PART 3

Appendices

APPENDIX A
HUMAN HEALTH RISK ASSESSMENT

Valentine Gold Project: Human Health Risk Assessment, Technical Modelling Report

Final Report

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VALENTINE GOLD PROJECT: HUMAN HEALTH RISK ASSESSMENT, TECHNICAL MODELLING REPORT

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Abbreviations

AAQM	Ambient Air Quality Monitoring
AAQS	Ambient Air Quality Standards
ACB	Air Contaminants Benchamrks
CAAQS	Canadian Ambient Air Quality Standards
CAC	criteria air contaminant
CCME	Canadian Council of Ministers of the Environment
CNF	Central Newfoundland Forest
CO	Carbon Monoxide
COPC	chemical of potential concern
CSM	conceptual site model
CWQG -FAL	Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life
DPM	diesel particulate matter
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EPC	exposure point concentration
FCSAP	Federal Contaminated Sites Action Plan
FNFNES	First Nations Food, Nutrition & Environment Study
HCN	hydrogen cyanide
HHRA	human health risk assessment
km	kilometres
LAA	Local Assessment Area
m	metre
mm	millimetre
mm/yr	millimetres per year
MAC	maximum acceptable concentrations
MDMER	Metal and Diamond Mining Effluent Regulations
MECP	Ontario of the Ministry of Environment, Conservation and Parks
NAPS	National Air Pollutant Surveillance
NL	Newfoundland and Labrador
NLDFLR	Newfoundland and Labrador Department of Fisheries and Land Resources

NO_2	nitrogen dioxide
PA	Project Area
PAA	Protected Areas Association
PAH	polyclic aromatic hydrocarbon
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 um diameter
RAA	Regional Assessment Area
SO_2	sulfur dioxide
SQG	soil quality guideline
TRV	Toxicological Reference Value
TMF	Tailings Management Facility
UCLM	upper confidence limit of the mean
US EPA	United States Environmental Protection Agency
VC	Valued Component
VOC	volatile organic compound
WHO	World Health Organization

1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) proposes to develop an open pit gold mine near Valentine Lake, located in the central region of the Island of Newfoundland, southwest of the Town of Millertown, Newfoundland and Labrador (NL) (Figure 1). The proposed Valentine Gold Project (the Project) will consist primarily of two open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities (the mill), a tailings management facility (TMF), personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities.

The Project is located in a rural region with a history of mining exploration and development activities and other land and resource uses including commercial forestry, hydroelectric developments, outfitting and recreational land use. The mine site is accessed by an existing public access road that extends south from Millertown, approximately 88 kilometres (km) to Marathon's existing exploration camp (Figure 1). Marathon will upgrade and maintain the access road from a turnoff approximately 8 km southwest of Millertown to the mine site, a distance of approximately 76 km.

A human health risk assessment (HHRA) is a scientific study that estimates the nature and magnitude of potential adverse health risks in humans following exposure to Project-related chemical emissions. This HHRA assesses interactions between measured or predicted concentrations of chemicals of potential concern (COPC) in environmental media (i.e., air, soil, water, and food items) that may occur due to Project-related emissions, and the potential for these interactions to result in adverse health risks to human receptors exposed to these media. The HHRA was completed to support the assessment of human health effects as part of the environmental assessment for the Project.

Construction, operation, and decommissioning, rehabilitation and closure of the Project have the potential to alter baseline conditions with respect to the concentrations of chemicals in the air, soil, water and biota near the Project. These changes to the environment have the potential to alter the level of exposure to human receptors. The HHRA quantifies the change to human health risk that may be attributed to the Project by characterizing the change in exposure to Project-related chemicals that human receptors may experience between existing and future conditions. If unacceptable health risks are identified, a HHRA also evaluates the potential for adverse effects to human health and provides recommendations for additional mitigation and monitoring.

The methods and guidance prescribed by Health Canada (Health Canada 2019, 2012, 2010a) were used to assess the human health risks. This approach is intended to protect the health of Indigenous and non-Indigenous people who rely on the viability of the local environment and ecological resources, and the health of off-duty workers housed in the accommodations camp and the exploration camp (Figure 2).

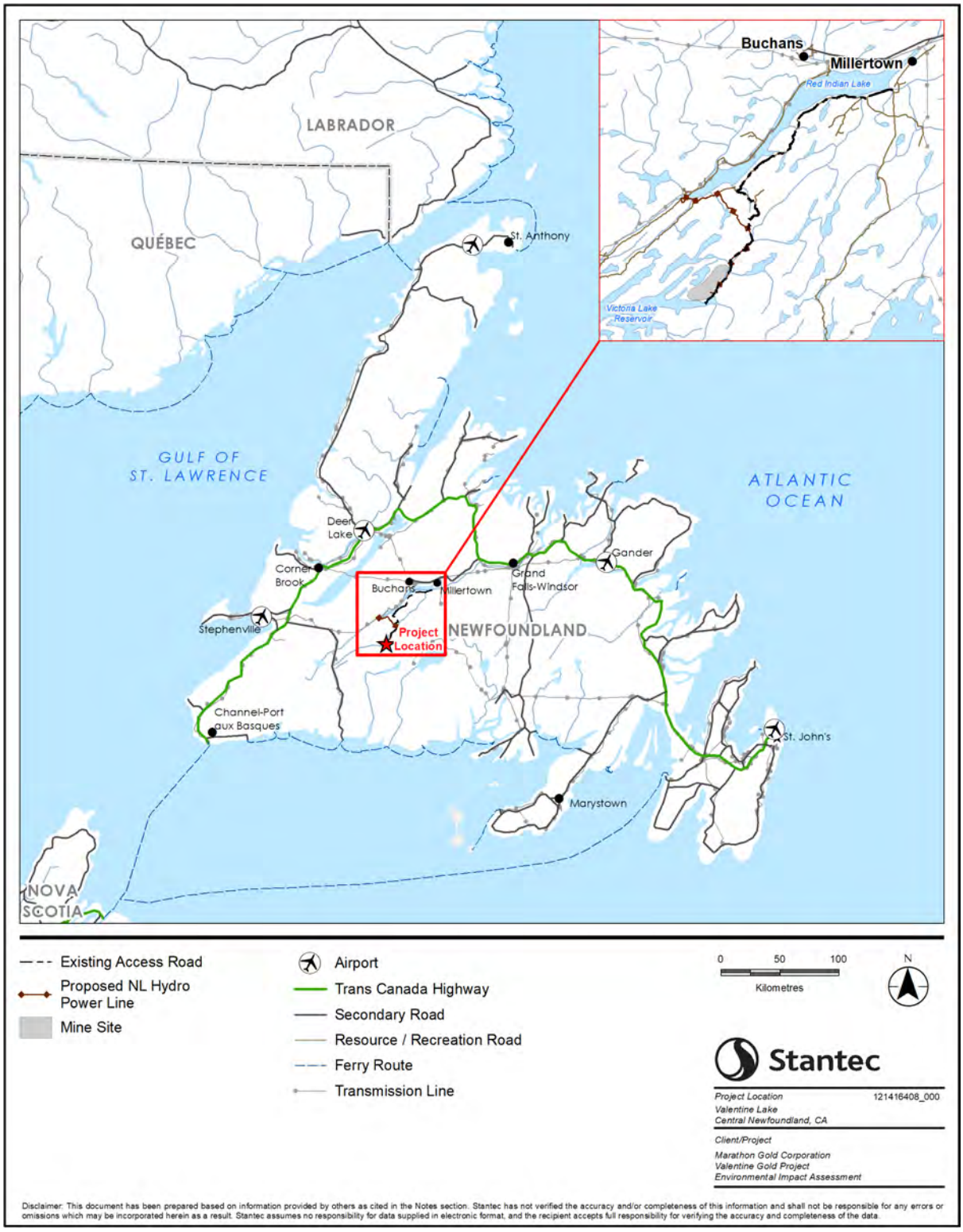

Figure 1-1 Project Location

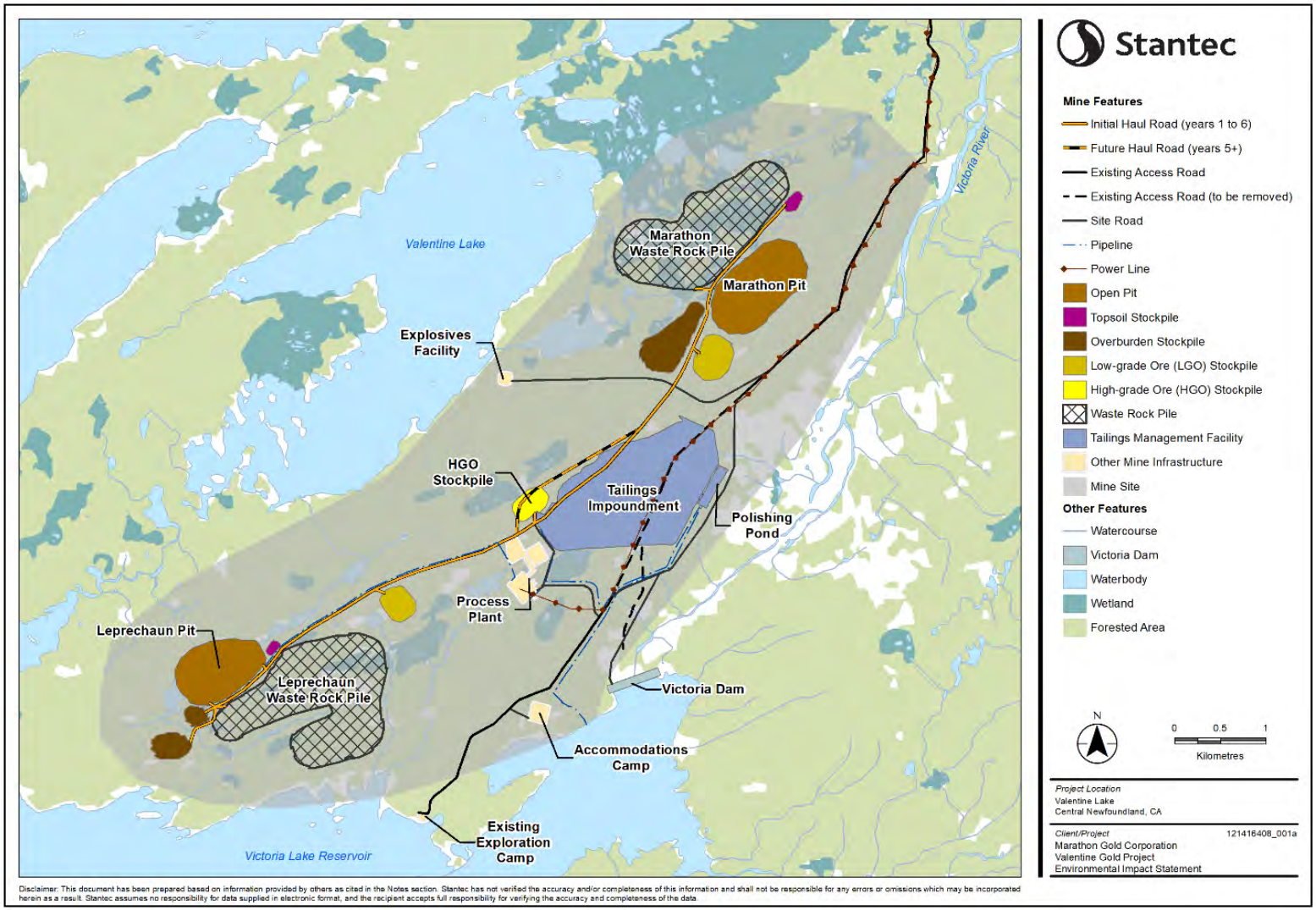

Figure 1-2 Project Site Plan as Presented in the EIS (Marathon 2020)

The information presented in this HHRA applies existing environmental quality data to establish baseline conditions for human health. Modelled future conditions are applied to characterize scenarios associated with the Project. The environmental data representing baseline and future scenarios are presented in the Valued Component (VC) sections of the Environmental Impact Statement (EIS) and associated baseline studies, technical data reports, and modelling reports for Atmospheric Environment, Surface Water, Indigenous Groups, and Community Health (Marathon 2020).

1.1 PROJECT DESCRIPTION

The Project includes two open pit mining areas, the Leprechaun and Marathon deposits (Figure 2), from which ore will be mined using standard surface mining techniques. Ore material will initially be mined and processed at a nominal rate of 6,850 tonnes per day (tpd), increasing to 10,960 tpd in Year 4. Ore will be processed through the mill, where it will be crushed, milled and put through floatation and cyanidation processes to recover the gold. High-grade and low-grade ore materials will be stockpiled for mixing and for processing later in the mine life. Tailings will be treated in the process plant to remove the cyanide and subsequently deposited in an engineered tailings management facility (TMF). Effluent will be treated in a water treatment plant and monitored for compliance with the *Metal and Diamond Mining Effluent Regulations* (MDMER). Gold will be formed into doré bars, which will be shipped from site to market in secured trucks.

As described in the EIS (Marathon 2020), the construction of the Project is expected to take place over a period of approximately 16 to 20 months, followed by an estimated mine operation life of 12 years. The Project will operate 24 hours a day, 7 days a week, on a 12-hour shift basis. Work rotations will be based on 2 weeks on and 2 weeks off, and 4 weeks on and 3 weeks off cycles, depending on the work being conducted. Upon cessation of mining, the operation will be closed and the site components will be decommissioned, rehabilitated and monitored in accordance with applicable regulations at the time of closure.

Other Project components and activities associated with the primary mining, milling and processing activities include site and haul road construction and maintenance, waste rock management, electrical power supply and distribution, process and potable water supply and distribution, and site-wide stormwater and effluent management including treatment, monitoring and discharge. Other Project facilities include fuel storage and fueling stations, mine and plant workshops and services, administrative offices, personnel accommodations, lunchrooms and security. A power line connected from the nearby NL Hydro's Star Lake Generating Station to the mine site will be required to supply power to the Project. The power line will be constructed and operated by NL Hydro and will be subject to separate environmental approvals, with NL Hydro as the proponent; however, it has been considered within this assessment as a contributor to potential cumulative effects. The Project components and activities associated with construction, operation, and decommissioning, rehabilitation and closure are further described in Chapter 2 (Project Description) of the EIS (Marathon 2020).

2.0 HUMAN HEALTH RISK ASSESSMENT METHODS

The HHRA evaluates and characterizes the short-term (acute) and long-term (chronic) health risk to human receptors from their exposure to chemicals in environmental media (e.g., air, soil, water and biota).

In the context of an environmental assessment for major infrastructure projects, the HHRA evaluates the potential change in human health risk that may occur between baseline environmental conditions and future conditions, during the various phases of the Project. Baseline environmental conditions may be based on historical monitoring data, measured data collected during baseline studies, or modelled data. Future conditions are based on modelled data that reflect predicted environmental conditions during the construction, operations, decommissioning, reclamation, closure, and post-closure phases of the Project.

The HHRA considers three scenarios or cases in evaluating the potential changes in human health risks. These include:

1. Baseline Case: evaluates the existing exposures and health risks based on the measured chemical concentrations in environmental media (air, soil, water, sediment, plants, and fish).
2. Future Case: evaluates the future health risks based on the predicted chemical concentrations in environmental media, as determined through detailed modelling from other VC chapters (e.g., air quality, surface water quality). These modelling results are used to predict the future chemical concentrations in exposure media to which human receptors are exposed (i.e., air, water, soil, sediment, vegetation, wild meat and fish)
3. Project Alone Case: evaluates health risks associated with exposure to predicted chemical concentrations in environmental media that are attributable only to Project activities (i.e., these do not consider the contribution that Baseline Case concentrations make to overall exposure). Project Alone Case concentrations are used in the HHRA to evaluate the potential incremental increase in lifetime cancer risk that would be associated with the release of carcinogenic chemicals from the Project.

The change in health risk from Baseline Case to Future Case during the various phases of the Project is the basis for determining whether the Project may result in an unacceptable risk to human health.

The following sections describe the underlying concepts and approach to conducting an HHRA that is prescribed by Health Canada, the Canadian Council of Ministers of the Environment (CCME), and the Federal Contaminated Sites Action Plan (FCSAP).

2.1 COMPONENTS OF HEALTH RISK

All chemicals have the potential to cause adverse health effects to biological organisms. The presence of health risk depends on three factors:

1. the presence of a human receptor
2. the presence of a COPC with inherent toxicity

3. the exposure pathway and the degree of human exposure to a chemical

As illustrated in Figure 3, a risk may exist where all three factors of health risk interact (i.e., a receptor is exposed to a chemical hazard). The degree of adverse health risk depends on other factors, such as the exposure dose or concentration, exposure duration, and the inherent toxicity of the chemical to the human receptor.

If one or more factors(s) is absent, there would be no potential health risk. Also, if a receptor is exposed to a chemical that is inherently non-toxic, then there is no potential risk.

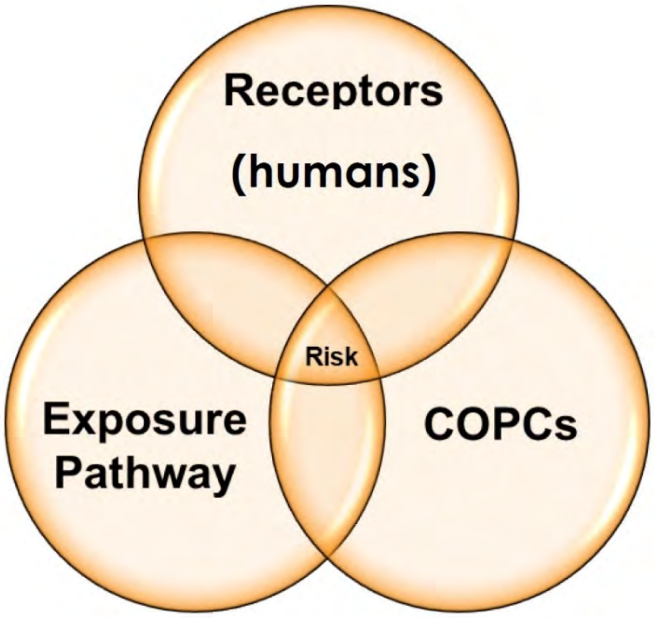

Figure 2-1 Considerations for a Quantitative HHRA (after Health Canada 2019)

2.2 RISK ASSESSMENT APPROACH AND FRAMEWORK

This HHRA was conducted according to accepted risk assessment methodologies and followed guidance published and endorsed by regulatory agencies such as Health Canada, the CCME, and the FCSAP. This approach is consistent with previous projects that have been reviewed by the Impact Assessment Agency of Canada. The HHRA applied the following guidance for assessing human health for an environmental assessment:

- Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment (Health Canada 2019)
- Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment: Air Quality (Health Canada 2017a)

- Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment: Country Foods (Health Canada 2017b)
- Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment: Drinking and Recreational Water Quality (Health Canada 2016a)

The HHRA guidance applicable to federal contaminated sites in Canada was also considered where applicable, including:

- Federal Contaminated Sites Risk Assessment in Canada, Part I: Guidance on Human Health Risk Preliminary Quantitative Risk Assessment (PQRA), Version 2.0 (Health Canada 2012)
- Federal Contaminated Sites Risk Assessment in Canada, Part V: Guidance on Complex Human Health Detailed Quantitative Risk Assessment For Chemicals ($DQRA_{CHEM}$) (Health Canada 2010a)
- Federal Contaminated Sites Risk Assessment in Canada, Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors Version 2.0 (Health Canada 2010b)Federal Contaminated Site Risk Assessment in Canada: Supplemental Guidance on Human Health Risk Assessment for Country Foods ($HHRA_{Foods}$) (Health Canada, 2010c)

The basic risk assessment framework includes the following fundamental stages: site characterization, problem formulation, toxicological assessment, exposure assessment, risk characterization, and uncertainty assessment. Each component is discussed below:

- The **Site Characterization** stage includes a review of existing biophysical, chemical, and land use information completed in support of the Environmental Assessment (EA) and identifies the information that is relevant to the HHRA. The identification of COPCs and the modelled predictions of chemical concentrations in biotic and abiotic environments are presented in this stage.
- The **Problem Formulation** stage is an information gathering and interpretation stage that is employed to focus the HHRA on the primary areas of concern for the Project. Problem formulation defines the nature and scope of the risk assessment, permits practical boundaries to be placed on the overall scope, and confirms that the HHRA is directed at the key areas and issues of concern related to the Project emissions. The data gathered provide information regarding the physical layout and characteristics of the assessment area (e.g., the LAA), possible exposure pathways, potential human receptors, and other specific areas or issues of concern.
- The **Toxicity Assessment** stage involves the selection of toxicity reference values (TRVs) and the identification of regulatory benchmarks for each COPC as appropriate. Toxicity is the potential for a chemical to produce permanent or temporary damage to the structure or functioning of the receptor's body. The toxicity of a chemical depends on the amount of chemical taken into the body (referred to as the "dose") and the duration of exposure (i.e., the length of time the receptor is exposed to the chemical). A specific dose and duration of exposure necessary to produce a toxic effect is defined for each COPC, with TRVs published by provincial, federal or international (e.g., United States Environmental Protection Agency [US EPA]) agencies.
- The **Exposure Assessment** stage builds on the receptor and exposure pathway identification completed in the problem formulation stage. For each COPC, exposures are estimated for each receptor, for each of the exposure pathways relevant to that receptor. The rate of exposure to chemicals may be expressed as a dose, which is the amount of chemical taken in per body weight

per unit time (e.g., microgram (µg) of chemical per kilogram (kg) body weight per day), or as a concentration in the exposure pathway (e.g., when considering health risks to people from the inhalation of COPC, the rate of exposure would be the chemical concentration in air) or environmental media. Exposures are estimated for Baseline Case and Future Case. For carcinogenic COPC, exposures are also estimated for the Project Alone Case.

- The **Risk Characterization** stage involves assessing qualitatively and quantitatively the potential risk to receptors from exposure to COPC. The risk characterization compares the results of the exposure assessment with the TRV established in the toxicity assessment to quantify the level of health risk associated with the predicted exposures. Within an EA framework, the health risks associated with the Future Case are compared to the health risks associated with Baseline Case to provide the context for how the Project may affect health.
- The **Uncertainty Assessment** stage involves identifying the uncertainties associated with the data used in the assessment and predicting how these uncertainties may influence the final risk estimates and conclusions. Uncertainties may exist in numerous areas including the collection and analysis of samples, estimates of exposure, derivation of TRV, and the assumptions used when professional judgment is applied. Understanding how the uncertainties can influence the exposure and risk estimated for Baseline Case and Future Case conditions provides an indication of the confidence associated with the risk assessment conclusions.

Overall, the industry standard in risk assessment is to overstate, rather than understate, potential health risks, andregulatory guidance supports the use of a conservative approach (i.e., one that overestimates exposures and toxicological responses) when assessing potential health risks. This conservative approach has been employed in the assessment of potential human health risks for the Project.

3.0 SITE CHARACTERIZATION

Site characterization provides the context for how the Project could affect the environment in a manner that could influence human health risk. This includes defining the spatial and temporal boundaries of the study areas for the HHRA, summarizing the environmental setting, and identifying and describing the receptor locations used to evaluate human health risks.

3.1 ENVIRONMENTAL SETTING

The Project is in a rural region in central Newfoundland, with a history of exploration and mining activities. Other land and resource uses in the area include commercial forestry, multiple hydroelectric developments, mineral exploration, outfitting, cabins, harvesting (e.g., trapping, hunting and fishing), and recreational land use (e.g., hiking, boating, snowmobiling and all-terrain vehicle [ATV] use). Adjacent land uses are described in Section 16.2 of Chapter 16 (Land and Resource Use) in the EIS (Marathon 2020).

The Project is located within the Central Newfoundland Forest (CNF) Ecoregion (Newfoundland and Labrador Department of Fisheries and Land Resources [NLDFLR] 2019a). This ecoregion typically consists of rolling hills, dense forest and organic deposits occurring in valleys and basins (PAA 2008). The CNF Ecoregion has the warmest summers and coldest winters on the Island of Newfoundland, with the potential for night frost year-round (NLDFLR 2019b). Terrain (i.e., topography and landforms) varies and includes boggy areas, thin to thick glacial till layers, and bedrock outcrops. Scattered wetlands, specifically patterned fens and bogs, are common in the Project Area (planned mine site development area and access road) and surrounding areas. Elevations range from 270 to 437 m above sea level (masl) across the mine site and from 160 to 437 masl across the Project Area.

There are no historical baseline records for air quality or sound levels in the Project Area; however, given its rural nature, the existing concentrations of air contaminants are assumed to be low and close to average background concentrations for similar rural areas in NL at most locations, most of the time.

Similarly, the sound levels in a rural environment are likely to be dominated by natural phenomena or activities, such as wind, rain and wildlife. Sound pressure levels depend upon the distance from the source and the acoustic characteristics of the area in which the sound is located. In the Project Area, these are expected to be low most of the time. Local sources of sound may include forestry and exploration activities, vehicles, generators, snowmobiles and ATVs, or recreational boat engines. These activities and sources are assumed to not exceed regulatory thresholds. Baseline sound pressure levels measured in the Project Area in June 2020 were representative of a quiet rural to quiet suburban area, with limited to no existing sources of noise. The baseline noise assessment is described in greater detail in Section 5.5.3 of Chapter 5 (Atmospheric Environment) of the EIS (Marathon 2020).

The Project is situated along a boundary between the Exploits River Watershed and the Bay d'Espoir Watershed. The Victoria Lake Reservoir, to the south of the Project Area is the headwater system for the Bay d'Espoir Watershed, which includes multiple hydroelectric projects downstream of the Victoria Lake Reservoir. The head of the Victoria River to the east of the Project Area, and Valentine Lake to the northwest, feed into the Exploits River, one of the most important Atlantic salmon rivers on the Island in

terms of numbers of salmon returning. The Exploits River Watershed is the largest watershed on the Island of Newfoundland, with a total area of 10,241 km^2.

Water discharge from the Exploits River is highly regulated by dams located in Millertown, Grand Falls-Windsor, and Bishops Falls. The mouth of Red Indian Lake is controlled by a dam located in Millertown. Historically, Victoria Lake drained to Red Indian Lake via the Victoria River; however, with the construction of the Victoria Dam in 1967 (to create the Victoria Lake Reservoir), the flow from Victoria Lake was altered to flow in a generally southerly direction to Burnt Lake and Granite Lake, providing flow to the hydrogeneration station in Bay d'Espoir. In recent years, the Victoria Lake Reservoir has contributed negligible to no flow to the Victoria River because the Victoria Dam operates as an overflow spillway, and spilling occurs infrequently.

3.2 SPATIAL AND TEMPORAL BOUNDARIES

3.2.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on human health risk in areas surrounding the mine site and access road.

Project Area: The Project Area (PA) encompasses the immediate area in which Project activities and components occur and is comprised of two distinct areas: the mine site and the access road. The mine site includes the area within which Project infrastructure will be located, and the access road is the existing road to the site, plus a 20 metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation, and decommissioning, rehabilitation and closure of the Project.

As the future environmental conditions used to predict potential changes in human health risk are based on modelled future conditions from the Atmospheric Environment VC (Chapter 5 of the EIS [Marathon 2020]) and the Surface Water VC (Chapter 7 of the EIS), the local assessment area (LAA) for the HHRA employed the spatial boundaries from these VCs. The LAAs for these VCs were selected because the future conditions within these areas can be predicted or measured with a level of confidence that allows assessment of potential Project-related changes in human health risk. Areas of land and resource use that fall beyond the boundaries of the Atmospheric Environment and Surface Water LAAs will not be affected by Project activities and therefore will not contribute to potential exposures to Project-related emissions. Use of these lands and the harvesting of country foods from areas beyond the LAAs listed above would reduce the quantity of country foods harvested from within the LAAs and thereby reduce the potential exposures to Project-related COPC harvested within the LAA for the HHRA. Thus, land and resource areas beyond the Atmospheric Environment and Surface Water LAAs have not been included in the LAA for the HHRA.

The LAA and regional assessment area (RAA) for the Atmospheric Environment and the HHRA consist of a 40 km by 40 km square area centred on the Project Area, plus a 500 m buffer on either side of the access road. This 40 km by 40 km area is the modelling domain used for dispersion modelling and includes receptors within and beyond the Project Area. The LAA and RAA are therefore considered together as the LAA/RAA in the remainder of the assessment (Figure 4).

The LAA for surface water resources incorporates the Project Area and watersheds that intersect with the Project Area, as shown in Figure 5. The LAA also includes portions of Victoria Lake Reservoir in the expected effluent mixing zones, which are typically considered to be up to several hundred metres from points of discharge into the lake. The LAA includes Valentine Lake and Victoria River to the point downstream where Project-affected tributaries converge with the main branch of the river and the Project access road extending from the Exploits River Crossing to the Project Area. It also includes a 500 m buffer around the access road. The RAA for surface water resources incorporates the Project Area and LAA and extends to include where potential Project interactions may be observed, as shown in Figure 3. This includes Valentine Lake, a portion of Victoria Lake Reservoir, Victoria River and Red Indian Lake, including its discharge at the head of the Exploits River. This area encompasses the potential downstream receivers of surface water that may flow from the Project Area, and was selected as the area within which accidental events were assessed. As the HHRA considers health risks associated with routine Project activities, the LAA is most relevant to this study.

Since the Atmospheric Environment LAA/RAA and Surface Water LAA overlap (LAA for Surface Water lies within the LAA/RAA for Atmospheric Environment), the LAA/RAA for Atmospheric Environment was used in the HHRA, as shown in Figure 6.

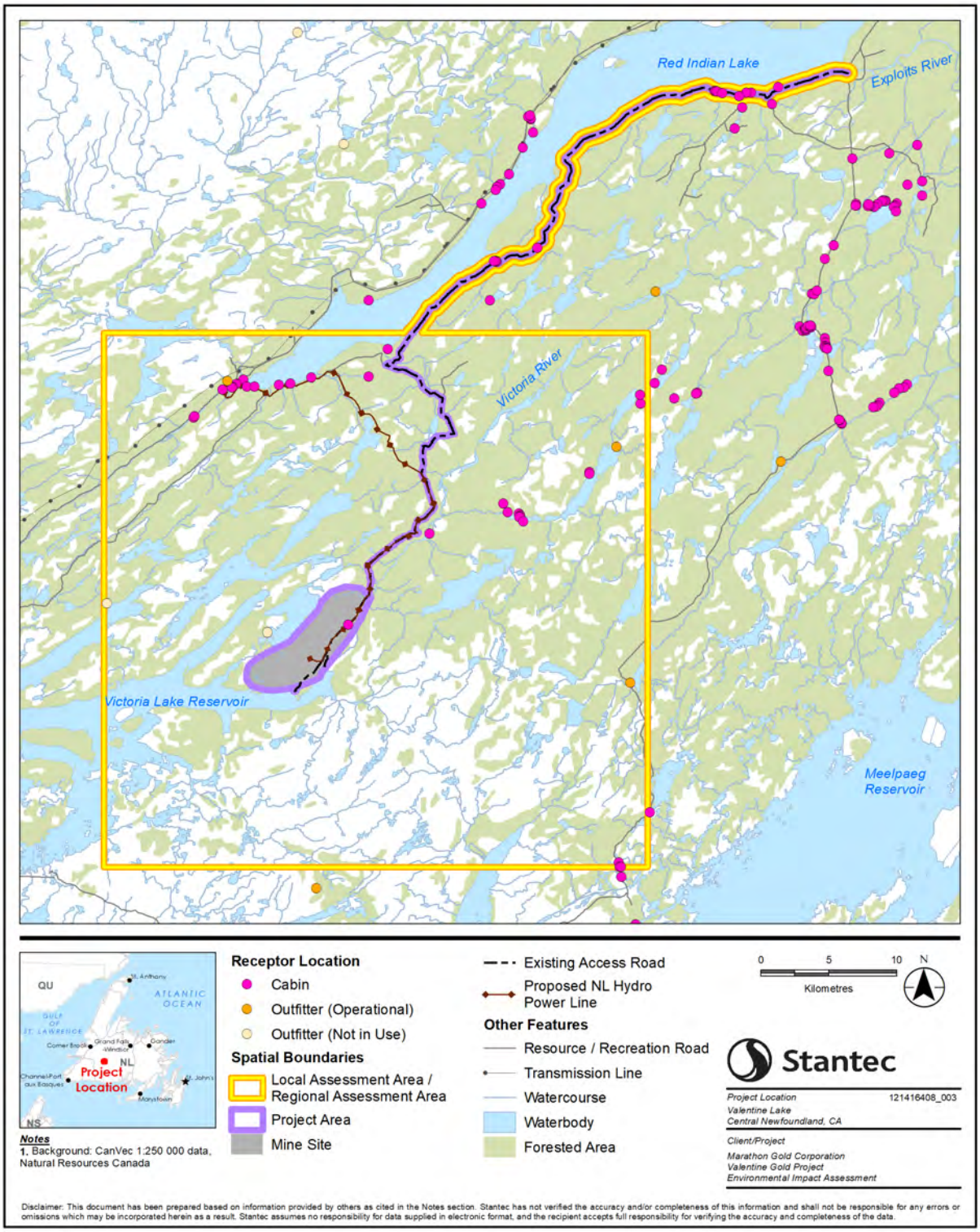

Figure 3-1 Local Assessment Area and Regional Assessment Area – Atmospheric Environment

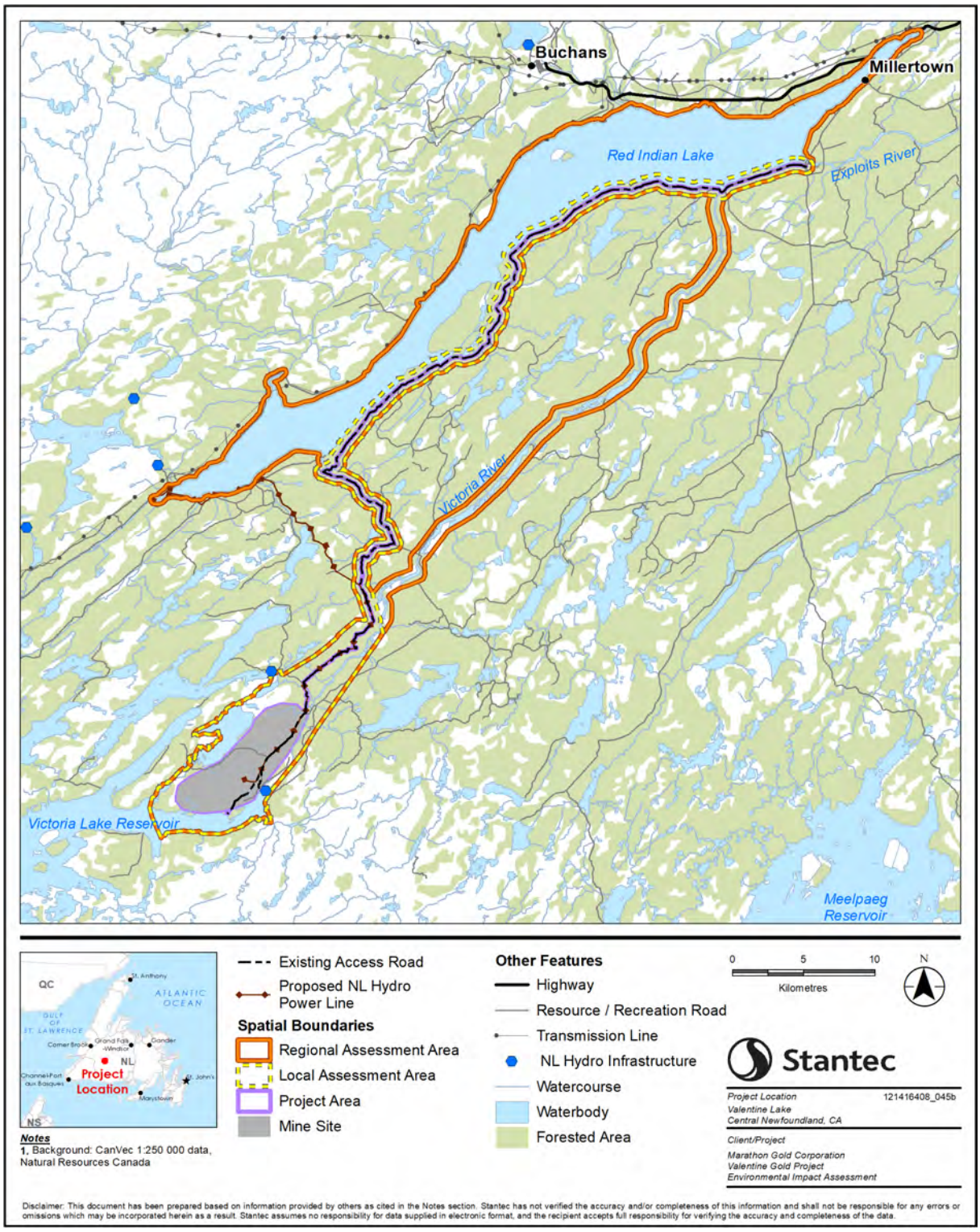

Figure 3-2 Local Assessment Area and Regional Assessment Area – Surface Water

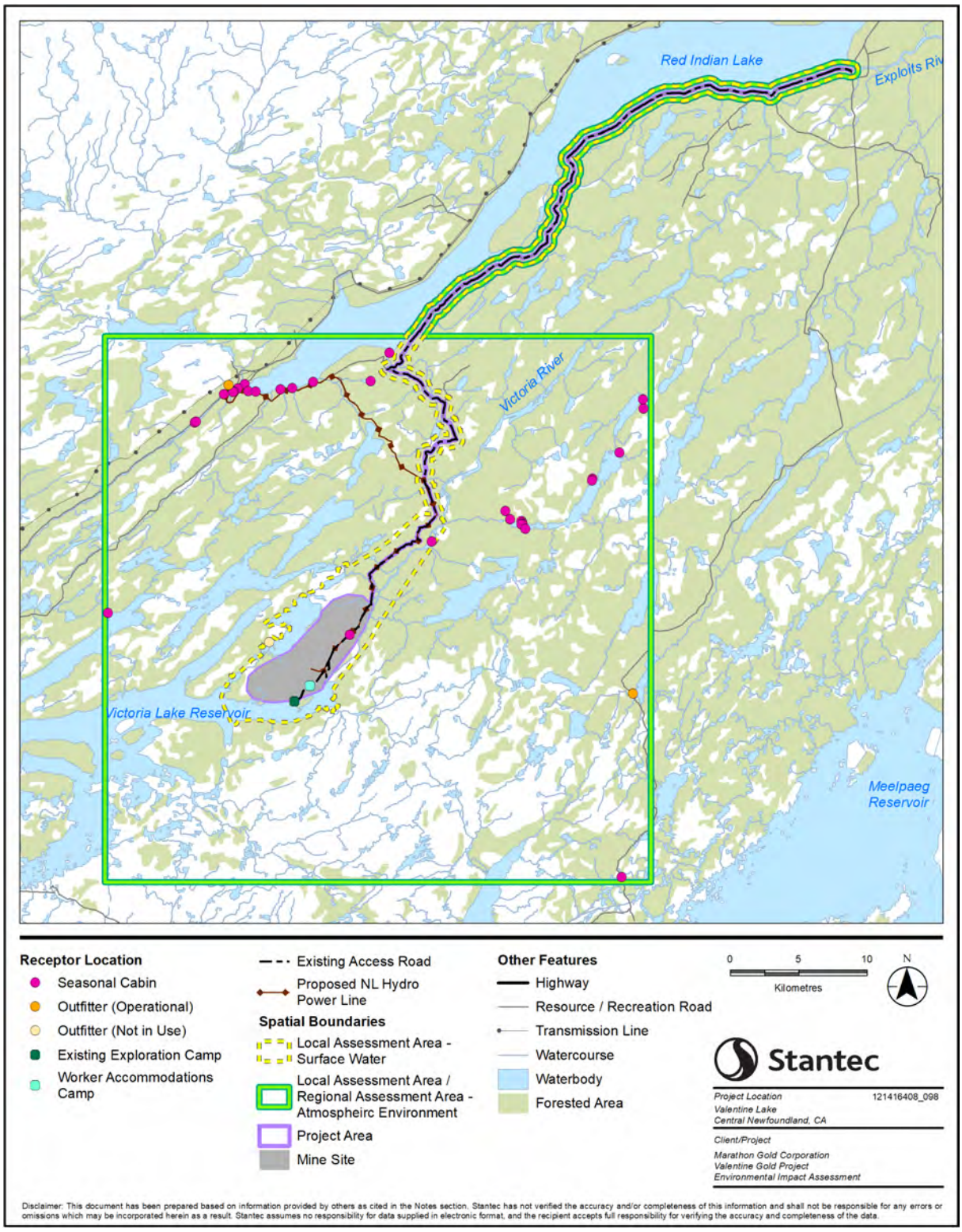

Figure 3-3 Local Assessment Area and Regional Assessment Area for HHRA

3.2.2 Temporal Boundaries

The temporal boundaries for the Project consist of the following phases.

- Construction Phase –16 to 20 months, beginning in Q4 2021, with 90% of activities occurring in 2022
- Operation Phase – Estimated 12-year operation, with commissioning / start-up and mine / mill operation slated to start Q2 2023
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation to occur once it is no longer economical to mine or resources are exhausted

This HHRA evaluates potential human health risks associated with inhalation exposures to Project-related COPC using the air quality modelling predictions provided in Chapter 5 (Atmospheric Environment) in the EIS (Marathon 2020). The air quality modelling was based on the highest production years, which provide upper-bound estimates of COPC concentrations in ambient air. The HHRA assumes these concentrations to be present in ambient air over the construction and operation phases of the Project. Post closure, air quality are expected to return to Baseline Conditions. The HHRA evaluates potential changes in soil and country food based on deposition estimates provided in the air quality assessment. These predicted changes are assumed to be permanent. The HHRA evaluates potential changes in surface water quality based on information provided in the surface water quality assessment (Chapter 7 of the EIS; Marathon 2020). The predicted changes in surface water quality are also assumed to be permanent. Therefore, for soil, country food and surface water quality, the temporal boundaries of the HHRA extend well into the future.

3.3 RECEPTOR LOCATIONS

Receptor locations were selected to represent places where human receptors are likely to be present and could be exposed to air emissions from the Project. The selection of receptor locations was based on consideration of land use and on input from local communities. Traditional Knowledge and land and resource use information was collected through meetings and information sharing with Indigenous groups. To gain a better understanding of current use within the area of the Project, a study entitled, “The Collection of Current Land Use and Aboriginal Traditional Knowledge” (ATK Study) was conducted in 2020 by the Qalipu Mi’kmaq First Nation (Qalipu), with financial support from Marathon. Information collected through the ATK Study has been integrated into the assessment. Marathon also met in person with representatives of Miawpukek First Nation (Miawpukek) to review and update this information. Additional information on the community engagement process is provided in Chapter 14 (Community Health) and Chapter 17 (Indigenous Groups) in the EIS (Marathon 2020). The information gathered from engagement with Indigenous groups and communities was used to help identify 32 receptor locations within the LAA that are outside the Project Area. Of the 32 sensitive receptor locations, 29 are seasonal cabins, two are outfitters, and one is an unused outfitter cabin. This last receptor is located on the shore of Valentine Lake on the west side of the Project Area. These 32 receptor locations represent the nearest sensitive receptor locations to the Project (Figure 6).

3.4 CHEMICALS OF POTENTIAL CONCERN

COPCs are identified as Project-related chemicals that may be released to the receiving environment and that have potential to elicit adverse human health effects. Emissions of air contaminants during construction and operation phases of the Project may result from combustion of fossil fuels (such as diesel and gasoline) by heavy mobile equipment and vehicles, and from dust generated by land clearing and equipment movements on unpaved roads. Fugitive releases of dust during blasting, ore handling and processing, and wind erosion of stockpiles and tailings beach surfaces may occur during operation. Project-related effluents, such as discharge from sedimentation ponds and groundwater that is not captured by the contact water management infrastructure and TMF effluent, which will ultimately discharge to one of three receiving waterbodies: Victoria Lake Reservoir, Valentine Lake, and Victoria River.

An inventory of air contaminant emissions associated with construction and operations activities was completed as part of the air quality assessment (Chapter 5 [Atmospheric Environment] of the EIS [Marathon 2020]). Air contaminants that may be released from Project activities have been identified as the following:

- Particulate matter released during activities such as ore handling and processing, wind erosion, blasting, and exhaust from internal combustion engines, TSP, respirable particulate matter (PM_{10}) with an aerodynamic diameter less than 10 µm, fine particulate matter ($PM_{2.5}$) with an aerodynamic diameter less than 2.5 µm, and diesel particulate matter (DPM). Although TSP was identified as a contaminant in the Atmospheric Environment VC, it was not considered to be a COPC for human health because the larger particles of the TSP fraction (particles greater than 10 µm in aerodynamic diameter) are not part of the respirable or inhalable fractions and these larger fractions are addressed by considering PM_{10} and $PM_{2.5}$.
- Other criteria air contaminants (CACs) – carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NOx) – from blasting and internal combustion engines.
- Ammonia (NH_3) and hydrogen cyanide (HCN) from processing plant sources.
- Trace metals within the dust released during ore handling and processing, wind erosion, and blasting: arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), strontium (Sr), and zinc (Zn).
- Mercury was not detected in the geochemical testing of the ore samples. The mining processes planned for the Project do not require the use of mercury. Although the results of the geochemical water quality modelling showed that the concentrations of mercury in Victoria Lake Reservoir, Valentine Lake and Victoria River would not change from baseline concentrations (Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]), mercury was identified as a COPC due to community concerns regarding the potential for mercury and methylmercury to bioaccumulate in aquatic country foods.

The estimated quantities of air contaminants released from sources associated with the operation of the Project were based on the requirements in the EIS guidelines for assessing potential effects on the atmospheric environment. Based on the result of the emissions inventory completed as part of the air quality assessment (Section 5.1 [Atmospheric Environment] of the EIS [Marathon 2020]), the air quality

assessment concluded that volatile organic compound (VOC) and polyclic aromatic hydrocarbon (PAH) emissions from this Project would be too low to affect ambient air quality. Therefore, these chemical species were not included in the air dispersion modelling. Although these chemicals were not included in the assessment for the Valentine Gold Project, carcinogenic and non-carcinogenic PAH and speciated VOCs have been assessed in other mining projects of similar scope and magnitude (Greenstone Gold Project - Ontario, Lynn Lake Gold Project – Manitoba, Ajax Copper-Gold Project – British Columbia). These assessments evaluated the potential human health risks for 1-hour, 24-hour, and annual average exposures for speciated VOC (including acetaldehyde, benzene, 1,3-butadiene, ethylbenzene, formaldehyde, proprionaldehyde, toluene, 2,2,4-trimethylpentane, and xylenes) and annual average exposures to non-carcinogenic and carcinogenic PAH (as Benzo[a]pyrene toxic equivalents – B[a]PTPE), and carcinogenic VOCs. The hazard quotients associated with short-term (1-hour and 24 hour) and long-term (annual average) inhalation exposures to the non-carcinogenic VOC and PAH were all less than 0.2 with most being in the 10^{-4} to 10^{-6} range for each of the projects listed above. These results apply to Indigenous and non-Indigenous receptors in the LAAs for these projects and for workers in the accommodations camp (Lynn Lake Gold Project). The incremental lifetime cancer risks associated with inhalation exposures to the carcinogenic VOC (acetaldehyde, benzene, 1,3-butadiene, formaldehyde, 2,2,4-trimethylpentane) and carcinogenic PAH (as B[a]PTPE) were all below the 10^{-5} negligible cancer risk benchmark ranging between 10^{-6} and 10^{-12}. Based on the results for similar studies, where predicted human health risks are more than 10-fold below the corresponding health risk benchmarks, it is reasonable to conclude that predicted human health risks associated with inhalation exposures to VOC and PAH would represent negligible human health risks for Indigenous and non-Indigenous receptors in the LAA, and for off-duty workers housed in the accommodations camp or exploration camp.

Consistent with Health Canada TRVs, the potential human health risks associated with inhalation exposure to diesel exhaust (DE) (as DPM) was based on the 2-hour and annual average TRVs for non-cancer effects. Diesel exhaust from diesel engines that pre-date 2007 has been identified as a potential human carcinogen by several agencies including California EPA, World Health Organization, International Agency for Research on Cancer, and Health Canada. However, an assessment of the potential cancer risks associated with inhalation exposures to diesel exhaust (as DPM) was not included in the assessment for the following reasons:

i. In 2015, the Health Effects Institute (HEI) released a detailed review of the available epidemiological information related to exposures to DE (https://www.healtheffects.org/publication/diesel-emissions-and-lung-cancer-evaluation-recent-epidemiological-evidence-quantitative). This review noted that the epidemiological evidence supports an association between occupational exposures to DE and increased incidence of lung cancer. The review also noted that notwithstanding the 1998 publication of an inhalation unit risk for DE by the California Office of Environmental Health Hazard Assessment (OEHHA), the general consensus within the scientific community is that the available epidemiological evidence is insufficient to undertake a credible quantitative assessment of DE carcinogenicity that could support the development of an inhalation unit risk value for DE (HEI 2015, Health Canada 2016d).
ii. As cited in HEI 2015, studies completed by McDonald et al. (2015) and Hesterberg et al. (2011) reported that there was no evidence of carcinogenicity or other adverse effects in rodents

following lifetime exposure to emissions from newer technology diesel engines (post 2007). Although adverse effects were noted at the highest exposure concentrations, these effects were attributed to NO_2. Based on this, the authors concluded that there is sufficient evidence to suggest that the results from studies using pre-2007 diesel exhaust likely have little relevance in assessing potential human health risks associated with inhalation exposures to exhaust from newer technology diesel engines, such as those which will be used for this Project.

iii. The Health Canada 2016 assessment of Diesel Exhaust did not include either a quantitative or a qualitative assessment of the potential carcinogenicity of DPM.

A list of parameters of potential concern for water quality was established for Chapter 7 (Surface Water Resources) of the EIS (Marathon 2020) based on the following selection criteria:

- Parameters found to be present at concentrations higher than the Canadian Council of Ministers of the Environment (CCME) *Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life* (CWQG-FAL) in the baseline monitoring program (aluminum, arsenic, cadmium, copper, iron, lead, nitrite, and zinc).
- Parameters listed in the *Metal and Diamond Mining Effluent Regulations* (MDMER) (ammonia, arsenic, copper, cyanide, lead, and zinc).
- Parameters considered potentially present in effluent because of mining activities (ammonia, cyanide, fluoride, manganese, phosphorus, and sulphate).

A summary of the COPC considered in the HHRA is provided in Table 1.

Table 3.1 Summary of COPC in Air and Surface Water

COPC	Air	Surface Water
CACs – CO, SO_2, NO_2	x	-
DPM, , $PM_{2.5}$, PM_{10}	x	-
NH_3	x	-
HCN	x	
Aluminum (Al)	-	x
Arsenic (As)	x	x
Beryllium (Be	x	-
Barium (Ba)	x	-
Cadmium (Cd)	x	x
Chromium (Cr)	x	-
Cobalt (Co)	x	-
Copper (Cu)	x	x
Iron (Fe)	-	x
Lead (Pb)	x	x
Manganese (Mn)	-	x
Mercury (Hg)	x	-

Table 3.1 Summary of COPC in Air and Surface Water

COPC	Air	Surface Water
Nickel (Ni)	x	-
Phosphorus (Ph)	-	x
Strontium (Sr)	x	-
Zinc (Zn)	x	x
Nitrite (N)	-	x
Ammonia (N)	-	x
Ammonia (N) Unionized	-	x
Cyanide (Total)	-	x
Cyanide (WAD)	-	x
Sulfate	-	x
Fluoride	-	x
Notes: X Considerd in HHRA - Not Applicable		

4.0 PROBLEM FORMULATION

Problem formulation is the first major component of an HHRA and is intended to define key issues that will be further evaluated in a risk assessment. Problem formulation includes the identification of relevant receptors of concern and their characteristics, COPC, and exposure pathways that potentially connect the receptors to relevant environmental media.

4.1 RECEPTOR CHARACTERIZATION

The HHRA evaluated Indigenous and non-Indigenous receptors, both of which were assumed to be present within the LAA.

- **Indigenous Receptors** – Includes Indigenous people who may live in or make use of the lands within the LAA for the harvesting of country foods and/or traditional plants, or who use the areas for ceremonial or spiritual purposes. Indigenous receptors are assumed to harvest and consume higher levels of country foods than non-Indigenous members of the population. Although there are no permanent dwellings within the LAA, for the purposes of the risk assessment, Indigenous receptors are conservatively assumed to spend 100% of their time within the LAA.
- **Non-Indigenous Receptors** – Includes non-Indigenous people who may live in or make use of the lands within the LAA for harvesting country foods and/or recreational activities. Non-indigenous receptors are assumed to harvest and consume smaller amounts of country foods than Indigenous members of the population. Although there are no permanent dwellings within the LAA, for the

purposes of the risk assessment non-Indigenous receptors are conservatively assumed to spend 100% of their time within the LAA.

- **Off-Duty Workers** – Includes mine workers housed at the accommodations camp and the exploration camp. Employees and contractors will be strictly prohibited from hunting or fishing while on rotation at the Project site. Workers from local communities who hunt and fish in the LAA while off rotation would be equivalent to the Indigenous and non-indigenous receptors identified above.

4.1.1 General Receptor Assumptions

The following assumptions apply to both the Indigenous and non-Indigenous receptors:

- Human receptors were assumed to spend 100% of their time within the LAA and no distinction was made between time spent indoors and time spent outdoors. This means that COPC concentrations in air predicted for each of the 32 receptor locations outside the Project Area were assumed to be the same indoors and outdoors. This approach conservatively assumes that inhalation exposures for COPC happens on a 24-hour per day basis and is not limited to the time a person spends outdoors.
- Human receptors were assumed to be exposed to the exposure point concentrations (EPCs) for the appropriate exposure averaging periods (e.g., 1-hour, 24-hour, annual average) for each COPC.
- The air quality modelling provided metal deposition estimates for each of the special receptor locations outside the Project Area. The deposition estimates for each metal from each of the 32 special receptor locations were used to calculate the 95% upper confidence limit on the mean (95% UCLM) deposition rate for that metal. The 95% UCLM for each metal was used to estimate the deposition of that metal across the LAA over the operational life of the mine. This approach provides reasonable upper estimates of potential increases in metal concentrations in soil and, therefore, the potential increases in exposures to metals in soil.
- Human receptors were assumed to potentially obtain drinking water from the surface water bodies inside the LAA (Victoria Lake Reservoir, Victoria River, Valentine Lake).
- Human receptors were conservatively assumed to obtain 100% of wild meat, berries, fish and traditional plants from within the LAA.

4.1.2 Specific Assumptions for Indigenous Receptors

The following specific assumption applies to Indigenous receptors.

- The country food consumption rates for the Indigenous receptor were based on 95th percentile grams of traditional food per day reported in the First Nations Food, Nutrition and Environment Study (FNFNES) – Atlantic Region Results 2014 (Chan et al. 2017).

4.1.3 Specific Assumptions for Non-Indigenous Receptors

The following specific assumption applies to non-Indigenous receptors.

- The country food consumption rates for the non-Indigenous receptor were based on the daily food ingestion rates recommended by Health Canada (Health Canada 2010a).

4.1.4 Specific Assumptions for Off-Duty Workers

The following specific assumptions apply to off-duty workers housed in the accommodations camp or exploration camp.

- Work rotations will be based on the nature of the work being conducted and may vary from a 2-weeks on / 2-weeks off rotation for heavy equipment operators, to a 4-weeks on / 3 weeks off rotation for more technical staff.
- Off-duty workers are assumed to be present in the accommodations camp or exploration camp on a 24-hour per day basis.
- Off-duty workers will not be permitted to hunt or fish in the LAA during their rotation.

4.2 EXPOSURE PATHWAYS

Activities through all phases of the Project are anticipated to release chemicals to the environment. In the absence of mitigation, such releases could change the chemical quality of air, soil, or surface water, and of terrestrial and/or aquatic country foods. These changes could alter the human health risk for Indigenous and non-Indigenous people who spend time in and harvest country foods from the LAA. The potential ways in which Project activities could alter environmental exposures to Project-related COPC through inhalation, direct contact with soil, dermal contact and incidental ingestion of surface water, and ingestion of country foods, are discussed below.

4.2.1 Inhalation Exposures

Emissions of air contaminants during construction and operation phases of the Project may result from combustion of fossil fuels (such as diesel and gasoline) by heavy mobile equipment and vehicles, and from dust generated by land clearing and equipment movements on unpaved roads. Fugitive releases of dust during blasting, ore handling and processing, and wind erosion of stockpiles and tailings beach surfaces may occur during operation. The processing plant is also a potential source of air contaminants during operation. In the absence of mitigation, potential changes in air quality could directly affect the exposures (through inhalation) of Indigenous and non-Indigenous persons in the LAA engaged in fishing, hunting, trapping, harvesting, gathering or camping.

4.2.2 Direct Contact Exposures

Emissions of dust-borne contaminants during Project construction and operation may result from heavy mobile equipment and vehicles, land clearing, and equipment movement on unpaved roads. Fugitive dust emissions during blasting, ore handling and processing, and wind erosion of stockpiles and tailings beach surfaces, may occur during operations. Particulates in air could settle onto the soil in the LAA, potentially altering contaminant concentrations in soil and resulting in Project-related changes in contaminant exposures through direct contact exposures (i.e., incidental soil ingestions and dermal contact with soil).

The areas of the accommodations camp and exploration camp outside the building footprints will be covered in aggregate material. This aggregate material will remain exposed for the lifetime of the Project. Dust deposited on the aggregate material would not be expected to accumulate on the surface, rather

would be washed from the surface into the interstitial spaces between the aggregate material by rain and snow. Aggregate is not considered to be soil and human contact with aggregate material does not result in the same types of exposures that result from human contact with soil. Aggregate material consists of stones that are too large to adhere to exposed skin surfaces; thus, it cannot contribute to direct contact exposures as with incidental soil ingestion or dermal uptake of contaminants from soil adhered to skin. Therefore, direct contact exposures have not been further assessed for off-duty workers housed at the accommodations camp or exploration camp.

4.2.3 Surface Water Exposures

In the absence of mitigation, Project construction, operation and/or decommissioning activities could affect the quality of surface water through the discharge or seepage of metal-enriched water into the environment. Changes in water quality could affect the contaminant exposures of Indigenous and non-Indigenous persons through dermal contact or incidental ingestion of surface water while in the LAA. Project-related changes in stream water quality could also result in changes in fish tissue quality, resulting in indirect exposures via ingestion of fish.

4.2.4 Country Food Exposures

Emissions of dust-borne contaminants during Project construction and operation may result from heavy mobile equipment and vehicles, land clearing, and equipment movement on unpaved roads. Fugitive dust emissions during blasting, ore handling and processing, and wind erosion of stockpiles and tailings beach surfaces may occur during operations. Particulates in air could settle onto the soil, potentially altering contaminant concentrations in soil and, in turn, country food quality, which could result in Project-related changes in contaminant exposures through country food consumption.

4.3 BASELINE AND FUTURE CASE EXPOSURE POINT CONCENTRATIONS

4.3.1 Air

Existing conditions are characterized in the LAA using background concentrations of air contaminants of concern based on ambient air quality data measured near the Project. Given the rural and undeveloped nature of the mine site, existing air contaminant concentrations in the LAA are likely to be low most of the time.

Background concentrations of $PM_{2.5}$, NO_2 and SO_2 are estimated using hourly ambient air quality data from 2016 and 2017, obtained from the ECCC NAPS for the Grand Falls-Windsor Ambient Air Quality Monitoring (AAQM) station (ECCC 2019). Although NO_2 and SO_2 concentrations were measured near the Project site, the background concentrations are estimated based on the NAPS data. This is because hourly data over a longer time frame (multiple years) are available from the NAPS station at Grand Falls-Windsor, whereas the samples near the Project site were collected passively over a four-day period. Use of long-term data from this NAPS station is likely conservative as compared to the Project Area, as it is located in a more developed area with local sources of emissions.

Background concentrations of TSP, PM_{10} and selected trace metals are estimated based on the results of the sampling conducted within the Project Area. The background concentrations are expected to include emissions from potential nearby sources and long-range transport of emissions from the northeastern United States. The background concentrations used in the assessment are provided in Table 2.

Changes to air quality from Project-related releases of air contaminants during operation were assessed using an atmospheric dispersion model in combination with ambient background air contaminant concentrations. Details of the emissions estimates and dispersion modelling for the operation phase of the Project are provided in Chapter 5, Section 5.5.1 (Atmospheric Environment) of the EIS (Marathon 2020). Although construction activities would add to existing air contaminant concentrations in the Project Area, emissions (and the resulting ground-level concentrations) would be lower in magnitude than during Project operations and would generally be confined to the area surrounding the Project Area, including the access road. Intermittent releases may also occur during decommissioning, rehabilitation and closure; however, these are expected to be lower in magnitude than during operations and therefore these phases were not assessed quantitatively in the dispersion modelling.

Air contaminant concentrations were predicted for each of the thirty-two sensitive receptor locations in the LAA outside the Project Area. From these data, the maximum predicted Future Case concentration per contaminant for each of the appropriate exposure averaging periods (e.g., 1-hour, 2-hour, 24-hour, annual average) was identified and summed with the measured or estimated background concentration to provide a maximum predicted Future Case concentration. Predicted Future Case concentrations of each contaminant for each of the 32 sensitive receptor locations in the LAA are provided in Section 5.5.1.3 of Chapter 5 (Atmospheric Environment) of the EIS (Marathon 2020). The maximum predicted Future Case concentrations were compared to the appropriate air quality standards, including Canadian Ambient Air Quality Standards (CAAQS) and NL Ambient Air Standards (NLAAS), where available. Predicted concentrations of HCN and some trace metals were compared to Ontario Air Contaminants Benchmarks (ACBs). Exposures to DPM were compared to the Health Canada Exposure Guidance Values for 2-hour and annual average exposure averaging periods. Air quality standards are not “pollute up-to” levels; they provide important benchmarks as they are meant to be protective of health.

Both short-term (1-hour, 24-hour) and annual average concentrations were assessed, as appropriate. The maximum predicted Future Case concentrations and the applicable standards are provided in Table 2. Where more than one AAQS is available for a given compound for the same exposure averaging period, the predicted Future Case concentration (including background) is compared to the lowest applicable AAQS. Predicted Future Case concentrations that exceed the lowest applicable AAQS are bolded and underlined. It is recognized that NO_2, SO_2, and $PM_{2.5}$ are considered to be non-threshold contaminants and that exposure to even very low levels of these compounds can be associated with potential human health risks. Regulatory agencies have not developed risk acceptability benchmarks for these compounds. In the absence of such benchmarks, predicted concentrations that are below the respective CAAQS for these compounds are considered to represent a negligible human health risk.

Table 4.1 Background and Predicted Future Case Ambient Air Concentrations: Local Assessment Area

COPC	Averaging Period	Background Concentrations (µg/m^3)	Maximum Predicted Concentrations + Background (µg/m^3)	NL AAQS (µg/m^3)	2020 CAAQS (µg/m^3)	2025 CAAQS (µg/m^3)	Ontario ACB (µg/m^3)	Health Canada Exposure Guidance Values (µg/m^3)
PM_{10}	24-hour	13	21.9	50	-	-	-	-
$PM_{2.5}$	24-hour	10.3	14.0	25	27	NA	-	-
	Annual	3.8	4.04	8.8	8.8	NA	-	-
DPM	2-hour	-	1.79	-	-	-	-	10
	Annual	-	2.76E-02	-	-	-	-	5
NO_2	1-hour	3.8	75.3	400	112.8	79	-	-
	24-hour	1.9	27.7	200	-	-	-	-
	Annual	1.4	3.83	100	32	22.6	-	-
SO_2	1-hour	2.6	36.2	900	183.4	170	-	-
	3-hour	2.6	22.9	600	-	-	-	-
	24-hour	neg.	8.90	300	-	-	-	-
	Annual	neg.	0.76	60	13.1	10.5	-	-
CO	1-hour	206	406	35,000	-	-	-	-
	8-hour	200	319	15,000	-	-	-	-
NH_3	24-hour	neg.	1.03	100	-	-	-	-
HCN	24-hour	neg.	0.92	-	-	-	8	-
As	24-hour	2.10E-03	3.68E-03	0.3	-	-	-	-
Cd	24-hour	4.20E-04	5.39E-04	2	-	-	-	-
Cu	24-hour	1.30E-03	1.08E-02	50	-	-	-	-
Pb	24-hour	1.30E-03	3.91E-03	2	-	-	-	-
	30-day	5.00E-04	1.51E-03	0.7	-	-	-	-

Table 4.1 Background and Predicted Future Case Ambient Air Concentrations: Local Assessment Area

COPC	Averaging Period	Background Concentrations (µg/m^3)	Maximum Predicted Concentrations + Background (µg/m^3)	NL AAQS (µg/m^3)	2020 CAAQS (µg/m^3)	2025 CAAQS (µg/m^3)	Ontario ACB (µg/m^3)	Health Canada Exposure Guidance Values (µg/m^3)
Hg	24-hour	neg.	1.11E-04	2	-	-	-	-
Ni	24-hour	2.10E-03	2.80E-03	2	-	-	-	-
Zn	24-hour	2.10E-02	2.61E-02	120	-	-	-	-
Ba	24-hour	2.10E-03	7.55E-03	-	-	-	10	-
Sr	24-hour	2.10E-03	6.18E-03	-	-	-	120	-
Be	24-hour	1.30E-03	1.31E-03	-	-	-	0.01	-
Cobalt	24-hour	1.30E-03	1.83E-03	-	-	-	0.1	-
Li	24-hour	neg.	1.91E-03	-	-	-	20	-
Sb	24-hour	2.10E-03	4.19E-03	-	-	-	25	-
Sn	24-hour	1.30E-03	4.69E-03	-	-	-	10	-
Se	24-hour	4.20E-03	8.30E-03	-	-	-	10	-
Cr	24-hour	2.10E-03	7.52E-03	-	-	-	0.5	-
Bi	24-hour	2.10E-03	3.36E-03	-	-	-	2.5	-

Notes:
- Not Available
NL AAQS Newfoundland and Labrador Ambient Air Quality Standards
CAAQS Canadian Ambient Air Quality Standards
Ontario ACB Ontario Air Contaminants Benchmark

The maximum predicted Future Case concentration of each COPC for each of the appropriate exposure averaging periods in the LAA is below its corresponding AAQS. Maximum COPC concentrations outside the Project Area are predicted to occur at the unused outfitter cabin located west of the Project Area across Valentine Lake from the Project. Maximum predicted COPC concentrations at the remaining 31 sensitive receptor locations within the LAA are lower than those predicted at the unused outfitter cabin. Based on this, it is reasonable to conclude that Project-related changes in air quality outside the Project Area would represent a negligible change in human health risk for Indigenous and non-Indigenous people present in the LAA.

Air COPC concentrations were predicted for the accommodations camp and exploration camp locations. From these data, the maximum predicted Future Case concentration of each COPC for each of the appropriate exposure averaging periods (e.g.,1-hour, 2-hour, 24-hour, annual average) was identified and summed with the measured or estimated background concentration to provide a maximum predicted Future Case concentration. Predicted Future Case concentrations of each contaminant for the accommodations camp and exploration camp receptor locations are provided in Section 5.5.1.3 of Chapter 5 (Atmospheric Environment) of the EIS (Marathon 2020). The maximum predicted Future Case concentrations were compared to the appropriate air quality standards including CAAQS, and NLAAS, where available. Predicted concentrations of HCN and metals were compared to ACBs. Exposures to DPM were compared to the Health Canada Exposure Guidance Values for 2-hour and annual average exposure averaging periods. Where more than one AAQS is available for a given compound for the same exposure averaging period, the predicted Future Case concentration (including background) was compared to the lowest applicable AAQS.

The maximum predicted Future Case concentrations for the accommodations camp and exploration camp locations and the applicable standards are provided in Table 3. Predicted Future Case concentrations that exceed the lowest applicable AAQS are bolded and underlined. For Indigenous and non-Indigenous receptors, maximum predicted Future Case concentrations of NO_2, SO_2, and $PM_{2.5}$ that are below their corresponding CAAQS are considered to represent negligible human health risks for off-duty workers housed at the accommodations camp or exploration camp.

With the exception of 1-hour NO_2, the maximum predicted Future Case concentration of each of the COPCs for each of the appropriate exposure averaging periods is below its corresponding AAQS. Based on these results, it is reasonable to conclude that, with the exception of 1-hour inhalation exposures to NO_2, Project-related emissions would represent a negligible human health risk for off-duty workers housed at the accommodations camp or exploration camp. As the maximum predicted Future Case 1-hour NO_2 concentrations in ambient air at the accommodations camp and exploration camp exceed the CAAQS, it is necessary to consider potential inhalation exposures to 1-hour NO_2 for off-duty workers at the accommodations camp and exploration camp locations in greater detail in the HHRA.

Table 4.2 Background and Predicted Future Case Ambient Air Concentrations: Off-Duty Worker Accommodation Camps

COPC	Averaging Period	Background Concentrations	Maximum Predicted Concentrations + Background	NL AAQS	2020 CAAQS	2025 CAAQS	Ontario ACB	Health Canada Exposure Guidance Values
		(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
PM_{10}	24-hour	13.0	29.6	50	-	-	-	-
$PM_{2.5}$	24-hour	10.3	19.3	25	27.0	NA	-	-
	Annual	3.8	4.48	8.8	8.8	NA	-	-
DPM	2-hour	-	3.15	-	-	-	-	10
	Annual	-	0.039	-	-	-	-	5
NO_2	1-hour	3.8	**83**	400	112.9	79	-	-
	24-hour	1.9	35.3	200	-	-	-	-
	Annual	1.4	4.69	100	32.0	28.2	-	-
SO_2	1-hour	2.6	49	900	183.4	170	-	-
	3-hour	2.6	33.3	600	-	-	-	-
	24-hour	neg.	12.0	300	-	-	-	-
	Annual	neg.	1.06	60	13.1	10.5	-	-
CO	1-hour	206	409	35,000	-	-	-	-
	8-hour	200	308	15,000	-	-	-	-
NH_3	24-hour	neg.	2.65	100	-	-	-	-
HCN	24-hour	neg.	2.65	-	-	-	8	-
As	24-hour	2.1E-03	3.45E-03	0.3	-	-	-	-
Cd	24-hour	4.2E-04	5.26E-04	2	-	-	-	-
Cu	24-hour	1.3E-03	0.0102	50	-	-	-	-
Pb	24-hour	1.3E-03	3.73E-03	2	-	-	-	-
	30-day	5.0E-04	5.02E-04	0.7	-	-	-	-

Table 4.2 Background and Predicted Future Case Ambient Air Concentrations: Off-Duty Worker Accommodation Camps

COPC	Averaging Period	Background Concentrations	Maximum Predicted Concentrations + Background	NL AAQS	2020 CAAQS	2025 CAAQS	Ontario ACB	Health Canada Exposure Guidance Values
		(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
Hg	24-hour	neg.	2.17E-04	2	-	-	-	-
Ni	24-hour	2.1E-03	2.77E-03	2	-	-	-	-
Zn	24-hour	2.1E-02	2.53E-02	120	-	-	-	-
Ba	24-hour	2.1E-03	6.72E-03	-	-	-	10	-
Sr	24-hour	2.1E-03	5.57E-03	-	-	-	120	-
Be	24-hour	1.3E-03	1.31E-03	-	-	-	0.01	-
Cobalt	24-hour	1.3E-03	1.83E-03	-	-	-	0.1	-
Li	24-hour	neg.	1.78E-03	-	-	-	20	-
Sb	24-hour	2.1E-03	4.44E-03	-	-	-	25	-
Sn	24-hour	1.3E-03	4.70E-03	-	-	-	10	-
Se	24-hour	4.2E-03	7.74E-03	-	-	-	10	-
Cr	24-hour	2.1E-03	7.15E-03	-	-	-	0.5	-
Bi	24-hour	2.1E-03	3.27E-03	-	-	-	2.5	-

Notes:

- not available
NL AAQS Newfoundland and Labrador Ambient Air Quality Standard
CAAQS Canadian Ambient Air Quality Standard
Ontario ACB Ontario Air Contaminants Benchmark

4.3.2 Soil

Deposition of dust from Project-related activities could increase the concentrations in soil in the LAA only for those metals that are present in the ore. Therefore, the HHRA focused on those metals identified in the ore including arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, strontium and zinc.

Baseline metal concentrations in soil were established as part of the Country Foods sampling program (Appendix C). The data from the paired soil and vegetation sample collection program were used to establish baseline metal concentrations in soil for the HHRA. A total of twenty soil samples were collected from across the LAA. The methods used to collect these samples are described in Appendix C. These data were used to calculate the 95% upper confidence limit on the mean (95% UCLM) baseline concentration for each of the metals listed above. The ProUCL outputs for the soil data are provided in Appendix A.

Annual deposition rates for each of the metals in the ore were predicted for each of the thirty-two sensitive receptor locations within the LAA that are outside the Project Area. These data were used to calculate a 95% UCLM deposition rate for each metal across the LAA. The 95% UCLM deposition rates were then used to predict total increase in metal loading to soil across the LAA. The predicted metal loads from deposition were added to the 95% UCLM baseline soil concentrations to provide predicted Future Case metals concentrations in soil within the LAA. Sample calculations for the Project-related change in soil concentrations are presented in Appendix B.

The 95% UCLM predicted deposition rate, the 95% UCLM baseline soil concentrations, and the predicted Future Case soil concentrations are provided in Table 4. The predicted percent increase between Baseline Case and Future Case conditions is also provided for each metal. The data show that for each metal in the ore, the predicted Future Case concentration is less than 2% above Baseline Case conditions. For most of the metals listed in Table 3, the predicted increases in concentrations are less than 1%. Based on these results, it is reasonable to conclude that predicted Future Case metal concentrations in soil within the LAA represent a negligible human health risk for Indigenous and non-Indigenous receptors who may spend time in the LAA.

Table 4.3 Summary of Baseline and Predicted Future Case Soil Concentrations

COPC	Total Deposition - 95th UCLM g/m^2/yr	95th UCLM of Measured Baseline Soil Concentration (mg/kg)	Predicted Future Soil Concentration (mg/kg)	% Increase Relative to 95th UCLM of Baseline unitless
Arsenic	8.4E-05	7.2	7.2	0.28%
Barium	1.6E-04	118	118	0.17%
Beryllium	8.0E-07	<2	2.0	0.00%
Cadmium	7.4E-06	0.5	0.50	0.41%
Chromium	4.6E-04	5.7	5.8	1.9%
Cobalt	4.8E-05	3.7	3.7	0.38%

Table 4.3 Summary of Baseline and Predicted Future Case Soil Concentrations

COPC	Total Deposition - 95th UCLM g/m²/yr	95th UCLM of Measured Baseline Soil Concentration (mg/kg)	Predicted Future Soil Concentration (mg/kg)	% Increase Relative to 95th UCLM of Baseline unitless
Copper	8.1E-04	9.9	10.0	1.5%
Lead	1.9E-04	25.8	25.8	0.16%
Mercury	1.9E-05	0.30	0.30	1.3%
Nickel	6.1E-05	3.6	3.6	0.33%
Strontium	1.7E-04	26.9	26.9	0.00%
Zinc	1.6E-04	60.9	60.9	0.03%

4.3.3 Surface Water

As described in Section 7.4.2 of Chapter 7 (Surface Water Resources) of the EIS (Marathon 2020), contact water (including discharge from sedimentation ponds and groundwater that is not captured by the contact water management infrastructure) and TMF effluent will ultimately discharge to one of three receiving waterbodies: Victoria Lake Reservoir, Valentine Lake and Victoria River. Indigenous persons could be exposed to water from these water bodies through dermal contact or incidental ingestion while in the LAA for other activities, such as fishing. It is unlikely that Indigenous persons would drink water from the receiving water bodies, and information gathered through engagement has not identified Victoria Lake Reservoir, Valentine Lake or Victoria River as potable water sources. As a result, occurrences of exposure to surface water, while possible, are expected to be infrequent.

Health Canada (2012) has not established health-based guidelines for incidental exposures (e.g., dermal contact and/or incidential ingestion of water during recreational water use) to metals in surface water. Health Canada does note that ingestion would be considered the primary exposure pathway. Therefore, human health-based drinking water quality guidelines that are based on lifetime daily exposures were used as conservative screening levels. In selecting drinking water screening guidelines, preference was given to maximum acceptable concentrations (MACs) for parameter concentrations in drinking water, established by Health Canada (2020). Where Health Canada does not list a MAC for a given chemical, values from the United States (US) and the World Health Organization (WHO) were selected. For some parameters, regulatory agencies have not established a health-based guideline for drinking water due to a lack of evidence that the parameter would be expected to cause adverse health effects in humans. The health-based screening values are provided in Table 5.

Table 4.4 Health-Based Screening Levels for Identified Parameters of Potential Concern in Surface Water

Parameter	Units	Health-based Screening Level	Source or Rationale
Aluminum	µg/L	Not required	Health Canada concluded there is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in humans (Health Canada 2020).
Ammonia	µg/L	Not required	Health Canada (2020) indicates that a guideline value is not necessary as it is produced in the body and efficiently metabolized in healthy people and no adverse effects occur at levels found in drinking water.
Arsenic	µg/L	10	Health Canada MAC (Health Canada 2020)
Cadmium	µg/L	7	Health Canada MAC (Health Canada 2020)
Copper	µg/L	2000	Health Canada MAC (Health Canada 2020)
Cyanide	µg/L	200	Health Canada MAC (Health Canada 2020)
Fluoride	µg/L	1500	Health Canada MAC (Health Canada 2020)
Iron	µg/L	Not required	Health Canada indicates that no evidence exists of dietary iron toxicity in the general population (Health Canada 2020).
Lead	µg/L	5	Health Canada MAC (Health Canada 2020)
Manganese	µg/L	120	Health Canada MAC (Health Canada 2020)
Nitrite (as N)	µg/L	1,000	Health Canada MAC (Health Canada 2020)
Phosphorus	µg/L	Not required	Phosphorus is an essential mineral that is naturally present in many foods and relatively non-toxic. Health Canada (2020) does not provide a guideline for phosphorus and the United States National Research Council (1980) concluded that there is no basis for the regulation of phosphorus in drinking water supplies.
Sulphate	µg/L	Not required	Health Canada (2020) does not provide a guideline for sulphate and the WHO (2004) concluded that the existing data do not identify a level of sulphate in drinking water that is likely to cause adverse human health effects.
Zinc (Total)	µg/L	Not required	Health Canada (2020) notes that zinc is an essential element and is generally considered to be non-toxic.

To assess the change in potential human health risk for Indigenous and non-Indigenous receptors related to exposures to the parameters of concern in surface water, the maximum predicted concentration of each parameter 100 m downstream of the receiving points in Victoria Lake Reservoir, Valentine Lake and the Victoria River were compared to the health-based screening values. The maximum predicted concentration of each parameter was below the health-based screening level (Table 6). These results suggest that even if surface water from the receiving bodies were to be used as a source of potable water, or if people were to contact this water during recreational activities, it would not result in a change in human health risk for Indigenous and non-Indigenous receptors. The assessment of surface water quality determined that concentrations of parameters of concern in surface water will have returned to baseline conditions within 300 m of each receiving point (Section 7.6.2 of Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]).

Table 4.5 Summary of Baseline and Predicted Average Conditions Water Concentrations at the End of 100 m Mixing Zone of the Receiver

Parameter, units	Health-based Screening Level	75th Percentile Baseline		Predicted Future Case Concentrations							
		Valentine Lake	Victoria Lake	LP- FDP-01	LP-FDP-02	LP-FDP-03/05	LP-FDP-04	MA- FDP-01	MA- FDP-01B	MA- FDP-02	MA- FDP-03/04
Aluminum (Total), µg/L	Not required	15	48	59	70	67	48	16	16	36	85
Arsenic (Total), µg/L	10	0.5	0.5	0.7	1.4	1.2	0.5	0.6	0.6	0.9	1.1
Cadmium (Total), µg/L	7	0.005	0.005	0.006	0.009	0.008	0.005	0.006	0.006	0.012	0.009
Copper (Total), µg/L	2000	0.75	0.81	0.8	1.8	1.5	0.8	0.7	0.7	2.3	2.0
Iron (Total), µg/L	Not required	25.0	70.5	74	93	88	71	28	28	37	175
Lead (Total), µg/L	5	0.25	0.25	0.4	0.5	0.5	0.3	0.3	0.3	0.3	0.3
Manganese (Total), µg/L	120	7	12	26	60	50	12	8	8	38	78
Phosphorus (Total), µg/L	Not required	50	50	50	50	50	50	50	50	50	50
Zinc (Total), µg/L	Not required	2.5	2.5	3.0	5.0	4.5	3	3	3	7	5
Nitrite (N), µg/L	1000	12	16	16	31	27	16	10	10	9	18
Ammonia (N), total, µg/L	Not required	25	25	43	119	100	25	31	31	27	76
Ammonia (N) Unionized, µg/L	Not required	0.95	0.95	0.1	0.3	0.3	1.0	0.1	0.1	0.1	0.2
Cyanide (Total), µg/L	200	10	10	10	10	10	10	10	10	10	10
Cyanide (WAD), µg/L	200	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sulfate, µg/L	Not required	1,000	1,000	2,092	2,580	2,190	1,000	1,493	1,493	6,253	4,803
Fluoride, µg/L	1500	60	60	71	116	104	60	64	64	111	89

4.3.4 Country Foods

Baseline metal concentrations in country foods were established as part of the Country Foods sampling program (Appendix C). The data from this program were used to establish baseline metal concentrations in terrestrial (plant and animal tissue) and aquatic (fish tissue) country foods. The methods used to collect these samples, as well as the analytical results and statistical analyses used to establish the exposure point concentrations for each metal in each tissue type are described in Appendix C. The baseline chemical concentrations in terrestrial and aquatic country foods identified in the Country Foods sampling program are summarized in Table 7.

Project-related changes in the concentrations of the parameters of concern in soil and surface water will govern the Project-related changes in the quality of terrestrial and aquatic country foods. Changes in country food quality could result in changes in human health risk associated with the consumption of country foods. The assessment of Project-related changes in metal concentrations in soil, resulting from deposition, determined that the maximum predicted Future Case concentrations of metals in soil would be less than 2% above Baseline Case concentrations, and for most of the metals the predicted increase from Baseline Case conditions was less than 1% (Section 4.3.2). These nominal increases in metal concentrations in soil would not be expected to alter the quality of terrestrial county food from baseline conditions. Therefore, it is reasonable to conclude that deposition over the operational life of the mine will not result in a change in human health risk associated with the consumption of terrestrial country foods for Indigenous and non-Indigenous receptors who consume plants and/or animals from within the LAA.

The assessment of surface water quality determined that within 300 m of each receiving point, the concentrations of Project-related chemicals will have returned to baseline conditions (Section 7.6.2 of Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]). The areas within 300 m of each receiving point represent a very small portion of the surface water bodies and a correspondingly small proportion of the area likely to be inhabited by fish species targeted for consumption. Mercury was not detected in the geochemical testing of the ore samples (BSA.5, Attachment 5-B of the EIS [Marathon 2020]). The Project processes do not include the use of mercury. The results of the geochemical water quality modelling showed that the concentrations of mercury in Victoria Lake Reservoir, Valentine Lake and Victoria River would not change from Baseline Case concentrations (Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]). Given that the Project is not predicted to alter mercury concentrations in the receiving water bodies, it is reasonable to conclude that methylmercury formation in fish tissue will remain unaltered from present levels and that the human health risks associated with exposure to methylmercury in fish tissue will remain unchanged from Baseline Case conditions. It is therefore reasonable to conclude that Project-related effects on surface water quality will not alter fish tissue quality and thus will not result in a change in human health risk to Indigenous and non-Indigenous receptors who consume fish from within the LAA.

As Project-related activities are not anticipated to alter the quality of terrestrial or aquatic country foods, metal concentrations in country foods Baseline Case concentrations have been used to represent Future Case conditions.

Table 4.6 Summary of Baseline Concentrations in Country Foods

Chemical Parameter	Units	Snowshoe Hare		Labrador Tea	Blueberry	Brook Trout
		Internal Organs	Tissue			
		Baseline				
Aluminum	mg/kg - ww	1.46	7.69	8.65	10.3	0.628
Antimony	mg/kg - ww	<0.001	0.0019	0.0271	0.00346	0.0032
Arsenic	mg/kg - ww	0.068	0.0319	0.0132	0.0106	0.5
Barium	mg/kg - ww	0.303	0.639	28.8	3.013	0.41
Beryllium	mg/kg - ww	<0.001	<0.001	<0.0053	<0.0017	<0.001
Bismuth	mg/kg - ww	<0.001	<0.001	<0.0053	<0.0017	<0.001
Boron	mg/kg - ww	0.28	0.23	6.58	1.298	0.21
Cadmium	mg/kg - ww	1.49	0.0086	<0.00265	0.00117	0.0194
Calcium	mg/kg - ww	149	109	2352	232	1763
Chromium	mg/kg - ww	<0.01	0.079	<0.053	<0.017	0.0734
Cobalt	mg/kg - ww	0.0837	0.0163	0.0127	<0.0034	0.0163
Copper	mg/kg - ww	3.86	2.31	1.61	0.42	0.381
Iron	mg/kg - ww	434	35.9	13.0	2.64	6.55
Lead	mg/kg - ww	0.0356	0.0477	0.0161	0.0104	0.0732
Magnesium	mg/kg - ww	188	287	709	88.0	304
Manganese	mg/kg - ww	16.4	14.6	554	111	2.59
Mercury	mg/kg - ww	0.263	0.0027	<0.0053	<0.0017	0.128
Molybdenum	mg/kg - ww	0.298	0.0082	0.0161	0.00815	0.00478
Nickel	mg/kg - ww	0.036	0.028	0.229	0.0483	0.022
Phosphorus	mg/kg - ww	2740	2570	473.2	164	3656
Potassium	mg/kg - ww	2830	3680	2234	887	4285
Selenium	mg/kg - ww	0.901	0.242	0.0289	<0.0085	0.403

Table 4.6 Summary of Baseline Concentrations in Country Foods

Chemical Parameter	Units	Snowshoe Hare		Labrador Tea	Blueberry	Brook Trout
		Internal Organs	Tissue			
		Baseline				
Silver	mg/kg - ww	0.0496	0.0014	<0.00265	<0.00085	0.00418
Sodium	mg/kg - ww	1350	715	6.37	4.46	514
Strontium	mg/kg - ww	0.241	0.112	6.68	0.97	1.74
Thallium	mg/kg - ww	0.0034	0.001	0.00854	0.000458	0.00888
Tin	mg/kg - ww	<0.02	0.039	<0.053	<0.017	0.0261
Titanium	mg/kg - ww	0.152	0.215	0.314	<0.085	0.195
Uranium	mg/kg - ww	<0.0004	<0.0004	<0.00106	<0.00034	0.00123
Vanadium	mg/kg - ww	<0.02	<0.02	<0.106	<0.034	0.025
Zinc	mg/kg - ww	21.6	20.5	7.06	1.09	14.8

4.4 CONCEPTUAL SITE MODEL

The exposure pathway screening and development of the conceptual site model (CSM) identify the exposure pathways through which people may be exposed to COPC. For the HHRA, the potential exposure media for human receptors and exposure pathway-specific rationale for the inclusion or exclusion of each pathway from the HHRA are provided in Table 8. Beginning with the source media (e.g., air, water, soil), the key exposure pathways through which potential dietary items may accumulate COPC, and through which human receptors can become exposures to COPC, are summarized in the human health CSM (Figure 7).

Although Indigenous and non-Indigenous receptors could be exposed to Project-related COPC in the air while in the LAA, the assessment of Baseline and Future Case air quality (Section 4.3.1) demonstrated that the maximum predicted Future Case concentrations of COPC in air were below their respective air quality standards and thus would represent a negligible human health risk for Indigenous and non-Indigenous receptors in the LAA.

Sections 4.3.2 through 4.3.4 presented the potential for Indigenous and non-Indigenous receptors to be exposed to COPC in soil and surface water while they are in the LAA, and to these COPC in country foods harvested from within the LAA. Based on the assessment of predicted Future Case concentrations, Project-related activities are not anticipated to alter soil, surface water and country food quality to the extent that a material change would result in human health risk for Indigenous and non-Indigenous receptors who spend time in the LAA.

Health Canada guidance for conducting a HHRA within an environmental assessment notes that a quantitative HHRA is required when elevated COPC concentrations are predicted in one or more environmental media for a proposed project (Health Canada 2019). Health Canada guidance further notes that where there are no predicted pathways that may result in exposure to the population, a qualitative (screening) approach may be sufficient. The assessment of Future Case COPC concentrations in air, soil, surface water and country foods determined that Project-related activities would not result in material changes in contaminant concentrations in these media such that they would be expected to contribute to exposures for Indigenous and non-Indigenous members of the population. Therefore, a qualitative assessment of potential human health risks is considered sufficient to evaluate changes in potential human health risks associated with Project-related activities for Indigenous and non-Indigenous members of the population.

Table 4.7 Rationale for Exposure Pathway Inclusion in the HHRA

Exposure Pathway	Receptor Category	Carried Forward for HHRA	Rationale
Inhalation of COPC from air emissions (Short-term and Long-term)	Indigenous Receptors	No	Predicted Future Case contaminant concentrations in air are below the corresponding human health-based ambient air quality standards and therefore represent a negligible human health risk for Indigenous and non-Indigenous people in the LAA. With the exception of 1-hour NO_2 concentrations, predicted Future Case contaminant concentrations in air are below the corresponding human health-based ambient air quality standards and therefore represent a negligible human health risk for off-duty workers housed at the accommodations camp or exploration camp. The assessment of potential human health risks associated with short-term (1-hour) exposures to NO_2 for off-duty workers has been carried forward into the HHRA.
	Non-Indigenous Receptors	No	
	Off-Duty Workers	Yes	
Incidental ingestion and dermal contact with soil	Indigenous Receptors	No	Predicted Future Case contaminant concentrations in soil are below the corresponding human health-based residential soil quality criteria and therefore represent a negligible human health risk for Indigenous and non-Indigenous people in the LAA.
	Non-Indigenous Receptors	No	
	Off-Duty Workers	No	The areas of the accommodations camp and exploration camp outside the building footprints will be covered in pavement, or aggregate material. This aggregate material will not be covered in soil and will remain exposed for the lifetime of the Project. Dust deposited on the aggregate material would not be expected to accumulate on the surface. Rather, it would be washed from the surface into the interstitial spaces between the aggregate material by rain and snow. Aggregate is not considered to be soil, and human contact with aggregate material does not result in the same types of exposures that result from human contact with soil.
Surface Water Ingestion	Indigenous Receptors	No	Predicted Future Case contaminant concentrations in surface water are below the corresponding human health-based MACs for drinking water and therefore, represent a negligible human health risk for Indigenous and non-Indigenous people in the LAA.
	Non-Indigenous Receptors	No	
	Off-Duty Workers	No	
Consumption of Country Foods	Indigenous Receptors	No	Predicted Future Case contaminant concentrations in soil are not anticipated to result in changes in the quality of terrestrial country foods and therefore would not result in a change in human health risk for Indigenous and non-Indigenous people who harvest terrestrial country foods from within the LAA.
	Non-Indigenous Receptors	No	

Table 4.7 Rationale for Exposure Pathway Inclusion in the HHRA

Exposure Pathway	Receptor Category	Carried Forward for HHRA	Rationale
	Off-Duty Workers	No	Off-duty workers will not be permitted to hunt or harvest country foods in the LAA during their rotation.
Fish Ingestion	Indigenous Receptors	No	The assessment of surface water quality noted that Project-related effects on surface water quality would be minor and localized to within 300 m of each of the Project receiving points. The limited extent of Project effects is not expected to alter the tissue quality of fish harvested from the surface water bodies within the LAA. Therefore, the consumption of fish caught within the LAA would not change the human health risk for Indigenous and non-Indigenous receptors who harvest fish in the LAA.
	Non-Indigenous Receptors	No	
	Off-Duty Workers	No	Off-duty workers will not be permitted to fish in the LAA while on rotation.
Recreational Water Use	Indigenous Receptors	No	There are no beaches or other recreational areas in the LAA where Indigenous and non-Indigenous people could reasonably be expected to swim or engage in other recreational water-use activities on a regular basis. In addition, predicted Future Case contaminant concentrations in surface water are below the corresponding human health-based MACs for drinking water and therefore represent a negligible human health risk for Indigenous and non-Indigenous people in the LAA.
	Non-Indigenous Receptors	No	
	Off-Duty Workers	No	Predicted Future Case contaminant concentrations in surface water are below the corresponding human health-based MACs for drinking water and therefore represent a negligible human health risk for off-duty workers who may swim in Victoria Lake Reservoir or Valentine Lake.
Incidental ingestion and dermal contact with sediment	Indigenous Receptors	No	There are no beaches or other recreational areas in the LAA where Indigenous and non-Indigenous people could reasonably be expected to come into contact with sediment. Therefore, contact with sediment would not be expected to result in a change in human health risk between Baseline Case and Future Case conditions for Indigenous and non-Indigenous receptors.
	Non-Indigenous Receptors	No	
	Off-Duty Workers	No	There are no beaches or other recreational areas in the Project Area where off-duty workers could reasonably be expected to come into contact with sediment. Therefore, contact with sediment would not be expected to result in a human health risk for off-duty workers.

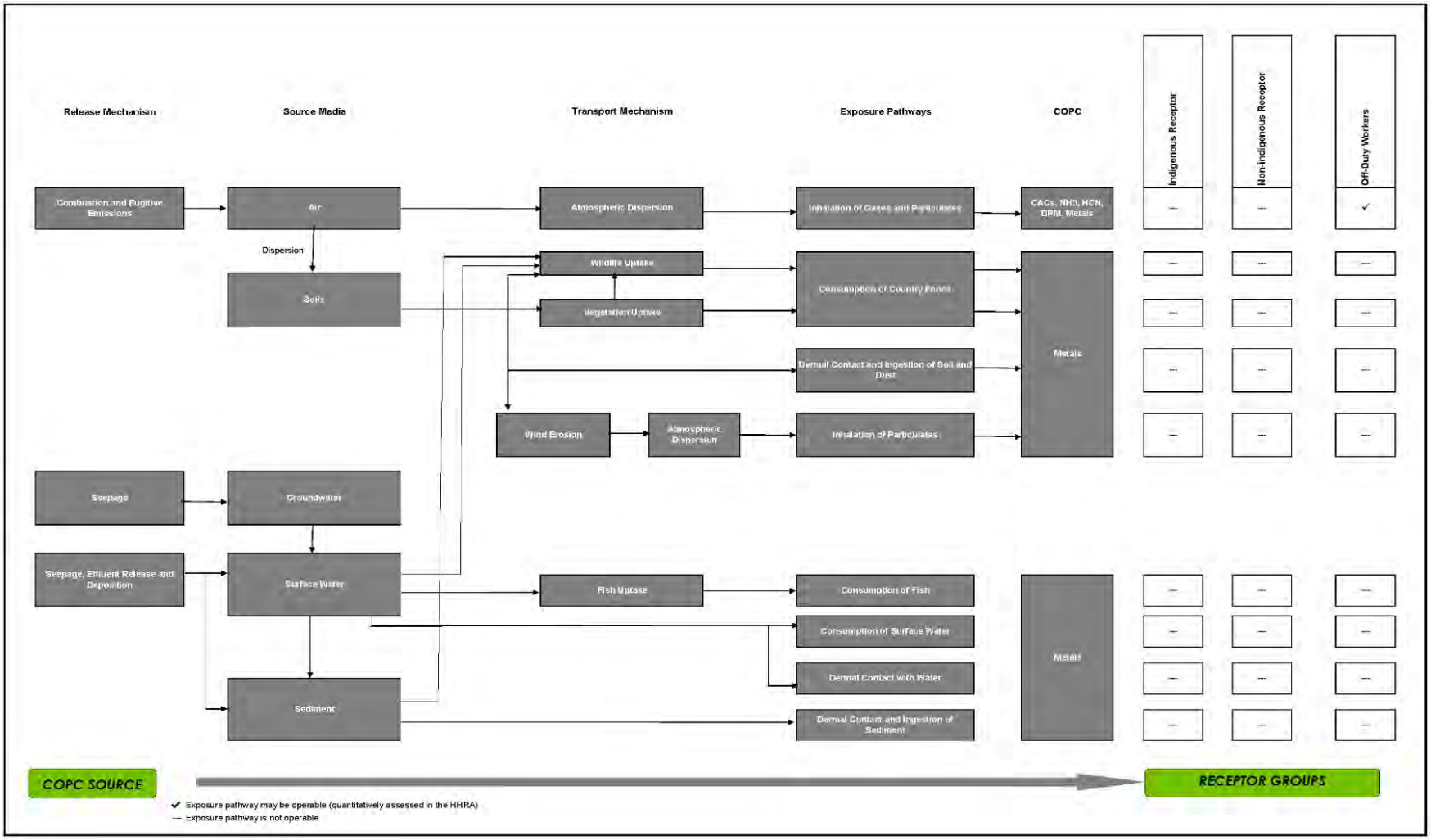

Figure 4-1 Human Health Conceptual Site Model

5.0 TOXICITY ASSESSMENT

Toxicity is the potential for a chemical to produce damage (whether permanent or temporary) to the structure or functioning of the receptor's body. The toxicity of a chemical depends on the amount taken into the body (referred to as the "dose") and the duration of exposure (the length of time the receptor is exposed to the chemical). For each chemical, there is a specific dose and duration of exposure necessary to produce a toxic environmental effect in a given receptor. This is referred to as the "dose-response relationship" of a chemical. The toxic potency of a chemical is dependent on the inherent properties of the chemical itself (its ability to cause a biochemical or physiological response at the site of action within the receptor's body) as well as the ability of the chemical to reach the site of action. This dose-response principle is central to the risk assessment methodology.

The Problem Formulation stage of the HHRA determined that a qualitative assessment of potential human health risks would be sufficient to evaluate changes in potential human health risks associated with Project-related activities for Indigenous and non-Indigenous members of the population in the LAA. The Problem Formulation also determined that, with the exception of NO_2, a qualitative assessment of potential human health risks would be sufficient to evaluate the potential human health risks for off-duty workers housed in the accommodations camp or exploration camp. Therefore, with the exception of NO_2, a Toxicity Assessment that identifies the TRVs to be used in a quantitative risk assessment was not required and has not been included in the HHRA. The 1-hour NO_2 concentrations are the only concentrations predicted to exceed the human health-based ambient air quality standard at the accommodations camp and exploration camp locations. Therefore, the toxicity assessment has focused on the selection of an appropriate human health-based exposure benchmark for off-duty workers that will be used to assess the potential human health risks associated with short-term inhalation exposures to NO_2.

5.1 SELECTION OF EXPOSURE BENCHMARKS FOR 1-HOUR NO_2

Health Canada has completed a human health risk assessment for NO_2 in ambient air (Health Canada 2016c). The Health Canada assessment provides a detailed review of the human health effects associated with exposures to varying levels of NO_2 in ambient air and concludes that, "the health evidence supports the establishment of both short-term and long-term standards to protect against the full suite of health effects associated with ambient NO_2." The Health Canada assessment, however, does not establish TRVs for NO_2, and therefore cannot be used as the basis for assessing the potential health risks associated with inhalation exposures to NO_2 for workers housed at the accommodations camp or exploration camp. The CCME has established 1-hour and annual average CAAQS for NO_2 for the years 2020 and 2025 (CCME 2018). Given that the Project will be in operation beyond 2025, the 2025 CAAQS have been used to evaluate potential human health risks for off-duty workers housed at the accommodations camp and exploration camp facilities.

It is recognized that NO_2 is considered a non-threshold contaminant in that exposures to even very low levels of NO_2 can be associated with potential human health risks. Risk acceptability benchmarks for NO_2 have not been established by regulatory agencies. The human health-based ambient air quality standards

for chemicals such as NO_2 are defined as representing concentrations in ambient air (over the specified averaging period) that represent negligible risk to human health, including sensitive members of the population. Therefore, the HHRA for off-duty workers at the accommodations camp and exploration camp will use the 1-hour and annual average NO_2 ambient air objectives as risk acceptability benchmarks. Exposures that are below these limits will be considered to represent a negligible human health risk. The guidelines for NO_2 are summarized in Table 9.

Table 5.1 Ambient Air Quality Objectives for NO_2

Exposure Duration	Air Quality Objective ($\mu g/m^3$)	Health Effect	Source
1-hour	79[a]	Respiratory effects	CAAQS 2025
Annual Average	23[b]	Respiratory effects	CAAQS 2025

Notes:
[a] Statistical form is the 98th percentile of the daily 1-hour maximum concentrations averaged over three years.
[b] Statistical form is the annual average of 1-hour average concentrations over a year.

6.0 EXPOSURE ASSESSMENT

The main objective of the exposure assessment is to develop quantitative estimates of the potential changes in exposure for human receptors to each COPC, that could occur between Baseline Case and Future Case conditions. The HHRA considers the exposure estimates based on COPC concentrations in environmental media under Baseline Case and Future Case conditions, and the receptor characteristics identified for the Indigenous and non-Indigenous receptors.

6.1 EXPOSURE ASSESSMENT FOR INDIGENOUS RECEPTORS

The Problem Formulation stage of the HHRA determined that a qualitative assessment of potential human health risks would be sufficient to evaluate changes in potential human health risks associated with Project-related activities for Indigenous and non-Indigenous members of the population. Therefore, quantitative exposure estimates for Indigenous receptors for Baseline Case and Future Case conditions were not required and have not been included in the HHRA.

6.2 EXPOSURE ASSESSMENT FOR NON-INDIGENOUS RECEPTORS

The Problem Formulation stage of the HHRA determined that a qualitative assessment of potential human health risks would be sufficient to evaluate changes in potential human health risks associated with Project-related activities for Indigenous and non-Indigenous members of the population. Therefore, quantitative exposure estimates for non-Indigenous receptors for Baseline Case and Future Case conditions were not required and have not been included in the HHRA.

6.3 EXPOSURE ASSESSMENT FOR OFF-DUTY WORKERS

For screening purposes, the maximum predicted 1-hour NO_2 concentrations for Future Case conditions were generated for the accommodations camp and exploration camp by calculating the 98th percentile concentrations throughout the three-year modelling period. The maximum predicted 98th percentile 1-hour NO_2 concentrations at the accommodations camp and exploration camp were 83 µg/m^3 and 80 µg/m^3, respectively. The higher of these two values was used in the Risk Characterization (Section 7.3) to assess the potential human health risks associated with inhalation exposures to 1-hour NO_2 concentrations for off-duty workers housed in the accommodations camp or exploration camp.

7.0 RISK CHARACTERIZATION

The final step in the HHRA is risk characterization. The risk characterization compares the estimated exposures to the COPC for each of the receptors with the toxicity reference values to determine if site related exposures exceed the identified limits. Given the differences in the biological mechanisms of action between non-carcinogenic and carcinogenic chemicals, the potential hazards/risks are determined differently for these two classes of compounds. Thus, where both types of contaminants are being evaluated in the HHRA, the characterization of the hazards associated with exposures for non-carcinogenic chemicals and the risks associated with exposures to carcinogenic chemicals are typically assessed and presented separately.

Health Canada guidance for conducting a HHRA within an environmental assessment notes that a quantitative HHRA is required when elevated COPC concentrations are predicted in one or more environmental media for a proposed project (Health Canada 2019). Health Canada guidance further notes that where there are no predicted pathways that may result in exposure to the population, a qualitative (screening) approach may be sufficient.

7.1 CHARACTERIZING RISKS FOR INDIGENOUS RECEPTORS

The Problem Formulation stage of the HHRA determined that Project-related activities would not result in material changes in contaminant concentrations in the environmental media (air, water, soil, and terrestrial and aquatic country foods) that would be expected to contribute to exposures for Indigenous members of the population. Thus, a qualitative assessment of potential human health risks is sufficient to evaluate changes in potential human health risks associated with Project-related activities for Indigenous members of the population.

In the absence of Project-related changes in contaminant exposures, it is reasonable to conclude that the Project will not alter potential human health risks for Indigenous members of the population who consume country foods or engage in traditional and/or recreational activities in the LAA.

7.2 CHARACTERIZING RISKS FOR NON-INDIGENOUS RECEPTORS

The Problem Formulation stage of the HHRA determined that Project-related activities would not result in material changes in contaminant concentrations in the environmental media (air, water, soil, and terrestrial and aquatic country foods) that would be expected to contribute to exposures for non-Indigenous members of the population. Thus, a qualitative assessment of potential human health risks is sufficient to evaluate changes in potential human health risks associated with Project-related activities for non-Indigenous members of the population.

In the absence of Project-related changes in contaminant exposures, it is reasonable to conclude that the Project will not alter potential human health risks for non-Indigenous members of the population who consume country or engage in traditional and/or recreational activities in the LAA.

7.3 OFF-DUTY WORKERS

With the exception of 1-hour exposures to NO_2, the maximum predicted concentrations for each COPC for each of the appropriate exposure averaging periods (e.g.,1-hour, 2-hour, 24-hour, annual average) were below their respective human health-based ambient air quality standards and thus represent negligible human health risks for off-duty workers housed at the accommodations camp or exploration camp.

The 98th percentile of the 1-hour daily maximum NO_2 concentrations exceeded the 2025 CAAQS of 79 µg/m3 at both the accommodations camp (83 µg/m^3) and the exploration camp (80 µg/m^3). These concentrations represent hazard quotients (HQs) of 1.05 and 1.01, respectively. The 1-hour NO_2 concentrations were predicted to exceed the 2025 CAAQS of 79 µg/m^3 for 42 1-hour periods over the three modelling years (26,280 hours) at the accommodations camp (0.16% of the time) and for 30 1-hour periods at the exploration camp (0.11% of the time). In general, the predicted exceedances do not occur in blocks of more than three consecutive hours, and these are separated by periods where the 1-hour NO_2 concentrations are below the 2025 CAAQS. Of the 52,560 predictions (26,280 1-hour predictions each at the accommodations camp and exploration camp locations), the 1-hour NO_2 concentration was also predicted to exceed the 2020 CAAQS (113 µg/m^3) for a single hour (at the accommodations camp location), meaning that based on the currently applicable CAAQS, 1-hour NO_2 concentrations would exceed the current health-based standard less than 0.004% of the time.

Exceedances of the 1-hour NO_2 CAAQS could result in increases in respiratory responses such as increased respiratory tract resistance in sensitive members of the workforce (asthmatics). Individual exceedances of the 1-hour NO_2 CAAQS that are separated by periods of time when the 1-hour NO_2 concentrations are below the CAAQS allow for recovery from the respiratory effects associated with the exposure. Respiratory recovery would be delayed in situations where multiple exceedances of the 1-hour NO_2 CAAQS occur in consecutive hours. Prolonged exposures to 1-hour NO_2 concentrations above the CAAQS could result in increased respiratory effects compared to shorter-term exposures. Thus, exceedances of the 1-hour NO_2 that occur in blocks of time may represent a greater potential human health risk than exceedances that occur on an individual (single hours) or a short-term (blocks of several hours) basis.

Exceedances of the 1-hour NO_2 CAAQS that occur over more than three hours are not predicted to occur at either the accommodations camp or exploration camp over the 26,280 hours of the 3-year modelling period. During these periods, particularly sensitive members of the workforce (e.g., those with asthma) who are directly exposed to 1-hour NO_2 concentrations above the CAAQS may experience respiratory effects, such as shortness of breath, that would be expected to subside as NO_2 concentrations decline.

The predicted 1-hour NO_2 exceedances usually occur in winter months (February to April). These exceedances generally happen overnight, occurring sometime between 19:00 and 6:00 the following morning. Within this period, there is no fixed pattern to when individual exceedances happen. In the winter months, between 19:00 and 6:00, workers would generally be expected to spend off-duty time indoors, and thus would not be expected to experience prolonged exposures to NO_2 concentrations that exceed the 1-hour CAAQS.

Considering the results of the assessment of potential health risks associated with inhalation exposures to NO_2, it is reasonable to conclude that inhalation exposure to NO_2 represents a negligible human health risk for off-duty workers housed at the accommodations camp and/or exploration camp.

8.0 UNCERTAINTY ANALYSIS

This HHRA was conducted according to accepted risk assessment methodologies and follows guidance published and endorsed by Health Canada. This approach is consistent with previous projects that have been reviewed by the Impact Assessment Agency of Canada. The HHRA included baseline data from multiple environmental media (i.e., air, soil, water and biota) and accepted modelling techniques were used to predict Future Case contaminant concentrations in these media, where required. Information with respect to likely human receptors and exposure pathways was collected through publicly available data, surveys, engagement and public meetings, as well as professional judgement. HHRAs have inherent uncertainties related to the assumptions applied in assessing potential human health risks associated with exposures to Project-related chemical releases to environmental media. This uncertainty often results from the use of conservative assumptions aimed at overestimating exposures and associated potential health risks. Although many factors contribute to risk estimate, the results are generally sensitive for only a few of these factors. The factors that are likely to have the greatest effect on this HHRA are described below.

8.1 UNCERTAINTIES IN AIR QUALITY MODELLING PREDICTIONS

The maximum predicted Future Case concentration for each of the COPC for each of the appropriate exposure averaging periods is below its corresponding AAQS. Maximum COPC concentrations outside the Project Area are predicted to occur at the unused outfitter cabin located west of the Project Area across Valentine Lake from the Project (Receptor ID 14639). Maximum predicted COPC concentrations at the remaining 31 sensitive receptor locations within the LAA are lower than those predicted at the unused outfitter cabin.

There is a high level of confidence in the predicted COPC concentrations in air in the LAA (Section 5.7, Chapter 5 [Atmospheric Environment] of the EIS [Marathon 2020]). The overall assessment of air quality is considered to be conservative, meaning the modelling results are likely to be higher than those that would be measured when the Project is in operation. Given that COPC concentrations in ambient air in the LAA are expected to have been over-estimated, and that the predicted COPC concentrations are below their respective AAQS, there is a high degree of confidence that the uncertainties in the predictions of Project-related changes in air quality are not expected to alter the conclusions of the HHRA.

8.2 UNCERTAINTIES IN SOIL QUALITY PREDICTIONS

Baseline metal concentrations in soil were established as part of the Country Foods sampling program. A total of twenty soil samples were collected from across the LAA. These data were used to calculate the 95% UCLM baseline concentration for each of the metals. Additional sampling would provide a larger data set for estimating Baseline soil concentrations. However, it is unlikely that the inclusion of additional samples would alter the estimated 95% UCLM soil concentrations sufficiently to result in a material difference to Baseline conditions.

Annual deposition rates for each of the metals in the ore were predicted for each of the 32 sensitive receptor locations within the LAA that are outside the Project Area. These data were used to calculate a 95% UCLM deposition rate for each metal across the LAA. These values were used in conjunction with the Baseline concentrations to provide Future Case metal concentrations in soil. Deposition estimates were calculated as part of the air dispersion modelling conducted as part of the Atmospheric Environment assessment. The air quality assessment (Section 5.7 of Chapter 5 [Atmospheric Environment] of the EIS [Marathon 2020]) describes that, while there is some uncertainty in the estimates of fugitive dust emissions, the overall assessment is conservative and the modelling results are likely to over-estimate fugitive dust emissions and, therefore, deposition rates. Given that deposition rates are expected to have been overestimated, and that the results from these overestimations indicate that deposition will not materially alter soil quality, the uncertainties in Project effects on soil quality are not expected to alter the conclusions of the HHRA.

8.3 UNCERTAINTIES IN SURFACE WATER QUALITY PREDICTIONS

The assessment of surface water quality determined that the concentrations of Project-related chemicals will be below their corresponding drinking water MACs within 100 m of each receiving point. The areas within 100 m of each receiving point represent a negligible portion of the surface water bodies and a correspondingly small proportion of the area likely to be used as occasional sources of drinking water. There is a high degree of confidence in the predictions of surface water quality (Section 7.7 of Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]), and therefore a high degree of confidence in the prediction that Project-related changes in surface water quality will not alter its suitability as a drinking water source. Thus, uncertainties in the effects of the Project on surface water quality are not expected to alter the conclusions of the HHRA.

8.4 UNCERTAINTIES IN COUNTRY FOOD QUALITY PREDICTIONS

Project-related changes in the concentrations of the parameters of concern in soil and surface water will govern the Project-related changes in the quality of terrestrial and aquatic country foods, whereby changes in country food quality could result in changes in human health risk associated with the consumption of country foods. The assessment of Project-related changes in metal concentrations in soil resulting from deposition determined that the maximum predicted Future Case concentrations of metals in soil would be well below the human health-based residential soil quality criteria (Section 4.3.2). The assessment of potential increases in metal concentrations in soil provided in Section 4.3.2 was based on a 95% UCLM deposition rate, which represents a reasonable upper limit of potential change in metal concentrations in soil and therefore in country foods (both animal and plant). Increases in metal concentrations in soil across the LAA would be lower than the increase noted in Section 4.3.2. Animals with the LAA would be expected to move throughout the LAA and thus experience a range of metal concentrations in soil. It is also reasonable to expect that plants would be harvested from areas across the LAA and would not be limited to harvesting solely at the point of maximum deposition. Thus, uncertainties in deposition estimates are not expected to alter the conclusions of the HHRA.

The assessment of surface water quality determined that the concentrations of Project-related chemicals will have returned to baseline conditions within 300 m of each receiving point (Section 7.6.2 of Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]). These areas represent a very small portion of the surface water bodies and a correspondingly small proportion of the area likely to be inhabited by fish species targeted for consumption. There is a high degree of confidence in the predictions of surface water quality (Section 7.7 of Chapter 7 [Surface Water Resources] of the EIS [Marathon 2020]), and therefore a high degree of confidence in the prediction that Project-related changes in surface water quality will not alter fish tissue quality. Thus, uncertainties in the effects of the Project on fish tissue quality are not expected to alter the conclusions of the HHRA.

9.0 CONCLUSIONS

The HHRA evaluated potential human health risks associated with exposures to Project-related COPC under Background and Predicted Future Case conditions for Indigenous and non-Indigenous receptors present in the LAA. The results demonstrated that the predicted changes in inhalation exposures, direct contact exposures to soil and surface water and ingestion exposures from the consumption of country foods represent a negligible change in human health risk for the Indigenous and non-Indigenous receptors.

The HHRA also evaluated potential human health risks associated with inhalation exposures to Project-related COPC for off-duty workers housed at the accommodations camp or exploration camp. The results demonstrated that, with the exception of 1-hour exposures to NO_2, the maximum predicted concentrations for each COPC for each of the appropriate exposure averaging periods (e.g.,1-hour, 2-hour, 24-hour, annual average) were below the respective human health-based ambient air quality standards and thus represent negligible human health risks for off-duty workers housed at the accommodations camp or exploration camp. The results also demonstrated that the exceedances of the 1-hour NO_2 CAAQS

predicted to occur at the accommodations camp and exploration camp were limited in magnitude and frequency and thus represent a negligible human health risk for off-duty workers. The HHRA determined that Project activities would not result in adverse residual effects on human health, and therefore a cumulative effects assessment is not required.

The conclusions of the HHRA are based on the EIS which assessed potential changes in air, soil and surface water quality as described in Chapter 5 (Atmospheric Environment) and Chapter 7 (Surface Water Resources) of the EIS (Marathon 2020). The predictions provided in these sections incorporate consideration of mitigation measures to reduce the environmental effects of the Project. These mitigation measures also serve to address the human health effects mechanisms described above, and additional mitigation measures specific to the HHRA are not required.

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APPENDIX A

ProUCL Outputs - Soil

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:07:52 PM
From File	Soil, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Aluminum, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	200	Mean	2291
Maximum	12500	Median	1300
SD	2920	Std. Error of Mean	653
Coefficient of Variation	1.275	Skewness	2.602

Normal GOF Test

Shapiro Wilk Test Statistic	0.689	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3420	95% Adjusted-CLT UCL (Chen-1995)	3771
		95% Modified-t UCL (Johnson-1978)	3484

Gamma GOF Test

A-D Test Statistic	0.402	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.77	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.112	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.2	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.966	k star (bias corrected MLE)	0.855
Theta hat (MLE)	2371	Theta star (bias corrected MLE)	2681
nu hat (MLE)	38.65	nu star (bias corrected)	34.18
MLE Mean (bias corrected)	2291	MLE Sd (bias corrected)	2478
		Approximate Chi Square Value (0.05)	21.81
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	21.03

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	3591	95% Adjusted Gamma UCL (use when n<50)	3724

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:07:52 PM
From File	Soil, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Aluminum, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0934	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.298	Mean of logged Data	7.137
Maximum of Logged Data	9.433	SD of logged Data	1.132

Assuming Lognormal Distribution

95% H-UCL	4978	90% Chebyshev (MVUE) UCL	4244
95% Chebyshev (MVUE) UCL	5137	97.5% Chebyshev (MVUE) UCL	6376
99% Chebyshev (MVUE) UCL	8810		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3365	95% Jackknife UCL	3420
95% Standard Bootstrap UCL	3314	95% Bootstrap-t UCL	4609
95% Hall's Bootstrap UCL	8319	95% Percentile Bootstrap UCL	3423
95% BCA Bootstrap UCL	3883		
90% Chebyshev(Mean, Sd) UCL	4250	95% Chebyshev(Mean, Sd) UCL	5138
97.5% Chebyshev(Mean, Sd) UCL	6369	99% Chebyshev(Mean, Sd) UCL	8788

Suggested UCL to Use

95% Adjusted Gamma UCL	3724

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:08:34 PM
From File	Soil, Antimony, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Antimony, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Antimony, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:16 PM
From File	Soil, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Arsenic, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	15
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	2.1	Minimum Non-Detect	2
Maximum Detect	21	Maximum Non-Detect	2
Variance Detects	62.14	Percent Non-Detects	75%
Mean Detects	7.16	SD Detects	7.883
Median Detects	3.8	CV Detects	1.101
Skewness Detects	2.041	Kurtosis Detects	4.247
Mean of Logged Detects	1.592	SD of Logged Detects	0.903

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.718	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.343	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	3.29	KM Standard Error of Mean	1.043
KM SD	4.174	95% KM (BCA) UCL	5.135
95% KM (t) UCL	5.094	95% KM (Percentile Bootstrap) UCL	5.1
95% KM (z) UCL	5.006	95% KM Bootstrap t UCL	10.62
90% KM Chebyshev UCL	6.42	95% KM Chebyshev UCL	7.838
97.5% KM Chebyshev UCL	9.806	99% KM Chebyshev UCL	13.67

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.498	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.687	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.264	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.362	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.472	k star (bias corrected MLE)	0.722
Theta hat (MLE)	4.864	Theta star (bias corrected MLE)	9.915
nu hat (MLE)	14.72	nu star (bias corrected)	7.221
Mean (detects)	7.16		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:16 PM
From File	Soil, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Arsenic, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.798
Maximum	21	Median	0.01
SD	4.814	CV	2.678
k hat (MLE)	0.202	k star (bias corrected MLE)	0.205
Theta hat (MLE)	8.909	Theta star (bias corrected MLE)	8.775
nu hat (MLE)	8.071	nu star (bias corrected)	8.194
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (8.19, α)	2.848	Adjusted Chi Square Value (8.19, β)	2.604
95% Gamma Approximate UCL (use when n>=50)	5.172	95% Gamma Adjusted UCL (use when n<50)	5.656

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.29	SD (KM)	4.174
Variance (KM)	17.42	SE of Mean (KM)	1.043
k hat (KM)	0.621	k star (KM)	0.561
nu hat (KM)	24.85	nu star (KM)	22.46
theta hat (KM)	5.295	theta star (KM)	5.86
80% gamma percentile (KM)	5.421	90% gamma percentile (KM)	8.684
95% gamma percentile (KM)	12.12	99% gamma percentile (KM)	20.5

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.46, α)	12.68	Adjusted Chi Square Value (22.46, β)	12.1
95% Gamma Approximate KM-UCL (use when n>=50)	5.826	95% Gamma Adjusted KM-UCL (use when n<50)	6.105

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:16 PM
From File	Soil, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Arsenic, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.964	Mean in Log Scale	-1.361
SD in Original Scale	4.755	SD in Log Scale	2.263
95% t UCL (assumes normality of ROS data)	3.803	95% Percentile Bootstrap UCL	3.798
95% BCA Bootstrap UCL	5.049	95% Bootstrap t UCL	8.56
95% H-UCL (Log ROS)	39.73		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.918	KM Geo Mean	2.504
KM SD (logged)	0.561	95% Critical H Value (KM-Log)	2.08
KM Standard Error of Mean (logged)	0.14	95% H-UCL (KM -Log)	3.83
KM SD (logged)	0.561	95% Critical H Value (KM-Log)	2.08
KM Standard Error of Mean (logged)	0.14		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.54	Mean in Log Scale	0.398
SD in Original Scale	4.536	SD in Log Scale	0.82
95% t UCL (Assumes normality)	4.294	95% H-Stat UCL	3.262

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	6.105

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:59 PM
From File	Soil, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Barium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
Number of Detects	19	Number of Non-Detects	1
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	9.25	Minimum Non-Detect	5
Maximum Detect	380	Maximum Non-Detect	5
Variance Detects	6993	Percent Non-Detects	5%
Mean Detects	66.67	SD Detects	83.62
Median Detects	41	CV Detects	1.254
Skewness Detects	3.235	Kurtosis Detects	11.85
Mean of Logged Detects	3.773	SD of Logged Detects	0.887

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.603	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	63.59	KM Standard Error of Mean	18.49
KM SD	80.46	95% KM (BCA) UCL	94.45
95% KM (t) UCL	95.55	95% KM (Percentile Bootstrap) UCL	96.45
95% KM (z) UCL	93.99	95% KM Bootstrap t UCL	140.3
90% KM Chebyshev UCL	119	95% KM Chebyshev UCL	144.2
97.5% KM Chebyshev UCL	179	99% KM Chebyshev UCL	247.5

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.659	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.203	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.313	k star (bias corrected MLE)	1.14
Theta hat (MLE)	50.79	Theta star (bias corrected MLE)	58.46
nu hat (MLE)	49.88	nu star (bias corrected)	43.34
Mean (detects)	66.67		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:59 PM
From File	Soil, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Barium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	63.34
Maximum	380	Median	39
SD	82.75	CV	1.306
k hat (MLE)	0.753	k star (bias corrected MLE)	0.673
Theta hat (MLE)	84.12	Theta star (bias corrected MLE)	94.06
nu hat (MLE)	30.12	nu star (bias corrected)	26.93
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (26.93, α)	16.1	Adjusted Chi Square Value (26.93, β)	15.44
95% Gamma Approximate UCL (use when n>=50)	106	95% Gamma Adjusted UCL (use when n<50)	110.5

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	63.59	SD (KM)	80.46
Variance (KM)	6474	SE of Mean (KM)	18.49
k hat (KM)	0.625	k star (KM)	0.564
nu hat (KM)	24.98	nu star (KM)	22.57
theta hat (KM)	101.8	theta star (KM)	112.7
80% gamma percentile (KM)	104.8	90% gamma percentile (KM)	167.7
95% gamma percentile (KM)	233.9	99% gamma percentile (KM)	395.1

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.57, α)	12.76	Adjusted Chi Square Value (22.57, β)	12.18
95% Gamma Approximate KM-UCL (use when n>=50)	112.4	95% Gamma Adjusted KM-UCL (use when n<50)	117.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.102	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:59 PM
From File	Soil, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Barium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	63.58	Mean in Log Scale	3.664
SD in Original Scale	82.56	SD in Log Scale	0.992
95% t UCL (assumes normality of ROS data)	95.5	95% Percentile Bootstrap UCL	95.99
95% BCA Bootstrap UCL	113.3	95% Bootstrap t UCL	141.5
95% H-UCL (Log ROS)	115.8		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.665	KM Geo Mean	39.04
KM SD (logged)	0.964	95% Critical H Value (KM-Log)	2.582
KM Standard Error of Mean (logged)	0.222	95% H-UCL (KM -Log)	110
KM SD (logged)	0.964	95% Critical H Value (KM-Log)	2.582
KM Standard Error of Mean (logged)	0.222		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	63.46	Mean in Log Scale	3.63
SD in Original Scale	82.65	SD in Log Scale	1.074
95% t UCL (Assumes normality)	95.42	95% H-Stat UCL	131.9

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	117.8	95% GROS Adjusted Gamma UCL	110.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:10:42 PM
From File	Soil, Beryllium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Beryllium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Beryllium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:11:24 PM
From File	Soil, Bismuth, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Bismuth, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Bismuth, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:06 PM
From File	Soil, Boron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Boron, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Boron, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:48 PM
From File	Soil, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cadmium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	10
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	0.37	Minimum Non-Detect	0.3
Maximum Detect	0.71	Maximum Non-Detect	0.3
Variance Detects	0.0124	Percent Non-Detects	50%
Mean Detects	0.493	SD Detects	0.111
Median Detects	0.478	CV Detects	0.226
Skewness Detects	0.676	Kurtosis Detects	-0.172
Mean of Logged Detects	-0.73	SD of Logged Detects	0.22

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.396	KM Standard Error of Mean	0.0287
KM SD	0.122	95% KM (BCA) UCL	0.445
95% KM (t) UCL	0.446	95% KM (Percentile Bootstrap) UCL	0.442
95% KM (z) UCL	0.443	95% KM Bootstrap t UCL	0.456
90% KM Chebyshev UCL	0.482	95% KM Chebyshev UCL	0.521
97.5% KM Chebyshev UCL	0.576	99% KM Chebyshev UCL	0.682

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.362	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.182	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	22.75	k star (bias corrected MLE)	15.99
Theta hat (MLE)	0.0216	Theta star (bias corrected MLE)	0.0308
nu hat (MLE)	455.1	nu star (bias corrected)	319.9
Mean (detects)	0.493		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:48 PM
From File	Soil, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cadmium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0507	Mean	0.348
Maximum	0.71	Median	0.343
SD	0.177	CV	0.509
k hat (MLE)	3.214	k star (bias corrected MLE)	2.766
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	0.126
nu hat (MLE)	128.6	nu star (bias corrected)	110.6
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (110.62, α)	87.35	Adjusted Chi Square Value (110.62, β)	85.71
95% Gamma Approximate UCL (use when n>=50)	0.44	95% Gamma Adjusted UCL (use when n<50)	0.449

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.396	SD (KM)	0.122
Variance (KM)	0.0148	SE of Mean (KM)	0.0287
k hat (KM)	10.59	k star (KM)	9.031
nu hat (KM)	423.4	nu star (KM)	361.3
theta hat (KM)	0.0374	theta star (KM)	0.0439
80% gamma percentile (KM)	0.501	90% gamma percentile (KM)	0.572
95% gamma percentile (KM)	0.635	99% gamma percentile (KM)	0.765

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (361.26, α)	318.2	Adjusted Chi Square Value (361.26, β)	315
95% Gamma Approximate KM-UCL (use when n>=50)	0.45	95% Gamma Adjusted KM-UCL (use when n<50)	0.454

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:48 PM
From File	Soil, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cadmium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.375	Mean in Log Scale	-1.052
SD in Original Scale	0.147	SD in Log Scale	0.392
95% t UCL (assumes normality of ROS data)	0.432	95% Percentile Bootstrap UCL	0.429
95% BCA Bootstrap UCL	0.435	95% Bootstrap t UCL	0.437
95% H-UCL (Log ROS)	0.448		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.967	KM Geo Mean	0.38
KM SD (logged)	0.279	95% Critical H Value (KM-Log)	1.836
KM Standard Error of Mean (logged)	0.0658	95% H-UCL (KM -Log)	0.445
KM SD (logged)	0.279	95% Critical H Value (KM-Log)	1.836
KM Standard Error of Mean (logged)	0.0658		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.321	Mean in Log Scale	-1.314
SD in Original Scale	0.192	SD in Log Scale	0.617
95% t UCL (Assumes normality)	0.395	95% H-Stat UCL	0.44

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.446

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:13:30 PM
From File	Soil, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Chromium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	15
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	2.15	Minimum Non-Detect	2
Maximum Detect	11.5	Maximum Non-Detect	2
Variance Detects	17.08	Percent Non-Detects	75%
Mean Detects	5.67	SD Detects	4.133
Median Detects	3.7	CV Detects	0.729
Skewness Detects	0.813	Kurtosis Detects	-1.62
Mean of Logged Detects	1.515	SD of Logged Detects	0.744

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.859	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.918	KM Standard Error of Mean	0.609
KM SD	2.437	95% KM (BCA) UCL	3.925
95% KM (t) UCL	3.971	95% KM (Percentile Bootstrap) UCL	3.9
95% KM (z) UCL	3.92	95% KM Bootstrap t UCL	6.195
90% KM Chebyshev UCL	4.746	95% KM Chebyshev UCL	5.574
97.5% KM Chebyshev UCL	6.723	99% KM Chebyshev UCL	8.981

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.404	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.684	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.419	k star (bias corrected MLE)	1.101
Theta hat (MLE)	2.344	Theta star (bias corrected MLE)	5.15
nu hat (MLE)	24.19	nu star (bias corrected)	11.01
Mean (detects)	5.67		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:13:30 PM
From File	Soil, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Chromium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.425
Maximum	11.5	Median	0.01
SD	3.149	CV	2.21
k hat (MLE)	0.213	k star (bias corrected MLE)	0.214
Theta hat (MLE)	6.704	Theta star (bias corrected MLE)	6.659
nu hat (MLE)	8.502	nu star (bias corrected)	8.56
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (8.56, α)	3.063	Adjusted Chi Square Value (8.56, β)	2.809
95% Gamma Approximate UCL (use when n>=50)	3.982	95% Gamma Adjusted UCL (use when n<50)	4.343

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.918	SD (KM)	2.437
Variance (KM)	5.941	SE of Mean (KM)	0.609
k hat (KM)	1.433	k star (KM)	1.251
nu hat (KM)	57.31	nu star (KM)	50.04
theta hat (KM)	2.036	theta star (KM)	2.332
80% gamma percentile (KM)	4.601	90% gamma percentile (KM)	6.356
95% gamma percentile (KM)	8.083	99% gamma percentile (KM)	12.03

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (50.04, α)	34.8	Adjusted Chi Square Value (50.04, β)	33.8
95% Gamma Approximate KM-UCL (use when n>=50)	4.195	95% Gamma Adjusted KM-UCL (use when n<50)	4.32

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:13:30 PM
From File	Soil, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Chromium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.675	Mean in Log Scale	-0.893
SD in Original Scale	3.048	SD in Log Scale	1.845
95% t UCL (assumes normality of ROS data)	2.853	95% Percentile Bootstrap UCL	2.903
95% BCA Bootstrap UCL	3.351	95% Bootstrap t UCL	4.788
95% H-UCL (Log ROS)	12.36		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.898	KM Geo Mean	2.456
KM SD (logged)	0.487	95% Critical H Value (KM-Log)	2.007
KM Standard Error of Mean (logged)	0.122	95% H-UCL (KM -Log)	3.46
KM SD (logged)	0.487	95% Critical H Value (KM-Log)	2.007
KM Standard Error of Mean (logged)	0.122		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.168	Mean in Log Scale	0.379
SD in Original Scale	2.811	SD in Log Scale	0.754
95% t UCL (Assumes normality)	3.254	95% H-Stat UCL	2.891

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.971

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:13 PM
From File	Soil, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cobalt, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	12
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	1.3	Minimum Non-Detect	1
Maximum Detect	10.75	Maximum Non-Detect	1
Variance Detects	9.824	Percent Non-Detects	60%
Mean Detects	3.656	SD Detects	3.134
Median Detects	2.55	CV Detects	0.857
Skewness Detects	2.001	Kurtosis Detects	4.367
Mean of Logged Detects	1.048	SD of Logged Detects	0.717

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.764	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.063	KM Standard Error of Mean	0.542
KM SD	2.265	95% KM (BCA) UCL	3.018
95% KM (t) UCL	2.999	95% KM (Percentile Bootstrap) UCL	2.983
95% KM (z) UCL	2.953	95% KM Bootstrap t UCL	4.005
90% KM Chebyshev UCL	3.687	95% KM Chebyshev UCL	4.423
97.5% KM Chebyshev UCL	5.444	99% KM Chebyshev UCL	7.451

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.403	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.162	k star (bias corrected MLE)	1.435
Theta hat (MLE)	1.691	Theta star (bias corrected MLE)	2.548
nu hat (MLE)	34.59	nu star (bias corrected)	22.95
Mean (detects)	3.656		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:13 PM
From File	Soil, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cobalt, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.469
Maximum	10.75	Median	0.01
SD	2.642	CV	1.799
k hat (MLE)	0.259	k star (bias corrected MLE)	0.253
Theta hat (MLE)	5.672	Theta star (bias corrected MLE)	5.796
nu hat (MLE)	10.36	nu star (bias corrected)	10.14
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (10.14, α)	4.027	Adjusted Chi Square Value (10.14, β)	3.726
95% Gamma Approximate UCL (use when n>=50)	3.696	95% Gamma Adjusted UCL (use when n<50)	3.994

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.063	SD (KM)	2.265
Variance (KM)	5.132	SE of Mean (KM)	0.542
k hat (KM)	0.829	k star (KM)	0.738
nu hat (KM)	33.16	nu star (KM)	29.52
theta hat (KM)	2.488	theta star (KM)	2.795
80% gamma percentile (KM)	3.384	90% gamma percentile (KM)	5.113
95% gamma percentile (KM)	6.888	99% gamma percentile (KM)	11.11

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (29.52, α)	18.11	Adjusted Chi Square Value (29.52, β)	17.41
95% Gamma Approximate KM-UCL (use when n>=50)	3.361	95% Gamma Adjusted KM-UCL (use when n<50)	3.497

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.165	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:13 PM
From File	Soil, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cobalt, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.672	Mean in Log Scale	-0.393
SD in Original Scale	2.533	SD in Log Scale	1.448
95% t UCL (assumes normality of ROS data)	2.652	95% Percentile Bootstrap UCL	2.675
95% BCA Bootstrap UCL	3.019	95% Bootstrap t UCL	3.504
95% H-UCL (Log ROS)	5.846		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.419	KM Geo Mean	1.521
KM SD (logged)	0.666	95% Critical H Value (KM-Log)	2.196
KM Standard Error of Mean (logged)	0.159	95% H-UCL (KM -Log)	2.654
KM SD (logged)	0.666	95% Critical H Value (KM-Log)	2.196
KM Standard Error of Mean (logged)	0.159		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.763	Mean in Log Scale	0.0032
SD in Original Scale	2.477	SD in Log Scale	0.977
95% t UCL (Assumes normality)	2.72	95% H-Stat UCL	2.897

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.999

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:56 PM
From File	Soil, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Copper, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
Number of Detects	18	Number of Non-Detects	2
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	3.1	Minimum Non-Detect	2
Maximum Detect	28	Maximum Non-Detect	2
Variance Detects	31.79	Percent Non-Detects	10%
Mean Detects	6.489	SD Detects	5.639
Median Detects	4.7	CV Detects	0.869
Skewness Detects	3.612	Kurtosis Detects	14.19
Mean of Logged Detects	1.698	SD of Logged Detects	0.517

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.525	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.202	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.04	KM Standard Error of Mean	1.236
KM SD	5.37	95% KM (BCA) UCL	8.345
95% KM (t) UCL	8.177	95% KM (Percentile Bootstrap) UCL	8.315
95% KM (z) UCL	8.072	95% KM Bootstrap t UCL	11.2
90% KM Chebyshev UCL	9.747	95% KM Chebyshev UCL	11.43
97.5% KM Chebyshev UCL	13.76	99% KM Chebyshev UCL	18.33

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.488	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.746	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.185	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.055	k star (bias corrected MLE)	2.582
Theta hat (MLE)	2.124	Theta star (bias corrected MLE)	2.513
nu hat (MLE)	110	nu star (bias corrected)	92.97
Mean (detects)	6.489		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:56 PM
From File	Soil, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Copper, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	5.841
Maximum	28	Median	4.4
SD	5.694	CV	0.975
k hat (MLE)	0.845	k star (bias corrected MLE)	0.751
Theta hat (MLE)	6.915	Theta star (bias corrected MLE)	7.774
nu hat (MLE)	33.79	nu star (bias corrected)	30.05
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (30.05, α)	18.54	Adjusted Chi Square Value (30.05, β)	17.82
95% Gamma Approximate UCL (use when n>=50)	9.471	95% Gamma Adjusted UCL (use when n<50)	9.85

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.04	SD (KM)	5.37
Variance (KM)	28.84	SE of Mean (KM)	1.236
k hat (KM)	1.265	k star (KM)	1.109
nu hat (KM)	50.6	nu star (KM)	44.35
theta hat (KM)	4.774	theta star (KM)	5.448
80% gamma percentile (KM)	9.635	90% gamma percentile (KM)	13.56
95% gamma percentile (KM)	17.45	99% gamma percentile (KM)	26.42

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (44.35, α)	30.07	Adjusted Chi Square Value (44.35, β)	29.14
95% Gamma Approximate KM-UCL (use when n>=50)	8.907	95% Gamma Adjusted KM-UCL (use when n<50)	9.191

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.149	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:56 PM
From File	Soil, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Copper, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.017	Mean in Log Scale	1.584
SD in Original Scale	5.528	SD in Log Scale	0.602
95% t UCL (assumes normality of ROS data)	8.154	95% Percentile Bootstrap UCL	8.282
95% BCA Bootstrap UCL	9.285	95% Bootstrap t UCL	11.1
95% H-UCL (Log ROS)	7.835		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.597	KM Geo Mean	4.939
KM SD (logged)	0.564	95% Critical H Value (KM-Log)	2.084
KM Standard Error of Mean (logged)	0.13	95% H-UCL (KM -Log)	7.584
KM SD (logged)	0.564	95% Critical H Value (KM-Log)	2.084
KM Standard Error of Mean (logged)	0.13		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	5.94	Mean in Log Scale	1.528
SD in Original Scale	5.595	SD in Log Scale	0.716
95% t UCL (Assumes normality)	8.103	95% H-Stat UCL	8.623

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	9.191	95% GROS Adjusted Gamma UCL	9.85

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:15:38 PM
From File	Soil, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Iron, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	230	Mean	4459
Maximum	22000	Median	1750
SD	5903	Std. Error of Mean	1320
Coefficient of Variation	1.324	Skewness	1.846

Normal GOF Test

Shapiro Wilk Test Statistic	0.739	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	6742	95% Adjusted-CLT UCL (Chen-1995)	7213
		95% Modified-t UCL (Johnson-1978)	6832

Gamma GOF Test

A-D Test Statistic	0.64	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.784	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.169	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.202	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.7	k star (bias corrected MLE)	0.629
Theta hat (MLE)	6367	Theta star (bias corrected MLE)	7094
nu hat (MLE)	28.01	nu star (bias corrected)	25.14
MLE Mean (bias corrected)	4459	MLE Sd (bias corrected)	5624
		Approximate Chi Square Value (0.05)	14.72
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	14.09

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	7616	95% Adjusted Gamma UCL (use when n<50)	7956

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:15:38 PM
From File	Soil, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Iron, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.126	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.438	Mean of logged Data	7.54
Maximum of Logged Data	9.999	SD of logged Data	1.41

Assuming Lognormal Distribution

95% H-UCL	14677	90% Chebyshev (MVUE) UCL	9874
95% Chebyshev (MVUE) UCL	12237	97.5% Chebyshev (MVUE) UCL	15517
99% Chebyshev (MVUE) UCL	21960		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6630	95% Jackknife UCL	6742
95% Standard Bootstrap UCL	6606	95% Bootstrap-t UCL	8091
95% Hall's Bootstrap UCL	7468	95% Percentile Bootstrap UCL	6723
95% BCA Bootstrap UCL	7190		
90% Chebyshev(Mean, Sd) UCL	8419	95% Chebyshev(Mean, Sd) UCL	10213
97.5% Chebyshev(Mean, Sd) UCL	12703	99% Chebyshev(Mean, Sd) UCL	17593

Suggested UCL to Use

95% Adjusted Gamma UCL	7956

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:16:20 PM
From File	Soil, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lead, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	5.8	Mean	21.14
Maximum	53	Median	19
SD	11.96	Std. Error of Mean	2.674
Coefficient of Variation	0.566	Skewness	1.419

Normal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	25.76	95% Adjusted-CLT UCL (Chen-1995)	26.44
		95% Modified-t UCL (Johnson-1978)	25.9

Gamma GOF Test

A-D Test Statistic	0.223	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.103	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.758	k star (bias corrected MLE)	3.227
Theta hat (MLE)	5.626	Theta star (bias corrected MLE)	6.55
nu hat (MLE)	150.3	nu star (bias corrected)	129.1
MLE Mean (bias corrected)	21.14	MLE Sd (bias corrected)	11.77
		Approximate Chi Square Value (0.05)	103.9
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	102.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	26.28	95% Adjusted Gamma UCL (use when n<50)	26.74

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:16:20 PM
From File	Soil, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lead, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.987	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0902	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.758	Mean of logged Data	2.912
Maximum of Logged Data	3.97	SD of logged Data	0.544

Assuming Lognormal Distribution

95% H-UCL	27.58	90% Chebyshev (MVUE) UCL	29.2
95% Chebyshev (MVUE) UCL	32.84	97.5% Chebyshev (MVUE) UCL	37.9
99% Chebyshev (MVUE) UCL	47.83		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	25.54	95% Jackknife UCL	25.76
95% Standard Bootstrap UCL	25.37	95% Bootstrap-t UCL	27.58
95% Hall's Bootstrap UCL	30.52	95% Percentile Bootstrap UCL	25.72
95% BCA Bootstrap UCL	26.25		
90% Chebyshev(Mean, Sd) UCL	29.16	95% Chebyshev(Mean, Sd) UCL	32.79
97.5% Chebyshev(Mean, Sd) UCL	37.84	99% Chebyshev(Mean, Sd) UCL	47.74

Suggested UCL to Use

95% Student's-t UCL	25.76

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:02 PM
From File	Soil, Lithium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lithium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	17
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	2.6	Minimum Non-Detect	2
Maximum Detect	4.5	Maximum Non-Detect	2
Variance Detects	0.916	Percent Non-Detects	85%
Mean Detects	3.483	SD Detects	0.957
Median Detects	3.35	CV Detects	0.275
Skewness Detects	0.615	Kurtosis Detects	N/A
Mean of Logged Detects	1.223	SD of Logged Detects	0.275

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.223	KM Standard Error of Mean	0.167
KM SD	0.61	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.511	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.497	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.724	95% KM Chebyshev UCL	2.951
97.5% KM Chebyshev UCL	3.266	99% KM Chebyshev UCL	3.885

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	20.05	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.174	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	120.3	nu star (bias corrected)	N/A
Mean (detects)	3.483		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:02 PM
From File	Soil, Lithium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lithium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.687
Maximum	4.5	Median	0.01
SD	1.302	CV	1.894
k hat (MLE)	0.276	k star (bias corrected MLE)	0.268
Theta hat (MLE)	2.494	Theta star (bias corrected MLE)	2.568
nu hat (MLE)	11.03	nu star (bias corrected)	10.71
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (10.71, α)	4.388	Adjusted Chi Square Value (10.71, β)	4.073
95% Gamma Approximate UCL (use when n>=50)	1.677	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.223	SD (KM)	0.61
Variance (KM)	0.372	SE of Mean (KM)	0.167
k hat (KM)	13.27	k star (KM)	11.32
nu hat (KM)	531	nu star (KM)	452.6
theta hat (KM)	0.167	theta star (KM)	0.196
80% gamma percentile (KM)	2.751	90% gamma percentile (KM)	3.1
95% gamma percentile (KM)	3.409	99% gamma percentile (KM)	4.04

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (452.65, α)	404.3	Adjusted Chi Square Value (452.65, β)	400.7
95% Gamma Approximate KM-UCL (use when n>=50)	2.488	95% Gamma Adjusted KM-UCL (use when n<50)	2.511

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.998	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:02 PM
From File	Soil, Lithium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lithium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.2	Mean in Log Scale	-0.185
SD in Original Scale	1.129	SD in Log Scale	0.884
95% t UCL (assumes normality of ROS data)	1.636	95% Percentile Bootstrap UCL	1.638
95% BCA Bootstrap UCL	1.703	95% Bootstrap t UCL	1.852
95% H-UCL (Log ROS)	2.027		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.773	KM Geo Mean	2.165
KM SD (logged)	0.208	95% Critical H Value (KM-Log)	1.791
KM Standard Error of Mean (logged)	0.057	95% H-UCL (KM -Log)	2.41
KM SD (logged)	0.208	95% Critical H Value (KM-Log)	1.791
KM Standard Error of Mean (logged)	0.057		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.373	Mean in Log Scale	0.183
SD in Original Scale	0.961	SD in Log Scale	0.457
95% t UCL (Assumes normality)	1.744	95% H-Stat UCL	1.641

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.511

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:45 PM
From File	Soil, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Manganese, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	23	Mean	272.3
Maximum	965	Median	215
SD	241.6	Std. Error of Mean	54.03
Coefficient of Variation	0.887	Skewness	1.416

Normal GOF Test

Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	365.7	95% Adjusted-CLT UCL (Chen-1995)	379.4
		95% Modified-t UCL (Johnson-1978)	368.5

Gamma GOF Test

A-D Test Statistic	0.159	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0815	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.319	k star (bias corrected MLE)	1.155
Theta hat (MLE)	206.4	Theta star (bias corrected MLE)	235.8
nu hat (MLE)	52.76	nu star (bias corrected)	46.18
MLE Mean (bias corrected)	272.3	MLE Sd (bias corrected)	253.4
		Approximate Chi Square Value (0.05)	31.59
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	30.64

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	398	95% Adjusted Gamma UCL (use when n<50)	410.4

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:45 PM
From File	Soil, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Manganese, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.135	Mean of logged Data	5.182
Maximum of Logged Data	6.872	SD of logged Data	1.027

Assuming Lognormal Distribution

95% H-UCL	566.6	90% Chebyshev (MVUE) UCL	515.5
95% Chebyshev (MVUE) UCL	617.4	97.5% Chebyshev (MVUE) UCL	758.9
99% Chebyshev (MVUE) UCL	1037		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	361.1	95% Jackknife UCL	365.7
95% Standard Bootstrap UCL	357.8	95% Bootstrap-t UCL	395.8
95% Hall's Bootstrap UCL	409.5	95% Percentile Bootstrap UCL	356.9
95% BCA Bootstrap UCL	375.5		
90% Chebyshev(Mean, Sd) UCL	434.3	95% Chebyshev(Mean, Sd) UCL	507.8
97.5% Chebyshev(Mean, Sd) UCL	609.7	99% Chebyshev(Mean, Sd) UCL	809.8

Suggested UCL to Use

95% Student's-t UCL	365.7

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:18:27 PM
From File	Soil, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Mercury, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
Number of Detects	17	Number of Non-Detects	3
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	0.13	Minimum Non-Detect	0.1
Maximum Detect	0.46	Maximum Non-Detect	0.1
Variance Detects	0.00839	Percent Non-Detects	15%
Mean Detects	0.284	SD Detects	0.0916
Median Detects	0.28	CV Detects	0.323
Skewness Detects	0.26	Kurtosis Detects	-0.583
Mean of Logged Detects	-1.312	SD of Logged Detects	0.341

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.207	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.256	KM Standard Error of Mean	0.0242
KM SD	0.105	95% KM (BCA) UCL	0.296
95% KM (t) UCL	0.298	95% KM (Percentile Bootstrap) UCL	0.295
95% KM (z) UCL	0.296	95% KM Bootstrap t UCL	0.3
90% KM Chebyshev UCL	0.329	95% KM Chebyshev UCL	0.362
97.5% KM Chebyshev UCL	0.407	99% KM Chebyshev UCL	0.497

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.222	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.121	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.209	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	9.74	k star (bias corrected MLE)	8.061
Theta hat (MLE)	0.0291	Theta star (bias corrected MLE)	0.0352
nu hat (MLE)	331.2	nu star (bias corrected)	274.1
Mean (detects)	0.284		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:18:27 PM
From File	Soil, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Mercury, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0804	Mean	0.257
Maximum	0.46	Median	0.253
SD	0.107	CV	0.416
k hat (MLE)	5.301	k star (bias corrected MLE)	4.539
Theta hat (MLE)	0.0485	Theta star (bias corrected MLE)	0.0566
nu hat (MLE)	212.1	nu star (bias corrected)	181.6
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (181.58, α)	151.4	Adjusted Chi Square Value (181.58, β)	149.2
95% Gamma Approximate UCL (use when n>=50)	0.308	95% Gamma Adjusted UCL (use when n<50)	0.313

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.256	SD (KM)	0.105
Variance (KM)	0.011	SE of Mean (KM)	0.0242
k hat (KM)	5.957	k star (KM)	5.097
nu hat (KM)	238.3	nu star (KM)	203.9
theta hat (KM)	0.043	theta star (KM)	0.0503
80% gamma percentile (KM)	0.344	90% gamma percentile (KM)	0.408
95% gamma percentile (KM)	0.467	99% gamma percentile (KM)	0.591

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (203.89, α)	171.8	Adjusted Chi Square Value (203.89, β)	169.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.304	95% Gamma Adjusted KM-UCL (use when n<50)	0.308

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.207	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:18:27 PM
From File	Soil, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Mercury, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.26	Mean in Log Scale	-1.43
SD in Original Scale	0.103	SD in Log Scale	0.428
95% t UCL (assumes normality of ROS data)	0.299	95% Percentile Bootstrap UCL	0.297
95% BCA Bootstrap UCL	0.297	95% Bootstrap t UCL	0.301
95% H-UCL (Log ROS)	0.318		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.46	KM Geo Mean	0.232
KM SD (logged)	0.467	95% Critical H Value (KM-Log)	1.988
KM Standard Error of Mean (logged)	0.108	95% H-UCL (KM -Log)	0.32
KM SD (logged)	0.467	95% Critical H Value (KM-Log)	1.988
KM Standard Error of Mean (logged)	0.108		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.249	Mean in Log Scale	-1.564
SD in Original Scale	0.12	SD in Log Scale	0.692
95% t UCL (Assumes normality)	0.295	95% H-Stat UCL	0.378

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.298

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:10 PM
From File	Soil, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Molybdenum, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Molybdenum, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:53 PM
From File	Soil, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Nickel, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	14	Number of Non-Detects	6
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	2.1	Minimum Non-Detect	2
Maximum Detect	9.3	Maximum Non-Detect	2
Variance Detects	3.695	Percent Non-Detects	30%
Mean Detects	3.261	SD Detects	1.922
Median Detects	2.55	CV Detects	0.589
Skewness Detects	2.776	Kurtosis Detects	8.254
Mean of Logged Detects	1.082	SD of Logged Detects	0.412

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.607	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.329	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.226	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.883	KM Standard Error of Mean	0.384
KM SD	1.654	95% KM (BCA) UCL	3.628
95% KM (t) UCL	3.546	95% KM (Percentile Bootstrap) UCL	3.565
95% KM (z) UCL	3.514	95% KM Bootstrap t UCL	4.674
90% KM Chebyshev UCL	4.034	95% KM Chebyshev UCL	4.555
97.5% KM Chebyshev UCL	5.279	99% KM Chebyshev UCL	6.701

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.637	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.738	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.229	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.189	k star (bias corrected MLE)	4.124
Theta hat (MLE)	0.628	Theta star (bias corrected MLE)	0.791
nu hat (MLE)	145.3	nu star (bias corrected)	115.5
Mean (detects)	3.261		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:53 PM
From File	Soil, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Nickel, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.352
Maximum	9.3	Median	2.35
SD	2.14	CV	0.91
k hat (MLE)	0.659	k star (bias corrected MLE)	0.593
Theta hat (MLE)	3.572	Theta star (bias corrected MLE)	3.966
nu hat (MLE)	26.34	nu star (bias corrected)	23.72
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (23.72, α)	13.64	Adjusted Chi Square Value (23.72, β)	13.03
95% Gamma Approximate UCL (use when n>=50)	4.092	95% Gamma Adjusted UCL (use when n<50)	4.281

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.883	SD (KM)	1.654
Variance (KM)	2.735	SE of Mean (KM)	0.384
k hat (KM)	3.038	k star (KM)	2.615
nu hat (KM)	121.5	nu star (KM)	104.6
theta hat (KM)	0.949	theta star (KM)	1.102
80% gamma percentile (KM)	4.18	90% gamma percentile (KM)	5.271
95% gamma percentile (KM)	6.297	99% gamma percentile (KM)	8.537

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (104.61, α)	82.01	Adjusted Chi Square Value (104.61, β)	80.43
95% Gamma Approximate KM-UCL (use when n>=50)	3.677	95% Gamma Adjusted KM-UCL (use when n<50)	3.749

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.752	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.265	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.226	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:53 PM
From File	Soil, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Nickel, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.634	Mean in Log Scale	0.799
SD in Original Scale	1.874	SD in Log Scale	0.574
95% t UCL (assumes normality of ROS data)	3.359	95% Percentile Bootstrap UCL	3.388
95% BCA Bootstrap UCL	3.67	95% Bootstrap t UCL	4.036
95% H-UCL (Log ROS)	3.451		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.966	KM Geo Mean	2.627
KM SD (logged)	0.377	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.0875	95% H-UCL (KM -Log)	3.327
KM SD (logged)	0.377	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.0875		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.583	Mean in Log Scale	0.758
SD in Original Scale	1.913	SD in Log Scale	0.613
95% t UCL (Assumes normality)	3.322	95% H-Stat UCL	3.475

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.546	KM H-UCL	3.327
95% KM (BCA) UCL	3.628		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:20:35 PM
From File	Soil, Rubidium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Rubidium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	7
Number of Detects	7	Number of Non-Detects	13
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	3.2	Maximum Non-Detect	2
Variance Detects	0.18	Percent Non-Detects	65%
Mean Detects	2.393	SD Detects	0.425
Median Detects	2.2	CV Detects	0.177
Skewness Detects	1.363	Kurtosis Detects	1.334
Mean of Logged Detects	0.86	SD of Logged Detects	0.166

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.138	KM Standard Error of Mean	0.0721
KM SD	0.299	95% KM (BCA) UCL	2.255
95% KM (t) UCL	2.262	95% KM (Percentile Bootstrap) UCL	2.255
95% KM (z) UCL	2.256	95% KM Bootstrap t UCL	2.418
90% KM Chebyshev UCL	2.354	95% KM Chebyshev UCL	2.452
97.5% KM Chebyshev UCL	2.588	99% KM Chebyshev UCL	2.855

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.458	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	40.61	k star (bias corrected MLE)	23.3
Theta hat (MLE)	0.0589	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	568.6	nu star (bias corrected)	326.2
Mean (detects)	2.393		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:20:35 PM
From File	Soil, Rubidium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Rubidium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.109	Mean	1.497
Maximum	3.2	Median	1.429
SD	0.811	CV	0.542
k hat (MLE)	2.52	k star (bias corrected MLE)	2.175
Theta hat (MLE)	0.594	Theta star (bias corrected MLE)	0.688
nu hat (MLE)	100.8	nu star (bias corrected)	87
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (87.00, α)	66.5	Adjusted Chi Square Value (87.00, β)	65.08
95% Gamma Approximate UCL (use when n>=50)	1.959	95% Gamma Adjusted UCL (use when n<50)	2.002

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.138	SD (KM)	0.299
Variance (KM)	0.0892	SE of Mean (KM)	0.0721
k hat (KM)	51.21	k star (KM)	43.56
nu hat (KM)	2048	nu star (KM)	1742
theta hat (KM)	0.0417	theta star (KM)	0.0491
80% gamma percentile (KM)	2.404	90% gamma percentile (KM)	2.562
95% gamma percentile (KM)	2.697	99% gamma percentile (KM)	2.962

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1647	Adjusted Chi Square Value (N/A, β)	1639
95% Gamma Approximate KM-UCL (use when n>=50)	2.262	95% Gamma Adjusted KM-UCL (use when n<50)	2.272

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.238	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:20:35 PM
From File	Soil, Rubidium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Rubidium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.704	Mean in Log Scale	0.473
SD in Original Scale	0.615	SD in Log Scale	0.356
95% t UCL (assumes normality of ROS data)	1.942	95% Percentile Bootstrap UCL	1.928
95% BCA Bootstrap UCL	1.955	95% Bootstrap t UCL	1.981
95% H-UCL (Log ROS)	1.995		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.752	KM Geo Mean	2.12
KM SD (logged)	0.121	95% Critical H Value (KM-Log)	1.743
KM Standard Error of Mean (logged)	0.0292	95% H-UCL (KM -Log)	2.242
KM SD (logged)	0.121	95% Critical H Value (KM-Log)	1.743
KM Standard Error of Mean (logged)	0.0292		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.488	Mean in Log Scale	0.301
SD in Original Scale	0.722	SD in Log Scale	0.431
95% t UCL (Assumes normality)	1.767	95% H-Stat UCL	1.799

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.262

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:21:18 PM
From File	Soil, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Selenium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	12
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.52	Minimum Non-Detect	0.5
Maximum Detect	0.84	Maximum Non-Detect	0.5
Variance Detects	0.0112	Percent Non-Detects	60%
Mean Detects	0.635	SD Detects	0.106
Median Detects	0.605	CV Detects	0.166
Skewness Detects	1.08	Kurtosis Detects	0.798
Mean of Logged Detects	-0.465	SD of Logged Detects	0.159

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.554	KM Standard Error of Mean	0.0218
KM SD	0.091	95% KM (BCA) UCL	0.587
95% KM (t) UCL	0.592	95% KM (Percentile Bootstrap) UCL	0.589
95% KM (z) UCL	0.59	95% KM Bootstrap t UCL	0.606
90% KM Chebyshev UCL	0.619	95% KM Chebyshev UCL	0.649
97.5% KM Chebyshev UCL	0.69	99% KM Chebyshev UCL	0.77

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.293	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.206	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.293	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	44.15	k star (bias corrected MLE)	27.68
Theta hat (MLE)	0.0144	Theta star (bias corrected MLE)	0.0229
nu hat (MLE)	706.4	nu star (bias corrected)	442.9
Mean (detects)	0.635		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:21:18 PM
From File	Soil, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Selenium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.107	Mean	0.441
Maximum	0.84	Median	0.423
SD	0.194	CV	0.44
k hat (MLE)	4.65	k star (bias corrected MLE)	3.986
Theta hat (MLE)	0.0947	Theta star (bias corrected MLE)	0.111
nu hat (MLE)	186	nu star (bias corrected)	159.4
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (159.44, α)	131.2	Adjusted Chi Square Value (159.44, β)	129.2
95% Gamma Approximate UCL (use when n>=50)	0.535	95% Gamma Adjusted UCL (use when n<50)	0.544

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.554	SD (KM)	0.091
Variance (KM)	0.00828	SE of Mean (KM)	0.0218
k hat (KM)	37.05	k star (KM)	31.53
nu hat (KM)	1482	nu star (KM)	1261
theta hat (KM)	0.015	theta star (KM)	0.0176
80% gamma percentile (KM)	0.635	90% gamma percentile (KM)	0.684
95% gamma percentile (KM)	0.726	99% gamma percentile (KM)	0.809

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1180	Adjusted Chi Square Value (N/A, β)	1173
95% Gamma Approximate KM-UCL (use when n>=50)	0.592	95% Gamma Adjusted KM-UCL (use when n<50)	0.595

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.191	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:21:18 PM
From File	Soil, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Selenium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.479	Mean in Log Scale	-0.785
SD in Original Scale	0.155	SD in Log Scale	0.322
95% t UCL (assumes normality of ROS data)	0.539	95% Percentile Bootstrap UCL	0.534
95% BCA Bootstrap UCL	0.539	95% Bootstrap t UCL	0.545
95% H-UCL (Log ROS)	0.551		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.602	KM Geo Mean	0.548
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.756
KM Standard Error of Mean (logged)	0.0349	95% H-UCL (KM -Log)	0.587
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.756
KM Standard Error of Mean (logged)	0.0349		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.404	Mean in Log Scale	-1.018
SD in Original Scale	0.204	SD in Log Scale	0.473
95% t UCL (Assumes normality)	0.483	95% H-Stat UCL	0.502

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.592

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:01 PM
From File	Soil, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Silver, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	13
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.56	Minimum Non-Detect	0.5
Maximum Detect	1.3	Maximum Non-Detect	0.5
Variance Detects	0.0842	Percent Non-Detects	65%
Mean Detects	0.919	SD Detects	0.29
Median Detects	0.925	CV Detects	0.316
Skewness Detects	0.073	Kurtosis Detects	-1.968
Mean of Logged Detects	-0.129	SD of Logged Detects	0.328

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.647	KM Standard Error of Mean	0.0617
KM SD	0.255	95% KM (BCA) UCL	0.748
95% KM (t) UCL	0.753	95% KM (Percentile Bootstrap) UCL	0.75
95% KM (z) UCL	0.748	95% KM Bootstrap t UCL	0.762
90% KM Chebyshev UCL	0.832	95% KM Chebyshev UCL	0.916
97.5% KM Chebyshev UCL	1.032	99% KM Chebyshev UCL	1.261

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.37	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	11.28	k star (bias corrected MLE)	6.542
Theta hat (MLE)	0.0815	Theta star (bias corrected MLE)	0.141
nu hat (MLE)	157.9	nu star (bias corrected)	91.59
Mean (detects)	0.919		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:01 PM
From File	Soil, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Silver, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.42
Maximum	1.3	Median	0.3
SD	0.43	CV	1.025
k hat (MLE)	0.601	k star (bias corrected MLE)	0.544
Theta hat (MLE)	0.699	Theta star (bias corrected MLE)	0.772
nu hat (MLE)	24.03	nu star (bias corrected)	21.76
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (21.76, α)	12.16	Adjusted Chi Square Value (21.76, β)	11.59
95% Gamma Approximate UCL (use when n>=50)	0.751	95% Gamma Adjusted UCL (use when n<50)	0.788

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.647	SD (KM)	0.255
Variance (KM)	0.0652	SE of Mean (KM)	0.0617
k hat (KM)	6.411	k star (KM)	5.483
nu hat (KM)	256.5	nu star (KM)	219.3
theta hat (KM)	0.101	theta star (KM)	0.118
80% gamma percentile (KM)	0.861	90% gamma percentile (KM)	1.016
95% gamma percentile (KM)	1.158	99% gamma percentile (KM)	1.455

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (219.32, α)	186	Adjusted Chi Square Value (219.32, β)	183.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.762	95% Gamma Adjusted KM-UCL (use when n<50)	0.772

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:01 PM
From File	Soil, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Silver, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.521	Mean in Log Scale	-0.866
SD in Original Scale	0.354	SD in Log Scale	0.679
95% t UCL (assumes normality of ROS data)	0.658	95% Percentile Bootstrap UCL	0.655
95% BCA Bootstrap UCL	0.674	95% Bootstrap t UCL	0.688
95% H-UCL (Log ROS)	0.747		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.496	KM Geo Mean	0.609
KM SD (logged)	0.324	95% Critical H Value (KM-Log)	1.868
KM Standard Error of Mean (logged)	0.0781	95% H-UCL (KM -Log)	0.737
KM SD (logged)	0.324	95% Critical H Value (KM-Log)	1.868
KM Standard Error of Mean (logged)	0.0781		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.484	Mean in Log Scale	-0.946
SD in Original Scale	0.366	SD in Log Scale	0.642
95% t UCL (Assumes normality)	0.626	95% H-Stat UCL	0.657

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.753

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:44 PM
From File	Soil, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Strontium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	16
Number of Detects	18	Number of Non-Detects	2
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	10.1	Minimum Non-Detect	5
Maximum Detect	61	Maximum Non-Detect	5
Variance Detects	158	Percent Non-Detects	10%
Mean Detects	21.64	SD Detects	12.57
Median Detects	15.5	CV Detects	0.581
Skewness Detects	1.954	Kurtosis Detects	4.782
Mean of Logged Detects	2.952	SD of Logged Detects	0.485

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.778	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	19.98	KM Standard Error of Mean	2.903
KM SD	12.62	95% KM (BCA) UCL	25.38
95% KM (t) UCL	25	95% KM (Percentile Bootstrap) UCL	24.98
95% KM (z) UCL	24.76	95% KM Bootstrap t UCL	26.63
90% KM Chebyshev UCL	28.69	95% KM Chebyshev UCL	32.64
97.5% KM Chebyshev UCL	38.11	99% KM Chebyshev UCL	48.87

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.842	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.743	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.22	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.204	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.224	k star (bias corrected MLE)	3.557
Theta hat (MLE)	5.124	Theta star (bias corrected MLE)	6.085
nu hat (MLE)	152.1	nu star (bias corrected)	128.1
Mean (detects)	21.64		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:44 PM
From File	Soil, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Strontium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	19.58
Maximum	61	Median	15
SD	13.48	CV	0.689
k hat (MLE)	1.11	k star (bias corrected MLE)	0.977
Theta hat (MLE)	17.63	Theta star (bias corrected MLE)	20.04
nu hat (MLE)	44.42	nu star (bias corrected)	39.09
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (39.09, α)	25.77	Adjusted Chi Square Value (39.09, β)	24.91
95% Gamma Approximate UCL (use when n>=50)	29.7	95% Gamma Adjusted UCL (use when n<50)	30.72

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	19.98	SD (KM)	12.62
Variance (KM)	159.2	SE of Mean (KM)	2.903
k hat (KM)	2.507	k star (KM)	2.165
nu hat (KM)	100.3	nu star (KM)	86.58
theta hat (KM)	7.969	theta star (KM)	9.23
80% gamma percentile (KM)	29.63	90% gamma percentile (KM)	38.15
95% gamma percentile (KM)	46.23	99% gamma percentile (KM)	64.08

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (86.58, α)	66.13	Adjusted Chi Square Value (86.58, β)	64.72
95% Gamma Approximate KM-UCL (use when n>=50)	26.16	95% Gamma Adjusted KM-UCL (use when n<50)	26.73

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:44 PM
From File	Soil, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Strontium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	20.1	Mean in Log Scale	2.839
SD in Original Scale	12.8	SD in Log Scale	0.577
95% t UCL (assumes normality of ROS data)	25.05	95% Percentile Bootstrap UCL	24.85
95% BCA Bootstrap UCL	26.53	95% Bootstrap t UCL	26.84
95% H-UCL (Log ROS)	26.65		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.818	KM Geo Mean	16.73
KM SD (logged)	0.602	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.139	95% H-UCL (KM -Log)	26.9
KM SD (logged)	0.602	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.139		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	19.73	Mean in Log Scale	2.748
SD in Original Scale	13.27	SD in Log Scale	0.777
95% t UCL (Assumes normality)	24.86	95% H-Stat UCL	31.98

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM Student's t	22.59	KM H-UCL	26.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:23:26 PM
From File	Soil, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Thallium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Thallium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:08 PM
From File	Soil, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Tin, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	5
Number of Detects	6	Number of Non-Detects	14
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	1
Maximum Detect	1.4	Maximum Non-Detect	1
Variance Detects	0.0147	Percent Non-Detects	70%
Mean Detects	1.233	SD Detects	0.121
Median Detects	1.25	CV Detects	0.0982
Skewness Detects	0.0751	Kurtosis Detects	-1.55
Mean of Logged Detects	0.206	SD of Logged Detects	0.0984

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.07	KM Standard Error of Mean	0.0301
KM SD	0.123	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.122	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.12	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.16	95% KM Chebyshev UCL	1.201
97.5% KM Chebyshev UCL	1.258	99% KM Chebyshev UCL	1.369

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.384	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.233	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	124.2	k star (bias corrected MLE)	62.23
Theta hat (MLE)	0.00993	Theta star (bias corrected MLE)	0.0198
nu hat (MLE)	1491	nu star (bias corrected)	746.7
Mean (detects)	1.233		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:08 PM
From File	Soil, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Tin, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.479	Mean	0.927
Maximum	1.4	Median	0.911
SD	0.255	CV	0.275
k hat (MLE)	13.35	k star (bias corrected MLE)	11.38
Theta hat (MLE)	0.0694	Theta star (bias corrected MLE)	0.0814
nu hat (MLE)	533.8	nu star (bias corrected)	455.1
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (455.09, α)	406.6	Adjusted Chi Square Value (455.09, β)	403
95% Gamma Approximate UCL (use when n>=50)	1.037	95% Gamma Adjusted UCL (use when n<50)	1.046

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.07	SD (KM)	0.123
Variance (KM)	0.0151	SE of Mean (KM)	0.0301
k hat (KM)	75.82	k star (KM)	64.48
nu hat (KM)	3033	nu star (KM)	2579
theta hat (KM)	0.0141	theta star (KM)	0.0166
80% gamma percentile (KM)	1.18	90% gamma percentile (KM)	1.244
95% gamma percentile (KM)	1.298	99% gamma percentile (KM)	1.404

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	2462	Adjusted Chi Square Value (N/A, β)	2453
95% Gamma Approximate KM-UCL (use when n>=50)	1.121	95% Gamma Adjusted KM-UCL (use when n<50)	1.125

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:08 PM
From File	Soil, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Tin, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.967	Mean in Log Scale	-0.0562
SD in Original Scale	0.215	SD in Log Scale	0.22
95% t UCL (assumes normality of ROS data)	1.05	95% Percentile Bootstrap UCL	1.047
95% BCA Bootstrap UCL	1.051	95% Bootstrap t UCL	1.055
95% H-UCL (Log ROS)	1.061		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0617	KM Geo Mean	1.064
KM SD (logged)	0.106	95% Critical H Value (KM-Log)	1.736
KM Standard Error of Mean (logged)	0.026	95% H-UCL (KM -Log)	1.116
KM SD (logged)	0.106	95% Critical H Value (KM-Log)	1.736
KM Standard Error of Mean (logged)	0.026		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.72	Mean in Log Scale	-0.423
SD in Original Scale	0.35	SD in Log Scale	0.426
95% t UCL (Assumes normality)	0.855	95% H-Stat UCL	0.867

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.122

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:51 PM
From File	Soil, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Uranium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	14
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	0.1
Maximum Detect	0.33	Maximum Non-Detect	0.1
Variance Detects	0.00695	Percent Non-Detects	70%
Mean Detects	0.197	SD Detects	0.0833
Median Detects	0.185	CV Detects	0.424
Skewness Detects	0.726	Kurtosis Detects	-0.221
Mean of Logged Detects	-1.701	SD of Logged Detects	0.423

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.129	KM Standard Error of Mean	0.0149
KM SD	0.0608	95% KM (BCA) UCL	0.154
95% KM (t) UCL	0.155	95% KM (Percentile Bootstrap) UCL	0.154
95% KM (z) UCL	0.154	95% KM Bootstrap t UCL	0.162
90% KM Chebyshev UCL	0.174	95% KM Chebyshev UCL	0.194
97.5% KM Chebyshev UCL	0.222	99% KM Chebyshev UCL	0.277

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.219	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.19	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.883	k star (bias corrected MLE)	3.552
Theta hat (MLE)	0.0286	Theta star (bias corrected MLE)	0.0554
nu hat (MLE)	82.59	nu star (bias corrected)	42.63
Mean (detects)	0.197		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:51 PM
From File	Soil, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Uranium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0701
Maximum	0.33	Median	0.01
SD	0.0959	CV	1.368
k hat (MLE)	0.677	k star (bias corrected MLE)	0.609
Theta hat (MLE)	0.104	Theta star (bias corrected MLE)	0.115
nu hat (MLE)	27.09	nu star (bias corrected)	24.36
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (24.36, α)	14.12	Adjusted Chi Square Value (24.36, β)	13.51
95% Gamma Approximate UCL (use when n>=50)	0.121	95% Gamma Adjusted UCL (use when n<50)	0.126

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.129	SD (KM)	0.0608
Variance (KM)	0.0037	SE of Mean (KM)	0.0149
k hat (KM)	4.499	k star (KM)	3.857
nu hat (KM)	180	nu star (KM)	154.3
theta hat (KM)	0.0287	theta star (KM)	0.0334
80% gamma percentile (KM)	0.179	90% gamma percentile (KM)	0.217
95% gamma percentile (KM)	0.252	99% gamma percentile (KM)	0.328

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (154.29, α)	126.6	Adjusted Chi Square Value (154.29, β)	124.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.157	95% Gamma Adjusted KM-UCL (use when n<50)	0.16

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.173	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:51 PM
From File	Soil, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Uranium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0881	Mean in Log Scale	-2.862
SD in Original Scale	0.0868	SD in Log Scale	0.975
95% t UCL (assumes normality of ROS data)	0.122	95% Percentile Bootstrap UCL	0.122
95% BCA Bootstrap UCL	0.128	95% Bootstrap t UCL	0.141
95% H-UCL (Log ROS)	0.164		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.122	KM Geo Mean	0.12
KM SD (logged)	0.348	95% Critical H Value (KM-Log)	1.887
KM Standard Error of Mean (logged)	0.0852	95% H-UCL (KM -Log)	0.148
KM SD (logged)	0.348	95% Critical H Value (KM-Log)	1.887
KM Standard Error of Mean (logged)	0.0852		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.094	Mean in Log Scale	-2.607
SD in Original Scale	0.0811	SD in Log Scale	0.646
95% t UCL (Assumes normality)	0.125	95% H-Stat UCL	0.125

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.155

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:25:34 PM
From File	Soil, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Vanadium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	12
Number of Detects	13	Number of Non-Detects	7
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	44	Maximum Non-Detect	2
Variance Detects	130.3	Percent Non-Detects	35%
Mean Detects	9.427	SD Detects	11.41
Median Detects	5.7	CV Detects	1.211
Skewness Detects	2.677	Kurtosis Detects	7.847
Mean of Logged Detects	1.802	SD of Logged Detects	0.916

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.651	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.326	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.828	KM Standard Error of Mean	2.217
KM SD	9.524	95% KM (BCA) UCL	10.85
95% KM (t) UCL	10.66	95% KM (Percentile Bootstrap) UCL	10.8
95% KM (z) UCL	10.47	95% KM Bootstrap t UCL	16.99
90% KM Chebyshev UCL	13.48	95% KM Chebyshev UCL	16.49
97.5% KM Chebyshev UCL	20.67	99% KM Chebyshev UCL	28.88

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.585	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.204	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.242	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.274	k star (bias corrected MLE)	1.032
Theta hat (MLE)	7.397	Theta star (bias corrected MLE)	9.138
nu hat (MLE)	33.14	nu star (bias corrected)	26.82
Mean (detects)	9.427		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:25:34 PM
From File	Soil, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Vanadium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.131
Maximum	44	Median	2.55
SD	10.17	CV	1.659
k hat (MLE)	0.305	k star (bias corrected MLE)	0.293
Theta hat (MLE)	20.09	Theta star (bias corrected MLE)	20.95
nu hat (MLE)	12.21	nu star (bias corrected)	11.71
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (11.71, α)	5.035	Adjusted Chi Square Value (11.71, β)	4.693
95% Gamma Approximate UCL (use when n>=50)	14.26	95% Gamma Adjusted UCL (use when n<50)	15.3

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.828	SD (KM)	9.524
Variance (KM)	90.71	SE of Mean (KM)	2.217
k hat (KM)	0.514	k star (KM)	0.47
nu hat (KM)	20.56	nu star (KM)	18.81
theta hat (KM)	13.29	theta star (KM)	14.52
80% gamma percentile (KM)	11.18	90% gamma percentile (KM)	18.71
95% gamma percentile (KM)	26.81	99% gamma percentile (KM)	46.85

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (18.81, α)	9.975	Adjusted Chi Square Value (18.81, β)	9.469
95% Gamma Approximate KM-UCL (use when n>=50)	12.87	95% Gamma Adjusted KM-UCL (use when n<50)	13.56

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.139	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:25:34 PM
From File	Soil, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Vanadium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.362	Mean in Log Scale	0.975
SD in Original Scale	10.03	SD in Log Scale	1.415
95% t UCL (assumes normality of ROS data)	10.24	95% Percentile Bootstrap UCL	10.32
95% BCA Bootstrap UCL	12.29	95% Bootstrap t UCL	15.45
95% H-UCL (Log ROS)	20.94		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.414	KM Geo Mean	4.113
KM SD (logged)	0.885	95% Critical H Value (KM-Log)	2.472
KM Standard Error of Mean (logged)	0.206	95% H-UCL (KM -Log)	10.06
KM SD (logged)	0.885	95% Critical H Value (KM-Log)	2.472
KM Standard Error of Mean (logged)	0.206		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.478	Mean in Log Scale	1.172
SD in Original Scale	9.964	SD in Log Scale	1.144
95% t UCL (Assumes normality)	10.33	95% H-Stat UCL	13.11

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	13.56	95% GROS Adjusted Gamma UCL	15.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:26:16 PM
From File	Soil, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Zinc, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	16	Mean	46.33
Maximum	112	Median	33.5
SD	30.18	Std. Error of Mean	6.749
Coefficient of Variation	0.651	Skewness	1.108

Normal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	57.99	95% Adjusted-CLT UCL (Chen-1995)	59.21
		95% Modified-t UCL (Johnson-1978)	58.27

Gamma GOF Test

A-D Test Statistic	0.482	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.825	k star (bias corrected MLE)	2.435
Theta hat (MLE)	16.4	Theta star (bias corrected MLE)	19.02
nu hat (MLE)	113	nu star (bias corrected)	97.4
MLE Mean (bias corrected)	46.33	MLE Sd (bias corrected)	29.69
		Approximate Chi Square Value (0.05)	75.63
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	74.12

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	59.66	95% Adjusted Gamma UCL (use when n<50)	60.88

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:26:16 PM
From File	Soil, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Zinc, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.128	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.773	Mean of logged Data	3.648
Maximum of Logged Data	4.718	SD of logged Data	0.622

Assuming Lognormal Distribution

95% H-UCL	63.34	90% Chebyshev (MVUE) UCL	66.39
95% Chebyshev (MVUE) UCL	75.58	97.5% Chebyshev (MVUE) UCL	88.33
99% Chebyshev (MVUE) UCL	113.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	57.43	95% Jackknife UCL	57.99
95% Standard Bootstrap UCL	56.93	95% Bootstrap-t UCL	61.39
95% Hall's Bootstrap UCL	58.54	95% Percentile Bootstrap UCL	57.73
95% BCA Bootstrap UCL	59.1		
90% Chebyshev(Mean, Sd) UCL	66.57	95% Chebyshev(Mean, Sd) UCL	75.74
97.5% Chebyshev(Mean, Sd) UCL	88.47	99% Chebyshev(Mean, Sd) UCL	113.5

Suggested UCL to Use

95% Adjusted Gamma UCL	60.88

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX B

Deposition Sample Calculations

APPENDIX B SAMPLE CALCULATIONS

Soil Concentration

The soil concentration (Cs) sample calculation for Project-related change in soil from arsenic deposition during the life of the project, based on Drivas et al. (2011), is provided below.

$$Cs = \frac{Q \cdot T}{\rho \cdot Z_d} \times 10^6 \div 10^4$$

Where

Cs	=	Predicted change in soil concentration, mg/kg
Q	=	Surface atmospheric deposition rate, $g_{COPC}/m^2/yr$
	=	8.39E-05 $g_{COPC}/m^2/yr$ (see Table B-2)
T	=	Time of deposition, yr
	=	12 yr (based on expected life of the project)
ρ	=	Bulk density of soil, g/cm^3
	=	1 g_{soil}/cm^3 (conservative, based on typical ranges of 1.0 to 1.8 g_{soil}/cm^3)
Z_d	=	Mixing depth, cm
	=	5 cm (Health Canada, 2010a)
10^6	=	Conversion factor (g_{COPC}/g_{soil} to mg_{COPC}/kg_{soil})
10^4	=	Conversion factor (m^2 to cm^2)

$$Cs = \frac{(8.39E^{-05}) \cdot (12)}{(1) \cdot (5)} \times 10^6 \div 10^4 = 0.0201$$

APPENDIX C

Country Foods Sampling Program

Valentine Gold Project: Country Foods Sampling Program

Report

May 3, 2021

Prepared for:

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VALENTINE GOLD PROJECT: COUNTRY FOODS SAMPLING PROGRAM

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Abbreviations

BB	blueberries
BT	brook trout
CRC	collision reaction cell
CVAF	cold vapor atomic fluorescence
EA	environmental assessment
EPC	exposure point concentrations
EQL	estimate of quantification
GOF	Goodness of Fit
HHERA	Human Health and Ecological Risk Assessment
ICP-MS	inductively coupled plasma – mass spectrometry
IO	internal organs
LT	Labrador tea
Marathon	Marathon Gold Corporation
Miawpukek	Miawpukek First Nation
Project	Valentine Gold Project
Qalipu	Qalipu Mi'kmaq First Nation
QA/QC	Quality Assurance/Quality Control
RDL	reportable detection limit
RPD	relative percent differences
SCC	Standards Council of Canada
SH	snowshoe hare
SOPs	standard operating procedures
Stantec	Stantec Consulting Ltd.
T	tissue
UCLM	upper confidence limit of the mean

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Marathon Gold Corporation (Marathon) to complete a country foods sampling program to establish baseline concentrations of contaminants of potential concern (i.e., metals) in locally harvested foods (country foods).

This work was conducted as part of the environmental assessment (EA) for the proposed Valentine Gold Project (the Project). The Project Area consists of the mine site, within which Project infrastructure will be located, and the existing 88 km-long access road to the site. When completed, the Project will contain two open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities, a tailings management facility, personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities. Because potential Project effects are likely to extend beyond the Project Area, sampling for the country foods program included locations up to ~2 km from the Project (the Assessment Area).

This report documents the methodology, and results of the country foods sampling program, as follows.

- Section 1.0 provides a general introduction and background information about the Project and the study objectives.
- Section 2.0 summarizes the methods used to collect, prepare and analyze the samples, as well as provides a description of the sampling locations.
- Section 3.0 summarizes the laboratory Quality Assurance/Quality Control (QA/QC) results.
- Section 4.0 summarizes the terrestrial and aquatic results from samples collected in the Assessment Area.
- Section 5.0 summarizes the country foods sampling program and the recommendation baseline concentrations of metals for the various sample media.
- References consulted as part of the work and personal communications are provided in Section 6.0, and additional supporting documentation is provided in the attachments.

1.1 PROJECT LOCATION

The proposed Project is located in the central region of the Island of Newfoundland, southwest of the towns of Buchans and Millertown near Valentine Lake and the Victoria Lake Reservoir (Figure 1-1). The area has a history of mining exploration and development activities and other land and resource uses, including commercial forestry, hydroelectric developments, outfitting, and recreational land use.

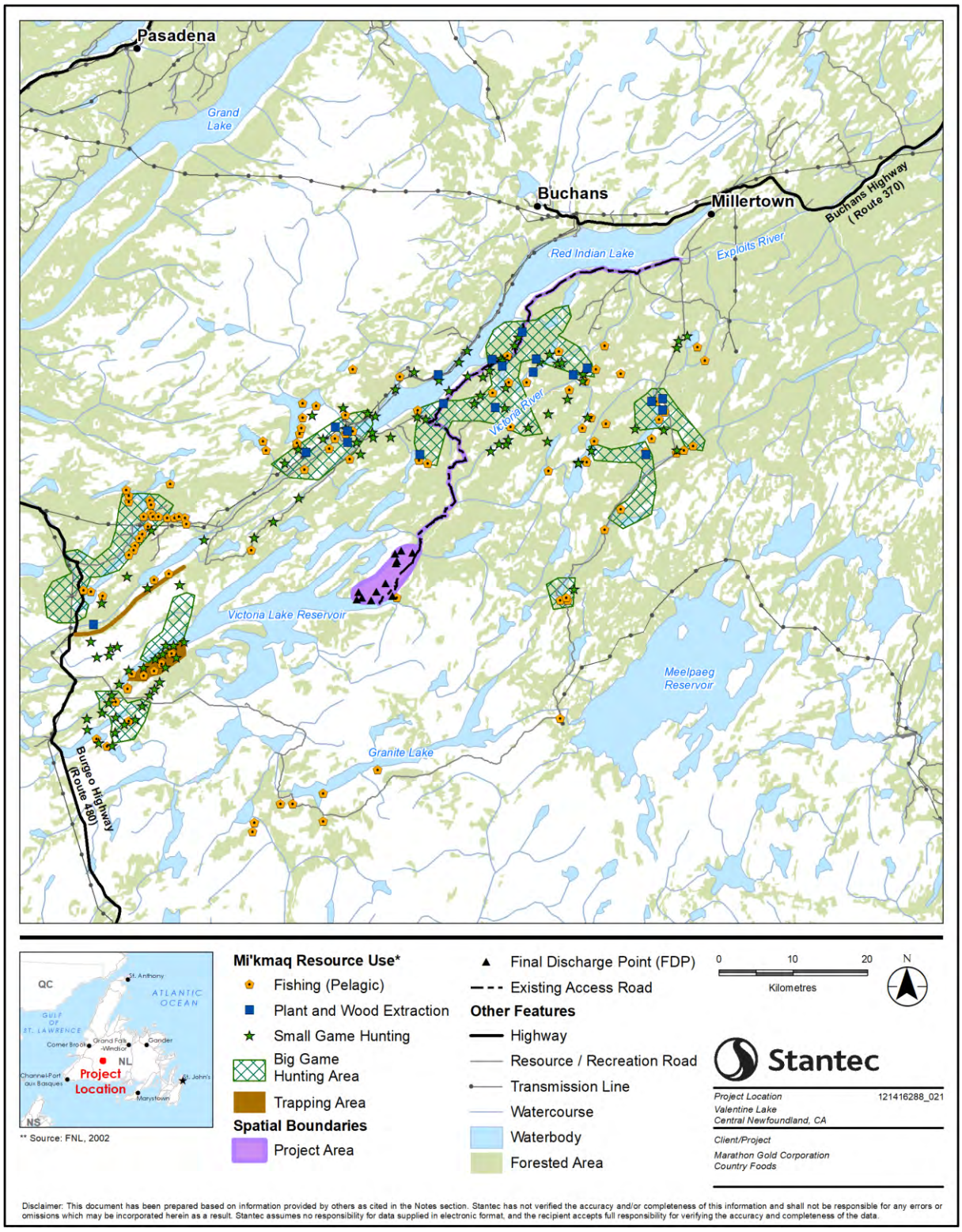

Figure 1-1 Project Location

There are two Mi'kmaq First Nation groups on the Island of Newfoundland potentially affected by / interested in the Project: Miawpukek First Nation (Miawpukek) and Qalipu Mi'kmaq First Nation (Qalipu). The Miawpukek Reserve is located at the mouth of the Conne River on the south coast of the Island of Newfoundland, approximately 113 km from the Project Area. Although a registered band, Qalipu does not manage any reserve lands. Its members reside within 67 communities across the island, including within the nearby communities of Buchans and Millertown. Indigenous and non-Indigenous people use the Red Indian Lake / Victoria Lake Reservoir area for harvesting wood, and for fishing and hunting for sustenance and/or recreation (Figure 1-1).

1.2 STUDY OBJECTIVES

The objective of this study is to determine concentrations of metals in the environment that can be used to establish a baseline against which the Project and cumulative environmental effects can be assessed.

Based on previous Human Health and Ecological Risk Assessment (HHERA) experience and standard assessment protocols for mining projects, metals, including mercury, were considered. The media of interest and the rationale for inclusion in the country foods sampling program are as follows:

- **Snowshoe Hare** (*Lepus americanus*): Small mammals are exposed directly to soil and forage/browse media as well as form an exposure pathway for both human and other ecological receptors.
- **Blueberries** (*Vaccinium sp.*): Ingestion of the fruit is an exposure pathway for both human and ecological receptors.
- **Brook Trout** (*Salvelinus fontinalis*): Fish ingestion is an exposure pathway for both human and ecological receptors.
- **Labrador Tea** (*Rhododendron sp.*): Ingestion of plants is a direct pathway for both human and ecological receptors.
- **Soil**: Soil is one of the most important of the media considered. Both human and ecological receptors are exposed directly to soil, and the models used rely heavily on the soil concentrations to predict concentrations in various other media. In addition, existing soil concentrations represent the current conditions associated with any historical deposition.

2.0 METHODS

2.1 SAMPLING PROGRAM

The different media selected for analysis were grouped by occurrence into sampling locations as follows:

- Terrestrial: snowshoe hare, blueberries, Labrador tea, and soil
- Aquatic: brook trout

The locations of the soil, terrestrial, freshwater, and marine sampling locations are shown on Figure 2-1, and the coordinates provided in Table 2.1. Consistent with Health Canada guidance, sampling of representative media was conducted in areas where Project-related effects would be most likely to occur

and where country foods are harvested. For this study, the Assessment Area encompassed the Project Area and accessible sites within approximately 2 km.

Table 2.1 Summary of 2020 Sample Locations and UTM Coordinates

Sampling Date	Sample Identifier	UTM Coordinates (Zone 21)		General Location
		Easting	Northing	
Terrestrial Samples – Snowshoe Hare: Tissue (T) and Internal Organs (IO)				
8-Sep	SH-T1 and SH-IO1	490800	5357019	Mine site
10-Sep	SH-T2 and SH-IO2	492545	5364806	~2.4 km from mine site / 1.8 km from access road
10-Sep	SH-T3 and SH-IO3	492616	5364736	
19-Oct	SH-T4 and SH-IO4	490248	5356376	Mine site
19-Oct	SH-T5 and SH-IO5	490772	5357018	
20-Oct	SH-T6 and SH-IO6	491071	5357308	
7-Nov	SH-T7 and SH-IO7	491071	5357308	
8-Nov	SH-T8 and SH-IO8	487750	5355454	
Terrestrial Samples – Blueberries and Co-Located Soil				
6-Sep	BB-1 / Soil	485602	5355737	Mine site
7-Sep	BB-2 / Soil	486546	5356279	
8-Sep	BB-3 / Soil	509379	5389666	Cutover ~1.4 km east of existing access road
8-Sep	BB-4 / Soil	509347	5389680	
8-Sep	BB-5 / Soil	509347	5389680	
8-Sep	BB-6 / Soil	511035	5390779	Cutover ~2.9 km east of existing access road
8-Sep	BB-7 / Soil	511084	5390707	
8-Sep	BB-8 / Soil	509201	5389833	Cutover ~1.2 km east of existing access road
8-Sep	BB-9 / Soil	508795	5389705	Cutover ~883 m east of existing access road
8-Sep	BB-10 / Soil	508795	5389705	
Terrestrial Samples – Labrador Tea and Co-Located Soil				
5-Sep	LT-1 / Soil	490257	5356426	Mine site
6-Sep	LT-2 / Soil	486546	5356279	
6-Sep	LT-3 / Soil	487410	5356825	
8-Sep	LT-4 / Soil	496063	5379136	Near access road
10-Sep	LT-5 / Soil	492600	5364410	~2.1 km from mine site / 1.7 km from access road
10-Sep	LT-6 / Soil	492615	5364412	
10-Sep	LT-7 / Soil	491848	5364526	~2.3 km from mine site / access road
10-Sep	LT-8 / Soil	491986	5364449	
10-Sep	LT-9 / Soil	495964	5372072	~2.9 km west of access road
11-Sep	LT-10 / Soil	530380	5400251	Northwest end of Red Indian Lake near the Exploits River

Table 2.1 Summary of 2020 Sample Locations and UTM Coordinates

Sampling Date	Sample Identifier	UTM Coordinates (Zone 21)		General Location
		Easting	Northing	
Aquatic Samples – Brook Trout				
05-Sep	BT-1 to BT-15	491686	5360061	Mine site, pond M1
07-Sep	BT-16	491986	5353843	Victoria Lake; ~2.1 km south of mine site
09-Sep	BT-17 to BT-26	493528	5358993	Victoria River, adjacent to mine site
09-Sep	BT-27 to BT-36	494104	5360105	
11-Sep	BT-37 to BT-40	503187	5386327	Unnamed tributaries to Red Indian Lake
11-Sep	BT-41	507892	5389689	
11-Sep	BT-42	506436	5387423	
11-Sep	BT-43 to BT-45	510129	5395783	
11-Sep	BT-46	523814	5399082	
29-Sep	BT-47	507892	5389689	
29-Sep	BT-48 to BT-50	509003	5392879	
29-Sep	BT-51	520643	5399288	

Notes:
SH = Snowshoe hare
T = Tissue
IO = Internal Organs
BT = Brook Trout
BB = Blueberries
LT = Labrador Tea

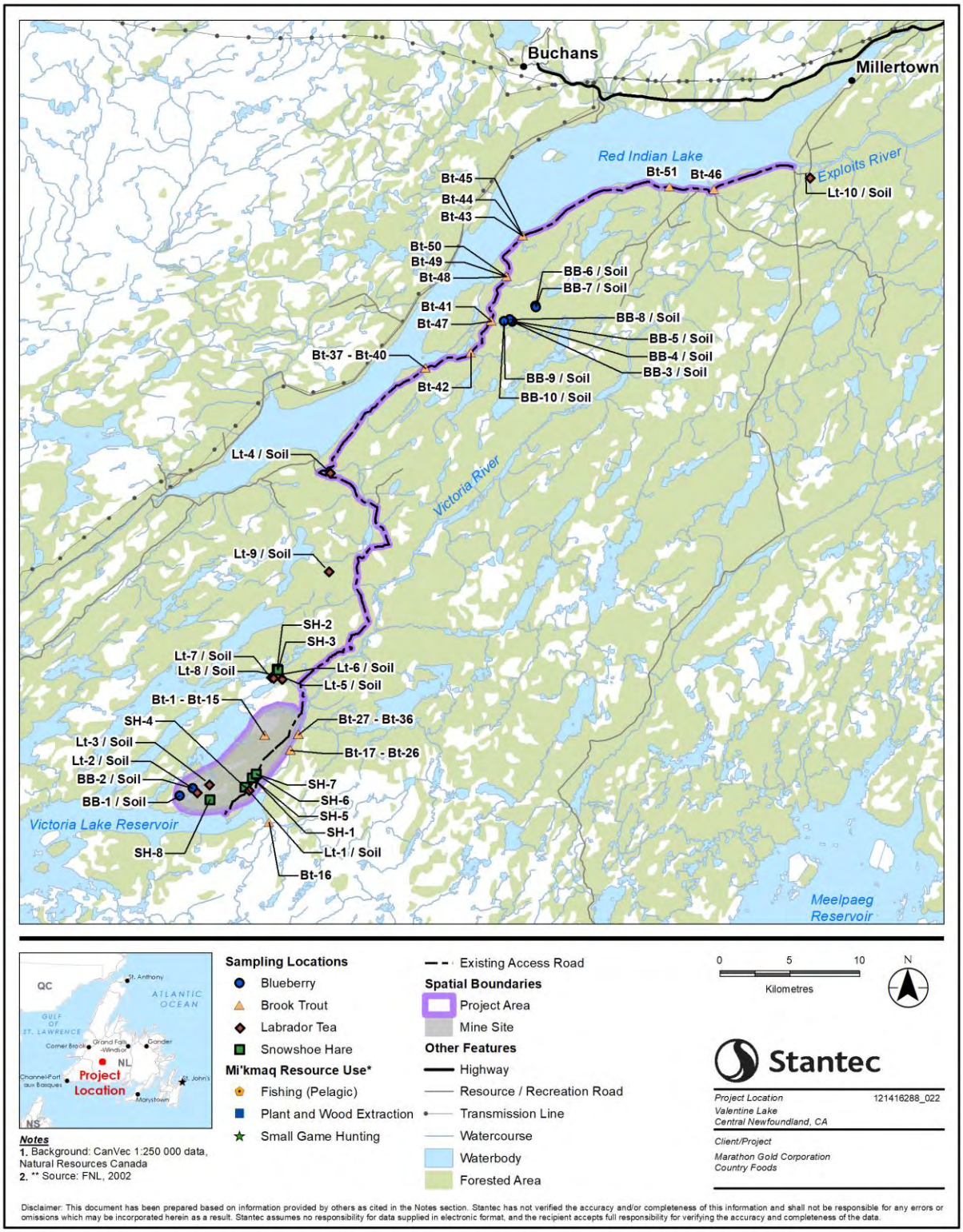

Figure 2-1 Sampling Locations

Stantec professionals, in teams of two, collected field samples from September 5, 2020 to October 20, 2020 at the various sampling locations (Table 2.1). Snares made using 22-gauge brass wire were used to capture snowshoe hare along wildlife trails and other areas of potential. Snowshoe hare were weighed prior to and following dissection and a sample of muscle tissue removed, weighed, and frozen. Internal organs (IO; heart, liver, and kidneys) were removed, grouped together, and weighed prior to freezing. The remaining carcass was also frozen in case future analysis is required.

Gill nets with 1" to 1-1/2" panels were set in brooks, streams and tributaries. Nets were set for a maximum of 20 minutes (as per Standard Operating Procedures) and then checked for brook trout. Brook trout were weighed prior to and following dissection, and a sample of muscle tissue removed, weighed and frozen. The entrails were also weighed, bagged and frozen for potential future analysis.

Google earth imagery was used to identify probable locations of blueberries, based on the presence of cutovers and burns. An attempt was made to collect one cup of berries at each site visited. Blueberries were then bagged and stored frozen.

Labrador tea was relatively abundant, and samples were mainly collected opportunistically in the field from various locations in the Assessment Area and mine site. Only the new growth parts of the Labrador tea plant were picked for analysis; these were similarly bagged and stored frozen.

Frozen samples were submitted to the Bureau Veritas Laboratory in Bedford, Nova Scotia for analysis. A summary of the sampling program and the number of samples collected for analysis for metals is provided in Table 2.2.

Table 2.2 Summary of Sampling Locations and Total Samples Sent for Metal Analysis

Media	Number of Sampling Locations	Total Number of Field Samples Sent for Analysis
Snowshoe Hare (Muscle Tissue)	8	8
Snowshoe Hare (Internal Organs)	8	8
Blueberries	10	10 + 1 field duplicate
Labrador Tea	10	10 + 1 field duplicate
Soil	20	20 + 2 field duplicates
Brook Trout (Muscle Tissue)	12	51

2.1.1 Description of Terrestrial Sampling Locations

2.1.1.1 Snowshoe Hare

Targeted areas for snowshoe hare were areas proximate to other sampling sites so that snares could be set and checked at regular intervals. Target areas included six locations in the Project Area (mine site) and two in the Assessment Area, at the north end of Long Lake approximately 2.4 km from the mine site and 1.8 km from the access road (Figure 2-1 and Table 2.1). Snares were set in locations with obvious wildlife trails and where there was evidence of their presence in the area (e.g., scat, browse).

2.1.1.2 Blueberries

Blueberries are generally scarce in the region (House, pers. comm.) and attempts to obtain samples from multiple locations in the Assessment Area were unsuccessful. Blueberries were collected from two nearby locations in the Project Area (mine site) and the remaining eight samples were collected in the same cutover, inland from Red Indian Lake and between approximately 800 m and 2.9 km southeast of the main access road (Figure 2-1 and Table 2.1). A photo of a typical blueberry cover found in the vicinity of the Project is shown in Photo 1.

Photo 1 Blueberries in the Vicinity of the Project

2.1.1.3 Labrador Tea

Labrador Tea was common in the area, particularly in bog and shoreline habitats (Figure 2-2). Four samples of Labrador Tea were collected in the Project Area (three in the mine site and one along the access road) and six samples from three distinct locations in the Assessment Area (Figure 2-1 and Table 2.1): on a tributary of the Exploits River near the northeast end of Red Indian Lake; approximately 2.9 km inland west of the access road about half-way between Red Indian Lake and the mine site; and at the north end of Long Lake approximately 2.4 km from the mine site and 1.8 km from the access road. Photos of typical Labrador tea bog and shoreline habitat found in the vicinity of the Project are shown in Photo 2.

Photo 2 Typical Labrador Tea Bog (left) and Shoreline (right) Habitat

2.1.1.4 Soil

One soil sample was collected at all Labrador tea and blueberry sampling points (20 samples total). Field sampling locations are described above and detailed in Table 2.1 and Figure 2-1.

2.1.2 Description of Aquatic Sampling Locations

2.1.2.1 Brook Trout

Sampling of brook trout focused primarily on small brooks and streams that could be accessed from the road and in specific target areas near the mine site. A total of 11 distinct areas were sampled (Figure 2-1), including seven tributaries of Red Indian Lake along the access road and four locations in the target areas on Victoria Lake (n=1), Victoria River (n=2) and in a small pond referred to as M1 (n=1). A photo of one location where brook trout was collected is shown in Photo 3.

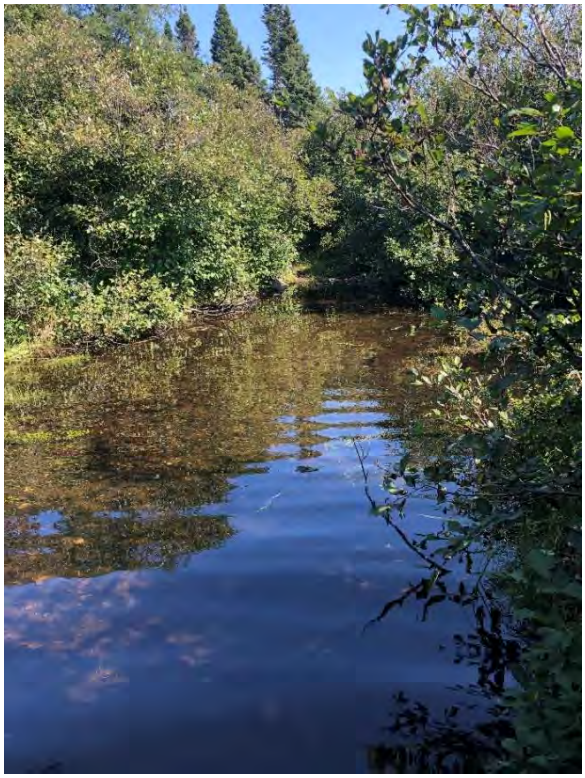

Photo 3 Brook Trout Sampling Location

2.2 SAMPLE PREPARATION

Field preparation of samples is summarized in Table 2.3. Frozen samples were sent to Bureau Veritas Laboratory in Dartmouth, Nova Scotia for sample preparation and analysis.

Table 2.3 Sample Preparation for Laboratory Analysis

Media	Sample Preparation
Snowshoe Hare	Snowshoe hare were weighed whole prior to dissection. Internal organs (IO; heart, liver, and kidneys) were removed, grouped together, and weighed prior to freezing and submission for analysis. IO samples were homogenized at the laboratory prior to analysis. After removal of the IOs, the carcass was weighed separately. Approximately 20 g of muscle tissue was removed, weighed and frozen prior to submission for analysis. The remaining carcass tissue was frozen and kept for potential future analysis. Concentrations of metals in tissue samples (muscle and IOs) are reported on a wet weight basis.
Blueberries	One cup of berries (if possible) was collected from each site. Berries were weighed, bagged and frozen. Concentrations of metals in blueberries are reported on a dry weight basis.
Labrador Tea	New growth parts were picked from plants, bagged and stored frozen. Concentrations of metals in Labrador tea are reported on a dry weight basis.

Table 2.3 Sample Preparation for Laboratory Analysis

Media	Sample Preparation
Soil	Soil was collected in a 250 mL glass jar at each blueberry and Labrador tea sampling site, representative of the rooting zone of the sampled plants. At the laboratory, soil was air-dried and sieved (2 mm), weighed and digested in a nitric acid and hydrochloric acid mixture. Concentrations of metals in soil are reported on a dry-weight basis.
Brook Trout	Brook trout were measured (total length) and weighed prior to and following dissection, and a sample of approximately 20 g of muscle tissue removed, weighed and frozen separately. The entrails were weighed and frozen and kept for potential future analysis. Concentrations of metals in brook trout tissue samples are reported on a wet weight basis.

2.3 LABORATORY METHODS AND INSTRUMENTATION

Bureau Veritas Laboratory has documented methods and internal protocols for the sample analysis. Bureau Veritas Laboratory is accredited by the Standards Council of Canada (SCC) for a wide range of analyses. Descriptions of the laboratory methods and instrumentation are provided on the laboratory certificates and are described as follows:

- **Metals in soil** - Portions of the samples are air-dried and sieved at 2 mm. Representative subsamples are digested in nitric acid and hydrochloric acid. Samples are analyzed by inductively coupled plasma – mass spectrometry (ICP-MS) in accordance with USEPA SW486 Method 6020A.
- **Metals in tissues and biota** - Representative portions of the samples are prepared by microwave digestion in nitric acid prior to analysis by collision reaction cell (CRC) ICP-MS in accordance with USEPA SW486 Method 6020B.
- **Mercury in tissues** - Portions of the solutions prepared for trace metals (above) are further digested with nitric and sulfuric acids and potassium permanganate. Analysis is by cold vapor atomic fluorescence (CVAF) in accordance with USEPA Method 245.7.

2.4 DATA ANALYSIS

Measured concentrations of metals were used to establish baseline exposure point concentrations (EPC) in media considered (i.e., snowshoe hare, blueberries, Labrador tea, soil, and brook trout). The complete analytical data set is included in Attachment A. The determination of EPCs was based on review of available data and statistical evaluation. In the event of field duplicates collected from a same location or laboratory duplicates, the average was carried forward. Non-detectable values were carried forward in the statistical analysis at half the laboratory estimate of quantification (EQL) value, sometimes referred to as the reportable detection limit (RDL), according to standard practice.

The statistical evaluation for each metal in each medium included, minimum, maximum, median and arithmetic mean (average). When sufficient data was available to support further statistical treatment (i.e., at least 10 samples), 95% upper confidence limit of the mean (UCLM) were calculated for each metal in each medium using the USEPA ProUCL software (USEPA 2015), version 5.1. The 95% UCLMs are deemed representative of reasonably expected and spatially distributed metal exposure concentrations for human and ecological receptors. The USEPA ProUCL software also provides summary statistics. The

ProUCL outputs, presenting both recommended 95% UCLM and summary statistics are provided as attachments below.

The following procedure was used to estimate baseline values for each medium.

- If a metal was not detected in any of the samples, the recommended baseline concentration was set as equal to the highest EQL.
- If the number of samples analysed was less than ten, the maximum concentration was recommended as the baseline concentration.
- If the number of samples equaled or exceeded ten, the 95% UCLM was calculated using the USEPA ProUCL software. The ProUCL outputs were reviewed and a baseline concentration was selected based on the following steps:
  - Select the highest of the “Suggested UCL to Use”. Disregard H-statistic results due to their unstable (both high and low) tendencies.
  - If no “Suggested UCL to Use” are available, review the “Gamma Goodness of Fit (GOF) Test” results.
  - If GOF result indicates that the data is Gamma distributed, then select one of the two “95% Approximate Gamma UCL” results, depending on whether the number of observations is >=50 or <50.
  - If GOF result indicates that "Data Not Gamma Distributed at 5% Significance Level" then select the maximum UCL value from the 8 (95% UCL) listed in the “Nonparametric Distribution Free UCLs” section of the ProUCL output.
  - If the selected UCL is greater than the maximum value in the dataset, then select the maximum value.
  - If the selected UCL is less than either the mean or the median, then select the highest of the mean or median.
  - In cases where analytical data is insufficient for ProUCL to provide UCL values, the maximum value between the detected and half of the non-detected concentration concentrations is selected.

2.5 QUALITY ASSURANCE/QUALITY CONTROL

Quality control for the collection, transport, and analysis of the samples was an important part of the study. Standard operating procedures (SOPs) that clearly describe the methods used to collect the samples were followed, field sheets were completed to document sample collection, and sample chain of custody forms were completed to ensure the integrity of the sample handling and transportation.

To confirm the adequacy of these quality controls and the reproducibility of the results, a number of QA/QC samples were analyzed. These samples included method blanks, spiked blanks, matrix spikes, laboratory duplicates, and field duplicates. Descriptions of these QA/QC samples and the purpose for each are provided in Table 2.4.

Table 2.4 QA/QC Description

QA/QC Sample	Description	Purpose
Method Blanks	High purity water/clean sand or process chemicals that are analyzed in the same way for each sample. It is exposed to glassware, equipment, solvents, reagents, and internal standards that are used during the analysis of other samples.	Determines bias due to the potential presence of impurities in the laboratory environment.
Spiked Blanks	A blank to which the lab adds a known amount of contaminant. The spiked blank is then prepared and analyzed by the same methodology as other samples. Spike blank recoveries represent the percentage of the added contaminant recovered during analysis.	Provides an indication of the recovery expected for analytes within a sample free of matrix bias, and an estimate of the method accuracy.
Matrix Spikes	A field sample to which the lab adds a known amount of contaminant. The spiked sample is then prepared and analyzed by the same methodology as other samples. Matrix spike recoveries represent the percentage of the added contaminant recovered during analysis.	Provides an indication of the recovery expected for field samples and the bias that the contaminant matrix (i.e., soil or water) has on the analysis, and an estimate of the method accuracy.
Laboratory Duplicates	Samples that were taken from one location in the field and split into two portions in the lab. The two portions are analyzed separately using identical procedures. Relative percent differences (RPD) are then calculated to understand differences between the two sets of results.	Used to measure precision or reproducibility of data.
Field Duplicates	Duplicate (second) samples collected in the field at the same location as the original sample. Each sample was carried through the remaining steps in the measurement process. Field duplicates were collected at a subset of locations for non-mobile samples (i.e., soil, Labrador tea, and blueberries). Field duplicates are not considered for mobile samples (e.g., snowshoe hare or brook trout). RPDs are then calculated to understand differences between the two sets of results.	Used to measure precision or reproducibility of data.

As indicated, the assessment of laboratory and field duplicates is based on the relative percent difference (RPD). The formula used to determine the RPD from the mean between two samples, the original and the duplicate, is the absolute value of the following:

$$RPD = 100\% \times \frac{C_{original} - C_{dup}}{\frac{1}{2}(C_{original} + C_{dup})}$$

Where:

RPD = relative percent difference
$C_{original}$ = concentration in the original sample
C_{dup} = concentration in the duplicate

If a parameter was not detected in one of the duplicates but was detected in the other, the concentration in the undetected one was set equal to the EQL of the parameter to evaluate the RPD.

A summary of the QA/QC results is presented in Section 3.0.

3.0 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

This section presents an assessment of the QA/QC program results for the country foods sampling program.

3.1 METHOD BLANKS

Metals were not detected in method blanks. The data is considered acceptable for the purposes of establishing baseline concentrations.

3.2 SPIKED BLANKS

Results for recovery for spiked blanks were within the laboratory QC limits for the metals assessed. The data is considered acceptable for the purposes of establishing baseline concentrations.

3.3 MATRIX SPIKES

Results for recovery for spiked blanks were generally within the laboratory QC limits for metals assessed. Some exceptions include occasional matrix spike fails, indicating possible matrix interference, in a limited number of tissue samples for a limited number of metals. These included matrix spike fails for calcium, phosphorus, potassium, sodium, and zinc in brook trout sample BT-3, matrix spike fails for silver and tin in brook trout sample BT-22, matrix spike fails for iron, potassium, and zinc in snowshoe hare internal organs sample SH-IO1, and a matrix spike fail for silver in snowshoe hare internal organs sample SH-IO8. These may be related to the complex nature of biological tissue matrices. The data is considered acceptable for the purposes of establishing baseline concentrations.

3.4 LABORATORY DUPLICATES

Results for the laboratory duplicates analyzed as part of the laboratory QA/QC program are summarized in Table 3.1. In general, the duplicate results agree closely with their corresponding samples and confirm the representativeness of the analytical procedures. Highest RPDs were generally encountered at concentrations less than three times the RDL (which tend to be inherently more variable) and/or associated with major elements (e.g., calcium). There are no firm guidelines for the degree of correlation expected between duplicates due to the potential for natural heterogeneity within the sample as well as potential interferences from complex matrices such as biological tissue. The reported values for the country foods sampling program are considered to indicate an acceptable duplicate correlation.

Table 3.1 Summary of QA/QC Laboratory Duplicates Results

Sample Type	Laboratory Duplicate ID	Range of RPD	Number of Parameters within ±20% RPD	Acceptable Duplicate Correlation?
Snowshoe Hare – Tissue	---	---	---	---
Snowshoe Hare – IO	SH-IO1 SH-IO8	0 to 37%	49 of 64	Yes
Blueberries	BB-4	0 to 30%	30 of 31	Yes
Labrador Tea	LT-1	0 to 19%	31 of 31	Yes
Co-Located Soil	LT-3	0 to 18%	27 of 27	Yes
Brook Trout	BT-3 BT-22	0 to 38%	52 of 64	Yes

Note:
Laboratory duplicates results were not reported for snowshoe hare tissue samples.

3.5 FIELD DUPLICATES

Field duplicates were collected for blueberries, Labrador tea and soil. This consisted of taking a second sample from the same location and submitting it separately for analysis. Results for the field duplicates analyzed as part of the laboratory QA/QC program are summarized in Table 3.2. In general, the duplicate results agree closely with their corresponding samples and confirm the representativeness of the analytical procedures. With few exceptions in biological tissue, the highest RPDs were encountered for concentrations measured in soil which may indicate some heterogeneity within the field original and duplicate samples pairs. Highest RPDs were generally encountered at concentrations less than three times the RDL (which tend to be inherently more variable) and/or associated with major elements (e.g., calcium). There are no firm guidelines for the degree of correlation expected between duplicates due to the potential for natural heterogeneity within the sample as well as potential interferences from complex matrices such as biological tissue. Overall, the reported values for the country foods sampling program are considered to indicate an acceptable duplicate correlation.

Table 3.2 Summary of QA/QC Field Duplicates Results

Sample Type	Field Duplicate ID	Range of RPD	Number of Parameters within ±40% RPD	Acceptable Duplicate Correlation?
Blueberries	BB-4 & BB-DUP	0 to 110%	28 of 32	Yes
Labrador Tea	LT-5 & LT-DUP	0 to 37%	32 of 32	Yes
Co-Located Soil	BB-4 & BB-DUP LT-5 & LT-DUP	0 to 172%	35 of 54	Yes

4.0 SAMPLING RESULTS

4.1 TERRESTRIAL SAMPLES

4.1.1 Metal Concentrations in Snowshoe Hare

Recommended baseline concentrations for metals in snowshoe hare are indicated in Table 4.1 (muscle tissue) and Table 4.2 (internal organs). Concentrations of beryllium, bismuth, uranium, and vanadium were less than the detection limits in each of the eight snowshoe hare tissue samples (Table 4.1). For samples of snowshoe hare internal organs, concentrations of antimony, beryllium, bismuth, chromium, tin, uranium, and vanadium were below detectable limits in all eight samples (Table 4.2). ProUCL outputs for snowshoe hare data are provided in Attachments B and C.

Table 4.1 Recommended Baseline Concentrations for Metals in Snowshoe Hare Tissue (mg/kg – wet weight)

Metal	No. Sample Analyzed	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Aluminum (Al)	8	7	<0.2	7.69	7.69	Maximum value
Antimony (Sb)	8	2	<0.001	0.0019	0.0019	Maximum value
Arsenic (As)	8	8	0.0047	0.0319	0.0319	Maximum value
Barium (Ba)	8	8	0.02	0.639	0.639	Maximum value
Beryllium (Be)	8	0	<0.001	<0.001	<0.001	Maximum value
Bismuth (Bi)	8	0	<0.001	<0.001	<0.001	Maximum value
Boron (B)	8	1	<0.2	0.23	0.23	Maximum value
Cadmium (Cd)	8	7	<0.001	0.0086	0.0086	Maximum value
Calcium (Ca)	8	8	49.2	109	109	Maximum value
Chromium (Cr)	8	4	<0.01	0.079	0.079	Maximum value
Cobalt (Co)	8	8	0.0045	0.0163	0.0163	Maximum value
Copper (Cu)	8	8	1.2	2.31	2.31	Maximum value
Iron (Fe)	8	8	17.7	35.9	35.9	Maximum value
Lead (Pb)	8	8	0.0021	0.0477	0.0477	Maximum value
Magnesium (Mg)	8	8	245	287	287	Maximum value
Manganese (Mn)	8	8	0.261	14.6	14.6	Maximum value
Mercury (Hg)	8	4	<0.001	0.0027	0.0027	Maximum value
Molybdenum (Mo)	8	4	<0.004	0.0082	0.0082	Maximum value
Nickel (Ni)	8	6	<0.01	0.028	0.028	Maximum value
Phosphorus (P)	8	8	2190	2570	2570	Maximum value
Potassium (K)	8	8	3460	3680	3680	Maximum value
Selenium (Se)	8	8	0.052	0.242	0.242	Maximum value

Table 4.1 Recommended Baseline Concentrations for Metals in Snowshoe Hare Tissue (mg/kg – wet weight)

Metal	No. Sample Analyzed	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Silver (Ag)	8	3	<0.001	0.0014	0.0014	Maximum value
Sodium (Na)	8	8	503	715	715	Maximum value
Strontium (Sr)	8	8	0.027	0.112	0.112	Maximum value
Thallium (Tl)	8	6	<0.0004	0.001	0.001	Maximum value
Tin (Sn)	8	4	<0.02	0.039	0.039	Maximum value
Titanium (Ti)	8	8	0.123	0.215	0.215	Maximum value
Uranium (U)	8	0	<0.0004	<0.0004	<0.0004	Maximum value
Vanadium (V)	8	0	<0.02	<0.02	<0.02	Maximum value
Zinc (Zn)	8	8	11.9	20.5	20.5	Maximum value

Table 4.2 Recommended Baseline Concentrations for Metals in Snowshoe Hare Internal Organs (mg/kg – wet weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Aluminum (Al)	10	10	0.29	1.46	1.46	Maximum value
Antimony (Sb)	10	0	<0.001	<0.001	<0.001	Maximum value
Arsenic (As)	10	8	<0.004	0.068	0.068	Maximum value
Barium (Ba)	10	10	0.051	0.303	0.303	Maximum value
Beryllium (Be)	10	0	<0.001	<0.001	<0.001	Maximum value
Bismuth (Bi)	10	0	<0.001	<0.001	<0.001	Maximum value
Boron (B)	10	7	<0.2	0.28	0.28	Maximum value
Cadmium (Cd)	10	10	0.0196	1.49	1.49	Maximum value
Calcium (Ca)	10	10	74	149	149	Maximum value
Chromium (Cr)	10	0	<0.01	<0.01	<0.01	Maximum value
Cobalt (Co)	10	10	0.0118	0.0837	0.0837	Maximum value
Copper (Cu)	10	10	1.92	3.86	3.86	Maximum value
Iron (Fe)	10	10	126	434	434	Maximum value
Lead (Pb)	10	10	0.0049	0.0356	0.0356	Maximum value
Magnesium (Mg)	10	10	142	188	188	Maximum value
Manganese (Mn)	10	10	2.69	16.4	16.4	Maximum value
Mercury (Hg)	10	9	0.0034	0.263	0.263	Maximum value
Molybdenum (Mo)	10	10	0.0842	0.298	0.298	Maximum value
Nickel (Ni)	10	7	<0.01	0.036	0.036	Maximum value

Table 4.2 Recommended Baseline Concentrations for Metals in Snowshoe Hare Internal Organs (mg/kg – wet weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Phosphorus (P)	10	10	2060	2740	2740	Maximum value
Potassium (K)	10	10	2080	2830	2830	Maximum value
Selenium (Se)	10	10	0.2	0.901	0.901	Maximum value
Silver (Ag)	10	6	<0.001	0.0496	0.0496	Maximum value
Sodium (Na)	10	10	935	1350	1350	Maximum value
Strontium (Sr)	10	10	0.061	0.241	0.241	Maximum value
Thallium (Tl)	10	10	0.00047	0.0034	0.0034	Maximum value
Tin (Sn)	10	0	<0.02	<0.02	<0.02	Maximum value
Titanium (Ti)	10	10	0.102	0.152	0.152	Maximum value
Uranium (U)	10	0	<0.0004	<0.0004	<0.0004	Maximum value
Vanadium (V)	10	0	<0.02	<0.02	<0.02	Maximum value
Zinc (Zn)	10	10	16.4	21.6	21.6	Maximum value

Note:
1. Number of samples analyzed include laboratory duplicates.

4.1.2 Metal Concentrations in Blueberries

Recommended baseline concentrations for metals in blueberries are indicated in Table 4.3. Concentrations of beryllium, bismuth, chromium, cobalt, mercury, selenium, silver, tin, uranium, and vanadium were less than the detection limits in each of the 12 blueberry samples analyzed (Table 4.3). ProUCL outputs for blueberry data are provided in Attachment D.

Table 4.3 Recommended Baseline Concentrations for Metals in Blueberries (mg/kg – dry weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Aluminum (Al)	12	12	32.3	99.5	70.09	95% Student's-t UCL
Antimony (Sb)	12	1	<0.005	0.0266	0.0266	Maximum value
Arsenic (As)	12	6	<0.02	0.122	0.0518	Mean used since it is greater than UCL
Barium (Ba)	12	12	14.4	22.8	19.57	95% Student's-t UCL
Beryllium (Be)	12	0	<0.01	<0.01	<0.01	Maximum value
Bismuth (Bi)	12	0	<0.01	<0.01	<0.01	Maximum value
Boron (B)	12	12	5.4	10.5	8.901	95% Student's-t UCL
Cadmium (Cd)	12	10	<0.005	0.01	0.00788	95% KM (t) UCL
Calcium (Ca)	12	12	1220	1810	1620	95% Student's-t UCL

Table 4.3 Recommended Baseline Concentrations for Metals in Blueberries (mg/kg – dry weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Chromium (Cr)	12	0	<0.1	<0.1	<0.1	Maximum value
Cobalt (Co)	12	0	<0.02	<0.02	<0.02	Maximum value
Copper (Cu)	12	12	1.96	3.02	2.794	95% Student's-t UCL
Iron (Fe)	12	12	11.5	23.6	17.88	95% Student's-t UCL
Lead (Pb)	12	12	0.022	0.114	0.0708	95% Student's-t UCL
Magnesium (Mg)	12	12	460	687	600.8	95% Student's-t UCL
Manganese (Mn)	12	12	361	870	727.8	95% Student's-t UCL
Mercury (Hg)	12	0	<0.01	<0.01	<0.01	Maximum value
Molybdenum (Mo)	12	12	0.028	0.074	0.0543	95% Student's-t UCL
Nickel (Ni)	12	12	0.219	0.403	0.318	95% Student's-t UCL
Phosphorus (P)	12	12	658	1320	1063	95% Student's-t UCL
Potassium (K)	12	12	5070	6830	5799	95% Student's-t UCL
Selenium (Se)	12	0	<0.05	<0.05	<0.05	Maximum value
Silver (Ag)	12	0	<0.005	<0.005	<0.005	Maximum value
Sodium (Na)	12	12	12	52	34.74	95% Adjusted Gamma UCL
Strontium (Sr)	12	12	0.697	9.61	7.083	95% Chebyshev (Mean, Sd) UCL
Thallium (Tl)	12	4	<0.002	0.0047	0.0032	Mean used since it is greater than UCL
Tin (Sn)	12	0	<0.1	<0.1	<0.1	Maximum value
Titanium (Ti)	12	1	<0.5	0.55	0.55	Maximum value
Uranium (U)	12	0	<0.002	<0.002	<0.002	Maximum value
Vanadium (V)	12	0	<0.2	<0.2	<0.2	Maximum value
Zinc (Zn)	12	12	5.88	7.84	7.26	95% Student's-t UCL

Note:
1. Number of samples analyzed include field and laboratory duplicates.

4.1.3 Metal Concentrations in Labrador Tea

Recommended baseline concentrations for metals in Labrador tea are indicated in Table 4.4. Concentrations of beryllium, bismuth, cadmium, chromium, mercury, silver, tin, uranium, and vanadium were less than the detection limits in each of the 12 Labrador tea samples analyzed (Table 4.4). ProUCL outputs for Labrador tea data are provided in Attachment E.

Table 4.4 Recommended Baseline Concentrations for Metals in Labrador Tea (mg/kg – dry weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Aluminum (Al)	12	12	8.7	24.3	17.25	95% Student's-t UCL
Antimony (Sb)	12	3	<0.005	0.0512	0.0512	Maximum value
Arsenic (As)	12	8	<0.02	0.035	0.0266	95% KM (t) UCL
Barium (Ba)	12	12	34.7	73	58.21	95% Student's-t UCL
Beryllium (Be)	12	0	<0.01	<0.01	<0.01	Maximum value
Bismuth (Bi)	12	0	<0.01	<0.01	<0.01	Maximum value
Boron (B)	12	12	9.7	14.7	13.3	95% Student's-t UCL
Cadmium (Cd)	12	0	<0.005	<0.005	<0.005	Maximum value
Calcium (Ca)	12	12	4190	5080	4734	95% Student's-t UCL
Chromium (Cr)	12	0	<0.1	<0.1	<0.1	Maximum value
Cobalt (Co)	12	1	<0.02	0.024	0.024	Maximum value
Copper (Cu)	12	12	2.2	3.46	3.238	95% Student's-t UCL
Iron (Fe)	12	12	20.9	29.7	26.11	95% Student's-t UCL
Lead (Pb)	12	12	0.021	0.046	0.0322	95% Student's-t UCL
Magnesium (Mg)	12	12	1160	1590	1405	95% Student's-t UCL
Manganese (Mn)	12	12	523	1410	1130	95% Student's-t UCL
Mercury (Hg)	12	0	<0.01	<0.01	<0.01	Maximum value
Molybdenum (Mo)	12	10	<0.02	0.046	0.0318	95% KM (t) UCL
Nickel (Ni)	12	12	0.085	0.695	0.695	Maximum used since it's lower than suggested UCL
Phosphorus (P)	12	12	824	1050	935.9	95% Modified-t UCL
Potassium (K)	12	12	3400	4850	4522	95% Student's-t UCL
Selenium (Se)	12	1	<0.05	0.059	0.059	Maximum value
Silver (Ag)	12	0	<0.005	<0.005	<0.005	Maximum value
Sodium (Na)	12	5	<10	13	13	Median used since it is greater than the UCL
Strontium (Sr)	12	12	4.37	15.8	9.791	95% Modified-t UCL
Thallium (Tl)	12	12	0.0077	0.0425	0.0174	95% Student's-t UCL
Tin (Sn)	12	0	<0.1	<0.1	<0.1	Maximum value
Titanium (Ti)	12	1	<0.5	0.64	0.64	Maximum value
Uranium (U)	12	0	<0.002	<0.002	<0.002	Maximum value
Vanadium (V)	12	0	<0.2	<0.2	<0.2	Maximum value
Zinc (Zn)	12	12	11.9	14.6	14.2	95% Student's-t UCL

Note:
1. Number of samples analyzed include field and laboratory duplicates.

4.1.4 Metal Concentrations in Soil

Recommended baseline concentrations for metals in soil samples are indicated in Table 4.5. Concentrations of antimony, beryllium, bismuth, boron, molybdenum, and thallium were less than the detection limits in each of the 23 soil samples analyzed (Table 4.5). ProUCL outputs for soil data are provided in Attachment F.

Table 4.5 Recommended Baseline Concentrations for Metals in Soil (mg/kg – dry weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Aluminum (Al)	23	23	200	13000	3724	95% Adjusted Gamma UCL
Antimony (Sb)	23	0	<2	<2	<2	Maximum value
Arsenic (As)	23	7	<2	21	7.16	Mean used since it is greater than UCL
Barium (Ba)	23	22	<5	380	117.8	95% KM Adjusted Gamma UCL
Beryllium (Be)	23	0	<2	<2	<2	Maximum value
Bismuth (Bi)	23	0	<2	<2	<2	Maximum value
Boron (B)	23	0	<50	<50	<50	Maximum value
Cadmium (Cd)	23	11	<0.3	0.71	0.493	Mean used since it is greater than UCL
Chromium (Cr)	23	7	<2	12	5.67	Mean used since it is greater than UCL
Cobalt (Co)	23	11	<1	20	3.656	Mean used since it is greater than UCL
Copper (Cu)	23	21	<2	28	9.85	95% GROS Adjusted Gamma UCL
Iron (Fe)	23	23	230	23000	7956	95% Adjusted Gamma UCL
Lead (Pb)	23	23	5.7	53	25.76	95% Student's-t UCL
Lithium (Li)	23	4	<2	4.5	4.5	Maximum value
Manganese (Mn)	23	23	23	1500	365.7	95% Student's-t UCL
Mercury (Hg)	23	19	<0.1	0.46	0.298	95% KM (t) UCL
Molybdenum (Mo)	23	0	<2	<2	<2	Maximum value
Nickel (Ni)	23	17	<2	9.3	3.628	95% KM (BCA) UCL
Rubidium (Rb)	23	8	<2	3.3	2.393	Mean used since it is greater than UCL
Selenium (Se)	23	9	<0.5	0.84	0.635	Mean used since it is greater than UCL
Silver (Ag)	23	8	<0.5	1.6	0.925	Median used since it is greater than the UCL

Table 4.5 Recommended Baseline Concentrations for Metals in Soil (mg/kg – dry weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Strontium (Sr)	23	20	<5	61	26.9	KM H-UCL
Thallium (Tl)	23	0	<0.1	<0.1	<0.1	Maximum value
Tin (Sn)	23	7	<1	1.4	1.25	Median used since it is greater than the UCL
Uranium (U)	23	9	<0.1	0.33	0.197	Mean used since it is greater than UCL
Vanadium (V)	23	15	<2	45	15.3	95% GROS Adjusted Gamma UCL
Zinc (Zn)	23	23	11	190	60.88	95% Adjusted Gamma UCL

Note:
1. Number of samples analyzed include field and laboratory duplicates.

4.2 AQUATIC SAMPLES

4.2.1 Metal Concentrations in Brook Trout

Recommended baseline concentrations for metals in brook trout are indicated in Table 4.6. Concentrations of beryllium and bismuth were less than the detection limits in each of the 53 brook trout samples analyzed (Table 4.6). ProUCL outputs for brook trout are provided in Attachment G.

Table 4.6 Recommended Baseline Concentrations for Metals in Brook Trout (mg/kg – wet weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Aluminum (Al)	53	53	0.21	1.47	0.628	95% Approximate Gamma UCL
Antimony (Sb)	53	2	<0.001	0.0032	0.0032	Maximum value
Arsenic (As)	53	53	0.0256	1.55	0.5	95% Chebyshev (Mean, Sd) UCL
Barium (Ba)	53	53	0.025	1.61	0.41	95% Chebyshev (Mean, Sd) UCL
Beryllium (Be)	53	0	<0.001	<0.001	<0.001	Maximum value
Bismuth (Bi)	53	0	<0.001	<0.001	<0.001	Maximum value
Boron (B)	53	1	<0.2	0.21	0.21	Maximum value
Cadmium (Cd)	53	50	<0.001	0.0769	0.0194	95% KM (Chebyshev) UCL
Calcium (Ca)	53	53	821	3760	1763	95% Modified-t UCL

Table 4.6 Recommended Baseline Concentrations for Metals in Brook Trout (mg/kg – wet weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Chromium (Cr)	53	15	<0.01	0.586	0.0734	Mean used since it is greater than UCL
Cobalt (Co)	53	53	0.0059	0.0329	0.0163	95% Approximate Gamma UCL
Copper (Cu)	53	53	0.224	1.54	0.381	95% Modified-t UCL
Iron (Fe)	53	53	3.37	11	6.552	95% Student's-t UCL
Lead (Pb)	53	53	0.0025	0.293	0.0732	95% Chebyshev (Mean, Sd) UCL
Magnesium (Mg)	53	53	223	339	304.1	95% Student's-t UCL
Manganese (Mn)	53	53	0.522	5.86	2.585	95% Approximate Gamma UCL
Mercury (Hg)	53	53	0.021	0.327	0.128	95% Approximate Gamma UCL
Molybdenum (Mo)	53	31	<0.004	0.0068	0.00478	Mean used since it is greater than UCL
Nickel (Ni)	53	24	<0.01	0.053	0.022	Mean used since it is greater than UCL
Phosphorus (P)	53	53	2810	4190	3656	95% Student's-t UCL
Potassium (K)	53	53	3620	4620	4285	95% Student's-t UCL
Selenium (Se)	53	53	0.22	0.879	0.403	95% Student's-t UCL
Silver (Ag)	53	5	<0.001	0.0102	0.00418	Mean used since it is greater than UCL
Sodium (Na)	53	53	362	748	513.7	95% Approximate Gamma UCL
Strontium (Sr)	53	53	0.645	4.52	1.737	95% Modified-t UCL
Thallium (Tl)	53	53	0.00096	0.0346	0.00888	95% Chebyshev (Mean, Sd) UCL
Tin (Sn)	53	13	<0.02	0.039	0.0261	Mean used since it is greater than UCL
Titanium (Ti)	53	53	0.14	0.345	0.195	95% Student's-t UCL
Uranium (U)	53	10	<0.0004	0.00123	0.00123	Maximum used since it's lower than suggested UCL
Vanadium (V)	53	1	<0.02	0.025	0.025	Maximum value

Table 4.6 Recommended Baseline Concentrations for Metals in Brook Trout (mg/kg – wet weight)

Metal	No. Sample Analyzed[1]	No. Detected	Min	Max	Recommended Baseline	Baseline selection
Zinc (Zn)	53	53	8.97	22.3	14.76	95% Student's-t UCL

Note:
1. Number of samples analyzed include laboratory duplicates.

5.0 SUMMARY

Stantec has completed a country foods sampling program for Marathon to establish baseline concentrations of metals in locally harvested foods. A summary of the media selected for analysis and the recommended baseline concentrations for metals is provided in Table 5.1.

Table 5.1 Recommended Baseline Concentrations for Metals

Chemical Parameter	Snowshoe Hare		Blueberries (mg/kg - dw)	Labrador Tea (mg/kg - dw)	Soil (mg/kg - dw)	Brook Trout (mg/kg - ww)
	Muscle Tissue (mg/kg - ww)	Internal Organs (mg/kg - ww)				
Aluminum (Al)	7.69	1.46	70.09	17.25	3724	0.628
Antimony (Sb)	0.0019	<0.001	0.0266	0.0512	<2	0.0032
Arsenic (As)	0.0319	0.068	0.0518	0.0266	7.16	0.5
Barium (Ba)	0.639	0.303	19.57	58.21	117.8	0.41
Beryllium (Be)	<0.001	<0.001	<0.01	<0.01	<2	<0.001
Bismuth (Bi)	<0.001	<0.001	<0.01	<0.01	<2	<0.001
Boron (B)	0.23	0.28	8.901	13.3	<50	0.21
Cadmium (Cd)	0.0086	1.49	0.00788	<0.005	0.493	0.0194
Calcium (Ca)	109	149	1620	4734	---	1763
Chromium (Cr)	0.079	<0.01	<0.1	<0.1	5.67	0.0734
Cobalt (Co)	0.0163	0.0837	<0.02	0.024	3.656	0.0163
Copper (Cu)	2.31	3.86	2.794	3.238	9.85	0.381
Iron (Fe)	35.9	434	17.88	26.11	7956	6.552
Lead (Pb)	0.0477	0.0356	0.0708	0.0322	25.76	0.0732
Lithium (Li)	---	---	---	---	4.5	---
Magnesium (Mg)	287	188	600.8	1405	---	304.1
Manganese (Mn)	14.6	16.4	727.8	1130	365.7	2.585
Mercury (Hg)	0.0027	0.263	<0.01	<0.01	0.298	0.128
Molybdenum (Mo)	0.0082	0.298	0.0543	0.0318	<2	0.00478

Table 5.1 Recommended Baseline Concentrations for Metals

Chemical Parameter	Snowshoe Hare		Blueberries (mg/kg - dw)	Labrador Tea (mg/kg - dw)	Soil (mg/kg - dw)	Brook Trout (mg/kg - ww)
	Muscle Tissue (mg/kg - ww)	Internal Organs (mg/kg - ww)				
Nickel (Ni)	0.028	0.036	0.318	0.695	3.628	0.022
Rubidium (Rb)	2570	2740	1063	935.9	---	3656
Phosphorus (P)	3680	2830	5799	4522	---	4285
Phosphorus (P)	---	---	---	---	2.393	---
Selenium (Se)	0.242	0.901	<0.05	0.059	0.635	0.403
Silver (Ag)	0.0014	0.0496	<0.005	<0.005	0.925	0.00418
Sodium (Na)	715	1350	34.74	13	---	513.7
Strontium (Sr)	0.112	0.241	7.083	9.791	26.9	1.737
Thallium (Tl)	0.001	0.0034	0.0032	0.0174	<0.1	0.00888
Tin (Sn)	0.039	<0.02	<0.1	<0.1	1.25	0.0261
Titanium (Ti)	0.215	0.152	0.55	0.64	---	0.195
Uranium (U)	<0.0004	<0.0004	<0.002	<0.002	0.197	0.00123
Vanadium (V)	<0.02	<0.02	<0.2	<0.2	15.3	0.025
Zinc (Zn)	20.5	21.6	7.26	14.2	60.88	14.76

Notes: dw = dry weight; ww = wet weight; "---" indicates data not available or not reported.

6.0 REFERENCES

House, Kent. 2020. Camp Manager, Marathon Gold Corp. Personal communication on September 5, 2020.

USEPA. 2015. ProUCL Version 5.1 User Guide Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. EPA/600/R-07/041

ATTACHMENT A

Laboratory Analytical Data

Your Project #: 121416288
Your C.O.C. #: n/a

Attention: Barry Wicks

Stantec Consulting Ltd
141 Kelsey Drive
St. John's, NL
CANADA A1B 0L2

Report Date: 2021/01/14
Report #: R6480394
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0V9779
Received: 2020/12/01, 09:55

Sample Matrix: Tissue
Samples Received: 89

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Tissue by CVAF - Wet Wt (1)	66	N/A	2021/01/12	BBY7SOp-00012	BCMOE BCLM Oct2013 m
Mercury in Tissue by CVAF - Wet Wt (1)	1	N/A	2021/01/13	BBY7SOp-00012	BCMOE BCLM Oct2013 m
Elements in Plants by CRC ICPMS -Dry Wt (1)	22	2021/01/07	2021/01/10	BBY7SOP-00021 BBY7SOP-00002	EPA 6020b R2 m
Elements by CRC ICPMS - Tissue Wet Wt (1)	24	2021/01/06	2021/01/10	BBY7SOP00021/ BBY7SOP-00002	EPA 6020b R2 m
Elements by CRC ICPMS - Tissue Wet Wt (1)	2	2021/01/06	2021/01/12	BBY7SOP00021/ BBY7SOP-00002	EPA 6020b R2 m
Elements by CRC ICPMS - Tissue Wet Wt (1)	41	2021/01/06	2021/01/09	BBY7SOP00021/ BBY7SOP-00002	EPA 6020b R2 m
Moisture in Tissue (Subcontracted) (1, 2)	27	2021/01/11	2021/01/12	BBY8SOP-00017	BCMOE BCLM Dec2000 m
Moisture in Tissue (Subcontracted) (1, 2)	40	2021/01/06	2021/01/12	BBY8SOP-00017	BCMOE BCLM Dec2000 m
Moisture in Tissue (Subcontracted) (1, 2)	20	2020/12/11	2020/12/16	BBY8SOP-00017	BCMOE BCLM Dec2000 m
Moisture in Tissue (Subcontracted) (1, 2)	2	2020/12/16	2021/01/12	BBY8SOP-00017	BCMOE BCLM Dec2000 m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

Your Project #: 121416288
Your C.O.C. #: n/a

Attention: Barry Wicks

Stantec Consulting Ltd
141 Kelsey Drive
St. John's, NL
CANADA A1B 0L2

Report Date: 2021/01/14
Report #: R6480394
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0V9779
Received: 2020/12/01, 09:55

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BVLabs Burnaby via Bedford
(2) Offsite analysis requires that subcontracted moisture be reported.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Heather Macumber, Senior Project Manager
Email: Heather.MACUMBER@bureauveritas.com
Phone# (902)420-0203 Ext:226
==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP410	OHP411	OHP412	OHP412	OHP413		
Sampling Date		2020/09/05	2020/09/05	2020/09/05	2020/09/05	2020/09/05		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-1**	**BT-2**	**BT-3**	**BT-3 Lab-Dup**	**BT-4**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.71	0.50	0.32	0.41	0.53	0.20	7148857
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Arsenic (As)	mg/kg	0.154	0.290	0.404	0.374	0.278	0.0040	7148857
Total (Wet Wt) Barium (Ba)	mg/kg	0.076	0.045	0.030	0.039	0.057	0.010	7148857
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Boron (B)	mg/kg	0.21	<0.20	<0.20	<0.20	<0.20	0.20	7148857
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0026	0.0024	0.0033	0.0030	0.0038	0.0010	7148857
Total (Wet Wt) Calcium (Ca)	mg/kg	1300	1030	821 (1)	1060	1300	2.0	7148857
Total (Wet Wt) Chromium (Cr)	mg/kg	0.586	0.011	0.098	0.139	0.023	0.010	7148857
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0064	0.0116	0.0131	0.0126	0.0102	0.0013	7148857
Total (Wet Wt) Copper (Cu)	mg/kg	0.499	0.296	0.295	0.282	0.253	0.010	7148857
Total (Wet Wt) Iron (Fe)	mg/kg	10.2	7.29	5.95	5.84	6.13	0.25	7148857
Total (Wet Wt) Lead (Pb)	mg/kg	0.0399	0.0155	0.0106	0.0092	0.0089	0.0010	7148857
Total (Wet Wt) Magnesium (Mg)	mg/kg	306	327	308	318	323	0.40	7148857
Total (Wet Wt) Manganese (Mn)	mg/kg	1.33	0.842	0.698	0.810	1.27	0.010	7148857
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	0.0051	0.0042	0.0044	0.0040	7148857
Total (Wet Wt) Nickel (Ni)	mg/kg	0.025	<0.010	0.014	0.011	0.010	0.010	7148857
Total (Wet Wt) Phosphorus (P)	mg/kg	3370	3430	3210 (2)	3350	3540	2.0	7148857
Total (Wet Wt) Potassium (K)	mg/kg	4300	4550	4420 (3)	4470	4480	2.0	7148857
Total (Wet Wt) Selenium (Se)	mg/kg	0.353	0.333	0.306	0.303	0.293	0.010	7148857
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Sodium (Na)	mg/kg	457	440	425 (4)	445	429	2.0	7148857
Total (Wet Wt) Strontium (Sr)	mg/kg	1.64	1.11	0.842	1.04	1.41	0.010	7148857
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00162	0.00227	0.00233	0.00223	0.00212	0.00040	7148857
Total (Wet Wt) Tin (Sn)	mg/kg	0.038	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Titanium (Ti)	mg/kg	0.154	0.158	0.149	0.161	0.158	0.020	7148857
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148857
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Zinc (Zn)	mg/kg	11.5	17.2	12.7 (5)	12.1	15.9	0.040	7148857

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Matrix spike fails for (Calcium), suspected matrix interference.
(2) Matrix spike fails for (Phosphorus), suspected matrix interference.
(3) Matrix spike fails for (Potassium), suspected matrix interference.
(4) Matrix spike fails for (Sodium), suspected matrix interference.
(5) Matrix spike fails for (Zinc), suspected matrix interference.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP410	OHP411	OHP412	OHP412	OHP413		
Sampling Date		2020/09/05	2020/09/05	2020/09/05	2020/09/05	2020/09/05		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-1**	**BT-2**	**BT-3**	**BT-3 Lab-Dup**	**BT-4**	**RDL**	**QC Batch**
Mercury (Hg)	mg/kg	0.123 (1)	0.161 (1)	0.167 (1)	0.149 (1)	0.141 (1)	0.010	7148860
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	76	75	76	77	77	0.30	7148859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP414	OHP415	OHP416	OHP417	OHP418		
Sampling Date		2020/09/05	2020/09/05	2020/09/05	2020/09/05	2020/09/05		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-5**	**BT-6**	**BT-7**	**BT-8**	**BT-9**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	1.10	0.58	0.26	0.22	0.37	0.20	7148857
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Arsenic (As)	mg/kg	0.227	0.275	0.198	0.238	0.235	0.0040	7148857
Total (Wet Wt) Barium (Ba)	mg/kg	0.035	0.037	0.025	0.030	0.040	0.010	7148857
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148857
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0026	0.0063	<0.0010	0.0032	0.0063	0.0010	7148857
Total (Wet Wt) Calcium (Ca)	mg/kg	950	1440	1160	964	1160	2.0	7148857
Total (Wet Wt) Chromium (Cr)	mg/kg	0.015	0.020	0.012	0.010	0.011	0.010	7148857
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0139	0.0116	0.0083	0.0108	0.0107	0.0013	7148857
Total (Wet Wt) Copper (Cu)	mg/kg	0.301	0.267	0.252	0.268	0.288	0.010	7148857
Total (Wet Wt) Iron (Fe)	mg/kg	5.88	6.33	6.26	4.75	6.05	0.25	7148857
Total (Wet Wt) Lead (Pb)	mg/kg	0.0102	0.0102	0.0053	0.0031	0.0165	0.0010	7148857
Total (Wet Wt) Magnesium (Mg)	mg/kg	321	283	285	324	332	0.40	7148857
Total (Wet Wt) Manganese (Mn)	mg/kg	0.959	0.858	0.839	0.522	1.07	0.010	7148857
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	0.0041	<0.0040	0.0050	0.0047	0.0040	7148857
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148857
Total (Wet Wt) Phosphorus (P)	mg/kg	3400	3400	3220	3430	3700	2.0	7148857
Total (Wet Wt) Potassium (K)	mg/kg	4550	4440	4330	4500	4520	2.0	7148857
Total (Wet Wt) Selenium (Se)	mg/kg	0.309	0.298	0.306	0.319	0.286	0.010	7148857
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Sodium (Na)	mg/kg	448	459	429	394	453	2.0	7148857
Total (Wet Wt) Strontium (Sr)	mg/kg	0.959	1.33	1.11	0.963	1.21	0.010	7148857
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00157	0.00209	0.00198	0.00240	0.00215	0.00040	7148857
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Titanium (Ti)	mg/kg	0.201	0.185	0.154	0.167	0.181	0.020	7148857
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148857
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Zinc (Zn)	mg/kg	12.5	15.4	12.9	13.3	11.8	0.040	7148857
Mercury (Hg)	mg/kg	0.152 (1)	0.228 (1)	0.283 (1)	0.144 (1)	0.184 (1)	0.010	7148860
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	77	78	78	75	75	0.30	7148859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Bureau Veritas Laboratories 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP419	OHP420	OHP421	OHP422	OHP423		
Sampling Date		2020/09/05	2020/09/05	2020/09/05	2020/09/05	2020/09/05		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-10**	**BT-11**	**BT-12**	**BT-13**	**BT-14**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.23	0.34	0.34	1.10	1.20	0.20	7148857
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Arsenic (As)	mg/kg	0.367	0.202	0.114	0.206	0.433	0.0040	7148857
Total (Wet Wt) Barium (Ba)	mg/kg	0.057	0.036	0.038	0.044	0.055	0.010	7148857
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148857
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0033	0.0019	0.0047	0.0076	0.0030	0.0010	7148857
Total (Wet Wt) Calcium (Ca)	mg/kg	1130	1140	956	1210	1890	2.0	7148857
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148857
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0104	0.0059	0.0063	0.0101	0.0098	0.0013	7148857
Total (Wet Wt) Copper (Cu)	mg/kg	0.224	0.278	0.248	0.238	0.267	0.010	7148857
Total (Wet Wt) Iron (Fe)	mg/kg	5.68	5.55	5.97	7.09	7.64	0.25	7148857
Total (Wet Wt) Lead (Pb)	mg/kg	0.0081	0.0143	0.0084	0.0075	0.0077	0.0010	7148857
Total (Wet Wt) Magnesium (Mg)	mg/kg	324	335	305	326	322	0.40	7148857
Total (Wet Wt) Manganese (Mn)	mg/kg	1.24	0.819	0.679	0.954	1.89	0.010	7148857
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	<0.0040	0.0046	0.0044	0.0040	7148857
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148857
Total (Wet Wt) Phosphorus (P)	mg/kg	3460	3550	3220	3650	4080	2.0	7148857
Total (Wet Wt) Potassium (K)	mg/kg	4420	4510	4240	4320	4450	2.0	7148857
Total (Wet Wt) Selenium (Se)	mg/kg	0.327	0.279	0.277	0.348	0.301	0.010	7148857
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Sodium (Na)	mg/kg	446	421	362	409	485	2.0	7148857
Total (Wet Wt) Strontium (Sr)	mg/kg	1.29	1.17	1.08	1.35	2.04	0.010	7148857
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00176	0.00206	0.00133	0.00175	0.00254	0.00040	7148857
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Titanium (Ti)	mg/kg	0.150	0.158	0.153	0.218	0.254	0.020	7148857
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148857
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Zinc (Zn)	mg/kg	14.1	10.9	11.1	13.8	13.6	0.040	7148857
Mercury (Hg)	mg/kg	0.146 (1)	0.327 (1)	0.206 (1)	0.137 (1)	0.149 (1)	0.010	7148860
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	76	75	76	77	75	0.30	7148859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP424	OHP425	OHP426	OHP427	OHP428		
Sampling Date		2020/09/05	2020/09/07	2020/09/09	2020/09/09	2020/09/09		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-15**	**BT-16**	**BT-17**	**BT-18**	**BT-19**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.44	0.81	0.54	0.42	0.57	0.20	7148857
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Arsenic (As)	mg/kg	0.205	0.121	0.844	0.192	0.352	0.0040	7148857
Total (Wet Wt) Barium (Ba)	mg/kg	0.025	0.188	0.058	0.126	0.127	0.010	7148857
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148857
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0028	0.0156	0.0045	0.0011	0.0027	0.0010	7148857
Total (Wet Wt) Calcium (Ca)	mg/kg	1230	1860	1690	2520	1580	2.0	7148857
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.013	<0.010	<0.010	<0.010	0.010	7148857
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0075	0.0144	0.0162	0.0226	0.0140	0.0013	7148857
Total (Wet Wt) Copper (Cu)	mg/kg	0.259	0.302	0.312	0.256	0.279	0.010	7148857
Total (Wet Wt) Iron (Fe)	mg/kg	5.82	8.14	5.48	5.51	4.93	0.25	7148857
Total (Wet Wt) Lead (Pb)	mg/kg	0.0055	0.140	0.0185	0.0209	0.0288	0.0010	7148857
Total (Wet Wt) Magnesium (Mg)	mg/kg	319	305	295	324	291	0.40	7148857
Total (Wet Wt) Manganese (Mn)	mg/kg	0.839	0.831	2.42	4.51	4.91	0.010	7148857
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0048	<0.0040	0.0041	0.0046	0.0048	0.0040	7148857
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	0.011	0.031	0.016	0.010	7148857
Total (Wet Wt) Phosphorus (P)	mg/kg	3550	3850	3730	4110	3490	2.0	7148857
Total (Wet Wt) Potassium (K)	mg/kg	4370	4410	4620	4170	4200	2.0	7148857
Total (Wet Wt) Selenium (Se)	mg/kg	0.310	0.491	0.633	0.289	0.354	0.010	7148857
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148857
Total (Wet Wt) Sodium (Na)	mg/kg	388	527	528	501	446	2.0	7148857
Total (Wet Wt) Strontium (Sr)	mg/kg	1.17	2.24	1.23	1.11	1.06	0.010	7148857
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00229	0.00646	0.00426	0.00215	0.00201	0.00040	7148857
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	0.021	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Titanium (Ti)	mg/kg	0.169	0.229	0.213	0.193	0.201	0.020	7148857
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148857
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148857
Total (Wet Wt) Zinc (Zn)	mg/kg	13.0	13.9	16.6	12.7	13.6	0.040	7148857
Mercury (Hg)	mg/kg	0.140 (1)	0.264 (1)	0.070 (1)	0.062 (1)	0.077 (1)	0.010	7148860
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	75	78	77	77	77	0.30	7148859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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BV Labs Job #: C0V9779
Report Date: 2021/01/14

Stantec Consulting Ltd
Client Project #: 121416288

RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP429		OHP430	OHP431	OHP431	OHP432		
Sampling Date		2020/09/09		2020/09/09	2020/09/09	2020/09/09	2020/09/09		
COC Number		n/a		n/a	n/a	n/a	n/a		
	UNITS	**BT-20**	**QC Batch**	**BT-21**	**BT-22**	**BT-22 Lab-Dup**	**BT-23**	**RDL**	**QC Batch**
Metals									
Total (Wet Wt) Aluminum (Al)	mg/kg	0.37	7148857	0.49	0.34	0.31	0.27	0.20	7148861
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	7148857	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Arsenic (As)	mg/kg	0.770	7148857	0.291	0.132	0.127	0.0947	0.0040	7148861
Total (Wet Wt) Barium (Ba)	mg/kg	0.110	7148857	0.090	0.066	0.047	0.056	0.010	7148861
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	7148857	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	7148857	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Boron (B)	mg/kg	<0.20	7148857	<0.20	<0.20	<0.20	<0.20	0.20	7148861
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0051	7148857	0.0015	0.0012	<0.0010	0.0022	0.0010	7148861
Total (Wet Wt) Calcium (Ca)	mg/kg	2550	7148857	1400	1460	1030	1160	2.0	7148861
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	7148857	<0.010	<0.010	<0.010	<0.010	0.010	7148861
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0275	7148857	0.0200	0.0070	0.0064	0.0101	0.0013	7148861
Total (Wet Wt) Copper (Cu)	mg/kg	0.247	7148857	0.307	0.257	0.243	0.314	0.010	7148861
Total (Wet Wt) Iron (Fe)	mg/kg	7.29	7148857	5.39	3.87	3.37	4.51	0.25	7148861
Total (Wet Wt) Lead (Pb)	mg/kg	0.0204	7148857	0.0187	0.0125	0.0099	0.0082	0.0010	7148861
Total (Wet Wt) Magnesium (Mg)	mg/kg	278	7148857	304	314	290	274	0.40	7148861
Total (Wet Wt) Manganese (Mn)	mg/kg	2.20	7148857	4.81	3.24	2.21	2.42	0.010	7148861
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0050	7148857	<0.0040	<0.0040	<0.0040	0.0044	0.0040	7148861
Total (Wet Wt) Nickel (Ni)	mg/kg	0.010	7148857	<0.010	<0.010	<0.010	<0.010	0.010	7148861
Total (Wet Wt) Phosphorus (P)	mg/kg	3990	7148857	3620	3640	3170	3310	2.0	7148861
Total (Wet Wt) Potassium (K)	mg/kg	4230	7148857	4430	4200	4130	4200	2.0	7148861
Total (Wet Wt) Selenium (Se)	mg/kg	0.419	7148857	0.393	0.313	0.300	0.300	0.010	7148861
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	7148857	<0.0010	<0.0010 (1)	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Sodium (Na)	mg/kg	565	7148857	530	508	475	476	2.0	7148861
Total (Wet Wt) Strontium (Sr)	mg/kg	2.03	7148857	0.807	0.873	0.645	0.866	0.010	7148861
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00300	7148857	0.00213	0.00098	0.00096	0.00103	0.00040	7148861
Total (Wet Wt) Tin (Sn)	mg/kg	0.025	7148857	<0.020	<0.020 (2)	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Titanium (Ti)	mg/kg	0.181	7148857	0.166	0.190	0.140	0.157	0.020	7148861
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	7148857	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148861
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	7148857	<0.020	<0.020	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Zinc (Zn)	mg/kg	15.1	7148857	11.7	14.6	12.8	9.51	0.040	7148861
Mercury (Hg)	mg/kg	0.071 (3)	7148860	0.054 (3)	0.096 (3)	0.089 (3)	0.065 (3)	0.010	7148863
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	79	7148859	78	76	77	77	0.30	7148862

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Matrix spike fails for (Silver), suspected matrix interference
(2) Matrix spike fails for (Tin), suspected matrix interference
(3) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP433	OHP434	OHP435	OHP436	OHP437		
Sampling Date		2020/09/09	2020/09/09	2020/09/09	2020/09/09	2020/09/09		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-24**	**BT-25**	**BT-26**	**BT-27**	**BT-28**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	1.47	0.77	0.63	0.68	1.14	0.20	7148861
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Arsenic (As)	mg/kg	0.124	0.202	0.353	0.277	0.547	0.0040	7148861
Total (Wet Wt) Barium (Ba)	mg/kg	0.066	0.046	0.153	0.115	0.048	0.010	7148861
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148861
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0052	0.0030	0.0090	0.0025	0.0027	0.0010	7148861
Total (Wet Wt) Calcium (Ca)	mg/kg	1300	1250	2310	2210	1100	2.0	7148861
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148861
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0178	0.0159	0.0211	0.0282	0.0181	0.0013	7148861
Total (Wet Wt) Copper (Cu)	mg/kg	0.266	0.304	0.350	0.243	0.295	0.010	7148861
Total (Wet Wt) Iron (Fe)	mg/kg	7.15	4.51	6.46	7.30	6.92	0.25	7148861
Total (Wet Wt) Lead (Pb)	mg/kg	0.0119	0.0063	0.0160	0.0123	0.0336	0.0010	7148861
Total (Wet Wt) Magnesium (Mg)	mg/kg	281	311	286	323	267	0.40	7148861
Total (Wet Wt) Manganese (Mn)	mg/kg	3.10	1.37	2.65	4.63	1.92	0.010	7148861
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0041	0.0042	0.0068	0.0051	0.0042	0.0040	7148861
Total (Wet Wt) Nickel (Ni)	mg/kg	0.015	0.013	0.014	0.012	0.053	0.010	7148861
Total (Wet Wt) Phosphorus (P)	mg/kg	3410	3770	3920	4060	3130	2.0	7148861
Total (Wet Wt) Potassium (K)	mg/kg	4190	4390	3950	4200	4140	2.0	7148861
Total (Wet Wt) Selenium (Se)	mg/kg	0.401	0.333	0.311	0.267	0.442	0.010	7148861
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Sodium (Na)	mg/kg	442	431	543	520	421	2.0	7148861
Total (Wet Wt) Strontium (Sr)	mg/kg	1.04	0.987	2.21	1.37	0.756	0.010	7148861
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00237	0.00169	0.00462	0.00146	0.00274	0.00040	7148861
Total (Wet Wt) Tin (Sn)	mg/kg	0.021	0.026	0.025	<0.020	0.022	0.020	7148861
Total (Wet Wt) Titanium (Ti)	mg/kg	0.217	0.198	0.203	0.185	0.176	0.020	7148861
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148861
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Zinc (Zn)	mg/kg	13.7	12.0	16.7	14.6	14.8	0.040	7148861
Mercury (Hg)	mg/kg	0.051 (1)	0.092 (1)	0.034 (1)	0.061 (1)	0.066 (1)	0.010	7148863
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	77	73	77	78	80	0.30	7148862

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP438	OHP439	OHP440	OHP441	OHP442		
Sampling Date		2020/09/09	2020/09/09	2020/09/09	2020/09/09	2020/09/09		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-29**	**BT-30**	**BT-31**	**BT-32**	**BT-33**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.42	0.47	0.35	0.39	0.31	0.20	7148861
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Arsenic (As)	mg/kg	0.138	0.105	0.0933	0.142	0.273	0.0040	7148861
Total (Wet Wt) Barium (Ba)	mg/kg	0.094	0.067	0.070	0.082	0.069	0.010	7148861
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148861
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0026	0.0017	0.0015	0.0034	0.0025	0.0010	7148861
Total (Wet Wt) Calcium (Ca)	mg/kg	1660	1310	1640	1550	2600	2.0	7148861
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148861
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0137	0.0094	0.0087	0.0220	0.0195	0.0013	7148861
Total (Wet Wt) Copper (Cu)	mg/kg	0.316	0.292	0.226	0.260	0.284	0.010	7148861
Total (Wet Wt) Iron (Fe)	mg/kg	5.06	4.43	5.54	5.69	5.87	0.25	7148861
Total (Wet Wt) Lead (Pb)	mg/kg	0.0050	0.0076	0.0055	0.0068	0.0059	0.0010	7148861
Total (Wet Wt) Magnesium (Mg)	mg/kg	320	289	264	273	315	0.40	7148861
Total (Wet Wt) Manganese (Mn)	mg/kg	2.00	2.90	4.87	1.28	4.28	0.010	7148861
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0042	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	7148861
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	<0.010	0.012	<0.010	0.010	7148861
Total (Wet Wt) Phosphorus (P)	mg/kg	3710	3260	3290	3460	4180	2.0	7148861
Total (Wet Wt) Potassium (K)	mg/kg	4360	4040	4030	4200	3920	2.0	7148861
Total (Wet Wt) Selenium (Se)	mg/kg	0.301	0.240	0.220	0.277	0.312	0.010	7148861
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Sodium (Na)	mg/kg	517	426	521	493	544	2.0	7148861
Total (Wet Wt) Strontium (Sr)	mg/kg	1.44	1.12	1.16	1.52	2.25	0.010	7148861
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00359	0.00159	0.00135	0.00289	0.00425	0.00040	7148861
Total (Wet Wt) Tin (Sn)	mg/kg	0.022	0.023	<0.020	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Titanium (Ti)	mg/kg	0.192	0.171	0.169	0.151	0.183	0.020	7148861
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148861
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Zinc (Zn)	mg/kg	12.9	10.8	13.3	15.2	13.5	0.040	7148861
Mercury (Hg)	mg/kg	0.100 (1)	0.059 (1)	0.074 (1)	0.064 (1)	0.055 (1)	0.010	7148863
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	76	76	77	75	78	0.30	7148862

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP443	OHP444	OHP445	OHP446	OHP447		
Sampling Date		2020/09/09	2020/09/09	2020/09/09	2020/09/11	2020/09/11		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-34**	**BT-35**	**BT-36**	**BT-37**	**BT-38**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.38	0.25	0.26	0.30	0.27	0.20	7148861
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Arsenic (As)	mg/kg	0.210	0.132	0.128	0.664	0.264	0.0040	7148861
Total (Wet Wt) Barium (Ba)	mg/kg	0.113	0.086	0.095	0.088	0.073	0.010	7148861
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148861
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0015	<0.0010	0.0017	0.0027	0.0036	0.0010	7148861
Total (Wet Wt) Calcium (Ca)	mg/kg	1480	1360	1670	2560	2090	2.0	7148861
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148861
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0166	0.0104	0.0211	0.0329	0.0111	0.0013	7148861
Total (Wet Wt) Copper (Cu)	mg/kg	0.281	0.273	0.316	0.251	0.238	0.010	7148861
Total (Wet Wt) Iron (Fe)	mg/kg	6.60	4.60	6.35	6.06	5.94	0.25	7148861
Total (Wet Wt) Lead (Pb)	mg/kg	0.0056	0.0042	0.0040	0.0066	0.0051	0.0010	7148861
Total (Wet Wt) Magnesium (Mg)	mg/kg	283	339	298	304	328	0.40	7148861
Total (Wet Wt) Manganese (Mn)	mg/kg	5.86	2.87	4.00	3.16	2.88	0.010	7148861
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0058	0.0050	<0.0040	0.0050	0.0049	0.0040	7148861
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148861
Total (Wet Wt) Phosphorus (P)	mg/kg	3490	3660	3640	4050	4120	2.0	7148861
Total (Wet Wt) Potassium (K)	mg/kg	3920	4310	4130	4070	4330	2.0	7148861
Total (Wet Wt) Selenium (Se)	mg/kg	0.364	0.303	0.252	0.334	0.373	0.010	7148861
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148861
Total (Wet Wt) Sodium (Na)	mg/kg	511	479	527	552	527	2.0	7148861
Total (Wet Wt) Strontium (Sr)	mg/kg	0.928	0.946	1.18	1.73	1.29	0.010	7148861
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00223	0.00143	0.00192	0.00458	0.00173	0.00040	7148861
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Titanium (Ti)	mg/kg	0.159	0.162	0.149	0.179	0.195	0.020	7148861
Total (Wet Wt) Uranium (U)	mg/kg	0.00050	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148861
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148861
Total (Wet Wt) Zinc (Zn)	mg/kg	12.1	17.2	12.9	15.3	17.4	0.040	7148861
Mercury (Hg)	mg/kg	0.056 (1)	0.086 (1)	0.075 (1)	0.057 (1)	0.067 (1)	0.010	7148863
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	77	77	76	78	78	0.30	7148862

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP448	OHP449		OHP450	OHP451	OHP452		
Sampling Date		2020/09/11	2020/09/11		2020/09/11	2020/09/11	2020/09/11		
COC Number		n/a	n/a		n/a	n/a	n/a		
	UNITS	**BT-39**	**BT-40**	**QC Batch**	**BT-41**	**BT-42**	**BT-43**	**RDL**	**QC Batch**
Metals									
Total (Wet Wt) Aluminum (Al)	mg/kg	0.21	0.56	7148861	0.34	0.49	1.00	0.20	7148864
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	7148861	0.0032	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Arsenic (As)	mg/kg	0.0401	0.296	7148861	0.0920	0.268	0.0540	0.0040	7148864
Total (Wet Wt) Barium (Ba)	mg/kg	0.061	0.418	7148861	0.042	0.051	1.21	0.010	7148864
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	7148861	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	7148861	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	7148861	<0.20	<0.20	<0.20	0.20	7148864
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0029	0.0361	7148861	0.0038	0.0062	0.0710	0.0010	7148864
Total (Wet Wt) Calcium (Ca)	mg/kg	1320	1060	7148861	940	1280	1750	2.0	7148864
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.010	7148861	<0.010	<0.010	<0.010	0.010	7148864
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0110	0.0147	7148861	0.0081	0.0059	0.0270	0.0013	7148864
Total (Wet Wt) Copper (Cu)	mg/kg	0.285	0.466	7148861	0.398	0.369	0.381	0.010	7148864
Total (Wet Wt) Iron (Fe)	mg/kg	3.85	7.01	7148861	7.27	5.72	7.17	0.25	7148864
Total (Wet Wt) Lead (Pb)	mg/kg	0.0025	0.0528	7148861	0.179	0.0121	0.293	0.0010	7148864
Total (Wet Wt) Magnesium (Mg)	mg/kg	307	280	7148861	293	268	271	0.40	7148864
Total (Wet Wt) Manganese (Mn)	mg/kg	1.04	0.759	7148861	1.34	0.764	2.16	0.010	7148864
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	<0.0040	7148861	0.0050	<0.0040	<0.0040	0.0040	7148864
Total (Wet Wt) Nickel (Ni)	mg/kg	<0.010	0.038	7148861	0.020	0.041	0.036	0.010	7148864
Total (Wet Wt) Phosphorus (P)	mg/kg	3650	3130	7148861	3110	3100	3360	2.0	7148864
Total (Wet Wt) Potassium (K)	mg/kg	4570	4400	7148861	4410	3880	3980	2.0	7148864
Total (Wet Wt) Selenium (Se)	mg/kg	0.285	0.684	7148861	0.879	0.398	0.337	0.010	7148864
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	0.0011	7148861	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Sodium (Na)	mg/kg	491	439	7148861	400	541	534	2.0	7148864
Total (Wet Wt) Strontium (Sr)	mg/kg	1.23	1.12	7148861	0.887	1.76	1.64	0.010	7148864
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00300	0.0110	7148861	0.00185	0.00146	0.0213	0.00040	7148864
Total (Wet Wt) Tin (Sn)	mg/kg	0.022	<0.020	7148861	<0.020	<0.020	<0.020	0.020	7148864
Total (Wet Wt) Titanium (Ti)	mg/kg	0.162	0.345	7148861	0.321	0.153	0.173	0.020	7148864
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	7148861	<0.00040	<0.00040	0.00102	0.00040	7148864
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	7148861	<0.020	<0.020	<0.020	0.020	7148864
Total (Wet Wt) Zinc (Zn)	mg/kg	8.97	12.3	7148861	12.7	18.6	16.3	0.040	7148864
Mercury (Hg)	mg/kg	0.122 (1)	0.106 (1)	7148863	0.039 (1)	0.097 (1)	0.034 (1)	0.010	7148866
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	75	76	7148862	77	77	80	0.30	7148865

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP453	OHP454	OHP455	OHP456	OHP457	OHP458		
Sampling Date		2020/09/11	2020/09/11	2020/09/11	2020/09/29	2020/09/29	2020/09/29		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	**BT-44**	**BT-45**	**BT-46**	**BT-47**	**BT-48**	**BT-49**	**RDL**	**QC Batch**
Metals									
Total (Wet Wt) Aluminum (Al)	mg/kg	0.90	0.78	0.69	0.42	0.46	1.08	0.20	7148864
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0010	7148864
Total (Wet Wt) Arsenic (As)	mg/kg	0.0685	0.232	0.0256	0.0961	0.0863	0.931	0.0040	7148864
Total (Wet Wt) Barium (Ba)	mg/kg	1.61	1.36	1.36	0.051	0.088	0.159	0.010	7148864
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148864
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0405	0.0769	0.0345	0.0163	0.0073	0.0105	0.0010	7148864
Total (Wet Wt) Calcium (Ca)	mg/kg	2050	2100	1840	1180	2650	2810	2.0	7148864
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.120	0.010	7148864
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0184	0.0193	0.0158	0.0063	0.0059	0.0203	0.0013	7148864
Total (Wet Wt) Copper (Cu)	mg/kg	0.408	0.369	0.381	0.358	1.54	0.531	0.010	7148864
Total (Wet Wt) Iron (Fe)	mg/kg	5.16	6.19	6.52	4.86	5.42	11.0	0.25	7148864
Total (Wet Wt) Lead (Pb)	mg/kg	0.277	0.153	0.131	0.0068	0.0063	0.0158	0.0010	7148864
Total (Wet Wt) Magnesium (Mg)	mg/kg	290	302	288	223	250	299	0.40	7148864
Total (Wet Wt) Manganese (Mn)	mg/kg	2.51	2.06	1.92	0.892	1.50	3.73	0.010	7148864
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0043	0.0046	0.0047	<0.0040	<0.0040	0.0058	0.0040	7148864
Total (Wet Wt) Nickel (Ni)	mg/kg	0.022	0.018	0.022	<0.010	<0.010	0.050	0.010	7148864
Total (Wet Wt) Phosphorus (P)	mg/kg	3680	3890	3500	2810	3720	4100	2.0	7148864
Total (Wet Wt) Potassium (K)	mg/kg	4020	4220	4020	3930	3700	4130	2.0	7148864
Total (Wet Wt) Selenium (Se)	mg/kg	0.426	0.535	0.319	0.430	0.407	0.582	0.010	7148864
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	0.0039	<0.0010	<0.0010	<0.0010	0.0027	0.0010	7148864
Total (Wet Wt) Sodium (Na)	mg/kg	491	441	477	582	712	666	2.0	7148864
Total (Wet Wt) Strontium (Sr)	mg/kg	2.40	2.25	2.37	1.56	4.52	3.87	0.010	7148864
Total (Wet Wt) Thallium (Tl)	mg/kg	0.0346	0.0225	0.0311	0.00159	0.00155	0.00403	0.00040	7148864
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	0.026	<0.020	<0.020	0.039	0.020	7148864
Total (Wet Wt) Titanium (Ti)	mg/kg	0.183	0.199	0.182	0.148	0.198	0.226	0.020	7148864
Total (Wet Wt) Uranium (U)	mg/kg	0.00094	0.00123	0.00059	0.00064	0.00052	0.00055	0.00040	7148864
Total (Wet Wt) Vanadium (V)	mg/kg	0.025	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148864
Total (Wet Wt) Zinc (Zn)	mg/kg	15.5	20.3	17.7	14.1	13.8	15.8	0.040	7148864
Mercury (Hg)	mg/kg	0.030 (1)	0.021 (1)	0.029 (1)	0.226 (1)	0.252 (1)	0.059 (1)	0.010	7148866
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	76	78	78	81	80	79	0.30	7148865

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP459	OHP460		OHP461	OHP462	OHP463		
Sampling Date		2020/09/29	2020/09/29		2020/09/07	2020/09/10	2020/09/10		
COC Number		n/a	n/a		n/a	n/a	n/a		
	UNITS	**BT-50**	**BT-51**	**RDL**	**SH-T1**	**SH-T2**	**SH-T3**	**RDL**	**QC Batch**
Metals									
Total (Wet Wt) Aluminum (Al)	mg/kg	0.62	0.66	0.20	0.94	7.69	1.72	0.20	7148864
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	0.0010	0.0015	0.0019	<0.0010	0.0010	7148864
Total (Wet Wt) Arsenic (As)	mg/kg	1.55	1.55	0.0040	0.0141	0.0118	0.0106	0.0040	7148864
Total (Wet Wt) Barium (Ba)	mg/kg	0.134	0.364	0.010	0.031	0.132	0.639	0.010	7148864
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	0.20	<0.20	<0.20	0.23	0.20	7148864
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0130	0.0351	0.0010	0.0086	0.0012	<0.0010	0.0010	7148864
Total (Wet Wt) Calcium (Ca)	mg/kg	1930	3760	2.0	53.4	109	74.6	2.0	7148864
Total (Wet Wt) Chromium (Cr)	mg/kg	0.051	0.027	0.010	0.026	0.079	0.019	0.010	7148864
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0216	0.0254	0.0013	0.0100	0.0069	0.0045	0.0013	7148864
Total (Wet Wt) Copper (Cu)	mg/kg	0.494	0.367	0.010	1.20	2.12	1.77	0.010	7148864
Total (Wet Wt) Iron (Fe)	mg/kg	9.28	7.76	0.25	25.8	31.9	30.6	0.25	7148864
Total (Wet Wt) Lead (Pb)	mg/kg	0.0126	0.0119	0.0010	0.0126	0.0477	0.0079	0.0010	7148864
Total (Wet Wt) Magnesium (Mg)	mg/kg	278	270	0.40	256	245	266	0.40	7148864
Total (Wet Wt) Manganese (Mn)	mg/kg	2.61	4.31	0.010	0.261	8.56	14.6	0.010	7148864
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.0044	0.0057	0.0040	0.0048	0.0082	0.0074	0.0040	7148864
Total (Wet Wt) Nickel (Ni)	mg/kg	0.012	0.013	0.010	0.028	0.026	0.016	0.010	7148864
Total (Wet Wt) Phosphorus (P)	mg/kg	3410	4190	2.0	2190	2310	2420	2.0	7148864
Total (Wet Wt) Potassium (K)	mg/kg	3790	3620	2.0	3490	3460	3500	2.0	7148864
Total (Wet Wt) Selenium (Se)	mg/kg	0.660	0.501	0.010	0.058	0.052	0.054	0.010	7148864
Total (Wet Wt) Silver (Ag)	mg/kg	0.0030	0.0102	0.0010	0.0014	0.0011	0.0011	0.0010	7148864
Total (Wet Wt) Sodium (Na)	mg/kg	748	735	2.0	503	660	715	2.0	7148864
Total (Wet Wt) Strontium (Sr)	mg/kg	2.71	3.67	0.010	0.030	0.112	0.063	0.010	7148864
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00398	0.00329	0.00040	0.00090	<0.00040	<0.00040	0.00040	7148864
Total (Wet Wt) Tin (Sn)	mg/kg	0.029	<0.020	0.020	0.020	0.039	0.026	0.020	7148864
Total (Wet Wt) Titanium (Ti)	mg/kg	0.187	0.208	0.020	0.146	0.215	0.158	0.020	7148864
Total (Wet Wt) Uranium (U)	mg/kg	0.00045	0.00061	0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148864
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	0.020	7148864
Total (Wet Wt) Zinc (Zn)	mg/kg	15.4	22.3	0.040	20.5	11.9	12.7	0.040	7148864
Mercury (Hg)	mg/kg	0.091 (1)	0.054 (1)	0.010	<0.0010	<0.0010	0.0011	0.0010	7148866
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	78	80	0.30	78	80	76	0.30	7148865

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP464	OHP465	OHP466	OHP467	OHP468		
Sampling Date		2020/10/20	2020/10/20	2020/10/20	2020/11/07	2020/11/08		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**SH-T4**	**SH-T5**	**SH-T6**	**SH-T7**	**SH-T8**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.37	0.43	0.43	0.40	<0.20	0.20	7148864
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Arsenic (As)	mg/kg	0.0216	0.0075	0.0319	0.0209	0.0047	0.0040	7148864
Total (Wet Wt) Barium (Ba)	mg/kg	0.138	0.109	0.035	0.152	0.020	0.010	7148864
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Boron (B)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148864
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.0015	0.0014	0.0028	0.0022	0.0041	0.0010	7148864
Total (Wet Wt) Calcium (Ca)	mg/kg	65.2	64.3	57.8	70.9	49.2	2.0	7148864
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.012	<0.010	<0.010	<0.010	0.010	7148864
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0065	0.0107	0.0139	0.0163	0.0068	0.0013	7148864
Total (Wet Wt) Copper (Cu)	mg/kg	1.69	1.51	1.53	1.99	2.31	0.010	7148864
Total (Wet Wt) Iron (Fe)	mg/kg	17.7	23.5	20.7	31.8	35.9	0.25	7148864
Total (Wet Wt) Lead (Pb)	mg/kg	0.0032	0.0043	0.0027	0.0039	0.0021	0.0010	7148864
Total (Wet Wt) Magnesium (Mg)	mg/kg	271	269	257	264	287	0.40	7148864
Total (Wet Wt) Manganese (Mn)	mg/kg	3.58	1.70	2.16	5.18	0.519	0.010	7148864
Total (Wet Wt) Molybdenum (Mo)	mg/kg	<0.0040	0.0051	<0.0040	<0.0040	<0.0040	0.0040	7148864
Total (Wet Wt) Nickel (Ni)	mg/kg	0.028	0.027	<0.010	0.013	<0.010	0.010	7148864
Total (Wet Wt) Phosphorus (P)	mg/kg	2330	2380	2280	2360	2570	2.0	7148864
Total (Wet Wt) Potassium (K)	mg/kg	3580	3680	3540	3470	3460	2.0	7148864
Total (Wet Wt) Selenium (Se)	mg/kg	0.177	0.069	0.228	0.242	0.161	0.010	7148864
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148864
Total (Wet Wt) Sodium (Na)	mg/kg	567	623	530	548	523	2.0	7148864
Total (Wet Wt) Strontium (Sr)	mg/kg	0.106	0.102	0.078	0.102	0.027	0.010	7148864
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00080	0.00043	0.00100	0.00057	0.00046	0.00040	7148864
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	<0.020	0.020	7148864
Total (Wet Wt) Titanium (Ti)	mg/kg	0.123	0.129	0.126	0.125	0.132	0.020	7148864
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148864
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148864
Total (Wet Wt) Zinc (Zn)	mg/kg	13.6	13.7	12.2	12.8	12.8	0.040	7148864
Mercury (Hg)	mg/kg	0.0018	<0.0010	0.0027	0.0016	<0.0010	0.0010	7148866
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	76	77	77	76	74	0.30	7148865

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP469	OHP469			OHP470	OHP471		
Sampling Date		2020/09/07	2020/09/07			2020/09/10	2020/09/10		
COC Number		n/a	n/a			n/a	n/a		
	UNITS	**SH-IO1**	**SH-IO1 Lab-Dup**	**RDL**	**QC Batch**	**SH-IO2**	**SH-IO3**	**RDL**	**QC Batch**
Metals									
Total (Wet Wt) Aluminum (Al)	mg/kg	0.44	0.40	0.20	7148864	0.34	1.46	0.20	7148868
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	0.0010	7148864	<0.0010	<0.0010	0.0010	7148868
Total (Wet Wt) Arsenic (As)	mg/kg	0.0196	0.0190	0.0040	7148864	0.0061	0.0151	0.0040	7148868
Total (Wet Wt) Barium (Ba)	mg/kg	0.052	0.051	0.010	7148864	0.105	0.152	0.010	7148868
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	0.0010	7148864	<0.0010	<0.0010	0.0010	7148868
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	0.0010	7148864	<0.0010	<0.0010	0.0010	7148868
Total (Wet Wt) Boron (B)	mg/kg	0.20	<0.20	0.20	7148864	0.24	0.28	0.20	7148868
Total (Wet Wt) Cadmium (Cd)	mg/kg	1.49	1.36	0.0010	7148864	0.0252	0.0196	0.0010	7148868
Total (Wet Wt) Calcium (Ca)	mg/kg	105	105	2.0	7148864	74.0	104	2.0	7148868
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	0.010	7148864	<0.010	<0.010	0.010	7148868
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0690	0.0671	0.0013	7148864	0.0143	0.0118	0.0013	7148868
Total (Wet Wt) Copper (Cu)	mg/kg	2.78	2.75	0.010	7148864	3.86	2.06	0.010	7148868
Total (Wet Wt) Iron (Fe)	mg/kg	245 (1)	243	0.25	7148864	243	202	0.25	7148868
Total (Wet Wt) Lead (Pb)	mg/kg	0.0233	0.0227	0.0010	7148864	0.0063	0.0050	0.0010	7148868
Total (Wet Wt) Magnesium (Mg)	mg/kg	170	169	0.40	7148864	149	165	0.40	7148868
Total (Wet Wt) Manganese (Mn)	mg/kg	2.73	2.69	0.010	7148864	16.4	14.8	0.010	7148868
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.236	0.234	0.0040	7148864	0.114	0.129	0.0040	7148868
Total (Wet Wt) Nickel (Ni)	mg/kg	0.036	0.036	0.010	7148864	<0.010	<0.010	0.010	7148868
Total (Wet Wt) Phosphorus (P)	mg/kg	2130	2120	2.0	7148864	2470	2500	2.0	7148868
Total (Wet Wt) Potassium (K)	mg/kg	2330 (2)	2360	2.0	7148864	2680	2770	2.0	7148868
Total (Wet Wt) Selenium (Se)	mg/kg	0.225	0.200	0.010	7148864	0.256	0.239	0.010	7148868
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	<0.0010	0.0010	7148864	0.0496	0.0382	0.0010	7148868
Total (Wet Wt) Sodium (Na)	mg/kg	1240	1250	2.0	7148864	1250	1350	2.0	7148868
Total (Wet Wt) Strontium (Sr)	mg/kg	0.077	0.078	0.010	7148864	0.061	0.075	0.010	7148868
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00157	0.00151	0.00040	7148864	0.00093	0.00047	0.00040	7148868
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	0.020	7148864	<0.020	<0.020	0.020	7148868
Total (Wet Wt) Titanium (Ti)	mg/kg	0.129	0.106	0.020	7148864	0.106	0.106	0.020	7148868
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	0.00040	7148864	<0.00040	<0.00040	0.00040	7148868
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	0.020	7148864	<0.020	<0.020	0.020	7148868
Total (Wet Wt) Zinc (Zn)	mg/kg	20.6 (3)	20.3	0.040	7148864	18.6	20.6	0.040	7148868
Mercury (Hg)	mg/kg	0.0043	0.0034	0.0010	7148866	<0.010 (4)	0.023 (4)	0.010	7148870

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Matrix spike fails for (Iron), suspected matrix interference.
(2) Matrix spike fails for (Potassium), suspected matrix interference.
(3) Matrix spike fails for (Zinc), suspected matrix interference.
(4) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP469	OHP469			OHP470	OHP471		
Sampling Date		2020/09/07	2020/09/07			2020/09/10	2020/09/10		
COC Number		n/a	n/a			n/a	n/a		
	UNITS	**SH-IO1**	**SH-IO1 Lab-Dup**	**RDL**	**QC Batch**	**SH-IO2**	**SH-IO3**	**RDL**	**QC Batch**
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	80	79	0.30	7148865	79	78	0.30	7148869

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP472	OHP473	OHP474	OHP475	OHP476		
Sampling Date		2020/10/20	2020/10/20	2020/10/20	2020/11/07	2020/11/08		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**SH-IO4**	**SH-IO5**	**SH-IO6**	**SH-IO7**	**SH-IO8**	**RDL**	**QC Batch**
Metals								
Total (Wet Wt) Aluminum (Al)	mg/kg	0.41	0.29	0.56	0.40	0.53	0.20	7148868
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148868
Total (Wet Wt) Arsenic (As)	mg/kg	0.0160	0.0077	0.0680	0.0245	<0.0040	0.0040	7148868
Total (Wet Wt) Barium (Ba)	mg/kg	0.160	0.170	0.121	0.303	0.158	0.010	7148868
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148868
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	7148868
Total (Wet Wt) Boron (B)	mg/kg	0.23	<0.20	0.25	0.25	<0.20	0.20	7148868
Total (Wet Wt) Cadmium (Cd)	mg/kg	0.138	0.126	0.343	0.172	0.903	0.0010	7148868
Total (Wet Wt) Calcium (Ca)	mg/kg	109	120	95.5	149	102	2.0	7148868
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148868
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0357	0.0577	0.0837	0.0302	0.0267	0.0013	7148868
Total (Wet Wt) Copper (Cu)	mg/kg	2.67	2.38	3.18	2.59	1.92	0.010	7148868
Total (Wet Wt) Iron (Fe)	mg/kg	126	223	434	177	320	0.25	7148868
Total (Wet Wt) Lead (Pb)	mg/kg	0.0055	0.0049	0.0199	0.0063	0.0287	0.0010	7148868
Total (Wet Wt) Magnesium (Mg)	mg/kg	165	172	181	188	142	0.40	7148868
Total (Wet Wt) Manganese (Mn)	mg/kg	4.36	3.80	10.9	14.1	5.90	0.010	7148868
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.136	0.298	0.245	0.253	0.0842	0.0040	7148868
Total (Wet Wt) Nickel (Ni)	mg/kg	0.011	0.036	0.017	0.020	<0.010	0.010	7148868
Total (Wet Wt) Phosphorus (P)	mg/kg	2370	2460	2740	2680	2060	2.0	7148868
Total (Wet Wt) Potassium (K)	mg/kg	2620	2740	2830	2640	2080	2.0	7148868
Total (Wet Wt) Selenium (Se)	mg/kg	0.618	0.218	0.901	0.701	0.416	0.010	7148868
Total (Wet Wt) Silver (Ag)	mg/kg	0.0102	0.0038	0.0112	0.0031	<0.0010 (1)	0.0010	7148868
Total (Wet Wt) Sodium (Na)	mg/kg	1300	1260	1210	1120	935	2.0	7148868
Total (Wet Wt) Strontium (Sr)	mg/kg	0.129	0.160	0.119	0.241	0.099	0.010	7148868
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00167	0.00094	0.00340	0.00179	0.00126	0.00040	7148868
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148868
Total (Wet Wt) Titanium (Ti)	mg/kg	0.103	0.102	0.121	0.119	0.121	0.020	7148868
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00040	7148868
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148868
Total (Wet Wt) Zinc (Zn)	mg/kg	19.7	20.7	21.6	20.5	16.4	0.040	7148868
Mercury (Hg)	mg/kg	0.109 (2)	0.054 (2)	0.263 (2)	0.094 (2)	0.086 (2)	0.010	7148870
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	77	77	76	75	73	0.30	7148869

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Matrix spike fails for (Silver), suspected matrix interference
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP476			OHP477			OHP477		
Sampling Date		2020/11/08			2020/09/05			2020/09/05		
COC Number		n/a			n/a			n/a		
	UNITS	**SH-IO8 Lab-Dup**	**RDL**	**QC Batch**	**LT-1**	**RDL**	**QC Batch**	**LT-1 Lab-Dup**	**RDL**	**QC Batch**
Metals										
Total (Dry Wt) Aluminum (Al)	mg/kg				8.7	1.0	7148871	10.5	1.0	7148871
Total (Wet Wt) Aluminum (Al)	mg/kg	0.61	0.20	7148868						
Total (Dry Wt) Antimony (Sb)	mg/kg				<0.0050	0.0050	7148871	<0.0050	0.0050	7148871
Total (Wet Wt) Antimony (Sb)	mg/kg	<0.0010	0.0010	7148868						
Total (Dry Wt) Arsenic (As)	mg/kg				<0.020	0.020	7148871	<0.020	0.020	7148871
Total (Wet Wt) Arsenic (As)	mg/kg	<0.0040	0.0040	7148868						
Total (Dry Wt) Barium (Ba)	mg/kg				34.7	0.050	7148871	35.6	0.050	7148871
Total (Wet Wt) Barium (Ba)	mg/kg	0.229	0.010	7148868						
Total (Dry Wt) Beryllium (Be)	mg/kg				<0.010	0.010	7148871	<0.010	0.010	7148871
Total (Wet Wt) Beryllium (Be)	mg/kg	<0.0010	0.0010	7148868						
Total (Dry Wt) Bismuth (Bi)	mg/kg				<0.010	0.010	7148871	<0.010	0.010	7148871
Total (Wet Wt) Bismuth (Bi)	mg/kg	<0.0010	0.0010	7148868						
Total (Dry Wt) Boron (B)	mg/kg				11.4	1.0	7148871	10.9	1.0	7148871
Total (Wet Wt) Boron (B)	mg/kg	0.25	0.20	7148868						
Total (Dry Wt) Cadmium (Cd)	mg/kg				<0.0050	0.0050	7148871	<0.0050	0.0050	7148871
Total (Wet Wt) Cadmium (Cd)	mg/kg	1.15	0.0010	7148868						
Total (Dry Wt) Calcium (Ca)	mg/kg				4810	10	7148871	4730	10	7148871
Total (Wet Wt) Calcium (Ca)	mg/kg	120	2.0	7148868						
Total (Dry Wt) Chromium (Cr)	mg/kg				<0.10	0.10	7148871	<0.10	0.10	7148871
Total (Wet Wt) Chromium (Cr)	mg/kg	<0.010	0.010	7148868						
Total (Dry Wt) Cobalt (Co)	mg/kg				<0.020	0.020	7148871	<0.020	0.020	7148871
Total (Wet Wt) Cobalt (Co)	mg/kg	0.0320	0.0013	7148868						
Total (Dry Wt) Copper (Cu)	mg/kg				2.39	0.050	7148871	2.35	0.050	7148871
Total (Wet Wt) Copper (Cu)	mg/kg	2.39	0.010	7148868						
Total (Dry Wt) Iron (Fe)	mg/kg				21.7	5.0	7148871	20.9	5.0	7148871
Total (Wet Wt) Iron (Fe)	mg/kg	395	0.25	7148868						
Total (Dry Wt) Lead (Pb)	mg/kg				0.046	0.010	7148871	0.043	0.010	7148871
Total (Wet Wt) Lead (Pb)	mg/kg	0.0356	0.0010	7148868						
Total (Dry Wt) Magnesium (Mg)	mg/kg				1160	5.0	7148871	1160	5.0	7148871
Total (Wet Wt) Magnesium (Mg)	mg/kg	182	0.40	7148868						
Total (Dry Wt) Manganese (Mn)	mg/kg				523	0.050	7148871	554	0.050	7148871
Total (Wet Wt) Manganese (Mn)	mg/kg	7.27	0.010	7148868						
Total (Dry Wt) Mercury (Hg)	mg/kg				<0.010	0.010	7148871	<0.010	0.010	7148871
Total (Dry Wt) Molybdenum (Mo)	mg/kg				0.020	0.020	7148871	0.020	0.020	7148871
Total (Wet Wt) Molybdenum (Mo)	mg/kg	0.104	0.0040	7148868						

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP476			OHP477			OHP477		
Sampling Date		2020/11/08			2020/09/05			2020/09/05		
COC Number		n/a			n/a			n/a		
	UNITS	**SH-IO8 Lab-Dup**	**RDL**	**QC Batch**	**LT-1**	**RDL**	**QC Batch**	**LT-1 Lab-Dup**	**RDL**	**QC Batch**
Total (Dry Wt) Nickel (Ni)	mg/kg				0.087	0.050	7148871	0.085	0.050	7148871
Total (Wet Wt) Nickel (Ni)	mg/kg	0.011	0.010	7148868						
Total (Dry Wt) Phosphorus (P)	mg/kg				846	10	7148871	849	10	7148871
Total (Wet Wt) Phosphorus (P)	mg/kg	2630	2.0	7148868						
Total (Dry Wt) Potassium (K)	mg/kg				4020	10	7148871	4000	10	7148871
Total (Wet Wt) Potassium (K)	mg/kg	2720	2.0	7148868						
Total (Dry Wt) Selenium (Se)	mg/kg				<0.050	0.050	7148871	<0.050	0.050	7148871
Total (Wet Wt) Selenium (Se)	mg/kg	0.507	0.010	7148868						
Total (Dry Wt) Silver (Ag)	mg/kg				<0.0050	0.0050	7148871	<0.0050	0.0050	7148871
Total (Wet Wt) Silver (Ag)	mg/kg	<0.0010	0.0010	7148868						
Total (Dry Wt) Sodium (Na)	mg/kg				11	10	7148871	<10	10	7148871
Total (Wet Wt) Sodium (Na)	mg/kg	1200	2.0	7148868						
Total (Dry Wt) Strontium (Sr)	mg/kg				4.81	0.050	7148871	4.79	0.050	7148871
Total (Wet Wt) Strontium (Sr)	mg/kg	0.121	0.010	7148868						
Total (Dry Wt) Thallium (Tl)	mg/kg				0.0119	0.0020	7148871	0.0113	0.0020	7148871
Total (Wet Wt) Thallium (Tl)	mg/kg	0.00163	0.00040	7148868						
Total (Dry Wt) Tin (Sn)	mg/kg				<0.10	0.10	7148871	<0.10	0.10	7148871
Total (Wet Wt) Tin (Sn)	mg/kg	<0.020	0.020	7148868						
Total (Dry Wt) Titanium (Ti)	mg/kg				<0.50	0.50	7148871	<0.50	0.50	7148871
Total (Wet Wt) Titanium (Ti)	mg/kg	0.152	0.020	7148868						
Total (Dry Wt) Uranium (U)	mg/kg				<0.0020	0.0020	7148871	<0.0020	0.0020	7148871
Total (Wet Wt) Uranium (U)	mg/kg	<0.00040	0.00040	7148868						
Total (Dry Wt) Vanadium (V)	mg/kg				<0.20	0.20	7148871	<0.20	0.20	7148871
Total (Wet Wt) Vanadium (V)	mg/kg	<0.020	0.020	7148868						
Total (Dry Wt) Zinc (Zn)	mg/kg				13.9	0.20	7148871	14.2	0.20	7148871
Total (Wet Wt) Zinc (Zn)	mg/kg	19.9	0.040	7148868						
Mercury (Hg)	mg/kg	0.076 (1)	0.010	7148870						
PHYSICAL PROPERTIES										
Moisture-Subcontracted	%	72	0.30	7148869	50	0.30	7148872			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP478	OHP479	OHP480	OHP481	OHP482	OHP483		
Sampling Date		2020/09/06	2020/09/07	2020/09/08	2020/09/10	2020/09/10	2020/09/10		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	**LT-2**	**LT-3**	**LT-4**	**LT-5**	**LT-6**	**LT-7**	**RDL**	**QC Batch**
Metals									
Total (Dry Wt) Aluminum (Al)	mg/kg	24.3	19.8	18.1	11.6	12.4	10.4	1.0	7148871
Total (Dry Wt) Antimony (Sb)	mg/kg	0.0181	0.0512	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7148871
Total (Dry Wt) Arsenic (As)	mg/kg	0.035	0.029	0.021	<0.020	0.022	0.021	0.020	7148871
Total (Dry Wt) Barium (Ba)	mg/kg	63.8	52.6	62.6	73.0	44.9	48.8	0.050	7148871
Total (Dry Wt) Beryllium (Be)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148871
Total (Dry Wt) Bismuth (Bi)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148871
Total (Dry Wt) Boron (B)	mg/kg	14.4	9.7	14.7	12.3	12.6	12.3	1.0	7148871
Total (Dry Wt) Cadmium (Cd)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7148871
Total (Dry Wt) Calcium (Ca)	mg/kg	4330	4360	4770	4870	4190	4320	10	7148871
Total (Dry Wt) Chromium (Cr)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7148871
Total (Dry Wt) Cobalt (Co)	mg/kg	<0.020	0.024	<0.020	<0.020	<0.020	<0.020	0.020	7148871
Total (Dry Wt) Copper (Cu)	mg/kg	3.17	3.11	2.20	2.74	3.15	3.20	0.050	7148871
Total (Dry Wt) Iron (Fe)	mg/kg	29.5	24.9	29.7	23.7	23.0	22.7	5.0	7148871
Total (Dry Wt) Lead (Pb)	mg/kg	0.027	0.027	0.031	0.029	0.026	0.023	0.010	7148871
Total (Dry Wt) Magnesium (Mg)	mg/kg	1450	1590	1180	1180	1360	1260	5.0	7148871
Total (Dry Wt) Manganese (Mn)	mg/kg	548	635	1100	1330	957	1080	0.050	7148871
Total (Dry Wt) Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148871
Total (Dry Wt) Molybdenum (Mo)	mg/kg	0.025	0.046	0.036	0.024	0.027	0.020	0.020	7148871
Total (Dry Wt) Nickel (Ni)	mg/kg	0.695	0.634	0.246	0.104	0.126	0.091	0.050	7148871
Total (Dry Wt) Phosphorus (P)	mg/kg	862	1050	1020	824	833	833	10	7148871
Total (Dry Wt) Potassium (K)	mg/kg	3400	3870	4270	4850	4430	4680	10	7148871
Total (Dry Wt) Selenium (Se)	mg/kg	0.059	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7148871
Total (Dry Wt) Silver (Ag)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7148871
Total (Dry Wt) Sodium (Na)	mg/kg	13	13	<10	<10	<10	<10	10	7148871
Total (Dry Wt) Strontium (Sr)	mg/kg	15.8	14.6	5.30	6.27	4.50	4.59	0.050	7148871
Total (Dry Wt) Thallium (Tl)	mg/kg	0.0133	0.0148	0.0077	0.0425	0.0078	0.0140	0.0020	7148871
Total (Dry Wt) Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7148871
Total (Dry Wt) Titanium (Ti)	mg/kg	0.64	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7148871
Total (Dry Wt) Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	7148871
Total (Dry Wt) Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148871
Total (Dry Wt) Zinc (Zn)	mg/kg	14.6	13.9	11.9	14.4	13.4	14.0	0.20	7148871
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	51	47	50	53	48	54	0.30	7148872

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP484	OHP485	OHP486	OHP487		OHP488		
Sampling Date		2020/09/10	2020/09/10	2020/09/11	2020/11/30		2020/11/07		
COC Number		n/a	n/a	n/a	n/a		n/a		
	UNITS	**LT-8**	**LT-9**	**LT-10**	**LT-DUP**	**QC Batch**	**BB-1**	**RDL**	**QC Batch**
Metals									
Total (Dry Wt) Aluminum (Al)	mg/kg	11.5	13.4	11.6	16.3	7148871	43.6	1.0	7148873
Total (Dry Wt) Antimony (Sb)	mg/kg	<0.0050	<0.0050	<0.0050	0.0051	7148871	<0.0050	0.0050	7148873
Total (Dry Wt) Arsenic (As)	mg/kg	<0.020	0.025	0.024	0.020	7148871	0.032	0.020	7148873
Total (Dry Wt) Barium (Ba)	mg/kg	53.2	58.9	46.8	50.9	7148871	14.4	0.050	7148873
Total (Dry Wt) Beryllium (Be)	mg/kg	<0.010	<0.010	<0.010	<0.010	7148871	<0.010	0.010	7148873
Total (Dry Wt) Bismuth (Bi)	mg/kg	<0.010	<0.010	<0.010	<0.010	7148871	<0.010	0.010	7148873
Total (Dry Wt) Boron (B)	mg/kg	13.3	12.2	12.2	11.6	7148871	10.1	1.0	7148873
Total (Dry Wt) Cadmium (Cd)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	7148871	<0.0050	0.0050	7148873
Total (Dry Wt) Calcium (Ca)	mg/kg	4740	5080	4370	4610	7148871	1700	10	7148873
Total (Dry Wt) Chromium (Cr)	mg/kg	<0.10	<0.10	<0.10	<0.10	7148871	<0.10	0.10	7148873
Total (Dry Wt) Cobalt (Co)	mg/kg	<0.020	<0.020	<0.020	<0.020	7148871	<0.020	0.020	7148873
Total (Dry Wt) Copper (Cu)	mg/kg	3.46	3.16	3.39	2.69	7148871	2.87	0.050	7148873
Total (Dry Wt) Iron (Fe)	mg/kg	21.5	23.9	21.9	26.3	7148871	13.1	5.0	7148873
Total (Dry Wt) Lead (Pb)	mg/kg	0.024	0.031	0.021	0.030	7148871	0.114	0.010	7148873
Total (Dry Wt) Magnesium (Mg)	mg/kg	1410	1320	1300	1350	7148871	687	5.0	7148873
Total (Dry Wt) Manganese (Mn)	mg/kg	1240	1410	1060	708	7148871	361	0.050	7148873
Total (Dry Wt) Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	7148871	<0.010	0.010	7148873
Total (Dry Wt) Molybdenum (Mo)	mg/kg	0.021	<0.020	<0.020	0.038	7148871	0.032	0.020	7148873
Total (Dry Wt) Nickel (Ni)	mg/kg	0.099	0.094	0.107	0.260	7148871	0.237	0.050	7148873
Total (Dry Wt) Phosphorus (P)	mg/kg	885	831	842	915	7148871	763	10	7148873
Total (Dry Wt) Potassium (K)	mg/kg	4750	4490	4600	3750	7148871	5070	10	7148873
Total (Dry Wt) Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	7148871	<0.050	0.050	7148873
Total (Dry Wt) Silver (Ag)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	7148871	<0.0050	0.0050	7148873
Total (Dry Wt) Sodium (Na)	mg/kg	<10	11	<10	10	7148871	47	10	7148873
Total (Dry Wt) Strontium (Sr)	mg/kg	4.80	4.92	4.37	9.24	7148871	9.61	0.050	7148873
Total (Dry Wt) Thallium (Tl)	mg/kg	0.0203	0.0122	0.0105	0.0122	7148871	0.0027	0.0020	7148873
Total (Dry Wt) Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	7148871	<0.10	0.10	7148873
Total (Dry Wt) Titanium (Ti)	mg/kg	<0.50	<0.50	<0.50	<0.50	7148871	<0.50	0.50	7148873
Total (Dry Wt) Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	7148871	<0.0020	0.0020	7148873
Total (Dry Wt) Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	7148871	<0.20	0.20	7148873
Total (Dry Wt) Zinc (Zn)	mg/kg	14.0	14.3	13.6	13.5	7148871	5.88	0.20	7148873
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	50	52	51	48	7148872	86	0.30	7148872

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP489	OHP490	OHP491			OHP491		
Sampling Date		2020/11/08	2020/09/08	2020/09/08			2020/09/08		
COC Number		n/a	n/a	n/a			n/a		
	UNITS	**BB-2**	**BB-3**	**BB-4**	**RDL**	**QC Batch**	**BB-4 Lab-Dup**	**RDL**	**QC Batch**
Metals									
Total (Dry Wt) Aluminum (Al)	mg/kg	45.2	33.5	39.1	1.0	7148873	35.7	1.0	7148873
Total (Dry Wt) Antimony (Sb)	mg/kg	0.0266	<0.0050	<0.0050	0.0050	7148873	<0.0050	0.0050	7148873
Total (Dry Wt) Arsenic (As)	mg/kg	0.122	<0.020	0.031	0.020	7148873	0.023	0.020	7148873
Total (Dry Wt) Barium (Ba)	mg/kg	17.7	22.8	21.1	0.050	7148873	22.1	0.050	7148873
Total (Dry Wt) Beryllium (Be)	mg/kg	<0.010	<0.010	<0.010	0.010	7148873	<0.010	0.010	7148873
Total (Dry Wt) Bismuth (Bi)	mg/kg	<0.010	<0.010	<0.010	0.010	7148873	<0.010	0.010	7148873
Total (Dry Wt) Boron (B)	mg/kg	10.5	8.8	8.3	1.0	7148873	8.2	1.0	7148873
Total (Dry Wt) Cadmium (Cd)	mg/kg	<0.0050	0.0059	0.0070	0.0050	7148873	0.0059	0.0050	7148873
Total (Dry Wt) Calcium (Ca)	mg/kg	1760	1330	1410	10	7148873	1460	10	7148873
Total (Dry Wt) Chromium (Cr)	mg/kg	<0.10	<0.10	<0.10	0.10	7148873	<0.10	0.10	7148873
Total (Dry Wt) Cobalt (Co)	mg/kg	<0.020	<0.020	<0.020	0.020	7148873	<0.020	0.020	7148873
Total (Dry Wt) Copper (Cu)	mg/kg	2.93	2.89	3.02	0.050	7148873	2.88	0.050	7148873
Total (Dry Wt) Iron (Fe)	mg/kg	23.6	18.3	18.0	5.0	7148873	17.0	5.0	7148873
Total (Dry Wt) Lead (Pb)	mg/kg	0.068	0.066	0.054	0.010	7148873	0.048	0.010	7148873
Total (Dry Wt) Magnesium (Mg)	mg/kg	679	554	610	5.0	7148873	619	5.0	7148873
Total (Dry Wt) Manganese (Mn)	mg/kg	656	870	712	0.050	7148873	710	0.050	7148873
Total (Dry Wt) Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	0.010	7148873	<0.010	0.010	7148873
Total (Dry Wt) Molybdenum (Mo)	mg/kg	0.048	0.058	0.050	0.020	7148873	0.049	0.020	7148873
Total (Dry Wt) Nickel (Ni)	mg/kg	0.308	0.326	0.293	0.050	7148873	0.286	0.050	7148873
Total (Dry Wt) Phosphorus (P)	mg/kg	822	1260	1320	10	7148873	1300	10	7148873
Total (Dry Wt) Potassium (K)	mg/kg	5070	5780	6630	10	7148873	6830	10	7148873
Total (Dry Wt) Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	0.050	7148873	<0.050	0.050	7148873
Total (Dry Wt) Silver (Ag)	mg/kg	<0.0050	<0.0050	<0.0050	0.0050	7148873	<0.0050	0.0050	7148873
Total (Dry Wt) Sodium (Na)	mg/kg	52	17	16	10	7148873	18	10	7148873
Total (Dry Wt) Strontium (Sr)	mg/kg	7.75	1.07	1.18	0.050	7148873	1.23	0.050	7148873
Total (Dry Wt) Thallium (Tl)	mg/kg	0.0031	<0.0020	<0.0020	0.0020	7148873	<0.0020	0.0020	7148873
Total (Dry Wt) Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	0.10	7148873	<0.10	0.10	7148873
Total (Dry Wt) Titanium (Ti)	mg/kg	0.55	<0.50	<0.50	0.50	7148873	<0.50	0.50	7148873
Total (Dry Wt) Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	7148873	<0.0020	0.0020	7148873
Total (Dry Wt) Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	0.20	7148873	<0.20	0.20	7148873
Total (Dry Wt) Zinc (Zn)	mg/kg	7.08	7.25	7.29	0.20	7148873	6.76	0.20	7148873
PHYSICAL PROPERTIES									
Moisture-Subcontracted	%	87	83	84	0.30	7148872			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP492	OHP493	OHP494	OHP495	OHP496		
Sampling Date		2020/09/08	2020/09/08	2020/09/08	2020/09/08	2020/09/08		
COC Number		n/a	n/a	n/a	n/a	n/a		
	UNITS	**BB-5**	**BB-6**	**BB-7**	**BB-8**	**BB-9**	**RDL**	**QC Batch**
Metals								
Total (Dry Wt) Aluminum (Al)	mg/kg	57.4	32.3	42.2	74.8	99.5	1.0	7148873
Total (Dry Wt) Antimony (Sb)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7148873
Total (Dry Wt) Arsenic (As)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148873
Total (Dry Wt) Barium (Ba)	mg/kg	18.3	17.9	17.3	14.8	16.0	0.050	7148873
Total (Dry Wt) Beryllium (Be)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148873
Total (Dry Wt) Bismuth (Bi)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148873
Total (Dry Wt) Boron (B)	mg/kg	7.1	8.1	8.4	6.6	5.4	1.0	7148873
Total (Dry Wt) Cadmium (Cd)	mg/kg	0.0077	0.0100	0.0079	0.0057	0.0075	0.0050	7148873
Total (Dry Wt) Calcium (Ca)	mg/kg	1380	1500	1810	1260	1220	10	7148873
Total (Dry Wt) Chromium (Cr)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7148873
Total (Dry Wt) Cobalt (Co)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7148873
Total (Dry Wt) Copper (Cu)	mg/kg	2.79	2.81	2.36	2.14	1.96	0.050	7148873
Total (Dry Wt) Iron (Fe)	mg/kg	18.8	12.5	13.2	14.5	11.5	5.0	7148873
Total (Dry Wt) Lead (Pb)	mg/kg	0.066	0.038	0.022	0.035	0.037	0.010	7148873
Total (Dry Wt) Magnesium (Mg)	mg/kg	564	522	542	460	470	5.0	7148873
Total (Dry Wt) Manganese (Mn)	mg/kg	665	484	605	574	752	0.050	7148873
Total (Dry Wt) Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7148873
Total (Dry Wt) Molybdenum (Mo)	mg/kg	0.074	0.028	0.043	0.057	0.029	0.020	7148873
Total (Dry Wt) Nickel (Ni)	mg/kg	0.403	0.259	0.219	0.248	0.270	0.050	7148873
Total (Dry Wt) Phosphorus (P)	mg/kg	1150	658	729	935	860	10	7148873
Total (Dry Wt) Potassium (K)	mg/kg	5780	5870	5750	5130	5080	10	7148873
Total (Dry Wt) Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7148873
Total (Dry Wt) Silver (Ag)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7148873
Total (Dry Wt) Sodium (Na)	mg/kg	14	13	12	23	18	10	7148873
Total (Dry Wt) Strontium (Sr)	mg/kg	1.27	0.715	0.697	0.986	0.987	0.050	7148873
Total (Dry Wt) Thallium (Tl)	mg/kg	0.0047	0.0023	<0.0020	<0.0020	<0.0020	0.0020	7148873
Total (Dry Wt) Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7148873
Total (Dry Wt) Titanium (Ti)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	7148873
Total (Dry Wt) Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	7148873
Total (Dry Wt) Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7148873
Total (Dry Wt) Zinc (Zn)	mg/kg	7.17	7.35	7.84	6.12	6.25	0.20	7148873
PHYSICAL PROPERTIES								
Moisture-Subcontracted	%	85	85	87	86	85	0.30	7148872

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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RESULTS OF ANALYSES OF TISSUE

BV Labs ID		OHP497	OHP498		
Sampling Date		2020/09/08	2020/11/30		
COC Number		n/a	n/a		
	UNITS	**BB-10**	**BB-DUP**	**RDL**	**QC Batch**
Metals					
Total (Dry Wt) Aluminum (Al)	mg/kg	90.5	56.0	1.0	7148873
Total (Dry Wt) Antimony (Sb)	mg/kg	<0.0050	<0.0050	0.0050	7148873
Total (Dry Wt) Arsenic (As)	mg/kg	0.025	0.031	0.020	7148873
Total (Dry Wt) Barium (Ba)	mg/kg	20.9	17.2	0.050	7148873
Total (Dry Wt) Beryllium (Be)	mg/kg	<0.010	<0.010	0.010	7148873
Total (Dry Wt) Bismuth (Bi)	mg/kg	<0.010	<0.010	0.010	7148873
Total (Dry Wt) Boron (B)	mg/kg	6.9	7.5	1.0	7148873
Total (Dry Wt) Cadmium (Cd)	mg/kg	0.0081	0.0069	0.0050	7148873
Total (Dry Wt) Calcium (Ca)	mg/kg	1600	1390	10	7148873
Total (Dry Wt) Chromium (Cr)	mg/kg	<0.10	<0.10	0.10	7148873
Total (Dry Wt) Cobalt (Co)	mg/kg	<0.020	<0.020	0.020	7148873
Total (Dry Wt) Copper (Cu)	mg/kg	2.43	2.37	0.050	7148873
Total (Dry Wt) Iron (Fe)	mg/kg	15.2	15.2	5.0	7148873
Total (Dry Wt) Lead (Pb)	mg/kg	0.064	0.037	0.010	7148873
Total (Dry Wt) Magnesium (Mg)	mg/kg	509	501	5.0	7148873
Total (Dry Wt) Manganese (Mn)	mg/kg	770	650	0.050	7148873
Total (Dry Wt) Mercury (Hg)	mg/kg	<0.010	<0.010	0.010	7148873
Total (Dry Wt) Molybdenum (Mo)	mg/kg	0.042	0.045	0.020	7148873
Total (Dry Wt) Nickel (Ni)	mg/kg	0.294	0.342	0.050	7148873
Total (Dry Wt) Phosphorus (P)	mg/kg	1010	1020	10	7148873
Total (Dry Wt) Potassium (K)	mg/kg	5680	5400	10	7148873
Total (Dry Wt) Selenium (Se)	mg/kg	<0.050	<0.050	0.050	7148873
Total (Dry Wt) Silver (Ag)	mg/kg	<0.0050	<0.0050	0.0050	7148873
Total (Dry Wt) Sodium (Na)	mg/kg	20	19	10	7148873
Total (Dry Wt) Strontium (Sr)	mg/kg	1.80	1.40	0.050	7148873
Total (Dry Wt) Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0020	7148873
Total (Dry Wt) Tin (Sn)	mg/kg	<0.10	<0.10	0.10	7148873
Total (Dry Wt) Titanium (Ti)	mg/kg	<0.50	<0.50	0.50	7148873
Total (Dry Wt) Uranium (U)	mg/kg	<0.0020	<0.0020	0.0020	7148873
Total (Dry Wt) Vanadium (V)	mg/kg	<0.20	<0.20	0.20	7148873
Total (Dry Wt) Zinc (Zn)	mg/kg	7.09	6.93	0.20	7148873
PHYSICAL PROPERTIES					
Moisture-Subcontracted	%	85	84	0.30	7148874

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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TEST SUMMARY

BV Labs ID: OHP410 **Collected:** 2020/09/05
Sample ID: BT-1 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP411 **Collected:** 2020/09/05
Sample ID: BT-2 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP412 **Collected:** 2020/09/05
Sample ID: BT-3 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP412 Dup **Collected:** 2020/09/05
Sample ID: BT-3 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP413 **Collected:** 2020/09/05
Sample ID: BT-4 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP414 **Collected:** 2020/09/05
Sample ID: BT-5 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP415
Sample ID: BT-6
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP416
Sample ID: BT-7
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP417
Sample ID: BT-8
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP418
Sample ID: BT-9
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP419
Sample ID: BT-10
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP420
Sample ID: BT-11
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP421 **Collected:** 2020/09/05
Sample ID: BT-12 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP422 **Collected:** 2020/09/05
Sample ID: BT-13 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP423 **Collected:** 2020/09/05
Sample ID: BT-14 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP424 **Collected:** 2020/09/05
Sample ID: BT-15 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP425 **Collected:** 2020/09/07
Sample ID: BT-16 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP426 **Collected:** 2020/09/09
Sample ID: BT-17 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP427
Sample ID: BT-18
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP428
Sample ID: BT-19
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP429
Sample ID: BT-20
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148860	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148857	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148859	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP430
Sample ID: BT-21
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP431
Sample ID: BT-22
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP431 Dup
Sample ID: BT-22
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP432
Sample ID: BT-23
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP433
Sample ID: BT-24
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP434
Sample ID: BT-25
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP435
Sample ID: BT-26
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP436
Sample ID: BT-27
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP437
Sample ID: BT-28
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP438
Sample ID: BT-29
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP439
Sample ID: BT-30
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP440
Sample ID: BT-31
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP441
Sample ID: BT-32
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP442
Sample ID: BT-33
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP443
Sample ID: BT-34
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP444
Sample ID: BT-35
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP445
Sample ID: BT-36
Matrix: Tissue

Collected: 2020/09/09
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP446
Sample ID: BT-37
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP447
Sample ID: BT-38
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP448
Sample ID: BT-39
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/13	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

BV Labs ID: OHP449
Sample ID: BT-40
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148863	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148861	2021/01/06	2021/01/12	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148862	2021/01/06	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP450
Sample ID: BT-41
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/12	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP451
Sample ID: BT-42
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP452
Sample ID: BT-43
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP453
Sample ID: BT-44
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP454
Sample ID: BT-45
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP455
Sample ID: BT-46
Matrix: Tissue

Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP456
Sample ID: BT-47
Matrix: Tissue

Collected: 2020/09/29
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP457
Sample ID: BT-48
Matrix: Tissue

Collected: 2020/09/29
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP458
Sample ID: BT-49
Matrix: Tissue

Collected: 2020/09/29
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP459
Sample ID: BT-50
Matrix: Tissue

Collected: 2020/09/29
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP460
Sample ID: BT-51
Matrix: Tissue

Collected: 2020/09/29
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP461
Sample ID: SH-T1
Matrix: Tissue

Collected: 2020/09/07
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP462
Sample ID: SH-T2
Matrix: Tissue

Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP463
Sample ID: SH-T3
Matrix: Tissue

Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP464
Sample ID: SH-T4
Matrix: Tissue

Collected: 2020/10/20
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP465
Sample ID: SH-T5
Matrix: Tissue

Collected: 2020/10/20
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP466
Sample ID: SH-T6
Matrix: Tissue

Collected: 2020/10/20
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP467
Sample ID: SH-T7
Matrix: Tissue

Collected: 2020/11/07
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP468 **Collected:** 2020/11/08
Sample ID: SH-T8 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP469 **Collected:** 2020/09/07
Sample ID: SH-IO1 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP469 Dup **Collected:** 2020/09/07
Sample ID: SH-IO1 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148866	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148864	2021/01/06	2021/01/09	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148865	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP470 **Collected:** 2020/09/10
Sample ID: SH-IO2 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP471 **Collected:** 2020/09/10
Sample ID: SH-IO3 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP472 **Collected:** 2020/10/20
Sample ID: SH-IO4 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

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TEST SUMMARY

BV Labs ID: OHP473
Sample ID: SH-IO5
Matrix: Tissue

Collected: 2020/10/20
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP474
Sample ID: SH-IO6
Matrix: Tissue

Collected: 2020/10/20
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP475
Sample ID: SH-IO7
Matrix: Tissue

Collected: 2020/11/07
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP476
Sample ID: SH-IO8
Matrix: Tissue

Collected: 2020/11/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP476 Dup
Sample ID: SH-IO8
Matrix: Tissue

Collected: 2020/11/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury in Tissue by CVAF - Wet Wt	CV/AF	7148870	N/A	2021/01/12	Chamila Jayasinghe
Elements by CRC ICPMS - Tissue Wet Wt	ICP/MS	7148868	2021/01/06	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148869	2021/01/11	2021/01/12	Luz Aliaga

BV Labs ID: OHP477
Sample ID: LT-1
Matrix: Tissue

Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

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TEST SUMMARY

BV Labs ID: OHP477 Dup
Sample ID: LT-1
Matrix: Tissue
Collected: 2020/09/05
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive

BV Labs ID: OHP478
Sample ID: LT-2
Matrix: Tissue
Collected: 2020/09/06
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP479
Sample ID: LT-3
Matrix: Tissue
Collected: 2020/09/07
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP480
Sample ID: LT-4
Matrix: Tissue
Collected: 2020/09/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP481
Sample ID: LT-5
Matrix: Tissue
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP482
Sample ID: LT-6
Matrix: Tissue
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP483
Sample ID: LT-7
Matrix: Tissue
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive

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TEST SUMMARY

BV Labs ID: OHP483 **Collected:** 2020/09/10
Sample ID: LT-7 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP484 **Collected:** 2020/09/10
Sample ID: LT-8 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP485 **Collected:** 2020/09/10
Sample ID: LT-9 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP486 **Collected:** 2020/09/11
Sample ID: LT-10 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP487 **Collected:** 2020/11/30
Sample ID: LT-DUP **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148871	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP488 **Collected:** 2020/11/07
Sample ID: BB-1 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP489 **Collected:** 2020/11/08
Sample ID: BB-2 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive

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TEST SUMMARY

BV Labs ID: OHP489 **Collected:** 2020/11/08
Sample ID: BB-2 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP490 **Collected:** 2020/09/08
Sample ID: BB-3 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP491 **Collected:** 2020/09/08
Sample ID: BB-4 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP491 Dup **Collected:** 2020/09/08
Sample ID: BB-4 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive

BV Labs ID: OHP492 **Collected:** 2020/09/08
Sample ID: BB-5 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP493 **Collected:** 2020/09/08
Sample ID: BB-6 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP494 **Collected:** 2020/09/08
Sample ID: BB-7 **Shipped:**
Matrix: Tissue **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

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TEST SUMMARY

BV Labs ID: OHP495
Sample ID: BB-8
Matrix: Tissue

Collected: 2020/09/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP496
Sample ID: BB-9
Matrix: Tissue

Collected: 2020/09/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148872	2020/12/11	2020/12/16	Cyrhea Goda

BV Labs ID: OHP497
Sample ID: BB-10
Matrix: Tissue

Collected: 2020/09/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148874	2020/12/16	2021/01/12	Cyrhea Goda

BV Labs ID: OHP498
Sample ID: BB-DUP
Matrix: Tissue

Collected: 2020/11/30
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Elements in Plants by CRC ICPMS -Dry Wt	ICP/MS	7148873	2021/01/07	2021/01/10	Jocelyn Baron-Inactive
Moisture in Tissue (Subcontracted)	BAL/BAL	7148874	2020/12/16	2021/01/12	Cyrhea Goda

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	-5.0°C

Results relate only to the items tested.

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			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
7148857	Total (Wet Wt) Aluminum (Al)	2021/01/09	26	40
7148857	Total (Wet Wt) Antimony (Sb)	2021/01/09	NC	40
7148857	Total (Wet Wt) Arsenic (As)	2021/01/09	7.5	40
7148857	Total (Wet Wt) Barium (Ba)	2021/01/09	25	40
7148857	Total (Wet Wt) Beryllium (Be)	2021/01/09	NC	40
7148857	Total (Wet Wt) Bismuth (Bi)	2021/01/09	NC	40
7148857	Total (Wet Wt) Boron (B)	2021/01/09	NC	40
7148857	Total (Wet Wt) Cadmium (Cd)	2021/01/09	7.3	40
7148857	Total (Wet Wt) Calcium (Ca)	2021/01/09	25	60
7148857	Total (Wet Wt) Chromium (Cr)	2021/01/09	35	40
7148857	Total (Wet Wt) Cobalt (Co)	2021/01/09	3.7	40
7148857	Total (Wet Wt) Copper (Cu)	2021/01/09	4.4	40
7148857	Total (Wet Wt) Iron (Fe)	2021/01/09	1.8	40
7148857	Total (Wet Wt) Lead (Pb)	2021/01/09	13	40
7148857	Total (Wet Wt) Magnesium (Mg)	2021/01/09	3.4	40
7148857	Total (Wet Wt) Manganese (Mn)	2021/01/09	15	40
7148857	Total (Wet Wt) Molybdenum (Mo)	2021/01/09	18	40
7148857	Total (Wet Wt) Nickel (Ni)	2021/01/09	21	40
7148857	Total (Wet Wt) Phosphorus (P)	2021/01/09	4.0	40
7148857	Total (Wet Wt) Potassium (K)	2021/01/09	1.1	40
7148857	Total (Wet Wt) Selenium (Se)	2021/01/09	1.0	40
7148857	Total (Wet Wt) Silver (Ag)	2021/01/09	NC	40
7148857	Total (Wet Wt) Sodium (Na)	2021/01/09	4.5	40
7148857	Total (Wet Wt) Strontium (Sr)	2021/01/09	21	60
7148857	Total (Wet Wt) Thallium (Tl)	2021/01/09	4.4	40
7148857	Total (Wet Wt) Tin (Sn)	2021/01/09	NC	40
7148857	Total (Wet Wt) Titanium (Ti)	2021/01/09	7.8	40
7148857	Total (Wet Wt) Uranium (U)	2021/01/09	NC	40
7148857	Total (Wet Wt) Vanadium (V)	2021/01/09	NC	40
7148857	Total (Wet Wt) Zinc (Zn)	2021/01/09	4.9	40
7148859	Moisture-Subcontracted	2021/01/12	0.65	20
7148860	Mercury (Hg)	2021/01/12	11 (1)	20
7148861	Total (Wet Wt) Aluminum (Al)	2021/01/10	7.8	40

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			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
7148861	Total (Wet Wt) Antimony (Sb)	2021/01/10	NC	40
7148861	Total (Wet Wt) Arsenic (As)	2021/01/10	3.5	40
7148861	Total (Wet Wt) Barium (Ba)	2021/01/10	34	40
7148861	Total (Wet Wt) Beryllium (Be)	2021/01/10	NC	40
7148861	Total (Wet Wt) Bismuth (Bi)	2021/01/10	NC	40
7148861	Total (Wet Wt) Boron (B)	2021/01/10	NC	40
7148861	Total (Wet Wt) Cadmium (Cd)	2021/01/10	20	40
7148861	Total (Wet Wt) Calcium (Ca)	2021/01/10	34	60
7148861	Total (Wet Wt) Chromium (Cr)	2021/01/10	NC	40
7148861	Total (Wet Wt) Cobalt (Co)	2021/01/10	10	40
7148861	Total (Wet Wt) Copper (Cu)	2021/01/10	5.5	40
7148861	Total (Wet Wt) Iron (Fe)	2021/01/10	14	40
7148861	Total (Wet Wt) Lead (Pb)	2021/01/10	23	40
7148861	Total (Wet Wt) Magnesium (Mg)	2021/01/10	8.1	40
7148861	Total (Wet Wt) Manganese (Mn)	2021/01/10	38	40
7148861	Total (Wet Wt) Molybdenum (Mo)	2021/01/10	NC	40
7148861	Total (Wet Wt) Nickel (Ni)	2021/01/10	NC	40
7148861	Total (Wet Wt) Phosphorus (P)	2021/01/10	14	40
7148861	Total (Wet Wt) Potassium (K)	2021/01/10	1.6	40
7148861	Total (Wet Wt) Selenium (Se)	2021/01/10	4.3	40
7148861	Total (Wet Wt) Silver (Ag)	2021/01/10	NC	40
7148861	Total (Wet Wt) Sodium (Na)	2021/01/10	6.7	40
7148861	Total (Wet Wt) Strontium (Sr)	2021/01/10	30	60
7148861	Total (Wet Wt) Thallium (Tl)	2021/01/10	2.1	40
7148861	Total (Wet Wt) Tin (Sn)	2021/01/10	NC	40
7148861	Total (Wet Wt) Titanium (Ti)	2021/01/10	31	40
7148861	Total (Wet Wt) Uranium (U)	2021/01/10	NC	40
7148861	Total (Wet Wt) Vanadium (V)	2021/01/10	NC	40
7148861	Total (Wet Wt) Zinc (Zn)	2021/01/10	13	40
7148862	Moisture-Subcontracted	2021/01/12	1.0	20
7148863	Mercury (Hg)	2021/01/12	6.9 (1)	20
7148864	Total (Wet Wt) Aluminum (Al)	2021/01/09	8.9	40
7148864	Total (Wet Wt) Antimony (Sb)	2021/01/09	NC	40

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			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
7148864	Total (Wet Wt) Arsenic (As)	2021/01/09	3.1	40
7148864	Total (Wet Wt) Barium (Ba)	2021/01/09	2.1	40
7148864	Total (Wet Wt) Beryllium (Be)	2021/01/09	NC	40
7148864	Total (Wet Wt) Bismuth (Bi)	2021/01/09	NC	40
7148864	Total (Wet Wt) Boron (B)	2021/01/09	0.49	40
7148864	Total (Wet Wt) Cadmium (Cd)	2021/01/09	9.0	40
7148864	Total (Wet Wt) Calcium (Ca)	2021/01/09	0.11	60
7148864	Total (Wet Wt) Chromium (Cr)	2021/01/09	NC	40
7148864	Total (Wet Wt) Cobalt (Co)	2021/01/09	2.7	40
7148864	Total (Wet Wt) Copper (Cu)	2021/01/09	1.0	40
7148864	Total (Wet Wt) Iron (Fe)	2021/01/09	0.81	40
7148864	Total (Wet Wt) Lead (Pb)	2021/01/09	3.0	40
7148864	Total (Wet Wt) Magnesium (Mg)	2021/01/09	0.82	40
7148864	Total (Wet Wt) Manganese (Mn)	2021/01/09	1.4	40
7148864	Total (Wet Wt) Molybdenum (Mo)	2021/01/09	0.96	40
7148864	Total (Wet Wt) Nickel (Ni)	2021/01/09	0.77	40
7148864	Total (Wet Wt) Phosphorus (P)	2021/01/09	0.31	40
7148864	Total (Wet Wt) Potassium (K)	2021/01/09	1.1	40
7148864	Total (Wet Wt) Selenium (Se)	2021/01/09	12	40
7148864	Total (Wet Wt) Silver (Ag)	2021/01/09	NC	40
7148864	Total (Wet Wt) Sodium (Na)	2021/01/09	0.20	40
7148864	Total (Wet Wt) Strontium (Sr)	2021/01/09	1.1	60
7148864	Total (Wet Wt) Thallium (Tl)	2021/01/09	3.9	40
7148864	Total (Wet Wt) Tin (Sn)	2021/01/09	NC	40
7148864	Total (Wet Wt) Titanium (Ti)	2021/01/09	19	40
7148864	Total (Wet Wt) Uranium (U)	2021/01/09	NC	40
7148864	Total (Wet Wt) Vanadium (V)	2021/01/09	NC	40
7148864	Total (Wet Wt) Zinc (Zn)	2021/01/09	1.5	40
7148865	Moisture-Subcontracted	2021/01/12	0.50	20
7148866	Mercury (Hg)	2021/01/12	NC	20
7148868	Total (Wet Wt) Aluminum (Al)	2021/01/10	14	40
7148868	Total (Wet Wt) Antimony (Sb)	2021/01/10	NC	40
7148868	Total (Wet Wt) Arsenic (As)	2021/01/10	NC	40

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			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
7148868	Total (Wet Wt) Barium (Ba)	2021/01/10	37	40
7148868	Total (Wet Wt) Beryllium (Be)	2021/01/10	NC	40
7148868	Total (Wet Wt) Bismuth (Bi)	2021/01/10	NC	40
7148868	Total (Wet Wt) Boron (B)	2021/01/10	23	40
7148868	Total (Wet Wt) Cadmium (Cd)	2021/01/10	24	40
7148868	Total (Wet Wt) Calcium (Ca)	2021/01/10	17	60
7148868	Total (Wet Wt) Chromium (Cr)	2021/01/10	NC	40
7148868	Total (Wet Wt) Cobalt (Co)	2021/01/10	18	40
7148868	Total (Wet Wt) Copper (Cu)	2021/01/10	22	40
7148868	Total (Wet Wt) Iron (Fe)	2021/01/10	21	40
7148868	Total (Wet Wt) Lead (Pb)	2021/01/10	21	40
7148868	Total (Wet Wt) Magnesium (Mg)	2021/01/10	25	40
7148868	Total (Wet Wt) Manganese (Mn)	2021/01/10	21	40
7148868	Total (Wet Wt) Molybdenum (Mo)	2021/01/10	21	40
7148868	Total (Wet Wt) Nickel (Ni)	2021/01/10	9.7	40
7148868	Total (Wet Wt) Phosphorus (P)	2021/01/10	24	40
7148868	Total (Wet Wt) Potassium (K)	2021/01/10	27	40
7148868	Total (Wet Wt) Selenium (Se)	2021/01/10	20	40
7148868	Total (Wet Wt) Silver (Ag)	2021/01/10	NC	40
7148868	Total (Wet Wt) Sodium (Na)	2021/01/10	25	40
7148868	Total (Wet Wt) Strontium (Sr)	2021/01/10	21	60
7148868	Total (Wet Wt) Thallium (Tl)	2021/01/10	26	40
7148868	Total (Wet Wt) Tin (Sn)	2021/01/10	NC	40
7148868	Total (Wet Wt) Titanium (Ti)	2021/01/10	23	40
7148868	Total (Wet Wt) Uranium (U)	2021/01/10	NC	40
7148868	Total (Wet Wt) Vanadium (V)	2021/01/10	NC	40
7148868	Total (Wet Wt) Zinc (Zn)	2021/01/10	19	40
7148869	Moisture-Subcontracted	2021/01/12	1.7	20
7148870	Mercury (Hg)	2021/01/12	13 (1)	20
7148871	Total (Dry Wt) Aluminum (Al)	2021/01/10	19	40
7148871	Total (Dry Wt) Antimony (Sb)	2021/01/10	NC	40
7148871	Total (Dry Wt) Arsenic (As)	2021/01/10	NC	40
7148871	Total (Dry Wt) Barium (Ba)	2021/01/10	2.5	40

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			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
7148871	Total (Dry Wt) Beryllium (Be)	2021/01/10	NC	40
7148871	Total (Dry Wt) Bismuth (Bi)	2021/01/10	NC	40
7148871	Total (Dry Wt) Boron (B)	2021/01/10	4.1	40
7148871	Total (Dry Wt) Cadmium (Cd)	2021/01/10	NC	40
7148871	Total (Dry Wt) Calcium (Ca)	2021/01/10	1.6	60
7148871	Total (Dry Wt) Chromium (Cr)	2021/01/10	NC	40
7148871	Total (Dry Wt) Cobalt (Co)	2021/01/10	NC	40
7148871	Total (Dry Wt) Copper (Cu)	2021/01/10	1.5	40
7148871	Total (Dry Wt) Iron (Fe)	2021/01/10	3.8	40
7148871	Total (Dry Wt) Lead (Pb)	2021/01/10	6.2	40
7148871	Total (Dry Wt) Magnesium (Mg)	2021/01/10	0.039	40
7148871	Total (Dry Wt) Manganese (Mn)	2021/01/10	5.7	40
7148871	Total (Dry Wt) Mercury (Hg)	2021/01/10	NC	40
7148871	Total (Dry Wt) Molybdenum (Mo)	2021/01/10	0.10	40
7148871	Total (Dry Wt) Nickel (Ni)	2021/01/10	2.3	40
7148871	Total (Dry Wt) Phosphorus (P)	2021/01/10	0.37	40
7148871	Total (Dry Wt) Potassium (K)	2021/01/10	0.56	40
7148871	Total (Dry Wt) Selenium (Se)	2021/01/10	NC	40
7148871	Total (Dry Wt) Silver (Ag)	2021/01/10	NC	40
7148871	Total (Dry Wt) Sodium (Na)	2021/01/10	5.1	40
7148871	Total (Dry Wt) Strontium (Sr)	2021/01/10	0.32	40
7148871	Total (Dry Wt) Thallium (Tl)	2021/01/10	4.7	40
7148871	Total (Dry Wt) Tin (Sn)	2021/01/10	NC	40
7148871	Total (Dry Wt) Titanium (Ti)	2021/01/10	NC	40
7148871	Total (Dry Wt) Uranium (U)	2021/01/10	NC	40
7148871	Total (Dry Wt) Vanadium (V)	2021/01/10	NC	40
7148871	Total (Dry Wt) Zinc (Zn)	2021/01/10	1.8	40
7148873	Total (Dry Wt) Aluminum (Al)	2021/01/10	9.1	40
7148873	Total (Dry Wt) Antimony (Sb)	2021/01/10	NC	40
7148873	Total (Dry Wt) Arsenic (As)	2021/01/10	29	40
7148873	Total (Dry Wt) Barium (Ba)	2021/01/10	4.7	40
7148873	Total (Dry Wt) Beryllium (Be)	2021/01/10	NC	40
7148873	Total (Dry Wt) Bismuth (Bi)	2021/01/10	NC	40

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			RPD	
QC Batch	Parameter	Date	Value (%)	QC Limits
7148873	Total (Dry Wt) Boron (B)	2021/01/10	2.1	40
7148873	Total (Dry Wt) Cadmium (Cd)	2021/01/10	17	40
7148873	Total (Dry Wt) Calcium (Ca)	2021/01/10	3.7	60
7148873	Total (Dry Wt) Chromium (Cr)	2021/01/10	NC	40
7148873	Total (Dry Wt) Cobalt (Co)	2021/01/10	NC	40
7148873	Total (Dry Wt) Copper (Cu)	2021/01/10	4.9	40
7148873	Total (Dry Wt) Iron (Fe)	2021/01/10	5.9	40
7148873	Total (Dry Wt) Lead (Pb)	2021/01/10	12	40
7148873	Total (Dry Wt) Magnesium (Mg)	2021/01/10	1.4	40
7148873	Total (Dry Wt) Manganese (Mn)	2021/01/10	0.34	40
7148873	Total (Dry Wt) Mercury (Hg)	2021/01/10	NC	40
7148873	Total (Dry Wt) Molybdenum (Mo)	2021/01/10	2.6	40
7148873	Total (Dry Wt) Nickel (Ni)	2021/01/10	2.4	40
7148873	Total (Dry Wt) Phosphorus (P)	2021/01/10	1.2	40
7148873	Total (Dry Wt) Potassium (K)	2021/01/10	2.9	40
7148873	Total (Dry Wt) Selenium (Se)	2021/01/10	NC	40
7148873	Total (Dry Wt) Silver (Ag)	2021/01/10	NC	40
7148873	Total (Dry Wt) Sodium (Na)	2021/01/10	9.6	40
7148873	Total (Dry Wt) Strontium (Sr)	2021/01/10	3.7	40
7148873	Total (Dry Wt) Thallium (Tl)	2021/01/10	NC	40
7148873	Total (Dry Wt) Tin (Sn)	2021/01/10	NC	40
7148873	Total (Dry Wt) Titanium (Ti)	2021/01/10	NC	40
7148873	Total (Dry Wt) Uranium (U)	2021/01/10	NC	40
7148873	Total (Dry Wt) Vanadium (V)	2021/01/10	NC	40
7148873	Total (Dry Wt) Zinc (Zn)	2021/01/10	7.5	40

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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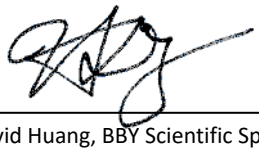
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



David Huang, BBY Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Stantec Consulting	Company Name:	Quotation #:	X Regular TAT (5 business days) Most analyses
Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's Nl x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: ###	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-6, -7, -2	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS (Total Metals) Well / Surface water	RCAP-MS (Dissolved Metals) Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (tissue): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (tissue): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.Coli (Count)				HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	Bt-1	9/5/2020		tissue									x													do not pre-weight
2	Bt-2	9/5/2020		tissue									x													do not pre-weight
3	Bt-3	9/5/2020		tissue									x													do not pre-weight
4	Bt-4	9/5/2020		tissue									x													do not pre-weight
5	Bt-5	9/5/2020		tissue									x													do not pre-weight
6	Bt-6	9/5/2020		tissue									x													do not pre-weight
7	Bt-7	9/5/2020		tissue									x													do not pre-weight
8	Bt-8	9/5/2020		tissue									x													do not pre-weight
9	Bt-9	9/5/2020		tissue									x													do not pre-weight
10	Bt-10	9/5/2020		tissue									x													do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	8:00	C0V9779

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CHAIN OF CUSTODY RECORD

COC #:

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Company Name:	Stantec Consulting	Company Name:		Quotation #:		X Regular TAT (5 business days) Most analyses
Contact Name:	Barry Wicks	Contact Name:		Purchase Order#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
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	St. John's Nl x PC:	PC:		Site Location:		IF RUSH please specify date (Surcharges will be applied)
Phone:	###	Phone:		Site Province:		DATE REQUIRED:
Email:	barry.wicks@stantec.com	Email:		Site #:		
Report Copies:		Report Copies:		Sampled By:		

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-6 -7 -2	
		/ /	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS [Total Metals] Well / Surface water	RCAP-MS [Dissolved Metals] Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (tissue): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (tissue): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.coli (Count)				HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	Bt-11	9/5/2020		tissue									x														do not pre-weight
2	Bt-12	9/5/2020		tissue									x														do not pre-weight
3	Bt-13	9/5/2020		tissue									x														do not pre-weight
4	Bt-14	9/5/2020		tissue									x														do not pre-weight
5	Bt-15	9/5/2020		tissue									x														do not pre-weight
6	Bt-16	9/7/2020		tissue									x														do not pre-weight
7	Bt-17	9/9/2020		tissue									x														do not pre-weight
8	Bt-18	9/9/2020		tissue									x														do not pre-weight
9	Bt-19	9/9/2020		tissue									x														do not pre-weight
10	Bt-20	9/9/2020		tissue									x														do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
			[illegible signature]	NOV 30 2020	9:00	C0V9779

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465 George Street,Unit G,Sydney, NS B1P 1K5 Tel: 902-567-1255 Fax: 902-539-8504 Toll Free: 1-888-535-7770
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St. John's Nl x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: ###	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-6, -7, -2	

COOLING MEDIA PRESENT Y / N

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Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS [Total Metals] Well / Surface water	RCAP-MS [Dissolved Metals] Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (tissue): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (tissue): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.Coli (Count)				HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	Bt-21	9/9/2020		tissue									x													do not pre-weight
2	Bt-22	9/9/2020		tissue									x													do not pre-weight
3	Bt-23	9/9/2020		tissue									x													do not pre-weight
4	Bt-24	9/9/2020		tissue									x													do not pre-weight
5	Bt-25	9/9/2020		tissue									x													do not pre-weight
6	Bt-26	9/9/2020		tissue									x													do not pre-weight
7	Bt-27	9/9/2020		tissue									x													do not pre-weight
8	Bt-28	9/9/2020		tissue									x													do not pre-weight
9	Bt-29	9/9/2020		tissue									x													do not pre-weight
10	Bt-30	9/9/2020		tissue									x													do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	9:00	C0V9779

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CHAIN OF CUSTODY RECORD

COC #:

Page _4 of 9

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required
Company Name:	Stantec Consulting	Company Name:		Quotation #:		X Regular TAT (5 business days) Most analyses
Contact Name:	Barry Wicks	Contact Name:		Purchase Order#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	141 Kelsey Dr	Address:		Project #:		IF RUSH please specify date (Surcharges will be applied)
	St. John's Nl x PC:		PC:	Site Location:		
Phone:	(709)576-1458	Phone:		Site Province:		DATE REQUIRED:
Email:	barry.wicks@stantec.com	Email:		Site #:		
Report Copies:		Report Copies:		Sampled By:		

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		6, 7, 2	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

#	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS [Total Metals] Well / Surface water	RCAP-MS [Dissolved Metals] Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (tissue): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (tissue): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.Coli (Count)				HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	Bt-31	9/9/2020		tissue									x														do not pre-weight
2	Bt-32	9/9/2020		tissue									x														do not pre-weight
3	Bt-33	9/9/2020		tissue									x														do not pre-weight
4	Bt-34	9/9/2020		tissue									x														do not pre-weight
5	Bt-35	9/9/2020		tissue									x														do not pre-weight
6	Bt-36	9/9/2020		tissue									x														do not pre-weight
7	Bt-37	9/11/2020		tissue									x														do not pre-weight
8	Bt-38	9/11/2020		tissue									x														do not pre-weight
9	Bt-39	9/11/2020		tissue									x														do not pre-weight
10	Bt-40	9/11/2020		tissue									x														do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
			[signature]	NOV 30 2020	700	C0V9779

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200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax: 902-420-8612 Toll Free: 1-800-565-7227
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Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's NI x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

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CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		6.7,2	

COOLING MEDIA PRESENT Y / N

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Analysis Requested

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1	Bt-41	9/11/2020		tissue									x													do not pre-weight
2	Bt-42	9/11/2020		tissue									x													do not pre-weight
3	Bt-43	9/11/2020		tissue									x													do not pre-weight
4	Bt-44	9/11/2020		tissue									x													do not pre-weight
5	Bt-45	9/11/2020		tissue									x													do not pre-weight
6	Bt-46	9/11/2020		tissue									x													do not pre-weight
7	Bt-47	9/29/2020		tissue									x													do not pre-weight
8	Bt-48	9/29/2020		tissue									x													do not pre-weight
9	Bt-49	9/29/2020		tissue									x													do not pre-weight
10	Bt-50	9/29/2020		tissue									x													do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
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St. John's NI x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		6.7.2	

COOLING MEDIA PRESENT Y / N

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1	Bt-51	9/29/2020		tissue									x													do not pre-weight
2	SH-T1	9/7/2020		tissue									x													do not pre-weight
3	SH-T2	9/10/2020		tissue									x													do not pre-weight
4	SH-T3	9/10/2020		tissue									x													do not pre-weight
5	SH-T4	10/20/2020		tissue									x													do not pre-weight
6	SH-T5	10/20/2020		tissue									x													do not pre-weight
7	SH-T6	10/20/2020		tissue									x													do not pre-weight
8	SH-T7	11/7/2020		tissue									x													do not pre-weight
9	SH-T8	11/8/2020		tissue									x													do not pre-weight
10	SH-IO1	9/7/2020		organs									x													do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
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Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-6, 7, 2	

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1	SH-IO2	9/10/2020		organs									x													do not pre-weight
2	SH-IO3	9/10/2020		organs									x													do not pre-weight
3	SH-IO4	10/20/2020		organs									x													do not pre-weight
4	SH-IO5	10/20/2020		organs									x													do not pre-weight
5	SH-IO6	10/20/2020		organs									x													do not pre-weight
6	SH-IO7	11/7/2020		organs									x													do not pre-weight
7	SH-IO8	11/8/2020		organs									x													do not pre-weight
8	LT-1	9/5/2020		organic									x													do not pre-weight
9	LT-2	9/6/2020		organic									x													do not pre-weight
10	LT-3	9/7/2020		organic									x													do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	700	C0V9779

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White: Maxxam Pink: Client

200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax: 902-420-8612 Toll Free: 1-800-565-7227
49-55 Elizabeth Avenue, St John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
465 George Street, Unit G, Sydney, NS B1P 1K5 Tel: 902-567-1255 Fax: 902-539-6504 Toll Free: 1-888-535-7770
www.bvlabs.com E-mail: customerservicebedford@bvlabs.com

CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Stantec Consulting	Company Name:	Quotation #:	X Regular TAT (5 business days) Most analyses
Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's Nl x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		6.7.2	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS [Total Metals] Well / Surface water	RCAP-MS [Dissolved Metals] Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (tissue): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (tissue): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.Coli (Count)				HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	Lt-4	9/8/2020		organic									x													do not pre-weight
2	Lt-5	9/10/2020		organic									x													do not pre-weight
3	Lt-6	9/10/2020		organic									x													do not pre-weight
4	Lt-7	9/10/2020		organic									x													do not pre-weight
5	Lt-8	9/10/2020		organic									x													do not pre-weight
6	Lt-9	9/10/2020		organic									x													do not pre-weight
7	Lt-10	9/11/2020		organic									x													do not pre-weight
8	Lt-dup			organic									x													do not pre-weight
9	BB-1	11/7/2020		organic									x													do not pre-weight
10	BB-2	11/8/2020		organic									x													do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	900	C0V9779

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White: Maxxam Pink: Client

200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax: 902-420-8612 Toll Free: 1-800-565-7227
49-55 Elizabeth Avenue, St John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
465 George Street,Unit G,Sydney, NS B1P 1K5 Tel: 902-567-1255 Fax: 902-539-6504 Toll Free: 1-888-535-7770
www.bvlabs.com E-mail: customerservicebedford@bvlabs.com

CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Stantec Consulting	Company Name:	Quotation #:	X Regular TAT (5 business days) Most analyses
Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's NI x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-6.7.2	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS (Total Metals) Well / Surface water	RCAP-MS (Dissolved Metals) Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (tissue): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (tissue): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.Coli (Count)				HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	BB-3	9/8/2020		organic									x													do not pre-weight
2	BB-4	9/8/2020		organic									x													do not pre-weight
3	BB-5	9/8/2020		organic									x													do not pre-weight
4	BB-6	9/8/2020		organic									x													do not pre-weight
5	BB-7	9/8/2020		organic									x													do not pre-weight
6	BB-8	9/8/2020		organic									x													do not pre-weight
7	BB-9	9/8/2020		organic									x													do not pre-weight
8	BB-10	9/8/2020		organic									x													do not pre-weight
9	BB-dup			organic									x													do not pre-weight
10																										

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	900	C0V9779

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White: Maxxam Pink: Client

Your Project #: 121416288
Your C.O.C. #: n/a

Attention: Barry Wicks

Stantec Consulting Ltd
141 Kelsey Drive
St. John's, NL
CANADA A1B 0L2

Report Date: 2020/12/10
Report #: R6444235
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C0W4941
Received: 2020/12/01, 09:55

Sample Matrix: Soil
Samples Received: 22

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Metals Solids Acid Extr. ICPMS	22	2020/12/09	2020/12/10	ATL SOP 00058	EPA 6020B R2 m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Heather Macumber, Senior Project Manager
Email: Heather.MACUMBER@bvlabs.com
Phone# (902)420-0203 Ext:226

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This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		OIR770	OIR771		OIR772	OIR772		OIR773		
Sampling Date		2020/09/05	2020/09/06		2020/09/07	2020/09/07		2020/09/08		
COC Number		n/a	n/a		n/a	n/a		n/a		
	UNITS	**LT-1**	**LT-2**	**QC Batch**	**LT-3**	**LT-3 Lab-Dup**	**QC Batch**	**LT-4**	**RDL**	**QC Batch**
Metals										
Acid Extractable Aluminum (Al)	mg/kg	350	600	7099631	12000	13000	7099641	3800	10	7099631
Acid Extractable Antimony (Sb)	mg/kg	<2.0	<2.0	7099631	<2.0	<2.0	7099641	<2.0	2.0	7099631
Acid Extractable Arsenic (As)	mg/kg	<2.0	<2.0	7099631	21	21	7099641	<2.0	2.0	7099631
Acid Extractable Barium (Ba)	mg/kg	16	23	7099631	9.3	9.2	7099641	59	5.0	7099631
Acid Extractable Beryllium (Be)	mg/kg	<2.0	<2.0	7099631	<2.0	<2.0	7099641	<2.0	2.0	7099631
Acid Extractable Bismuth (Bi)	mg/kg	<2.0	<2.0	7099631	<2.0	<2.0	7099641	<2.0	2.0	7099631
Acid Extractable Boron (B)	mg/kg	<50	<50	7099631	<50	<50	7099641	<50	50	7099631
Acid Extractable Cadmium (Cd)	mg/kg	0.37	0.37	7099631	<0.30	<0.30	7099641	0.41	0.30	7099631
Acid Extractable Chromium (Cr)	mg/kg	<2.0	<2.0	7099631	11	12	7099641	2.5	2.0	7099631
Acid Extractable Cobalt (Co)	mg/kg	<1.0	<1.0	7099631	2.9	3.1	7099641	1.3	1.0	7099631
Acid Extractable Copper (Cu)	mg/kg	<2.0	7.7	7099631	8.3	8.9	7099641	6.3	2.0	7099631
Acid Extractable Iron (Fe)	mg/kg	350	580	7099631	21000	23000	7099641	8000	50	7099631
Acid Extractable Lead (Pb)	mg/kg	21	12	7099631	5.7	5.9	7099641	23	0.50	7099631
Acid Extractable Lithium (Li)	mg/kg	<2.0	<2.0	7099631	3.2	3.5	7099641	<2.0	2.0	7099631
Acid Extractable Manganese (Mn)	mg/kg	58	320	7099631	130	140	7099641	280	2.0	7099631
Acid Extractable Mercury (Hg)	mg/kg	0.23	0.27	7099631	0.11	<0.10	7099641	0.20	0.10	7099631
Acid Extractable Molybdenum (Mo)	mg/kg	<2.0	<2.0	7099631	<2.0	<2.0	7099641	<2.0	2.0	7099631
Acid Extractable Nickel (Ni)	mg/kg	<2.0	<2.0	7099631	5.0	5.2	7099641	2.8	2.0	7099631
Acid Extractable Rubidium (Rb)	mg/kg	<2.0	2.1	7099631	2.6	2.8	7099641	<2.0	2.0	7099631
Acid Extractable Selenium (Se)	mg/kg	0.72	<0.50	7099631	0.52	0.62	7099641	0.55	0.50	7099631
Acid Extractable Silver (Ag)	mg/kg	<0.50	<0.50	7099631	<0.50	<0.50	7099641	<0.50	0.50	7099631
Acid Extractable Strontium (Sr)	mg/kg	16	13	7099631	<5.0	<5.0	7099641	12	5.0	7099631
Acid Extractable Thallium (Tl)	mg/kg	<0.10	<0.10	7099631	<0.10	<0.10	7099641	<0.10	0.10	7099631
Acid Extractable Tin (Sn)	mg/kg	1.2	1.3	7099631	<1.0	<1.0	7099641	1.1	1.0	7099631
Acid Extractable Uranium (U)	mg/kg	<0.10	<0.10	7099631	0.23	0.27	7099641	0.12	0.10	7099631
Acid Extractable Vanadium (V)	mg/kg	<2.0	<2.0	7099631	43	45	7099641	10	2.0	7099631
Acid Extractable Zinc (Zn)	mg/kg	16	31	7099631	18	19	7099641	34	5.0	7099631

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvlabs.com

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		OIR774		OIR775	OIR776	OIR777	OIR778	OIR779		
Sampling Date		2020/09/10		2020/09/10	2020/09/10	2020/09/10	2020/09/10	2020/09/11		
COC Number		n/a		n/a	n/a	n/a	n/a	n/a		
	UNITS	**LT-5**	**QC Batch**	**LT-6**	**LT-7**	**LT-8**	**LT-9**	**LT-10**	**RDL**	**QC Batch**
Metals										
Acid Extractable Aluminum (Al)	mg/kg	1700	7099631	1500	4000	200	2800	6800	10	7099641
Acid Extractable Antimony (Sb)	mg/kg	<2.0	7099631	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Arsenic (As)	mg/kg	3.4	7099631	<2.0	2.1	<2.0	3.8	6.1	2.0	7099641
Acid Extractable Barium (Ba)	mg/kg	39	7099631	28	45	17	37	380	5.0	7099641
Acid Extractable Beryllium (Be)	mg/kg	<2.0	7099631	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Bismuth (Bi)	mg/kg	<2.0	7099631	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Boron (B)	mg/kg	<50	7099631	<50	<50	<50	<50	<50	50	7099641
Acid Extractable Cadmium (Cd)	mg/kg	0.40	7099631	<0.30	<0.30	<0.30	<0.30	0.71	0.30	7099641
Acid Extractable Chromium (Cr)	mg/kg	<2.0	7099631	<2.0	<2.0	<2.0	<2.0	8.5	2.0	7099641
Acid Extractable Cobalt (Co)	mg/kg	20	7099631	1.4	1.8	<1.0	4.8	4.1	1.0	7099641
Acid Extractable Copper (Cu)	mg/kg	6.5	7099631	3.1	8.0	3.8	4.1	28	2.0	7099641
Acid Extractable Iron (Fe)	mg/kg	9900	7099631	1700	7500	230	15000	12000	50	7099641
Acid Extractable Lead (Pb)	mg/kg	11	7099631	9.4	19	9.0	14	47	0.50	7099641
Acid Extractable Lithium (Li)	mg/kg	<2.0	7099631	<2.0	<2.0	<2.0	<2.0	4.5	2.0	7099641
Acid Extractable Manganese (Mn)	mg/kg	1500	7099631	190	130	620	580	440	2.0	7099641
Acid Extractable Mercury (Hg)	mg/kg	0.16	7099631	<0.10	0.20	0.19	0.13	0.28	0.10	7099641
Acid Extractable Molybdenum (Mo)	mg/kg	<2.0	7099631	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Nickel (Ni)	mg/kg	2.5	7099631	<2.0	2.3	<2.0	2.2	9.3	2.0	7099641
Acid Extractable Rubidium (Rb)	mg/kg	<2.0	7099631	<2.0	2.0	<2.0	<2.0	3.2	2.0	7099641
Acid Extractable Selenium (Se)	mg/kg	<0.50	7099631	<0.50	0.58	<0.50	<0.50	0.52	0.50	7099641
Acid Extractable Silver (Ag)	mg/kg	<0.50	7099631	<0.50	<0.50	<0.50	<0.50	1.1	0.50	7099641
Acid Extractable Strontium (Sr)	mg/kg	32	7099631	28	30	14	20	31	5.0	7099641
Acid Extractable Thallium (Tl)	mg/kg	<0.10	7099631	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7099641
Acid Extractable Tin (Sn)	mg/kg	1.3	7099631	1.4	1.3	<1.0	<1.0	<1.0	1.0	7099641
Acid Extractable Uranium (U)	mg/kg	0.11	7099631	<0.10	0.20	<0.10	0.17	0.33	0.10	7099641
Acid Extractable Vanadium (V)	mg/kg	8.8	7099631	<2.0	5.7	<2.0	10	19	2.0	7099641
Acid Extractable Zinc (Zn)	mg/kg	34	7099631	21	25	29	18	110	5.0	7099641

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		OIR780	OIR781	OIR782	OIR783	OIR784	OIR785		
Sampling Date		2020/09/10	2020/11/07	2020/11/08	2020/09/08	2020/09/08	2020/09/08		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	**LT-DUP**	**BB-1**	**BB-2**	**BB-3**	**BB-4**	**BB-5**	**RDL**	**QC Batch**
Metals									
Acid Extractable Aluminum (Al)	mg/kg	2400	2200	2900	1100	350	280	10	7099641
Acid Extractable Antimony (Sb)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Arsenic (As)	mg/kg	2.2	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Barium (Ba)	mg/kg	140	54	<5.0	120	22	30	5.0	7099641
Acid Extractable Beryllium (Be)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Bismuth (Bi)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Boron (B)	mg/kg	<50	<50	<50	<50	<50	<50	50	7099641
Acid Extractable Cadmium (Cd)	mg/kg	0.55	0.57	0.40	0.58	<0.30	0.48	0.30	7099641
Acid Extractable Chromium (Cr)	mg/kg	2.4	<2.0	3.7	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Cobalt (Co)	mg/kg	1.5	<1.0	2.1	<1.0	<1.0	<1.0	1.0	7099641
Acid Extractable Copper (Cu)	mg/kg	5.5	7.4	<2.0	4.3	3.5	3.9	2.0	7099641
Acid Extractable Iron (Fe)	mg/kg	3900	2600	4100	900	380	320	50	7099641
Acid Extractable Lead (Pb)	mg/kg	19	53	15	27	9.2	17	0.50	7099641
Acid Extractable Lithium (Li)	mg/kg	<2.0	<2.0	2.6	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Manganese (Mn)	mg/kg	430	23	47	150	96	36	2.0	7099641
Acid Extractable Mercury (Hg)	mg/kg	0.31	0.37	<0.10	0.43	0.31	0.32	0.10	7099641
Acid Extractable Molybdenum (Mo)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Nickel (Ni)	mg/kg	3.6	2.4	4.0	2.7	<2.0	2.4	2.0	7099641
Acid Extractable Rubidium (Rb)	mg/kg	3.3	2.2	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Selenium (Se)	mg/kg	<0.50	0.84	<0.50	0.63	<0.50	<0.50	0.50	7099641
Acid Extractable Silver (Ag)	mg/kg	1.6	<0.50	<0.50	1.3	0.64	0.68	0.50	7099641
Acid Extractable Strontium (Sr)	mg/kg	31	61	<5.0	33	12	14	5.0	7099641
Acid Extractable Thallium (Tl)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7099641
Acid Extractable Tin (Sn)	mg/kg	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	1.0	7099641
Acid Extractable Uranium (U)	mg/kg	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	0.10	7099641
Acid Extractable Vanadium (V)	mg/kg	9.3	4.9	6.8	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Zinc (Zn)	mg/kg	190	30	17	47	55	56	5.0	7099641

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

BV Labs ID		OIR786	OIR787	OIR788	OIR789	OIR790	OIR791		
Sampling Date		2020/09/08	2020/09/08	2020/09/08	2020/09/08	2020/09/08	2020/09/08		
COC Number		n/a	n/a	n/a	n/a	n/a	n/a		
	UNITS	**BB-6**	**BB-7**	**BB-8**	**BB-9**	**BB-10**	**BB-DUP**	**RDL**	**QC Batch**
Metals									
Acid Extractable Aluminum (Al)	mg/kg	570	300	460	890	1000	2700	10	7099641
Acid Extractable Antimony (Sb)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Arsenic (As)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Barium (Ba)	mg/kg	58	41	35	140	69	10	5.0	7099641
Acid Extractable Beryllium (Be)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Bismuth (Bi)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Boron (B)	mg/kg	<50	<50	<50	<50	<50	<50	50	7099641
Acid Extractable Cadmium (Cd)	mg/kg	<0.30	<0.30	<0.30	0.56	<0.30	<0.30	0.30	7099641
Acid Extractable Chromium (Cr)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	3.3	2.0	7099641
Acid Extractable Cobalt (Co)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	1.0	7099641
Acid Extractable Copper (Cu)	mg/kg	5.2	3.9	4.0	4.5	4.9	2.7	2.0	7099641
Acid Extractable Iron (Fe)	mg/kg	990	350	540	980	1800	4300	50	7099641
Acid Extractable Lead (Pb)	mg/kg	19	25	27	31	22	14	0.50	7099641
Acid Extractable Lithium (Li)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Manganese (Mn)	mg/kg	440	240	91	290	340	44	2.0	7099641
Acid Extractable Mercury (Hg)	mg/kg	0.34	0.31	0.46	0.35	0.33	<0.10	0.10	7099641
Acid Extractable Molybdenum (Mo)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	7099641
Acid Extractable Nickel (Ni)	mg/kg	<2.0	2.2	2.1	2.4	2.7	2.9	2.0	7099641
Acid Extractable Rubidium (Rb)	mg/kg	<2.0	<2.0	<2.0	2.4	<2.0	<2.0	2.0	7099641
Acid Extractable Selenium (Se)	mg/kg	<0.50	<0.50	0.67	<0.50	<0.50	<0.50	0.50	7099641
Acid Extractable Silver (Ag)	mg/kg	<0.50	<0.50	0.56	1.2	0.67	<0.50	0.50	7099641
Acid Extractable Strontium (Sr)	mg/kg	11	15	14	21	15	8.2	5.0	7099641
Acid Extractable Thallium (Tl)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7099641
Acid Extractable Tin (Sn)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	7099641
Acid Extractable Uranium (U)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	0.10	7099641
Acid Extractable Vanadium (V)	mg/kg	2.1	<2.0	2.2	2.0	2.9	6.8	2.0	7099641
Acid Extractable Zinc (Zn)	mg/kg	65	79	51	89	45	11	5.0	7099641

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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TEST SUMMARY

BV Labs ID: OIR770 **Collected:** 2020/09/05
Sample ID: LT-1 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099631	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR771 **Collected:** 2020/09/06
Sample ID: LT-2 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099631	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR772 **Collected:** 2020/09/07
Sample ID: LT-3 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR772 Dup **Collected:** 2020/09/07
Sample ID: LT-3 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR773 **Collected:** 2020/09/08
Sample ID: LT-4 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099631	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR774 **Collected:** 2020/09/10
Sample ID: LT-5 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099631	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR775 **Collected:** 2020/09/10
Sample ID: LT-6 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

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TEST SUMMARY

BV Labs ID: OIR776
Sample ID: LT-7
Matrix: Soil
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR777
Sample ID: LT-8
Matrix: Soil
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR778
Sample ID: LT-9
Matrix: Soil
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR779
Sample ID: LT-10
Matrix: Soil
Collected: 2020/09/11
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR780
Sample ID: LT-DUP
Matrix: Soil
Collected: 2020/09/10
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR781
Sample ID: BB-1
Matrix: Soil
Collected: 2020/11/07
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR782
Sample ID: BB-2
Matrix: Soil
Collected: 2020/11/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

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TEST SUMMARY

BV Labs ID: OIR783 **Collected:** 2020/09/08
Sample ID: BB-3 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR784 **Collected:** 2020/09/08
Sample ID: BB-4 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR785 **Collected:** 2020/09/08
Sample ID: BB-5 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR786 **Collected:** 2020/09/08
Sample ID: BB-6 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR787 **Collected:** 2020/09/08
Sample ID: BB-7 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR788 **Collected:** 2020/09/08
Sample ID: BB-8 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR789 **Collected:** 2020/09/08
Sample ID: BB-9 **Shipped:**
Matrix: Soil **Received:** 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

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TEST SUMMARY

BV Labs ID: OIR790
Sample ID: BB-10
Matrix: Soil

Collected: 2020/09/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

BV Labs ID: OIR791
Sample ID: BB-DUP
Matrix: Soil

Collected: 2020/09/08
Shipped:
Received: 2020/12/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals Solids Acid Extr. ICPMS	ICP/MS	7099641	2020/12/09	2020/12/10	Bryon Angevine

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	-13.7°C

Mercury analyzed past recommended hold time.

Results relate only to the items tested.

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			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7099631	Acid Extractable Aluminum (Al)	2020/12/10					<10	mg/kg	0.55	35
7099631	Acid Extractable Antimony (Sb)	2020/12/10	90	75 - 125	107	75 - 125	<2.0	mg/kg	NC	35
7099631	Acid Extractable Arsenic (As)	2020/12/10	110	75 - 125	100	75 - 125	<2.0	mg/kg	1.9	35
7099631	Acid Extractable Barium (Ba)	2020/12/10	NC	75 - 125	103	75 - 125	<5.0	mg/kg	5.7	35
7099631	Acid Extractable Beryllium (Be)	2020/12/10	112	75 - 125	103	75 - 125	<2.0	mg/kg	NC	35
7099631	Acid Extractable Bismuth (Bi)	2020/12/10	108	75 - 125	102	75 - 125	<2.0	mg/kg	NC	35
7099631	Acid Extractable Boron (B)	2020/12/10	101	75 - 125	100	75 - 125	<50	mg/kg	NC	35
7099631	Acid Extractable Cadmium (Cd)	2020/12/10	107	75 - 125	99	75 - 125	<0.30	mg/kg	0.64	35
7099631	Acid Extractable Chromium (Cr)	2020/12/10	108	75 - 125	97	75 - 125	<2.0	mg/kg	0.23	35
7099631	Acid Extractable Cobalt (Co)	2020/12/10	107	75 - 125	99	75 - 125	<1.0	mg/kg	0.39	35
7099631	Acid Extractable Copper (Cu)	2020/12/10	NC	75 - 125	96	75 - 125	<2.0	mg/kg	0.19	35
7099631	Acid Extractable Iron (Fe)	2020/12/10					<50	mg/kg	1.3	35
7099631	Acid Extractable Lead (Pb)	2020/12/10	NC	75 - 125	101	75 - 125	<0.50	mg/kg	0.095	35
7099631	Acid Extractable Lithium (Li)	2020/12/10	123	75 - 125	105	75 - 125	<2.0	mg/kg	2.1	35
7099631	Acid Extractable Manganese (Mn)	2020/12/10	NC	75 - 125	99	75 - 125	<2.0	mg/kg	2.3	35
7099631	Acid Extractable Mercury (Hg)	2020/12/10	107	75 - 125	107	75 - 125	<0.10	mg/kg	5.0	35
7099631	Acid Extractable Molybdenum (Mo)	2020/12/10	NC	75 - 125	103	75 - 125	<2.0	mg/kg	1.6	35
7099631	Acid Extractable Nickel (Ni)	2020/12/10	109	75 - 125	100	75 - 125	<2.0	mg/kg	0.46	35
7099631	Acid Extractable Rubidium (Rb)	2020/12/10	104	75 - 125	100	75 - 125	<2.0	mg/kg	0.66	35
7099631	Acid Extractable Selenium (Se)	2020/12/10	106	75 - 125	100	75 - 125	<0.50	mg/kg	7.4	35
7099631	Acid Extractable Silver (Ag)	2020/12/10	NC	75 - 125	101	75 - 125	<0.50	mg/kg	0.17	35
7099631	Acid Extractable Strontium (Sr)	2020/12/10	NC	75 - 125	102	75 - 125	<5.0	mg/kg	1.3	35
7099631	Acid Extractable Thallium (Tl)	2020/12/10	108	75 - 125	101	75 - 125	<0.10	mg/kg	1.8	35
7099631	Acid Extractable Tin (Sn)	2020/12/10	NC	75 - 125	104	75 - 125	<1.0	mg/kg	2.7	35
7099631	Acid Extractable Uranium (U)	2020/12/10	111	75 - 125	102	75 - 125	<0.10	mg/kg	1.9	35
7099631	Acid Extractable Vanadium (V)	2020/12/10	NC	75 - 125	98	75 - 125	<2.0	mg/kg	1.2	35
7099631	Acid Extractable Zinc (Zn)	2020/12/10	NC	75 - 125	102	75 - 125	<5.0	mg/kg	0.69	35
7099641	Acid Extractable Aluminum (Al)	2020/12/10					<10	mg/kg	4.1	35
7099641	Acid Extractable Antimony (Sb)	2020/12/10	111	75 - 125	105	75 - 125	<2.0	mg/kg	NC	35
7099641	Acid Extractable Arsenic (As)	2020/12/10	109	75 - 125	101	75 - 125	<2.0	mg/kg	2.7	35
7099641	Acid Extractable Barium (Ba)	2020/12/10	114	75 - 125	102	75 - 125	<5.0	mg/kg	0.91	35
7099641	Acid Extractable Beryllium (Be)	2020/12/10	113	75 - 125	101	75 - 125	<2.0	mg/kg	NC	35
7099641	Acid Extractable Bismuth (Bi)	2020/12/10	108	75 - 125	101	75 - 125	<2.0	mg/kg	NC	35

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			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7099641	Acid Extractable Boron (B)	2020/12/10	99	75 - 125	103	75 - 125	<50	mg/kg	NC	35
7099641	Acid Extractable Cadmium (Cd)	2020/12/10	106	75 - 125	99	75 - 125	<0.30	mg/kg	NC	35
7099641	Acid Extractable Chromium (Cr)	2020/12/10	110	75 - 125	99	75 - 125	<2.0	mg/kg	4.4	35
7099641	Acid Extractable Cobalt (Co)	2020/12/10	107	75 - 125	101	75 - 125	<1.0	mg/kg	7.6	35
7099641	Acid Extractable Copper (Cu)	2020/12/10	106	75 - 125	97	75 - 125	<2.0	mg/kg	7.3	35
7099641	Acid Extractable Iron (Fe)	2020/12/10					<50	mg/kg	6.7	35
7099641	Acid Extractable Lead (Pb)	2020/12/10	111	75 - 125	102	75 - 125	<0.50	mg/kg	3.5	35
7099641	Acid Extractable Lithium (Li)	2020/12/10	119	75 - 125	104	75 - 125	<2.0	mg/kg	9.9	35
7099641	Acid Extractable Manganese (Mn)	2020/12/10	NC	75 - 125	98	75 - 125	<2.0	mg/kg	5.9	35
7099641	Acid Extractable Mercury (Hg)	2020/12/10	106	75 - 125	107	75 - 125	<0.10	mg/kg	7.0	35
7099641	Acid Extractable Molybdenum (Mo)	2020/12/10	116	75 - 125	105	75 - 125	<2.0	mg/kg	NC	35
7099641	Acid Extractable Nickel (Ni)	2020/12/10	107	75 - 125	100	75 - 125	<2.0	mg/kg	3.9	35
7099641	Acid Extractable Rubidium (Rb)	2020/12/10	106	75 - 125	100	75 - 125	<2.0	mg/kg	4.5	35
7099641	Acid Extractable Selenium (Se)	2020/12/10	104	75 - 125	101	75 - 125	<0.50	mg/kg	17	35
7099641	Acid Extractable Silver (Ag)	2020/12/10	109	75 - 125	99	75 - 125	<0.50	mg/kg	NC	35
7099641	Acid Extractable Strontium (Sr)	2020/12/10	114	75 - 125	104	75 - 125	<5.0	mg/kg	NC	35
7099641	Acid Extractable Thallium (Tl)	2020/12/10	110	75 - 125	99	75 - 125	<0.10	mg/kg	NC	35
7099641	Acid Extractable Tin (Sn)	2020/12/10	106	75 - 125	104	75 - 125	<1.0	mg/kg	NC	35
7099641	Acid Extractable Uranium (U)	2020/12/10	112	75 - 125	102	75 - 125	<0.10	mg/kg	17	35
7099641	Acid Extractable Vanadium (V)	2020/12/10	117	75 - 125	100	75 - 125	<2.0	mg/kg	3.4	35
7099641	Acid Extractable Zinc (Zn)	2020/12/10	108	75 - 125	100	75 - 125	<5.0	mg/kg	6.6	35

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Mike MacGillivray, Scientific Specialist (Inorganics)

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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ATL FCD 00149 / 25

CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Stantec Consulting	Company Name:	Quotation #:	X Regular TAT (5 business days) Most analyses
Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's NI x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-13,13,15	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS (Total Metals) Well / Surface water	RCAP-MS (Dissolved Metals) Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (soil): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (soil): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.coli (Count)					HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	LT-1	9/5/2020		organic									x														do not pre-weight
2	LT-2	9/6/2020		organic									x														do not pre-weight
3	LT-3	9/7/2020		organic									x														do not pre-weight
4	LT-4	9/8/2020		organic									x														do not pre-weight
5	LT-5	9/10/2020		organic									x														do not pre-weight
6	LT-6	9/10/2020		organic									x														do not pre-weight
7	LT-7	9/10/2020		organic									x														do not pre-weight
8	LT-8	9/10/2020		organic									x														do not pre-weight
9	LT-9	9/10/2020		organic									x														do not pre-weight
10	LT-10	9/11/2020		organic									x														do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	900	C0W4941

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200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax: 902-420-8612 Toll Free: 1-800-565-7227
49-55 Elizabeth Avenue, St John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
465 George Street, Unit G, Sydney, NS B1P 1K5 Tel: 902-567-1255 Fax: 902-539-6504 Toll Free: 1-888-535-7770
www.bvlabs.com E-mail: customerservicebedford@bvlabs.com

CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Stantec Consulting	Company Name:	Quotation #:	X Regular TAT (5 business days) Most analyses
Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's Nl x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

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CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-13, -13, -15	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS [Total Metals] Well / Surface water	RCAP-MS [Dissolved Metals] Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (soil): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (soil): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS-PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.coli (Count)					HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	Lt_dup			organic									x														do not pre-weight
2	BB-1	11/7/2020		organic									x														do not pre-weight
3	BB-2	11/8/2020		organic									x														do not pre-weight
4	BB-3	9/8/2020		organic									x														do not pre-weight
5	BB-4	9/8/2020		organic									x														do not pre-weight
6	BB-5	9/8/2020		organic									x														do not pre-weight
7	BB-6	9/8/2020		organic									x														do not pre-weight
8	BB-7	9/8/2020		organic									x														do not pre-weight
9	BB-8	9/8/2020		organic									x														do not pre-weight
10	BB-9	9/8/2020											x														do not pre-weight

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	700	C0W4941

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200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax: 902-420-8612 Toll Free: 1-800-565-7227
49-55 Elizabeth Avenue, St John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
465 George Street,Unit G,Sydney, NS B1P 1K5 Tel: 902-567-1255 Fax: 902-539-6504 Toll Free: 1-888-535-7770
www.bvlabs.com E-mail: customerservicebedford@bvlabs.com

CHAIN OF CUSTODY RECORD

COC #:

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Stantec Consulting	Company Name:	Quotation #:	X Regular TAT (5 business days) Most analyses
Contact Name: Barry Wicks	Contact Name:	Purchase Order#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 141 Kelsey Dr	Address:	Project #:	IF RUSH please specify date (Surcharges will be applied)
St. John's NL x PC:	PC:	Site Location:	DATE REQUIRED:
Phone: (709)576-1458	Phone:	Site Province:	
Email: barry.wicks@stantec.com	Email:	Site #:	
Report Copies:	Report Copies:	Sampled By:	

Laboratory Use Only

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES	COOLER TEMPERATURES
		-13, -13, -15	

COOLING MEDIA PRESENT Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED &PRESERVED	LAB FILTRATION REQUIRED	RCAP-MS (Total Metals) Well / Surface water	RCAP-MS (Dissolved Metals) Ground waters	Metals (Water): Total Digest (Default Method) for well water & surface water	Metals (Water): Dissolved for ground water	Metals (Water): Mercury (CIRCLE) TOTAL / DISSOLVED	Metals (soil): Metals & Mercury Default Acid Extractable (Available) Digest	Metals (soil): Hot Water Soluble Boron (required for CCME Agricultural/ Landfill)	RBCA Hydrocarbons (BTEX, C6-C32)	CCME Hydrocarbons (CWS:PHC F1/BTEX, F2-F4)	PAHs (Default for water/soil)	PAHs (FWAL /CCME Sediment)	PCBs - Select One: Default or CCME Sediment	VOCs	Total Coliform/E.coli (Presence/Absence)	Total Coliform/E.Coli (Count)					HOLD- DO NOT ANALYZE	Regulatory Requirements (Specify) / COMMENTS
1	BB-10	9/8/2020		organic									x														do not pre-weight
2	BB-dup			organic									x														do not pre-weight
3																											
4																											
5																											
6																											
7																											
8																											
9																											
10																											

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY:(Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV LABS JOB #
				NOV 30 2020	930	C0W4941

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ATTACHMENT B

ProUCL Outputs: Snowshoe Hare - Tissue

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:34:33 PM
From File	Snowshoe Hare - Tissue, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Aluminum, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.37	Minimum Non-Detect	0.2
Maximum Detect	7.69	Maximum Non-Detect	0.2
Variance Detects	7.19	Percent Non-Detects	12.5%
Mean Detects	1.711	SD Detects	2.681
Median Detects	0.43	CV Detects	1.567
Skewness Detects	2.473	Kurtosis Detects	6.24
Mean of Logged Detects	-0.154	SD of Logged Detects	1.121

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.587	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.356	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.523	KM Standard Error of Mean	0.907
KM SD	2.375	95% KM (BCA) UCL	3.186
95% KM (t) UCL	3.241	95% KM (Percentile Bootstrap) UCL	3.223
95% KM (z) UCL	3.015	95% KM Bootstrap t UCL	13.51
90% KM Chebyshev UCL	4.244	95% KM Chebyshev UCL	5.477
97.5% KM Chebyshev UCL	7.188	99% KM Chebyshev UCL	10.55

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.954	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.733	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.313	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.321	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:34:33 PM
From File	Snowshoe Hare - Tissue, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Aluminum, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	0.852	k star (bias corrected MLE)	0.582
Theta hat (MLE)	2.01	Theta star (bias corrected MLE)	2.941
nu hat (MLE)	11.92	nu star (bias corrected)	8.146
Mean (detects)	1.711		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.499
Maximum	7.69	Median	0.43
SD	2.554	CV	1.704
k hat (MLE)	0.56	k star (bias corrected MLE)	0.433
Theta hat (MLE)	2.677	Theta star (bias corrected MLE)	3.459
nu hat (MLE)	8.958	nu star (bias corrected)	6.932
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (6.93, α)	2.133	Adjusted Chi Square Value (6.93, β)	1.526
95% Gamma Approximate UCL (use when n>=50)	4.87	95% Gamma Adjusted UCL (use when n<50)	6.81

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.523	SD (KM)	2.375
Variance (KM)	5.643	SE of Mean (KM)	0.907
k hat (KM)	0.411	k star (KM)	0.34
nu hat (KM)	6.573	nu star (KM)	5.441
theta hat (KM)	3.706	theta star (KM)	4.477
80% gamma percentile (KM)	2.398	90% gamma percentile (KM)	4.416
95% gamma percentile (KM)	6.684	99% gamma percentile (KM)	12.49

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.44, α)	1.361	Adjusted Chi Square Value (5.44, β)	0.914
95% Gamma Approximate KM-UCL (use when n>=50)	6.085	95% Gamma Adjusted KM-UCL (use when n<50)	9.064

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:34:33 PM
From File	Snowshoe Hare - Tissue, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Aluminum, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.302	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.505	Mean in Log Scale	-0.479
SD in Original Scale	2.55	SD in Log Scale	1.386
95% t UCL (assumes normality of ROS data)	3.214	95% Percentile Bootstrap UCL	3.163
95% BCA Bootstrap UCL	4.01	95% Bootstrap t UCL	11.96
95% H-UCL (Log ROS)	16.52		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.336	KM Geo Mean	0.715
KM SD (logged)	1.084	95% Critical H Value (KM-Log)	3.636
KM Standard Error of Mean (logged)	0.414	95% H-UCL (KM -Log)	5.703
KM SD (logged)	1.084	95% Critical H Value (KM-Log)	3.636
KM Standard Error of Mean (logged)	0.414		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.51	Mean in Log Scale	-0.423
SD in Original Scale	2.547	SD in Log Scale	1.286
95% t UCL (Assumes normality)	3.216	95% H-Stat UCL	11.36

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Bootstrap t UCL	13.51	a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	9.064

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:34:33 PM
From File	Snowshoe Hare - Tissue, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Aluminum, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:35:18 PM
From File	Snowshoe Hare - Tissue, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Antimony, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	6
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0015	Minimum Non-Detect	0.001
Maximum Detect	0.0019	Maximum Non-Detect	0.001
Variance Detects	8.0000E-8	Percent Non-Detects	75%
Mean Detects	0.0017	SD Detects	2.8284E-4
Median Detects	0.0017	CV Detects	0.166
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-6.384	SD of Logged Detects	0.167

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00118	KM Standard Error of Mean	1.5959E-4
KM SD	3.1918E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00148	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00144	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00165	95% KM Chebyshev UCL	0.00187
97.5% KM Chebyshev UCL	0.00217	99% KM Chebyshev UCL	0.00276

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	71.92	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.3639E-5	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	287.7	nu star (bias corrected)	N/A
Mean (detects)	0.0017		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:35:18 PM
From File	Snowshoe Hare - Tissue, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Antimony, mg/kg - ww

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00118	SD (KM)	3.1918E-4
Variance (KM)	1.0188E-7	SE of Mean (KM)	1.5959E-4
k hat (KM)	13.55	k star (KM)	8.553
nu hat (KM)	216.8	nu star (KM)	136.9
theta hat (KM)	8.6702E-5	theta star (KM)	1.3737E-4
80% gamma percentile (KM)	0.00149	90% gamma percentile (KM)	0.00171
95% gamma percentile (KM)	0.0019	99% gamma percentile (KM)	0.0023

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0195
Approximate Chi Square Value (136.85, α)	110.8	Adjusted Chi Square Value (136.85, β)	104.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.00145	95% Gamma Adjusted KM-UCL (use when n<50)	0.00153

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.7498E-4	Mean in Log Scale	-7.043
SD in Original Scale	5.0106E-4	SD in Log Scale	0.5
95% t UCL (assumes normality of ROS data)	0.00131	95% Percentile Bootstrap UCL	0.00125
95% BCA Bootstrap UCL	0.00131	95% Bootstrap t UCL	0.00153
95% H-UCL (Log ROS)	0.00154		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.777	KM Geo Mean	0.00114
KM SD (logged)	0.234	95% Critical H Value (KM-Log)	1.98
KM Standard Error of Mean (logged)	0.117	95% H-UCL (KM -Log)	0.0014
KM SD (logged)	0.234	95% Critical H Value (KM-Log)	1.98
KM Standard Error of Mean (logged)	0.117		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	8.0000E-4	Mean in Log Scale	-7.297
SD in Original Scale	5.6569E-4	SD in Log Scale	0.567
95% t UCL (Assumes normality)	0.00118	95% H-Stat UCL	0.00135

DL/2 is not a recommended method, provided for comparisons and historical reasons

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:35:18 PM
From File	Snowshoe Hare - Tissue, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Antimony, mg/kg - ww

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00148	KM H-UCL	0.0014
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:36:02 PM
From File	Snowshoe Hare - Tissue, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Arsenic, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0047	Mean	0.0154
Maximum	0.0319	Median	0.013
SD	0.00891	Std. Error of Mean	0.00315
Coefficient of Variation	0.579	Skewness	0.819

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.182	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0214	95% Adjusted-CLT UCL (Chen-1995)	0.0215
		95% Modified-t UCL (Johnson-1978)	0.0215

Gamma GOF Test

A-D Test Statistic	0.169	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.296	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.343	k star (bias corrected MLE)	2.173
Theta hat (MLE)	0.0046	Theta star (bias corrected MLE)	0.00708
nu hat (MLE)	53.48	nu star (bias corrected)	34.76
MLE Mean (bias corrected)	0.0154	MLE Sd (bias corrected)	0.0104
		Approximate Chi Square Value (0.05)	22.27
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	19.78

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:36:02 PM
From File	Snowshoe Hare - Tissue, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Arsenic, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.024	95% Adjusted Gamma UCL (use when n<50)	0.027

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.148	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.36	Mean of logged Data	-4.331
Maximum of Logged Data	-3.445	SD of logged Data	0.619

Assuming Lognormal Distribution

95% H-UCL	0.0291	90% Chebyshev (MVUE) UCL	0.0258
95% Chebyshev (MVUE) UCL	0.0305	97.5% Chebyshev (MVUE) UCL	0.037
99% Chebyshev (MVUE) UCL	0.0497		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0206	95% Jackknife UCL	0.0214
95% Standard Bootstrap UCL	0.0203	95% Bootstrap-t UCL	0.0229
95% Hall's Bootstrap UCL	0.0224	95% Percentile Bootstrap UCL	0.0205
95% BCA Bootstrap UCL	0.021		
90% Chebyshev(Mean, Sd) UCL	0.0248	95% Chebyshev(Mean, Sd) UCL	0.0291
97.5% Chebyshev(Mean, Sd) UCL	0.0351	99% Chebyshev(Mean, Sd) UCL	0.0467

Suggested UCL to Use

95% Student's-t UCL	0.0214

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:36:45 PM
From File	Snowshoe Hare - Tissue, Barium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Barium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.02	Mean	0.157
Maximum	0.639	Median	0.121
SD	0.202	Std. Error of Mean	0.0714
Coefficient of Variation	1.286	Skewness	2.443

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.655	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.292	95% Adjusted-CLT UCL (Chen-1995)	0.34
		95% Modified-t UCL (Johnson-1978)	0.302

Gamma GOF Test

A-D Test Statistic	0.52	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.257	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.301	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.028	k star (bias corrected MLE)	0.726
Theta hat (MLE)	0.153	Theta star (bias corrected MLE)	0.216
nu hat (MLE)	16.44	nu star (bias corrected)	11.61
MLE Mean (bias corrected)	0.157	MLE Sd (bias corrected)	0.184
		Approximate Chi Square Value (0.05)	4.971
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3.93

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:36:45 PM
From File	Snowshoe Hare - Tissue, Barium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Barium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.367	95% Adjusted Gamma UCL (use when n<50)	0.464

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.194	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.912	Mean of logged Data	-2.411
Maximum of Logged Data	-0.448	SD of logged Data	1.119

Assuming Lognormal Distribution

95% H-UCL	0.812	90% Chebyshev (MVUE) UCL	0.333
95% Chebyshev (MVUE) UCL	0.416	97.5% Chebyshev (MVUE) UCL	0.531
99% Chebyshev (MVUE) UCL	0.756		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.274	95% Jackknife UCL	0.292
95% Standard Bootstrap UCL	0.266	95% Bootstrap-t UCL	0.505
95% Hall's Bootstrap UCL	0.765	95% Percentile Bootstrap UCL	0.285
95% BCA Bootstrap UCL	0.316		
90% Chebyshev(Mean, Sd) UCL	0.371	95% Chebyshev(Mean, Sd) UCL	0.468
97.5% Chebyshev(Mean, Sd) UCL	0.603	99% Chebyshev(Mean, Sd) UCL	0.867

Suggested UCL to Use

95% Adjusted Gamma UCL	0.464

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:37:28 PM
From File	Snowshoe Hare - Tissue, Beryllium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Beryllium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Tissue, Beryllium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:38:11 PM
From File	Snowshoe Hare - Tissue, Bismuth, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Bismuth, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Tissue, Bismuth, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:38:54 PM
From File	Snowshoe Hare - Tissue, Boron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Boron, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	7
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Tissue, Boron, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:39:37 PM
From File	Snowshoe Hare - Tissue, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Cadmium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.0012	Minimum Non-Detect	0.001
Maximum Detect	0.0086	Maximum Non-Detect	0.001
Variance Detects	6.8681E-6	Percent Non-Detects	12.5%
Mean Detects	0.00311	SD Detects	0.00262
Median Detects	0.0022	CV Detects	0.842
Skewness Detects	1.931	Kurtosis Detects	3.861
Mean of Logged Detects	-6.007	SD of Logged Detects	0.699

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.765	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.262	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00285	KM Standard Error of Mean	9.0692E-4
KM SD	0.00237	95% KM (BCA) UCL	0.0045
95% KM (t) UCL	0.00457	95% KM (Percentile Bootstrap) UCL	0.00435
95% KM (z) UCL	0.00434	95% KM Bootstrap t UCL	0.00736
90% KM Chebyshev UCL	0.00557	95% KM Chebyshev UCL	0.0068
97.5% KM Chebyshev UCL	0.00851	99% KM Chebyshev UCL	0.0119

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.446	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.714	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.315	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:39:37 PM
From File	Snowshoe Hare - Tissue, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Cadmium, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	2.278	k star (bias corrected MLE)	1.397
Theta hat (MLE)	0.00137	Theta star (bias corrected MLE)	0.00223
nu hat (MLE)	31.89	nu star (bias corrected)	19.56
Mean (detects)	0.00311		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0012	Mean	0.00398
Maximum	0.01	Median	0.0025
SD	0.00344	CV	0.865
k hat (MLE)	1.793	k star (bias corrected MLE)	1.204
Theta hat (MLE)	0.00222	Theta star (bias corrected MLE)	0.0033
nu hat (MLE)	28.69	nu star (bias corrected)	19.26
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (19.26, α)	10.31	Adjusted Chi Square Value (19.26, β)	8.703
95% Gamma Approximate UCL (use when n>=50)	0.00743	95% Gamma Adjusted UCL (use when n<50)	0.0088

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00285	SD (KM)	0.00237
Variance (KM)	5.6400E-6	SE of Mean (KM)	9.0692E-4
k hat (KM)	1.44	k star (KM)	0.983
nu hat (KM)	23.04	nu star (KM)	15.73
theta hat (KM)	0.00198	theta star (KM)	0.0029
80% gamma percentile (KM)	0.00459	90% gamma percentile (KM)	0.00659
95% gamma percentile (KM)	0.00859	99% gamma percentile (KM)	0.0132

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (15.73, α)	7.776	Adjusted Chi Square Value (15.73, β)	6.413
95% Gamma Approximate KM-UCL (use when n>=50)	0.00577	95% Gamma Adjusted KM-UCL (use when n<50)	0.00699

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:39:37 PM
From File	Snowshoe Hare - Tissue, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Cadmium, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00278	Mean in Log Scale	-6.224
SD in Original Scale	0.0026	SD in Log Scale	0.892
95% t UCL (assumes normality of ROS data)	0.00452	95% Percentile Bootstrap UCL	0.00423
95% BCA Bootstrap UCL	0.00476	95% Bootstrap t UCL	0.00678
95% H-UCL (Log ROS)	0.00856		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.12	KM Geo Mean	0.0022
KM SD (logged)	0.675	95% Critical H Value (KM-Log)	2.683
KM Standard Error of Mean (logged)	0.258	95% H-UCL (KM -Log)	0.00548
KM SD (logged)	0.675	95% Critical H Value (KM-Log)	2.683
KM Standard Error of Mean (logged)	0.258		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00279	Mean in Log Scale	-6.206
SD in Original Scale	0.0026	SD in Log Scale	0.858
95% t UCL (Assumes normality)	0.00453	95% H-Stat UCL	0.00793

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00457

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:39:37 PM
From File	Snowshoe Hare - Tissue, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Cadmium, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:40:21 PM
From File	Snowshoe Hare - Tissue, Calcium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Calcium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	49.2	Mean	68.05
Maximum	109	Median	64.75
SD	18.61	Std. Error of Mean	6.581
Coefficient of Variation	0.274	Skewness	1.713

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	80.52	95% Adjusted-CLT UCL (Chen-1995)	83.13
		95% Modified-t UCL (Johnson-1978)	81.18

Gamma GOF Test

A-D Test Statistic	0.39	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.91	k star (bias corrected MLE)	11.27
Theta hat (MLE)	3.8	Theta star (bias corrected MLE)	6.036
nu hat (MLE)	286.5	nu star (bias corrected)	180.4
MLE Mean (bias corrected)	68.05	MLE Sd (bias corrected)	20.27
		Approximate Chi Square Value (0.05)	150.3
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	143.4

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:40:21 PM
From File	Snowshoe Hare - Tissue, Calcium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Calcium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	81.66	95% Adjusted Gamma UCL (use when n<50)	85.62

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.187	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.896	Mean of logged Data	4.192
Maximum of Logged Data	4.691	SD of logged Data	0.245

Assuming Lognormal Distribution

95% H-UCL	82.02	90% Chebyshev (MVUE) UCL	85.64
95% Chebyshev (MVUE) UCL	93.67	97.5% Chebyshev (MVUE) UCL	104.8
99% Chebyshev (MVUE) UCL	126.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	78.87	95% Jackknife UCL	80.52
95% Standard Bootstrap UCL	78.32	95% Bootstrap-t UCL	88.55
95% Hall's Bootstrap UCL	131	95% Percentile Bootstrap UCL	78.69
95% BCA Bootstrap UCL	81.33		
90% Chebyshev(Mean, Sd) UCL	87.79	95% Chebyshev(Mean, Sd) UCL	96.73
97.5% Chebyshev(Mean, Sd) UCL	109.1	99% Chebyshev(Mean, Sd) UCL	133.5

Suggested UCL to Use

95% Student's-t UCL	80.52

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:41:04 PM
From File	Snowshoe Hare - Tissue, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Chromium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	4
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.012	Minimum Non-Detect	0.01
Maximum Detect	0.079	Maximum Non-Detect	0.01
Variance Detects	9.3267E-4	Percent Non-Detects	50%
Mean Detects	0.034	SD Detects	0.0305
Median Detects	0.0225	CV Detects	0.898
Skewness Detects	1.793	Kurtosis Detects	3.321
Mean of Logged Detects	-3.644	SD of Logged Detects	0.802

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.022	KM Standard Error of Mean	0.00907
KM SD	0.0222	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0392	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0369	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0492	95% KM Chebyshev UCL	0.0615
97.5% KM Chebyshev UCL	0.0787	99% KM Chebyshev UCL	0.112

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.387	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.302	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:41:04 PM
From File	Snowshoe Hare - Tissue, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Chromium, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	2.059	k star (bias corrected MLE)	0.681
Theta hat (MLE)	0.0165	Theta star (bias corrected MLE)	0.0499
nu hat (MLE)	16.47	nu star (bias corrected)	5.45
Mean (detects)	0.034		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.022
Maximum	0.079	Median	0.011
SD	0.0238	CV	1.08
k hat (MLE)	1.774	k star (bias corrected MLE)	1.192
Theta hat (MLE)	0.0124	Theta star (bias corrected MLE)	0.0185
nu hat (MLE)	28.38	nu star (bias corrected)	19.07
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (19.07, α)	10.17	Adjusted Chi Square Value (19.07, β)	8.574
95% Gamma Approximate UCL (use when n>=50)	0.0413	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.022	SD (KM)	0.0222
Variance (KM)	4.9375E-4	SE of Mean (KM)	0.00907
k hat (KM)	0.98	k star (KM)	0.696
nu hat (KM)	15.68	nu star (KM)	11.14
theta hat (KM)	0.0224	theta star (KM)	0.0316
80% gamma percentile (KM)	0.0362	90% gamma percentile (KM)	0.0553
95% gamma percentile (KM)	0.075	99% gamma percentile (KM)	0.122

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.14, α)	4.664	Adjusted Chi Square Value (11.14, β)	3.663
95% Gamma Approximate KM-UCL (use when n>=50)	0.0525	95% Gamma Adjusted KM-UCL (use when n<50)	0.0669

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:41:04 PM
From File	Snowshoe Hare - Tissue, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Chromium, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.253	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0182	Mean in Log Scale	-4.938
SD in Original Scale	0.0262	SD in Log Scale	1.568
95% t UCL (assumes normality of ROS data)	0.0358	95% Percentile Bootstrap UCL	0.0354
95% BCA Bootstrap UCL	0.0411	95% Bootstrap t UCL	0.0624
95% H-UCL (Log ROS)	0.454		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.124	KM Geo Mean	0.0162
KM SD (logged)	0.687	95% Critical H Value (KM-Log)	2.709
KM Standard Error of Mean (logged)	0.281	95% H-UCL (KM -Log)	0.0414
KM SD (logged)	0.687	95% Critical H Value (KM-Log)	2.709
KM Standard Error of Mean (logged)	0.281		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0195	Mean in Log Scale	-4.471
SD in Original Scale	0.0253	SD in Log Scale	1.029
95% t UCL (Assumes normality)	0.0364	95% H-Stat UCL	0.0756

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0392

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:41:47 PM
From File	Snowshoe Hare - Tissue, Cobalt, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Cobalt, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0045	Mean	0.00945
Maximum	0.0163	Median	0.00845
SD	0.00406	Std. Error of Mean	0.00144
Coefficient of Variation	0.43	Skewness	0.654

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.235	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0122	95% Adjusted-CLT UCL (Chen-1995)	0.0122
		95% Modified-t UCL (Johnson-1978)	0.0122

Gamma GOF Test

A-D Test Statistic	0.294	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.718	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.231	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.336	k star (bias corrected MLE)	4.043
Theta hat (MLE)	0.00149	Theta star (bias corrected MLE)	0.00234
nu hat (MLE)	101.4	nu star (bias corrected)	64.69
MLE Mean (bias corrected)	0.00945	MLE Sd (bias corrected)	0.0047
		Approximate Chi Square Value (0.05)	47.18
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	43.43

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:41:47 PM
From File	Snowshoe Hare - Tissue, Cobalt, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Cobalt, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.013	95% Adjusted Gamma UCL (use when n<50)	0.0141

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.404	Mean of logged Data	-4.743
Maximum of Logged Data	-4.117	SD of logged Data	0.433

Assuming Lognormal Distribution

95% H-UCL	0.0138	90% Chebyshev (MVUE) UCL	0.0138
95% Chebyshev (MVUE) UCL	0.0158	97.5% Chebyshev (MVUE) UCL	0.0185
99% Chebyshev (MVUE) UCL	0.0239		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0118	95% Jackknife UCL	0.0122
95% Standard Bootstrap UCL	0.0117	95% Bootstrap-t UCL	0.0128
95% Hall's Bootstrap UCL	0.0129	95% Percentile Bootstrap UCL	0.0118
95% BCA Bootstrap UCL	0.012		
90% Chebyshev(Mean, Sd) UCL	0.0138	95% Chebyshev(Mean, Sd) UCL	0.0157
97.5% Chebyshev(Mean, Sd) UCL	0.0184	99% Chebyshev(Mean, Sd) UCL	0.0237

Suggested UCL to Use

95% Student's-t UCL	0.0122

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:42:31 PM
From File	Snowshoe Hare - Tissue, Copper, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Copper, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	1.2	Mean	1.765
Maximum	2.31	Median	1.73
SD	0.362	Std. Error of Mean	0.128
Coefficient of Variation	0.205	Skewness	0.0307

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.119	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.008	95% Adjusted-CLT UCL (Chen-1995)	1.977
		95% Modified-t UCL (Johnson-1978)	2.008

Gamma GOF Test

A-D Test Statistic	0.174	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.131	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	26.31	k star (bias corrected MLE)	16.53
Theta hat (MLE)	0.0671	Theta star (bias corrected MLE)	0.107
nu hat (MLE)	420.9	nu star (bias corrected)	264.4
MLE Mean (bias corrected)	1.765	MLE Sd (bias corrected)	0.434
		Approximate Chi Square Value (0.05)	227.8
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	219.1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:42:31 PM
From File	Snowshoe Hare - Tissue, Copper, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Copper, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.049	95% Adjusted Gamma UCL (use when n<50)	2.13

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.134	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	0.549
Maximum of Logged Data	0.837	SD of logged Data	0.211

Assuming Lognormal Distribution

95% H-UCL	2.07	90% Chebyshev (MVUE) UCL	2.163
95% Chebyshev (MVUE) UCL	2.342	97.5% Chebyshev (MVUE) UCL	2.592
99% Chebyshev (MVUE) UCL	3.082		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.976	95% Jackknife UCL	2.008
95% Standard Bootstrap UCL	1.968	95% Bootstrap-t UCL	2.012
95% Hall's Bootstrap UCL	1.995	95% Percentile Bootstrap UCL	1.966
95% BCA Bootstrap UCL	1.968		
90% Chebyshev(Mean, Sd) UCL	2.149	95% Chebyshev(Mean, Sd) UCL	2.323
97.5% Chebyshev(Mean, Sd) UCL	2.565	99% Chebyshev(Mean, Sd) UCL	3.039

Suggested UCL to Use

95% Student's-t UCL	2.008

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:43:14 PM
From File	Snowshoe Hare - Tissue, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Iron, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	17.7	Mean	27.24
Maximum	35.9	Median	28.2
SD	6.309	Std. Error of Mean	2.231
Coefficient of Variation	0.232	Skewness	-0.241

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.203	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	31.46	95% Adjusted-CLT UCL (Chen-1995)	30.7
		95% Modified-t UCL (Johnson-1978)	31.43

Gamma GOF Test

A-D Test Statistic	0.309	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.227	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	19.98	k star (bias corrected MLE)	12.57
Theta hat (MLE)	1.363	Theta star (bias corrected MLE)	2.167
nu hat (MLE)	319.7	nu star (bias corrected)	201.1
MLE Mean (bias corrected)	27.24	MLE Sd (bias corrected)	7.682
		Approximate Chi Square Value (0.05)	169.3
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	161.9

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:43:14 PM
From File	Snowshoe Hare - Tissue, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Iron, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	32.36	95% Adjusted Gamma UCL (use when n<50)	33.83

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.219	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.874	Mean of logged Data	3.279
Maximum of Logged Data	3.581	SD of logged Data	0.245

Assuming Lognormal Distribution

95% H-UCL	32.91	90% Chebyshev (MVUE) UCL	34.36
95% Chebyshev (MVUE) UCL	37.58	97.5% Chebyshev (MVUE) UCL	42.04
99% Chebyshev (MVUE) UCL	50.81		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	30.91	95% Jackknife UCL	31.46
95% Standard Bootstrap UCL	30.66	95% Bootstrap-t UCL	30.99
95% Hall's Bootstrap UCL	30.33	95% Percentile Bootstrap UCL	30.56
95% BCA Bootstrap UCL	30.53		
90% Chebyshev(Mean, Sd) UCL	33.93	95% Chebyshev(Mean, Sd) UCL	36.96
97.5% Chebyshev(Mean, Sd) UCL	41.17	99% Chebyshev(Mean, Sd) UCL	49.43

Suggested UCL to Use

95% Student's-t UCL	31.46

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:43:14 PM
From File	Snowshoe Hare - Tissue, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Iron, mg/kg - ww

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:43:57 PM
From File	Snowshoe Hare - Tissue, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Lead, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0021	Mean	0.0106
Maximum	0.0477	Median	0.0041
SD	0.0154	Std. Error of Mean	0.00545
Coefficient of Variation	1.46	Skewness	2.564

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.6	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.322	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0209	95% Adjusted-CLT UCL (Chen-1995)	0.0248
		95% Modified-t UCL (Johnson-1978)	0.0217

Gamma GOF Test

A-D Test Statistic	0.809	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.736	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.302	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.991	k star (bias corrected MLE)	0.703
Theta hat (MLE)	0.0106	Theta star (bias corrected MLE)	0.015
nu hat (MLE)	15.85	nu star (bias corrected)	11.24
MLE Mean (bias corrected)	0.0106	MLE Sd (bias corrected)	0.0126
		Approximate Chi Square Value (0.05)	4.732
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3.722

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:43:57 PM
From File	Snowshoe Hare - Tissue, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Lead, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.0251	95% Adjusted Gamma UCL (use when n<50)	0.0319

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-6.166	Mean of logged Data	-5.135
Maximum of Logged Data	-3.043	SD of logged Data	1.025

Assuming Lognormal Distribution

95% H-UCL	0.0384	90% Chebyshev (MVUE) UCL	0.0193
95% Chebyshev (MVUE) UCL	0.0238	97.5% Chebyshev (MVUE) UCL	0.0302
99% Chebyshev (MVUE) UCL	0.0427		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0195	95% Jackknife UCL	0.0209
95% Standard Bootstrap UCL	0.019	95% Bootstrap-t UCL	0.0673
95% Hall's Bootstrap UCL	0.0561	95% Percentile Bootstrap UCL	0.0203
95% BCA Bootstrap UCL	0.0266		
90% Chebyshev(Mean, Sd) UCL	0.0269	95% Chebyshev(Mean, Sd) UCL	0.0343
97.5% Chebyshev(Mean, Sd) UCL	0.0446	99% Chebyshev(Mean, Sd) UCL	0.0647

Suggested UCL to Use

95% Adjusted Gamma UCL	0.0319

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:43:57 PM
From File	Snowshoe Hare - Tissue, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Lead, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:44:41 PM
From File	Snowshoe Hare - Tissue, Magnesium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Magnesium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	245	Mean	264.4
Maximum	287	Median	265
SD	12.42	Std. Error of Mean	4.391
Coefficient of Variation	0.047	Skewness	0.369

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	272.7	95% Adjusted-CLT UCL (Chen-1995)	272.2
		95% Modified-t UCL (Johnson-1978)	272.8

Gamma GOF Test

A-D Test Statistic	0.219	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.155	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	521.1	k star (bias corrected MLE)	325.8
Theta hat (MLE)	0.507	Theta star (bias corrected MLE)	0.812
nu hat (MLE)	8337	nu star (bias corrected)	5212
MLE Mean (bias corrected)	264.4	MLE Sd (bias corrected)	14.65
		Approximate Chi Square Value (0.05)	5045
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	5003

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:44:41 PM
From File	Snowshoe Hare - Tissue, Magnesium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Magnesium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	273.1	95% Adjusted Gamma UCL (use when n<50)	275.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.166	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.501	Mean of logged Data	5.576
Maximum of Logged Data	5.659	SD of logged Data	0.0468

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	277.5
95% Chebyshev (MVUE) UCL	283.4	97.5% Chebyshev (MVUE) UCL	291.7
99% Chebyshev (MVUE) UCL	307.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	271.6	95% Jackknife UCL	272.7
95% Standard Bootstrap UCL	271	95% Bootstrap-t UCL	273.4
95% Hall's Bootstrap UCL	275.1	95% Percentile Bootstrap UCL	271.8
95% BCA Bootstrap UCL	271.6		
90% Chebyshev(Mean, Sd) UCL	277.5	95% Chebyshev(Mean, Sd) UCL	283.5
97.5% Chebyshev(Mean, Sd) UCL	291.8	99% Chebyshev(Mean, Sd) UCL	308.1

Suggested UCL to Use

95% Student's-t UCL	272.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:45:24 PM
From File	Snowshoe Hare - Tissue, Manganese, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Manganese, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.261	Mean	4.57
Maximum	14.6	Median	2.87
SD	4.883	Std. Error of Mean	1.726
Coefficient of Variation	1.068	Skewness	1.452

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.85	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.841	95% Adjusted-CLT UCL (Chen-1995)	8.357
		95% Modified-t UCL (Johnson-1978)	7.988

Gamma GOF Test

A-D Test Statistic	0.146	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.126	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.302	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.914	k star (bias corrected MLE)	0.655
Theta hat (MLE)	4.999	Theta star (bias corrected MLE)	6.98
nu hat (MLE)	14.63	nu star (bias corrected)	10.47
MLE Mean (bias corrected)	4.57	MLE Sd (bias corrected)	5.648
		Approximate Chi Square Value (0.05)	4.241
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3.297

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:45:24 PM
From File	Snowshoe Hare - Tissue, Manganese, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Manganese, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.29	95% Adjusted Gamma UCL (use when n<50)	14.52

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.343	Mean of logged Data	0.881
Maximum of Logged Data	2.681	SD of logged Data	1.364

Assuming Lognormal Distribution

95% H-UCL	58.3	90% Chebyshev (MVUE) UCL	12.63
95% Chebyshev (MVUE) UCL	16.04	97.5% Chebyshev (MVUE) UCL	20.76
99% Chebyshev (MVUE) UCL	30.03		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7.41	95% Jackknife UCL	7.841
95% Standard Bootstrap UCL	7.238	95% Bootstrap-t UCL	11.12
95% Hall's Bootstrap UCL	21.99	95% Percentile Bootstrap UCL	7.508
95% BCA Bootstrap UCL	8.143		
90% Chebyshev(Mean, Sd) UCL	9.749	95% Chebyshev(Mean, Sd) UCL	12.09
97.5% Chebyshev(Mean, Sd) UCL	15.35	99% Chebyshev(Mean, Sd) UCL	21.75

Suggested UCL to Use

95% Student's-t UCL	7.841

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:46:07 PM
From File	Snowshoe Hare - Tissue, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Mercury, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	4
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.001
Maximum Detect	0.0027	Maximum Non-Detect	0.001
Variance Detects	4.4667E-7	Percent Non-Detects	50%
Mean Detects	0.0018	SD Detects	6.6833E-4
Median Detects	0.0017	CV Detects	0.371
Skewness Detects	0.844	Kurtosis Detects	1.5
Mean of Logged Detects	-6.371	SD of Logged Detects	0.37

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0014	KM Standard Error of Mean	2.3363E-4
KM SD	5.7228E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00184	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00178	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0021	95% KM Chebyshev UCL	0.00242
97.5% KM Chebyshev UCL	0.00286	99% KM Chebyshev UCL	0.00372

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.232	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:46:07 PM
From File	Snowshoe Hare - Tissue, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Mercury, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	9.93	k star (bias corrected MLE)	2.649
Theta hat (MLE)	1.8128E-4	Theta star (bias corrected MLE)	6.7948E-4
nu hat (MLE)	79.44	nu star (bias corrected)	21.19
Mean (detects)	0.0018		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.0059
Maximum	0.01	Median	0.00635
SD	0.0044	CV	0.747
k hat (MLE)	1.553	k star (bias corrected MLE)	1.054
Theta hat (MLE)	0.0038	Theta star (bias corrected MLE)	0.0056
nu hat (MLE)	24.84	nu star (bias corrected)	16.86
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (16.86, α)	8.572	Adjusted Chi Square Value (16.86, β)	7.129
95% Gamma Approximate UCL (use when n>=50)	0.0116	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0014	SD (KM)	5.7228E-4
Variance (KM)	3.2750E-7	SE of Mean (KM)	2.3363E-4
k hat (KM)	5.985	k star (KM)	3.824
nu hat (KM)	95.76	nu star (KM)	61.18
theta hat (KM)	2.3393E-4	theta star (KM)	3.6613E-4
80% gamma percentile (KM)	0.00194	90% gamma percentile (KM)	0.00236
95% gamma percentile (KM)	0.00275	99% gamma percentile (KM)	0.00357

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (61.18, α)	44.19	Adjusted Chi Square Value (61.18, β)	40.56
95% Gamma Approximate KM-UCL (use when n>=50)	0.00194	95% Gamma Adjusted KM-UCL (use when n<50)	0.00211

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:46:07 PM
From File	Snowshoe Hare - Tissue, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Mercury, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.988	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00117	Mean in Log Scale	-6.967
SD in Original Scale	8.1042E-4	SD in Log Scale	0.722
95% t UCL (assumes normality of ROS data)	0.00172	95% Percentile Bootstrap UCL	0.00162
95% BCA Bootstrap UCL	0.00169	95% Bootstrap t UCL	0.0019
95% H-UCL (Log ROS)	0.00261		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.639	KM Geo Mean	0.00131
KM SD (logged)	0.351	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.143	95% H-UCL (KM -Log)	0.00184
KM SD (logged)	0.351	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00115	Mean in Log Scale	-6.986
SD in Original Scale	8.2115E-4	SD in Log Scale	0.7
95% t UCL (Assumes normality)	0.0017	95% H-Stat UCL	0.00244

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00184

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:46:51 PM
From File	Snowshoe Hare - Tissue, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Molybdenum, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	4
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.0048	Minimum Non-Detect	0.004
Maximum Detect	0.0082	Maximum Non-Detect	0.004
Variance Detects	2.8292E-6	Percent Non-Detects	50%
Mean Detects	0.00638	SD Detects	0.00168
Median Detects	0.00625	CV Detects	0.264
Skewness Detects	0.165	Kurtosis Detects	-4.757
Mean of Logged Detects	-5.082	SD of Logged Detects	0.267

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.873	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00519	KM Standard Error of Mean	6.4175E-4
KM SD	0.00157	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0064	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00624	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00711	95% KM Chebyshev UCL	0.00798
97.5% KM Chebyshev UCL	0.0092	99% KM Chebyshev UCL	0.0116

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.438	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:46:51 PM
From File	Snowshoe Hare - Tissue, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Molybdenum, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	19.02	k star (bias corrected MLE)	4.922
Theta hat (MLE)	3.3515E-4	Theta star (bias corrected MLE)	0.0013
nu hat (MLE)	152.2	nu star (bias corrected)	39.38
Mean (detects)	0.00638		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0048	Mean	0.00819
Maximum	0.01	Median	0.0091
SD	0.00223	CV	0.272
k hat (MLE)	13.19	k star (bias corrected MLE)	8.328
Theta hat (MLE)	6.2067E-4	Theta star (bias corrected MLE)	9.8314E-4
nu hat (MLE)	211.1	nu star (bias corrected)	133.2
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (133.25, α)	107.6	Adjusted Chi Square Value (133.25, β)	101.7
95% Gamma Approximate UCL (use when n>=50)	0.0101	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00519	SD (KM)	0.00157
Variance (KM)	2.4711E-6	SE of Mean (KM)	6.4175E-4
k hat (KM)	10.89	k star (KM)	6.89
nu hat (KM)	174.2	nu star (KM)	110.2
theta hat (KM)	4.7636E-4	theta star (KM)	7.5295E-4
80% gamma percentile (KM)	0.00674	90% gamma percentile (KM)	0.00783
95% gamma percentile (KM)	0.00881	99% gamma percentile (KM)	0.0109

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (110.23, α)	87	Adjusted Chi Square Value (110.23, β)	81.79
95% Gamma Approximate KM-UCL (use when n>=50)	0.00657	95% Gamma Adjusted KM-UCL (use when n<50)	0.00699

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:46:51 PM
From File	Snowshoe Hare - Tissue, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Molybdenum, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00457	Mean in Log Scale	-5.498
SD in Original Scale	0.00226	SD in Log Scale	0.506
95% t UCL (assumes normality of ROS data)	0.00609	95% Percentile Bootstrap UCL	0.00587
95% BCA Bootstrap UCL	0.00595	95% Bootstrap t UCL	0.00667
95% H-UCL (Log ROS)	0.00731		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.302	KM Geo Mean	0.00498
KM SD (logged)	0.274	95% Critical H Value (KM-Log)	2.026
KM Standard Error of Mean (logged)	0.112	95% H-UCL (KM -Log)	0.00638
KM SD (logged)	0.274	95% Critical H Value (KM-Log)	2.026
KM Standard Error of Mean (logged)	0.112		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00419	Mean in Log Scale	-5.648
SD in Original Scale	0.00258	SD in Log Scale	0.63
95% t UCL (Assumes normality)	0.00592	95% H-Stat UCL	0.00797

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0064

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:47:35 PM
From File	Snowshoe Hare - Tissue, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Nickel, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	6
Number of Detects	6	Number of Non-Detects	2
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.013	Minimum Non-Detect	0.01
Maximum Detect	0.028	Maximum Non-Detect	0.01
Variance Detects	4.4800E-5	Percent Non-Detects	25%
Mean Detects	0.023	SD Detects	0.00669
Median Detects	0.0265	CV Detects	0.291
Skewness Detects	-1.002	Kurtosis Detects	-1.371
Mean of Logged Detects	-3.815	SD of Logged Detects	0.336

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.766	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.34	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0198	KM Standard Error of Mean	0.00299
KM SD	0.00773	95% KM (BCA) UCL	0.024
95% KM (t) UCL	0.0254	95% KM (Percentile Bootstrap) UCL	0.024
95% KM (z) UCL	0.0247	95% KM Bootstrap t UCL	0.0242
90% KM Chebyshev UCL	0.0287	95% KM Chebyshev UCL	0.0328
97.5% KM Chebyshev UCL	0.0384	99% KM Chebyshev UCL	0.0495

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.827	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.698	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.367	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.332	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:47:35 PM
From File	Snowshoe Hare - Tissue, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Nickel, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	11.83	k star (bias corrected MLE)	6.028
Theta hat (MLE)	0.00194	Theta star (bias corrected MLE)	0.00382
nu hat (MLE)	142	nu star (bias corrected)	72.33
Mean (detects)	0.023		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.02
Maximum	0.028	Median	0.021
SD	0.00798	CV	0.399
k hat (MLE)	6.515	k star (bias corrected MLE)	4.155
Theta hat (MLE)	0.00307	Theta star (bias corrected MLE)	0.00481
nu hat (MLE)	104.2	nu star (bias corrected)	66.48
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (66.48, α)	48.72	Adjusted Chi Square Value (66.48, β)	44.9
95% Gamma Approximate UCL (use when n>=50)	0.0273	95% Gamma Adjusted UCL (use when n<50)	0.0296

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0198	SD (KM)	0.00773
Variance (KM)	5.9688E-5	SE of Mean (KM)	0.00299
k hat (KM)	6.535	k star (KM)	4.168
nu hat (KM)	104.6	nu star (KM)	66.68
theta hat (KM)	0.00302	theta star (KM)	0.00474
80% gamma percentile (KM)	0.0271	90% gamma percentile (KM)	0.0327
95% gamma percentile (KM)	0.0379	99% gamma percentile (KM)	0.0489

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (66.68, α)	48.89	Adjusted Chi Square Value (66.68, β)	45.06
95% Gamma Approximate KM-UCL (use when n>=50)	0.0269	95% Gamma Adjusted KM-UCL (use when n<50)	0.0292

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:47:35 PM
From File	Snowshoe Hare - Tissue, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Nickel, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.757	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.355	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0199	Mean in Log Scale	-4.001
SD in Original Scale	0.0081	SD in Log Scale	0.449
95% t UCL (assumes normality of ROS data)	0.0253	95% Percentile Bootstrap UCL	0.0242
95% BCA Bootstrap UCL	0.0241	95% Bootstrap t UCL	0.0248
95% H-UCL (Log ROS)	0.0297		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.013	KM Geo Mean	0.0181
KM SD (logged)	0.433	95% Critical H Value (KM-Log)	2.245
KM Standard Error of Mean (logged)	0.168	95% H-UCL (KM -Log)	0.0287
KM SD (logged)	0.433	95% Critical H Value (KM-Log)	2.245
KM Standard Error of Mean (logged)	0.168		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0185	Mean in Log Scale	-4.186
SD in Original Scale	0.0101	SD in Log Scale	0.743
95% t UCL (Assumes normality)	0.0252	95% H-Stat UCL	0.0443

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0254	KM H-UCL	0.0287
95% KM (BCA) UCL	0.024		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:48:18 PM
From File	Snowshoe Hare - Tissue, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Phosphorus, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	2190	Mean	2355
Maximum	2570	Median	2345
SD	111.2	Std. Error of Mean	39.32
Coefficient of Variation	0.0472	Skewness	0.721

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2430	95% Adjusted-CLT UCL (Chen-1995)	2430
		95% Modified-t UCL (Johnson-1978)	2431

Gamma GOF Test

A-D Test Statistic	0.236	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	519.8	k star (bias corrected MLE)	325
Theta hat (MLE)	4.53	Theta star (bias corrected MLE)	7.247
nu hat (MLE)	8317	nu star (bias corrected)	5199
MLE Mean (bias corrected)	2355	MLE Sd (bias corrected)	130.6
		Approximate Chi Square Value (0.05)	5033
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	4991

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:48:18 PM
From File	Snowshoe Hare - Tissue, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Phosphorus, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2433	95% Adjusted Gamma UCL (use when n<50)	2453

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.153	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.692	Mean of logged Data	7.763
Maximum of Logged Data	7.852	SD of logged Data	0.0467

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	2472
95% Chebyshev (MVUE) UCL	2525	97.5% Chebyshev (MVUE) UCL	2598
99% Chebyshev (MVUE) UCL	2742		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2420	95% Jackknife UCL	2430
95% Standard Bootstrap UCL	2416	95% Bootstrap-t UCL	2443
95% Hall's Bootstrap UCL	2475	95% Percentile Bootstrap UCL	2418
95% BCA Bootstrap UCL	2423		
90% Chebyshev(Mean, Sd) UCL	2473	95% Chebyshev(Mean, Sd) UCL	2526
97.5% Chebyshev(Mean, Sd) UCL	2601	99% Chebyshev(Mean, Sd) UCL	2746

Suggested UCL to Use

95% Student's-t UCL	2430

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:49:02 PM
From File	Snowshoe Hare - Tissue, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Potassium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	3460	Mean	3523
Maximum	3680	Median	3495
SD	76.11	Std. Error of Mean	26.91
Coefficient of Variation	0.0216	Skewness	1.479

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.241	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3573	95% Adjusted-CLT UCL (Chen-1995)	3582
		95% Modified-t UCL (Johnson-1978)	3576

Gamma GOF Test

A-D Test Statistic	0.608	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.258	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2486	k star (bias corrected MLE)	1554
Theta hat (MLE)	1.417	Theta star (bias corrected MLE)	2.267
nu hat (MLE)	39780	nu star (bias corrected)	24864
MLE Mean (bias corrected)	3523	MLE Sd (bias corrected)	89.36
		Approximate Chi Square Value (0.05)	24498
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	24405

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:49:02 PM
From File	Snowshoe Hare - Tissue, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Potassium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3575	95% Adjusted Gamma UCL (use when n<50)	3589

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.838	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.239	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.149	Mean of logged Data	8.167
Maximum of Logged Data	8.211	SD of logged Data	0.0214

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	3602
95% Chebyshev (MVUE) UCL	3638	97.5% Chebyshev (MVUE) UCL	3689
99% Chebyshev (MVUE) UCL	3787		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3567	95% Jackknife UCL	3573
95% Standard Bootstrap UCL	3563	95% Bootstrap-t UCL	3615
95% Hall's Bootstrap UCL	3753	95% Percentile Bootstrap UCL	3566
95% BCA Bootstrap UCL	3576		
90% Chebyshev(Mean, Sd) UCL	3603	95% Chebyshev(Mean, Sd) UCL	3640
97.5% Chebyshev(Mean, Sd) UCL	3691	99% Chebyshev(Mean, Sd) UCL	3790

Suggested UCL to Use

95% Student's-t UCL	3573

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:49:46 PM
From File	Snowshoe Hare - Tissue, Selenium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Selenium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.052	Mean	0.13
Maximum	0.242	Median	0.115
SD	0.0811	Std. Error of Mean	0.0287
Coefficient of Variation	0.624	Skewness	0.338

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.833	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.184	95% Adjusted-CLT UCL (Chen-1995)	0.181
		95% Modified-t UCL (Johnson-1978)	0.185

Gamma GOF Test

A-D Test Statistic	0.698	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.271	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.757	k star (bias corrected MLE)	1.807
Theta hat (MLE)	0.0472	Theta star (bias corrected MLE)	0.072
nu hat (MLE)	44.12	nu star (bias corrected)	28.91
MLE Mean (bias corrected)	0.13	MLE Sd (bias corrected)	0.0968
		Approximate Chi Square Value (0.05)	17.63
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	15.45

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:49:46 PM
From File	Snowshoe Hare - Tissue, Selenium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Selenium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.213	95% Adjusted Gamma UCL (use when n<50)	0.243

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.825	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.957	Mean of logged Data	-2.231
Maximum of Logged Data	-1.419	SD of logged Data	0.678

Assuming Lognormal Distribution

95% H-UCL	0.269	90% Chebyshev (MVUE) UCL	0.226
95% Chebyshev (MVUE) UCL	0.269	97.5% Chebyshev (MVUE) UCL	0.329
99% Chebyshev (MVUE) UCL	0.447		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.177	95% Jackknife UCL	0.184
95% Standard Bootstrap UCL	0.174	95% Bootstrap-t UCL	0.193
95% Hall's Bootstrap UCL	0.172	95% Percentile Bootstrap UCL	0.175
95% BCA Bootstrap UCL	0.178		
90% Chebyshev(Mean, Sd) UCL	0.216	95% Chebyshev(Mean, Sd) UCL	0.255
97.5% Chebyshev(Mean, Sd) UCL	0.309	99% Chebyshev(Mean, Sd) UCL	0.416

Suggested UCL to Use

95% Student's-t UCL	0.184

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:50:29 PM
From File	Snowshoe Hare - Tissue, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Silver, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	3
Number of Detects	3	Number of Non-Detects	5
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.001
Maximum Detect	0.0014	Maximum Non-Detect	0.001
Variance Detects	3.0000E-8	Percent Non-Detects	62.5%
Mean Detects	0.0012	SD Detects	1.7321E-4
Median Detects	0.0011	CV Detects	0.144
Skewness Detects	1.732	Kurtosis Detects	N/A
Mean of Logged Detects	-6.732	SD of Logged Detects	0.139

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00108	KM Standard Error of Mean	5.6250E-5
KM SD	1.2990E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00118	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00117	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00124	95% KM Chebyshev UCL	0.00132
97.5% KM Chebyshev UCL	0.00143	99% KM Chebyshev UCL	0.00163

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:50:29 PM
From File	Snowshoe Hare - Tissue, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Silver, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	75.65	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.5863E-5	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	453.9	nu star (bias corrected)	N/A
Mean (detects)	0.0012		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.0067
Maximum	0.01	Median	0.01
SD	0.00456	CV	0.68
k hat (MLE)	1.402	k star (bias corrected MLE)	0.96
Theta hat (MLE)	0.00478	Theta star (bias corrected MLE)	0.00698
nu hat (MLE)	22.44	nu star (bias corrected)	15.36
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (15.36, α)	7.511	Adjusted Chi Square Value (15.36, β)	6.176
95% Gamma Approximate UCL (use when n>=50)	0.0137	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00108	SD (KM)	1.2990E-4
Variance (KM)	1.6875E-8	SE of Mean (KM)	5.6250E-5
k hat (KM)	68.48	k star (KM)	42.88
nu hat (KM)	1096	nu star (KM)	686.1
theta hat (KM)	1.5698E-5	theta star (KM)	2.5067E-5
80% gamma percentile (KM)	0.00121	90% gamma percentile (KM)	0.00129
95% gamma percentile (KM)	0.00136	99% gamma percentile (KM)	0.00149

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (686.15, α)	626.4	Adjusted Chi Square Value (686.15, β)	611.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.00118	95% Gamma Adjusted KM-UCL (use when n<50)	0.00121

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:50:29 PM
From File	Snowshoe Hare - Tissue, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Silver, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.0632E-4	Mean in Log Scale	-7.046
SD in Original Scale	2.7676E-4	SD in Log Scale	0.301
95% t UCL (assumes normality of ROS data)	0.00109	95% Percentile Bootstrap UCL	0.00106
95% BCA Bootstrap UCL	0.00108	95% Bootstrap t UCL	0.00114
95% H-UCL (Log ROS)	0.00115		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.842	KM Geo Mean	0.00107
KM SD (logged)	0.11	95% Critical H Value (KM-Log)	1.857
KM Standard Error of Mean (logged)	0.0476	95% H-UCL (KM -Log)	0.00116
KM SD (logged)	0.11	95% Critical H Value (KM-Log)	1.857
KM Standard Error of Mean (logged)	0.0476		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	7.6250E-4	Mean in Log Scale	-7.275
SD in Original Scale	3.7393E-4	SD in Log Scale	0.456
95% t UCL (Assumes normality)	0.00101	95% H-Stat UCL	0.00114

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00118

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:50:29 PM
From File	Snowshoe Hare - Tissue, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Silver, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:02:06 PM
From File	Snowshoe Hare - Tissue, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Sodium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	503	Mean	583.6
Maximum	715	Median	557.5
SD	74.87	Std. Error of Mean	26.47
Coefficient of Variation	0.128	Skewness	0.827

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.213	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	633.8	95% Adjusted-CLT UCL (Chen-1995)	635.4
		95% Modified-t UCL (Johnson-1978)	635.1

Gamma GOF Test

A-D Test Statistic	0.372	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.206	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.293	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	72.48	k star (bias corrected MLE)	45.38
Theta hat (MLE)	8.053	Theta star (bias corrected MLE)	12.86
nu hat (MLE)	1160	nu star (bias corrected)	726.1
MLE Mean (bias corrected)	583.6	MLE Sd (bias corrected)	86.64
		Approximate Chi Square Value (0.05)	664.6
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	649.6

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:02:06 PM
From File	Snowshoe Hare - Tissue, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Sodium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	637.7	95% Adjusted Gamma UCL (use when n<50)	652.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.195	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.221	Mean of logged Data	6.362
Maximum of Logged Data	6.572	SD of logged Data	0.124

Assuming Lognormal Distribution

95% H-UCL	637.8	90% Chebyshev (MVUE) UCL	660.6
95% Chebyshev (MVUE) UCL	695.6	97.5% Chebyshev (MVUE) UCL	744
99% Chebyshev (MVUE) UCL	839.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	627.2	95% Jackknife UCL	633.8
95% Standard Bootstrap UCL	623.8	95% Bootstrap-t UCL	653.1
95% Hall's Bootstrap UCL	635.1	95% Percentile Bootstrap UCL	627.3
95% BCA Bootstrap UCL	625.5		
90% Chebyshev(Mean, Sd) UCL	663	95% Chebyshev(Mean, Sd) UCL	699
97.5% Chebyshev(Mean, Sd) UCL	748.9	99% Chebyshev(Mean, Sd) UCL	847

Suggested UCL to Use

95% Student's-t UCL	633.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:02:49 PM
From File	Snowshoe Hare - Tissue, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Strontium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	0.027	Mean	0.0775
Maximum	0.112	Median	0.09
SD	0.0343	Std. Error of Mean	0.0121
Coefficient of Variation	0.442	Skewness	-0.688

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.263	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.1	95% Adjusted-CLT UCL (Chen-1995)	0.0943
		95% Modified-t UCL (Johnson-1978)	0.1

Gamma GOF Test

A-D Test Statistic	0.733	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.719	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.274	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.269	k star (bias corrected MLE)	2.751
Theta hat (MLE)	0.0182	Theta star (bias corrected MLE)	0.0282
nu hat (MLE)	68.3	nu star (bias corrected)	44.02
MLE Mean (bias corrected)	0.0775	MLE Sd (bias corrected)	0.0467
		Approximate Chi Square Value (0.05)	29.8
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	26.88

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:02:49 PM
From File	Snowshoe Hare - Tissue, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Strontium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.114	95% Adjusted Gamma UCL (use when n<50)	0.127

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.796	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.254	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.612	Mean of logged Data	-2.679
Maximum of Logged Data	-2.189	SD of logged Data	0.576

Assuming Lognormal Distribution

95% H-UCL	0.139	90% Chebyshev (MVUE) UCL	0.128
95% Chebyshev (MVUE) UCL	0.15	97.5% Chebyshev (MVUE) UCL	0.181
99% Chebyshev (MVUE) UCL	0.242		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0974	95% Jackknife UCL	0.1
95% Standard Bootstrap UCL	0.0961	95% Bootstrap-t UCL	0.0977
95% Hall's Bootstrap UCL	0.0926	95% Percentile Bootstrap UCL	0.0951
95% BCA Bootstrap UCL	0.0941		
90% Chebyshev(Mean, Sd) UCL	0.114	95% Chebyshev(Mean, Sd) UCL	0.13
97.5% Chebyshev(Mean, Sd) UCL	0.153	99% Chebyshev(Mean, Sd) UCL	0.198

Suggested UCL to Use

95% Student's-t UCL	0.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:02:49 PM
From File	Snowshoe Hare - Tissue, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Strontium, mg/kg - ww

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:03:33 PM
From File	Snowshoe Hare - Tissue, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Thallium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	2
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	4.3000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.001	Maximum Non-Detect	4.0000E-4
Variance Detects	5.7427E-8	Percent Non-Detects	25%
Mean Detects	6.9333E-4	SD Detects	2.3964E-4
Median Detects	6.8500E-4	CV Detects	0.346
Skewness Detects	0.132	Kurtosis Detects	-2.259
Mean of Logged Detects	-7.326	SD of Logged Detects	0.358

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.197	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.2000E-4	KM Standard Error of Mean	8.8339E-5
KM SD	2.2809E-4	95% KM (BCA) UCL	7.5000E-4
95% KM (t) UCL	7.8736E-4	95% KM (Percentile Bootstrap) UCL	7.6125E-4
95% KM (z) UCL	7.6530E-4	95% KM Bootstrap t UCL	8.1330E-4
90% KM Chebyshev UCL	8.8502E-4	95% KM Chebyshev UCL	0.00101
97.5% KM Chebyshev UCL	0.00117	99% KM Chebyshev UCL	0.0015

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.37	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.213	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:03:33 PM
From File	Snowshoe Hare - Tissue, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Thallium, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	9.728	k star (bias corrected MLE)	4.975
Theta hat (MLE)	7.1270E-5	Theta star (bias corrected MLE)	1.3936E-4
nu hat (MLE)	116.7	nu star (bias corrected)	59.7
Mean (detects)	6.9333E-4		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.3000E-4	Mean	0.00302
Maximum	0.01	Median	8.5000E-4
SD	0.00431	CV	1.428
k hat (MLE)	0.714	k star (bias corrected MLE)	0.53
Theta hat (MLE)	0.00423	Theta star (bias corrected MLE)	0.0057
nu hat (MLE)	11.43	nu star (bias corrected)	8.478
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (8.48, α)	3.015	Adjusted Chi Square Value (8.48, β)	2.253
95% Gamma Approximate UCL (use when n>=50)	0.00849	95% Gamma Adjusted UCL (use when n<50)	0.0114

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.2000E-4	SD (KM)	2.2809E-4
Variance (KM)	5.2025E-8	SE of Mean (KM)	8.8339E-5
k hat (KM)	7.389	k star (KM)	4.701
nu hat (KM)	118.2	nu star (KM)	75.22
theta hat (KM)	8.3911E-5	theta star (KM)	1.3188E-4
80% gamma percentile (KM)	8.3918E-4	90% gamma percentile (KM)	0.001
95% gamma percentile (KM)	0.00115	99% gamma percentile (KM)	0.00147

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (75.22, α)	56.25	Adjusted Chi Square Value (75.22, β)	52.11
95% Gamma Approximate KM-UCL (use when n>=50)	8.2917E-4	95% Gamma Adjusted KM-UCL (use when n<50)	8.9489E-4

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:03:33 PM
From File	Snowshoe Hare - Tissue, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Thallium, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.8682E-4	Mean in Log Scale	-7.553
SD in Original Scale	2.8322E-4	SD in Log Scale	0.522
95% t UCL (assumes normality of ROS data)	7.7654E-4	95% Percentile Bootstrap UCL	7.4247E-4
95% BCA Bootstrap UCL	7.5435E-4	95% Bootstrap t UCL	7.9834E-4
95% H-UCL (Log ROS)	9.6351E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.451	KM Geo Mean	5.8102E-4
KM SD (logged)	0.356	95% Critical H Value (KM-Log)	2.132
KM Standard Error of Mean (logged)	0.138	95% H-UCL (KM -Log)	8.2451E-4
KM SD (logged)	0.356	95% Critical H Value (KM-Log)	2.132
KM Standard Error of Mean (logged)	0.138		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	5.7000E-4	Mean in Log Scale	-7.624
SD in Original Scale	3.0524E-4	SD in Log Scale	0.629
95% t UCL (Assumes normality)	7.7446E-4	95% H-Stat UCL	0.0011

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 7.8736E-4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:04:16 PM
From File	Snowshoe Hare - Tissue, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Tin, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	3
Number of Detects	4	Number of Non-Detects	4
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.02	Minimum Non-Detect	0.02
Maximum Detect	0.039	Maximum Non-Detect	0.02
Variance Detects	8.0250E-5	Percent Non-Detects	50%
Mean Detects	0.0263	SD Detects	0.00896
Median Detects	0.023	CV Detects	0.341
Skewness Detects	1.469	Kurtosis Detects	1.758
Mean of Logged Detects	-3.679	SD of Logged Detects	0.315

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.261	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0231	KM Standard Error of Mean	0.00258
KM SD	0.00631	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.028	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0274	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0309	95% KM Chebyshev UCL	0.0344
97.5% KM Chebyshev UCL	0.0392	99% KM Chebyshev UCL	0.0488

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.47	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.299	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:04:16 PM
From File	Snowshoe Hare - Tissue, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Tin, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	12.86	k star (bias corrected MLE)	3.382
Theta hat (MLE)	0.00204	Theta star (bias corrected MLE)	0.00776
nu hat (MLE)	102.9	nu star (bias corrected)	27.05
Mean (detects)	0.0263		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0181
Maximum	0.039	Median	0.015
SD	0.0105	CV	0.578
k hat (MLE)	3.951	k star (bias corrected MLE)	2.553
Theta hat (MLE)	0.00459	Theta star (bias corrected MLE)	0.0071
nu hat (MLE)	63.21	nu star (bias corrected)	40.84
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (40.84, α)	27.2	Adjusted Chi Square Value (40.84, β)	24.42
95% Gamma Approximate UCL (use when n>=50)	0.0272	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0231	SD (KM)	0.00631
Variance (KM)	3.9859E-5	SE of Mean (KM)	0.00258
k hat (KM)	13.42	k star (KM)	8.469
nu hat (KM)	214.7	nu star (KM)	135.5
theta hat (KM)	0.00172	theta star (KM)	0.00273
80% gamma percentile (KM)	0.0294	90% gamma percentile (KM)	0.0337
95% gamma percentile (KM)	0.0376	99% gamma percentile (KM)	0.0455

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (135.50, α)	109.6	Adjusted Chi Square Value (135.50, β)	103.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.0286	95% Gamma Adjusted KM-UCL (use when n<50)	0.0302

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:04:16 PM
From File	Snowshoe Hare - Tissue, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Tin, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0179	Mean in Log Scale	-4.177
SD in Original Scale	0.0108	SD in Log Scale	0.604
95% t UCL (assumes normality of ROS data)	0.0252	95% Percentile Bootstrap UCL	0.0241
95% BCA Bootstrap UCL	0.0254	95% Bootstrap t UCL	0.0291
95% H-UCL (Log ROS)	0.0329		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.796	KM Geo Mean	0.0225
KM SD (logged)	0.225	95% Critical H Value (KM-Log)	1.97
KM Standard Error of Mean (logged)	0.092	95% H-UCL (KM -Log)	0.0273
KM SD (logged)	0.225	95% Critical H Value (KM-Log)	1.97
KM Standard Error of Mean (logged)	0.092		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0181	Mean in Log Scale	-4.142
SD in Original Scale	0.0105	SD in Log Scale	0.536
95% t UCL (Assumes normality)	0.0251	95% H-Stat UCL	0.0299

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.028

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:05:00 PM
From File	Snowshoe Hare - Tissue, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Titanium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.123	Mean	0.144
Maximum	0.215	Median	0.131
SD	0.031	Std. Error of Mean	0.011
Coefficient of Variation	0.215	Skewness	2.097

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.165	95% Adjusted-CLT UCL (Chen-1995)	0.171
		95% Modified-t UCL (Johnson-1978)	0.166

Gamma GOF Test

A-D Test Statistic	0.877	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.285	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	29.55	k star (bias corrected MLE)	18.55
Theta hat (MLE)	0.00488	Theta star (bias corrected MLE)	0.00778
nu hat (MLE)	472.7	nu star (bias corrected)	296.8
MLE Mean (bias corrected)	0.144	MLE Sd (bias corrected)	0.0335
		Approximate Chi Square Value (0.05)	257.9
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	248.7

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:05:00 PM
From File	Snowshoe Hare - Tissue, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Titanium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.166	95% Adjusted Gamma UCL (use when n<50)	0.172

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.771	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.096	Mean of logged Data	-1.953
Maximum of Logged Data	-1.537	SD of logged Data	0.189

Assuming Lognormal Distribution

95% H-UCL	0.166	90% Chebyshev (MVUE) UCL	0.173
95% Chebyshev (MVUE) UCL	0.186	97.5% Chebyshev (MVUE) UCL	0.204
99% Chebyshev (MVUE) UCL	0.24		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.162	95% Jackknife UCL	0.165
95% Standard Bootstrap UCL	0.161	95% Bootstrap-t UCL	0.206
95% Hall's Bootstrap UCL	0.227	95% Percentile Bootstrap UCL	0.162
95% BCA Bootstrap UCL	0.17		
90% Chebyshev(Mean, Sd) UCL	0.177	95% Chebyshev(Mean, Sd) UCL	0.192
97.5% Chebyshev(Mean, Sd) UCL	0.213	99% Chebyshev(Mean, Sd) UCL	0.253

Suggested UCL to Use

95% Student's-t UCL	0.165

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:05:00 PM
From File	Snowshoe Hare - Tissue, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Titanium, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:05:43 PM
From File	Snowshoe Hare - Tissue, Uranium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Uranium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Tissue, Uranium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:06:26 PM
From File	Snowshoe Hare - Tissue, Vanadium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Vanadium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Tissue, Vanadium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:07:09 PM
From File	Snowshoe Hare - Tissue, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Zinc, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	11.9	Mean	13.78
Maximum	20.5	Median	12.8
SD	2.786	Std. Error of Mean	0.985
Coefficient of Variation	0.202	Skewness	2.56

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.627	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.386	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	15.64	95% Adjusted-CLT UCL (Chen-1995)	16.35
		95% Modified-t UCL (Johnson-1978)	15.79

Gamma GOF Test

A-D Test Statistic	1.26	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.365	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	34.5	k star (bias corrected MLE)	21.65
Theta hat (MLE)	0.399	Theta star (bias corrected MLE)	0.636
nu hat (MLE)	552.1	nu star (bias corrected)	346.4
MLE Mean (bias corrected)	13.78	MLE Sd (bias corrected)	2.961
		Approximate Chi Square Value (0.05)	304.3
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	294.2

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:07:09 PM
From File	Snowshoe Hare - Tissue, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Tissue, Zinc, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15.68	95% Adjusted Gamma UCL (use when n<50)	16.22

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.679	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.354	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.477	Mean of logged Data	2.608
Maximum of Logged Data	3.02	SD of logged Data	0.173

Assuming Lognormal Distribution

95% H-UCL	15.62	90% Chebyshev (MVUE) UCL	16.29
95% Chebyshev (MVUE) UCL	17.43	97.5% Chebyshev (MVUE) UCL	19.02
99% Chebyshev (MVUE) UCL	22.15		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	15.39	95% Jackknife UCL	15.64
95% Standard Bootstrap UCL	15.25	95% Bootstrap-t UCL	19.87
95% Hall's Bootstrap UCL	21.81	95% Percentile Bootstrap UCL	15.59
95% BCA Bootstrap UCL	16.5		
90% Chebyshev(Mean, Sd) UCL	16.73	95% Chebyshev(Mean, Sd) UCL	18.07
97.5% Chebyshev(Mean, Sd) UCL	19.93	99% Chebyshev(Mean, Sd) UCL	23.57

Suggested UCL to Use

95% Student's-t UCL	15.64	or 95% Modified-t UCL	15.79

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ATTACHMENT C

ProUCL Outputs: Snowshoe Hare - Internal Organs

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:11:58 PM
From File	Snowshoe Hare - Internal Organs, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Aluminum, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.29	Mean	0.556
Maximum	1.46	Median	0.415
SD	0.378	Std. Error of Mean	0.134
Coefficient of Variation	0.679	Skewness	2.472

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.36	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.809	95% Adjusted-CLT UCL (Chen-1995)	0.901
		95% Modified-t UCL (Johnson-1978)	0.829

Gamma GOF Test

A-D Test Statistic	0.849	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.719	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.289	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.921	k star (bias corrected MLE)	2.534
Theta hat (MLE)	0.142	Theta star (bias corrected MLE)	0.22
nu hat (MLE)	62.73	nu star (bias corrected)	40.54
MLE Mean (bias corrected)	0.556	MLE Sd (bias corrected)	0.349
		Approximate Chi Square Value (0.05)	26.95
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	24.18

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:11:58 PM
From File	Snowshoe Hare - Internal Organs, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Aluminum, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.837	95% Adjusted Gamma UCL (use when n<50)	0.933

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.251	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.238	Mean of logged Data	-0.719
Maximum of Logged Data	0.378	SD of logged Data	0.498

Assuming Lognormal Distribution

95% H-UCL	0.859	90% Chebyshev (MVUE) UCL	0.832
95% Chebyshev (MVUE) UCL	0.963	97.5% Chebyshev (MVUE) UCL	1.145
99% Chebyshev (MVUE) UCL	1.502		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.776	95% Jackknife UCL	0.809
95% Standard Bootstrap UCL	0.764	95% Bootstrap-t UCL	1.305
95% Hall's Bootstrap UCL	1.578	95% Percentile Bootstrap UCL	0.804
95% BCA Bootstrap UCL	0.93		
90% Chebyshev(Mean, Sd) UCL	0.957	95% Chebyshev(Mean, Sd) UCL	1.138
97.5% Chebyshev(Mean, Sd) UCL	1.39	99% Chebyshev(Mean, Sd) UCL	1.885

Suggested UCL to Use

95% Adjusted Gamma UCL	0.933

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:11:58 PM
From File	Snowshoe Hare - Internal Organs, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Aluminum, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:12:42 PM
From File	Snowshoe Hare - Internal Organs, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Antimony, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Antimony, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:13:25 PM
From File	Snowshoe Hare - Internal Organs, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Arsenic, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.0061	Minimum Non-Detect	0.004
Maximum Detect	0.068	Maximum Non-Detect	0.004
Variance Detects	4.4490E-4	Percent Non-Detects	12.5%
Mean Detects	0.0224	SD Detects	0.0211
Median Detects	0.016	CV Detects	0.942
Skewness Detects	2.157	Kurtosis Detects	5.093
Mean of Logged Detects	-4.091	SD of Logged Detects	0.792

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.734	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0201	KM Standard Error of Mean	0.00735
KM SD	0.0193	95% KM (BCA) UCL	0.0342
95% KM (t) UCL	0.034	95% KM (Percentile Bootstrap) UCL	0.0328
95% KM (z) UCL	0.0322	95% KM Bootstrap t UCL	0.05
90% KM Chebyshev UCL	0.0421	95% KM Chebyshev UCL	0.0521
97.5% KM Chebyshev UCL	0.066	99% KM Chebyshev UCL	0.0932

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.412	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.717	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.213	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.316	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:13:25 PM
From File	Snowshoe Hare - Internal Organs, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Arsenic, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	1.862	k star (bias corrected MLE)	1.159
Theta hat (MLE)	0.012	Theta star (bias corrected MLE)	0.0193
nu hat (MLE)	26.06	nu star (bias corrected)	16.23
Mean (detects)	0.0224		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0061	Mean	0.0208
Maximum	0.068	Median	0.0156
SD	0.02	CV	0.96
k hat (MLE)	1.907	k star (bias corrected MLE)	1.275
Theta hat (MLE)	0.0109	Theta star (bias corrected MLE)	0.0163
nu hat (MLE)	30.51	nu star (bias corrected)	20.4
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (20.40, α)	11.15	Adjusted Chi Square Value (20.40, β)	9.467
95% Gamma Approximate UCL (use when n>=50)	0.0381	95% Gamma Adjusted UCL (use when n<50)	0.0449

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0201	SD (KM)	0.0193
Variance (KM)	3.7065E-4	SE of Mean (KM)	0.00735
k hat (KM)	1.089	k star (KM)	0.764
nu hat (KM)	17.42	nu star (KM)	12.22
theta hat (KM)	0.0185	theta star (KM)	0.0263
80% gamma percentile (KM)	0.0329	90% gamma percentile (KM)	0.0494
95% gamma percentile (KM)	0.0663	99% gamma percentile (KM)	0.106

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.22, α)	5.372	Adjusted Chi Square Value (12.22, β)	4.281
95% Gamma Approximate KM-UCL (use when n>=50)	0.0457	95% Gamma Adjusted KM-UCL (use when n<50)	0.0573

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:13:25 PM
From File	Snowshoe Hare - Internal Organs, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Arsenic, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0199	Mean in Log Scale	-4.336
SD in Original Scale	0.0208	SD in Log Scale	1.007
95% t UCL (assumes normality of ROS data)	0.0338	95% Percentile Bootstrap UCL	0.0332
95% BCA Bootstrap UCL	0.0396	95% Bootstrap t UCL	0.0497
95% H-UCL (Log ROS)	0.0808		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.27	KM Geo Mean	0.014
KM SD (logged)	0.833	95% Critical H Value (KM-Log)	3.028
KM Standard Error of Mean (logged)	0.318	95% H-UCL (KM -Log)	0.0513
KM SD (logged)	0.833	95% Critical H Value (KM-Log)	3.028
KM Standard Error of Mean (logged)	0.318		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0198	Mean in Log Scale	-4.357
SD in Original Scale	0.0208	SD in Log Scale	1.049
95% t UCL (Assumes normality)	0.0338	95% H-Stat UCL	0.0909

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	0.0573	95% GROS Adjusted Gamma UCL	0.0449

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:14:09 PM
From File	Snowshoe Hare - Internal Organs, Barium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Barium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0515	Mean	0.157
Maximum	0.303	Median	0.156
SD	0.0737	Std. Error of Mean	0.026
Coefficient of Variation	0.469	Skewness	0.858

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.185	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.206	95% Adjusted-CLT UCL (Chen-1995)	0.208
		95% Modified-t UCL (Johnson-1978)	0.208

Gamma GOF Test

A-D Test Statistic	0.25	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.896	k star (bias corrected MLE)	3.143
Theta hat (MLE)	0.0321	Theta star (bias corrected MLE)	0.05
nu hat (MLE)	78.33	nu star (bias corrected)	50.29
MLE Mean (bias corrected)	0.157	MLE Sd (bias corrected)	0.0886
		Approximate Chi Square Value (0.05)	35.01
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	31.81

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:14:09 PM
From File	Snowshoe Hare - Internal Organs, Barium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Barium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.226	95% Adjusted Gamma UCL (use when n<50)	0.248

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.181	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.966	Mean of logged Data	-1.957
Maximum of Logged Data	-1.194	SD of logged Data	0.516

Assuming Lognormal Distribution

95% H-UCL	0.257	90% Chebyshev (MVUE) UCL	0.246
95% Chebyshev (MVUE) UCL	0.286	97.5% Chebyshev (MVUE) UCL	0.341
99% Chebyshev (MVUE) UCL	0.45		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.2	95% Jackknife UCL	0.206
95% Standard Bootstrap UCL	0.196	95% Bootstrap-t UCL	0.217
95% Hall's Bootstrap UCL	0.25	95% Percentile Bootstrap UCL	0.198
95% BCA Bootstrap UCL	0.204		
90% Chebyshev(Mean, Sd) UCL	0.235	95% Chebyshev(Mean, Sd) UCL	0.271
97.5% Chebyshev(Mean, Sd) UCL	0.32	99% Chebyshev(Mean, Sd) UCL	0.416

Suggested UCL to Use

95% Student's-t UCL	0.206

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:14:53 PM
From File	Snowshoe Hare - Internal Organs, Beryllium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Beryllium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Beryllium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:15:36 PM
From File	Snowshoe Hare - Internal Organs, Bismuth, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Bismuth, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Bismuth, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:16:19 PM
From File	Snowshoe Hare - Internal Organs, Boron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Boron, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
Number of Detects	5	Number of Non-Detects	3
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.23	Minimum Non-Detect	0.2
Maximum Detect	0.28	Maximum Non-Detect	0.2
Variance Detects	3.5000E-4	Percent Non-Detects	37.5%
Mean Detects	0.25	SD Detects	0.0187
Median Detects	0.25	CV Detects	0.0748
Skewness Detects	1.145	Kurtosis Detects	2
Mean of Logged Detects	-1.388	SD of Logged Detects	0.0732

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.231	KM Standard Error of Mean	0.0109
KM SD	0.0276	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.252	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.249	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.264	95% KM Chebyshev UCL	0.279
97.5% KM Chebyshev UCL	0.299	99% KM Chebyshev UCL	0.34

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.358	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.291	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:16:19 PM
From File	Snowshoe Hare - Internal Organs, Boron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Boron, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	230.1	k star (bias corrected MLE)	92.15
Theta hat (MLE)	0.00109	Theta star (bias corrected MLE)	0.00271
nu hat (MLE)	2301	nu star (bias corrected)	921.5
Mean (detects)	0.25		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.188	Mean	0.231
Maximum	0.28	Median	0.235
SD	0.0301	CV	0.13
k hat (MLE)	67.14	k star (bias corrected MLE)	42.05
Theta hat (MLE)	0.00345	Theta star (bias corrected MLE)	0.0055
nu hat (MLE)	1074	nu star (bias corrected)	672.8
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (672.76, α)	613.6	Adjusted Chi Square Value (672.76, β)	599.2
95% Gamma Approximate UCL (use when n>=50)	0.254	95% Gamma Adjusted UCL (use when n<50)	0.26

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.231	SD (KM)	0.0276
Variance (KM)	7.6094E-4	SE of Mean (KM)	0.0109
k hat (KM)	70.28	k star (KM)	44.01
nu hat (KM)	1124	nu star (KM)	704.1
theta hat (KM)	0.00329	theta star (KM)	0.00525
80% gamma percentile (KM)	0.26	90% gamma percentile (KM)	0.277
95% gamma percentile (KM)	0.291	99% gamma percentile (KM)	0.32

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (704.11, α)	643.5	Adjusted Chi Square Value (704.11, β)	628.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.253	95% Gamma Adjusted KM-UCL (use when n<50)	0.259

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:16:19 PM
From File	Snowshoe Hare - Internal Organs, Boron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Boron, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.922	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.288	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.233	Mean in Log Scale	-1.464
SD in Original Scale	0.0282	SD in Log Scale	0.121
95% t UCL (assumes normality of ROS data)	0.252	95% Percentile Bootstrap UCL	0.249
95% BCA Bootstrap UCL	0.249	95% Bootstrap t UCL	0.253
95% H-UCL (Log ROS)	0.254		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.471	KM Geo Mean	0.23
KM SD (logged)	0.119	95% Critical H Value (KM-Log)	1.865
KM Standard Error of Mean (logged)	0.047	95% H-UCL (KM -Log)	0.251
KM SD (logged)	0.119	95% Critical H Value (KM-Log)	1.865
KM Standard Error of Mean (logged)	0.047		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.194	Mean in Log Scale	-1.731
SD in Original Scale	0.0789	SD in Log Scale	0.476
95% t UCL (Assumes normality)	0.247	95% H-Stat UCL	0.301

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.252

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:17:03 PM
From File	Snowshoe Hare - Internal Organs, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Cadmium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0196	Mean	0.409
Maximum	1.425	Median	0.155
SD	0.525	Std. Error of Mean	0.185
Coefficient of Variation	1.281	Skewness	1.464

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.756	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.761	95% Adjusted-CLT UCL (Chen-1995)	0.817
		95% Modified-t UCL (Johnson-1978)	0.777

Gamma GOF Test

A-D Test Statistic	0.361	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.305	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.694	k star (bias corrected MLE)	0.517
Theta hat (MLE)	0.59	Theta star (bias corrected MLE)	0.791
nu hat (MLE)	11.11	nu star (bias corrected)	8.277
MLE Mean (bias corrected)	0.409	MLE Sd (bias corrected)	0.569
		Approximate Chi Square Value (0.05)	2.896
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	2.154

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:17:03 PM
From File	Snowshoe Hare - Internal Organs, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Cadmium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	1.17	95% Adjusted Gamma UCL (use when n<50)	1.573

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.171	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.932	Mean of logged Data	-1.764
Maximum of Logged Data	0.354	SD of logged Data	1.544

Assuming Lognormal Distribution

95% H-UCL	9.632	90% Chebyshev (MVUE) UCL	1.166
95% Chebyshev (MVUE) UCL	1.494	97.5% Chebyshev (MVUE) UCL	1.95
99% Chebyshev (MVUE) UCL	2.845		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.714	95% Jackknife UCL	0.761
95% Standard Bootstrap UCL	0.697	95% Bootstrap-t UCL	1.803
95% Hall's Bootstrap UCL	2.5	95% Percentile Bootstrap UCL	0.706
95% BCA Bootstrap UCL	0.814		
90% Chebyshev(Mean, Sd) UCL	0.966	95% Chebyshev(Mean, Sd) UCL	1.218
97.5% Chebyshev(Mean, Sd) UCL	1.568	99% Chebyshev(Mean, Sd) UCL	2.255

Suggested UCL to Use

95% Adjusted Gamma UCL	1.573

Recommended UCL exceeds the maximum observation

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:17:03 PM
From File	Snowshoe Hare - Internal Organs, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Cadmium, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:17:47 PM
From File	Snowshoe Hare - Internal Organs, Calcium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Calcium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	74	Mean	108.4
Maximum	149	Median	107
SD	21.28	Std. Error of Mean	7.525
Coefficient of Variation	0.196	Skewness	0.497

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	122.7	95% Adjusted-CLT UCL (Chen-1995)	122.2
		95% Modified-t UCL (Johnson-1978)	122.9

Gamma GOF Test

A-D Test Statistic	0.341	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.185	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	29.68	k star (bias corrected MLE)	18.63
Theta hat (MLE)	3.654	Theta star (bias corrected MLE)	5.82
nu hat (MLE)	474.9	nu star (bias corrected)	298.1
MLE Mean (bias corrected)	108.4	MLE Sd (bias corrected)	25.12
		Approximate Chi Square Value (0.05)	259.1
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	249.9

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:17:47 PM
From File	Snowshoe Hare - Internal Organs, Calcium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Calcium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	124.8	95% Adjusted Gamma UCL (use when n<50)	129.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.2	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.304	Mean of logged Data	4.669
Maximum of Logged Data	5.004	SD of logged Data	0.198

Assuming Lognormal Distribution

95% H-UCL	125.7	90% Chebyshev (MVUE) UCL	131.3
95% Chebyshev (MVUE) UCL	141.6	97.5% Chebyshev (MVUE) UCL	156
99% Chebyshev (MVUE) UCL	184.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	120.8	95% Jackknife UCL	122.7
95% Standard Bootstrap UCL	119.7	95% Bootstrap-t UCL	124.5
95% Hall's Bootstrap UCL	132.9	95% Percentile Bootstrap UCL	120.3
95% BCA Bootstrap UCL	120.6		
90% Chebyshev(Mean, Sd) UCL	131	95% Chebyshev(Mean, Sd) UCL	141.2
97.5% Chebyshev(Mean, Sd) UCL	155.4	99% Chebyshev(Mean, Sd) UCL	183.3

Suggested UCL to Use

95% Student's-t UCL	122.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:18:31 PM
From File	Snowshoe Hare - Internal Organs, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Chromium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Chromium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:19:14 PM
From File	Snowshoe Hare - Internal Organs, Cobalt, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Cobalt, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0118	Mean	0.0414
Maximum	0.0837	Median	0.033
SD	0.0259	Std. Error of Mean	0.00914
Coefficient of Variation	0.625	Skewness	0.556

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0587	95% Adjusted-CLT UCL (Chen-1995)	0.0583
		95% Modified-t UCL (Johnson-1978)	0.059

Gamma GOF Test

A-D Test Statistic	0.268	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.682	k star (bias corrected MLE)	1.759
Theta hat (MLE)	0.0154	Theta star (bias corrected MLE)	0.0235
nu hat (MLE)	42.9	nu star (bias corrected)	28.15
MLE Mean (bias corrected)	0.0414	MLE Sd (bias corrected)	0.0312
		Approximate Chi Square Value (0.05)	17.04
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	14.9

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:19:14 PM
From File	Snowshoe Hare - Internal Organs, Cobalt, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Cobalt, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0683	95% Adjusted Gamma UCL (use when n<50)	0.0781

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.44	Mean of logged Data	-3.384
Maximum of Logged Data	-2.481	SD of logged Data	0.705

Assuming Lognormal Distribution

95% H-UCL	0.0904	90% Chebyshev (MVUE) UCL	0.0739
95% Chebyshev (MVUE) UCL	0.0883	97.5% Chebyshev (MVUE) UCL	0.108
99% Chebyshev (MVUE) UCL	0.148		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0564	95% Jackknife UCL	0.0587
95% Standard Bootstrap UCL	0.0555	95% Bootstrap-t UCL	0.0619
95% Hall's Bootstrap UCL	0.0587	95% Percentile Bootstrap UCL	0.0559
95% BCA Bootstrap UCL	0.0583		
90% Chebyshev(Mean, Sd) UCL	0.0688	95% Chebyshev(Mean, Sd) UCL	0.0812
97.5% Chebyshev(Mean, Sd) UCL	0.0984	99% Chebyshev(Mean, Sd) UCL	0.132

Suggested UCL to Use

95% Student's-t UCL	0.0587

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:19:58 PM
From File	Snowshoe Hare - Internal Organs, Copper, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Copper, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	2.06	Mean	2.708
Maximum	3.86	Median	2.63
SD	0.586	Std. Error of Mean	0.207
Coefficient of Variation	0.216	Skewness	1.099

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.1	95% Adjusted-CLT UCL (Chen-1995)	3.134
		95% Modified-t UCL (Johnson-1978)	3.113

Gamma GOF Test

A-D Test Statistic	0.254	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	26.43	k star (bias corrected MLE)	16.6
Theta hat (MLE)	0.102	Theta star (bias corrected MLE)	0.163
nu hat (MLE)	422.9	nu star (bias corrected)	265.7
MLE Mean (bias corrected)	2.708	MLE Sd (bias corrected)	0.664
		Approximate Chi Square Value (0.05)	228.9
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	220.3

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:19:58 PM
From File	Snowshoe Hare - Internal Organs, Copper, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Copper, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.142	95% Adjusted Gamma UCL (use when n<50)	3.266

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.173	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.723	Mean of logged Data	0.977
Maximum of Logged Data	1.351	SD of logged Data	0.205

Assuming Lognormal Distribution

95% H-UCL	3.156	90% Chebyshev (MVUE) UCL	3.296
95% Chebyshev (MVUE) UCL	3.563	97.5% Chebyshev (MVUE) UCL	3.934
99% Chebyshev (MVUE) UCL	4.663		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.048	95% Jackknife UCL	3.1
95% Standard Bootstrap UCL	3.017	95% Bootstrap-t UCL	3.3
95% Hall's Bootstrap UCL	5.242	95% Percentile Bootstrap UCL	3.049
95% BCA Bootstrap UCL	3.156		
90% Chebyshev(Mean, Sd) UCL	3.329	95% Chebyshev(Mean, Sd) UCL	3.61
97.5% Chebyshev(Mean, Sd) UCL	4.001	99% Chebyshev(Mean, Sd) UCL	4.768

Suggested UCL to Use

95% Student's-t UCL	3.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:20:42 PM
From File	Snowshoe Hare - Internal Organs, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Iron, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	126	Mean	250.8
Maximum	434	Median	233
SD	99.45	Std. Error of Mean	35.16
Coefficient of Variation	0.397	Skewness	0.944

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.277	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	317.4	95% Adjusted-CLT UCL (Chen-1995)	321.2
		95% Modified-t UCL (Johnson-1978)	319.4

Gamma GOF Test

A-D Test Statistic	0.278	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.717	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.232	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.748	k star (bias corrected MLE)	4.926
Theta hat (MLE)	32.37	Theta star (bias corrected MLE)	50.92
nu hat (MLE)	124	nu star (bias corrected)	78.81
MLE Mean (bias corrected)	250.8	MLE Sd (bias corrected)	113
		Approximate Chi Square Value (0.05)	59.36
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	55.11

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:20:42 PM
From File	Snowshoe Hare - Internal Organs, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Iron, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	333	95% Adjusted Gamma UCL (use when n<50)	358.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.836	Mean of logged Data	5.459
Maximum of Logged Data	6.073	SD of logged Data	0.387

Assuming Lognormal Distribution

95% H-UCL	348	90% Chebyshev (MVUE) UCL	354.2
95% Chebyshev (MVUE) UCL	401.1	97.5% Chebyshev (MVUE) UCL	466.2
99% Chebyshev (MVUE) UCL	594.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	308.6	95% Jackknife UCL	317.4
95% Standard Bootstrap UCL	305.4	95% Bootstrap-t UCL	371.7
95% Hall's Bootstrap UCL	791.7	95% Percentile Bootstrap UCL	307.3
95% BCA Bootstrap UCL	318.2		
90% Chebyshev(Mean, Sd) UCL	356.3	95% Chebyshev(Mean, Sd) UCL	404.1
97.5% Chebyshev(Mean, Sd) UCL	470.4	99% Chebyshev(Mean, Sd) UCL	600.7

Suggested UCL to Use

95% Student's-t UCL	317.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:21:26 PM
From File	Snowshoe Hare - Internal Organs, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Lead, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	0.0049	Mean	0.0129
Maximum	0.0322	Median	0.0063
SD	0.0106	Std. Error of Mean	0.00376
Coefficient of Variation	0.825	Skewness	1.043

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.772	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.357	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.02	95% Adjusted-CLT UCL (Chen-1995)	0.0205
		95% Modified-t UCL (Johnson-1978)	0.0202

Gamma GOF Test

A-D Test Statistic	0.92	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.361	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.298	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.916	k star (bias corrected MLE)	1.281
Theta hat (MLE)	0.00672	Theta star (bias corrected MLE)	0.0101
nu hat (MLE)	30.65	nu star (bias corrected)	20.49
MLE Mean (bias corrected)	0.0129	MLE Sd (bias corrected)	0.0114
		Approximate Chi Square Value (0.05)	11.21
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	9.527

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:21:26 PM
From File	Snowshoe Hare - Internal Organs, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Lead, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0235	95% Adjusted Gamma UCL (use when n<50)	0.0277

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.792	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.334	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.319	Mean of logged Data	-4.635
Maximum of Logged Data	-3.437	SD of logged Data	0.784

Assuming Lognormal Distribution

95% H-UCL	0.0313	90% Chebyshev (MVUE) UCL	0.0233
95% Chebyshev (MVUE) UCL	0.0281	97.5% Chebyshev (MVUE) UCL	0.0348
99% Chebyshev (MVUE) UCL	0.048		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0191	95% Jackknife UCL	0.02
95% Standard Bootstrap UCL	0.0188	95% Bootstrap-t UCL	0.0243
95% Hall's Bootstrap UCL	0.0174	95% Percentile Bootstrap UCL	0.0188
95% BCA Bootstrap UCL	0.02		
90% Chebyshev(Mean, Sd) UCL	0.0241	95% Chebyshev(Mean, Sd) UCL	0.0293
97.5% Chebyshev(Mean, Sd) UCL	0.0363	99% Chebyshev(Mean, Sd) UCL	0.0502

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.0293

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:22:09 PM
From File	Snowshoe Hare - Internal Organs, Magnesium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Magnesium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	149	Mean	168.9
Maximum	188	Median	167.3
SD	11.92	Std. Error of Mean	4.216
Coefficient of Variation	0.0706	Skewness	0.037

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	176.9	95% Adjusted-CLT UCL (Chen-1995)	175.9
		95% Modified-t UCL (Johnson-1978)	176.9

Gamma GOF Test

A-D Test Statistic	0.233	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.147	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	228.6	k star (bias corrected MLE)	143
Theta hat (MLE)	0.739	Theta star (bias corrected MLE)	1.182
nu hat (MLE)	3658	nu star (bias corrected)	2287
MLE Mean (bias corrected)	168.9	MLE Sd (bias corrected)	14.13
		Approximate Chi Square Value (0.05)	2177
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	2150

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:22:09 PM
From File	Snowshoe Hare - Internal Organs, Magnesium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Magnesium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	177.5	95% Adjusted Gamma UCL (use when n<50)	179.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.162	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.004	Mean of logged Data	5.127
Maximum of Logged Data	5.236	SD of logged Data	0.0708

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	181.6
95% Chebyshev (MVUE) UCL	187.4	97.5% Chebyshev (MVUE) UCL	195.4
99% Chebyshev (MVUE) UCL	211		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	175.9	95% Jackknife UCL	176.9
95% Standard Bootstrap UCL	175.5	95% Bootstrap-t UCL	177.7
95% Hall's Bootstrap UCL	179.2	95% Percentile Bootstrap UCL	175.6
95% BCA Bootstrap UCL	175.5		
90% Chebyshev(Mean, Sd) UCL	181.6	95% Chebyshev(Mean, Sd) UCL	187.3
97.5% Chebyshev(Mean, Sd) UCL	195.3	99% Chebyshev(Mean, Sd) UCL	210.9

Suggested UCL to Use

95% Student's-t UCL	176.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:22:53 PM
From File	Snowshoe Hare - Internal Organs, Manganese, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Manganese, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	2.71	Mean	9.207
Maximum	16.4	Median	8.743
SD	5.499	Std. Error of Mean	1.944
Coefficient of Variation	0.597	Skewness	0.12

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.188	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	12.89	95% Adjusted-CLT UCL (Chen-1995)	12.49
		95% Modified-t UCL (Johnson-1978)	12.9

Gamma GOF Test

A-D Test Statistic	0.439	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.205	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.747	k star (bias corrected MLE)	1.8
Theta hat (MLE)	3.352	Theta star (bias corrected MLE)	5.115
nu hat (MLE)	43.95	nu star (bias corrected)	28.8
MLE Mean (bias corrected)	9.207	MLE Sd (bias corrected)	6.862
		Approximate Chi Square Value (0.05)	17.55
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	15.37

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:22:53 PM
From File	Snowshoe Hare - Internal Organs, Manganese, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Manganese, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15.11	95% Adjusted Gamma UCL (use when n<50)	17.25

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.198	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.997	Mean of logged Data	2.027
Maximum of Logged Data	2.797	SD of logged Data	0.699

Assuming Lognormal Distribution

95% H-UCL	19.96	90% Chebyshev (MVUE) UCL	16.4
95% Chebyshev (MVUE) UCL	19.6	97.5% Chebyshev (MVUE) UCL	24.03
99% Chebyshev (MVUE) UCL	32.73		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	12.4	95% Jackknife UCL	12.89
95% Standard Bootstrap UCL	12.23	95% Bootstrap-t UCL	13.13
95% Hall's Bootstrap UCL	11.66	95% Percentile Bootstrap UCL	12.28
95% BCA Bootstrap UCL	12.3		
90% Chebyshev(Mean, Sd) UCL	15.04	95% Chebyshev(Mean, Sd) UCL	17.68
97.5% Chebyshev(Mean, Sd) UCL	21.35	99% Chebyshev(Mean, Sd) UCL	28.55

Suggested UCL to Use

95% Student's-t UCL	12.89

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:23:37 PM
From File	Snowshoe Hare - Internal Organs, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Mercury, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.00385	Minimum Non-Detect	0.01
Maximum Detect	0.263	Maximum Non-Detect	0.01
Variance Detects	0.00727	Percent Non-Detects	12.5%
Mean Detects	0.0897	SD Detects	0.0852
Median Detects	0.081	CV Detects	0.95
Skewness Detects	1.596	Kurtosis Detects	3.246
Mean of Logged Detects	-2.954	SD of Logged Detects	1.364

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.268	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.079	KM Standard Error of Mean	0.0302
KM SD	0.0791	95% KM (BCA) UCL	0.129
95% KM (t) UCL	0.136	95% KM (Percentile Bootstrap) UCL	0.127
95% KM (z) UCL	0.129	95% KM Bootstrap t UCL	0.17
90% KM Chebyshev UCL	0.17	95% KM Chebyshev UCL	0.211
97.5% KM Chebyshev UCL	0.268	99% KM Chebyshev UCL	0.379

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.236	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.161	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.319	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:23:37 PM
From File	Snowshoe Hare - Internal Organs, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Mercury, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	1.056	k star (bias corrected MLE)	0.699
Theta hat (MLE)	0.0849	Theta star (bias corrected MLE)	0.128
nu hat (MLE)	14.79	nu star (bias corrected)	9.784
Mean (detects)	0.0897		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00385	Mean	0.0797
Maximum	0.263	Median	0.0675
SD	0.0838	CV	1.051
k hat (MLE)	0.923	k star (bias corrected MLE)	0.66
Theta hat (MLE)	0.0864	Theta star (bias corrected MLE)	0.121
nu hat (MLE)	14.76	nu star (bias corrected)	10.56
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (10.56, α)	4.295	Adjusted Chi Square Value (10.56, β)	3.344
95% Gamma Approximate UCL (use when n>=50)	0.196	95% Gamma Adjusted UCL (use when n<50)	0.252

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.079	SD (KM)	0.0791
Variance (KM)	0.00626	SE of Mean (KM)	0.0302
k hat (KM)	0.997	k star (KM)	0.706
nu hat (KM)	15.95	nu star (KM)	11.3
theta hat (KM)	0.0792	theta star (KM)	0.112
80% gamma percentile (KM)	0.13	90% gamma percentile (KM)	0.198
95% gamma percentile (KM)	0.268	99% gamma percentile (KM)	0.435

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.30, α)	4.77	Adjusted Chi Square Value (11.30, β)	3.756
95% Gamma Approximate KM-UCL (use when n>=50)	0.187	95% Gamma Adjusted KM-UCL (use when n<50)	0.238

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:23:37 PM
From File	Snowshoe Hare - Internal Organs, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Mercury, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.225	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0792	Mean in Log Scale	-3.228
SD in Original Scale	0.0843	SD in Log Scale	1.481
95% t UCL (assumes normality of ROS data)	0.136	95% Percentile Bootstrap UCL	0.129
95% BCA Bootstrap UCL	0.137	95% Bootstrap t UCL	0.178
95% H-UCL (Log ROS)	1.638		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.28	KM Geo Mean	0.0376
KM SD (logged)	1.462	95% Critical H Value (KM-Log)	4.637
KM Standard Error of Mean (logged)	0.558	95% H-UCL (KM -Log)	1.422
KM SD (logged)	1.462	95% Critical H Value (KM-Log)	4.637
KM Standard Error of Mean (logged)	0.558		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0791	Mean in Log Scale	-3.247
SD in Original Scale	0.0844	SD in Log Scale	1.511
95% t UCL (Assumes normality)	0.136	95% H-Stat UCL	1.853

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.136

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:24:21 PM
From File	Snowshoe Hare - Internal Organs, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Molybdenum, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0941	Mean	0.188
Maximum	0.298	Median	0.186
SD	0.0777	Std. Error of Mean	0.0275
Coefficient of Variation	0.413	Skewness	0.127

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.248	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.24	95% Adjusted-CLT UCL (Chen-1995)	0.235
		95% Modified-t UCL (Johnson-1978)	0.24

Gamma GOF Test

A-D Test Statistic	0.55	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.718	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.262	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.338	k star (bias corrected MLE)	4.044
Theta hat (MLE)	0.0297	Theta star (bias corrected MLE)	0.0465
nu hat (MLE)	101.4	nu star (bias corrected)	64.71
MLE Mean (bias corrected)	0.188	MLE Sd (bias corrected)	0.0935
		Approximate Chi Square Value (0.05)	47.2
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	43.44

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:24:21 PM
From File	Snowshoe Hare - Internal Organs, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Molybdenum, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.258	95% Adjusted Gamma UCL (use when n<50)	0.28

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.256	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.363	Mean of logged Data	-1.752
Maximum of Logged Data	-1.211	SD of logged Data	0.438

Assuming Lognormal Distribution

95% H-UCL	0.277	90% Chebyshev (MVUE) UCL	0.277
95% Chebyshev (MVUE) UCL	0.317	97.5% Chebyshev (MVUE) UCL	0.372
99% Chebyshev (MVUE) UCL	0.481		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.233	95% Jackknife UCL	0.24
95% Standard Bootstrap UCL	0.23	95% Bootstrap-t UCL	0.239
95% Hall's Bootstrap UCL	0.223	95% Percentile Bootstrap UCL	0.231
95% BCA Bootstrap UCL	0.228		
90% Chebyshev(Mean, Sd) UCL	0.27	95% Chebyshev(Mean, Sd) UCL	0.308
97.5% Chebyshev(Mean, Sd) UCL	0.36	99% Chebyshev(Mean, Sd) UCL	0.461

Suggested UCL to Use

95% Student's-t UCL	0.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:25:05 PM
From File	Snowshoe Hare - Internal Organs, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Nickel, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
Number of Detects	5	Number of Non-Detects	3
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.011	Minimum Non-Detect	0.01
Maximum Detect	0.036	Maximum Non-Detect	0.01
Variance Detects	1.3050E-4	Percent Non-Detects	37.5%
Mean Detects	0.024	SD Detects	0.0114
Median Detects	0.02	CV Detects	0.476
Skewness Detects	0.238	Kurtosis Detects	-2.665
Mean of Logged Detects	-3.829	SD of Logged Detects	0.51

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.861	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0188	KM Standard Error of Mean	0.00417
KM SD	0.0105	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0266	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0256	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0313	95% KM Chebyshev UCL	0.0369
97.5% KM Chebyshev UCL	0.0448	99% KM Chebyshev UCL	0.0602

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.39	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.271	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:25:05 PM
From File	Snowshoe Hare - Internal Organs, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Nickel, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	5.197	k star (bias corrected MLE)	2.212
Theta hat (MLE)	0.00462	Theta star (bias corrected MLE)	0.0108
nu hat (MLE)	51.97	nu star (bias corrected)	22.12
Mean (detects)	0.024		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0188
Maximum	0.036	Median	0.014
SD	0.0113	CV	0.601
k hat (MLE)	3.643	k star (bias corrected MLE)	2.36
Theta hat (MLE)	0.00515	Theta star (bias corrected MLE)	0.00794
nu hat (MLE)	58.29	nu star (bias corrected)	37.76
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (37.76, α)	24.69	Adjusted Chi Square Value (37.76, β)	22.05
95% Gamma Approximate UCL (use when n>=50)	0.0287	95% Gamma Adjusted UCL (use when n<50)	0.0321

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0188	SD (KM)	0.0105
Variance (KM)	1.1119E-4	SE of Mean (KM)	0.00417
k hat (KM)	3.162	k star (KM)	2.06
nu hat (KM)	50.59	nu star (KM)	32.95
theta hat (KM)	0.00593	theta star (KM)	0.0091
80% gamma percentile (KM)	0.028	90% gamma percentile (KM)	0.0362
95% gamma percentile (KM)	0.0441	99% gamma percentile (KM)	0.0614

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (32.95, α)	20.83	Adjusted Chi Square Value (32.95, β)	18.43
95% Gamma Approximate KM-UCL (use when n>=50)	0.0297	95% Gamma Adjusted KM-UCL (use when n<50)	0.0335

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:25:05 PM
From File	Snowshoe Hare - Internal Organs, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Nickel, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.239	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0171	Mean in Log Scale	-4.348
SD in Original Scale	0.0129	SD in Log Scale	0.834
95% t UCL (assumes normality of ROS data)	0.0257	95% Percentile Bootstrap UCL	0.0243
95% BCA Bootstrap UCL	0.0255	95% Bootstrap t UCL	0.0305
95% H-UCL (Log ROS)	0.0476		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.12	KM Geo Mean	0.0162
KM SD (logged)	0.521	95% Critical H Value (KM-Log)	2.39
KM Standard Error of Mean (logged)	0.206	95% H-UCL (KM -Log)	0.0298
KM SD (logged)	0.521	95% Critical H Value (KM-Log)	2.39
KM Standard Error of Mean (logged)	0.206		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0169	Mean in Log Scale	-4.38
SD in Original Scale	0.0131	SD in Log Scale	0.853
95% t UCL (Assumes normality)	0.0256	95% H-Stat UCL	0.0485

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0266

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:25:48 PM
From File	Snowshoe Hare - Internal Organs, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Phosphorus, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	2125	Mean	2461
Maximum	2740	Median	2465
SD	193.5	Std. Error of Mean	68.4
Coefficient of Variation	0.0786	Skewness	-0.215

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2591	95% Adjusted-CLT UCL (Chen-1995)	2568
		95% Modified-t UCL (Johnson-1978)	2590

Gamma GOF Test

A-D Test Statistic	0.262	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	182.3	k star (bias corrected MLE)	114
Theta hat (MLE)	13.5	Theta star (bias corrected MLE)	21.59
nu hat (MLE)	2917	nu star (bias corrected)	1824
MLE Mean (bias corrected)	2461	MLE Sd (bias corrected)	230.5
		Approximate Chi Square Value (0.05)	1726
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	1702

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:25:48 PM
From File	Snowshoe Hare - Internal Organs, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Phosphorus, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2601	95% Adjusted Gamma UCL (use when n<50)	2638

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.159	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.662	Mean of logged Data	7.806
Maximum of Logged Data	7.916	SD of logged Data	0.0796

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	2669
95% Chebyshev (MVUE) UCL	2763	97.5% Chebyshev (MVUE) UCL	2894
99% Chebyshev (MVUE) UCL	3150		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2574	95% Jackknife UCL	2591
95% Standard Bootstrap UCL	2569	95% Bootstrap-t UCL	2585
95% Hall's Bootstrap UCL	2619	95% Percentile Bootstrap UCL	2566
95% BCA Bootstrap UCL	2569		
90% Chebyshev(Mean, Sd) UCL	2666	95% Chebyshev(Mean, Sd) UCL	2759
97.5% Chebyshev(Mean, Sd) UCL	2888	99% Chebyshev(Mean, Sd) UCL	3142

Suggested UCL to Use

95% Student's-t UCL	2591

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:25:48 PM
From File	Snowshoe Hare - Internal Organs, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Phosphorus, mg/kg - ww

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:26:32 PM
From File	Snowshoe Hare - Internal Organs, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Potassium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	2345	Mean	2628
Maximum	2830	Median	2660
SD	172.6	Std. Error of Mean	61.02
Coefficient of Variation	0.0657	Skewness	-0.813

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.231	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2744	95% Adjusted-CLT UCL (Chen-1995)	2710
		95% Modified-t UCL (Johnson-1978)	2741

Gamma GOF Test

A-D Test Statistic	0.465	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.238	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	257.2	k star (bias corrected MLE)	160.9
Theta hat (MLE)	10.22	Theta star (bias corrected MLE)	16.34
nu hat (MLE)	4116	nu star (bias corrected)	2574
MLE Mean (bias corrected)	2628	MLE Sd (bias corrected)	207.2
		Approximate Chi Square Value (0.05)	2457
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	2428

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:26:32 PM
From File	Snowshoe Hare - Internal Organs, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Potassium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2753	95% Adjusted Gamma UCL (use when n<50)	2786

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.76	Mean of logged Data	7.872
Maximum of Logged Data	7.948	SD of logged Data	0.0672

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	2816
95% Chebyshev (MVUE) UCL	2900	97.5% Chebyshev (MVUE) UCL	3018
99% Chebyshev (MVUE) UCL	3250		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2728	95% Jackknife UCL	2744
95% Standard Bootstrap UCL	2720	95% Bootstrap-t UCL	2724
95% Hall's Bootstrap UCL	2709	95% Percentile Bootstrap UCL	2719
95% BCA Bootstrap UCL	2711		
90% Chebyshev(Mean, Sd) UCL	2811	95% Chebyshev(Mean, Sd) UCL	2894
97.5% Chebyshev(Mean, Sd) UCL	3009	99% Chebyshev(Mean, Sd) UCL	3235

Suggested UCL to Use

95% Student's-t UCL	2744

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:26:32 PM
From File	Snowshoe Hare - Internal Organs, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Potassium, mg/kg - ww

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:27:16 PM
From File	Snowshoe Hare - Internal Organs, Selenium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Selenium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.213	Mean	0.451
Maximum	0.901	Median	0.359
SD	0.264	Std. Error of Mean	0.0933
Coefficient of Variation	0.585	Skewness	0.71

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.628	95% Adjusted-CLT UCL (Chen-1995)	0.629
		95% Modified-t UCL (Johnson-1978)	0.631

Gamma GOF Test

A-D Test Statistic	0.563	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.281	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.296	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.471	k star (bias corrected MLE)	2.252
Theta hat (MLE)	0.13	Theta star (bias corrected MLE)	0.2
nu hat (MLE)	55.53	nu star (bias corrected)	36.04
MLE Mean (bias corrected)	0.451	MLE Sd (bias corrected)	0.3
		Approximate Chi Square Value (0.05)	23.3
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	20.75

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:27:16 PM
From File	Snowshoe Hare - Internal Organs, Selenium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Selenium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.697	95% Adjusted Gamma UCL (use when n<50)	0.783

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.864	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.26	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.549	Mean of logged Data	-0.947
Maximum of Logged Data	-0.104	SD of logged Data	0.587

Assuming Lognormal Distribution

95% H-UCL	0.803	90% Chebyshev (MVUE) UCL	0.733
95% Chebyshev (MVUE) UCL	0.861	97.5% Chebyshev (MVUE) UCL	1.039
99% Chebyshev (MVUE) UCL	1.389		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.604	95% Jackknife UCL	0.628
95% Standard Bootstrap UCL	0.596	95% Bootstrap-t UCL	0.658
95% Hall's Bootstrap UCL	0.585	95% Percentile Bootstrap UCL	0.603
95% BCA Bootstrap UCL	0.612		
90% Chebyshev(Mean, Sd) UCL	0.731	95% Chebyshev(Mean, Sd) UCL	0.857
97.5% Chebyshev(Mean, Sd) UCL	1.033	99% Chebyshev(Mean, Sd) UCL	1.379

Suggested UCL to Use

95% Student's-t UCL	0.628

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:00 PM
From File	Snowshoe Hare - Internal Organs, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Silver, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	2
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.0031	Minimum Non-Detect	0.001
Maximum Detect	0.0496	Maximum Non-Detect	0.001
Variance Detects	3.8528E-4	Percent Non-Detects	25%
Mean Detects	0.0194	SD Detects	0.0196
Median Detects	0.0107	CV Detects	1.014
Skewness Detects	0.993	Kurtosis Detects	-1.048
Mean of Logged Detects	-4.449	SD of Logged Detects	1.143

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.816	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.328	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0148	KM Standard Error of Mean	0.00675
KM SD	0.0174	95% KM (BCA) UCL	0.0259
95% KM (t) UCL	0.0276	95% KM (Percentile Bootstrap) UCL	0.0263
95% KM (z) UCL	0.0259	95% KM Bootstrap t UCL	0.0552
90% KM Chebyshev UCL	0.035	95% KM Chebyshev UCL	0.0442
97.5% KM Chebyshev UCL	0.0569	99% KM Chebyshev UCL	0.0819

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.407	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.713	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.248	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.34	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:00 PM
From File	Snowshoe Hare - Internal Organs, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Silver, mg/kg - ww

Gamma Statistics on Detected Data Only

k hat (MLE)	1.129	k star (bias corrected MLE)	0.676
Theta hat (MLE)	0.0171	Theta star (bias corrected MLE)	0.0286
nu hat (MLE)	13.55	nu star (bias corrected)	8.11
Mean (detects)	0.0194		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0031	Mean	0.017
Maximum	0.0496	Median	0.0101
SD	0.0171	CV	1.008
k hat (MLE)	1.349	k star (bias corrected MLE)	0.926
Theta hat (MLE)	0.0126	Theta star (bias corrected MLE)	0.0184
nu hat (MLE)	21.58	nu star (bias corrected)	14.82
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (14.82, α)	7.139	Adjusted Chi Square Value (14.82, β)	5.844
95% Gamma Approximate UCL (use when n>=50)	0.0353	95% Gamma Adjusted UCL (use when n<50)	0.0432

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0148	SD (KM)	0.0174
Variance (KM)	3.0393E-4	SE of Mean (KM)	0.00675
k hat (KM)	0.717	k star (KM)	0.531
nu hat (KM)	11.47	nu star (KM)	8.504
theta hat (KM)	0.0206	theta star (KM)	0.0278
80% gamma percentile (KM)	0.0243	90% gamma percentile (KM)	0.0394
95% gamma percentile (KM)	0.0555	99% gamma percentile (KM)	0.0947

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.50, α)	3.03	Adjusted Chi Square Value (8.50, β)	2.266
95% Gamma Approximate KM-UCL (use when n>=50)	0.0414	95% Gamma Adjusted KM-UCL (use when n<50)	0.0554

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:00 PM
From File	Snowshoe Hare - Internal Organs, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Silver, mg/kg - ww

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0147	Mean in Log Scale	-5.178
SD in Original Scale	0.0187	SD in Log Scale	1.673
95% t UCL (assumes normality of ROS data)	0.0272	95% Percentile Bootstrap UCL	0.0251
95% BCA Bootstrap UCL	0.0281	95% Bootstrap t UCL	0.0581
95% H-UCL (Log ROS)	0.619		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.064	KM Geo Mean	0.00632
KM SD (logged)	1.397	95% Critical H Value (KM-Log)	4.459
KM Standard Error of Mean (logged)	0.541	95% H-UCL (KM -Log)	0.176
KM SD (logged)	1.397	95% Critical H Value (KM-Log)	4.459
KM Standard Error of Mean (logged)	0.541		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0146	Mean in Log Scale	-5.237
SD in Original Scale	0.0187	SD in Log Scale	1.75
95% t UCL (Assumes normality)	0.0272	95% H-Stat UCL	0.893

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0276

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:00 PM
From File	Snowshoe Hare - Internal Organs, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Silver, mg/kg - ww

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:44 PM
From File	Snowshoe Hare - Internal Organs, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Sodium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	1068	Mean	1225
Maximum	1350	Median	1248
SD	92.24	Std. Error of Mean	32.61
Coefficient of Variation	0.0753	Skewness	-0.651

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1287	95% Adjusted-CLT UCL (Chen-1995)	1271
		95% Modified-t UCL (Johnson-1978)	1286

Gamma GOF Test

A-D Test Statistic	0.358	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.223	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	195.9	k star (bias corrected MLE)	122.5
Theta hat (MLE)	6.256	Theta star (bias corrected MLE)	10
nu hat (MLE)	3134	nu star (bias corrected)	1960
MLE Mean (bias corrected)	1225	MLE Sd (bias corrected)	110.7
		Approximate Chi Square Value (0.05)	1858
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	1833

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:44 PM
From File	Snowshoe Hare - Internal Organs, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Sodium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1292	95% Adjusted Gamma UCL (use when n<50)	1310

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.22	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.973	Mean of logged Data	7.108
Maximum of Logged Data	7.208	SD of logged Data	0.077

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	1325
95% Chebyshev (MVUE) UCL	1371	97.5% Chebyshev (MVUE) UCL	1434
99% Chebyshev (MVUE) UCL	1557		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1279	95% Jackknife UCL	1287
95% Standard Bootstrap UCL	1275	95% Bootstrap-t UCL	1275
95% Hall's Bootstrap UCL	1272	95% Percentile Bootstrap UCL	1273
95% BCA Bootstrap UCL	1266		
90% Chebyshev(Mean, Sd) UCL	1323	95% Chebyshev(Mean, Sd) UCL	1367
97.5% Chebyshev(Mean, Sd) UCL	1429	99% Chebyshev(Mean, Sd) UCL	1550

Suggested UCL to Use

95% Student's-t UCL	1287

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:28:44 PM
From File	Snowshoe Hare - Internal Organs, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Sodium, mg/kg - ww

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:29:27 PM
From File	Snowshoe Hare - Internal Organs, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Strontium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.061	Mean	0.122
Maximum	0.241	Median	0.115
SD	0.0582	Std. Error of Mean	0.0206
Coefficient of Variation	0.479	Skewness	1.305

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.161	95% Adjusted-CLT UCL (Chen-1995)	0.166
		95% Modified-t UCL (Johnson-1978)	0.162

Gamma GOF Test

A-D Test Statistic	0.254	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.178	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.676	k star (bias corrected MLE)	3.631
Theta hat (MLE)	0.0214	Theta star (bias corrected MLE)	0.0335
nu hat (MLE)	90.81	nu star (bias corrected)	58.09
MLE Mean (bias corrected)	0.122	MLE Sd (bias corrected)	0.0638
		Approximate Chi Square Value (0.05)	41.57
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	38.06

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:29:27 PM
From File	Snowshoe Hare - Internal Organs, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Strontium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.17	95% Adjusted Gamma UCL (use when n<50)	0.186

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.164	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.797	Mean of logged Data	-2.198
Maximum of Logged Data	-1.423	SD of logged Data	0.448

Assuming Lognormal Distribution

95% H-UCL	0.18	90% Chebyshev (MVUE) UCL	0.179
95% Chebyshev (MVUE) UCL	0.205	97.5% Chebyshev (MVUE) UCL	0.242
99% Chebyshev (MVUE) UCL	0.313		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.155	95% Jackknife UCL	0.161
95% Standard Bootstrap UCL	0.153	95% Bootstrap-t UCL	0.181
95% Hall's Bootstrap UCL	0.332	95% Percentile Bootstrap UCL	0.156
95% BCA Bootstrap UCL	0.161		
90% Chebyshev(Mean, Sd) UCL	0.183	95% Chebyshev(Mean, Sd) UCL	0.211
97.5% Chebyshev(Mean, Sd) UCL	0.25	99% Chebyshev(Mean, Sd) UCL	0.326

Suggested UCL to Use

95% Student's-t UCL	0.161

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:30:11 PM
From File	Snowshoe Hare - Internal Organs, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Thallium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	4.7000E-4	Mean	0.00152
Maximum	0.0034	Median	0.00149
SD	8.8016E-4	Std. Error of Mean	3.1118E-4
Coefficient of Variation	0.578	Skewness	1.413

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.256	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.00211	95% Adjusted-CLT UCL (Chen-1995)	0.0022
		95% Modified-t UCL (Johnson-1978)	0.00214

Gamma GOF Test

A-D Test Statistic	0.299	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.187	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.296	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.677	k star (bias corrected MLE)	2.381
Theta hat (MLE)	4.1426E-4	Theta star (bias corrected MLE)	6.3962E-4
nu hat (MLE)	58.83	nu star (bias corrected)	38.1
MLE Mean (bias corrected)	0.00152	MLE Sd (bias corrected)	9.8702E-4
		Approximate Chi Square Value (0.05)	24.97
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	22.31

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:30:11 PM
From File	Snowshoe Hare - Internal Organs, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Thallium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.00232	95% Adjusted Gamma UCL (use when n<50)	0.0026

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-7.663	Mean of logged Data	-6.629
Maximum of Logged Data	-5.684	SD of logged Data	0.583

Assuming Lognormal Distribution

95% H-UCL	0.00272	90% Chebyshev (MVUE) UCL	0.00249
95% Chebyshev (MVUE) UCL	0.00292	97.5% Chebyshev (MVUE) UCL	0.00352
99% Chebyshev (MVUE) UCL	0.00471		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.00203	95% Jackknife UCL	0.00211
95% Standard Bootstrap UCL	0.00201	95% Bootstrap-t UCL	0.00232
95% Hall's Bootstrap UCL	0.00462	95% Percentile Bootstrap UCL	0.00201
95% BCA Bootstrap UCL	0.00217		
90% Chebyshev(Mean, Sd) UCL	0.00246	95% Chebyshev(Mean, Sd) UCL	0.00288
97.5% Chebyshev(Mean, Sd) UCL	0.00347	99% Chebyshev(Mean, Sd) UCL	0.00462

Suggested UCL to Use

95% Student's-t UCL	0.00211

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:30:55 PM
From File	Snowshoe Hare - Internal Organs, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Tin, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Tin, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:31:38 PM
From File	Snowshoe Hare - Internal Organs, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Titanium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	0.102	Mean	0.114
Maximum	0.137	Median	0.112
SD	0.0119	Std. Error of Mean	0.00419
Coefficient of Variation	0.104	Skewness	0.934

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.122	95% Adjusted-CLT UCL (Chen-1995)	0.122
		95% Modified-t UCL (Johnson-1978)	0.122

Gamma GOF Test

A-D Test Statistic	0.464	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.261	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	109.6	k star (bias corrected MLE)	68.58
Theta hat (MLE)	0.00104	Theta star (bias corrected MLE)	0.00166
nu hat (MLE)	1754	nu star (bias corrected)	1097
MLE Mean (bias corrected)	0.114	MLE Sd (bias corrected)	0.0138
		Approximate Chi Square Value (0.05)	1021
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	1003

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:31:38 PM
From File	Snowshoe Hare - Internal Organs, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Titanium, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.122	95% Adjusted Gamma UCL (use when n<50)	0.125

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.246	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.283	Mean of logged Data	-2.177
Maximum of Logged Data	-1.991	SD of logged Data	0.101

Assuming Lognormal Distribution

95% H-UCL	0.122	90% Chebyshev (MVUE) UCL	0.126
95% Chebyshev (MVUE) UCL	0.132	97.5% Chebyshev (MVUE) UCL	0.139
99% Chebyshev (MVUE) UCL	0.154		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.121	95% Jackknife UCL	0.122
95% Standard Bootstrap UCL	0.12	95% Bootstrap-t UCL	0.124
95% Hall's Bootstrap UCL	0.122	95% Percentile Bootstrap UCL	0.12
95% BCA Bootstrap UCL	0.122		
90% Chebyshev(Mean, Sd) UCL	0.126	95% Chebyshev(Mean, Sd) UCL	0.132
97.5% Chebyshev(Mean, Sd) UCL	0.14	99% Chebyshev(Mean, Sd) UCL	0.156

Suggested UCL to Use

95% Student's-t UCL	0.122

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:32:22 PM
From File	Snowshoe Hare - Internal Organs, Uranium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Uranium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Uranium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:33:06 PM
From File	Snowshoe Hare - Internal Organs, Vanadium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Vanadium, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Snowshoe Hare - Internal Organs, Vanadium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:33:49 PM
From File	Snowshoe Hare - Internal Organs, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Zinc, mg/kg - ww

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	18.15	Mean	20.04
Maximum	21.6	Median	20.48
SD	1.154	Std. Error of Mean	0.408
Coefficient of Variation	0.0576	Skewness	-0.654

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.265	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	20.81	95% Adjusted-CLT UCL (Chen-1995)	20.61
		95% Modified-t UCL (Johnson-1978)	20.79

Gamma GOF Test

A-D Test Statistic	0.498	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.278	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	337.2	k star (bias corrected MLE)	210.8
Theta hat (MLE)	0.0594	Theta star (bias corrected MLE)	0.095
nu hat (MLE)	5396	nu star (bias corrected)	3374
MLE Mean (bias corrected)	20.04	MLE Sd (bias corrected)	1.38
		Approximate Chi Square Value (0.05)	3240
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3206

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:33:49 PM
From File	Snowshoe Hare - Internal Organs, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Zinc, mg/kg - ww

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	20.87	95% Adjusted Gamma UCL (use when n<50)	21.08

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.271	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.899	Mean of logged Data	2.996
Maximum of Logged Data	3.073	SD of logged Data	0.0586

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	21.28
95% Chebyshev (MVUE) UCL	21.85	97.5% Chebyshev (MVUE) UCL	22.63
99% Chebyshev (MVUE) UCL	24.17		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	20.71	95% Jackknife UCL	20.81
95% Standard Bootstrap UCL	20.66	95% Bootstrap-t UCL	20.68
95% Hall's Bootstrap UCL	20.62	95% Percentile Bootstrap UCL	20.64
95% BCA Bootstrap UCL	20.57		
90% Chebyshev(Mean, Sd) UCL	21.26	95% Chebyshev(Mean, Sd) UCL	21.82
97.5% Chebyshev(Mean, Sd) UCL	22.59	99% Chebyshev(Mean, Sd) UCL	24.1

Suggested UCL to Use

95% Student's-t UCL	20.81

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 5:33:49 PM
From File	Snowshoe Hare - Internal Organs, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Snowshoe Hare - Internal Organs, Zinc, mg/kg - ww

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ATTACHMENT D

ProUCL Outputs: Blueberry

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:50:26 PM
From File	Blueberry, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Aluminum, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	32.3	Mean	56.26
Maximum	99.5	Median	44.4
SD	23.85	Std. Error of Mean	7.542
Coefficient of Variation	0.424	Skewness	0.958

Normal GOF Test

Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	70.09	95% Adjusted-CLT UCL (Chen-1995)	71.11
		95% Modified-t UCL (Johnson-1978)	70.47

Gamma GOF Test

A-D Test Statistic	0.568	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.926	k star (bias corrected MLE)	4.915
Theta hat (MLE)	8.123	Theta star (bias corrected MLE)	11.45
nu hat (MLE)	138.5	nu star (bias corrected)	98.3
MLE Mean (bias corrected)	56.26	MLE Sd (bias corrected)	25.38
		Approximate Chi Square Value (0.05)	76.43
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	73.08

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	72.36	95% Adjusted Gamma UCL (use when n<50)	75.67

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:50:26 PM
From File	Blueberry, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Aluminum, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.243	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.475	Mean of logged Data	3.956
Maximum of Logged Data	4.6	SD of logged Data	0.397

Assuming Lognormal Distribution

95% H-UCL	74.46	90% Chebyshev (MVUE) UCL	77.4
95% Chebyshev (MVUE) UCL	87.06	97.5% Chebyshev (MVUE) UCL	100.5
99% Chebyshev (MVUE) UCL	126.8		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	68.67	95% Jackknife UCL	70.09
95% Standard Bootstrap UCL	67.88	95% Bootstrap-t UCL	76.07
95% Hall's Bootstrap UCL	70.3	95% Percentile Bootstrap UCL	68.21
95% BCA Bootstrap UCL	69.44		
90% Chebyshev(Mean, Sd) UCL	78.89	95% Chebyshev(Mean, Sd) UCL	89.14
97.5% Chebyshev(Mean, Sd) UCL	103.4	99% Chebyshev(Mean, Sd) UCL	131.3

Suggested UCL to Use

95% Student's-t UCL	70.09

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:51:09 PM
From File	Blueberry, Antimony, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Antimony, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Antimony, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:51:50 PM
From File	Blueberry, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Arsenic, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	6
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.025	Minimum Non-Detect	0.02
Maximum Detect	0.122	Maximum Non-Detect	0.02
Variance Detects	0.0022	Percent Non-Detects	60%
Mean Detects	0.0518	SD Detects	0.0469
Median Detects	0.0302	CV Detects	0.904
Skewness Detects	1.978	Kurtosis Detects	3.926
Mean of Logged Detects	-3.2	SD of Logged Detects	0.737

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.687	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.414	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0327	KM Standard Error of Mean	0.011
KM SD	0.03	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0528	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0508	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0656	95% KM Chebyshev UCL	0.0805
97.5% KM Chebyshev UCL	0.101	99% KM Chebyshev UCL	0.142

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.731	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.66	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.418	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.398	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.237	k star (bias corrected MLE)	0.726
Theta hat (MLE)	0.0232	Theta star (bias corrected MLE)	0.0714
nu hat (MLE)	17.9	nu star (bias corrected)	5.807
Mean (detects)	0.0518		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:51:50 PM
From File	Blueberry, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Arsenic, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0267
Maximum	0.122	Median	0.01
SD	0.0346	CV	1.295
k hat (MLE)	1.329	k star (bias corrected MLE)	0.997
Theta hat (MLE)	0.0201	Theta star (bias corrected MLE)	0.0268
nu hat (MLE)	26.59	nu star (bias corrected)	19.94
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (19.94, α)	10.81	Adjusted Chi Square Value (19.94, β)	9.662
95% Gamma Approximate UCL (use when n>=50)	0.0493	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0327	SD (KM)	0.03
Variance (KM)	9.0211E-4	SE of Mean (KM)	0.011
k hat (KM)	1.188	k star (KM)	0.898
nu hat (KM)	23.75	nu star (KM)	17.96
theta hat (KM)	0.0276	theta star (KM)	0.0364
80% gamma percentile (KM)	0.0531	90% gamma percentile (KM)	0.0774
95% gamma percentile (KM)	0.102	99% gamma percentile (KM)	0.159

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (17.96, α)	9.363	Adjusted Chi Square Value (17.96, β)	8.305
95% Gamma Approximate KM-UCL (use when n>=50)	0.0628	95% Gamma Adjusted KM-UCL (use when n<50)	0.0708

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.755	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.379	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data Not Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:51:50 PM
From File	Blueberry, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Arsenic, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0235	Mean in Log Scale	-4.677
SD in Original Scale	0.0365	SD in Log Scale	1.486
95% t UCL (assumes normality of ROS data)	0.0446	95% Percentile Bootstrap UCL	0.0447
95% BCA Bootstrap UCL	0.0532	95% Bootstrap t UCL	0.0787
95% H-UCL (Log ROS)	0.222		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.627	KM Geo Mean	0.0266
KM SD (logged)	0.534	95% Critical H Value (KM-Log)	2.268
KM Standard Error of Mean (logged)	0.195	95% H-UCL (KM -Log)	0.0459
KM SD (logged)	0.534	95% Critical H Value (KM-Log)	2.268
KM Standard Error of Mean (logged)	0.195		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0267	Mean in Log Scale	-4.043
SD in Original Scale	0.0346	SD in Log Scale	0.842
95% t UCL (Assumes normality)	0.0468	95% H-Stat UCL	0.0546

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.0459

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:52:33 PM
From File	Blueberry, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Barium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	14.4	Mean	18.02
Maximum	22.8	Median	17.8
SD	2.664	Std. Error of Mean	0.842
Coefficient of Variation	0.148	Skewness	0.385

Normal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19.57	95% Adjusted-CLT UCL (Chen-1995)	19.52
		95% Modified-t UCL (Johnson-1978)	19.58

Gamma GOF Test

A-D Test Statistic	0.204	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.138	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	51.52	k star (bias corrected MLE)	36.13
Theta hat (MLE)	0.35	Theta star (bias corrected MLE)	0.499
nu hat (MLE)	1030	nu star (bias corrected)	722.6
MLE Mean (bias corrected)	18.02	MLE Sd (bias corrected)	2.999
		Approximate Chi Square Value (0.05)	661.2
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	651

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	19.7	95% Adjusted Gamma UCL (use when n<50)	20.01

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:52:33 PM
From File	Blueberry, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Barium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.667	Mean of logged Data	2.882
Maximum of Logged Data	3.127	SD of logged Data	0.147

Assuming Lognormal Distribution

95% H-UCL	19.74	90% Chebyshev (MVUE) UCL	20.54
95% Chebyshev (MVUE) UCL	21.68	97.5% Chebyshev (MVUE) UCL	23.26
99% Chebyshev (MVUE) UCL	26.37		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	19.41	95% Jackknife UCL	19.57
95% Standard Bootstrap UCL	19.31	95% Bootstrap-t UCL	19.75
95% Hall's Bootstrap UCL	19.68	95% Percentile Bootstrap UCL	19.36
95% BCA Bootstrap UCL	19.38		
90% Chebyshev(Mean, Sd) UCL	20.55	95% Chebyshev(Mean, Sd) UCL	21.7
97.5% Chebyshev(Mean, Sd) UCL	23.28	99% Chebyshev(Mean, Sd) UCL	26.41

Suggested UCL to Use

95% Student's-t UCL	19.57

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:53:15 PM
From File	Blueberry, Beryllium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Beryllium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Beryllium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:53:57 PM
From File	Blueberry, Bismuth, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Bismuth, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Bismuth, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:54:38 PM
From File	Blueberry, Boron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Boron, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	5.4	Mean	7.99
Maximum	10.5	Median	8.05
SD	1.571	Std. Error of Mean	0.497
Coefficient of Variation	0.197	Skewness	0.134

Normal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	8.901	95% Adjusted-CLT UCL (Chen-1995)	8.83
		95% Modified-t UCL (Johnson-1978)	8.904

Gamma GOF Test

A-D Test Statistic	0.184	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	28.16	k star (bias corrected MLE)	19.78
Theta hat (MLE)	0.284	Theta star (bias corrected MLE)	0.404
nu hat (MLE)	563.2	nu star (bias corrected)	395.5
MLE Mean (bias corrected)	7.99	MLE Sd (bias corrected)	1.797
		Approximate Chi Square Value (0.05)	350.4
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	343.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.018	95% Adjusted Gamma UCL (use when n<50)	9.212

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:54:38 PM
From File	Blueberry, Boron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Boron, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.138	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.686	Mean of logged Data	2.06
Maximum of Logged Data	2.351	SD of logged Data	0.201

Assuming Lognormal Distribution

95% H-UCL	9.085	90% Chebyshev (MVUE) UCL	9.522
95% Chebyshev (MVUE) UCL	10.21	97.5% Chebyshev (MVUE) UCL	11.18
99% Chebyshev (MVUE) UCL	13.07		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	8.807	95% Jackknife UCL	8.901
95% Standard Bootstrap UCL	8.767	95% Bootstrap-t UCL	8.96
95% Hall's Bootstrap UCL	9.011	95% Percentile Bootstrap UCL	8.74
95% BCA Bootstrap UCL	8.77		
90% Chebyshev(Mean, Sd) UCL	9.48	95% Chebyshev(Mean, Sd) UCL	10.16
97.5% Chebyshev(Mean, Sd) UCL	11.09	99% Chebyshev(Mean, Sd) UCL	12.93

Suggested UCL to Use

95% Student's-t UCL	8.901

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:55:20 PM
From File	Blueberry, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Cadmium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	2
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.0057	Minimum Non-Detect	0.005
Maximum Detect	0.01	Maximum Non-Detect	0.005
Variance Detects	1.9107E-6	Percent Non-Detects	20%
Mean Detects	0.00743	SD Detects	0.00138
Median Detects	0.0076	CV Detects	0.186
Skewness Detects	0.596	Kurtosis Detects	0.637
Mean of Logged Detects	-4.918	SD of Logged Detects	0.184

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.188	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00694	KM Standard Error of Mean	5.1028E-4
KM SD	0.00151	95% KM (BCA) UCL	0.0077
95% KM (t) UCL	0.00788	95% KM (Percentile Bootstrap) UCL	0.00777
95% KM (z) UCL	0.00778	95% KM Bootstrap t UCL	0.00795
90% KM Chebyshev UCL	0.00847	95% KM Chebyshev UCL	0.00916
97.5% KM Chebyshev UCL	0.0101	99% KM Chebyshev UCL	0.012

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.292	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.171	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	33.81	k star (bias corrected MLE)	21.21
Theta hat (MLE)	2.1962E-4	Theta star (bias corrected MLE)	3.5001E-4
nu hat (MLE)	540.9	nu star (bias corrected)	339.4
Mean (detects)	0.00743		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:55:20 PM
From File	Blueberry, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Cadmium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0057	Mean	0.00794
Maximum	0.01	Median	0.0078
SD	0.00163	CV	0.206
k hat (MLE)	25.93	k star (bias corrected MLE)	18.22
Theta hat (MLE)	3.0617E-4	Theta star (bias corrected MLE)	4.3578E-4
nu hat (MLE)	518.7	nu star (bias corrected)	364.4
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (364.40, α)	321.2	Adjusted Chi Square Value (364.40, β)	314.1
95% Gamma Approximate UCL (use when n>=50)	0.00901	95% Gamma Adjusted UCL (use when n<50)	0.00921

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00694	SD (KM)	0.00151
Variance (KM)	2.2784E-6	SE of Mean (KM)	5.1028E-4
k hat (KM)	21.14	k star (KM)	14.86
nu hat (KM)	422.8	nu star (KM)	297.3
theta hat (KM)	3.2830E-4	theta star (KM)	4.6690E-4
80% gamma percentile (KM)	0.00839	90% gamma percentile (KM)	0.00932
95% gamma percentile (KM)	0.0101	99% gamma percentile (KM)	0.0118

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (297.28, α)	258.3	Adjusted Chi Square Value (297.28, β)	252
95% Gamma Approximate KM-UCL (use when n>=50)	0.00799	95% Gamma Adjusted KM-UCL (use when n<50)	0.00819

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:55:20 PM
From File	Blueberry, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Cadmium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00688	Mean in Log Scale	-5.007
SD in Original Scale	0.00169	SD in Log Scale	0.25
95% t UCL (assumes normality of ROS data)	0.00785	95% Percentile Bootstrap UCL	0.0077
95% BCA Bootstrap UCL	0.00773	95% Bootstrap t UCL	0.00791
95% H-UCL (Log ROS)	0.0081		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.994	KM Geo Mean	0.00678
KM SD (logged)	0.216	95% Critical H Value (KM-Log)	1.896
KM Standard Error of Mean (logged)	0.0731	95% H-UCL (KM -Log)	0.00796
KM SD (logged)	0.216	95% Critical H Value (KM-Log)	1.896
KM Standard Error of Mean (logged)	0.0731		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00644	Mean in Log Scale	-5.133
SD in Original Scale	0.00241	SD in Log Scale	0.481
95% t UCL (Assumes normality)	0.00784	95% H-Stat UCL	0.00942

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00788

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:56:02 PM
From File	Blueberry, Calcium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Calcium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1220	Mean	1498
Maximum	1810	Median	1460
SD	210.6	Std. Error of Mean	66.61
Coefficient of Variation	0.141	Skewness	0.235

Normal GOF Test

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1620	95% Adjusted-CLT UCL (Chen-1995)	1613
		95% Modified-t UCL (Johnson-1978)	1621

Gamma GOF Test

A-D Test Statistic	0.274	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.145	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	56.54	k star (bias corrected MLE)	39.65
Theta hat (MLE)	26.49	Theta star (bias corrected MLE)	37.78
nu hat (MLE)	1131	nu star (bias corrected)	792.9
MLE Mean (bias corrected)	1498	MLE Sd (bias corrected)	237.9
		Approximate Chi Square Value (0.05)	728.6
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	717.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1630	95% Adjusted Gamma UCL (use when n<50)	1655

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:56:02 PM
From File	Blueberry, Calcium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Calcium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.107	Mean of logged Data	7.303
Maximum of Logged Data	7.501	SD of logged Data	0.14

Assuming Lognormal Distribution

95% H-UCL	1634	90% Chebyshev (MVUE) UCL	1698
95% Chebyshev (MVUE) UCL	1788	97.5% Chebyshev (MVUE) UCL	1914
99% Chebyshev (MVUE) UCL	2160		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1608	95% Jackknife UCL	1620
95% Standard Bootstrap UCL	1602	95% Bootstrap-t UCL	1622
95% Hall's Bootstrap UCL	1595	95% Percentile Bootstrap UCL	1602
95% BCA Bootstrap UCL	1607		
90% Chebyshev(Mean, Sd) UCL	1698	95% Chebyshev(Mean, Sd) UCL	1788
97.5% Chebyshev(Mean, Sd) UCL	1914	99% Chebyshev(Mean, Sd) UCL	2161

Suggested UCL to Use

95% Student's-t UCL	1620

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:56:44 PM
From File	Blueberry, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Chromium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Chromium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:57:26 PM
From File	Blueberry, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Cobalt, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Cobalt, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:58:08 PM
From File	Blueberry, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Copper, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.96	Mean	2.594
Maximum	2.93	Median	2.773
SD	0.346	Std. Error of Mean	0.109
Coefficient of Variation	0.133	Skewness	-0.864

Normal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.794	95% Adjusted-CLT UCL (Chen-1995)	2.742
		95% Modified-t UCL (Johnson-1978)	2.789

Gamma GOF Test

A-D Test Statistic	0.738	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.296	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	57.9	k star (bias corrected MLE)	40.6
Theta hat (MLE)	0.0448	Theta star (bias corrected MLE)	0.0639
nu hat (MLE)	1158	nu star (bias corrected)	811.9
MLE Mean (bias corrected)	2.594	MLE Sd (bias corrected)	0.407
		Approximate Chi Square Value (0.05)	746.8
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	735.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.82	95% Adjusted Gamma UCL (use when n<50)	2.862

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:58:08 PM
From File	Blueberry, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Copper, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.843	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.289	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.673	Mean of logged Data	0.944
Maximum of Logged Data	1.075	SD of logged Data	0.141

Assuming Lognormal Distribution

95% H-UCL	2.832	90% Chebyshev (MVUE) UCL	2.943
95% Chebyshev (MVUE) UCL	3.101	97.5% Chebyshev (MVUE) UCL	3.321
99% Chebyshev (MVUE) UCL	3.751		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.774	95% Jackknife UCL	2.794
95% Standard Bootstrap UCL	2.767	95% Bootstrap-t UCL	2.763
95% Hall's Bootstrap UCL	2.735	95% Percentile Bootstrap UCL	2.757
95% BCA Bootstrap UCL	2.738		
90% Chebyshev(Mean, Sd) UCL	2.922	95% Chebyshev(Mean, Sd) UCL	3.071
97.5% Chebyshev(Mean, Sd) UCL	3.277	99% Chebyshev(Mean, Sd) UCL	3.683

Suggested UCL to Use

95% Student's-t UCL	2.794

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:58:08 PM
From File	Blueberry, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Copper, mg/kg - dw

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:58:50 PM
From File	Blueberry, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Iron, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	11.5	Mean	15.74
Maximum	23.6	Median	14.85
SD	3.688	Std. Error of Mean	1.166
Coefficient of Variation	0.234	Skewness	1.062

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.88	95% Adjusted-CLT UCL (Chen-1995)	18.08
		95% Modified-t UCL (Johnson-1978)	17.95

Gamma GOF Test

A-D Test Statistic	0.284	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.168	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	22.06	k star (bias corrected MLE)	15.51
Theta hat (MLE)	0.714	Theta star (bias corrected MLE)	1.015
nu hat (MLE)	441.1	nu star (bias corrected)	310.1
MLE Mean (bias corrected)	15.74	MLE Sd (bias corrected)	3.998
		Approximate Chi Square Value (0.05)	270.3
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	263.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	18.06	95% Adjusted Gamma UCL (use when n<50)	18.5

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:58:50 PM
From File	Blueberry, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Iron, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.442	Mean of logged Data	2.734
Maximum of Logged Data	3.161	SD of logged Data	0.221

Assuming Lognormal Distribution

95% H-UCL	18.14	90% Chebyshev (MVUE) UCL	19.05
95% Chebyshev (MVUE) UCL	20.55	97.5% Chebyshev (MVUE) UCL	22.64
99% Chebyshev (MVUE) UCL	26.73		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	17.66	95% Jackknife UCL	17.88
95% Standard Bootstrap UCL	17.53	95% Bootstrap-t UCL	18.45
95% Hall's Bootstrap UCL	18.47	95% Percentile Bootstrap UCL	17.55
95% BCA Bootstrap UCL	18.02		
90% Chebyshev(Mean, Sd) UCL	19.24	95% Chebyshev(Mean, Sd) UCL	20.83
97.5% Chebyshev(Mean, Sd) UCL	23.03	99% Chebyshev(Mean, Sd) UCL	27.35

Suggested UCL to Use

95% Student's-t UCL	17.88

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:59:32 PM
From File	Blueberry, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Lead, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	0.022	Mean	0.0556
Maximum	0.114	Median	0.0552
SD	0.0261	Std. Error of Mean	0.00826
Coefficient of Variation	0.47	Skewness	1.12

Normal GOF Test

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0708	95% Adjusted-CLT UCL (Chen-1995)	0.0724
		95% Modified-t UCL (Johnson-1978)	0.0713

Gamma GOF Test

A-D Test Statistic	0.366	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.183	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.352	k star (bias corrected MLE)	3.813
Theta hat (MLE)	0.0104	Theta star (bias corrected MLE)	0.0146
nu hat (MLE)	107	nu star (bias corrected)	76.27
MLE Mean (bias corrected)	0.0556	MLE Sd (bias corrected)	0.0285
		Approximate Chi Square Value (0.05)	57.15
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	54.28

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0742	95% Adjusted Gamma UCL (use when n<50)	0.0782

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 7:59:32 PM
From File	Blueberry, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Lead, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.194	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.817	Mean of logged Data	-2.985
Maximum of Logged Data	-2.172	SD of logged Data	0.467

Assuming Lognormal Distribution

95% H-UCL	0.079	90% Chebyshev (MVUE) UCL	0.0807
95% Chebyshev (MVUE) UCL	0.0921	97.5% Chebyshev (MVUE) UCL	0.108
99% Chebyshev (MVUE) UCL	0.139		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0692	95% Jackknife UCL	0.0708
95% Standard Bootstrap UCL	0.0682	95% Bootstrap-t UCL	0.0739
95% Hall's Bootstrap UCL	0.0803	95% Percentile Bootstrap UCL	0.0683
95% BCA Bootstrap UCL	0.0706		
90% Chebyshev(Mean, Sd) UCL	0.0804	95% Chebyshev(Mean, Sd) UCL	0.0917
97.5% Chebyshev(Mean, Sd) UCL	0.107	99% Chebyshev(Mean, Sd) UCL	0.138

Suggested UCL to Use

95% Student's-t UCL	0.0708

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:00:14 PM
From File	Blueberry, Magnesium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Magnesium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	460	Mean	556.4
Maximum	687	Median	548
SD	76.71	Std. Error of Mean	24.26
Coefficient of Variation	0.138	Skewness	0.736

Normal GOF Test

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.196	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	600.8	95% Adjusted-CLT UCL (Chen-1995)	602.3
		95% Modified-t UCL (Johnson-1978)	601.8

Gamma GOF Test

A-D Test Statistic	0.368	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	60.78	k star (bias corrected MLE)	42.61
Theta hat (MLE)	9.154	Theta star (bias corrected MLE)	13.06
nu hat (MLE)	1216	nu star (bias corrected)	852.2
MLE Mean (bias corrected)	556.4	MLE Sd (bias corrected)	85.23
		Approximate Chi Square Value (0.05)	785.4
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	774.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	603.6	95% Adjusted Gamma UCL (use when n<50)	612.3

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:00:14 PM
From File	Blueberry, Magnesium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Magnesium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.171	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.131	Mean of logged Data	6.313
Maximum of Logged Data	6.532	SD of logged Data	0.134

Assuming Lognormal Distribution

95% H-UCL	604.2	90% Chebyshev (MVUE) UCL	627.3
95% Chebyshev (MVUE) UCL	659.4	97.5% Chebyshev (MVUE) UCL	704
99% Chebyshev (MVUE) UCL	791.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	596.3	95% Jackknife UCL	600.8
95% Standard Bootstrap UCL	594.3	95% Bootstrap-t UCL	616.3
95% Hall's Bootstrap UCL	649.4	95% Percentile Bootstrap UCL	595.7
95% BCA Bootstrap UCL	600.2		
90% Chebyshev(Mean, Sd) UCL	629.1	95% Chebyshev(Mean, Sd) UCL	662.1
97.5% Chebyshev(Mean, Sd) UCL	707.9	99% Chebyshev(Mean, Sd) UCL	797.7

Suggested UCL to Use

95% Student's-t UCL	600.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:00:56 PM
From File	Blueberry, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Manganese, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	361	Mean	642.8
Maximum	870	Median	660.5
SD	146.6	Std. Error of Mean	46.36
Coefficient of Variation	0.228	Skewness	-0.508

Normal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.136	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	727.8	95% Adjusted-CLT UCL (Chen-1995)	711.1
		95% Modified-t UCL (Johnson-1978)	726.5

Gamma GOF Test

A-D Test Statistic	0.286	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.166	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	18.84	k star (bias corrected MLE)	13.25
Theta hat (MLE)	34.12	Theta star (bias corrected MLE)	48.5
nu hat (MLE)	376.8	nu star (bias corrected)	265.1
MLE Mean (bias corrected)	642.8	MLE Sd (bias corrected)	176.6
		Approximate Chi Square Value (0.05)	228.4
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	222.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	746.1	95% Adjusted Gamma UCL (use when n<50)	765.9

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:00:56 PM
From File	Blueberry, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Manganese, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.889	Mean of logged Data	6.439
Maximum of Logged Data	6.768	SD of logged Data	0.253

Assuming Lognormal Distribution

95% H-UCL	760.7	90% Chebyshev (MVUE) UCL	799.8
95% Chebyshev (MVUE) UCL	870.3	97.5% Chebyshev (MVUE) UCL	968.1
99% Chebyshev (MVUE) UCL	1160		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	719	95% Jackknife UCL	727.8
95% Standard Bootstrap UCL	714.9	95% Bootstrap-t UCL	721.8
95% Hall's Bootstrap UCL	713.8	95% Percentile Bootstrap UCL	713
95% BCA Bootstrap UCL	716.7		
90% Chebyshev(Mean, Sd) UCL	781.9	95% Chebyshev(Mean, Sd) UCL	844.9
97.5% Chebyshev(Mean, Sd) UCL	932.3	99% Chebyshev(Mean, Sd) UCL	1104

Suggested UCL to Use

95% Student's-t UCL	727.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:01:38 PM
From File	Blueberry, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Mercury, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Mercury, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:02:20 PM
From File	Blueberry, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Molybdenum, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.028	Mean	0.0459
Maximum	0.074	Median	0.0455
SD	0.0145	Std. Error of Mean	0.00458
Coefficient of Variation	0.316	Skewness	0.548

Normal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0543	95% Adjusted-CLT UCL (Chen-1995)	0.0543
		95% Modified-t UCL (Johnson-1978)	0.0544

Gamma GOF Test

A-D Test Statistic	0.265	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.26	k star (bias corrected MLE)	7.949
Theta hat (MLE)	0.00408	Theta star (bias corrected MLE)	0.00577
nu hat (MLE)	225.2	nu star (bias corrected)	159
MLE Mean (bias corrected)	0.0459	MLE Sd (bias corrected)	0.0163
		Approximate Chi Square Value (0.05)	130.8
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	126.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0558	95% Adjusted Gamma UCL (use when n<50)	0.0577

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:02:20 PM
From File	Blueberry, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Molybdenum, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.145	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.576	Mean of logged Data	-3.126
Maximum of Logged Data	-2.604	SD of logged Data	0.318

Assuming Lognormal Distribution

95% H-UCL	0.057	90% Chebyshev (MVUE) UCL	0.0599
95% Chebyshev (MVUE) UCL	0.0662	97.5% Chebyshev (MVUE) UCL	0.075
99% Chebyshev (MVUE) UCL	0.0922		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0534	95% Jackknife UCL	0.0543
95% Standard Bootstrap UCL	0.0532	95% Bootstrap-t UCL	0.0554
95% Hall's Bootstrap UCL	0.0557	95% Percentile Bootstrap UCL	0.0533
95% BCA Bootstrap UCL	0.0533		
90% Chebyshev(Mean, Sd) UCL	0.0597	95% Chebyshev(Mean, Sd) UCL	0.0659
97.5% Chebyshev(Mean, Sd) UCL	0.0745	99% Chebyshev(Mean, Sd) UCL	0.0915

Suggested UCL to Use

95% Student's-t UCL	0.0543

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:03:04 PM
From File	Blueberry, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Nickel, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.219	Mean	0.287
Maximum	0.403	Median	0.282
SD	0.0533	Std. Error of Mean	0.0169
Coefficient of Variation	0.186	Skewness	1.012

Normal GOF Test

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.148	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.318	95% Adjusted-CLT UCL (Chen-1995)	0.321
		95% Modified-t UCL (Johnson-1978)	0.319

Gamma GOF Test

A-D Test Statistic	0.223	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.118	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	34.38	k star (bias corrected MLE)	24.13
Theta hat (MLE)	0.00835	Theta star (bias corrected MLE)	0.0119
nu hat (MLE)	687.6	nu star (bias corrected)	482.7
MLE Mean (bias corrected)	0.287	MLE Sd (bias corrected)	0.0584
		Approximate Chi Square Value (0.05)	432.7
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	424.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.32	95% Adjusted Gamma UCL (use when n<50)	0.326

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:03:04 PM
From File	Blueberry, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Nickel, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.519	Mean of logged Data	-1.263
Maximum of Logged Data	-0.909	SD of logged Data	0.178

Assuming Lognormal Distribution

95% H-UCL	0.321	90% Chebyshev (MVUE) UCL	0.336
95% Chebyshev (MVUE) UCL	0.358	97.5% Chebyshev (MVUE) UCL	0.388
99% Chebyshev (MVUE) UCL	0.448		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.315	95% Jackknife UCL	0.318
95% Standard Bootstrap UCL	0.313	95% Bootstrap-t UCL	0.326
95% Hall's Bootstrap UCL	0.336	95% Percentile Bootstrap UCL	0.315
95% BCA Bootstrap UCL	0.319		
90% Chebyshev(Mean, Sd) UCL	0.338	95% Chebyshev(Mean, Sd) UCL	0.361
97.5% Chebyshev(Mean, Sd) UCL	0.392	99% Chebyshev(Mean, Sd) UCL	0.455

Suggested UCL to Use

95% Student's-t UCL	0.318

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:03:46 PM
From File	Blueberry, Phosphorus, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Phosphorus, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	658	Mean	940
Maximum	1260	Median	897.5
SD	211.3	Std. Error of Mean	66.82
Coefficient of Variation	0.225	Skewness	0.342

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.148	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1063	95% Adjusted-CLT UCL (Chen-1995)	1058
		95% Modified-t UCL (Johnson-1978)	1064

Gamma GOF Test

A-D Test Statistic	0.264	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	22.23	k star (bias corrected MLE)	15.63
Theta hat (MLE)	42.28	Theta star (bias corrected MLE)	60.14
nu hat (MLE)	444.7	nu star (bias corrected)	312.6
MLE Mean (bias corrected)	940	MLE Sd (bias corrected)	237.8
		Approximate Chi Square Value (0.05)	272.6
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	266.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1078	95% Adjusted Gamma UCL (use when n<50)	1104

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:03:46 PM
From File	Blueberry, Phosphorus, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Phosphorus, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.489	Mean of logged Data	6.823
Maximum of Logged Data	7.139	SD of logged Data	0.224

Assuming Lognormal Distribution

95% H-UCL	1087	90% Chebyshev (MVUE) UCL	1141
95% Chebyshev (MVUE) UCL	1232	97.5% Chebyshev (MVUE) UCL	1358
99% Chebyshev (MVUE) UCL	1606		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1050	95% Jackknife UCL	1063
95% Standard Bootstrap UCL	1042	95% Bootstrap-t UCL	1076
95% Hall's Bootstrap UCL	1047	95% Percentile Bootstrap UCL	1048
95% BCA Bootstrap UCL	1043		
90% Chebyshev(Mean, Sd) UCL	1140	95% Chebyshev(Mean, Sd) UCL	1231
97.5% Chebyshev(Mean, Sd) UCL	1357	99% Chebyshev(Mean, Sd) UCL	1605

Suggested UCL to Use

95% Student's-t UCL	1063

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:04:28 PM
From File	Blueberry, Potassium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Potassium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	5070	Mean	5550
Maximum	6287	Median	5715
SD	430.2	Std. Error of Mean	136.1
Coefficient of Variation	0.0775	Skewness	0.121

Normal GOF Test

Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.235	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5799	95% Adjusted-CLT UCL (Chen-1995)	5779
		95% Modified-t UCL (Johnson-1978)	5800

Gamma GOF Test

A-D Test Statistic	0.789	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.249	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	185.1	k star (bias corrected MLE)	129.6
Theta hat (MLE)	29.98	Theta star (bias corrected MLE)	42.81
nu hat (MLE)	3702	nu star (bias corrected)	2593
MLE Mean (bias corrected)	5550	MLE Sd (bias corrected)	487.4
		Approximate Chi Square Value (0.05)	2476
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	2456

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5813	95% Adjusted Gamma UCL (use when n<50)	5860

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:04:28 PM
From File	Blueberry, Potassium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Potassium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.85	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.236	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.531	Mean of logged Data	8.619
Maximum of Logged Data	8.746	SD of logged Data	0.0775

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	5958
95% Chebyshev (MVUE) UCL	6143	97.5% Chebyshev (MVUE) UCL	6400
99% Chebyshev (MVUE) UCL	6904		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5773	95% Jackknife UCL	5799
95% Standard Bootstrap UCL	5761	95% Bootstrap-t UCL	5797
95% Hall's Bootstrap UCL	5767	95% Percentile Bootstrap UCL	5769
95% BCA Bootstrap UCL	5756		
90% Chebyshev(Mean, Sd) UCL	5958	95% Chebyshev(Mean, Sd) UCL	6143
97.5% Chebyshev(Mean, Sd) UCL	6399	99% Chebyshev(Mean, Sd) UCL	6903

Suggested UCL to Use

95% Student's-t UCL	5799

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:05:11 PM
From File	Blueberry, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Selenium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Selenium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:05:52 PM
From File	Blueberry, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Silver, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Silver, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:06:34 PM
From File	Blueberry, Sodium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Sodium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	12	Mean	23.37
Maximum	52	Median	17.83
SD	14.21	Std. Error of Mean	4.492
Coefficient of Variation	0.608	Skewness	1.581

Normal GOF Test

Shapiro Wilk Test Statistic	0.732	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.31	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	31.6	95% Adjusted-CLT UCL (Chen-1995)	33.16
		95% Modified-t UCL (Johnson-1978)	31.98

Gamma GOF Test

A-D Test Statistic	0.908	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.016	k star (bias corrected MLE)	2.878
Theta hat (MLE)	5.818	Theta star (bias corrected MLE)	8.119
nu hat (MLE)	80.32	nu star (bias corrected)	57.56
MLE Mean (bias corrected)	23.37	MLE Sd (bias corrected)	13.77
		Approximate Chi Square Value (0.05)	41.12
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	38.72

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	32.71	95% Adjusted Gamma UCL (use when n<50)	34.74

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:06:34 PM
From File	Blueberry, Sodium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Sodium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.848	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.221	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.485	Mean of logged Data	3.022
Maximum of Logged Data	3.951	SD of logged Data	0.504

Assuming Lognormal Distribution

95% H-UCL	33.85	90% Chebyshev (MVUE) UCL	34.16
95% Chebyshev (MVUE) UCL	39.22	97.5% Chebyshev (MVUE) UCL	46.25
99% Chebyshev (MVUE) UCL	60.05		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	30.76	95% Jackknife UCL	31.6
95% Standard Bootstrap UCL	30.48	95% Bootstrap-t UCL	51.63
95% Hall's Bootstrap UCL	81.55	95% Percentile Bootstrap UCL	31.17
95% BCA Bootstrap UCL	32.87		
90% Chebyshev(Mean, Sd) UCL	36.84	95% Chebyshev(Mean, Sd) UCL	42.95
97.5% Chebyshev(Mean, Sd) UCL	51.42	99% Chebyshev(Mean, Sd) UCL	68.06

Suggested UCL to Use

95% Adjusted Gamma UCL	34.74

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:07:16 PM
From File	Blueberry, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Strontium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	0.697	Mean	2.616
Maximum	9.61	Median	1.17
SD	3.241	Std. Error of Mean	1.025
Coefficient of Variation	1.239	Skewness	1.818

Normal GOF Test

Shapiro Wilk Test Statistic	0.618	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.399	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.494	95% Adjusted-CLT UCL (Chen-1995)	4.931
		95% Modified-t UCL (Johnson-1978)	4.593

Gamma GOF Test

A-D Test Statistic	1.431	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.343	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.273	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.16	k star (bias corrected MLE)	0.879
Theta hat (MLE)	2.255	Theta star (bias corrected MLE)	2.977
nu hat (MLE)	23.2	nu star (bias corrected)	17.57
MLE Mean (bias corrected)	2.616	MLE Sd (bias corrected)	2.79
		Approximate Chi Square Value (0.05)	9.082
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	8.043

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.06	95% Adjusted Gamma UCL (use when n<50)	5.714

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:07:16 PM
From File	Blueberry, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Strontium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.299	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.361	Mean of logged Data	0.472
Maximum of Logged Data	2.263	SD of logged Data	0.931

Assuming Lognormal Distribution

95% H-UCL	6.195	90% Chebyshev (MVUE) UCL	4.493
95% Chebyshev (MVUE) UCL	5.47	97.5% Chebyshev (MVUE) UCL	6.825
99% Chebyshev (MVUE) UCL	9.488		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	4.302	95% Jackknife UCL	4.494
95% Standard Bootstrap UCL	4.231	95% Bootstrap-t UCL	18.36
95% Hall's Bootstrap UCL	15.73	95% Percentile Bootstrap UCL	4.266
95% BCA Bootstrap UCL	4.944		
90% Chebyshev(Mean, Sd) UCL	5.691	95% Chebyshev(Mean, Sd) UCL	7.083
97.5% Chebyshev(Mean, Sd) UCL	9.017	99% Chebyshev(Mean, Sd) UCL	12.81

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	7.083

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:07:58 PM
From File	Blueberry, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Thallium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	6
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.0023	Minimum Non-Detect	0.002
Maximum Detect	0.0047	Maximum Non-Detect	0.002
Variance Detects	1.1067E-6	Percent Non-Detects	60%
Mean Detects	0.0032	SD Detects	0.00105
Median Detects	0.0029	CV Detects	0.329
Skewness Detects	1.443	Kurtosis Detects	2.235
Mean of Logged Detects	-5.781	SD of Logged Detects	0.306

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.887	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.288	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00248	KM Standard Error of Mean	3.0058E-4
KM SD	8.2316E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00303	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00297	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00338	95% KM Chebyshev UCL	0.00379
97.5% KM Chebyshev UCL	0.00436	99% KM Chebyshev UCL	0.00547

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.329	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.261	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	13.73	k star (bias corrected MLE)	3.598
Theta hat (MLE)	2.3314E-4	Theta star (bias corrected MLE)	8.8934E-4
nu hat (MLE)	109.8	nu star (bias corrected)	28.79
Mean (detects)	0.0032		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:07:58 PM
From File	Blueberry, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Thallium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0023	Mean	0.00728
Maximum	0.01	Median	0.01
SD	0.00356	CV	0.49
k hat (MLE)	3.424	k star (bias corrected MLE)	2.464
Theta hat (MLE)	0.00213	Theta star (bias corrected MLE)	0.00295
nu hat (MLE)	68.48	nu star (bias corrected)	49.27
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (49.27, α)	34.16	Adjusted Chi Square Value (49.27, β)	31.98
95% Gamma Approximate UCL (use when n>=50)	0.0105	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00248	SD (KM)	8.2316E-4
Variance (KM)	6.7760E-7	SE of Mean (KM)	3.0058E-4
k hat (KM)	9.077	k star (KM)	6.42
nu hat (KM)	181.5	nu star (KM)	128.4
theta hat (KM)	2.7323E-4	theta star (KM)	3.8627E-4
80% gamma percentile (KM)	0.00324	90% gamma percentile (KM)	0.00379
95% gamma percentile (KM)	0.00428	99% gamma percentile (KM)	0.0053

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (128.41, α)	103.2	Adjusted Chi Square Value (128.41, β)	99.31
95% Gamma Approximate KM-UCL (use when n>=50)	0.00308	95% Gamma Adjusted KM-UCL (use when n<50)	0.00321

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:07:58 PM
From File	Blueberry, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Thallium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00193	Mean in Log Scale	-6.447
SD in Original Scale	0.00129	SD in Log Scale	0.665
95% t UCL (assumes normality of ROS data)	0.00267	95% Percentile Bootstrap UCL	0.00259
95% BCA Bootstrap UCL	0.00267	95% Bootstrap t UCL	0.00294
95% H-UCL (Log ROS)	0.00342		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.041	KM Geo Mean	0.00238
KM SD (logged)	0.27	95% Critical H Value (KM-Log)	1.947
KM Standard Error of Mean (logged)	0.0988	95% H-UCL (KM -Log)	0.00294
KM SD (logged)	0.27	95% Critical H Value (KM-Log)	1.947
KM Standard Error of Mean (logged)	0.0988		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00188	Mean in Log Scale	-6.457
SD in Original Scale	0.00129	SD in Log Scale	0.608
95% t UCL (Assumes normality)	0.00263	95% H-Stat UCL	0.00306

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00303

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:08:40 PM
From File	Blueberry, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Tin, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Tin, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:09:22 PM
From File	Blueberry, Titanium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Titanium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Titanium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:10:04 PM
From File	Blueberry, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Uranium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Uranium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:10:46 PM
From File	Blueberry, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Vanadium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Blueberry, Vanadium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:11:28 PM
From File	Blueberry, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Zinc, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	5.88	Mean	6.902
Maximum	7.84	Median	7.085
SD	0.617	Std. Error of Mean	0.195
Coefficient of Variation	0.0894	Skewness	-0.494

Normal GOF Test

Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7.26	95% Adjusted-CLT UCL (Chen-1995)	7.191
		95% Modified-t UCL (Johnson-1978)	7.255

Gamma GOF Test

A-D Test Statistic	0.613	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.272	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	134.8	k star (bias corrected MLE)	94.44
Theta hat (MLE)	0.0512	Theta star (bias corrected MLE)	0.0731
nu hat (MLE)	2696	nu star (bias corrected)	1889
MLE Mean (bias corrected)	6.902	MLE Sd (bias corrected)	0.71
		Approximate Chi Square Value (0.05)	1789
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	1772

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.288	95% Adjusted Gamma UCL (use when n<50)	7.358

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:11:28 PM
From File	Blueberry, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Blueberry, Zinc, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.772	Mean of logged Data	1.928
Maximum of Logged Data	2.059	SD of logged Data	0.0916

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	7.503
95% Chebyshev (MVUE) UCL	7.775	97.5% Chebyshev (MVUE) UCL	8.152
99% Chebyshev (MVUE) UCL	8.893		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7.223	95% Jackknife UCL	7.26
95% Standard Bootstrap UCL	7.208	95% Bootstrap-t UCL	7.233
95% Hall's Bootstrap UCL	7.176	95% Percentile Bootstrap UCL	7.202
95% BCA Bootstrap UCL	7.174		
90% Chebyshev(Mean, Sd) UCL	7.488	95% Chebyshev(Mean, Sd) UCL	7.753
97.5% Chebyshev(Mean, Sd) UCL	8.121	99% Chebyshev(Mean, Sd) UCL	8.845

Suggested UCL to Use

95% Student's-t UCL	7.26

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ATTACHMENT E

ProUCL Outputs: Labrador Tea

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:12:10 PM
From File	Labrador Tea, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Aluminum, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	9.6	Mean	14.51
Maximum	24.3	Median	12.9
SD	4.729	Std. Error of Mean	1.495
Coefficient of Variation	0.326	Skewness	1.162

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.25	95% Adjusted-CLT UCL (Chen-1995)	17.55
		95% Modified-t UCL (Johnson-1978)	17.34

Gamma GOF Test

A-D Test Statistic	0.453	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.214	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.86	k star (bias corrected MLE)	8.369
Theta hat (MLE)	1.223	Theta star (bias corrected MLE)	1.733
nu hat (MLE)	237.2	nu star (bias corrected)	167.4
MLE Mean (bias corrected)	14.51	MLE Sd (bias corrected)	5.014
		Approximate Chi Square Value (0.05)	138.5
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	133.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	17.53	95% Adjusted Gamma UCL (use when n<50)	18.13

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:12:10 PM
From File	Labrador Tea, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Aluminum, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.262	Mean of logged Data	2.632
Maximum of Logged Data	3.19	SD of logged Data	0.3

Assuming Lognormal Distribution

95% H-UCL	17.72	90% Chebyshev (MVUE) UCL	18.62
95% Chebyshev (MVUE) UCL	20.5	97.5% Chebyshev (MVUE) UCL	23.11
99% Chebyshev (MVUE) UCL	28.24		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	16.96	95% Jackknife UCL	17.25
95% Standard Bootstrap UCL	16.83	95% Bootstrap-t UCL	18.51
95% Hall's Bootstrap UCL	17.7	95% Percentile Bootstrap UCL	17.08
95% BCA Bootstrap UCL	17.55		
90% Chebyshev(Mean, Sd) UCL	18.99	95% Chebyshev(Mean, Sd) UCL	21.02
97.5% Chebyshev(Mean, Sd) UCL	23.84	99% Chebyshev(Mean, Sd) UCL	29.38

Suggested UCL to Use

95% Student's-t UCL	17.25

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:12:52 PM
From File	Labrador Tea, Antimony, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Antimony, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	8
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0181	Minimum Non-Detect	0.005
Maximum Detect	0.0512	Maximum Non-Detect	0.005
Variance Detects	5.4781E-4	Percent Non-Detects	80%
Mean Detects	0.0347	SD Detects	0.0234
Median Detects	0.0347	CV Detects	0.675
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.492	SD of Logged Detects	0.735

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0109	KM Standard Error of Mean	0.00625
KM SD	0.014	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0224	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0212	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0297	95% KM Chebyshev UCL	0.0382
97.5% KM Chebyshev UCL	0.05	99% KM Chebyshev UCL	0.0731

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	4.021	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00862	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	16.08	nu star (bias corrected)	N/A
Mean (detects)	0.0347		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:12:52 PM
From File	Labrador Tea, Antimony, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Antimony, mg/kg - dw

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0109	SD (KM)	0.014
Variance (KM)	1.9544E-4	SE of Mean (KM)	0.00625
k hat (KM)	0.611	k star (KM)	0.495
nu hat (KM)	12.23	nu star (KM)	9.891
theta hat (KM)	0.0179	theta star (KM)	0.0221
80% gamma percentile (KM)	0.0179	90% gamma percentile (KM)	0.0296
95% gamma percentile (KM)	0.0422	99% gamma percentile (KM)	0.073

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0267
Approximate Chi Square Value (9.89, α)	3.874	Adjusted Chi Square Value (9.89, β)	3.246
95% Gamma Approximate KM-UCL (use when n>=50)	0.0279	95% Gamma Adjusted KM-UCL (use when n<50)	0.0333

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0078	Mean in Log Scale	-6.929
SD in Original Scale	0.0162	SD in Log Scale	2.368
95% t UCL (assumes normality of ROS data)	0.0172	95% Percentile Bootstrap UCL	0.0163
95% BCA Bootstrap UCL	0.0207	95% Bootstrap t UCL	0.0884
95% H-UCL (Log ROS)	2.33		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.937	KM Geo Mean	0.00718
KM SD (logged)	0.759	95% Critical H Value (KM-Log)	2.635
KM Standard Error of Mean (logged)	0.339	95% H-UCL (KM -Log)	0.0186
KM SD (logged)	0.759	95% Critical H Value (KM-Log)	2.635
KM Standard Error of Mean (logged)	0.339		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00893	Mean in Log Scale	-5.492
SD in Original Scale	0.0156	SD in Log Scale	1.082
95% t UCL (Assumes normality)	0.018	95% H-Stat UCL	0.0241

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:12:52 PM
From File	Labrador Tea, Antimony, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Antimony, mg/kg - dw

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.0382

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:13:34 PM
From File	Labrador Tea, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Arsenic, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Number of Detects	7	Number of Non-Detects	3
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.021	Minimum Non-Detect	0.02
Maximum Detect	0.035	Maximum Non-Detect	0.02
Variance Detects	2.6238E-5	Percent Non-Detects	30%
Mean Detects	0.0253	SD Detects	0.00512
Median Detects	0.024	CV Detects	0.203
Skewness Detects	1.342	Kurtosis Detects	1.304
Mean of Logged Detects	-3.694	SD of Logged Detects	0.189

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0237	KM Standard Error of Mean	0.00159
KM SD	0.00465	95% KM (BCA) UCL	0.0266
95% KM (t) UCL	0.0266	95% KM (Percentile Bootstrap) UCL	0.0264
95% KM (z) UCL	0.0263	95% KM Bootstrap t UCL	0.0294
90% KM Chebyshev UCL	0.0285	95% KM Chebyshev UCL	0.0306
97.5% KM Chebyshev UCL	0.0336	99% KM Chebyshev UCL	0.0395

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.451	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.216	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	31.41	k star (bias corrected MLE)	18.04
Theta hat (MLE)	8.0499E-4	Theta star (bias corrected MLE)	0.0014
nu hat (MLE)	439.8	nu star (bias corrected)	252.6
Mean (detects)	0.0253		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:13:34 PM
From File	Labrador Tea, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Arsenic, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0108	Mean	0.0217
Maximum	0.035	Median	0.0215
SD	0.00722	CV	0.333
k hat (MLE)	9.473	k star (bias corrected MLE)	6.698
Theta hat (MLE)	0.00229	Theta star (bias corrected MLE)	0.00324
nu hat (MLE)	189.5	nu star (bias corrected)	134
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (133.95, α)	108.2	Adjusted Chi Square Value (133.95, β)	104.2
95% Gamma Approximate UCL (use when n>=50)	0.0269	95% Gamma Adjusted UCL (use when n<50)	0.0279

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0237	SD (KM)	0.00465
Variance (KM)	2.1610E-5	SE of Mean (KM)	0.00159
k hat (KM)	25.99	k star (KM)	18.26
nu hat (KM)	519.8	nu star (KM)	365.2
theta hat (KM)	9.1181E-4	theta star (KM)	0.0013
80% gamma percentile (KM)	0.0282	90% gamma percentile (KM)	0.031
95% gamma percentile (KM)	0.0335	99% gamma percentile (KM)	0.0385

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (365.22, α)	321.9	Adjusted Chi Square Value (365.22, β)	314.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.0269	95% Gamma Adjusted KM-UCL (use when n<50)	0.0275

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:13:34 PM
From File	Labrador Tea, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Arsenic, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0223	Mean in Log Scale	-3.84
SD in Original Scale	0.00641	SD in Log Scale	0.286
95% t UCL (assumes normality of ROS data)	0.026	95% Percentile Bootstrap UCL	0.0256
95% BCA Bootstrap UCL	0.0259	95% Bootstrap t UCL	0.0268
95% H-UCL (Log ROS)	0.027		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.759	KM Geo Mean	0.0233
KM SD (logged)	0.177	95% Critical H Value (KM-Log)	1.862
KM Standard Error of Mean (logged)	0.0605	95% H-UCL (KM -Log)	0.0264
KM SD (logged)	0.177	95% Critical H Value (KM-Log)	1.862
KM Standard Error of Mean (logged)	0.0605		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0207	Mean in Log Scale	-3.967
SD in Original Scale	0.00849	SD in Log Scale	0.467
95% t UCL (Assumes normality)	0.0256	95% H-Stat UCL	0.0296

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0266

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:14:17 PM
From File	Labrador Tea, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Barium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	35.15	Mean	52.87
Maximum	63.8	Median	52.9
SD	9.214	Std. Error of Mean	2.914
Coefficient of Variation	0.174	Skewness	-0.562

Normal GOF Test

Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	58.21	95% Adjusted-CLT UCL (Chen-1995)	57.11
		95% Modified-t UCL (Johnson-1978)	58.12

Gamma GOF Test

A-D Test Statistic	0.324	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	33.67	k star (bias corrected MLE)	23.64
Theta hat (MLE)	1.57	Theta star (bias corrected MLE)	2.237
nu hat (MLE)	673.5	nu star (bias corrected)	472.8
MLE Mean (bias corrected)	52.87	MLE Sd (bias corrected)	10.87
		Approximate Chi Square Value (0.05)	423.3
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	415.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	59.04	95% Adjusted Gamma UCL (use when n<50)	60.2

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:14:17 PM
From File	Labrador Tea, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Barium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.145	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.56	Mean of logged Data	3.953
Maximum of Logged Data	4.156	SD of logged Data	0.187

Assuming Lognormal Distribution

95% H-UCL	59.53	90% Chebyshev (MVUE) UCL	62.3
95% Chebyshev (MVUE) UCL	66.55	97.5% Chebyshev (MVUE) UCL	72.45
99% Chebyshev (MVUE) UCL	84.04		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	57.66	95% Jackknife UCL	58.21
95% Standard Bootstrap UCL	57.47	95% Bootstrap-t UCL	57.82
95% Hall's Bootstrap UCL	57.41	95% Percentile Bootstrap UCL	57.31
95% BCA Bootstrap UCL	56.74		
90% Chebyshev(Mean, Sd) UCL	61.61	95% Chebyshev(Mean, Sd) UCL	65.57
97.5% Chebyshev(Mean, Sd) UCL	71.07	99% Chebyshev(Mean, Sd) UCL	81.86

Suggested UCL to Use

95% Student's-t UCL	58.21

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:14:59 PM
From File	Labrador Tea, Beryllium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Beryllium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Beryllium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:15:41 PM
From File	Labrador Tea, Bismuth, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Bismuth, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Bismuth, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:16:23 PM
From File	Labrador Tea, Boron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Boron, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	9.7	Mean	12.45
Maximum	14.7	Median	12.25
SD	1.463	Std. Error of Mean	0.463
Coefficient of Variation	0.117	Skewness	-0.166

Normal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.166	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	13.3	95% Adjusted-CLT UCL (Chen-1995)	13.19
		95% Modified-t UCL (Johnson-1978)	13.29

Gamma GOF Test

A-D Test Statistic	0.33	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	78.41	k star (bias corrected MLE)	54.95
Theta hat (MLE)	0.159	Theta star (bias corrected MLE)	0.227
nu hat (MLE)	1568	nu star (bias corrected)	1099
MLE Mean (bias corrected)	12.45	MLE Sd (bias corrected)	1.679
		Approximate Chi Square Value (0.05)	1023
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	1010

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	13.37	95% Adjusted Gamma UCL (use when n<50)	13.54

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:16:23 PM
From File	Labrador Tea, Boron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Boron, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.187	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.272	Mean of logged Data	2.515
Maximum of Logged Data	2.688	SD of logged Data	0.12

Assuming Lognormal Distribution

95% H-UCL	13.4	90% Chebyshev (MVUE) UCL	13.87
95% Chebyshev (MVUE) UCL	14.52	97.5% Chebyshev (MVUE) UCL	15.41
99% Chebyshev (MVUE) UCL	17.16		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	13.21	95% Jackknife UCL	13.3
95% Standard Bootstrap UCL	13.17	95% Bootstrap-t UCL	13.28
95% Hall's Bootstrap UCL	13.45	95% Percentile Bootstrap UCL	13.15
95% BCA Bootstrap UCL	13.12		
90% Chebyshev(Mean, Sd) UCL	13.84	95% Chebyshev(Mean, Sd) UCL	14.47
97.5% Chebyshev(Mean, Sd) UCL	15.34	99% Chebyshev(Mean, Sd) UCL	17.05

Suggested UCL to Use

95% Student's-t UCL	13.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:17:05 PM
From File	Labrador Tea, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Cadmium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Cadmium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:17:47 PM
From File	Labrador Tea, Calcium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Calcium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	4190	Mean	4567
Maximum	5080	Median	4555
SD	288	Std. Error of Mean	91.07
Coefficient of Variation	0.0631	Skewness	0.37

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4734	95% Adjusted-CLT UCL (Chen-1995)	4728
		95% Modified-t UCL (Johnson-1978)	4736

Gamma GOF Test

A-D Test Statistic	0.672	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.263	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	282.2	k star (bias corrected MLE)	197.6
Theta hat (MLE)	16.18	Theta star (bias corrected MLE)	23.11
nu hat (MLE)	5644	nu star (bias corrected)	3952
MLE Mean (bias corrected)	4567	MLE Sd (bias corrected)	324.9
		Approximate Chi Square Value (0.05)	3807
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	3782

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4741	95% Adjusted Gamma UCL (use when n<50)	4772

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:17:47 PM
From File	Labrador Tea, Calcium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Calcium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.34	Mean of logged Data	8.425
Maximum of Logged Data	8.533	SD of logged Data	0.0626

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4838
95% Chebyshev (MVUE) UCL	4961	97.5% Chebyshev (MVUE) UCL	5132
99% Chebyshev (MVUE) UCL	5467		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4717	95% Jackknife UCL	4734
95% Standard Bootstrap UCL	4708	95% Bootstrap-t UCL	4757
95% Hall's Bootstrap UCL	4719	95% Percentile Bootstrap UCL	4716
95% BCA Bootstrap UCL	4710		
90% Chebyshev(Mean, Sd) UCL	4840	95% Chebyshev(Mean, Sd) UCL	4964
97.5% Chebyshev(Mean, Sd) UCL	5136	99% Chebyshev(Mean, Sd) UCL	5473

Suggested UCL to Use

95% Student's-t UCL	4734

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:18:29 PM
From File	Labrador Tea, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Chromium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Chromium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:19:11 PM
From File	Labrador Tea, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Cobalt, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Cobalt, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:19:53 PM
From File	Labrador Tea, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Copper, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2.2	Mean	2.993
Maximum	3.46	Median	3.155
SD	0.423	Std. Error of Mean	0.134
Coefficient of Variation	0.141	Skewness	-1.047

Normal GOF Test

Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.238	95% Adjusted-CLT UCL (Chen-1995)	3.165
		95% Modified-t UCL (Johnson-1978)	3.23

Gamma GOF Test

A-D Test Statistic	0.864	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.326	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	50.48	k star (bias corrected MLE)	35.4
Theta hat (MLE)	0.0593	Theta star (bias corrected MLE)	0.0845
nu hat (MLE)	1010	nu star (bias corrected)	708.1
MLE Mean (bias corrected)	2.993	MLE Sd (bias corrected)	0.503
		Approximate Chi Square Value (0.05)	647.3
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	637.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.273	95% Adjusted Gamma UCL (use when n<50)	3.325

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:19:53 PM
From File	Labrador Tea, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Copper, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.825	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.325	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.788	Mean of logged Data	1.086
Maximum of Logged Data	1.241	SD of logged Data	0.152

Assuming Lognormal Distribution

95% H-UCL	3.291	90% Chebyshev (MVUE) UCL	3.428
95% Chebyshev (MVUE) UCL	3.624	97.5% Chebyshev (MVUE) UCL	3.897
99% Chebyshev (MVUE) UCL	4.432		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.213	95% Jackknife UCL	3.238
95% Standard Bootstrap UCL	3.198	95% Bootstrap-t UCL	3.182
95% Hall's Bootstrap UCL	3.167	95% Percentile Bootstrap UCL	3.186
95% BCA Bootstrap UCL	3.168		
90% Chebyshev(Mean, Sd) UCL	3.394	95% Chebyshev(Mean, Sd) UCL	3.576
97.5% Chebyshev(Mean, Sd) UCL	3.828	99% Chebyshev(Mean, Sd) UCL	4.323

Suggested UCL to Use

95% Student's-t UCL	3.238

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:19:53 PM
From File	Labrador Tea, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Copper, mg/kg - dw

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:20:35 PM
From File	Labrador Tea, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Iron, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	21.3	Mean	24.34
Maximum	29.7	Median	23.45
SD	3.056	Std. Error of Mean	0.966
Coefficient of Variation	0.126	Skewness	1.068

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.215	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	26.11	95% Adjusted-CLT UCL (Chen-1995)	26.28
		95% Modified-t UCL (Johnson-1978)	26.17

Gamma GOF Test

A-D Test Statistic	0.602	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	74.85	k star (bias corrected MLE)	52.46
Theta hat (MLE)	0.325	Theta star (bias corrected MLE)	0.464
nu hat (MLE)	1497	nu star (bias corrected)	1049
MLE Mean (bias corrected)	24.34	MLE Sd (bias corrected)	3.36
		Approximate Chi Square Value (0.05)	975.1
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	962.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	26.19	95% Adjusted Gamma UCL (use when n<50)	26.53

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:20:35 PM
From File	Labrador Tea, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Iron, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.059	Mean of logged Data	3.185
Maximum of Logged Data	3.391	SD of logged Data	0.12

Assuming Lognormal Distribution

95% H-UCL	26.19	90% Chebyshev (MVUE) UCL	27.11
95% Chebyshev (MVUE) UCL	28.37	97.5% Chebyshev (MVUE) UCL	30.12
99% Chebyshev (MVUE) UCL	33.55		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	25.93	95% Jackknife UCL	26.11
95% Standard Bootstrap UCL	25.83	95% Bootstrap-t UCL	27.27
95% Hall's Bootstrap UCL	28.52	95% Percentile Bootstrap UCL	25.95
95% BCA Bootstrap UCL	26.15		
90% Chebyshev(Mean, Sd) UCL	27.24	95% Chebyshev(Mean, Sd) UCL	28.55
97.5% Chebyshev(Mean, Sd) UCL	30.37	99% Chebyshev(Mean, Sd) UCL	33.96

Suggested UCL to Use

95% Student's-t UCL	26.11

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:21:18 PM
From File	Labrador Tea, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Lead, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.021	Mean	0.0284
Maximum	0.0445	Median	0.027
SD	0.00656	Std. Error of Mean	0.00207
Coefficient of Variation	0.231	Skewness	1.746

Normal GOF Test

Shapiro Wilk Test Statistic	0.842	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0322	95% Adjusted-CLT UCL (Chen-1995)	0.033
		95% Modified-t UCL (Johnson-1978)	0.0324

Gamma GOF Test

A-D Test Statistic	0.436	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.207	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	24.18	k star (bias corrected MLE)	16.99
Theta hat (MLE)	0.00117	Theta star (bias corrected MLE)	0.00167
nu hat (MLE)	483.6	nu star (bias corrected)	339.9
MLE Mean (bias corrected)	0.0284	MLE Sd (bias corrected)	0.00689
		Approximate Chi Square Value (0.05)	298.2
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	291.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0324	95% Adjusted Gamma UCL (use when n<50)	0.0331

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:21:18 PM
From File	Labrador Tea, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Lead, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.919	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.201	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.863	Mean of logged Data	-3.582
Maximum of Logged Data	-3.112	SD of logged Data	0.208

Assuming Lognormal Distribution

95% H-UCL	0.0324	90% Chebyshev (MVUE) UCL	0.034
95% Chebyshev (MVUE) UCL	0.0365	97.5% Chebyshev (MVUE) UCL	0.0401
99% Chebyshev (MVUE) UCL	0.047		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0318	95% Jackknife UCL	0.0322
95% Standard Bootstrap UCL	0.0317	95% Bootstrap-t UCL	0.0343
95% Hall's Bootstrap UCL	0.0482	95% Percentile Bootstrap UCL	0.032
95% BCA Bootstrap UCL	0.0328		
90% Chebyshev(Mean, Sd) UCL	0.0346	95% Chebyshev(Mean, Sd) UCL	0.0374
97.5% Chebyshev(Mean, Sd) UCL	0.0413	99% Chebyshev(Mean, Sd) UCL	0.049

Suggested UCL to Use

95% Student's-t UCL	0.0322

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:22:00 PM
From File	Labrador Tea, Magnesium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Magnesium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1160	Mean	1330
Maximum	1590	Median	1310
SD	129.5	Std. Error of Mean	40.94
Coefficient of Variation	0.0974	Skewness	0.713

Normal GOF Test

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1405	95% Adjusted-CLT UCL (Chen-1995)	1407
		95% Modified-t UCL (Johnson-1978)	1406

Gamma GOF Test

A-D Test Statistic	0.188	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.119	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	120.5	k star (bias corrected MLE)	84.43
Theta hat (MLE)	11.03	Theta star (bias corrected MLE)	15.75
nu hat (MLE)	2410	nu star (bias corrected)	1689
MLE Mean (bias corrected)	1330	MLE Sd (bias corrected)	144.7
		Approximate Chi Square Value (0.05)	1594
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	1578

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1408	95% Adjusted Gamma UCL (use when n<50)	1423

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:22:00 PM
From File	Labrador Tea, Magnesium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Magnesium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.113	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.056	Mean of logged Data	7.188
Maximum of Logged Data	7.371	SD of logged Data	0.0955

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	1450
95% Chebyshev (MVUE) UCL	1505	97.5% Chebyshev (MVUE) UCL	1580
99% Chebyshev (MVUE) UCL	1729		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1397	95% Jackknife UCL	1405
95% Standard Bootstrap UCL	1393	95% Bootstrap-t UCL	1426
95% Hall's Bootstrap UCL	1428	95% Percentile Bootstrap UCL	1392
95% BCA Bootstrap UCL	1407		
90% Chebyshev(Mean, Sd) UCL	1452	95% Chebyshev(Mean, Sd) UCL	1508
97.5% Chebyshev(Mean, Sd) UCL	1585	99% Chebyshev(Mean, Sd) UCL	1737

Suggested UCL to Use

95% Student's-t UCL	1405

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:22:42 PM
From File	Labrador Tea, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Manganese, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	538.5	Mean	958.8
Maximum	1410	Median	1040
SD	294.7	Std. Error of Mean	93.18
Coefficient of Variation	0.307	Skewness	-0.312

Normal GOF Test

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.198	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1130	95% Adjusted-CLT UCL (Chen-1995)	1102
		95% Modified-t UCL (Johnson-1978)	1128

Gamma GOF Test

A-D Test Statistic	0.632	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.239	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	10.38	k star (bias corrected MLE)	7.336
Theta hat (MLE)	92.33	Theta star (bias corrected MLE)	130.7
nu hat (MLE)	207.7	nu star (bias corrected)	146.7
MLE Mean (bias corrected)	958.8	MLE Sd (bias corrected)	354
		Approximate Chi Square Value (0.05)	119.7
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	115.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1175	95% Adjusted Gamma UCL (use when n<50)	1218

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:22:42 PM
From File	Labrador Tea, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Manganese, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.866	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.289	Mean of logged Data	6.817
Maximum of Logged Data	7.251	SD of logged Data	0.342

Assuming Lognormal Distribution

95% H-UCL	1219	90% Chebyshev (MVUE) UCL	1277
95% Chebyshev (MVUE) UCL	1420	97.5% Chebyshev (MVUE) UCL	1618
99% Chebyshev (MVUE) UCL	2007		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1112	95% Jackknife UCL	1130
95% Standard Bootstrap UCL	1107	95% Bootstrap-t UCL	1125
95% Hall's Bootstrap UCL	1099	95% Percentile Bootstrap UCL	1097
95% BCA Bootstrap UCL	1098		
90% Chebyshev(Mean, Sd) UCL	1238	95% Chebyshev(Mean, Sd) UCL	1365
97.5% Chebyshev(Mean, Sd) UCL	1541	99% Chebyshev(Mean, Sd) UCL	1886

Suggested UCL to Use

95% Student's-t UCL	1130

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:23:24 PM
From File	Labrador Tea, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Mercury, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Mercury, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:24:06 PM
From File	Labrador Tea, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Molybdenum, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Number of Detects	8	Number of Non-Detects	2
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.02	Minimum Non-Detect	0.02
Maximum Detect	0.046	Maximum Non-Detect	0.02
Variance Detects	8.3357E-5	Percent Non-Detects	20%
Mean Detects	0.0283	SD Detects	0.00913
Median Detects	0.026	CV Detects	0.323
Skewness Detects	1.136	Kurtosis Detects	0.778
Mean of Logged Detects	-3.608	SD of Logged Detects	0.301

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.879	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0266	KM Standard Error of Mean	0.00281
KM SD	0.00832	95% KM (BCA) UCL	0.0312
95% KM (t) UCL	0.0318	95% KM (Percentile Bootstrap) UCL	0.0309
95% KM (z) UCL	0.0312	95% KM Bootstrap t UCL	0.0349
90% KM Chebyshev UCL	0.035	95% KM Chebyshev UCL	0.0389
97.5% KM Chebyshev UCL	0.0442	99% KM Chebyshev UCL	0.0546

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.357	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.188	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	12.22	k star (bias corrected MLE)	7.718
Theta hat (MLE)	0.00231	Theta star (bias corrected MLE)	0.00366
nu hat (MLE)	195.5	nu star (bias corrected)	123.5
Mean (detects)	0.0283		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:24:06 PM
From File	Labrador Tea, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Molybdenum, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0247
Maximum	0.046	Median	0.023
SD	0.011	CV	0.446
k hat (MLE)	5.269	k star (bias corrected MLE)	3.755
Theta hat (MLE)	0.00468	Theta star (bias corrected MLE)	0.00657
nu hat (MLE)	105.4	nu star (bias corrected)	75.1
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (75.10, α)	56.14	Adjusted Chi Square Value (75.10, β)	53.3
95% Gamma Approximate UCL (use when n>=50)	0.033	95% Gamma Adjusted UCL (use when n<50)	0.0348

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0266	SD (KM)	0.00832
Variance (KM)	6.9240E-5	SE of Mean (KM)	0.00281
k hat (KM)	10.22	k star (KM)	7.22
nu hat (KM)	204.4	nu star (KM)	144.4
theta hat (KM)	0.0026	theta star (KM)	0.00368
80% gamma percentile (KM)	0.0344	90% gamma percentile (KM)	0.0398
95% gamma percentile (KM)	0.0447	99% gamma percentile (KM)	0.0548

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (144.40, α)	117.6	Adjusted Chi Square Value (144.40, β)	113.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.0327	95% Gamma Adjusted KM-UCL (use when n<50)	0.0339

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:24:06 PM
From File	Labrador Tea, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Molybdenum, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0252	Mean in Log Scale	-3.757
SD in Original Scale	0.0103	SD in Log Scale	0.414
95% t UCL (assumes normality of ROS data)	0.0312	95% Percentile Bootstrap UCL	0.0302
95% BCA Bootstrap UCL	0.0313	95% Bootstrap t UCL	0.0327
95% H-UCL (Log ROS)	0.034		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.669	KM Geo Mean	0.0255
KM SD (logged)	0.28	95% Critical H Value (KM-Log)	1.956
KM Standard Error of Mean (logged)	0.0946	95% H-UCL (KM -Log)	0.0318
KM SD (logged)	0.28	95% Critical H Value (KM-Log)	1.956
KM Standard Error of Mean (logged)	0.0946		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0246	Mean in Log Scale	-3.808
SD in Original Scale	0.0111	SD in Log Scale	0.497
95% t UCL (Assumes normality)	0.0311	95% H-Stat UCL	0.0363

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0318

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:24:49 PM
From File	Labrador Tea, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Nickel, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.086	Mean	0.236
Maximum	0.695	Median	0.117
SD	0.232	Std. Error of Mean	0.0733
Coefficient of Variation	0.982	Skewness	1.61

Normal GOF Test

Shapiro Wilk Test Statistic	0.676	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.292	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.37	95% Adjusted-CLT UCL (Chen-1995)	0.396
		95% Modified-t UCL (Johnson-1978)	0.377

Gamma GOF Test

A-D Test Statistic	1.131	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.276	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.271	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.653	k star (bias corrected MLE)	1.224
Theta hat (MLE)	0.143	Theta star (bias corrected MLE)	0.193
nu hat (MLE)	33.06	nu star (bias corrected)	24.47
MLE Mean (bias corrected)	0.236	MLE Sd (bias corrected)	0.213
		Approximate Chi Square Value (0.05)	14.21
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	12.87

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.406	95% Adjusted Gamma UCL (use when n<50)	0.449

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:24:49 PM
From File	Labrador Tea, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Nickel, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.798	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.453	Mean of logged Data	-1.776
Maximum of Logged Data	-0.364	SD of logged Data	0.793

Assuming Lognormal Distribution

95% H-UCL	0.473	90% Chebyshev (MVUE) UCL	0.397
95% Chebyshev (MVUE) UCL	0.476	97.5% Chebyshev (MVUE) UCL	0.586
99% Chebyshev (MVUE) UCL	0.8		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.357	95% Jackknife UCL	0.37
95% Standard Bootstrap UCL	0.35	95% Bootstrap-t UCL	0.74
95% Hall's Bootstrap UCL	1.01	95% Percentile Bootstrap UCL	0.356
95% BCA Bootstrap UCL	0.388		
90% Chebyshev(Mean, Sd) UCL	0.456	95% Chebyshev(Mean, Sd) UCL	0.555
97.5% Chebyshev(Mean, Sd) UCL	0.694	99% Chebyshev(Mean, Sd) UCL	0.965

Suggested UCL to Use

95% H-UCL	0.473

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:24:49 PM
From File	Labrador Tea, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Nickel, mg/kg - dw

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:25:32 PM
From File	Labrador Tea, Phosphorus, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Phosphorus, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	831	Mean	887.3
Maximum	1050	Median	854.8
SD	80.1	Std. Error of Mean	25.33
Coefficient of Variation	0.0903	Skewness	1.613

Normal GOF Test

Shapiro Wilk Test Statistic	0.709	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.311	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	933.7	95% Adjusted-CLT UCL (Chen-1995)	942.8
		95% Modified-t UCL (Johnson-1978)	935.9

Gamma GOF Test

A-D Test Statistic	1.334	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.302	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	146.4	k star (bias corrected MLE)	102.5
Theta hat (MLE)	6.062	Theta star (bias corrected MLE)	8.654
nu hat (MLE)	2927	nu star (bias corrected)	2051
MLE Mean (bias corrected)	887.3	MLE Sd (bias corrected)	87.63
		Approximate Chi Square Value (0.05)	1946
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	1929

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	934.8	95% Adjusted Gamma UCL (use when n<50)	943.4

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:25:32 PM
From File	Labrador Tea, Phosphorus, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Phosphorus, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.723	Mean of logged Data	6.785
Maximum of Logged Data	6.957	SD of logged Data	0.0857

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	959.3
95% Chebyshev (MVUE) UCL	992	97.5% Chebyshev (MVUE) UCL	1037
99% Chebyshev (MVUE) UCL	1126		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	929	95% Jackknife UCL	933.7
95% Standard Bootstrap UCL	927.1	95% Bootstrap-t UCL	1057
95% Hall's Bootstrap UCL	1188	95% Percentile Bootstrap UCL	928.7
95% BCA Bootstrap UCL	944.3		
90% Chebyshev(Mean, Sd) UCL	963.3	95% Chebyshev(Mean, Sd) UCL	997.7
97.5% Chebyshev(Mean, Sd) UCL	1045	99% Chebyshev(Mean, Sd) UCL	1139

Suggested UCL to Use

95% Student's-t UCL	933.7	or 95% Modified-t UCL	935.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:26:15 PM
From File	Labrador Tea, Potassium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Potassium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	3400	Mean	4280
Maximum	4750	Median	4365
SD	417.1	Std. Error of Mean	131.9
Coefficient of Variation	0.0975	Skewness	-1.066

Normal GOF Test

Shapiro Wilk Test Statistic	0.919	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4522	95% Adjusted-CLT UCL (Chen-1995)	4449
		95% Modified-t UCL (Johnson-1978)	4514

Gamma GOF Test

A-D Test Statistic	0.409	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.203	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	109.5	k star (bias corrected MLE)	76.72
Theta hat (MLE)	39.08	Theta star (bias corrected MLE)	55.79
nu hat (MLE)	2190	nu star (bias corrected)	1534
MLE Mean (bias corrected)	4280	MLE Sd (bias corrected)	488.6
		Approximate Chi Square Value (0.05)	1444
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	1429

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4547	95% Adjusted Gamma UCL (use when n<50)	4595

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:26:15 PM
From File	Labrador Tea, Potassium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Potassium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.132	Mean of logged Data	8.357
Maximum of Logged Data	8.466	SD of logged Data	0.103

Assuming Lognormal Distribution

95% H-UCL	4555	90% Chebyshev (MVUE) UCL	4698
95% Chebyshev (MVUE) UCL	4886	97.5% Chebyshev (MVUE) UCL	5149
99% Chebyshev (MVUE) UCL	5664		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4497	95% Jackknife UCL	4522
95% Standard Bootstrap UCL	4482	95% Bootstrap-t UCL	4481
95% Hall's Bootstrap UCL	4462	95% Percentile Bootstrap UCL	4474
95% BCA Bootstrap UCL	4458		
90% Chebyshev(Mean, Sd) UCL	4676	95% Chebyshev(Mean, Sd) UCL	4855
97.5% Chebyshev(Mean, Sd) UCL	5104	99% Chebyshev(Mean, Sd) UCL	5592

Suggested UCL to Use

95% Student's-t UCL 4522

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:26:57 PM
From File	Labrador Tea, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Selenium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Selenium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:27:40 PM
From File	Labrador Tea, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Silver, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Silver, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:28:22 PM
From File	Labrador Tea, Sodium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Sodium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	3
Number of Detects	3	Number of Non-Detects	7
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	11	Minimum Non-Detect	10
Maximum Detect	13	Maximum Non-Detect	10
Variance Detects	1.333	Percent Non-Detects	70%
Mean Detects	12.33	SD Detects	1.155
Median Detects	13	CV Detects	0.0936
Skewness Detects	-1.732	Kurtosis Detects	N/A
Mean of Logged Detects	2.509	SD of Logged Detects	0.0964

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	10.7	KM Standard Error of Mean	0.46
KM SD	1.187	95% KM (BCA) UCL	N/A
95% KM (t) UCL	11.54	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	11.46	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	12.08	95% KM Chebyshev UCL	12.7
97.5% KM Chebyshev UCL	13.57	99% KM Chebyshev UCL	15.28

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	164.6	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0749	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	987.5	nu star (bias corrected)	N/A
Mean (detects)	12.33		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:28:22 PM
From File	Labrador Tea, Sodium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Sodium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	6.137	Mean	9.566
Maximum	13	Median	9.37
SD	2.305	CV	0.241
k hat (MLE)	18.95	k star (bias corrected MLE)	13.33
Theta hat (MLE)	0.505	Theta star (bias corrected MLE)	0.718
nu hat (MLE)	379	nu star (bias corrected)	266.6
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (266.64, α)	229.8	Adjusted Chi Square Value (266.64, β)	223.9
95% Gamma Approximate UCL (use when n>=50)	11.1	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	10.7	SD (KM)	1.187
Variance (KM)	1.41	SE of Mean (KM)	0.46
k hat (KM)	81.2	k star (KM)	56.91
nu hat (KM)	1624	nu star (KM)	1138
theta hat (KM)	0.132	theta star (KM)	0.188
80% gamma percentile (KM)	11.87	90% gamma percentile (KM)	12.55
95% gamma percentile (KM)	13.14	99% gamma percentile (KM)	14.27

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1061	Adjusted Chi Square Value (N/A, β)	1048
95% Gamma Approximate KM-UCL (use when n>=50)	11.48	95% Gamma Adjusted KM-UCL (use when n<50)	11.62

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:28:22 PM
From File	Labrador Tea, Sodium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Sodium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.833	Mean in Log Scale	2.267
SD in Original Scale	2.028	SD in Log Scale	0.203
95% t UCL (assumes normality of ROS data)	11.01	95% Percentile Bootstrap UCL	10.85
95% BCA Bootstrap UCL	10.92	95% Bootstrap t UCL	11.24
95% H-UCL (Log ROS)	11.2		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.365	KM Geo Mean	10.64
KM SD (logged)	0.104	95% Critical H Value (KM-Log)	1.805
KM Standard Error of Mean (logged)	0.0403	95% H-UCL (KM -Log)	11.39
KM SD (logged)	0.104	95% Critical H Value (KM-Log)	1.805
KM Standard Error of Mean (logged)	0.0403		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	7.2	Mean in Log Scale	1.879
SD in Original Scale	3.584	SD in Log Scale	0.437
95% t UCL (Assumes normality)	9.278	95% H-Stat UCL	9.835

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 11.54

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:29:04 PM
From File	Labrador Tea, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Strontium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	4.37	Mean	7.144
Maximum	15.8	Median	4.86
SD	4.364	Std. Error of Mean	1.38
Coefficient of Variation	0.611	Skewness	1.611

Normal GOF Test

Shapiro Wilk Test Statistic	0.659	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.364	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.673	95% Adjusted-CLT UCL (Chen-1995)	10.16
		95% Modified-t UCL (Johnson-1978)	9.791

Gamma GOF Test

A-D Test Statistic	1.501	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.358	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.268	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.091	k star (bias corrected MLE)	2.93
Theta hat (MLE)	1.746	Theta star (bias corrected MLE)	2.438
nu hat (MLE)	81.82	nu star (bias corrected)	58.61
MLE Mean (bias corrected)	7.144	MLE Sd (bias corrected)	4.173
		Approximate Chi Square Value (0.05)	42.01
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	39.58

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.967	95% Adjusted Gamma UCL (use when n<50)	10.58

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:29:04 PM
From File	Labrador Tea, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Strontium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.717	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.336	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.475	Mean of logged Data	1.839
Maximum of Logged Data	2.76	SD of logged Data	0.492

Assuming Lognormal Distribution

95% H-UCL	10.2	90% Chebyshev (MVUE) UCL	10.34
95% Chebyshev (MVUE) UCL	11.85	97.5% Chebyshev (MVUE) UCL	13.94
99% Chebyshev (MVUE) UCL	18.05		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.414	95% Jackknife UCL	9.673
95% Standard Bootstrap UCL	9.303	95% Bootstrap-t UCL	16.43
95% Hall's Bootstrap UCL	19.88	95% Percentile Bootstrap UCL	9.352
95% BCA Bootstrap UCL	9.976		
90% Chebyshev(Mean, Sd) UCL	11.28	95% Chebyshev(Mean, Sd) UCL	13.16
97.5% Chebyshev(Mean, Sd) UCL	15.76	99% Chebyshev(Mean, Sd) UCL	20.88

Suggested UCL to Use

95% Student's-t UCL	9.673	or 95% Modified-t UCL	9.791

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:29:46 PM
From File	Labrador Tea, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Thallium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.0077	Mean	0.014
Maximum	0.0274	Median	0.0128
SD	0.00595	Std. Error of Mean	0.00188
Coefficient of Variation	0.426	Skewness	1.4

Normal GOF Test

Shapiro Wilk Test Statistic	0.871	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.244	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0174	95% Adjusted-CLT UCL (Chen-1995)	0.0179
		95% Modified-t UCL (Johnson-1978)	0.0175

Gamma GOF Test

A-D Test Statistic	0.33	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.189	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.122	k star (bias corrected MLE)	5.052
Theta hat (MLE)	0.00196	Theta star (bias corrected MLE)	0.00276
nu hat (MLE)	142.4	nu star (bias corrected)	101
MLE Mean (bias corrected)	0.014	MLE Sd (bias corrected)	0.00621
		Approximate Chi Square Value (0.05)	78.85
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	75.45

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0179	95% Adjusted Gamma UCL (use when n<50)	0.0187

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:29:46 PM
From File	Labrador Tea, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Thallium, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.169	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.867	Mean of logged Data	-4.344
Maximum of Logged Data	-3.599	SD of logged Data	0.391

Assuming Lognormal Distribution

95% H-UCL	0.0184	90% Chebyshev (MVUE) UCL	0.0191
95% Chebyshev (MVUE) UCL	0.0215	97.5% Chebyshev (MVUE) UCL	0.0248
99% Chebyshev (MVUE) UCL	0.0312		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.017	95% Jackknife UCL	0.0174
95% Standard Bootstrap UCL	0.0168	95% Bootstrap-t UCL	0.0201
95% Hall's Bootstrap UCL	0.0369	95% Percentile Bootstrap UCL	0.0171
95% BCA Bootstrap UCL	0.018		
90% Chebyshev(Mean, Sd) UCL	0.0196	95% Chebyshev(Mean, Sd) UCL	0.0222
97.5% Chebyshev(Mean, Sd) UCL	0.0257	99% Chebyshev(Mean, Sd) UCL	0.0327

Suggested UCL to Use

95% Student's-t UCL	0.0174

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:30:29 PM
From File	Labrador Tea, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Tin, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Tin, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:31:11 PM
From File	Labrador Tea, Titanium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Titanium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Titanium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:31:53 PM
From File	Labrador Tea, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Uranium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Uranium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:32:35 PM
From File	Labrador Tea, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Vanadium, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Labrador Tea, Vanadium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:33:17 PM
From File	Labrador Tea, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Zinc, mg/kg - dw

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	11.9	Mean	13.77
Maximum	14.6	Median	13.98
SD	0.735	Std. Error of Mean	0.233
Coefficient of Variation	0.0534	Skewness	-2.033

Normal GOF Test

Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	14.2	95% Adjusted-CLT UCL (Chen-1995)	13.99
		95% Modified-t UCL (Johnson-1978)	14.17

Gamma GOF Test

A-D Test Statistic	0.987	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.278	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.266	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	365.8	k star (bias corrected MLE)	256.1
Theta hat (MLE)	0.0376	Theta star (bias corrected MLE)	0.0538
nu hat (MLE)	7317	nu star (bias corrected)	5123
MLE Mean (bias corrected)	13.77	MLE Sd (bias corrected)	0.86
		Approximate Chi Square Value (0.05)	4958
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	4929

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.23	95% Adjusted Gamma UCL (use when n<50)	14.31

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2021 8:33:17 PM
From File	Labrador Tea, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Labrador Tea, Zinc, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.762	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.477	Mean of logged Data	2.621
Maximum of Logged Data	2.681	SD of logged Data	0.056

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	14.5
95% Chebyshev (MVUE) UCL	14.83	97.5% Chebyshev (MVUE) UCL	15.29
99% Chebyshev (MVUE) UCL	16.2		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	14.15	95% Jackknife UCL	14.2
95% Standard Bootstrap UCL	14.13	95% Bootstrap-t UCL	14.07
95% Hall's Bootstrap UCL	14.04	95% Percentile Bootstrap UCL	14.09
95% BCA Bootstrap UCL	14.04		
90% Chebyshev(Mean, Sd) UCL	14.47	95% Chebyshev(Mean, Sd) UCL	14.78
97.5% Chebyshev(Mean, Sd) UCL	15.22	99% Chebyshev(Mean, Sd) UCL	16.08

Suggested UCL to Use

95% Student's-t UCL	14.2	or 95% Modified-t UCL	14.17

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ATTACHMENT F

ProUCL Outputs: Soil

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:07:52 PM
From File	Soil, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Aluminum, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	200	Mean	2291
Maximum	12500	Median	1300
SD	2920	Std. Error of Mean	653
Coefficient of Variation	1.275	Skewness	2.602

Normal GOF Test

Shapiro Wilk Test Statistic	0.689	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3420	95% Adjusted-CLT UCL (Chen-1995)	3771
		95% Modified-t UCL (Johnson-1978)	3484

Gamma GOF Test

A-D Test Statistic	0.402	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.77	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.112	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.2	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.966	k star (bias corrected MLE)	0.855
Theta hat (MLE)	2371	Theta star (bias corrected MLE)	2681
nu hat (MLE)	38.65	nu star (bias corrected)	34.18
MLE Mean (bias corrected)	2291	MLE Sd (bias corrected)	2478
		Approximate Chi Square Value (0.05)	21.81
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	21.03

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	3591	95% Adjusted Gamma UCL (use when n<50)	3724

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:07:52 PM
From File	Soil, Aluminum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Aluminum, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0934	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.298	Mean of logged Data	7.137
Maximum of Logged Data	9.433	SD of logged Data	1.132

Assuming Lognormal Distribution

95% H-UCL	4978	90% Chebyshev (MVUE) UCL	4244
95% Chebyshev (MVUE) UCL	5137	97.5% Chebyshev (MVUE) UCL	6376
99% Chebyshev (MVUE) UCL	8810		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3365	95% Jackknife UCL	3420
95% Standard Bootstrap UCL	3314	95% Bootstrap-t UCL	4609
95% Hall's Bootstrap UCL	8319	95% Percentile Bootstrap UCL	3423
95% BCA Bootstrap UCL	3883		
90% Chebyshev(Mean, Sd) UCL	4250	95% Chebyshev(Mean, Sd) UCL	5138
97.5% Chebyshev(Mean, Sd) UCL	6369	99% Chebyshev(Mean, Sd) UCL	8788

Suggested UCL to Use

95% Adjusted Gamma UCL	3724

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:08:34 PM
From File	Soil, Antimony, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Antimony, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Antimony, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:16 PM
From File	Soil, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Arsenic, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	15
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	2.1	Minimum Non-Detect	2
Maximum Detect	21	Maximum Non-Detect	2
Variance Detects	62.14	Percent Non-Detects	75%
Mean Detects	7.16	SD Detects	7.883
Median Detects	3.8	CV Detects	1.101
Skewness Detects	2.041	Kurtosis Detects	4.247
Mean of Logged Detects	1.592	SD of Logged Detects	0.903

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.718	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.343	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	3.29	KM Standard Error of Mean	1.043
KM SD	4.174	95% KM (BCA) UCL	5.135
95% KM (t) UCL	5.094	95% KM (Percentile Bootstrap) UCL	5.1
95% KM (z) UCL	5.006	95% KM Bootstrap t UCL	10.62
90% KM Chebyshev UCL	6.42	95% KM Chebyshev UCL	7.838
97.5% KM Chebyshev UCL	9.806	99% KM Chebyshev UCL	13.67

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.498	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.687	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.264	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.362	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.472	k star (bias corrected MLE)	0.722
Theta hat (MLE)	4.864	Theta star (bias corrected MLE)	9.915
nu hat (MLE)	14.72	nu star (bias corrected)	7.221
Mean (detects)	7.16		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:16 PM
From File	Soil, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Arsenic, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.798
Maximum	21	Median	0.01
SD	4.814	CV	2.678
k hat (MLE)	0.202	k star (bias corrected MLE)	0.205
Theta hat (MLE)	8.909	Theta star (bias corrected MLE)	8.775
nu hat (MLE)	8.071	nu star (bias corrected)	8.194
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (8.19, α)	2.848	Adjusted Chi Square Value (8.19, β)	2.604
95% Gamma Approximate UCL (use when n>=50)	5.172	95% Gamma Adjusted UCL (use when n<50)	5.656

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.29	SD (KM)	4.174
Variance (KM)	17.42	SE of Mean (KM)	1.043
k hat (KM)	0.621	k star (KM)	0.561
nu hat (KM)	24.85	nu star (KM)	22.46
theta hat (KM)	5.295	theta star (KM)	5.86
80% gamma percentile (KM)	5.421	90% gamma percentile (KM)	8.684
95% gamma percentile (KM)	12.12	99% gamma percentile (KM)	20.5

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.46, α)	12.68	Adjusted Chi Square Value (22.46, β)	12.1
95% Gamma Approximate KM-UCL (use when n>=50)	5.826	95% Gamma Adjusted KM-UCL (use when n<50)	6.105

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:16 PM
From File	Soil, Arsenic, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Arsenic, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.964	Mean in Log Scale	-1.361
SD in Original Scale	4.755	SD in Log Scale	2.263
95% t UCL (assumes normality of ROS data)	3.803	95% Percentile Bootstrap UCL	3.798
95% BCA Bootstrap UCL	5.049	95% Bootstrap t UCL	8.56
95% H-UCL (Log ROS)	39.73		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.918	KM Geo Mean	2.504
KM SD (logged)	0.561	95% Critical H Value (KM-Log)	2.08
KM Standard Error of Mean (logged)	0.14	95% H-UCL (KM -Log)	3.83
KM SD (logged)	0.561	95% Critical H Value (KM-Log)	2.08
KM Standard Error of Mean (logged)	0.14		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.54	Mean in Log Scale	0.398
SD in Original Scale	4.536	SD in Log Scale	0.82
95% t UCL (Assumes normality)	4.294	95% H-Stat UCL	3.262

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	6.105

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:59 PM
From File	Soil, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Barium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
Number of Detects	19	Number of Non-Detects	1
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	9.25	Minimum Non-Detect	5
Maximum Detect	380	Maximum Non-Detect	5
Variance Detects	6993	Percent Non-Detects	5%
Mean Detects	66.67	SD Detects	83.62
Median Detects	41	CV Detects	1.254
Skewness Detects	3.235	Kurtosis Detects	11.85
Mean of Logged Detects	3.773	SD of Logged Detects	0.887

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.603	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	63.59	KM Standard Error of Mean	18.49
KM SD	80.46	95% KM (BCA) UCL	94.45
95% KM (t) UCL	95.55	95% KM (Percentile Bootstrap) UCL	96.45
95% KM (z) UCL	93.99	95% KM Bootstrap t UCL	140.3
90% KM Chebyshev UCL	119	95% KM Chebyshev UCL	144.2
97.5% KM Chebyshev UCL	179	99% KM Chebyshev UCL	247.5

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.659	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.203	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.313	k star (bias corrected MLE)	1.14
Theta hat (MLE)	50.79	Theta star (bias corrected MLE)	58.46
nu hat (MLE)	49.88	nu star (bias corrected)	43.34
Mean (detects)	66.67		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:59 PM
From File	Soil, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Barium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	63.34
Maximum	380	Median	39
SD	82.75	CV	1.306
k hat (MLE)	0.753	k star (bias corrected MLE)	0.673
Theta hat (MLE)	84.12	Theta star (bias corrected MLE)	94.06
nu hat (MLE)	30.12	nu star (bias corrected)	26.93
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (26.93, α)	16.1	Adjusted Chi Square Value (26.93, β)	15.44
95% Gamma Approximate UCL (use when n>=50)	106	95% Gamma Adjusted UCL (use when n<50)	110.5

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	63.59	SD (KM)	80.46
Variance (KM)	6474	SE of Mean (KM)	18.49
k hat (KM)	0.625	k star (KM)	0.564
nu hat (KM)	24.98	nu star (KM)	22.57
theta hat (KM)	101.8	theta star (KM)	112.7
80% gamma percentile (KM)	104.8	90% gamma percentile (KM)	167.7
95% gamma percentile (KM)	233.9	99% gamma percentile (KM)	395.1

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.57, α)	12.76	Adjusted Chi Square Value (22.57, β)	12.18
95% Gamma Approximate KM-UCL (use when n>=50)	112.4	95% Gamma Adjusted KM-UCL (use when n<50)	117.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.102	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:09:59 PM
From File	Soil, Barium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Barium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	63.58	Mean in Log Scale	3.664
SD in Original Scale	82.56	SD in Log Scale	0.992
95% t UCL (assumes normality of ROS data)	95.5	95% Percentile Bootstrap UCL	95.99
95% BCA Bootstrap UCL	113.3	95% Bootstrap t UCL	141.5
95% H-UCL (Log ROS)	115.8		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.665	KM Geo Mean	39.04
KM SD (logged)	0.964	95% Critical H Value (KM-Log)	2.582
KM Standard Error of Mean (logged)	0.222	95% H-UCL (KM -Log)	110
KM SD (logged)	0.964	95% Critical H Value (KM-Log)	2.582
KM Standard Error of Mean (logged)	0.222		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	63.46	Mean in Log Scale	3.63
SD in Original Scale	82.65	SD in Log Scale	1.074
95% t UCL (Assumes normality)	95.42	95% H-Stat UCL	131.9

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	117.8	95% GROS Adjusted Gamma UCL	110.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:10:42 PM
From File	Soil, Beryllium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Beryllium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Beryllium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:11:24 PM
From File	Soil, Bismuth, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Bismuth, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Bismuth, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:06 PM
From File	Soil, Boron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Boron, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Boron, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:48 PM
From File	Soil, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cadmium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	10
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	0.37	Minimum Non-Detect	0.3
Maximum Detect	0.71	Maximum Non-Detect	0.3
Variance Detects	0.0124	Percent Non-Detects	50%
Mean Detects	0.493	SD Detects	0.111
Median Detects	0.478	CV Detects	0.226
Skewness Detects	0.676	Kurtosis Detects	-0.172
Mean of Logged Detects	-0.73	SD of Logged Detects	0.22

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.396	KM Standard Error of Mean	0.0287
KM SD	0.122	95% KM (BCA) UCL	0.445
95% KM (t) UCL	0.446	95% KM (Percentile Bootstrap) UCL	0.442
95% KM (z) UCL	0.443	95% KM Bootstrap t UCL	0.456
90% KM Chebyshev UCL	0.482	95% KM Chebyshev UCL	0.521
97.5% KM Chebyshev UCL	0.576	99% KM Chebyshev UCL	0.682

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.362	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.182	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	22.75	k star (bias corrected MLE)	15.99
Theta hat (MLE)	0.0216	Theta star (bias corrected MLE)	0.0308
nu hat (MLE)	455.1	nu star (bias corrected)	319.9
Mean (detects)	0.493		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:48 PM
From File	Soil, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cadmium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0507	Mean	0.348
Maximum	0.71	Median	0.343
SD	0.177	CV	0.509
k hat (MLE)	3.214	k star (bias corrected MLE)	2.766
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	0.126
nu hat (MLE)	128.6	nu star (bias corrected)	110.6
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (110.62, α)	87.35	Adjusted Chi Square Value (110.62, β)	85.71
95% Gamma Approximate UCL (use when n>=50)	0.44	95% Gamma Adjusted UCL (use when n<50)	0.449

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.396	SD (KM)	0.122
Variance (KM)	0.0148	SE of Mean (KM)	0.0287
k hat (KM)	10.59	k star (KM)	9.031
nu hat (KM)	423.4	nu star (KM)	361.3
theta hat (KM)	0.0374	theta star (KM)	0.0439
80% gamma percentile (KM)	0.501	90% gamma percentile (KM)	0.572
95% gamma percentile (KM)	0.635	99% gamma percentile (KM)	0.765

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (361.26, α)	318.2	Adjusted Chi Square Value (361.26, β)	315
95% Gamma Approximate KM-UCL (use when n>=50)	0.45	95% Gamma Adjusted KM-UCL (use when n<50)	0.454

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:12:48 PM
From File	Soil, Cadmium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cadmium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.375	Mean in Log Scale	-1.052
SD in Original Scale	0.147	SD in Log Scale	0.392
95% t UCL (assumes normality of ROS data)	0.432	95% Percentile Bootstrap UCL	0.429
95% BCA Bootstrap UCL	0.435	95% Bootstrap t UCL	0.437
95% H-UCL (Log ROS)	0.448		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.967	KM Geo Mean	0.38
KM SD (logged)	0.279	95% Critical H Value (KM-Log)	1.836
KM Standard Error of Mean (logged)	0.0658	95% H-UCL (KM -Log)	0.445
KM SD (logged)	0.279	95% Critical H Value (KM-Log)	1.836
KM Standard Error of Mean (logged)	0.0658		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.321	Mean in Log Scale	-1.314
SD in Original Scale	0.192	SD in Log Scale	0.617
95% t UCL (Assumes normality)	0.395	95% H-Stat UCL	0.44

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.446

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:13:30 PM
From File	Soil, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Chromium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	15
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	2.15	Minimum Non-Detect	2
Maximum Detect	11.5	Maximum Non-Detect	2
Variance Detects	17.08	Percent Non-Detects	75%
Mean Detects	5.67	SD Detects	4.133
Median Detects	3.7	CV Detects	0.729
Skewness Detects	0.813	Kurtosis Detects	-1.62
Mean of Logged Detects	1.515	SD of Logged Detects	0.744

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.859	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.918	KM Standard Error of Mean	0.609
KM SD	2.437	95% KM (BCA) UCL	3.925
95% KM (t) UCL	3.971	95% KM (Percentile Bootstrap) UCL	3.9
95% KM (z) UCL	3.92	95% KM Bootstrap t UCL	6.195
90% KM Chebyshev UCL	4.746	95% KM Chebyshev UCL	5.574
97.5% KM Chebyshev UCL	6.723	99% KM Chebyshev UCL	8.981

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.404	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.684	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.419	k star (bias corrected MLE)	1.101
Theta hat (MLE)	2.344	Theta star (bias corrected MLE)	5.15
nu hat (MLE)	24.19	nu star (bias corrected)	11.01
Mean (detects)	5.67		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:13:30 PM
From File	Soil, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Chromium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.425
Maximum	11.5	Median	0.01
SD	3.149	CV	2.21
k hat (MLE)	0.213	k star (bias corrected MLE)	0.214
Theta hat (MLE)	6.704	Theta star (bias corrected MLE)	6.659
nu hat (MLE)	8.502	nu star (bias corrected)	8.56
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (8.56, α)	3.063	Adjusted Chi Square Value (8.56, β)	2.809
95% Gamma Approximate UCL (use when n>=50)	3.982	95% Gamma Adjusted UCL (use when n<50)	4.343

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.918	SD (KM)	2.437
Variance (KM)	5.941	SE of Mean (KM)	0.609
k hat (KM)	1.433	k star (KM)	1.251
nu hat (KM)	57.31	nu star (KM)	50.04
theta hat (KM)	2.036	theta star (KM)	2.332
80% gamma percentile (KM)	4.601	90% gamma percentile (KM)	6.356
95% gamma percentile (KM)	8.083	99% gamma percentile (KM)	12.03

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (50.04, α)	34.8	Adjusted Chi Square Value (50.04, β)	33.8
95% Gamma Approximate KM-UCL (use when n>=50)	4.195	95% Gamma Adjusted KM-UCL (use when n<50)	4.32

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:13:30 PM
From File	Soil, Chromium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Chromium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.675	Mean in Log Scale	-0.893
SD in Original Scale	3.048	SD in Log Scale	1.845
95% t UCL (assumes normality of ROS data)	2.853	95% Percentile Bootstrap UCL	2.903
95% BCA Bootstrap UCL	3.351	95% Bootstrap t UCL	4.788
95% H-UCL (Log ROS)	12.36		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.898	KM Geo Mean	2.456
KM SD (logged)	0.487	95% Critical H Value (KM-Log)	2.007
KM Standard Error of Mean (logged)	0.122	95% H-UCL (KM -Log)	3.46
KM SD (logged)	0.487	95% Critical H Value (KM-Log)	2.007
KM Standard Error of Mean (logged)	0.122		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.168	Mean in Log Scale	0.379
SD in Original Scale	2.811	SD in Log Scale	0.754
95% t UCL (Assumes normality)	3.254	95% H-Stat UCL	2.891

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.971

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:13 PM
From File	Soil, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cobalt, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	12
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	1.3	Minimum Non-Detect	1
Maximum Detect	10.75	Maximum Non-Detect	1
Variance Detects	9.824	Percent Non-Detects	60%
Mean Detects	3.656	SD Detects	3.134
Median Detects	2.55	CV Detects	0.857
Skewness Detects	2.001	Kurtosis Detects	4.367
Mean of Logged Detects	1.048	SD of Logged Detects	0.717

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.764	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.063	KM Standard Error of Mean	0.542
KM SD	2.265	95% KM (BCA) UCL	3.018
95% KM (t) UCL	2.999	95% KM (Percentile Bootstrap) UCL	2.983
95% KM (z) UCL	2.953	95% KM Bootstrap t UCL	4.005
90% KM Chebyshev UCL	3.687	95% KM Chebyshev UCL	4.423
97.5% KM Chebyshev UCL	5.444	99% KM Chebyshev UCL	7.451

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.403	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.162	k star (bias corrected MLE)	1.435
Theta hat (MLE)	1.691	Theta star (bias corrected MLE)	2.548
nu hat (MLE)	34.59	nu star (bias corrected)	22.95
Mean (detects)	3.656		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:13 PM
From File	Soil, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cobalt, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.469
Maximum	10.75	Median	0.01
SD	2.642	CV	1.799
k hat (MLE)	0.259	k star (bias corrected MLE)	0.253
Theta hat (MLE)	5.672	Theta star (bias corrected MLE)	5.796
nu hat (MLE)	10.36	nu star (bias corrected)	10.14
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (10.14, α)	4.027	Adjusted Chi Square Value (10.14, β)	3.726
95% Gamma Approximate UCL (use when n>=50)	3.696	95% Gamma Adjusted UCL (use when n<50)	3.994

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.063	SD (KM)	2.265
Variance (KM)	5.132	SE of Mean (KM)	0.542
k hat (KM)	0.829	k star (KM)	0.738
nu hat (KM)	33.16	nu star (KM)	29.52
theta hat (KM)	2.488	theta star (KM)	2.795
80% gamma percentile (KM)	3.384	90% gamma percentile (KM)	5.113
95% gamma percentile (KM)	6.888	99% gamma percentile (KM)	11.11

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (29.52, α)	18.11	Adjusted Chi Square Value (29.52, β)	17.41
95% Gamma Approximate KM-UCL (use when n>=50)	3.361	95% Gamma Adjusted KM-UCL (use when n<50)	3.497

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.165	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:13 PM
From File	Soil, Cobalt, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Cobalt, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.672	Mean in Log Scale	-0.393
SD in Original Scale	2.533	SD in Log Scale	1.448
95% t UCL (assumes normality of ROS data)	2.652	95% Percentile Bootstrap UCL	2.675
95% BCA Bootstrap UCL	3.019	95% Bootstrap t UCL	3.504
95% H-UCL (Log ROS)	5.846		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.419	KM Geo Mean	1.521
KM SD (logged)	0.666	95% Critical H Value (KM-Log)	2.196
KM Standard Error of Mean (logged)	0.159	95% H-UCL (KM -Log)	2.654
KM SD (logged)	0.666	95% Critical H Value (KM-Log)	2.196
KM Standard Error of Mean (logged)	0.159		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.763	Mean in Log Scale	0.0032
SD in Original Scale	2.477	SD in Log Scale	0.977
95% t UCL (Assumes normality)	2.72	95% H-Stat UCL	2.897

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.999

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:56 PM
From File	Soil, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Copper, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
Number of Detects	18	Number of Non-Detects	2
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	3.1	Minimum Non-Detect	2
Maximum Detect	28	Maximum Non-Detect	2
Variance Detects	31.79	Percent Non-Detects	10%
Mean Detects	6.489	SD Detects	5.639
Median Detects	4.7	CV Detects	0.869
Skewness Detects	3.612	Kurtosis Detects	14.19
Mean of Logged Detects	1.698	SD of Logged Detects	0.517

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.525	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.202	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.04	KM Standard Error of Mean	1.236
KM SD	5.37	95% KM (BCA) UCL	8.345
95% KM (t) UCL	8.177	95% KM (Percentile Bootstrap) UCL	8.315
95% KM (z) UCL	8.072	95% KM Bootstrap t UCL	11.2
90% KM Chebyshev UCL	9.747	95% KM Chebyshev UCL	11.43
97.5% KM Chebyshev UCL	13.76	99% KM Chebyshev UCL	18.33

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.488	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.746	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.185	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.055	k star (bias corrected MLE)	2.582
Theta hat (MLE)	2.124	Theta star (bias corrected MLE)	2.513
nu hat (MLE)	110	nu star (bias corrected)	92.97
Mean (detects)	6.489		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:56 PM
From File	Soil, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Copper, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	5.841
Maximum	28	Median	4.4
SD	5.694	CV	0.975
k hat (MLE)	0.845	k star (bias corrected MLE)	0.751
Theta hat (MLE)	6.915	Theta star (bias corrected MLE)	7.774
nu hat (MLE)	33.79	nu star (bias corrected)	30.05
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (30.05, α)	18.54	Adjusted Chi Square Value (30.05, β)	17.82
95% Gamma Approximate UCL (use when n>=50)	9.471	95% Gamma Adjusted UCL (use when n<50)	9.85

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.04	SD (KM)	5.37
Variance (KM)	28.84	SE of Mean (KM)	1.236
k hat (KM)	1.265	k star (KM)	1.109
nu hat (KM)	50.6	nu star (KM)	44.35
theta hat (KM)	4.774	theta star (KM)	5.448
80% gamma percentile (KM)	9.635	90% gamma percentile (KM)	13.56
95% gamma percentile (KM)	17.45	99% gamma percentile (KM)	26.42

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (44.35, α)	30.07	Adjusted Chi Square Value (44.35, β)	29.14
95% Gamma Approximate KM-UCL (use when n>=50)	8.907	95% Gamma Adjusted KM-UCL (use when n<50)	9.191

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.149	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:14:56 PM
From File	Soil, Copper, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Copper, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.017	Mean in Log Scale	1.584
SD in Original Scale	5.528	SD in Log Scale	0.602
95% t UCL (assumes normality of ROS data)	8.154	95% Percentile Bootstrap UCL	8.282
95% BCA Bootstrap UCL	9.285	95% Bootstrap t UCL	11.1
95% H-UCL (Log ROS)	7.835		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.597	KM Geo Mean	4.939
KM SD (logged)	0.564	95% Critical H Value (KM-Log)	2.084
KM Standard Error of Mean (logged)	0.13	95% H-UCL (KM -Log)	7.584
KM SD (logged)	0.564	95% Critical H Value (KM-Log)	2.084
KM Standard Error of Mean (logged)	0.13		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	5.94	Mean in Log Scale	1.528
SD in Original Scale	5.595	SD in Log Scale	0.716
95% t UCL (Assumes normality)	8.103	95% H-Stat UCL	8.623

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	9.191	95% GROS Adjusted Gamma UCL	9.85

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:15:38 PM
From File	Soil, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Iron, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	230	Mean	4459
Maximum	22000	Median	1750
SD	5903	Std. Error of Mean	1320
Coefficient of Variation	1.324	Skewness	1.846

Normal GOF Test

Shapiro Wilk Test Statistic	0.739	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	6742	95% Adjusted-CLT UCL (Chen-1995)	7213
		95% Modified-t UCL (Johnson-1978)	6832

Gamma GOF Test

A-D Test Statistic	0.64	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.784	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.169	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.202	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.7	k star (bias corrected MLE)	0.629
Theta hat (MLE)	6367	Theta star (bias corrected MLE)	7094
nu hat (MLE)	28.01	nu star (bias corrected)	25.14
MLE Mean (bias corrected)	4459	MLE Sd (bias corrected)	5624
		Approximate Chi Square Value (0.05)	14.72
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	14.09

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	7616	95% Adjusted Gamma UCL (use when n<50)	7956

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:15:38 PM
From File	Soil, Iron, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Iron, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.126	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.438	Mean of logged Data	7.54
Maximum of Logged Data	9.999	SD of logged Data	1.41

Assuming Lognormal Distribution

95% H-UCL	14677	90% Chebyshev (MVUE) UCL	9874
95% Chebyshev (MVUE) UCL	12237	97.5% Chebyshev (MVUE) UCL	15517
99% Chebyshev (MVUE) UCL	21960		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6630	95% Jackknife UCL	6742
95% Standard Bootstrap UCL	6606	95% Bootstrap-t UCL	8091
95% Hall's Bootstrap UCL	7468	95% Percentile Bootstrap UCL	6723
95% BCA Bootstrap UCL	7190		
90% Chebyshev(Mean, Sd) UCL	8419	95% Chebyshev(Mean, Sd) UCL	10213
97.5% Chebyshev(Mean, Sd) UCL	12703	99% Chebyshev(Mean, Sd) UCL	17593

Suggested UCL to Use

95% Adjusted Gamma UCL	7956

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:16:20 PM
From File	Soil, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lead, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	5.8	Mean	21.14
Maximum	53	Median	19
SD	11.96	Std. Error of Mean	2.674
Coefficient of Variation	0.566	Skewness	1.419

Normal GOF Test

Shapiro Wilk Test Statistic	0.876	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	25.76	95% Adjusted-CLT UCL (Chen-1995)	26.44
		95% Modified-t UCL (Johnson-1978)	25.9

Gamma GOF Test

A-D Test Statistic	0.223	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.103	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.758	k star (bias corrected MLE)	3.227
Theta hat (MLE)	5.626	Theta star (bias corrected MLE)	6.55
nu hat (MLE)	150.3	nu star (bias corrected)	129.1
MLE Mean (bias corrected)	21.14	MLE Sd (bias corrected)	11.77
		Approximate Chi Square Value (0.05)	103.9
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	102.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	26.28	95% Adjusted Gamma UCL (use when n<50)	26.74

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:16:20 PM
From File	Soil, Lead, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lead, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.987	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0902	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.758	Mean of logged Data	2.912
Maximum of Logged Data	3.97	SD of logged Data	0.544

Assuming Lognormal Distribution

95% H-UCL	27.58	90% Chebyshev (MVUE) UCL	29.2
95% Chebyshev (MVUE) UCL	32.84	97.5% Chebyshev (MVUE) UCL	37.9
99% Chebyshev (MVUE) UCL	47.83		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	25.54	95% Jackknife UCL	25.76
95% Standard Bootstrap UCL	25.37	95% Bootstrap-t UCL	27.58
95% Hall's Bootstrap UCL	30.52	95% Percentile Bootstrap UCL	25.72
95% BCA Bootstrap UCL	26.25		
90% Chebyshev(Mean, Sd) UCL	29.16	95% Chebyshev(Mean, Sd) UCL	32.79
97.5% Chebyshev(Mean, Sd) UCL	37.84	99% Chebyshev(Mean, Sd) UCL	47.74

Suggested UCL to Use

95% Student's-t UCL	25.76

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:02 PM
From File	Soil, Lithium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lithium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	17
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	2.6	Minimum Non-Detect	2
Maximum Detect	4.5	Maximum Non-Detect	2
Variance Detects	0.916	Percent Non-Detects	85%
Mean Detects	3.483	SD Detects	0.957
Median Detects	3.35	CV Detects	0.275
Skewness Detects	0.615	Kurtosis Detects	N/A
Mean of Logged Detects	1.223	SD of Logged Detects	0.275

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.223	KM Standard Error of Mean	0.167
KM SD	0.61	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.511	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.497	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.724	95% KM Chebyshev UCL	2.951
97.5% KM Chebyshev UCL	3.266	99% KM Chebyshev UCL	3.885

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	20.05	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.174	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	120.3	nu star (bias corrected)	N/A
Mean (detects)	3.483		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:02 PM
From File	Soil, Lithium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lithium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.687
Maximum	4.5	Median	0.01
SD	1.302	CV	1.894
k hat (MLE)	0.276	k star (bias corrected MLE)	0.268
Theta hat (MLE)	2.494	Theta star (bias corrected MLE)	2.568
nu hat (MLE)	11.03	nu star (bias corrected)	10.71
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (10.71, α)	4.388	Adjusted Chi Square Value (10.71, β)	4.073
95% Gamma Approximate UCL (use when n>=50)	1.677	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.223	SD (KM)	0.61
Variance (KM)	0.372	SE of Mean (KM)	0.167
k hat (KM)	13.27	k star (KM)	11.32
nu hat (KM)	531	nu star (KM)	452.6
theta hat (KM)	0.167	theta star (KM)	0.196
80% gamma percentile (KM)	2.751	90% gamma percentile (KM)	3.1
95% gamma percentile (KM)	3.409	99% gamma percentile (KM)	4.04

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (452.65, α)	404.3	Adjusted Chi Square Value (452.65, β)	400.7
95% Gamma Approximate KM-UCL (use when n>=50)	2.488	95% Gamma Adjusted KM-UCL (use when n<50)	2.511

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.998	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:02 PM
From File	Soil, Lithium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Lithium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.2	Mean in Log Scale	-0.185
SD in Original Scale	1.129	SD in Log Scale	0.884
95% t UCL (assumes normality of ROS data)	1.636	95% Percentile Bootstrap UCL	1.638
95% BCA Bootstrap UCL	1.703	95% Bootstrap t UCL	1.852
95% H-UCL (Log ROS)	2.027		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.773	KM Geo Mean	2.165
KM SD (logged)	0.208	95% Critical H Value (KM-Log)	1.791
KM Standard Error of Mean (logged)	0.057	95% H-UCL (KM -Log)	2.41
KM SD (logged)	0.208	95% Critical H Value (KM-Log)	1.791
KM Standard Error of Mean (logged)	0.057		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.373	Mean in Log Scale	0.183
SD in Original Scale	0.961	SD in Log Scale	0.457
95% t UCL (Assumes normality)	1.744	95% H-Stat UCL	1.641

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.511

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:45 PM
From File	Soil, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Manganese, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	23	Mean	272.3
Maximum	965	Median	215
SD	241.6	Std. Error of Mean	54.03
Coefficient of Variation	0.887	Skewness	1.416

Normal GOF Test

Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	365.7	95% Adjusted-CLT UCL (Chen-1995)	379.4
		95% Modified-t UCL (Johnson-1978)	368.5

Gamma GOF Test

A-D Test Statistic	0.159	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0815	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.319	k star (bias corrected MLE)	1.155
Theta hat (MLE)	206.4	Theta star (bias corrected MLE)	235.8
nu hat (MLE)	52.76	nu star (bias corrected)	46.18
MLE Mean (bias corrected)	272.3	MLE Sd (bias corrected)	253.4
		Approximate Chi Square Value (0.05)	31.59
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	30.64

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	398	95% Adjusted Gamma UCL (use when n<50)	410.4

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:17:45 PM
From File	Soil, Manganese, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Manganese, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.135	Mean of logged Data	5.182
Maximum of Logged Data	6.872	SD of logged Data	1.027

Assuming Lognormal Distribution

95% H-UCL	566.6	90% Chebyshev (MVUE) UCL	515.5
95% Chebyshev (MVUE) UCL	617.4	97.5% Chebyshev (MVUE) UCL	758.9
99% Chebyshev (MVUE) UCL	1037		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	361.1	95% Jackknife UCL	365.7
95% Standard Bootstrap UCL	357.8	95% Bootstrap-t UCL	395.8
95% Hall's Bootstrap UCL	409.5	95% Percentile Bootstrap UCL	356.9
95% BCA Bootstrap UCL	375.5		
90% Chebyshev(Mean, Sd) UCL	434.3	95% Chebyshev(Mean, Sd) UCL	507.8
97.5% Chebyshev(Mean, Sd) UCL	609.7	99% Chebyshev(Mean, Sd) UCL	809.8

Suggested UCL to Use

95% Student's-t UCL	365.7

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:18:27 PM
From File	Soil, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Mercury, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
Number of Detects	17	Number of Non-Detects	3
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	0.13	Minimum Non-Detect	0.1
Maximum Detect	0.46	Maximum Non-Detect	0.1
Variance Detects	0.00839	Percent Non-Detects	15%
Mean Detects	0.284	SD Detects	0.0916
Median Detects	0.28	CV Detects	0.323
Skewness Detects	0.26	Kurtosis Detects	-0.583
Mean of Logged Detects	-1.312	SD of Logged Detects	0.341

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.207	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.256	KM Standard Error of Mean	0.0242
KM SD	0.105	95% KM (BCA) UCL	0.296
95% KM (t) UCL	0.298	95% KM (Percentile Bootstrap) UCL	0.295
95% KM (z) UCL	0.296	95% KM Bootstrap t UCL	0.3
90% KM Chebyshev UCL	0.329	95% KM Chebyshev UCL	0.362
97.5% KM Chebyshev UCL	0.407	99% KM Chebyshev UCL	0.497

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.222	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.121	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.209	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	9.74	k star (bias corrected MLE)	8.061
Theta hat (MLE)	0.0291	Theta star (bias corrected MLE)	0.0352
nu hat (MLE)	331.2	nu star (bias corrected)	274.1
Mean (detects)	0.284		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:18:27 PM
From File	Soil, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Mercury, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0804	Mean	0.257
Maximum	0.46	Median	0.253
SD	0.107	CV	0.416
k hat (MLE)	5.301	k star (bias corrected MLE)	4.539
Theta hat (MLE)	0.0485	Theta star (bias corrected MLE)	0.0566
nu hat (MLE)	212.1	nu star (bias corrected)	181.6
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (181.58, α)	151.4	Adjusted Chi Square Value (181.58, β)	149.2
95% Gamma Approximate UCL (use when n>=50)	0.308	95% Gamma Adjusted UCL (use when n<50)	0.313

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.256	SD (KM)	0.105
Variance (KM)	0.011	SE of Mean (KM)	0.0242
k hat (KM)	5.957	k star (KM)	5.097
nu hat (KM)	238.3	nu star (KM)	203.9
theta hat (KM)	0.043	theta star (KM)	0.0503
80% gamma percentile (KM)	0.344	90% gamma percentile (KM)	0.408
95% gamma percentile (KM)	0.467	99% gamma percentile (KM)	0.591

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (203.89, α)	171.8	Adjusted Chi Square Value (203.89, β)	169.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.304	95% Gamma Adjusted KM-UCL (use when n<50)	0.308

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.207	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:18:27 PM
From File	Soil, Mercury, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Mercury, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.26	Mean in Log Scale	-1.43
SD in Original Scale	0.103	SD in Log Scale	0.428
95% t UCL (assumes normality of ROS data)	0.299	95% Percentile Bootstrap UCL	0.297
95% BCA Bootstrap UCL	0.297	95% Bootstrap t UCL	0.301
95% H-UCL (Log ROS)	0.318		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.46	KM Geo Mean	0.232
KM SD (logged)	0.467	95% Critical H Value (KM-Log)	1.988
KM Standard Error of Mean (logged)	0.108	95% H-UCL (KM -Log)	0.32
KM SD (logged)	0.467	95% Critical H Value (KM-Log)	1.988
KM Standard Error of Mean (logged)	0.108		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.249	Mean in Log Scale	-1.564
SD in Original Scale	0.12	SD in Log Scale	0.692
95% t UCL (Assumes normality)	0.295	95% H-Stat UCL	0.378

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.298

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:10 PM
From File	Soil, Molybdenum, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Molybdenum, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Molybdenum, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:53 PM
From File	Soil, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Nickel, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	14	Number of Non-Detects	6
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	2.1	Minimum Non-Detect	2
Maximum Detect	9.3	Maximum Non-Detect	2
Variance Detects	3.695	Percent Non-Detects	30%
Mean Detects	3.261	SD Detects	1.922
Median Detects	2.55	CV Detects	0.589
Skewness Detects	2.776	Kurtosis Detects	8.254
Mean of Logged Detects	1.082	SD of Logged Detects	0.412

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.607	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.329	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.226	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.883	KM Standard Error of Mean	0.384
KM SD	1.654	95% KM (BCA) UCL	3.628
95% KM (t) UCL	3.546	95% KM (Percentile Bootstrap) UCL	3.565
95% KM (z) UCL	3.514	95% KM Bootstrap t UCL	4.674
90% KM Chebyshev UCL	4.034	95% KM Chebyshev UCL	4.555
97.5% KM Chebyshev UCL	5.279	99% KM Chebyshev UCL	6.701

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.637	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.738	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.229	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.189	k star (bias corrected MLE)	4.124
Theta hat (MLE)	0.628	Theta star (bias corrected MLE)	0.791
nu hat (MLE)	145.3	nu star (bias corrected)	115.5
Mean (detects)	3.261		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:53 PM
From File	Soil, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Nickel, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.352
Maximum	9.3	Median	2.35
SD	2.14	CV	0.91
k hat (MLE)	0.659	k star (bias corrected MLE)	0.593
Theta hat (MLE)	3.572	Theta star (bias corrected MLE)	3.966
nu hat (MLE)	26.34	nu star (bias corrected)	23.72
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (23.72, α)	13.64	Adjusted Chi Square Value (23.72, β)	13.03
95% Gamma Approximate UCL (use when n>=50)	4.092	95% Gamma Adjusted UCL (use when n<50)	4.281

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.883	SD (KM)	1.654
Variance (KM)	2.735	SE of Mean (KM)	0.384
k hat (KM)	3.038	k star (KM)	2.615
nu hat (KM)	121.5	nu star (KM)	104.6
theta hat (KM)	0.949	theta star (KM)	1.102
80% gamma percentile (KM)	4.18	90% gamma percentile (KM)	5.271
95% gamma percentile (KM)	6.297	99% gamma percentile (KM)	8.537

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (104.61, α)	82.01	Adjusted Chi Square Value (104.61, β)	80.43
95% Gamma Approximate KM-UCL (use when n>=50)	3.677	95% Gamma Adjusted KM-UCL (use when n<50)	3.749

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.752	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.265	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.226	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:19:53 PM
From File	Soil, Nickel, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Nickel, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.634	Mean in Log Scale	0.799
SD in Original Scale	1.874	SD in Log Scale	0.574
95% t UCL (assumes normality of ROS data)	3.359	95% Percentile Bootstrap UCL	3.388
95% BCA Bootstrap UCL	3.67	95% Bootstrap t UCL	4.036
95% H-UCL (Log ROS)	3.451		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.966	KM Geo Mean	2.627
KM SD (logged)	0.377	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.0875	95% H-UCL (KM -Log)	3.327
KM SD (logged)	0.377	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.0875		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.583	Mean in Log Scale	0.758
SD in Original Scale	1.913	SD in Log Scale	0.613
95% t UCL (Assumes normality)	3.322	95% H-Stat UCL	3.475

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.546	KM H-UCL	3.327
95% KM (BCA) UCL	3.628		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:20:35 PM
From File	Soil, Rubidium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Rubidium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	7
Number of Detects	7	Number of Non-Detects	13
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	3.2	Maximum Non-Detect	2
Variance Detects	0.18	Percent Non-Detects	65%
Mean Detects	2.393	SD Detects	0.425
Median Detects	2.2	CV Detects	0.177
Skewness Detects	1.363	Kurtosis Detects	1.334
Mean of Logged Detects	0.86	SD of Logged Detects	0.166

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.138	KM Standard Error of Mean	0.0721
KM SD	0.299	95% KM (BCA) UCL	2.255
95% KM (t) UCL	2.262	95% KM (Percentile Bootstrap) UCL	2.255
95% KM (z) UCL	2.256	95% KM Bootstrap t UCL	2.418
90% KM Chebyshev UCL	2.354	95% KM Chebyshev UCL	2.452
97.5% KM Chebyshev UCL	2.588	99% KM Chebyshev UCL	2.855

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.458	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	40.61	k star (bias corrected MLE)	23.3
Theta hat (MLE)	0.0589	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	568.6	nu star (bias corrected)	326.2
Mean (detects)	2.393		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:20:35 PM
From File	Soil, Rubidium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Rubidium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.109	Mean	1.497
Maximum	3.2	Median	1.429
SD	0.811	CV	0.542
k hat (MLE)	2.52	k star (bias corrected MLE)	2.175
Theta hat (MLE)	0.594	Theta star (bias corrected MLE)	0.688
nu hat (MLE)	100.8	nu star (bias corrected)	87
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (87.00, α)	66.5	Adjusted Chi Square Value (87.00, β)	65.08
95% Gamma Approximate UCL (use when n>=50)	1.959	95% Gamma Adjusted UCL (use when n<50)	2.002

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.138	SD (KM)	0.299
Variance (KM)	0.0892	SE of Mean (KM)	0.0721
k hat (KM)	51.21	k star (KM)	43.56
nu hat (KM)	2048	nu star (KM)	1742
theta hat (KM)	0.0417	theta star (KM)	0.0491
80% gamma percentile (KM)	2.404	90% gamma percentile (KM)	2.562
95% gamma percentile (KM)	2.697	99% gamma percentile (KM)	2.962

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1647	Adjusted Chi Square Value (N/A, β)	1639
95% Gamma Approximate KM-UCL (use when n>=50)	2.262	95% Gamma Adjusted KM-UCL (use when n<50)	2.272

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.238	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:20:35 PM
From File	Soil, Rubidium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Rubidium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.704	Mean in Log Scale	0.473
SD in Original Scale	0.615	SD in Log Scale	0.356
95% t UCL (assumes normality of ROS data)	1.942	95% Percentile Bootstrap UCL	1.928
95% BCA Bootstrap UCL	1.955	95% Bootstrap t UCL	1.981
95% H-UCL (Log ROS)	1.995		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.752	KM Geo Mean	2.12
KM SD (logged)	0.121	95% Critical H Value (KM-Log)	1.743
KM Standard Error of Mean (logged)	0.0292	95% H-UCL (KM -Log)	2.242
KM SD (logged)	0.121	95% Critical H Value (KM-Log)	1.743
KM Standard Error of Mean (logged)	0.0292		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.488	Mean in Log Scale	0.301
SD in Original Scale	0.722	SD in Log Scale	0.431
95% t UCL (Assumes normality)	1.767	95% H-Stat UCL	1.799

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.262

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:21:18 PM
From File	Soil, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Selenium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	12
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.52	Minimum Non-Detect	0.5
Maximum Detect	0.84	Maximum Non-Detect	0.5
Variance Detects	0.0112	Percent Non-Detects	60%
Mean Detects	0.635	SD Detects	0.106
Median Detects	0.605	CV Detects	0.166
Skewness Detects	1.08	Kurtosis Detects	0.798
Mean of Logged Detects	-0.465	SD of Logged Detects	0.159

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.554	KM Standard Error of Mean	0.0218
KM SD	0.091	95% KM (BCA) UCL	0.587
95% KM (t) UCL	0.592	95% KM (Percentile Bootstrap) UCL	0.589
95% KM (z) UCL	0.59	95% KM Bootstrap t UCL	0.606
90% KM Chebyshev UCL	0.619	95% KM Chebyshev UCL	0.649
97.5% KM Chebyshev UCL	0.69	99% KM Chebyshev UCL	0.77

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.293	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.206	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.293	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	44.15	k star (bias corrected MLE)	27.68
Theta hat (MLE)	0.0144	Theta star (bias corrected MLE)	0.0229
nu hat (MLE)	706.4	nu star (bias corrected)	442.9
Mean (detects)	0.635		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:21:18 PM
From File	Soil, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Selenium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.107	Mean	0.441
Maximum	0.84	Median	0.423
SD	0.194	CV	0.44
k hat (MLE)	4.65	k star (bias corrected MLE)	3.986
Theta hat (MLE)	0.0947	Theta star (bias corrected MLE)	0.111
nu hat (MLE)	186	nu star (bias corrected)	159.4
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (159.44, α)	131.2	Adjusted Chi Square Value (159.44, β)	129.2
95% Gamma Approximate UCL (use when n>=50)	0.535	95% Gamma Adjusted UCL (use when n<50)	0.544

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.554	SD (KM)	0.091
Variance (KM)	0.00828	SE of Mean (KM)	0.0218
k hat (KM)	37.05	k star (KM)	31.53
nu hat (KM)	1482	nu star (KM)	1261
theta hat (KM)	0.015	theta star (KM)	0.0176
80% gamma percentile (KM)	0.635	90% gamma percentile (KM)	0.684
95% gamma percentile (KM)	0.726	99% gamma percentile (KM)	0.809

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1180	Adjusted Chi Square Value (N/A, β)	1173
95% Gamma Approximate KM-UCL (use when n>=50)	0.592	95% Gamma Adjusted KM-UCL (use when n<50)	0.595

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.191	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:21:18 PM
From File	Soil, Selenium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Selenium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.479	Mean in Log Scale	-0.785
SD in Original Scale	0.155	SD in Log Scale	0.322
95% t UCL (assumes normality of ROS data)	0.539	95% Percentile Bootstrap UCL	0.534
95% BCA Bootstrap UCL	0.539	95% Bootstrap t UCL	0.545
95% H-UCL (Log ROS)	0.551		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.602	KM Geo Mean	0.548
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.756
KM Standard Error of Mean (logged)	0.0349	95% H-UCL (KM -Log)	0.587
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.756
KM Standard Error of Mean (logged)	0.0349		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.404	Mean in Log Scale	-1.018
SD in Original Scale	0.204	SD in Log Scale	0.473
95% t UCL (Assumes normality)	0.483	95% H-Stat UCL	0.502

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.592

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:01 PM
From File	Soil, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Silver, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	13
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.56	Minimum Non-Detect	0.5
Maximum Detect	1.3	Maximum Non-Detect	0.5
Variance Detects	0.0842	Percent Non-Detects	65%
Mean Detects	0.919	SD Detects	0.29
Median Detects	0.925	CV Detects	0.316
Skewness Detects	0.073	Kurtosis Detects	-1.968
Mean of Logged Detects	-0.129	SD of Logged Detects	0.328

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.647	KM Standard Error of Mean	0.0617
KM SD	0.255	95% KM (BCA) UCL	0.748
95% KM (t) UCL	0.753	95% KM (Percentile Bootstrap) UCL	0.75
95% KM (z) UCL	0.748	95% KM Bootstrap t UCL	0.762
90% KM Chebyshev UCL	0.832	95% KM Chebyshev UCL	0.916
97.5% KM Chebyshev UCL	1.032	99% KM Chebyshev UCL	1.261

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.37	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	11.28	k star (bias corrected MLE)	6.542
Theta hat (MLE)	0.0815	Theta star (bias corrected MLE)	0.141
nu hat (MLE)	157.9	nu star (bias corrected)	91.59
Mean (detects)	0.919		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:01 PM
From File	Soil, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Silver, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.42
Maximum	1.3	Median	0.3
SD	0.43	CV	1.025
k hat (MLE)	0.601	k star (bias corrected MLE)	0.544
Theta hat (MLE)	0.699	Theta star (bias corrected MLE)	0.772
nu hat (MLE)	24.03	nu star (bias corrected)	21.76
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (21.76, α)	12.16	Adjusted Chi Square Value (21.76, β)	11.59
95% Gamma Approximate UCL (use when n>=50)	0.751	95% Gamma Adjusted UCL (use when n<50)	0.788

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.647	SD (KM)	0.255
Variance (KM)	0.0652	SE of Mean (KM)	0.0617
k hat (KM)	6.411	k star (KM)	5.483
nu hat (KM)	256.5	nu star (KM)	219.3
theta hat (KM)	0.101	theta star (KM)	0.118
80% gamma percentile (KM)	0.861	90% gamma percentile (KM)	1.016
95% gamma percentile (KM)	1.158	99% gamma percentile (KM)	1.455

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (219.32, α)	186	Adjusted Chi Square Value (219.32, β)	183.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.762	95% Gamma Adjusted KM-UCL (use when n<50)	0.772

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:01 PM
From File	Soil, Silver, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Silver, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.521	Mean in Log Scale	-0.866
SD in Original Scale	0.354	SD in Log Scale	0.679
95% t UCL (assumes normality of ROS data)	0.658	95% Percentile Bootstrap UCL	0.655
95% BCA Bootstrap UCL	0.674	95% Bootstrap t UCL	0.688
95% H-UCL (Log ROS)	0.747		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.496	KM Geo Mean	0.609
KM SD (logged)	0.324	95% Critical H Value (KM-Log)	1.868
KM Standard Error of Mean (logged)	0.0781	95% H-UCL (KM -Log)	0.737
KM SD (logged)	0.324	95% Critical H Value (KM-Log)	1.868
KM Standard Error of Mean (logged)	0.0781		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.484	Mean in Log Scale	-0.946
SD in Original Scale	0.366	SD in Log Scale	0.642
95% t UCL (Assumes normality)	0.626	95% H-Stat UCL	0.657

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.753

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:44 PM
From File	Soil, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Strontium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	16
Number of Detects	18	Number of Non-Detects	2
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	10.1	Minimum Non-Detect	5
Maximum Detect	61	Maximum Non-Detect	5
Variance Detects	158	Percent Non-Detects	10%
Mean Detects	21.64	SD Detects	12.57
Median Detects	15.5	CV Detects	0.581
Skewness Detects	1.954	Kurtosis Detects	4.782
Mean of Logged Detects	2.952	SD of Logged Detects	0.485

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.778	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	19.98	KM Standard Error of Mean	2.903
KM SD	12.62	95% KM (BCA) UCL	25.38
95% KM (t) UCL	25	95% KM (Percentile Bootstrap) UCL	24.98
95% KM (z) UCL	24.76	95% KM Bootstrap t UCL	26.63
90% KM Chebyshev UCL	28.69	95% KM Chebyshev UCL	32.64
97.5% KM Chebyshev UCL	38.11	99% KM Chebyshev UCL	48.87

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.842	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.743	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.22	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.204	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.224	k star (bias corrected MLE)	3.557
Theta hat (MLE)	5.124	Theta star (bias corrected MLE)	6.085
nu hat (MLE)	152.1	nu star (bias corrected)	128.1
Mean (detects)	21.64		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:44 PM
From File	Soil, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Strontium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	19.58
Maximum	61	Median	15
SD	13.48	CV	0.689
k hat (MLE)	1.11	k star (bias corrected MLE)	0.977
Theta hat (MLE)	17.63	Theta star (bias corrected MLE)	20.04
nu hat (MLE)	44.42	nu star (bias corrected)	39.09
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (39.09, α)	25.77	Adjusted Chi Square Value (39.09, β)	24.91
95% Gamma Approximate UCL (use when n>=50)	29.7	95% Gamma Adjusted UCL (use when n<50)	30.72

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	19.98	SD (KM)	12.62
Variance (KM)	159.2	SE of Mean (KM)	2.903
k hat (KM)	2.507	k star (KM)	2.165
nu hat (KM)	100.3	nu star (KM)	86.58
theta hat (KM)	7.969	theta star (KM)	9.23
80% gamma percentile (KM)	29.63	90% gamma percentile (KM)	38.15
95% gamma percentile (KM)	46.23	99% gamma percentile (KM)	64.08

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (86.58, α)	66.13	Adjusted Chi Square Value (86.58, β)	64.72
95% Gamma Approximate KM-UCL (use when n>=50)	26.16	95% Gamma Adjusted KM-UCL (use when n<50)	26.73

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:22:44 PM
From File	Soil, Strontium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Strontium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	20.1	Mean in Log Scale	2.839
SD in Original Scale	12.8	SD in Log Scale	0.577
95% t UCL (assumes normality of ROS data)	25.05	95% Percentile Bootstrap UCL	24.85
95% BCA Bootstrap UCL	26.53	95% Bootstrap t UCL	26.84
95% H-UCL (Log ROS)	26.65		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.818	KM Geo Mean	16.73
KM SD (logged)	0.602	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.139	95% H-UCL (KM -Log)	26.9
KM SD (logged)	0.602	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.139		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	19.73	Mean in Log Scale	2.748
SD in Original Scale	13.27	SD in Log Scale	0.777
95% t UCL (Assumes normality)	24.86	95% H-Stat UCL	31.98

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM Student's t	22.59	KM H-UCL	26.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:23:26 PM
From File	Soil, Thallium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Thallium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Soil, Thallium, mg/kg - dw was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:08 PM
From File	Soil, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Tin, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	5
Number of Detects	6	Number of Non-Detects	14
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	1
Maximum Detect	1.4	Maximum Non-Detect	1
Variance Detects	0.0147	Percent Non-Detects	70%
Mean Detects	1.233	SD Detects	0.121
Median Detects	1.25	CV Detects	0.0982
Skewness Detects	0.0751	Kurtosis Detects	-1.55
Mean of Logged Detects	0.206	SD of Logged Detects	0.0984

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.07	KM Standard Error of Mean	0.0301
KM SD	0.123	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.122	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.12	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.16	95% KM Chebyshev UCL	1.201
97.5% KM Chebyshev UCL	1.258	99% KM Chebyshev UCL	1.369

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.384	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.233	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	124.2	k star (bias corrected MLE)	62.23
Theta hat (MLE)	0.00993	Theta star (bias corrected MLE)	0.0198
nu hat (MLE)	1491	nu star (bias corrected)	746.7
Mean (detects)	1.233		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:08 PM
From File	Soil, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Tin, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.479	Mean	0.927
Maximum	1.4	Median	0.911
SD	0.255	CV	0.275
k hat (MLE)	13.35	k star (bias corrected MLE)	11.38
Theta hat (MLE)	0.0694	Theta star (bias corrected MLE)	0.0814
nu hat (MLE)	533.8	nu star (bias corrected)	455.1
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (455.09, α)	406.6	Adjusted Chi Square Value (455.09, β)	403
95% Gamma Approximate UCL (use when n>=50)	1.037	95% Gamma Adjusted UCL (use when n<50)	1.046

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.07	SD (KM)	0.123
Variance (KM)	0.0151	SE of Mean (KM)	0.0301
k hat (KM)	75.82	k star (KM)	64.48
nu hat (KM)	3033	nu star (KM)	2579
theta hat (KM)	0.0141	theta star (KM)	0.0166
80% gamma percentile (KM)	1.18	90% gamma percentile (KM)	1.244
95% gamma percentile (KM)	1.298	99% gamma percentile (KM)	1.404

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	2462	Adjusted Chi Square Value (N/A, β)	2453
95% Gamma Approximate KM-UCL (use when n>=50)	1.121	95% Gamma Adjusted KM-UCL (use when n<50)	1.125

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:08 PM
From File	Soil, Tin, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Tin, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.967	Mean in Log Scale	-0.0562
SD in Original Scale	0.215	SD in Log Scale	0.22
95% t UCL (assumes normality of ROS data)	1.05	95% Percentile Bootstrap UCL	1.047
95% BCA Bootstrap UCL	1.051	95% Bootstrap t UCL	1.055
95% H-UCL (Log ROS)	1.061		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0617	KM Geo Mean	1.064
KM SD (logged)	0.106	95% Critical H Value (KM-Log)	1.736
KM Standard Error of Mean (logged)	0.026	95% H-UCL (KM -Log)	1.116
KM SD (logged)	0.106	95% Critical H Value (KM-Log)	1.736
KM Standard Error of Mean (logged)	0.026		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.72	Mean in Log Scale	-0.423
SD in Original Scale	0.35	SD in Log Scale	0.426
95% t UCL (Assumes normality)	0.855	95% H-Stat UCL	0.867

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.122

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:51 PM
From File	Soil, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Uranium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	14
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	0.1
Maximum Detect	0.33	Maximum Non-Detect	0.1
Variance Detects	0.00695	Percent Non-Detects	70%
Mean Detects	0.197	SD Detects	0.0833
Median Detects	0.185	CV Detects	0.424
Skewness Detects	0.726	Kurtosis Detects	-0.221
Mean of Logged Detects	-1.701	SD of Logged Detects	0.423

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.129	KM Standard Error of Mean	0.0149
KM SD	0.0608	95% KM (BCA) UCL	0.154
95% KM (t) UCL	0.155	95% KM (Percentile Bootstrap) UCL	0.154
95% KM (z) UCL	0.154	95% KM Bootstrap t UCL	0.162
90% KM Chebyshev UCL	0.174	95% KM Chebyshev UCL	0.194
97.5% KM Chebyshev UCL	0.222	99% KM Chebyshev UCL	0.277

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.219	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.19	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.883	k star (bias corrected MLE)	3.552
Theta hat (MLE)	0.0286	Theta star (bias corrected MLE)	0.0554
nu hat (MLE)	82.59	nu star (bias corrected)	42.63
Mean (detects)	0.197		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:51 PM
From File	Soil, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Uranium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0701
Maximum	0.33	Median	0.01
SD	0.0959	CV	1.368
k hat (MLE)	0.677	k star (bias corrected MLE)	0.609
Theta hat (MLE)	0.104	Theta star (bias corrected MLE)	0.115
nu hat (MLE)	27.09	nu star (bias corrected)	24.36
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (24.36, α)	14.12	Adjusted Chi Square Value (24.36, β)	13.51
95% Gamma Approximate UCL (use when n>=50)	0.121	95% Gamma Adjusted UCL (use when n<50)	0.126

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.129	SD (KM)	0.0608
Variance (KM)	0.0037	SE of Mean (KM)	0.0149
k hat (KM)	4.499	k star (KM)	3.857
nu hat (KM)	180	nu star (KM)	154.3
theta hat (KM)	0.0287	theta star (KM)	0.0334
80% gamma percentile (KM)	0.179	90% gamma percentile (KM)	0.217
95% gamma percentile (KM)	0.252	99% gamma percentile (KM)	0.328

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (154.29, α)	126.6	Adjusted Chi Square Value (154.29, β)	124.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.157	95% Gamma Adjusted KM-UCL (use when n<50)	0.16

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.173	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:24:51 PM
From File	Soil, Uranium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Uranium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0881	Mean in Log Scale	-2.862
SD in Original Scale	0.0868	SD in Log Scale	0.975
95% t UCL (assumes normality of ROS data)	0.122	95% Percentile Bootstrap UCL	0.122
95% BCA Bootstrap UCL	0.128	95% Bootstrap t UCL	0.141
95% H-UCL (Log ROS)	0.164		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.122	KM Geo Mean	0.12
KM SD (logged)	0.348	95% Critical H Value (KM-Log)	1.887
KM Standard Error of Mean (logged)	0.0852	95% H-UCL (KM -Log)	0.148
KM SD (logged)	0.348	95% Critical H Value (KM-Log)	1.887
KM Standard Error of Mean (logged)	0.0852		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.094	Mean in Log Scale	-2.607
SD in Original Scale	0.0811	SD in Log Scale	0.646
95% t UCL (Assumes normality)	0.125	95% H-Stat UCL	0.125

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.155

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:25:34 PM
From File	Soil, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Vanadium, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	12
Number of Detects	13	Number of Non-Detects	7
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	44	Maximum Non-Detect	2
Variance Detects	130.3	Percent Non-Detects	35%
Mean Detects	9.427	SD Detects	11.41
Median Detects	5.7	CV Detects	1.211
Skewness Detects	2.677	Kurtosis Detects	7.847
Mean of Logged Detects	1.802	SD of Logged Detects	0.916

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.651	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.326	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.828	KM Standard Error of Mean	2.217
KM SD	9.524	95% KM (BCA) UCL	10.85
95% KM (t) UCL	10.66	95% KM (Percentile Bootstrap) UCL	10.8
95% KM (z) UCL	10.47	95% KM Bootstrap t UCL	16.99
90% KM Chebyshev UCL	13.48	95% KM Chebyshev UCL	16.49
97.5% KM Chebyshev UCL	20.67	99% KM Chebyshev UCL	28.88

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.585	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.204	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.242	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.274	k star (bias corrected MLE)	1.032
Theta hat (MLE)	7.397	Theta star (bias corrected MLE)	9.138
nu hat (MLE)	33.14	nu star (bias corrected)	26.82
Mean (detects)	9.427		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:25:34 PM
From File	Soil, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Vanadium, mg/kg - dw

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.131
Maximum	44	Median	2.55
SD	10.17	CV	1.659
k hat (MLE)	0.305	k star (bias corrected MLE)	0.293
Theta hat (MLE)	20.09	Theta star (bias corrected MLE)	20.95
nu hat (MLE)	12.21	nu star (bias corrected)	11.71
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (11.71, α)	5.035	Adjusted Chi Square Value (11.71, β)	4.693
95% Gamma Approximate UCL (use when n>=50)	14.26	95% Gamma Adjusted UCL (use when n<50)	15.3

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.828	SD (KM)	9.524
Variance (KM)	90.71	SE of Mean (KM)	2.217
k hat (KM)	0.514	k star (KM)	0.47
nu hat (KM)	20.56	nu star (KM)	18.81
theta hat (KM)	13.29	theta star (KM)	14.52
80% gamma percentile (KM)	11.18	90% gamma percentile (KM)	18.71
95% gamma percentile (KM)	26.81	99% gamma percentile (KM)	46.85

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (18.81, α)	9.975	Adjusted Chi Square Value (18.81, β)	9.469
95% Gamma Approximate KM-UCL (use when n>=50)	12.87	95% Gamma Adjusted KM-UCL (use when n<50)	13.56

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.139	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:25:34 PM
From File	Soil, Vanadium, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Vanadium, mg/kg - dw

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.362	Mean in Log Scale	0.975
SD in Original Scale	10.03	SD in Log Scale	1.415
95% t UCL (assumes normality of ROS data)	10.24	95% Percentile Bootstrap UCL	10.32
95% BCA Bootstrap UCL	12.29	95% Bootstrap t UCL	15.45
95% H-UCL (Log ROS)	20.94		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.414	KM Geo Mean	4.113
KM SD (logged)	0.885	95% Critical H Value (KM-Log)	2.472
KM Standard Error of Mean (logged)	0.206	95% H-UCL (KM -Log)	10.06
KM SD (logged)	0.885	95% Critical H Value (KM-Log)	2.472
KM Standard Error of Mean (logged)	0.206		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.478	Mean in Log Scale	1.172
SD in Original Scale	9.964	SD in Log Scale	1.144
95% t UCL (Assumes normality)	10.33	95% H-Stat UCL	13.11

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	13.56	95% GROS Adjusted Gamma UCL	15.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:26:16 PM
From File	Soil, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Zinc, mg/kg - dw

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	16	Mean	46.33
Maximum	112	Median	33.5
SD	30.18	Std. Error of Mean	6.749
Coefficient of Variation	0.651	Skewness	1.108

Normal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	57.99	95% Adjusted-CLT UCL (Chen-1995)	59.21
		95% Modified-t UCL (Johnson-1978)	58.27

Gamma GOF Test

A-D Test Statistic	0.482	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.825	k star (bias corrected MLE)	2.435
Theta hat (MLE)	16.4	Theta star (bias corrected MLE)	19.02
nu hat (MLE)	113	nu star (bias corrected)	97.4
MLE Mean (bias corrected)	46.33	MLE Sd (bias corrected)	29.69
		Approximate Chi Square Value (0.05)	75.63
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	74.12

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	59.66	95% Adjusted Gamma UCL (use when n<50)	60.88

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 6:26:16 PM
From File	Soil, Zinc, mg_kg - dw.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Soil, Zinc, mg/kg - dw

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.128	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.773	Mean of logged Data	3.648
Maximum of Logged Data	4.718	SD of logged Data	0.622

Assuming Lognormal Distribution

95% H-UCL	63.34	90% Chebyshev (MVUE) UCL	66.39
95% Chebyshev (MVUE) UCL	75.58	97.5% Chebyshev (MVUE) UCL	88.33
99% Chebyshev (MVUE) UCL	113.4		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	57.43	95% Jackknife UCL	57.99
95% Standard Bootstrap UCL	56.93	95% Bootstrap-t UCL	61.39
95% Hall's Bootstrap UCL	58.54	95% Percentile Bootstrap UCL	57.73
95% BCA Bootstrap UCL	59.1		
90% Chebyshev(Mean, Sd) UCL	66.57	95% Chebyshev(Mean, Sd) UCL	75.74
97.5% Chebyshev(Mean, Sd) UCL	88.47	99% Chebyshev(Mean, Sd) UCL	113.5

Suggested UCL to Use

95% Adjusted Gamma UCL	60.88

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ATTACHMENT G

ProUCL Outputs: Brook Trout

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:28:05 PM
From File	Brook Trout, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Aluminum, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	0.21	Mean	0.556
Maximum	1.47	Median	0.47
SD	0.297	Std. Error of Mean	0.0416
Coefficient of Variation	0.534	Skewness	1.193

Normal GOF Test

Shapiro Wilk Test Statistic	0.877	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.7506E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.626	95% Adjusted-CLT UCL (Chen-1995)	0.632
		95% Modified-t UCL (Johnson-1978)	0.627

Gamma GOF Test

A-D Test Statistic	0.73	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0993	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.125	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.164	k star (bias corrected MLE)	3.932
Theta hat (MLE)	0.134	Theta star (bias corrected MLE)	0.142
nu hat (MLE)	424.7	nu star (bias corrected)	401
MLE Mean (bias corrected)	0.556	MLE Sd (bias corrected)	0.281
		Approximate Chi Square Value (0.05)	355.6
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	354.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.628	95% Adjusted Gamma UCL (use when n<50)	0.63

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:28:05 PM
From File	Brook Trout, Aluminum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Aluminum, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.183	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0746	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.561	Mean of logged Data	-0.711
Maximum of Logged Data	0.385	SD of logged Data	0.497

Assuming Lognormal Distribution

95% H-UCL	0.634	90% Chebyshev (MVUE) UCL	0.676
95% Chebyshev (MVUE) UCL	0.731	97.5% Chebyshev (MVUE) UCL	0.807
99% Chebyshev (MVUE) UCL	0.957		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.625	95% Jackknife UCL	0.626
95% Standard Bootstrap UCL	0.624	95% Bootstrap-t UCL	0.642
95% Hall's Bootstrap UCL	0.634	95% Percentile Bootstrap UCL	0.626
95% BCA Bootstrap UCL	0.635		
90% Chebyshev(Mean, Sd) UCL	0.681	95% Chebyshev(Mean, Sd) UCL	0.738
97.5% Chebyshev(Mean, Sd) UCL	0.816	99% Chebyshev(Mean, Sd) UCL	0.97

Suggested UCL to Use

95% Approximate Gamma UCL	0.628

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:28:47 PM
From File	Brook Trout, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Antimony, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	49
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0013	Minimum Non-Detect	0.001
Maximum Detect	0.0032	Maximum Non-Detect	0.001
Variance Detects	1.8050E-6	Percent Non-Detects	96.08%
Mean Detects	0.00225	SD Detects	0.00134
Median Detects	0.00225	CV Detects	0.597
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-6.195	SD of Logged Detects	0.637

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00105	KM Standard Error of Mean	6.0800E-5
KM SD	3.0702E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00115	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00115	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00123	95% KM Chebyshev UCL	0.00131
97.5% KM Chebyshev UCL	0.00143	99% KM Chebyshev UCL	0.00165

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	5.254	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.2824E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	21.02	nu star (bias corrected)	N/A
Mean (detects)	0.00225		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:28:47 PM
From File	Brook Trout, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Antimony, mg/kg - ww

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00105	SD (KM)	3.0702E-4
Variance (KM)	9.4264E-8	SE of Mean (KM)	6.0800E-5
k hat (KM)	11.67	k star (KM)	11
nu hat (KM)	1191	nu star (KM)	1122
theta hat (KM)	8.9859E-5	theta star (KM)	9.5362E-5
80% gamma percentile (KM)	0.0013	90% gamma percentile (KM)	0.00147
95% gamma percentile (KM)	0.00162	99% gamma percentile (KM)	0.00192

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0453
Approximate Chi Square Value (N/A, α)	1045	Adjusted Chi Square Value (N/A, β)	1043
95% Gamma Approximate KM-UCL (use when n>=50)	0.00113	95% Gamma Adjusted KM-UCL (use when n<50)	0.00113

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.1573E-4	Mean in Log Scale	-12.8
SD in Original Scale	4.8024E-4	SD in Log Scale	3.04
95% t UCL (assumes normality of ROS data)	2.2844E-4	95% Percentile Bootstrap UCL	2.3403E-4
95% BCA Bootstrap UCL	3.1885E-4	95% Bootstrap t UCL	8.2608E-4
95% H-UCL (Log ROS)	0.00241		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.88	KM Geo Mean	0.00103
KM SD (logged)	0.165	95% Critical H Value (KM-Log)	1.71
KM Standard Error of Mean (logged)	0.0326	95% H-UCL (KM -Log)	0.00108
KM SD (logged)	0.165	95% Critical H Value (KM-Log)	1.71
KM Standard Error of Mean (logged)	0.0326		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	5.6863E-4	Mean in Log Scale	-7.546
SD in Original Scale	3.9217E-4	SD in Log Scale	0.29
95% t UCL (Assumes normality)	6.6066E-4	95% H-Stat UCL	5.9124E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:28:47 PM
From File	Brook Trout, Antimony, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Antimony, mg/kg - ww

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.00131

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:29:30 PM
From File	Brook Trout, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Arsenic, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	49
		Number of Missing Observations	0
Minimum	0.0256	Mean	0.305
Maximum	1.55	Median	0.21
SD	0.32	Std. Error of Mean	0.0448
Coefficient of Variation	1.05	Skewness	2.693

Normal GOF Test

Shapiro Wilk Test Statistic	0.671	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	6.839E-14	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.38	95% Adjusted-CLT UCL (Chen-1995)	0.397
		95% Modified-t UCL (Johnson-1978)	0.383

Gamma GOF Test

A-D Test Statistic	1.383	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.126	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.533	k star (bias corrected MLE)	1.456
Theta hat (MLE)	0.199	Theta star (bias corrected MLE)	0.209
nu hat (MLE)	156.4	nu star (bias corrected)	148.5
MLE Mean (bias corrected)	0.305	MLE Sd (bias corrected)	0.253
		Approximate Chi Square Value (0.05)	121.3
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	120.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.373	95% Adjusted Gamma UCL (use when n<50)	0.375

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:29:30 PM
From File	Brook Trout, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Arsenic, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.567	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.111	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.665	Mean of logged Data	-1.548
Maximum of Logged Data	0.438	SD of logged Data	0.834

Assuming Lognormal Distribution

95% H-UCL	0.388	90% Chebyshev (MVUE) UCL	0.417
95% Chebyshev (MVUE) UCL	0.47	97.5% Chebyshev (MVUE) UCL	0.544
99% Chebyshev (MVUE) UCL	0.69		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.379	95% Jackknife UCL	0.38
95% Standard Bootstrap UCL	0.377	95% Bootstrap-t UCL	0.411
95% Hall's Bootstrap UCL	0.414	95% Percentile Bootstrap UCL	0.381
95% BCA Bootstrap UCL	0.398		
90% Chebyshev(Mean, Sd) UCL	0.439	95% Chebyshev(Mean, Sd) UCL	0.5
97.5% Chebyshev(Mean, Sd) UCL	0.585	99% Chebyshev(Mean, Sd) UCL	0.751

Suggested UCL to Use

95% H-UCL	0.388

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:29:30 PM
From File	Brook Trout, Arsenic, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Arsenic, mg/kg - ww

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:30:12 PM
From File	Brook Trout, Barium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Barium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	0.025	Mean	0.189
Maximum	1.61	Median	0.069
SD	0.362	Std. Error of Mean	0.0507
Coefficient of Variation	1.92	Skewness	3.106

Normal GOF Test

Shapiro Wilk Test Statistic	0.446	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.395	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.274	95% Adjusted-CLT UCL (Chen-1995)	0.296
		95% Modified-t UCL (Johnson-1978)	0.277

Gamma GOF Test

A-D Test Statistic	6.598	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.791	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.283	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.129	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.784	k star (bias corrected MLE)	0.751
Theta hat (MLE)	0.241	Theta star (bias corrected MLE)	0.251
nu hat (MLE)	79.97	nu star (bias corrected)	76.6
MLE Mean (bias corrected)	0.189	MLE Sd (bias corrected)	0.218
		Approximate Chi Square Value (0.05)	57.44
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	56.96

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.252	95% Adjusted Gamma UCL (use when n<50)	0.254

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:30:12 PM
From File	Brook Trout, Barium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Barium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.818	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	3.8435E-8	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.689	Mean of logged Data	-2.427
Maximum of Logged Data	0.476	SD of logged Data	1

Assuming Lognormal Distribution

95% H-UCL	0.202	90% Chebyshev (MVUE) UCL	0.215
95% Chebyshev (MVUE) UCL	0.247	97.5% Chebyshev (MVUE) UCL	0.291
99% Chebyshev (MVUE) UCL	0.379		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.272	95% Jackknife UCL	0.274
95% Standard Bootstrap UCL	0.271	95% Bootstrap-t UCL	0.337
95% Hall's Bootstrap UCL	0.263	95% Percentile Bootstrap UCL	0.277
95% BCA Bootstrap UCL	0.309		
90% Chebyshev(Mean, Sd) UCL	0.341	95% Chebyshev(Mean, Sd) UCL	0.41
97.5% Chebyshev(Mean, Sd) UCL	0.505	99% Chebyshev(Mean, Sd) UCL	0.693

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.41

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:30:55 PM
From File	Brook Trout, Beryllium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Beryllium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	51
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Brook Trout, Beryllium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:31:37 PM
From File	Brook Trout, Bismuth, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Bismuth, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	51
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Brook Trout, Bismuth, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:32:19 PM
From File	Brook Trout, Boron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Boron, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	50
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Brook Trout, Boron, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:33:01 PM
From File	Brook Trout, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Cadmium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	38
Number of Detects	48	Number of Non-Detects	3
Number of Distinct Detects	37	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.001
Maximum Detect	0.0769	Maximum Non-Detect	0.001
Variance Detects	2.7306E-4	Percent Non-Detects	5.882%
Mean Detects	0.0101	SD Detects	0.0165
Median Detects	0.00335	CV Detects	1.639
Skewness Detects	2.892	Kurtosis Detects	8.425
Mean of Logged Detects	-5.307	SD of Logged Detects	1.051

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.548	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.331	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.127	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00955	KM Standard Error of Mean	0.00227
KM SD	0.016	95% KM (BCA) UCL	0.0135
95% KM (t) UCL	0.0133	95% KM (Percentile Bootstrap) UCL	0.0134
95% KM (z) UCL	0.0133	95% KM Bootstrap t UCL	0.016
90% KM Chebyshev UCL	0.0163	95% KM Chebyshev UCL	0.0194
97.5% KM Chebyshev UCL	0.0237	99% KM Chebyshev UCL	0.0321

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.441	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.788	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.236	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.133	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.831	k star (bias corrected MLE)	0.793
Theta hat (MLE)	0.0121	Theta star (bias corrected MLE)	0.0127
nu hat (MLE)	79.79	nu star (bias corrected)	76.14
Mean (detects)	0.0101		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:33:01 PM
From File	Brook Trout, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Cadmium, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.0101
Maximum	0.0769	Median	0.0036
SD	0.016	CV	1.589
k hat (MLE)	0.877	k star (bias corrected MLE)	0.839
Theta hat (MLE)	0.0115	Theta star (bias corrected MLE)	0.012
nu hat (MLE)	89.46	nu star (bias corrected)	85.53
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (85.53, α)	65.21	Adjusted Chi Square Value (85.53, β)	64.7
95% Gamma Approximate UCL (use when n>=50)	0.0132	95% Gamma Adjusted UCL (use when n<50)	0.0133

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00955	SD (KM)	0.016
Variance (KM)	2.5621E-4	SE of Mean (KM)	0.00227
k hat (KM)	0.356	k star (KM)	0.348
nu hat (KM)	36.31	nu star (KM)	35.51
theta hat (KM)	0.0268	theta star (KM)	0.0274
80% gamma percentile (KM)	0.0151	90% gamma percentile (KM)	0.0276
95% gamma percentile (KM)	0.0416	99% gamma percentile (KM)	0.0774

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (35.51, α)	22.87	Adjusted Chi Square Value (35.51, β)	22.58
95% Gamma Approximate KM-UCL (use when n>=50)	0.0148	95% Gamma Adjusted KM-UCL (use when n<50)	0.015

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.127	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:33:01 PM
From File	Brook Trout, Cadmium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Cadmium, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00952	Mean in Log Scale	-5.449
SD in Original Scale	0.0162	SD in Log Scale	1.171
95% t UCL (assumes normality of ROS data)	0.0133	95% Percentile Bootstrap UCL	0.0137
95% BCA Bootstrap UCL	0.0141	95% Bootstrap t UCL	0.0157
95% H-UCL (Log ROS)	0.0129		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.401	KM Geo Mean	0.00451
KM SD (logged)	1.077	95% Critical H Value (KM-Log)	2.387
KM Standard Error of Mean (logged)	0.152	95% H-UCL (KM -Log)	0.0116
KM SD (logged)	1.077	95% Critical H Value (KM-Log)	2.387
KM Standard Error of Mean (logged)	0.152		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00952	Mean in Log Scale	-5.442
SD in Original Scale	0.0162	SD in Log Scale	1.156
95% t UCL (Assumes normality)	0.0133	95% H-Stat UCL	0.0127

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.0194

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:33:43 PM
From File	Brook Trout, Calcium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Calcium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	47
		Number of Missing Observations	0
Minimum	940	Mean	1619
Maximum	3760	Median	1400
SD	603.2	Std. Error of Mean	84.47
Coefficient of Variation	0.373	Skewness	1.304

Normal GOF Test

Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	2.0253E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.16	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1760	95% Adjusted-CLT UCL (Chen-1995)	1774
		95% Modified-t UCL (Johnson-1978)	1763

Gamma GOF Test

A-D Test Statistic	1.084	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.599	k star (bias corrected MLE)	8.106
Theta hat (MLE)	188.3	Theta star (bias corrected MLE)	199.7
nu hat (MLE)	877.1	nu star (bias corrected)	826.8
MLE Mean (bias corrected)	1619	MLE Sd (bias corrected)	568.6
		Approximate Chi Square Value (0.05)	761.1
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	759.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1759	95% Adjusted Gamma UCL (use when n<50)	1763

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:33:43 PM
From File	Brook Trout, Calcium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Calcium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0244	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.136	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.846	Mean of logged Data	7.33
Maximum of Logged Data	8.232	SD of logged Data	0.338

Assuming Lognormal Distribution

95% H-UCL	1756	90% Chebyshev (MVUE) UCL	1849
95% Chebyshev (MVUE) UCL	1955	97.5% Chebyshev (MVUE) UCL	2103
99% Chebyshev (MVUE) UCL	2393		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	1758	95% Jackknife UCL	1760
95% Standard Bootstrap UCL	1759	95% Bootstrap-t UCL	1782
95% Hall's Bootstrap UCL	1792	95% Percentile Bootstrap UCL	1764
95% BCA Bootstrap UCL	1767		
90% Chebyshev(Mean, Sd) UCL	1872	95% Chebyshev(Mean, Sd) UCL	1987
97.5% Chebyshev(Mean, Sd) UCL	2146	99% Chebyshev(Mean, Sd) UCL	2459

Suggested UCL to Use

95% Student's-t UCL	1760	or 95% Modified-t UCL	1763

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:34:26 PM
From File	Brook Trout, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Chromium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	12
Number of Detects	14	Number of Non-Detects	37
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.586	Maximum Non-Detect	0.01
Variance Detects	0.0232	Percent Non-Detects	72.55%
Mean Detects	0.0734	SD Detects	0.152
Median Detects	0.0175	CV Detects	2.076
Skewness Detects	3.373	Kurtosis Detects	11.88
Mean of Logged Detects	-3.59	SD of Logged Detects	1.225

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.467	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.344	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.226	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0274	KM Standard Error of Mean	0.0119
KM SD	0.0819	95% KM (BCA) UCL	0.0492
95% KM (t) UCL	0.0474	95% KM (Percentile Bootstrap) UCL	0.0499
95% KM (z) UCL	0.047	95% KM Bootstrap t UCL	0.106
90% KM Chebyshev UCL	0.0631	95% KM Chebyshev UCL	0.0793
97.5% KM Chebyshev UCL	0.102	99% KM Chebyshev UCL	0.146

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.731	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.782	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.307	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.24	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.628	k star (bias corrected MLE)	0.541
Theta hat (MLE)	0.117	Theta star (bias corrected MLE)	0.136
nu hat (MLE)	17.58	nu star (bias corrected)	15.14
Mean (detects)	0.0734		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:34:26 PM
From File	Brook Trout, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Chromium, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0274
Maximum	0.586	Median	0.01
SD	0.0828	CV	3.02
k hat (MLE)	0.812	k star (bias corrected MLE)	0.778
Theta hat (MLE)	0.0337	Theta star (bias corrected MLE)	0.0352
nu hat (MLE)	82.85	nu star (bias corrected)	79.31
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (79.31, α)	59.79	Adjusted Chi Square Value (79.31, β)	59.3
95% Gamma Approximate UCL (use when n>=50)	0.0363	95% Gamma Adjusted UCL (use when n<50)	0.0366

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0274	SD (KM)	0.0819
Variance (KM)	0.00672	SE of Mean (KM)	0.0119
k hat (KM)	0.112	k star (KM)	0.118
nu hat (KM)	11.4	nu star (KM)	12.07
theta hat (KM)	0.245	theta star (KM)	0.232
80% gamma percentile (KM)	0.0236	90% gamma percentile (KM)	0.0773
95% gamma percentile (KM)	0.157	99% gamma percentile (KM)	0.4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.07, α)	5.271	Adjusted Chi Square Value (12.07, β)	5.141
95% Gamma Approximate KM-UCL (use when n>=50)	0.0627	95% Gamma Adjusted KM-UCL (use when n<50)	0.0643

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.808	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.226	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:34:26 PM
From File	Brook Trout, Chromium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Chromium, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0208	Mean in Log Scale	-6.852
SD in Original Scale	0.0843	SD in Log Scale	2.646
95% t UCL (assumes normality of ROS data)	0.0406	95% Percentile Bootstrap UCL	0.0431
95% BCA Bootstrap UCL	0.0568	95% Bootstrap t UCL	0.0966
95% H-UCL (Log ROS)	0.184		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.326	KM Geo Mean	0.0132
KM SD (logged)	0.767	95% Critical H Value (KM-Log)	2.082
KM Standard Error of Mean (logged)	0.111	95% H-UCL (KM -Log)	0.0222
KM SD (logged)	0.767	95% Critical H Value (KM-Log)	2.082
KM Standard Error of Mean (logged)	0.111		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0238	Mean in Log Scale	-4.829
SD in Original Scale	0.0836	SD in Log Scale	0.992
95% t UCL (Assumes normality)	0.0434	95% H-Stat UCL	0.018

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.0222

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:35:08 PM
From File	Brook Trout, Cobalt, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Cobalt, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	0.0059	Mean	0.0146
Maximum	0.0329	Median	0.0137
SD	0.0067	Std. Error of Mean	9.3888E-4
Coefficient of Variation	0.46	Skewness	0.716

Normal GOF Test

Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.0059	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.143	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0162	95% Adjusted-CLT UCL (Chen-1995)	0.0162
		95% Modified-t UCL (Johnson-1978)	0.0162

Gamma GOF Test

A-D Test Statistic	0.44	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.103	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.125	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.942	k star (bias corrected MLE)	4.664
Theta hat (MLE)	0.00295	Theta star (bias corrected MLE)	0.00313
nu hat (MLE)	504.1	nu star (bias corrected)	475.8
MLE Mean (bias corrected)	0.0146	MLE Sd (bias corrected)	0.00676
		Approximate Chi Square Value (0.05)	426.2
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	424.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.0163	95% Adjusted Gamma UCL (use when n<50)	0.0163

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:35:08 PM
From File	Brook Trout, Cobalt, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Cobalt, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0927	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0757	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.133	Mean of logged Data	-4.332
Maximum of Logged Data	-3.414	SD of logged Data	0.468

Assuming Lognormal Distribution

95% H-UCL	0.0166	90% Chebyshev (MVUE) UCL	0.0176
95% Chebyshev (MVUE) UCL	0.019	97.5% Chebyshev (MVUE) UCL	0.0209
99% Chebyshev (MVUE) UCL	0.0246		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0161	95% Jackknife UCL	0.0162
95% Standard Bootstrap UCL	0.0161	95% Bootstrap-t UCL	0.0163
95% Hall's Bootstrap UCL	0.0163	95% Percentile Bootstrap UCL	0.0161
95% BCA Bootstrap UCL	0.0162		
90% Chebyshev(Mean, Sd) UCL	0.0174	95% Chebyshev(Mean, Sd) UCL	0.0187
97.5% Chebyshev(Mean, Sd) UCL	0.0205	99% Chebyshev(Mean, Sd) UCL	0.0239

Suggested UCL to Use

95% Approximate Gamma UCL	0.0163

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:35:51 PM
From File	Brook Trout, Copper, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Copper, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	0.224	Mean	0.334
Maximum	1.54	Median	0.289
SD	0.187	Std. Error of Mean	0.0261
Coefficient of Variation	0.559	Skewness	5.639

Normal GOF Test

Shapiro Wilk Test Statistic	0.445	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.378	95% Adjusted-CLT UCL (Chen-1995)	0.399
		95% Modified-t UCL (Johnson-1978)	0.381

Gamma GOF Test

A-D Test Statistic	4.342	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.238	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.705	k star (bias corrected MLE)	7.265
Theta hat (MLE)	0.0434	Theta star (bias corrected MLE)	0.046
nu hat (MLE)	785.9	nu star (bias corrected)	741
MLE Mean (bias corrected)	0.334	MLE Sd (bias corrected)	0.124
		Approximate Chi Square Value (0.05)	678.8
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	677.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.365	95% Adjusted Gamma UCL (use when n<50)	0.366

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:35:51 PM
From File	Brook Trout, Copper, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Copper, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.747	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	4.962E-11	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.212	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.496	Mean of logged Data	-1.163
Maximum of Logged Data	0.432	SD of logged Data	0.309

Assuming Lognormal Distribution

95% H-UCL	0.353	90% Chebyshev (MVUE) UCL	0.371
95% Chebyshev (MVUE) UCL	0.391	97.5% Chebyshev (MVUE) UCL	0.418
99% Chebyshev (MVUE) UCL	0.471		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.377	95% Jackknife UCL	0.378
95% Standard Bootstrap UCL	0.376	95% Bootstrap-t UCL	0.441
95% Hall's Bootstrap UCL	0.543	95% Percentile Bootstrap UCL	0.378
95% BCA Bootstrap UCL	0.409		
90% Chebyshev(Mean, Sd) UCL	0.412	95% Chebyshev(Mean, Sd) UCL	0.448
97.5% Chebyshev(Mean, Sd) UCL	0.497	99% Chebyshev(Mean, Sd) UCL	0.594

Suggested UCL to Use

95% Student's-t UCL	0.378	or 95% Modified-t UCL	0.381

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:36:33 PM
From File	Brook Trout, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Iron, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	49
		Number of Missing Observations	0
Minimum	3.62	Mean	6.218
Maximum	11	Median	5.97
SD	1.426	Std. Error of Mean	0.2
Coefficient of Variation	0.229	Skewness	1.14

Normal GOF Test

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.00529	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	6.552	95% Adjusted-CLT UCL (Chen-1995)	6.58
		95% Modified-t UCL (Johnson-1978)	6.557

Gamma GOF Test

A-D Test Statistic	0.472	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0862	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.03	k star (bias corrected MLE)	19.81
Theta hat (MLE)	0.296	Theta star (bias corrected MLE)	0.314
nu hat (MLE)	2145	nu star (bias corrected)	2021
MLE Mean (bias corrected)	6.218	MLE Sd (bias corrected)	1.397
		Approximate Chi Square Value (0.05)	1917
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	1914

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.553	95% Adjusted Gamma UCL (use when n<50)	6.563

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:36:33 PM
From File	Brook Trout, Iron, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Iron, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.691	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.082	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.286	Mean of logged Data	1.803
Maximum of Logged Data	2.398	SD of logged Data	0.219

Assuming Lognormal Distribution

95% H-UCL	6.557	90% Chebyshev (MVUE) UCL	6.791
95% Chebyshev (MVUE) UCL	7.053	97.5% Chebyshev (MVUE) UCL	7.416
99% Chebyshev (MVUE) UCL	8.128		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6.546	95% Jackknife UCL	6.552
95% Standard Bootstrap UCL	6.539	95% Bootstrap-t UCL	6.593
95% Hall's Bootstrap UCL	6.628	95% Percentile Bootstrap UCL	6.555
95% BCA Bootstrap UCL	6.567		
90% Chebyshev(Mean, Sd) UCL	6.817	95% Chebyshev(Mean, Sd) UCL	7.088
97.5% Chebyshev(Mean, Sd) UCL	7.465	99% Chebyshev(Mean, Sd) UCL	8.204

Suggested UCL to Use

95% Student's-t UCL	6.552

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:37:15 PM
From File	Brook Trout, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Lead, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	0.0025	Mean	0.0339
Maximum	0.293	Median	0.0102
SD	0.0644	Std. Error of Mean	0.00902
Coefficient of Variation	1.901	Skewness	2.959

Normal GOF Test

Shapiro Wilk Test Statistic	0.498	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.384	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.049	95% Adjusted-CLT UCL (Chen-1995)	0.0527
		95% Modified-t UCL (Johnson-1978)	0.0496

Gamma GOF Test

A-D Test Statistic	5.71	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.799	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.283	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.13	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.678	k star (bias corrected MLE)	0.652
Theta hat (MLE)	0.0499	Theta star (bias corrected MLE)	0.052
nu hat (MLE)	69.19	nu star (bias corrected)	66.45
MLE Mean (bias corrected)	0.0339	MLE Sd (bias corrected)	0.042
		Approximate Chi Square Value (0.05)	48.69
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	48.25

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0462	95% Adjusted Gamma UCL (use when n<50)	0.0467

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:37:15 PM
From File	Brook Trout, Lead, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Lead, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	2.8355E-6	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.165	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.991	Mean of logged Data	-4.28
Maximum of Logged Data	-1.228	SD of logged Data	1.144

Assuming Lognormal Distribution

95% H-UCL	0.0397	90% Chebyshev (MVUE) UCL	0.0414
95% Chebyshev (MVUE) UCL	0.0484	97.5% Chebyshev (MVUE) UCL	0.058
99% Chebyshev (MVUE) UCL	0.0769		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0487	95% Jackknife UCL	0.049
95% Standard Bootstrap UCL	0.0486	95% Bootstrap-t UCL	0.0576
95% Hall's Bootstrap UCL	0.0528	95% Percentile Bootstrap UCL	0.0501
95% BCA Bootstrap UCL	0.0533		
90% Chebyshev(Mean, Sd) UCL	0.0609	95% Chebyshev(Mean, Sd) UCL	0.0732
97.5% Chebyshev(Mean, Sd) UCL	0.0902	99% Chebyshev(Mean, Sd) UCL	0.124

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.0732

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:37:58 PM
From File	Brook Trout, Magnesium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Magnesium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	223	Mean	298.4
Maximum	339	Median	302
SD	24.18	Std. Error of Mean	3.385
Coefficient of Variation	0.081	Skewness	-0.588

Normal GOF Test

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.15	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0971	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	304.1	95% Adjusted-CLT UCL (Chen-1995)	303.7
		95% Modified-t UCL (Johnson-1978)	304

Gamma GOF Test

A-D Test Statistic	0.533	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.097	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	149.2	k star (bias corrected MLE)	140.4
Theta hat (MLE)	2	Theta star (bias corrected MLE)	2.125
nu hat (MLE)	15216	nu star (bias corrected)	14322
MLE Mean (bias corrected)	298.4	MLE Sd (bias corrected)	25.18
		Approximate Chi Square Value (0.05)	14045
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	14037

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	304.3	95% Adjusted Gamma UCL (use when n<50)	304.5

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:37:58 PM
From File	Brook Trout, Magnesium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Magnesium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.944	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0303	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0931	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.407	Mean of logged Data	5.695
Maximum of Logged Data	5.826	SD of logged Data	0.0837

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	308.9
95% Chebyshev (MVUE) UCL	313.7	97.5% Chebyshev (MVUE) UCL	320.3
99% Chebyshev (MVUE) UCL	333.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	304	95% Jackknife UCL	304.1
95% Standard Bootstrap UCL	303.8	95% Bootstrap-t UCL	303.9
95% Hall's Bootstrap UCL	303.9	95% Percentile Bootstrap UCL	303.8
95% BCA Bootstrap UCL	303.8		
90% Chebyshev(Mean, Sd) UCL	308.5	95% Chebyshev(Mean, Sd) UCL	313.1
97.5% Chebyshev(Mean, Sd) UCL	319.5	99% Chebyshev(Mean, Sd) UCL	332.1

Suggested UCL to Use

95% Student's-t UCL	304.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:38:40 PM
From File	Brook Trout, Manganese, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Manganese, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	0.522	Mean	2.217
Maximum	5.86	Median	1.92
SD	1.413	Std. Error of Mean	0.198
Coefficient of Variation	0.637	Skewness	0.826

Normal GOF Test

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	4.2801E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.548	95% Adjusted-CLT UCL (Chen-1995)	2.567
		95% Modified-t UCL (Johnson-1978)	2.552

Gamma GOF Test

A-D Test Statistic	0.967	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.125	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.594	k star (bias corrected MLE)	2.454
Theta hat (MLE)	0.855	Theta star (bias corrected MLE)	0.903
nu hat (MLE)	264.6	nu star (bias corrected)	250.4
MLE Mean (bias corrected)	2.217	MLE Sd (bias corrected)	1.415
		Approximate Chi Square Value (0.05)	214.7
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	213.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.585	95% Adjusted Gamma UCL (use when n<50)	2.596

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:38:40 PM
From File	Brook Trout, Manganese, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Manganese, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0132	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.106	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.65	Mean of logged Data	0.591
Maximum of Logged Data	1.768	SD of logged Data	0.658

Assuming Lognormal Distribution

95% H-UCL	2.7	90% Chebyshev (MVUE) UCL	2.901
95% Chebyshev (MVUE) UCL	3.204	97.5% Chebyshev (MVUE) UCL	3.625
99% Chebyshev (MVUE) UCL	4.451		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.542	95% Jackknife UCL	2.548
95% Standard Bootstrap UCL	2.541	95% Bootstrap-t UCL	2.585
95% Hall's Bootstrap UCL	2.552	95% Percentile Bootstrap UCL	2.523
95% BCA Bootstrap UCL	2.57		
90% Chebyshev(Mean, Sd) UCL	2.81	95% Chebyshev(Mean, Sd) UCL	3.079
97.5% Chebyshev(Mean, Sd) UCL	3.452	99% Chebyshev(Mean, Sd) UCL	4.185

Suggested UCL to Use

95% Approximate Gamma UCL	2.585

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:39:22 PM
From File	Brook Trout, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Mercury, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	0.021	Mean	0.11
Maximum	0.327	Median	0.086
SD	0.072	Std. Error of Mean	0.0101
Coefficient of Variation	0.656	Skewness	1.234

Normal GOF Test

Shapiro Wilk Test Statistic	0.871	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	8.9631E-6	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.165	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.127	95% Adjusted-CLT UCL (Chen-1995)	0.128
		95% Modified-t UCL (Johnson-1978)	0.127

Gamma GOF Test

A-D Test Statistic	0.693	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.125	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.679	k star (bias corrected MLE)	2.535
Theta hat (MLE)	0.0409	Theta star (bias corrected MLE)	0.0433
nu hat (MLE)	273.3	nu star (bias corrected)	258.6
MLE Mean (bias corrected)	0.11	MLE Sd (bias corrected)	0.0689
		Approximate Chi Square Value (0.05)	222.3
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	221.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.128	95% Adjusted Gamma UCL (use when n<50)	0.128

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:39:22 PM
From File	Brook Trout, Mercury, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Mercury, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.483	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0859	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.863	Mean of logged Data	-2.409
Maximum of Logged Data	-1.118	SD of logged Data	0.641

Assuming Lognormal Distribution

95% H-UCL	0.132	90% Chebyshev (MVUE) UCL	0.142
95% Chebyshev (MVUE) UCL	0.156	97.5% Chebyshev (MVUE) UCL	0.176
99% Chebyshev (MVUE) UCL	0.216		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.126	95% Jackknife UCL	0.127
95% Standard Bootstrap UCL	0.126	95% Bootstrap-t UCL	0.13
95% Hall's Bootstrap UCL	0.129	95% Percentile Bootstrap UCL	0.126
95% BCA Bootstrap UCL	0.127		
90% Chebyshev(Mean, Sd) UCL	0.14	95% Chebyshev(Mean, Sd) UCL	0.154
97.5% Chebyshev(Mean, Sd) UCL	0.173	99% Chebyshev(Mean, Sd) UCL	0.21

Suggested UCL to Use

95% Approximate Gamma UCL	0.128

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:40:05 PM
From File	Brook Trout, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Molybdenum, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	15
Number of Detects	30	Number of Non-Detects	21
Number of Distinct Detects	14	Number of Distinct Non-Detects	1
Minimum Detect	0.0041	Minimum Non-Detect	0.004
Maximum Detect	0.0068	Maximum Non-Detect	0.004
Variance Detects	3.6891E-7	Percent Non-Detects	41.18%
Mean Detects	0.00478	SD Detects	6.0738E-4
Median Detects	0.00468	CV Detects	0.127
Skewness Detects	1.551	Kurtosis Detects	3.126
Mean of Logged Detects	-5.351	SD of Logged Detects	0.119

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.861	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.191	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.159	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00446	KM Standard Error of Mean	8.5038E-5
KM SD	5.9708E-4	95% KM (BCA) UCL	0.0046
95% KM (t) UCL	0.0046	95% KM (Percentile Bootstrap) UCL	0.0046
95% KM (z) UCL	0.0046	95% KM Bootstrap t UCL	0.00463
90% KM Chebyshev UCL	0.00471	95% KM Chebyshev UCL	0.00483
97.5% KM Chebyshev UCL	0.00499	99% KM Chebyshev UCL	0.0053

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.911	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.745	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.169	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.16	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	70.48	k star (bias corrected MLE)	63.45
Theta hat (MLE)	6.7801E-5	Theta star (bias corrected MLE)	7.5309E-5
nu hat (MLE)	4229	nu star (bias corrected)	3807
Mean (detects)	0.00478		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:40:05 PM
From File	Brook Trout, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Molybdenum, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0041	Mean	0.00693
Maximum	0.01	Median	0.0051
SD	0.00264	CV	0.381
k hat (MLE)	7.142	k star (bias corrected MLE)	6.735
Theta hat (MLE)	9.7010E-4	Theta star (bias corrected MLE)	0.00103
nu hat (MLE)	728.5	nu star (bias corrected)	687
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (686.96, α)	627.2	Adjusted Chi Square Value (686.96, β)	625.5
95% Gamma Approximate UCL (use when n>=50)	0.00759	95% Gamma Adjusted UCL (use when n<50)	0.00761

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00446	SD (KM)	5.9708E-4
Variance (KM)	3.5651E-7	SE of Mean (KM)	8.5038E-5
k hat (KM)	55.74	k star (KM)	52.48
nu hat (KM)	5686	nu star (KM)	5353
theta hat (KM)	7.9973E-5	theta star (KM)	8.4950E-5
80% gamma percentile (KM)	0.00497	90% gamma percentile (KM)	0.00526
95% gamma percentile (KM)	0.00552	99% gamma percentile (KM)	0.00601

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	5184	Adjusted Chi Square Value (N/A, β)	5179
95% Gamma Approximate KM-UCL (use when n>=50)	0.0046	95% Gamma Adjusted KM-UCL (use when n<50)	0.00461

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.163	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.159	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:40:05 PM
From File	Brook Trout, Molybdenum, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Molybdenum, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00426	Mean in Log Scale	-5.476
SD in Original Scale	8.0720E-4	SD in Log Scale	0.187
95% t UCL (assumes normality of ROS data)	0.00445	95% Percentile Bootstrap UCL	0.00443
95% BCA Bootstrap UCL	0.00445	95% Bootstrap t UCL	0.00446
95% H-UCL (Log ROS)	0.00446		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.421	KM Geo Mean	0.00442
KM SD (logged)	0.123	95% Critical H Value (KM-Log)	1.695
KM Standard Error of Mean (logged)	0.0175	95% H-UCL (KM -Log)	0.00459
KM SD (logged)	0.123	95% Critical H Value (KM-Log)	1.695
KM Standard Error of Mean (logged)	0.0175		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00363	Mean in Log Scale	-5.706
SD in Original Scale	0.00146	SD in Log Scale	0.439
95% t UCL (Assumes normality)	0.00398	95% H-Stat UCL	0.0041

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0046	KM H-UCL	0.00459
95% KM (BCA) UCL	0.0046		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:40:48 PM
From File	Brook Trout, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Nickel, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	18
Number of Detects	23	Number of Non-Detects	28
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.053	Maximum Non-Detect	0.01
Variance Detects	1.7174E-4	Percent Non-Detects	54.9%
Mean Detects	0.022	SD Detects	0.0131
Median Detects	0.016	CV Detects	0.595
Skewness Detects	1.21	Kurtosis Detects	0.371
Mean of Logged Detects	-3.961	SD of Logged Detects	0.532

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.821	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0154	KM Standard Error of Mean	0.0015
KM SD	0.0105	95% KM (BCA) UCL	0.0182
95% KM (t) UCL	0.0179	95% KM (Percentile Bootstrap) UCL	0.0178
95% KM (z) UCL	0.0179	95% KM Bootstrap t UCL	0.0187
90% KM Chebyshev UCL	0.0199	95% KM Chebyshev UCL	0.022
97.5% KM Chebyshev UCL	0.0248	99% KM Chebyshev UCL	0.0304

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.062	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.183	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.596	k star (bias corrected MLE)	3.156
Theta hat (MLE)	0.00612	Theta star (bias corrected MLE)	0.00698
nu hat (MLE)	165.4	nu star (bias corrected)	145.2
Mean (detects)	0.022		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:40:48 PM
From File	Brook Trout, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Nickel, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0154
Maximum	0.053	Median	0.01
SD	0.0106	CV	0.686
k hat (MLE)	3.661	k star (bias corrected MLE)	3.459
Theta hat (MLE)	0.00421	Theta star (bias corrected MLE)	0.00446
nu hat (MLE)	373.4	nu star (bias corrected)	352.8
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (352.77, α)	310.2	Adjusted Chi Square Value (352.77, β)	309.1
95% Gamma Approximate UCL (use when n>=50)	0.0175	95% Gamma Adjusted UCL (use when n<50)	0.0176

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0154	SD (KM)	0.0105
Variance (KM)	1.0987E-4	SE of Mean (KM)	0.0015
k hat (KM)	2.165	k star (KM)	2.05
nu hat (KM)	220.8	nu star (KM)	209.1
theta hat (KM)	0.00712	theta star (KM)	0.00752
80% gamma percentile (KM)	0.023	90% gamma percentile (KM)	0.0298
95% gamma percentile (KM)	0.0363	99% gamma percentile (KM)	0.0506

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (209.14, α)	176.7	Adjusted Chi Square Value (209.14, β)	175.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.0183	95% Gamma Adjusted KM-UCL (use when n<50)	0.0183

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:40:48 PM
From File	Brook Trout, Nickel, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Nickel, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0125	Mean in Log Scale	-4.817
SD in Original Scale	0.0124	SD in Log Scale	0.958
95% t UCL (assumes normality of ROS data)	0.0154	95% Percentile Bootstrap UCL	0.0155
95% BCA Bootstrap UCL	0.0158	95% Bootstrap t UCL	0.0162
95% H-UCL (Log ROS)	0.0174		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.315	KM Geo Mean	0.0134
KM SD (logged)	0.474	95% Critical H Value (KM-Log)	1.863
KM Standard Error of Mean (logged)	0.0679	95% H-UCL (KM -Log)	0.017
KM SD (logged)	0.474	95% Critical H Value (KM-Log)	1.863
KM Standard Error of Mean (logged)	0.0679		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0127	Mean in Log Scale	-4.695
SD in Original Scale	0.0122	SD in Log Scale	0.759
95% t UCL (Assumes normality)	0.0155	95% H-Stat UCL	0.0152

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0183	95% GROS Approximate Gamma UCL	0.0175

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:41:31 PM
From File	Brook Trout, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Phosphorus, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	2810	Mean	3580
Maximum	4190	Median	3540
SD	324.8	Std. Error of Mean	45.47
Coefficient of Variation	0.0907	Skewness	0.18

Normal GOF Test

Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.179	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0876	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3656	95% Adjusted-CLT UCL (Chen-1995)	3656
		95% Modified-t UCL (Johnson-1978)	3656

Gamma GOF Test

A-D Test Statistic	0.454	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0809	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	124.2	k star (bias corrected MLE)	116.9
Theta hat (MLE)	28.83	Theta star (bias corrected MLE)	30.63
nu hat (MLE)	12665	nu star (bias corrected)	11922
MLE Mean (bias corrected)	3580	MLE Sd (bias corrected)	331.2
		Approximate Chi Square Value (0.05)	11669
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	11662

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3658	95% Adjusted Gamma UCL (use when n<50)	3660

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:41:31 PM
From File	Brook Trout, Phosphorus, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Phosphorus, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.299	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0766	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.941	Mean of logged Data	8.179
Maximum of Logged Data	8.34	SD of logged Data	0.0908

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	3717
95% Chebyshev (MVUE) UCL	3779	97.5% Chebyshev (MVUE) UCL	3865
99% Chebyshev (MVUE) UCL	4034		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3655	95% Jackknife UCL	3656
95% Standard Bootstrap UCL	3655	95% Bootstrap-t UCL	3658
95% Hall's Bootstrap UCL	3656	95% Percentile Bootstrap UCL	3652
95% BCA Bootstrap UCL	3651		
90% Chebyshev(Mean, Sd) UCL	3717	95% Chebyshev(Mean, Sd) UCL	3778
97.5% Chebyshev(Mean, Sd) UCL	3864	99% Chebyshev(Mean, Sd) UCL	4033

Suggested UCL to Use

95% Student's-t UCL	3656

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:42:14 PM
From File	Brook Trout, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Potassium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	3620	Mean	4229
Maximum	4620	Median	4230
SD	236.8	Std. Error of Mean	33.16
Coefficient of Variation	0.056	Skewness	-0.54

Normal GOF Test

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.122	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0878	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4285	95% Adjusted-CLT UCL (Chen-1995)	4281
		95% Modified-t UCL (Johnson-1978)	4285

Gamma GOF Test

A-D Test Statistic	0.59	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0941	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	318	k star (bias corrected MLE)	299.3
Theta hat (MLE)	13.3	Theta star (bias corrected MLE)	14.13
nu hat (MLE)	32436	nu star (bias corrected)	30530
MLE Mean (bias corrected)	4229	MLE Sd (bias corrected)	244.5
		Approximate Chi Square Value (0.05)	30124
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	30113

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4286	95% Adjusted Gamma UCL (use when n<50)	4288

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:42:14 PM
From File	Brook Trout, Potassium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Potassium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0551	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0953	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.194	Mean of logged Data	8.348
Maximum of Logged Data	8.438	SD of logged Data	0.057

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4331
95% Chebyshev (MVUE) UCL	4377	97.5% Chebyshev (MVUE) UCL	4440
99% Chebyshev (MVUE) UCL	4566		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4284	95% Jackknife UCL	4285
95% Standard Bootstrap UCL	4282	95% Bootstrap-t UCL	4284
95% Hall's Bootstrap UCL	4282	95% Percentile Bootstrap UCL	4283
95% BCA Bootstrap UCL	4280		
90% Chebyshev(Mean, Sd) UCL	4329	95% Chebyshev(Mean, Sd) UCL	4374
97.5% Chebyshev(Mean, Sd) UCL	4436	99% Chebyshev(Mean, Sd) UCL	4559

Suggested UCL to Use

95% Student's-t UCL 4285

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:42:56 PM
From File	Brook Trout, Selenium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Selenium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	47
		Number of Missing Observations	0
Minimum	0.22	Mean	0.373
Maximum	0.879	Median	0.327
SD	0.127	Std. Error of Mean	0.0179
Coefficient of Variation	0.342	Skewness	2.023

Normal GOF Test

Shapiro Wilk Test Statistic	0.79	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	2.6642E-9	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.403	95% Adjusted-CLT UCL (Chen-1995)	0.407
		95% Modified-t UCL (Johnson-1978)	0.403

Gamma GOF Test

A-D Test Statistic	2.457	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.38	k star (bias corrected MLE)	10.72
Theta hat (MLE)	0.0327	Theta star (bias corrected MLE)	0.0347
nu hat (MLE)	1161	nu star (bias corrected)	1094
MLE Mean (bias corrected)	0.373	MLE Sd (bias corrected)	0.114
		Approximate Chi Square Value (0.05)	1018
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	1016

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.4	95% Adjusted Gamma UCL (use when n<50)	0.401

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:42:56 PM
From File	Brook Trout, Selenium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Selenium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.899	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	1.9696E-4	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.166	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.514	Mean of logged Data	-1.032
Maximum of Logged Data	-0.129	SD of logged Data	0.285

Assuming Lognormal Distribution

95% H-UCL	0.398	90% Chebyshev (MVUE) UCL	0.416
95% Chebyshev (MVUE) UCL	0.437	97.5% Chebyshev (MVUE) UCL	0.465
99% Chebyshev (MVUE) UCL	0.521		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.402	95% Jackknife UCL	0.403
95% Standard Bootstrap UCL	0.402	95% Bootstrap-t UCL	0.411
95% Hall's Bootstrap UCL	0.412	95% Percentile Bootstrap UCL	0.403
95% BCA Bootstrap UCL	0.406		
90% Chebyshev(Mean, Sd) UCL	0.426	95% Chebyshev(Mean, Sd) UCL	0.45
97.5% Chebyshev(Mean, Sd) UCL	0.484	99% Chebyshev(Mean, Sd) UCL	0.55

Suggested UCL to Use

95% Student's-t UCL	0.403	or 95% Modified-t UCL	0.403

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:43:38 PM
From File	Brook Trout, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Silver, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	46
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.001
Maximum Detect	0.0102	Maximum Non-Detect	0.001
Variance Detects	1.2347E-5	Percent Non-Detects	90.2%
Mean Detects	0.00418	SD Detects	0.00351
Median Detects	0.003	CV Detects	0.841
Skewness Detects	1.768	Kurtosis Detects	3.562
Mean of Logged Detects	-5.734	SD of Logged Detects	0.799

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.813	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.332	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00131	KM Standard Error of Mean	2.1366E-4
KM SD	0.00136	95% KM (BCA) UCL	0.0017
95% KM (t) UCL	0.00167	95% KM (Percentile Bootstrap) UCL	0.00165
95% KM (z) UCL	0.00166	95% KM Bootstrap t UCL	0.0018
90% KM Chebyshev UCL	0.00195	95% KM Chebyshev UCL	0.00224
97.5% KM Chebyshev UCL	0.00265	99% KM Chebyshev UCL	0.00344

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.331	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.684	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.247	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.103	k star (bias corrected MLE)	0.975
Theta hat (MLE)	0.00199	Theta star (bias corrected MLE)	0.00429
nu hat (MLE)	21.03	nu star (bias corrected)	9.746
Mean (detects)	0.00418		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:43:38 PM
From File	Brook Trout, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Silver, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.00943
Maximum	0.0102	Median	0.01
SD	0.00201	CV	0.213
k hat (MLE)	9.801	k star (bias corrected MLE)	9.237
Theta hat (MLE)	9.6212E-4	Theta star (bias corrected MLE)	0.00102
nu hat (MLE)	999.7	nu star (bias corrected)	942.2
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (942.20, α)	871.9	Adjusted Chi Square Value (942.20, β)	870
95% Gamma Approximate UCL (use when n>=50)	0.0102	95% Gamma Adjusted UCL (use when n<50)	0.0102

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00131	SD (KM)	0.00136
Variance (KM)	1.8626E-6	SE of Mean (KM)	2.1366E-4
k hat (KM)	0.924	k star (KM)	0.883
nu hat (KM)	94.23	nu star (KM)	90.02
theta hat (KM)	0.00142	theta star (KM)	0.00149
80% gamma percentile (KM)	0.00213	90% gamma percentile (KM)	0.00311
95% gamma percentile (KM)	0.00411	99% gamma percentile (KM)	0.00644

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (90.02, α)	69.14	Adjusted Chi Square Value (90.02, β)	68.61
95% Gamma Approximate KM-UCL (use when n>=50)	0.00171	95% Gamma Adjusted KM-UCL (use when n<50)	0.00172

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:43:38 PM
From File	Brook Trout, Silver, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Silver, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.0715E-4	Mean in Log Scale	-10.2
SD in Original Scale	0.00159	SD in Log Scale	2.506
95% t UCL (assumes normality of ROS data)	8.7919E-4	95% Percentile Bootstrap UCL	9.0902E-4
95% BCA Bootstrap UCL	0.00111	95% Bootstrap t UCL	0.00141
95% H-UCL (Log ROS)	0.00387		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.793	KM Geo Mean	0.00112
KM SD (logged)	0.415	95% Critical H Value (KM-Log)	1.824
KM Standard Error of Mean (logged)	0.0649	95% H-UCL (KM -Log)	0.00136
KM SD (logged)	0.415	95% Critical H Value (KM-Log)	1.824
KM Standard Error of Mean (logged)	0.0649		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	8.6078E-4	Mean in Log Scale	-7.418
SD in Original Scale	0.00149	SD in Log Scale	0.605
95% t UCL (Assumes normality)	0.00121	95% H-Stat UCL	8.5164E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00167

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:44:21 PM
From File	Brook Trout, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Sodium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	362	Mean	494.7
Maximum	748	Median	485
SD	82.68	Std. Error of Mean	11.58
Coefficient of Variation	0.167	Skewness	1.394

Normal GOF Test

Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.9803E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.138	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	514.1	95% Adjusted-CLT UCL (Chen-1995)	516.2
		95% Modified-t UCL (Johnson-1978)	514.5

Gamma GOF Test

A-D Test Statistic	1.117	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	40.58	k star (bias corrected MLE)	38.2
Theta hat (MLE)	12.19	Theta star (bias corrected MLE)	12.95
nu hat (MLE)	4139	nu star (bias corrected)	3897
MLE Mean (bias corrected)	494.7	MLE Sd (bias corrected)	80.04
		Approximate Chi Square Value (0.05)	3753
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	3748

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	513.7	95% Adjusted Gamma UCL (use when n<50)	514.3

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:44:21 PM
From File	Brook Trout, Sodium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Sodium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00948	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.892	Mean of logged Data	6.192
Maximum of Logged Data	6.617	SD of logged Data	0.155

Assuming Lognormal Distribution

95% H-UCL	513.5	90% Chebyshev (MVUE) UCL	526.9
95% Chebyshev (MVUE) UCL	541.6	97.5% Chebyshev (MVUE) UCL	562
99% Chebyshev (MVUE) UCL	602		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	513.8	95% Jackknife UCL	514.1
95% Standard Bootstrap UCL	514	95% Bootstrap-t UCL	517.9
95% Hall's Bootstrap UCL	517.5	95% Percentile Bootstrap UCL	513.9
95% BCA Bootstrap UCL	516		
90% Chebyshev(Mean, Sd) UCL	529.4	95% Chebyshev(Mean, Sd) UCL	545.2
97.5% Chebyshev(Mean, Sd) UCL	567	99% Chebyshev(Mean, Sd) UCL	609.9

Suggested UCL to Use

95% Approximate Gamma UCL	513.7

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:45:03 PM
From File	Brook Trout, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Strontium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	0.756	Mean	1.545
Maximum	4.52	Median	1.23
SD	0.795	Std. Error of Mean	0.111
Coefficient of Variation	0.515	Skewness	2.01

Normal GOF Test

Shapiro Wilk Test Statistic	0.78	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.0318E-9	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.731	95% Adjusted-CLT UCL (Chen-1995)	1.761
		95% Modified-t UCL (Johnson-1978)	1.737

Gamma GOF Test

A-D Test Statistic	1.845	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.158	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.334	k star (bias corrected MLE)	5.033
Theta hat (MLE)	0.29	Theta star (bias corrected MLE)	0.307
nu hat (MLE)	544.1	nu star (bias corrected)	513.4
MLE Mean (bias corrected)	1.545	MLE Sd (bias corrected)	0.689
		Approximate Chi Square Value (0.05)	461.9
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	460.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.717	95% Adjusted Gamma UCL (use when n<50)	1.723

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:45:03 PM
From File	Brook Trout, Strontium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Strontium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.922	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0024	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.28	Mean of logged Data	0.338
Maximum of Logged Data	1.509	SD of logged Data	0.418

Assuming Lognormal Distribution

95% H-UCL	1.705	90% Chebyshev (MVUE) UCL	1.806
95% Chebyshev (MVUE) UCL	1.932	97.5% Chebyshev (MVUE) UCL	2.107
99% Chebyshev (MVUE) UCL	2.45		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	1.728	95% Jackknife UCL	1.731
95% Standard Bootstrap UCL	1.726	95% Bootstrap-t UCL	1.781
95% Hall's Bootstrap UCL	1.786	95% Percentile Bootstrap UCL	1.733
95% BCA Bootstrap UCL	1.753		
90% Chebyshev(Mean, Sd) UCL	1.879	95% Chebyshev(Mean, Sd) UCL	2.03
97.5% Chebyshev(Mean, Sd) UCL	2.24	99% Chebyshev(Mean, Sd) UCL	2.652

Suggested UCL to Use

95% Student's-t UCL	1.731	or 95% Modified-t UCL	1.737

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:45:46 PM
From File	Brook Trout, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Thallium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	47
		Number of Missing Observations	0
Minimum	9.7000E-4	Mean	0.00455
Maximum	0.0346	Median	0.00215
SD	0.0071	Std. Error of Mean	9.9360E-4
Coefficient of Variation	1.56	Skewness	3.258

Normal GOF Test

Shapiro Wilk Test Statistic	0.471	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.378	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.00621	95% Adjusted-CLT UCL (Chen-1995)	0.00667
		95% Modified-t UCL (Johnson-1978)	0.00629

Gamma GOF Test

A-D Test Statistic	6.483	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.776	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.264	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.127	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.155	k star (bias corrected MLE)	1.1
Theta hat (MLE)	0.00394	Theta star (bias corrected MLE)	0.00413
nu hat (MLE)	117.8	nu star (bias corrected)	112.2
MLE Mean (bias corrected)	0.00455	MLE Sd (bias corrected)	0.00434
		Approximate Chi Square Value (0.05)	88.76
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	88.16

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.00575	95% Adjusted Gamma UCL (use when n<50)	0.00579

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:45:46 PM
From File	Brook Trout, Thallium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Thallium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.794	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	3.9927E-9	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.2	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-6.938	Mean of logged Data	-5.885
Maximum of Logged Data	-3.364	SD of logged Data	0.808

Assuming Lognormal Distribution

95% H-UCL	0.00491	90% Chebyshev (MVUE) UCL	0.00528
95% Chebyshev (MVUE) UCL	0.00594	97.5% Chebyshev (MVUE) UCL	0.00686
99% Chebyshev (MVUE) UCL	0.00866		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.00618	95% Jackknife UCL	0.00621
95% Standard Bootstrap UCL	0.00618	95% Bootstrap-t UCL	0.00697
95% Hall's Bootstrap UCL	0.0063	95% Percentile Bootstrap UCL	0.0063
95% BCA Bootstrap UCL	0.00659		
90% Chebyshev(Mean, Sd) UCL	0.00753	95% Chebyshev(Mean, Sd) UCL	0.00888
97.5% Chebyshev(Mean, Sd) UCL	0.0108	99% Chebyshev(Mean, Sd) UCL	0.0144

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.00888

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:46:28 PM
From File	Brook Trout, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Tin, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	9
Number of Detects	13	Number of Non-Detects	38
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.021	Minimum Non-Detect	0.02
Maximum Detect	0.039	Maximum Non-Detect	0.02
Variance Detects	3.5910E-5	Percent Non-Detects	74.51%
Mean Detects	0.0261	SD Detects	0.00599
Median Detects	0.025	CV Detects	0.23
Skewness Detects	1.548	Kurtosis Detects	1.464
Mean of Logged Detects	-3.668	SD of Logged Detects	0.206

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.77	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0215	KM Standard Error of Mean	5.7312E-4
KM SD	0.00393	95% KM (BCA) UCL	0.0226
95% KM (t) UCL	0.0225	95% KM (Percentile Bootstrap) UCL	0.0225
95% KM (z) UCL	0.0225	95% KM Bootstrap t UCL	0.0232
90% KM Chebyshev UCL	0.0233	95% KM Chebyshev UCL	0.024
97.5% KM Chebyshev UCL	0.0251	99% KM Chebyshev UCL	0.0273

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.025	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.733	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.248	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.236	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	23.92	k star (bias corrected MLE)	18.45
Theta hat (MLE)	0.00109	Theta star (bias corrected MLE)	0.00141
nu hat (MLE)	622	nu star (bias corrected)	479.8
Mean (detects)	0.0261		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:46:28 PM
From File	Brook Trout, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Tin, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0151
Maximum	0.039	Median	0.0106
SD	0.00738	CV	0.487
k hat (MLE)	5.616	k star (bias corrected MLE)	5.298
Theta hat (MLE)	0.0027	Theta star (bias corrected MLE)	0.00286
nu hat (MLE)	572.8	nu star (bias corrected)	540.4
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (540.43, α)	487.5	Adjusted Chi Square Value (540.43, β)	486.1
95% Gamma Approximate UCL (use when n>=50)	0.0168	95% Gamma Adjusted UCL (use when n<50)	0.0168

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0215	SD (KM)	0.00393
Variance (KM)	1.5463E-5	SE of Mean (KM)	5.7312E-4
k hat (KM)	30.03	k star (KM)	28.28
nu hat (KM)	3063	nu star (KM)	2884
theta hat (KM)	7.1759E-4	theta star (KM)	7.6208E-4
80% gamma percentile (KM)	0.0249	90% gamma percentile (KM)	0.0269
95% gamma percentile (KM)	0.0286	99% gamma percentile (KM)	0.0321

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	2760	Adjusted Chi Square Value (N/A, β)	2757
95% Gamma Approximate KM-UCL (use when n>=50)	0.0225	95% Gamma Adjusted KM-UCL (use when n<50)	0.0225

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.234	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:46:28 PM
From File	Brook Trout, Tin, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Tin, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0158	Mean in Log Scale	-4.25
SD in Original Scale	0.00746	SD in Log Scale	0.456
95% t UCL (assumes normality of ROS data)	0.0175	95% Percentile Bootstrap UCL	0.0177
95% BCA Bootstrap UCL	0.0176	95% Bootstrap t UCL	0.0178
95% H-UCL (Log ROS)	0.0178		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.85	KM Geo Mean	0.0213
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.704
KM Standard Error of Mean (logged)	0.0213	95% H-UCL (KM -Log)	0.0223
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.704
KM Standard Error of Mean (logged)	0.0213		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0141	Mean in Log Scale	-4.366
SD in Original Scale	0.00766	SD in Log Scale	0.425
95% t UCL (Assumes normality)	0.0159	95% H-Stat UCL	0.0155

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0225	KM H-UCL	0.0223
95% KM (BCA) UCL	0.0226		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:47:11 PM
From File	Brook Trout, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Titanium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	0.148	Mean	0.186
Maximum	0.345	Median	0.181
SD	0.0385	Std. Error of Mean	0.00539
Coefficient of Variation	0.207	Skewness	2.36

Normal GOF Test

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	5.923E-10	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.195	95% Adjusted-CLT UCL (Chen-1995)	0.197
		95% Modified-t UCL (Johnson-1978)	0.195

Gamma GOF Test

A-D Test Statistic	1.738	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.127	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	29.55	k star (bias corrected MLE)	27.83
Theta hat (MLE)	0.0063	Theta star (bias corrected MLE)	0.00669
nu hat (MLE)	3015	nu star (bias corrected)	2839
MLE Mean (bias corrected)	0.186	MLE Sd (bias corrected)	0.0353
		Approximate Chi Square Value (0.05)	2716
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	2712

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.195	95% Adjusted Gamma UCL (use when n<50)	0.195

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:47:11 PM
From File	Brook Trout, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Titanium, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	6.8800E-6	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.116	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.911	Mean of logged Data	-1.698
Maximum of Logged Data	-1.064	SD of logged Data	0.178

Assuming Lognormal Distribution

95% H-UCL	0.194	90% Chebyshev (MVUE) UCL	0.2
95% Chebyshev (MVUE) UCL	0.206	97.5% Chebyshev (MVUE) UCL	0.215
99% Chebyshev (MVUE) UCL	0.232		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.195	95% Jackknife UCL	0.195
95% Standard Bootstrap UCL	0.195	95% Bootstrap-t UCL	0.198
95% Hall's Bootstrap UCL	0.202	95% Percentile Bootstrap UCL	0.195
95% BCA Bootstrap UCL	0.196		
90% Chebyshev(Mean, Sd) UCL	0.202	95% Chebyshev(Mean, Sd) UCL	0.21
97.5% Chebyshev(Mean, Sd) UCL	0.22	99% Chebyshev(Mean, Sd) UCL	0.24

Suggested UCL to Use

95% Student's-t UCL	0.195	or 95% Modified-t UCL	0.195
or 95% H-UCL	0.194		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:47:11 PM
From File	Brook Trout, Titanium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Titanium, mg/kg - ww

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:47:54 PM
From File	Brook Trout, Uranium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Uranium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	41
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	4.5000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.00123	Maximum Non-Detect	4.0000E-4
Variance Detects	6.9094E-8	Percent Non-Detects	80.39%
Mean Detects	7.0500E-4	SD Detects	2.6286E-4
Median Detects	6.0000E-4	CV Detects	0.373
Skewness Detects	1.155	Kurtosis Detects	0.0898
Mean of Logged Detects	-7.312	SD of Logged Detects	0.339

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.835	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.5980E-4	KM Standard Error of Mean	2.4189E-5
KM SD	1.6388E-4	95% KM (BCA) UCL	5.0490E-4
95% KM (t) UCL	5.0034E-4	95% KM (Percentile Bootstrap) UCL	5.0039E-4
95% KM (z) UCL	4.9959E-4	95% KM Bootstrap t UCL	5.2375E-4
90% KM Chebyshev UCL	5.3237E-4	95% KM Chebyshev UCL	5.6524E-4
97.5% KM Chebyshev UCL	6.1087E-4	99% KM Chebyshev UCL	7.0048E-4

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.675	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.726	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.271	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.267	Detected Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	9.236	k star (bias corrected MLE)	6.532
Theta hat (MLE)	7.6332E-5	Theta star (bias corrected MLE)	1.0793E-4
nu hat (MLE)	184.7	nu star (bias corrected)	130.6
Mean (detects)	7.0500E-4		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:47:54 PM
From File	Brook Trout, Uranium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Uranium, mg/kg - ww

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.5000E-4	Mean	0.00818
Maximum	0.01	Median	0.01
SD	0.00373	CV	0.456
k hat (MLE)	1.664	k star (bias corrected MLE)	1.579
Theta hat (MLE)	0.00491	Theta star (bias corrected MLE)	0.00518
nu hat (MLE)	169.7	nu star (bias corrected)	161.1
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (161.08, α)	132.7	Adjusted Chi Square Value (161.08, β)	132
95% Gamma Approximate UCL (use when n>=50)	0.00992	95% Gamma Adjusted UCL (use when n<50)	0.00998

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.5980E-4	SD (KM)	1.6388E-4
Variance (KM)	2.6857E-8	SE of Mean (KM)	2.4189E-5
k hat (KM)	7.872	k star (KM)	7.422
nu hat (KM)	803	nu star (KM)	757.1
theta hat (KM)	5.8409E-5	theta star (KM)	6.1951E-5
80% gamma percentile (KM)	5.9257E-4	90% gamma percentile (KM)	6.8499E-4
95% gamma percentile (KM)	7.6795E-4	99% gamma percentile (KM)	9.4026E-4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (757.06, α)	694.2	Adjusted Chi Square Value (757.06, β)	692.5
95% Gamma Approximate KM-UCL (use when n>=50)	5.0143E-4	95% Gamma Adjusted KM-UCL (use when n<50)	5.0269E-4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.249	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:47:54 PM
From File	Brook Trout, Uranium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Uranium, mg/kg - ww

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.8217E-4	Mean in Log Scale	-8.512
SD in Original Scale	2.5481E-4	SD in Log Scale	0.838
95% t UCL (assumes normality of ROS data)	3.4197E-4	95% Percentile Bootstrap UCL	3.4144E-4
95% BCA Bootstrap UCL	3.4888E-4	95% Bootstrap t UCL	3.6109E-4
95% H-UCL (Log ROS)	3.6863E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.724	KM Geo Mean	4.4221E-4
KM SD (logged)	0.248	95% Critical H Value (KM-Log)	1.722
KM Standard Error of Mean (logged)	0.0366	95% H-UCL (KM -Log)	4.8442E-4
KM SD (logged)	0.248	95% Critical H Value (KM-Log)	1.722
KM Standard Error of Mean (logged)	0.0366		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.9902E-4	Mean in Log Scale	-8.281
SD in Original Scale	2.3117E-4	SD in Log Scale	0.504
95% t UCL (Assumes normality)	3.5327E-4	95% H-Stat UCL	3.2882E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	5.0143E-4	95% GROS Approximate Gamma UCL	0.00992

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:48:37 PM
From File	Brook Trout, Vanadium, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Vanadium, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	50
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Brook Trout, Vanadium, mg/kg - ww was not processed!

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:49:19 PM
From File	Brook Trout, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Zinc, mg/kg - ww

General Statistics

Total Number of Observations	51	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	8.97	Mean	14.16
Maximum	22.3	Median	13.7
SD	2.558	Std. Error of Mean	0.358
Coefficient of Variation	0.181	Skewness	0.758

Normal GOF Test

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.267	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.118	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	14.76	95% Adjusted-CLT UCL (Chen-1995)	14.79
		95% Modified-t UCL (Johnson-1978)	14.77

Gamma GOF Test

A-D Test Statistic	0.278	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0948	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	32.52	k star (bias corrected MLE)	30.62
Theta hat (MLE)	0.436	Theta star (bias corrected MLE)	0.463
nu hat (MLE)	3317	nu star (bias corrected)	3123
MLE Mean (bias corrected)	14.16	MLE Sd (bias corrected)	2.56
		Approximate Chi Square Value (0.05)	2994
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	2991

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.77	95% Adjusted Gamma UCL (use when n<50)	14.79

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/1/2021 4:49:19 PM
From File	Brook Trout, Zinc, mg_kg - ww.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Brook Trout, Zinc, mg/kg - ww

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.99	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.978	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0833	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.123	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.194	Mean of logged Data	2.635
Maximum of Logged Data	3.105	SD of logged Data	0.177

Assuming Lognormal Distribution

95% H-UCL	14.79	90% Chebyshev (MVUE) UCL	15.22
95% Chebyshev (MVUE) UCL	15.7	97.5% Chebyshev (MVUE) UCL	16.37
99% Chebyshev (MVUE) UCL	17.68		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	14.75	95% Jackknife UCL	14.76
95% Standard Bootstrap UCL	14.75	95% Bootstrap-t UCL	14.81
95% Hall's Bootstrap UCL	14.83	95% Percentile Bootstrap UCL	14.78
95% BCA Bootstrap UCL	14.83		
90% Chebyshev(Mean, Sd) UCL	15.24	95% Chebyshev(Mean, Sd) UCL	15.73
97.5% Chebyshev(Mean, Sd) UCL	16.4	99% Chebyshev(Mean, Sd) UCL	17.73

Suggested UCL to Use

95% Student's-t UCL	14.76

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.