	16.5	86.2	12.2	44.1	30.9	62.6
06-7000	2006	0-50	11.2	76.3	12.7	39.7	26.9	64.3
06-7001	2006	0-50	15.6	80.7	13.8	45.2	29.1	66.8
06-7002	2006	0-50	10.6	75.5	12.7	45.9	28.6	65.9
06-7003	2006	0-50	3.6	36.9	8.0	16.8	17.4	40.7
06-7004	2006	0-50	2.7	44.0	8.4	20.1	21.5	51.5
06-7005	2006	0-50	3.2	55.9	8.8	18.7	21.6	52.4
06-7006	2006	0-50	3.6	55.9	11.4	22.9	25.4	60.8
06-7007	2006	0-50	5.4	64.7	12.9	31.1	32.3	59.8
06-7008	2006	0-50	7.7	48.6	9.0	16.7	20.3	44.7
06-7009	2006	0-50	9.6	42.8	7.7	22.3	16.7	37.0
06-7010	2006	0-50	8.3	62.2	12.5	32.6	24.6	60.3
06-7011	2006	0-50	7.9	60.5	11.7	31.6	23.8	59.4
06-7012	2006	0-50	7.8	61.6	11.9	35.3	25.8	60.5
06-7013	2006	0-50	14.6	77.6	13.8	45.0	32.5	67.7

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.2	20.0	5.0	3.0	5.0	15
06-7014	2006	0-50	20.6	76.5	12.5	55.2	32.7	67.5
06-7015	2006	0-50	21.2	88.7	13.8	34.1	33.2	64.4
06-7016	2006	0-50	23.0	91.4	14.8	36.9	37.0	73.1
06-7017	2006	0-50	14.2	70.2	11.8	36.9	27.9	63.3
06-7018	2006	0-50	9.5	63.7	10.6	30.9	25.8	58.8
06-7019	2006	0-50	19.3	65.4	12.5	45.8	30.6	66.5
06-7020	2006	0-50	14.6	74.9	12.1	36.2	27.3	62.0
06-7021	2006	0-50	12.4	67.7	10.8	34.1	24.7	57.3
06-7022	2006	0-50	9.4	67.5	10.6	24.3	24.3	55.4
06-7023	2006	0-50	19.3	97.6	14.7	36.0	36.1	81.9
06-7024	2006	0-50	14.9	83.9	14.8	42.8	35.7	82.5
06-7028	2006	0-50	8.1	62.9	11.6	22.4	26.8	58.7
06-7029	2006	0-50	8.1	57.9	11.7	23.7	26.9	56.3
06-7030	2006	0-50	10.1	50.3	9.5	20.3	27.4	52.5
06-7031	2006	0-50	11.0	54.0	10.9	20.0	34.6	55.7
06-7032	2006	0-50	8.9	55.9	10.8	26.0	29.9	57.6
06-7033	2006	0-50	14.4	64.0	12.5	47.3	36.9	70.1
06-7034	2006	0-50	9.2	69.2	13.0	27.6	28.5	68.3
06-7035	2006	0-50	10.5	78.0	15.9	34.7	36.2	75.2
06-7039	2006	0-50	57.9	48.8	7.7	24.8	16.8	43.4
06-7042	2006	0-50	11.6	82.7	14.5	33.8	33.0	83.3
06-7043	2006	0-50	8.8	93.7	14.0	39.2	34.5	83.5
06-7044	2006	0-50	9.6	72.7	11.7	39.9	27.8	64.4
06-7045	2006	0-50	12.7	76.4	13.3	42.5	30.9	66.1
06-7046	2006	0-50	11.5	41.9	7.8	31.0	20.6	50.6
06-7047	2006	0-50	12.5	47.9	8.1	30.4	21.8	40.3
06-7048	2006	0-50	13.2	52.8	8.8	29.5	21.2	43.3
06-7049	2006	0-50	10.7	77.7	15.0	36.4	36.1	63.2
06-7050	2006	0-50	10.3	82.9	11.7	28.6	33.7	58.4
06-7051	2006	0-50	12.6	80.8	11.2	27.8	32.5	56.9
06-7052	2006	0-50	9.9	67.6	13.3	38.8	26.1	64.5
06-7053	2006	0-50	8.2	67.8	12.9	28.9	29.9	64.3
06-7054	2006	0-50	12.4	75.7	15.2	38.4	33.9	71.0
06-7055	2006	0-50	5.3	35.0	6.5	9.7	13.8	37.6
06-7056	2006	0-50	4.0	34.7	6.0	16.4	13.8	37.4
06-7066	2006	0-50	11.3	74.8	11.9	29.4	29.8	58.8
06-7067	2006	0-50	10.9	71.0	12.5	26.1	30.5	53.1

Table 3: Site B (SG Terrain Unit) Background Soil Data.

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.1	0.5	0.1	0.5	0.5	2
2. Sandy Glaciolacustrine Terrain Unit								
14-37260/61	2014	0-50	6.1	19.8	6.1	6.9	14.5	51.0
14-37263	2014	0-50	8.3	21.9	7.7	12.0	18.2	59.0
14-37275	2014	0-50	2.8	18.6	6.6	5.3	12.7	58.0
14-37276	2014	0-50	8.1	15.0	6.1	15.0	20.1	53.0
14-37277	2014	0-50	3.8	20.2	6.0	4.5	13.9	49.0

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.1	0.5	0.1	0.5	0.5	2
2. Sandy Glaciolacustrine Terrain Unit								
14-37278	2014	0-50	3.1	17.3	5.8	5.2	11.5	45.0
14-37279	2014	0-50	4.7	18.4	6.4	7.1	13.8	46.0
14-37282	2014	0-50	3.9	20.9	7.4	6.6	14.7	52.0
14-37283	2014	0-50	4.7	21.6	7.9	7.7	15.7	59.0
14-37286	2014	0-50	3.9	18.6	6.2	6.6	12.9	44.0
14-37288	2014	0-50	3.0	15.8	5.9	6.4	11.3	50.0
14-37289	2014	0-50	10.1	24.6	8.4	23.3	30.4	67.0
14-37290/91	2014	0-50	2.5	16.8	6.4	6.3	11.6	47.0
14-37292	2014	0-50	3.8	16.7	4.8	5.0	13.2	35.0
14-37293	2014	0-50	3.4	15.5	4.8	4.8	10.9	35.0
14-37295	2014	0-50	3.0	20.5	7.7	8.3	16.2	78.0
14-37296	2014	0-50	5.2	20.4	6.8	8.4	16.4	48.0
14-37297	2014	0-50	3.2	18.3	6.0	4.6	12.7	51.0
14-37299	2014	0-50	5.7	21.0	7.2	8.6	16.1	63.0
14-37300/31	2014	0-50	6.5	18.8	7.2	9.7	15.4	49.0
14-37303	2014	0-50	6.6	19.6	6.1	6.6	14.4	41.0
14-37304	2014	0-50	5.6	20.1	7.4	8.5	16.6	57.0
14-37305	2014	0-50	5.6	24.3	7.8	7.6	17.0	68.0
14-37307	2014	0-50	6.1	22.0	7.4	9.5	18.1	59.0
14-37308	2014	0-50	5.4	15.4	5.7	5.8	12.9	42.0
14-37309	2014	0-50	4.3	21.0	6.3	8.5	15.0	69.0
14-37312	2014	0-50	7.4	26.3	8.9	10.3	21.2	75.0
14-37323	2014	0-50	4.6	20.3	7.5	7.8	14.7	63.0
14-37324	2014	0-50	7.0	20.6	7.4	9.6	16.4	61.0
14-37325	2014	0-50	6.3	22.1	7.2	9.0	16.6	60.0
14-37327	2014	0-50	6.2	20.7	7.1	7.6	15.7	54.0
14-37333	2014	0-50	2.9	20.4	6.4	8.7	13.9	63.0
14-37343	2014	0-50	5.5	19.8	5.0	6.3	13.3	51.0
14-37348	2014	0-50	6.4	21.1	6.6	8.5	16.4	61.0
14-37350/51	2014	0-50	6.5	18.7	6.3	8.3	14.8	47.0
14-37353	2014	0-50	3.0	18.1	5.3	6.5	12.2	51.0
14-37357	2014	0-50	5.3	23.0	6.8	7.9	14.7	62.0
14-37359	2014	0-50	3.2	19.2	6.9	7.7	14.3	60.0
14-37360/61	2014	0-50	6.6	23.3	7.9	9.0	18.3	75.0
14-37284	2014	0-50	4.4	18.7	6.5	6.9	14.7	48.0
14-37287	2014	0-50	4.5	20.8	7.0	7.3	16.0	51.0
14-37320/21	2014	0-50	7.4	22.8	7.8	10.4	18.1	57.0
14-37328	2014	0-50	6.6	21.8	7.3	8.5	16.8	55.0
14-37329	2014	0-50	3.8	24.5	8.4	9.7	17.1	120.0
14-37329	2014	0-50	5.5	22.1	7.3	8.7	16.2	61.0
14-37355	2014	0-50	6.5	24.0	8.1	17.5	20.1	76.0
14-37356	2014	0-50	5.2	19.5	7.7	9.0	14.4	62.0

Table 4: Site B (CG Terrain Unit) Background Soil Data.

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.1	0.5	0.1	0.5	0.5	2

Silty/Clayey Glaciolacustrine Terrain Unit								
14-37252	2014	0-50	8.5	22.1	9.0	21.8	27.3	88.0
14-37264	2014	0-50	6.7	19.9	7.4	20.6	24.3	93.0
14-37270/71	2014	0-50	8.7	23.7	9.5	22.4	28.0	80.0
14-37273	2014	0-50	2.2	17.9	7.1	8.7	13.7	77.0
14-37314	2014	0-50	8.6	33.7	10.5	20.1	28.0	88.0
14-37315	2014	0-50	7.5	29.7	9.7	24.9	36.5	190.0
14-37345	2014	0-50	9.5	29.5	9.9	23.6	36.0	160.0
14-37346	2014	0-50	7.2	27.8	9.3	23.7	32.1	190.0
14-37384	2014	0-50	8.2	21.5	9.1	26.0	29.0	88.0
14-37240/41	2014	0-50	8.2	20.3	8.8	22.1	26.4	95.0
14-37243	2014	0-50	9.2	20.2	9.2	24.0	27.7	98.0
14-37244	2014	0-50	9.0	21.8	9.6	24.0	27.7	100.0
14-37245	2014	0-50	8.1	23.1	10.0	29.8	33.4	110.0
14-37247	2014	0-50	7.6	19.8	8.2	30.6	29.7	66.0
14-37254	2014	0-50	9.4	24.3	9.5	23.7	29.7	94.0
14-37256	2014	0-50	8.1	19.3	7.7	41.1	41.1	72.0
14-37258	2014	0-50	9.5	25.0	9.6	24.9	30.0	90.0
14-37259	2014	0-50	9.9	22.8	6.4	29.6	26.9	53.0
14-37267	2014	0-50	8.9	20.3	9.9	23.9	27.5	100.0
14-37269	2014	0-50	8.0	20.3	11.1	23.6	26.6	96.0
14-37274	2014	0-50	3.4	19.1	7.5	6.7	13.9	58.0
14-37317	2014	0-50	5.9	31.8	7.4	22.6	21.4	180.0
14-37334	2014	0-50	9.8	33.5	10.4	23.3	35.2	110.0
14-37336	2014	0-50	7.0	30.7	5.1	15.0	18.6	100.0
14-37337	2014	0-50	5.9	26.8	6.8	24.0	35.7	140.0
14-37338	2014	0-50	7.6	34.3	10.3	22.6	31.3	110.0
14-37340/41	2014	0-50	2.0	29.1	4.6	27.6	25.0	330.0
14-37342	2014	0-50	7.0	32.0	10.7	23.7	34.9	220.0
14-37352	2014	0-50	3.4	26.9	10.2	20.1	26.5	110.0
14-37368	2014	0-50	7.2	29.3	10.3	22.9	30.3	170.0
14-37382	2014	0-50	7.3	25.9	8.5	20.2	24.2	130.0
14-37383	2014	0-50	8.0	19.4	8.0	24.3	27.1	110.0
14-37246	2014	0-50	8.5	21.2	8.6	21.0	25.3	88.0
14-37249	2014	0-50	5.3	18.4	8.1	29.1	30.6	110.0
14-37250/51	2014	0-50	9.6	21.1	8.0	26.7	25.0	65.0
14-37316	2014	0-50	7.6	29.9	10.8	25.0	34.5	200.0
14-37319	2014	0-50	8.2	33.3	8.9	24.0	35.7	170.0
14-37322	2014	0-50	9.1	32.4	11.2	24.6	33.5	110.0
14-37372	2014	0-50	9.0	28.6	9.9	24.5	33.5	150.0
14-37373	2014	0-50	8.1	30.7	10.9	25.4	31.9	210.0
14-37374	2014	0-50	8.3	28.4	9.6	22.9	34.9	130.0
14-37376	2014	0-50	6.1	29.6	9.8	17.5	32.2	230.0
14-37377	2014	0-50	6.1	27.1	9.6	25.9	42.0	250.0
14-37379	2014	0-50	7.1	22.6	7.8	16.1	23.5	110.0
14-37381	2014	0-50	6.7	29.1	10.1	23.3	32.9	160.0
14-37253	2014	0-50	11.3	23.4	8.9	19.3	24.5	89.0
14-37265	2014	0-50	8.5	21.9	7.9	21.2	24.7	88.0
14-37266	2014	0-50	13.0	14.5	9.8	29.9	31.3	64.0
14-37362	2014	0-50	10.1	30.8	10.7	23.9	30.5	140.0
14-37363	2014	0-50	9.7	30.0	9.6	20.1	29.5	110.0
14-37366	2014	0-50	4.5	26.4	6.7	22.2	27.6	200.0
14-37367	2014	0-50	7.0	29.1	8.7	28.5	33.2	180.0

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.1	0.5	0.1	0.5	0.5	2
Silty/Clayey Glaciolacustrine Terrain Unit								
14-37370/71	2014	0-50	4.9	26.9	6.1	23.4	24.9	150.0
14-37268	2014	0-50	8.5	23.3	9.5	22.2	33.5	130.0
14-37364	2014	0-50	5.9	23.6	5.4	10.4	15.7	100.0

Table 5: Site C Background Soil Data.

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.1	0.5	0.1	0.5	0.5	2
17-69071	2017	0-10	3.7	19.1	5.6	12.2	15.4	37
17-69073	2017	0-10	4.6	20.6	7.1	14.2	18.5	47
17-69075	2017	0-10	1.5	5.9	2.4	2.1	4.5	20
17-69077	2017	0-10	5.7	23.4	8.1	17.0	22.5	48
17-69079	2017	0-10	3.5	17.0	5.0	11.3	13.8	32
17-69084	2017	0-10	2.2	8.8	3.2	2.5	5.8	21
17-69087	2017	0-10	1.7	6.1	2.7	2.5	5.7	10
17-69089	2017	0-10	1.5	8.2	2.6	1.7	5.1	17
17-69092	2017	0-10	1.1	8.2	3.0	1.9	5.3	32
17-69094	2017	0-10	0.9	9.0	2.8	1.8	3.5	19
17-69095	2017	0-10	1.8	9.8	2.9	4.4	6.2	20
17-69097	2017	0-10	2.5	5.2	2.3	1.8	4.5	7
17-69099	2017	0-10	2.7	14.2	4.3	6.3	10.7	23
17-69102	2017	0-10	3.3	17.3	4.9	9.7	13.8	30
17-69104	2017	0-10	2.1	6.9	2.7	5.8	5.9	12
17-69107	2017	0-10	2.0	7.8	2.7	3.1	6.0	11
17-69109	2017	0-10	3.0	15.7	4.7	9.3	12.2	29
17-69112	2017	0-10	3.6	21.6	5.4	16.2	14.3	45
17-69114	2017	0-10	2.4	12.0	3.6	7.1	8.7	25
17-69116	2017	0-10	1.9	8.1	2.9	3.6	6.5	14
17-69118	2017	0-10	0.7	4.9	1.7	1.1	2.5	9
17-69120	2017	0-10	0.9	7.2	2.6	2.2	3.9	19
17-69121	2017	0-10	0.9	6.9	2.7	2.3	3.9	20
17-69123	2017	0-10	1.2	6.2	2.2	1.7	3.9	31
17-69126	2017	0-10	0.6	2.7	1.4	0.8	2.3	21
17-69128	2017	0-10	0.7	7.2	2.6	1.8	3.7	16
17-69130	2017	0-10	0.8	5.8	1.7	1.0	2.6	8
17-69131	2017	0-10	0.7	7.3	1.9	1.1	3.2	9
17-69133	2017	0-10	0.6	2.5	0.9	0.7	2.1	4
17-69135	2017	0-10	2.1	7.8	2.8	2.6	5.9	13
17-69137	2017	0-10	2.0	4.9	2.4	1.8	3.7	8
17-69139	2017	0-10	2.6	14.6	3.5	10.3	9.5	50
17-69144	2017	0-10	0.6	9.0	3.0	1.6	3.9	26
17-69147	2017	0-10	0.6	5.8	1.6	1.3	2.8	12
17-69149	2017	0-10	1.0	5.3	2.0	1.4	3.4	26
17-69152	2017	0-10	3.6	9.6	4.2	8.5	10.1	20
17-69153	2017	0-10	3.0	22.7	6.0	5.2	13.7	32
17-69155	2017	0-10	6.0	26.9	9.3	11.7	18.6	46
17-69157	2017	0-10	2.3	11.4	3.9	4.0	7.7	25

Sample #	Date	Depth (cm)	Arsenic (As)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Nickel (Ni)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lowest Detection Limit			0.1	0.5	0.1	0.5	0.5	2
17-69159	2017	0-10	2.8	19.3	6.5	8.1	14.6	39
17-69162	2017	0-10	2.2	11.8	3.7	6.4	9.1	23
17-69164	2017	0-10	3.0	15.6	4.6	9.2	12.1	29
17-69166	2017	0-10	1.9	8.1	3.0	3.1	6.0	28
17-69168	2017	0-10	1.3	4.9	2.0	1.8	3.9	11
17-69170	2017	0-10	4.5	22.3	7.2	14.0	18.4	38
17-69171	2017	0-10	4.6	24.1	7.2	14.2	18.9	40
17-69173	2017	0-10	3.9	19.1	5.6	10.5	16.2	32
17-69174	2017	0-10	0.5	4.8	1.7	0.8	2.4	30
17-69176	2017	0-10	1.3	4.1	2.2	1.3	3.8	6
17-69177	2017	0-10	1.3	7.6	2.9	2.1	5.0	22
17-69179	2017	0-10	1.0	4.0	1.4	1.3	2.4	9
17-69180	2017	0-10	3.1	15.1	3.8	9.3	10.2	24
17-69181	2017	0-10	1.9	9.5	2.6	5.8	6.9	17
17-69183	2017	0-10	1.0	5.8	2.0	1.4	3.7	11
17-69184	2017	0-10	1.4	8.5	2.5	1.5	4.4	11
17-69187	2017	0-10	1.3	7.1	2.6	2.2	4.2	13
17-69188	2017	0-10	2.7	13.0	3.7	7.0	8.7	31
17-69190	2017	0-10	1.4	7.2	2.4	1.9	4.9	17

C.2.1 Data Analysis Example

The raw Nickel data set is used as an example of data analysis performed. The raw nickel data set of Site B (SG terrain unit) was varied by random data sampling (without replacement) using XLSTAT 2018 (Addinsoft, 2019). New raw data sets were generated for each site by decreasing the sample size as shown in . Soil samples were randomly selected by the designated soil sample number to simulate a decrease in sample locations at each site.

Table 6: Data sets randomly generated from the raw nickel data set (N=47) at Site B (SG terrain Unit).

Trial 1				
Nickel (N=47)	**Nickel (N=40)**	**Nickel (N=30)**	**Nickel (N=20)**	**Nickel (N=10)**
14.45	13.2	12.9	14.8	14.45
18.20	20.1	16.2	12.7	13.9
12.70	16.2	14.4	12.9	15.35
20.10	16.2	16.4	14.45	11.5
13.90	14.3	18.1	15.35	14.4
11.50	15.35	16.6	13.9	18.2
13.80	21.2	15	16.4	17.1
14.70	16.4	14.8	14.3	13.8
15.70	20.1	15.7	16	12.7
12.90	14.4	14.4	16.4	15.7
11.30	14.7	17.1	13.8	
30.40	11.55	13.9	15.7	
11.55	15.7	17	16.6	
13.20	14.45	12.9	15	
10.90	11.3	14.45	10.9	
16.20	18.2	12.2	13.9	
16.40	17	18.1	11.5	
12.70	16.6	13.3	18.25	
16.10	14.7	14.3	12.2	
15.35	14.7	14.7	14.7	
14.40	16	18.2		
16.60	11.5	11.3		
17.00	30.4	16.1		
18.10	13.8	20.1		
12.90	12.9	10.9		
15.00	14.4	14.7		
21.20	13.3	13.2		
14.70	12.7	16.6		
16.40	18.25	13.9		
16.60	18.1	12.7		
15.70	14.7			
13.90	12.2			
13.30	12.9			
16.40	15.7			
14.80	12.7			
12.20	16.4			
14.70	16.6			
14.30	16.1			
18.25	15			
14.70	13.9			
16.00				
18.10				
16.80				
17.10				
16.20				
20.10				
14.40				

Data sets listed in Table 5 were recreated seven additional times using the method described above for a total of eight trials. The data set in Table 5 were screened for outliers using 4 separate outlier detection method in addition to not removing outliers. Background concentrations were calculated for each data set, as shown in Table 6.

Table 7: Background concentrations results for all nickel data sets from Site A (SG terrain unit) without the removal of outliers

Trail	N	UTL	UPL	USL	Mean+2SD	Mean+3SD	95%tile	95UCL	Med+2MAD	EOL
1	10	20.5	18.5	19.0	18.6	20.5	17.7	15.9	16.6	21.0
2	10	23.0	20.4	21.0	20.4	23.0	19.2	16.9	17.7	25.3
3	10	23.0	20.4	21.0	20.4	23.0	19.3	16.8	17.6	24.6
4	10	19.8	18.1	18.5	18.1	19.9	16.7	15.7	18.0	24.4
5	10	22.0	19.3	20.0	19.3	22.0	18.4	15.8	16.7	22.5
6	10	20.9	18.6	19.2	18.6	21.0	17.7	15.5	17.1	25.8
7	10	20.6	18.8	19.3	18.9	20.6	18.2	16.5	16.9	22.3
8	10	19.7	18.1	18.5	18.2	19.7	17.6	16.0	16.3	20.9
1	20	18.9	17.8	19.2	18.1	19.9	16.7	15.2	17.1	22.4
2	20	21.6	20.1	21.9	20.5	22.8	20.2	17.0	20.0	26.6
3	20	20.6	19.4	21.0	19.7	21.7	18.3	16.6	18.5	24.8
4	20	20.0	18.6	20.4	19.0	21.3	18.2	15.5	17.1	25.3
5	20	21.1	19.7	21.4	20.0	22.3	18.3	16.5	18.6	26.8
6	20	26.3	23.1	27.1	24.0	27.9	20.6	17.9	19.4	25.3
7	20	27.0	23.2	28.1	24.0	28.4	21.7	17.4	18.1	26.9
8	20	21.3	19.7	21.7	20.1	22.6	18.4	16.1	18.0	26.4
1	30	19.8	18.8	21.0	19.2	21.4	18.2	15.7	17.9	25.9
2	30	23.6	21.4	26.3	22.3	25.9	19.3	16.5	18.2	26.5
3	30	24.9	22.5	27.7	23.2	26.8	20.7	17.4	19.0	25.1
4	30	20.7	19.5	22.0	20.0	22.4	19.3	16.1	18.7	26.7
5	30	23.5	21.3	26.1	22.4	26.0	20.1	16.6	17.6	24.5
6	30	24.2	21.9	26.9	22.7	26.4	20.7	16.9	17.8	24.3
7	30	20.1	19.1	21.3	19.5	21.7	19.3	16.0	17.9	24.2
8	30	24.8	22.4	27.6	23.1	26.8	20.7	17.3	18.4	27.7
1	40	22.8	21.1	26.2	22.0	25.4	20.2	16.5	18.0	24.8
2	40	20.5	19.5	22.3	20.0	22.4	20.1	16.1	18.3	25.0
3	40	23.0	21.3	26.4	22.1	25.4	20.2	16.6	17.9	24.9
4	40	22.1	20.5	25.3	21.5	24.7	18.3	16.1	17.8	24.6
5	40	23.4	21.6	27.1	22.3	25.7	20.2	16.6	18.8	27.6
6	40	23.0	21.3	26.6	22.1	25.5	20.2	16.6	18.6	25.0
7	40	22.7	21.1	26.0	22.1	25.3	20.2	16.7	18.3	24.9
8	40	20.5	19.5	22.3	20.0	22.4	20.1	16.0	17.9	24.7
1	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
2	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
3	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
4	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
5	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
6	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
7	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9
8	47	22.4	20.9	26.2	21.7	24.9	20.1	16.4	18.2	24.9

From the concentrations values in Table 6, trials 1 to 8 were averaged for each sample size and a standard deviation was calculated.

Table 8: Average background concentrations and standard deviation for nickel data sets from Site A (SG terrain unit) without the removal of outliers.

	Average Concentration (Trial 1-8)								
N	**UTL**	**UPL**	**USL**	**Mean+2(SD)**	**Mean+3(SD)**	**95%tile**	**95UCL**	**Med+2MAD**	**EOL**
10	21.17	19.02	19.58	19.05	21.22	18.09	16.11	17.10	23.34
20	22.10	20.20	22.61	20.66	23.37	19.05	16.52	18.33	25.55
30	22.71	20.86	24.85	21.56	24.69	19.78	16.55	18.18	25.61
40	22.24	20.73	25.27	21.51	24.60	19.92	16.41	18.18	25.17
47	22.41	20.90	26.24	21.73	24.94	20.10	16.35	18.20	24.85
	Standard Deviation of Average Concentration (Trial 1-8)								
N	**UTL**	**UPL**	**USL**	**Mean+2(SD)**	**Mean+3(SD)**	**95%tile**	**95UCL**	**Med+2MAD**	**EOL**
10	1.23	0.86	0.95	0.85	1.21	0.80	0.49	0.55	1.79
20	2.74	1.85	3.01	2.04	2.90	1.51	0.87	0.94	1.41
30	1.98	1.41	2.72	1.58	2.25	0.87	0.56	0.45	1.20
40	1.07	0.76	1.80	0.89	1.30	0.60	0.26	0.35	0.92
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This procedure was also performed for data sets treated by other outlier methods as shown in Table 8 and Table 9.

Table 9: Average calculated background nickel concentrations at Site B (SG terrain unit) ranked from largest to smallest.

	No Outliers Removed		3×IQR		Mean +/- 4SD		Mean +/- 3SD		Mean +/- 2SD	
	USL	26.2	EOL	24.7	EOL	24.7	EOL	24.7	EOL	24.7
	Mean+3SD	24.9	USL	22.2	USL	22.2	USL	22.2	USL	22.2
	EOL	24.9	Mean+3SD	22.1	Mean+3SD	22.1	Mean+3SD	22.1	Mean+3SD	22.1
	UTL	22.4	UTL	20.2	UTL	20.2	UTL	20.2	UTL	20.2
N=47	Mean+2SD	21.7	Mean+2SD	19.8	Mean+2SD	19.8	Mean+2SD	19.8	Mean+2SD	19.8
	UPL	20.9	95%tile	19.6	95%tile	19.6	95%tile	19.6	95%tile	19.6
	95%tile	20.1	UPL	19.3	UPL	19.3	UPL	19.3	UPL	19.3
	Med+2MAD	18.2	Med+2MAD	18.0	Med+2MAD	18.0	95UCL	18.0	Med+2MAD	18.0
	95UCL	16.4	95UCL	15.8	95UCL	15.8	Med+2MAD	15.8	95UCL	15.8
	USL	25.3	EOL	25.0	EOL	25.0	EOL	25.0	EOL	24.8
	EOL	25.2	Mean+3SD	22.2	Mean+3SD	22.2	Mean+3SD	22.2	Mean+3SD	21.8
	Mean+3SD	24.6	USL	22.0	USL	22.0	USL	22.0	USL	21.6
	UTL	22.2	UTL	20.3	UTL	20.3	UTL	20.3	UTL	20.0
N=40	Mean+2SD	21.5	95%tile	19.9	95%tile	19.9	95%tile	19.9	Mean+2SD	19.5
	UPL	20.7	Mean+2SD	19.8	Mean+2SD	19.8	Mean+2SD	19.8	95%tile	19.4
	95%tile	19.9	UPL	19.3	UPL	19.3	UPL	19.3	UPL	19.0
	Med+2MAD	18.2	Med+2MAD	18.0	Med+2MAD	18.0	95UCL	18.0	Med+2MAD	18.0
	95UCL	16.4	95UCL	15.9	95UCL	15.9	Med+2MAD	15.9	95UCL	15.8
	EOL	25.6	EOL	24.8	EOL	25.4	EOL	24.8	EOL	24.8
	USL	24.8	Mean+3SD	22.2	Mean+3SD	23.1	Mean+3SD	22.2	Mean+3SD	23.3
	Mean+3SD	24.7	USL	21.7	USL	23.0	USL	21.7	USL	22.8
	UTL	22.7	UTL	20.5	UTL	21.4	UTL	20.5	UTL	21.4
N=30	Mean+2SD	21.6	Mean+2SD	19.8	Mean+2SD	20.5	Mean+2SD	19.8	Mean+2SD	20.5
	UPL	20.9	UPL	19.3	UPL	19.9	UPL	19.3	UPL	20.0
	95%tile	19.8	95%tile	19.2	95%tile	19.4	95%tile	19.2	95%tile	19.3
	Med+2MAD	18.2	Med+2MAD	17.9	Med+2MAD	18.1	95UCL	17.9	Med+2MAD	17.9
	95UCL	16.5	95UCL	16.0	95UCL	16.2	Med+2MAD	16.0	95UCL	16.2
	EOL	25.5	EOL	25.4	EOL	25.5	EOL	25.4	EOL	25.0
	Mean+3SD	23.4	Mean+3SD	22.0	Mean+3SD	23.4	Mean+3SD	22.0	Mean+3SD	22.0
	USL	22.6	USL	21.1	USL	22.6	USL	21.1	USL	21.1
	UTL	22.1	UTL	20.8	UTL	22.1	UTL	20.8	UTL	20.8
N=20	Mean+2SD	20.7	Mean+2SD	19.7	Mean+2SD	20.7	Mean+2SD	19.7	Mean+2SD	19.7
	UPL	20.2	UPL	19.3	UPL	20.2	UPL	19.3	UPL	19.3
	95%tile	19.1	95%tile	18.8	95%tile	19.1	95%tile	18.8	95%tile	18.5
	Med+2MAD	18.3	Med+2MAD	18.3	Med+2MAD	18.3	95UCL	18.3	Med+2MAD	18.1
	95UCL	16.5	95UCL	16.2	95UCL	16.5	Med+2MAD	16.2	95UCL	16.1
	EOL	23.3	EOL	23.3	EOL	23.3	EOL	23.3	EOL	23.1
	Mean+3SD	21.2	Mean+3SD	21.2	Mean+3SD	21.2	Mean+3SD	21.2	Mean+3SD	20.8
	UTL	21.2	UTL	21.2	UTL	21.2	UTL	21.2	UTL	20.8
	USL	19.6	USL	19.6	USL	19.6	USL	19.6	USL	19.2
N=10	Mean+2SD	19.0	Mean+2SD	19.0	Mean+2SD	19.0	Mean+2SD	19.0	Mean+2SD	18.8
	UPL	19.0	UPL	19.0	UPL	19.0	UPL	19.0	UPL	18.7
	95%tile	18.1	95%tile	18.1	95%tile	18.1	95%tile	18.1	95%tile	17.8
	Med+2MAD	17.1	Med+2MAD	17.1	Med+2MAD	17.1	95UCL	17.1	Med+2MAD	17.0
	95UCL	16.1	95UCL	16.1	95UCL	16.1	Med+2MAD	16.1	95UCL	16.0

Table 10: Standard deviation of the average calculated nickel concentrations at Site B (SG Terrain Unit) ranked from largest to smallest.

	No Outliers Removed		3×IQR		Mean +/- 4SD		Mean +/- 3SD		Mean +/- 2SD	
N=47	EOL	0.0	EOL	0.0	EOL	0.0	EOL	0.0	EOL	0.0
	USL	0.0	USL	0.0	USL	0.0	USL	0.0	USL	0.0
	UTL	0.0	UTL	0.0	UTL	0.0	UTL	0.0	UTL	0.0
	UPL	0.0	UPL	0.0	UPL	0.0	UPL	0.0	UPL	0.0
	Mean+3SD	0.0	Mean+3SD	0.0	Mean+3SD	0.0	Mean+3SD	0.0	Mean+3SD	0.0
	Mean+2SD	0.0	Mean+2SD	0.0	Mean+2SD	0.0	Mean+2SD	0.0	Mean+2SD	0.0
	Med+2MAD	0.0	Med+2MAD	0.0	Med+2MAD	0.0	Med+2MAD	0.0	Med+2MAD	0.0
	95%tile	0.0	95%tile	0.0	95%tile	0.0	95%tile	0.0	95%tile	0.0
	95UCL	0.0	95UCL	0.0	95UCL	0.0	95UCL	0.0	95UCL	0.0
N=40	USL	1.8	EOL	0.8	EOL	0.8	EOL	0.8	95%tile	0.9
	Mean+3SD	1.3	95%tile	0.6	95%tile	0.6	95%tile	0.6	EOL	0.9
	UTL	1.1	Mean+3SD	0.4	Mean+3SD	0.4	Mean+3SD	0.4	USL	0.7
	EOL	0.9	USL	0.4	USL	0.4	USL	0.4	Mean+3SD	0.7
	Mean+2SD	0.9	UTL	0.4	UTL	0.4	UTL	0.4	UTL	0.6
	UPL	0.8	Mean+2SD	0.3	Mean+2SD	0.3	Mean+2SD	0.3	Mean+2SD	0.5
	95%tile	0.6	UPL	0.3	UPL	0.3	UPL	0.3	UPL	0.5
	Med+2MAD	0.4	Med+2MAD	0.3	Med+2MAD	0.3	95UCL	0.3	Med+2MAD	0.3
	95UCL	0.3	95UCL	0.2	95UCL	0.2	Med+2MAD	0.2	95UCL	0.2
N=30	USL	2.7	EOL	1.3	USL	2.7	EOL	1.3	Mean+3SD	2.6
	Mean+3SD	2.2	95%tile	0.7	Mean+3SD	2.2	95%tile	0.7	USL	2.5
	UTL	2.0	Mean+3SD	0.6	UTL	2.0	Mean+3SD	0.6	UTL	2.1
	Mean+2SD	1.6	USL	0.6	Mean+2SD	1.6	USL	0.6	Mean+2SD	1.8
	UPL	1.4	UTL	0.6	UPL	1.5	UTL	0.6	UPL	1.7
	EOL	1.2	Mean+2SD	0.5	EOL	1.3	Mean+2SD	0.5	95%tile	1.1
	95%tile	0.9	UPL	0.5	95%tile	0.9	UPL	0.5	EOL	1.1
	95UCL	0.6	Med+2MAD	0.4	95UCL	0.7	95UCL	0.4	95UCL	0.7
	Med+2MAD	0.4	95UCL	0.3	Med+2MAD	0.5	Med+2MAD	0.3	Med+2MAD	0.5
N=20	USL	3.0	EOL	1.4	USL	3.0	EOL	1.4	Mean+3SD	2.5
	Mean+3SD	2.9	95%tile	1.2	Mean+3SD	2.9	95%tile	1.2	USL	2.3
	UTL	2.7	Mean+3SD	1.0	UTL	2.7	Mean+3SD	1.0	UTL	2.1
	Mean+2SD	2.0	Med+2MAD	0.9	Mean+2SD	2.0	95UCL	0.9	Mean+2SD	1.8
	UPL	1.8	USL	0.9	UPL	1.8	USL	0.9	UPL	1.7
	95%tile	1.5	UTL	0.9	95%tile	1.5	UTL	0.9	EOL	1.4
	EOL	1.4	Mean+2SD	0.7	EOL	1.4	Mean+2SD	0.7	95%tile	1.3
	Med+2MAD	0.9	UPL	0.7	Med+2MAD	0.9	UPL	0.7	Med+2MAD	1.0
	95UCL	0.9	95UCL	0.6	95UCL	0.9	Med+2MAD	0.6	95UCL	0.9
N=10	EOL	1.8	EOL	1.8	EOL	1.8	EOL	1.8	EOL	2.0
	UTL	1.2	UTL	1.2	UTL	1.2	UTL	1.2	Mean+3SD	1.4
	Mean+3SD	1.2	Mean+3SD	1.2	Mean+3SD	1.2	Mean+3SD	1.2	UTL	1.4
	USL	1.0	USL	1.0	USL	1.0	USL	1.0	USL	1.2
	UPL	0.9	UPL	0.9	UPL	0.9	UPL	0.9	95%tile	1.1
	Mean+2SD	0.8	Mean+2SD	0.8	Mean+2SD	0.8	Mean+2SD	0.8	UPL	1.1
	95%tile	0.8	95%tile	0.8	95%tile	0.8	95%tile	0.8	Mean+2SD	1.1
	Med+2MAD	0.5	Med+2MAD	0.5	Med+2MAD	0.5	95UCL	0.5	95UCL	0.7
	95UCL	0.5	95UCL	0.5	95UCL	0.5	Med+2MAD	0.5	Med+2MAD	0.6

Table 11: Each background concentration method ranked from highest concentration (1st) to lowest concentration (9th) in all background concentration calculations. Percentage value indicates frequency that each method was ranked in all concentration calculations.

	Site A (TB Terrain Unit)								
Rank	EOL	USL	Mean+3SD	UTL	Mean+2SD	UPL	95%tile	Med+2MAD	95UCL
1st	99%	0%	0%	1%	0%	0%	0%	0%	0%
2nd	1%	54%	35%	10%	0%	0%	0%	0%	0%
3rd	0%	34%	64%	2%	0%	0%	0%	0%	0%
4th	0%	12%	0%	87%	0%	0%	0%	0%	0%
5th	0%	0%	0%	0%	77%	15%	8%	0%	0%
6th	0%	0%	0%	0%	23%	74%	3%	0%	0%
7th	0%	0%	0%	0%	0%	11%	60%	28%	0%
8th	0%	0%	0%	0%	0%	0%	28%	72%	0%
9th	0%	0%	0%	0%	0%	0%	0%	0%	100%

	Site B (SG Terrain Unit)								
Rank	EOL	Mean+3SD	USL	UTL	Mean+2SD	UPL	95%tile	Med+2MAD	95UCL
1st	94%	0%	5%	1%	0%	0%	0%	0%	0%
2nd	5%	65%	21%	9%	0%	0%	0%	0%	0%
3rd	1%	34%	54%	11%	0%	0%	0%	0%	0%
4th	0%	1%	21%	79%	0%	0%	0%	0%	0%
5th	0%	0%	0%	0%	87%	11%	2%	0%	0%
6th	0%	0%	0%	0%	13%	77%	9%	2%	0%
7th	0%	0%	0%	0%	0%	13%	68%	19%	0%
8th	0%	0%	0%	0%	0%	0%	21%	75%	3%
9th	0%	0%	0%	0%	0%	0%	0%	3%	97%

	Site B (CG Terrain Unit)								
Rank	EOL	Mean+3SD	USL	UTL	Mean+2SD	UPL	95%tile	Med+2MAD	95UCL
1st	79%	7%	9%	5%	0%	0%	0%	0%	0%
2nd	12%	43%	37%	7%	0%	0%	0%	0%	0%
3rd	5%	24%	37%	28%	5%	0%	0%	0%	0%
4th	3%	8%	15%	54%	0%	17%	0%	3%	0%
5th	0%	17%	3%	3%	54%	23%	0%	0%	0%
6th	0%	0%	0%	3%	39%	43%	9%	7%	0%
7th	0%	0%	0%	0%	0%	18%	27%	53%	0%
8th	0%	0%	0%	0%	0%	0%	63%	36%	0%
9th	0%	0%	0%	0%	0%	0%	0%	0%	100%

	Site C								
Rank	EOL	USL	UTL	Mean+3SD	UPL	Mean+2SD	95%tile	Med+2MAD	95UCL
1st	54%	40%	6%	0%	0%	0%	0%	0%	0%
2nd	40%	31%	16%	13%	0%	0%	0%	0%	0%
3rd	6%	21%	40%	33%	0%	0%	0%	0%	0%
4th	0%	9%	38%	42%	11%	0%	0%	0%	0%
5th	0%	0%	0%	11%	59%	13%	17%	0%	0%
6th	0%	0%	0%	0%	12%	44%	43%	0%	0%
7th	0%	0%	0%	0%	18%	42%	38%	2%	0%
8th	0%	0%	0%	0%	0%	0%	2%	86%	12%
9th	0%	0%	0%	0%	0%	0%	0%	12%	88%

Table 12: Each background concentration method ranked from highest standard deviation (1st) to standard deviation (9th) in all background concentration calculations. Percentage value indicates frequency that each method was ranked in all concentration calculations.

Site A (TB Terrain Unit)

Rank	EOL	Mean+3SD	USL	UTL	Mean+2SD	95%tile	Med+2MAD	UPL	95UCL
1st	86%	11%	1%	1%	0%	0%	0%	0%	0%
2nd	4%	31%	15%	16%	0%	0%	17%	18%	0%
3rd	5%	37%	33%	18%	0%	5%	2%	1%	1%
4th	2%	16%	29%	21%	1%	18%	5%	8%	1%
5th	3%	3%	21%	29%	15%	10%	8%	9%	2%
6th	0%	1%	0%	12%	45%	29%	6%	5%	1%
7th	0%	0%	1%	2%	30%	22%	31%	10%	3%
8th	0%	0%	1%	2%	6%	13%	24%	29%	25%
9th	0%	0%	0%	0%	2%	3%	8%	20%	67%

Site B (SG Terrain Unit)

Rank	EOL	Mean+3SD	UTL	USL	Mean+2SD	95%tile	Med+2MAD	UPL	95UCL
1st	73%	11%	4%	7%	0%	0%	0%	5%	0%
2nd	3%	37%	13%	21%	0%	0%	13%	14%	0%
3rd	3%	20%	37%	34%	1%	0%	1%	3%	0%
4th	4%	19%	19%	15%	9%	21%	9%	4%	1%
5th	6%	13%	13%	24%	13%	19%	6%	6%	0%
6th	7%	1%	13%	0%	51%	23%	1%	3%	1%
7th	3%	0%	1%	0%	23%	24%	29%	20%	0%
8th	0%	0%	0%	0%	4%	12%	25%	39%	20%
9th	0%	0%	0%	0%	0%	1%	15%	6%	78%

Site B (CG Terrain Unit)

Rank	EOL	Mean+3SD	UTL	95%tile	USL	Mean+2SD	Med+2MAD	UPL	95UCL
1st	81%	4%	5%	9%	0%	0%	0%	0%	0%
2nd	9%	50%	8%	0%	21%	0%	13%	0%	0%
3rd	5%	25%	44%	1%	22%	0%	4%	0%	0%
4th	2%	18%	27%	25%	20%	1%	6%	1%	1%
5th	0%	2%	9%	21%	33%	12%	15%	4%	5%
6th	0%	1%	4%	15%	5%	57%	6%	11%	2%
7th	3%	0%	1%	21%	0%	21%	33%	15%	6%
8th	0%	1%	0%	2%	0%	7%	19%	55%	17%
9th	0%	0%	1%	7%	0%	2%	5%	15%	70%

Site C

Rank	EOL	Mean+3SD	UTL	95%tile	Med+2MAD	USL	Mean+2SD	UPL	95UCL
1st	64%	28%	7%	0%	0%	0%	0%	0%	0%
2nd	17%	51%	22%	0%	8%	0%	0%	3%	0%
3rd	14%	6%	49%	4%	3%	16%	0%	7%	0%
4th	4%	11%	3%	34%	24%	18%	0%	5%	0%
5th	0%	4%	13%	22%	14%	35%	2%	7%	2%
6th	0%	0%	6%	15%	8%	24%	33%	4%	10%
7th	0%	0%	0%	17%	23%	7%	38%	11%	4%
8th	0%	0%	0%	7%	13%	0%	24%	37%	18%
9th	0%	0%	0%	0%	6%	0%	3%	26%	66%

C.3 Additional Data

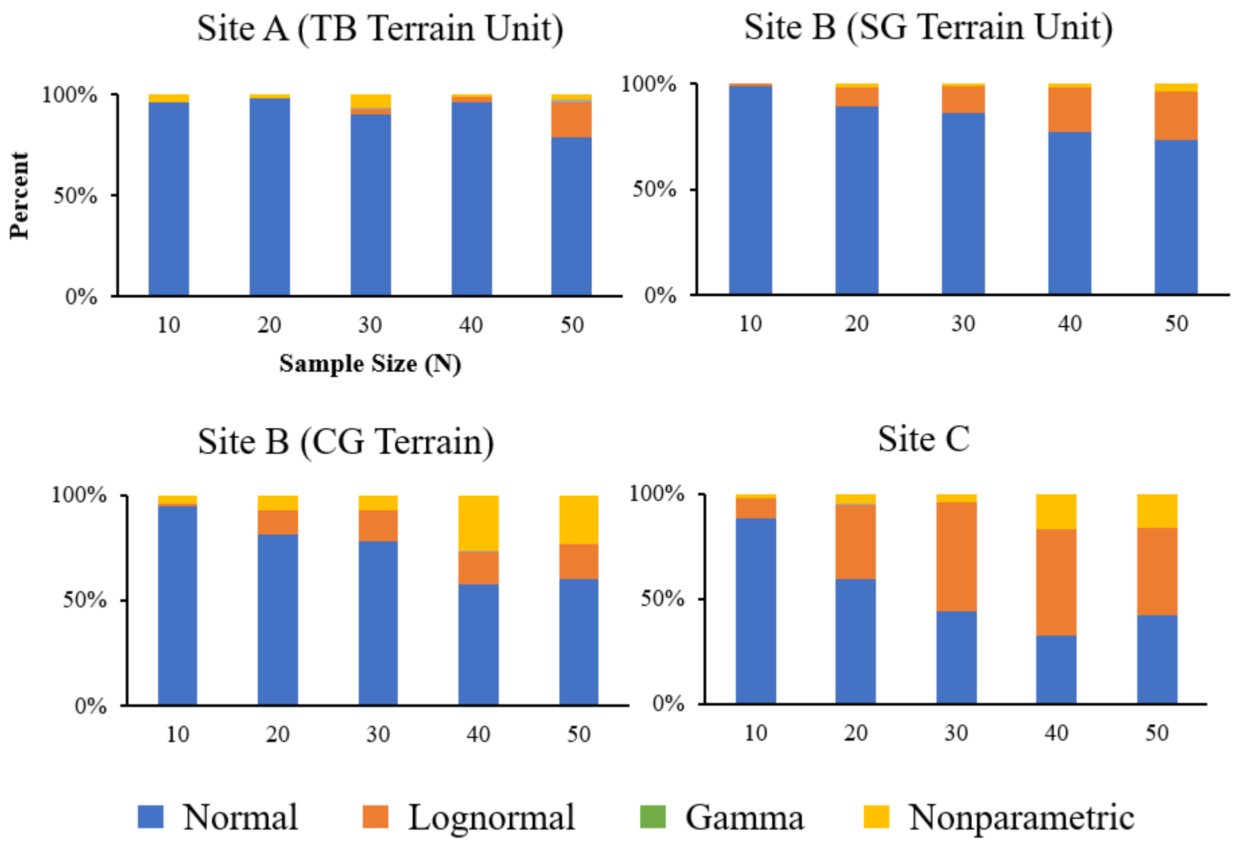

Figure 2: Summary of distribution analysis results for soil data at different sample size for all sites combined. Percent value indicates the frequency in which the data sets conformed to normal, lognormal, or gamma distributions or were considered nonparametric.

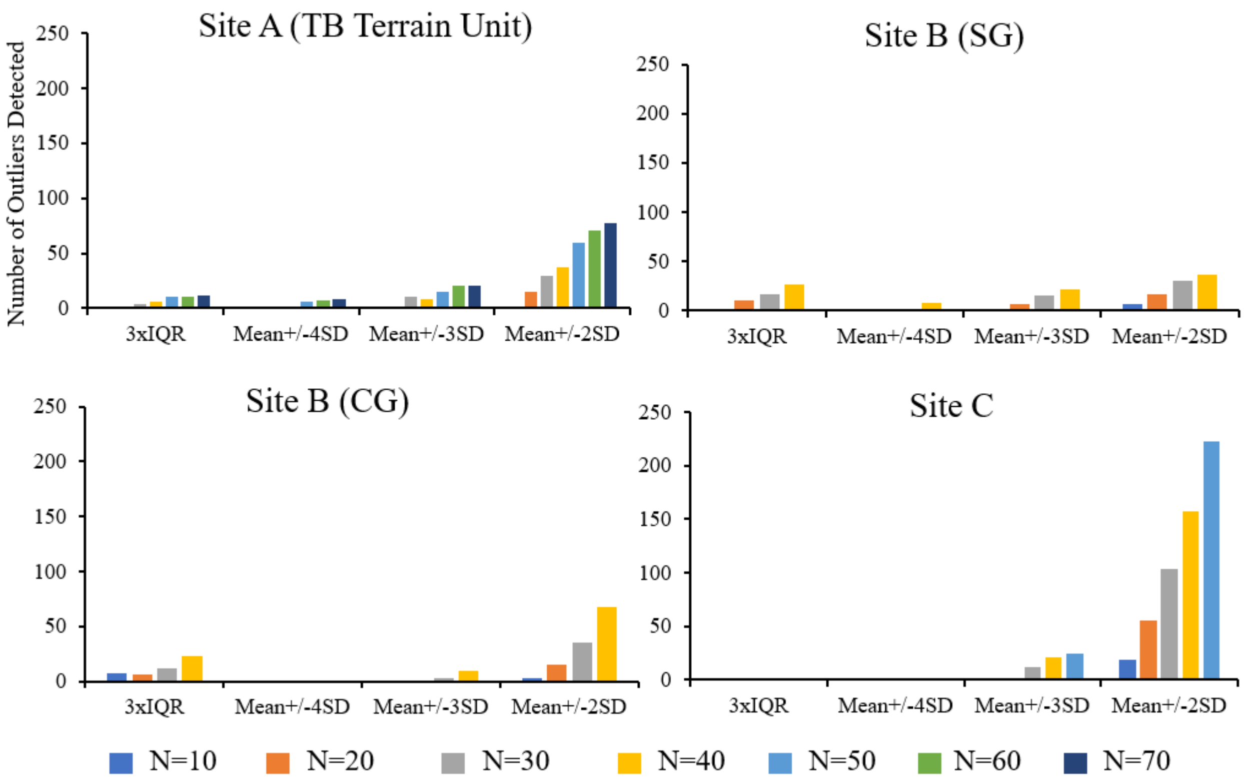

Figure 3: Total number of outliers detected by each outlier detection method.

Table 13: Summary of the Dunnett`s test results for outlier method comparison. Percentage value indicated the frequency that the methods are significantly different (within the 95% confidence interval) from the results with no outliers removed.

Site A (TB Terrain Unit)				
Sample Size	**EOL**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=70	2%	11%	11%	43%
N=60	2%	11%	11%	43%
N=50	13%	17%	17%	46%
N=40	2%	2%	2%	13%
N=30	2%	2%	2%	11%
N=20	2%	2%	0%	0%
N=10	0%	0%	0%	0%
Site B (SG Terrain Unit)				
		Frequency (%)		
Sample Size	**EOL**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=40	19%	28%	30%	46%
N=30	6%	11%	7%	11%
N=20	9%	0%	2%	9%
N=10	0%	0%	2%	0%
Site B (CG Terrain Unit)				
Sample Size	**EOL**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=40	9%	9%	7%	33%
N=30	7%	7%	0%	13%
N=20	2%	2%	0%	0%
N=10	0%	0%	0%	0%
Site C				
Sample Size	**EOL**	**Mean+/-4SD**	**Mean+/-3SD**	**Mean+/-2SD**
N=50	2%	2%	11%	61%
N=40	0%	0%	2%	46%
N=30	0%	0%	4%	15%
N=20	0%	0%	0%	0%
N=10	0%	0%	0%	0%