Baseline Human Health Risk Assessment

North Hollywood West Well Field

December 2016

Los Angeles Department of Water & Power

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December 2016

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SYNOPSIS

This report presents the human health risk assessment (HHRA) conducted for The City of Los Angeles Department of Water and Power (LADWP) for the North Hollywood West (NHW) Well Field in the San Fernando Groundwater Basin (San Fernando Basin; SFB), located in the San Fernando Valley in Southern California. The HHRA was prepared in support of the Interim RI/FS for the NHW Well Field and includes assumptions about site usage and exposure conditions to produce a tool that may be utilized to make decisions about potential remedial actions and/or risk management that may be required for the NHW Well Field.

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LIST OF ABBREVIATIONS AND ACRONYMS

Acronym/Abbreviation	Term
%	Percent
μg	microgram
AFY	Acre-feet per year
AL	Action Level
ADAF	Age Dependent Age Factors
ALM	Adult Lead Methodology
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
Bgs	Below Ground Surface
B	Dimensionless Dermal Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
BLL	Blood Lead Level
BTEX	Benzene, toluene, ethylbenzene and xylenes
BW	Body Weight
CA	Constituent Concentration in Air
chRD	Child Specific Reference Dose
CDI	Chronic Daily Intake
CAS_RN	Chemical Abstracts Service Registry Number
CDC	Centers for Disease Control and Prevention
CEC	Chemicals of Emerging Concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Los Angeles
COPC	Constituent of Potential Concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
CW	Constituent Concentration in Water
dl	deciliter
DAD	Dermal Absorbed Dose

DA_{event}	Dermal Absorbed Dose Per Event
DCA	Dichloroethane
DCE	Dichloroethylene (Dichloroethene)
DDW	Division of Drinking Water
DEHP	Bis(2-ethylhexyl)phthalate (Di (2-ethylhexyl)phthalate
DOE	Department of Energy
DTSC	Department of Toxic Substances Control
EC	Exposure Concentration
ED	Exposure Duration
EF	Exposure Frequency
ELCR	Excess Lifetime Cancer Risk
EPC	Exposure Point Concentration
ET	Exposure Time
EV	Event Frequency
FA	Fraction Absorbed
FSP	Field Sampling Plan
GI	Gastrointestinal
GMP	Groundwater Monitoring Program
GSIS	Groundwater System Improvement Study
H'	Henry's Law Constant
HERO	Human and Ecological Risk Office
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IR	Ingestion Rate
IEUBK	Integrated Exposure Biokinetic and Uptake (model)
IRIS	Integrated Risk Information System
IRw	Drinking Water Ingestion Rate
IUR	Inhalation Unit Risk
kg	Kilogram
Kp	Dermal Permeability Coefficient of a Compound in Water

L	Liter
LADWP	Los Angeles Department of Water and Power
LIMS	Laboratory Information Management System
LOAEL	Lowest-observed-adverse-effect-level
LUST	Leaking underground storage tank
MADL	Maximum Allowable Dose Level
MCL	Maximum Contaminant Level
mg	Milligram
MOA	Mode of action
MTBE	Methyl tert-butyl ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non-detect
NHW	North Hollywood West
NL	Notification Level
NOAEL	No-observed-adverse-effect-level
NRC	National Research Council
OEHHA	Office of Environmental Health Hazard Assessment
ORO	Oak Ridge Operations Office
PCE	Tetrachloroethylene (Perchloroethylene)
PbBs	Blood lead concentrations
PHG	Public Health Goal
PPRTV	Provisional Peer Reviewed Toxicity Value
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
REL	Reference Exposure Level
RfC	Reference Concentration
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study

RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SA	Skin Surface Area
SDH	Serum sorbitol dehydrogenase
SF	Slope Factor
SFB	San Fernando Basin
SFV	San Fernando Valley
SWRCB	State Water Resources Control Board
TCE	Trichloroethylene (Trichloroethene)
TCP	Trichloropropane
THQ	Target Hazard Quotient
τ_{event}	Lag Time Per Event
t_{event}	Event Duration
TR	Target Risk
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
UF	Uncertainty Factor
EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. INTRODUCTION

The City of Los Angeles (the "City"), Department of Water and Power (LADWP), in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), conducted an Interim Remedial Investigation/Feasibility Study (RI/FS; Hazen and Sawyer 2016) to address the presence of groundwater contaminants in the vicinity of the North Hollywood West (NHW) Well Field in the San Fernando Groundwater Basin (San Fernando Basin; SFB). The SFB underlies most of the San Fernando Valley and is approximately 175 square miles (112,000 acres) in area.

As part of the RI/FS process, a Human Health Risk Assessment (HHRA) was performed to evaluate the potential for adverse human health effects as a result of exposure to 1,4-dioxane and other constituents of potential concern (COPCs) due using groundwater use from the NHW Well Field as a domestic water source. Utilizing analytical data obtained from groundwater sampling efforts, the HHRA evaluates baseline risks as part of the Interim RI/FS. This HHRA was conducted in accordance with current guidance from the United States Environmental Protection Agency (EPA) and State of California Department of Environmental Protection/Department of Toxic Substances Control (DTSC), and other relevant guidance as applicable.

1.1 Background

The City encompasses an area of 456 square miles, with a population of nearly 4 million residents and a current water demand of more than 500,000 acre-feet per year (AFY; Figure 1). An important component of the City's water supply portfolio is local groundwater (City of Los Angeles 2015). Over the last five years, local groundwater has provided approximately 12 percent (%) of the total water supply for Los Angeles, and since 1970 has provided up to 23% of total supply during extended dry periods when imported supplies become less reliable. According to its Urban Water Management Plan, the City plans to obtain 50% of water locally by 2035. The primary source of local water is groundwater, and the primary source of local groundwater is the SFB (LADWP 2015).

The SFB underlies most of the San Fernando Valley. It serves as the primary source of groundwater for the City of Los Angeles, providing more than 90% of the City's local groundwater supply (Hazen 2016). Groundwater extracted from the SFB is mixed with other sources and distributed throughout the City's drinking water distribution system. There are 11 Well Fields in the SFB that have been or are currently being used to produce groundwater for the cities of Los Angeles, Burbank, and Glendale (Figure 2).

The NHW Well Field includes 14 groundwater production wells installed over a 60-year period from 1924 to 1984 (Figure 3). Individual wells extract groundwater from depths of 130 to 910 feet below ground surface (bgs) at flow rates ranging up to approximately 5,400 AFY. As discussed in the Interim RI/FS (Hazen 2016), production wells have been sampled since 1992 and concentrations of 1,4-dioxane, 1,1-dichloroethylene (1,1-DCE), tetrachloroethylene (PCE) and trichloroethylene (TCE) have exceeded regulatory limits. The production wells represent a potentially complete human health exposure pathway in that the mixture of water from several wells is delivered to homes for use as a domestic water source.

1.2 Overview of Risk Assessment

The EPA defines risk to be the potential for harmful effects to human health or ecological systems resulting from exposure to an environmental stressor. A stressor can be any physical, chemical or biological entity that can induce an adverse response. Stressors may affect specific natural resources, entire ecosystems and/or the environment with which they interact (EPA 2009).

Risk assessment is the systematic and iterative process of evaluating the nature and magnitude of health risks associated with exposure of receptors to chemical contaminants and other stressors.

The following four elements comprise the HHRA.

Step 1: Data Evaluation (Section 2) – describes the screening steps that are performed on available analytical data to select the COPCs in environmental media of interest (in this case, groundwater).

Step 2: Exposure Assessment (Section 3) – outlines the Conceptual Site Model (CSM) that forms the basis of the HHRA. The CSM identifies potential human receptors, the routes by which they may be exposed to the COPCs and estimates exposure concentrations of COPCs to receptors.

Step 3: Toxicity Assessment (Section 4) - summarizes and identifies the appropriate toxicity values for the selected COPCs.

Step 4: Risk Characterization (Section 5) – incorporates the information from Steps 1 through 3 to estimate potential health risks from exposure to COPCs in environmental media of concern. Calculated risks are compared to acceptable target risk levels to ensure protection of human health under both current and reasonably foreseeable future land uses.

This document presents the results of the HHRA performed on the LADWP production and monitoring wells in the NHW Well Field.

1.3 Objectives

The objective of the HHRA is to prepare an initial baseline assessment of the potential risk to human health from exposure to contaminants in groundwater as part of the Interim RI/FS for the NHW Well Field (Hazen 2016). An ecological risk assessment was not completed as part of the Interim RI/FS as no ecological receptor are expected to be exposed to the contaminants in groundwater at the NHW Well Field. This HHRA has been completed in a manner that is consistent with the human health evaluation procedures described by EPA’s Risk Assessment Guidance for Superfund (RAGS; EPA 1989, 2004, 2009).

1.4 Scope of Work

The scope of work for this HHRA is as follows:

- collate and review historical groundwater analytical data collected from production and monitoring wells;
- evaluate this data against published regulatory limits, screening levels and other criteria to determine COPCs which required further risk characterization;
- identify which receptors are potentially exposed to the COPCs via complete exposure pathways using a CSM;
- characterize carcinogenic risks and non-carcinogenic hazards based on EPA and State of California methodologies; and
- evaluate the results of the risk characterization to determine whether adverse human health effects could potentially occur from exposure to groundwater sources from NHW Well Field.

1.5 Regulatory Information

This HHRA was conducted in accordance with CERCLA (also known as “Superfund”) and the NCP and is a part of the RI/FS process. The NCP provides the organizational structure and procedures for preparing for, and responding to, discharges of oil and releases of hazardous substances, pollutants, and contaminants. Remedial investigations are conducted to characterize the contamination at a site and to obtain information needed to identify, evaluate, and select clean-up alternatives. The feasibility study includes an analysis of alternatives based on nine NCP evaluation criteria. The human health evaluation procedures described by EPA’s Risk Assessment Guidance for Superfund (RAGS; EPA 1989, 2004, 2009) is the guidance for developing risk information to support the Interim RI/FS

The State and Federal regulatory thresholds that are included in this HHRA are:

- **Maximum Contaminant Levels (MCLs)** are adopted as regulations. They are drinking water standards to be met by public water systems. MCLs take into account not only chemicals' health risks but also factors such as their detectability and treatability, as well as costs of treatment.
- **Secondary MCLs** are concerned with cosmetic effects (such as skin or tooth discoloration) or aesthetic factors (such as taste and odor).
- **Notification Levels (NLs)** The Division of Drinking Water (DDW) uses these health-based advisory levels for certain chemicals without MCLs. Before a Public Health Goal (PHG) is established in California, the California DDW may establish a NL for a potential contaminant. This is a health-based advisory level but it is not a regulated standard. NLs were created with the intent of providing early warning to the public of potential health effects prior to establishment of a drinking water standard. If a contaminant exceeds a Response Level, which can be 10 to 100 times its NL, depending on the contaminant, the DDW may recommend and advise a water purveyor to remove the water source (e.g., well) from service and may also require public notification.

The Interim RI/FS (Hazen 2016) and this HHRA includes analytical data collected from the SFB groundwater. Based on the site history, chemical usages, fate and transport of the contaminants in the environment groundwater samples were analyzed for those chemicals that have potential health effects, including:

- Title 22 drinking water regulated chemicals (those with MCLs, secondary MCLs and/or PHGs) and Title 22 unregulated chemicals (those with NLs) requiring monitoring;
- chemicals listed pursuant to Safe Drinking Water and Toxic Enforcement act of 1986;
- microbiological quality;
- priority pollutants;
- hazardous wastes and constituents mentioned in 40CFR Part 261, including Appendices VII and VIII; and
- Chemicals of Emerging Concern (CECs) as recommended in the State Water Resources Control Board's "Final Report Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water, Recommendations of a Science Advisory Panel".

It should be noted that this analysis was conducted on an "as-is" or "No Action" basis, indicating that the calculated risks/hazards reported herein were prepared as if no treatment was performed or a failure of treatment occurred on the groundwater source. This is in keeping with EPA methodology (EPA 1989). This HHRA considers the additive effects of multiple contaminants within an extremely impaired source of potable domestic water.

The risk assessment methodology used in this HHRA is as per EPA, RAGS: Volume I, Human Health Evaluation Manual, Part A (guidance for calculating hazard index and cancer risk [EPA 1989]), Part E (Supplemental Guidance for Dermal Risk Assessment [Final; EPA 2004]) and Part F (Supplemental Guidance for Inhalation Risk Assessment [EPA 2009]). Standard default exposure factors were used throughout this document except where noted to reflect potential site-specific conditions. These factors were as per Exposure Factors Handbook (EPA 2011a), OSWER Directive 9200.1-120 (EPA 2014a) and California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) Human and Ecological Risk Office (HERO) HHRA Note Number 1 (Cal/EPA 2014a).

2. DATA EVALUATION

The approach used in this HHRA relied on a screening process to focus the HHRA on those constituents that have the potential to contribute the majority of the health-risks. Once the list of COPCs was determined, exposure and toxicity assessments were conducted, culminating in the risk characterization.

2.1 Data Compilation

2.1.1 Delineating the Study Area

The Study Area for gathering raw water quality to support this risk assessment was delineated by determining a 30 year capture zone for the NHW Well Field as a means of forecasting the lateral extent of the groundwater system that will be influenced by NHW Well Field pumping activities over the next 30 years. This was carried out using a modified version of the forward-looking SFB Groundwater Flow Model developed by AMEC Environment & Infrastructure (AMEC; '2IR Model'; 2015). This model was developed using Groundwater Vistas (ESI 2011) software incorporating MODFLOW 2005 (Harbaugh 2005) as the simulation engine. This model was updated to include a forecasted (future) pumping plan and reverse particle tracking was performed to estimate the 30 year capture zone for each NHW production well. The capture zones for each well were then combined to generate a single 30 year capture zone to delineate the Study Area. Further information relating to this is provided in Appendix A of the Interim RI/FS (Hazen 2016).

2.1.2 Data Sources

The primary sources of groundwater data identified for use in this HHRA were as follows.

- **LADWP Laboratory Information Management System (LIMS) Database** - LADWP conducts sampling and analysis of its production wells in accordance with its Permit with the DDW. Samples are collected by LADWP personnel numerous times over years; therefore, there is a significant sample population. Samples are analyzed using standard EPA-approved analytical methods and the analyses are conducted by LADWP's laboratory; which is certified by the State of California. Analytical results are entered into LADWP's LIMS database and are transmitted in electronic format to DDW for use.
- **GSIS Database** - LADWP completed the GSIS in early 2015, which was a 6-year study characterizing the groundwater contamination in the SFB. Seventy-seven (77) groundwater monitoring wells were installed at 26 locations (multiple monitoring wells were installed for different groundwater layers at some locations). The wells were installed in accordance with applicable permits, and sampling was conducted by licensed professionals in accordance with procedures detailed in field planning documents (Field Sampling Plan [FSP] and Quality Assurance Project Plan [QAPP]) (Brown and Caldwell [BC] 2015a). Samples were analyzed using standard EPA-approved analytical methods and the analyses were conducted by a laboratory certified by the State of California for the analyses performed. A comprehensive list of more than 400 chemicals were analyzed and then subjected to Level 2a data validation. Analytical results were entered into a database and transmitted in electronic format to EPA for use.
- **EPA SFV Database** – Eighty-four (84) groundwater monitoring wells were constructed and the Groundwater Monitoring Program (GMP) was implemented as part of the 1992 RI (JMM 1992). EPA conducts periodic groundwater sampling and analysis for these wells. In addition,

groundwater quality data are received from potentially responsible parties (PRPs). The GMP has served as a regional monitoring program that is used to track changes in contaminant distribution, monitor water levels and contaminant trends, and provide data for various regional data evaluation activities conducted by a variety of stakeholders. These data are stored in the EPA SFV database.

- **GeoTracker** – GeoTracker is the State Water Resources Control Board (SWRCB) data management system for sites that impact, or have the potential to impact, water quality in California, with emphasis on groundwater. GeoTracker contains records for sites that require cleanup, such as Leaking Underground Storage Tank (LUST) Sites, Department of Defense Sites, and Cleanup Program Sites. GeoTracker also contains records for permitted facilities such as Irrigated Lands, Oil and Gas production, operating Permitted USTs, and Land Disposal Sites.

2.1.3 Data Queries

From the sources described in the Section 2.1.2, all identified sample records for production and monitoring wells were combined into a single project water quality database for querying and data analysis to support this HHRA. The identified production and monitoring wells within the Study Area were then used to query the water quality database and identify constituents analyzed in groundwater well samples. Criteria used to query the project water quality database included:

- well type (i.e., production or monitoring well);
- well screen depth/elevation interval (used to determine which model layer(s) screens are within based on the groundwater flow model construction);
- date of samples (samples taken between January, 2011 and August, 2016); and,
- number of samples (greater than zero count).

The following records were omitted from further study for the reasons listed.

- Records where the result field was blank or text (i.e., contained no numerical result value) were omitted from calculations;
- Wells relating to LUST sites were removed from the dataset, as these are under regulatory oversight of the California Regional Water Quality Control Board who is responsible for managing on-site remediation activities and managing risks to drinking water and human health from these sites. Many of these sites are subject to low-risk site closure, and LUST sites contaminants are known to have small localized contaminant plumes. For example benzene, toluene, ethylbenzene and xylenes (BTEX) plumes are generally less than 500 feet in length while MTBE plumes are generally less than 1100 feet in length, as documented in comprehensive plume studies by Lawrence Livermore National Laboratory (Rice et al., 1995) and Shih et al. (2004). The closest LUST site to the NHW production wells is approximately 1200 feet east of well NH-23 (site global ID T0603702604), and has status is listed as ‘Completed – Case Closed’ as of July 1998. The next closest LUST site to the NHW production wells is approximately 1300 feet north of well NH-34 (site global ID T0603702587), and also has status listed as ‘Completed – Case Closed’ as of October 2006. The closest LUST site to the NHW production wells which has status described as something other than ‘Completed – Case Closed’, is approximately 7,400 feet south-west of well NH-07 (site global ID T0603702406).

2.1.4 Data Summary

After the aforementioned data queries were carried out, production wells and monitoring wells were then separated into two groups for further analysis. The resultant datasets were used to conduct statistical analysis in support of COPC identification. After data queries were implemented, the final number of wells and records used for analysis of production and monitoring wells was as follows:

- For the production wells:
  - A total of 14 production wells were selected for assessment (Figure 4);
  - The total number of records in this production well population was 49,559;
  - The total number of detections was 4,297 (9% of the total population);
  - Of the total number of detections, 92 (2%) were below laboratory reporting limits (RLs);
- For the monitoring wells:
  - A total of 70 monitoring wells were selected for assessment (Figure 4);
  - The total number of records in this monitoring well population was 29,708;
  - The total number of detections was 8,300 (28% of the total population); and
  - Of the total number of detections, 1,846 (22%) were below laboratory RLs.

Of note are constituent concentrations occurring in the datasets that are J-qualified. This indicates that these constituents are present at estimated concentrations in laboratory samples below the reporting limit (RL). However, EPA guidance (1989) requires the inclusion of these data as positive detections, which could lead to a high bias for certain COPCs. Additionally, the guidance acknowledges the potential uncertainties associated with this qualifier, and in the event that these data qualified with a J contribute significantly to the risk, appropriate caveats can be attached.

2.2 COPC Identification

2.2.1 Screening Concentrations Based on Production Well Data

An estimated 'screening concentration' for each constituent for production wells was used for the purposes of COPC identification. The screening concentration for each constituent in production wells was selected based on the maximum observation in the raw water quality data. This result was then used for the purposes of COPC identification as part of the risk assessment.

2.2.2 Future Screening Concentrations Based on Monitoring Well Data

This risk assessment evaluates separately the potential future risks posed by up-gradient COPCs in groundwater, based on monitoring well data from wells within the capture zone of the NHW Well Field. While not necessarily required for a baseline risk assessment under the NCP, this information is useful for evaluating risks for drinking water under California rules and procedures.

To generate future screening concentrations for each constituent for monitoring wells, first the maximum observation for the entire population of monitoring well raw water quality data was selected. Then, to account for in-well dilution when estimating future screening concentrations based on monitoring well data, corresponding future screening concentrations in production wells were estimated using flow-weighted mass balance calculations by groundwater flow model layer (this is the same model used to develop the Study Area described in Section 2.1.1). The intent of this was to provide estimates for concentrations in future production well flows, incorporating the effects of in-well dilution. Relevant data and calculation assumptions for this approach are outlined as follows:

- The maximum concentration for each constituent was assumed to arrive in the future at all down-gradient production wells in the shallowest model layer 1 (i.e., it is assumed there are no contaminant transport mechanisms that reduce plume concentrations, such as attenuation, retardation or degradation). Model layers 2, 3 and 4 were assumed to have a concentration of zero.
- Flow-weighted mass balance concentration estimates for each production well were then calculated as follows:

$$C_w Q_w = C_1 Q_1 + C_2 Q_2 + C_3 Q_3 + C_4 Q_4$$

Where:
C_w is the flow-weighted concentration in the production well effluent;
C_1 to C_4 is the concentration in each model layer for the production well;
Q_w is the average forecasted 30-year flow rate for the production well; and,
Q_1 to Q_4 is the average forecasted 30-year flow rate in each model layer for the production well.

- The maximum flow-weighted mass balance concentration estimate for each constituent from all production wells was used to evaluate future COPCs as part of the risk assessment.

2.3 COPC Identification Criteria

COPC identification was carried out using screening concentrations and future screening concentrations for constituents detected in production well and monitoring wells. The goal of COPC identification is to focus the HHRA on those constituents with a significant contribution to risk. Constituents were evaluated based on a variety of criteria to identify COPCs; a complete list of all constituents assessed and the rationale for including/excluding each from further consideration in the risk assessment is provided in Appendix A; Appendix A-1 relates to COPC identification based on production well data and Appendix A-2 relates to future COPC identification based on monitoring well data. The criteria for eliminating constituents as COPCs are summarized as follows:

1. Constituents with a frequency of detection below 5%. According to the EPA (1989), chemicals that are infrequently detected in the environment may be artifacts due to sampling, analytical, or other problems, and may not be related to site activities. The EPA (1989) currently recommends that the list of detected analytes be reduced based on a certain frequency of detection before performing a quantitative HHRA. Thus, this list was further narrowed by removing any constituents with less than 5% positive detections (i.e., the percentage of positive detections as compared to the overall number of observations).
2. Constituents occurring at less than the Regional Screening Level (RSL) Generic Screening Table for Resident Tap water of Target Risk (TR) = 1E-06 and Target Hazard Index (THQ) = 0.1 or 10% of the relevant MCL/NL if available, whichever was lowest.
3. Constituents occurring at less than the Secondary MCL, which applies to cosmetic effects and aesthetics. This requires voluntary testing only under EPA regulations although it is enforceable in California in Community Water Systems. This applies to such substances as sulfate, color and odor.
4. Constituents that are disinfection by-products (e.g., trihalomethanes).
5. Constituents below published health-based screening levels or other exposure limits available (e.g. prescribed dose for pharmaceuticals, allowable daily exposure for food additives, etc.).

6. Constituents that relate to water quality parameters (e.g., temperature, pH, etc.) or microorganisms (e.g., fecal coliforms).

7. Constituents related to ions where toxicity is not differentiated by valence. For example, arsenic toxicity is not differentiated by valence and thus total arsenic is used to assess risk since total arsenic should be sum of Arsenic(III) and Arsenic(V).

8. Records related to physical parameters (e.g. barometric pressure, recorded water depth etc.).

9. Records related to laboratory quality control analysis (e.g., surrogate recoveries).

2.4 COPC Identification Results

2.4.1 COPCs Based on Production Well Data

After elimination of constituents based on the foregoing COPC identification criteria, COPCs based on screening concentrations from production well data are as follows:

- Organics
  - 1,1-Dichloroethene (1,1-DCE);
  - cis-1,2-Dichloroethylene (cis-1,2-DCE);
  - 1,4-Dioxane;
  - Tetrachloroethylene (PCE); and
  - Trichloroethylene (TCE).
- Inorganics
  - Aluminum;
  - Arsenic;
  - Boron;
  - Chromium VI;
  - Iron;
  - Lead;
  - Manganese;
  - Mercury;
  - Molybdenum;
  - Nitrogen, Nitrate (as N);
  - Selenium;
  - Uranium, total; and
  - Vanadium.

2.4.2 Future COPCs Based on Monitoring Well Data

After elimination of constituents based on the foregoing COPC identification criteria, future COPCs based on screening concentrations from monitoring well data are:

- Organics
  - 1,1-Dichloroethane (1,1-DCA);
  - 1,2-Dichloroethane (1,2-DCA);
  - 1,1-DCE;
  - 1,2,3-Trichloropropane (1,2,3-TCP);
  - 1,4-Dioxane;
  - Benzene;
  - Bis(2-ethylhexyl)phthalate (DEHP);
  - Carbon tetrachloride;
  - cis-1,2-DCE;
  - Formaldehyde;
  - Heptachlor;
  - Isopropanol;
- Inorganics
  - Aluminum;
  - Arsenic;
  - Barium;
  - Boron;
  - Chromium VI;
  - Cobalt;
  - Cyanide;
  - Lead;
  - Manganese;
  - Molybdenum;
  - Nitrogen, Nitrate as N;
  - Perchlorate;

- Methyl tert-butyl ether (MTBE);
- PCE; and
- TCE.
- Selenium; and
- Vanadium.

2.5 Fate and Transport

The stratigraphic conceptualization of the basin, as discussed by LADWP (2016), divides the SFB into three primary hydrostratigraphic zones: A-Zone, B-Zone, and Deeper Units. Figure 3-1 of AMEC (2015) depicts the relationship between various interpretations of model and hydrogeologic units. This is discussed in greater detail in the Interim RI/FS Report for North Hollywood West Well Field (Hazen 2016). As discussed by LADWP (2016), the A-Zone and B-Zone are important components of the conceptualization of the SFB because the vertical distribution of contaminants within the Study Area strongly correlates with these hydrostratigraphic zones.

Based on water quality data sampled from monitoring wells, which are screened in discrete hydrostratigraphic intervals or zones, interpreted contaminant distribution within the Study Area is primarily concentrated in the shallowest zone (A-Zone). Concentrations in the deeper zones (B-Zone and Deeper Units) are typically one to two orders of magnitude lower than those in the shallow A-Zone (Hazen 2016), although, it is also important to note that monitoring well data is dominated by samples taken from shallow monitoring wells within the A-Zone (as highlighted in Section 2.1.4). In contrast, the NHW production wells are screened across shallow and deeper zones from depths ranging from 130 to 910 feet bgs (Hazen 2016).

When the contaminants migrate from monitoring well locations to the NHW Well Field in the shallow zones, impacted groundwater is mixed with groundwater from deeper zones that are also screened by the production wells, resulting in concentrations in the production wells that are generally lower than those measured in the shallow discretely-screened monitoring wells. In addition, as contaminants migrate in through the groundwater system to the Well Field, they undergo fate and transport processes that can act to decrease contaminant concentrations; these processes include dispersion (mechanical mixing in the aquifer), degradation, sorption, and other retardation processes.

2.6 Exposure Pathways

From the CSM, complete and potentially complete exposure pathways under both current and future land use conditions, as well as fate and transport models and modelling/analytical data requirements are identified. A complete exposure pathway consists of the following elements (EPA 1989):

- a mechanism by which the chemical is released;
- a retention or transport medium through which a chemical travels from the point of release to the receptor location; and
- a route of exposure (ingestion, inhalation, or dermal contact) by which the chemical enters the receptors' body and has the potential to cause adverse health effect.

If any of these elements do not exist, the exposure pathway is considered incomplete and further evaluation of the health risks associated with the incomplete pathway is not required. In some instances, a complete or potentially complete exposure pathway may be considered a minor or insignificant pathway (meaning a pathway that is not expected to contribute significantly to the overall exposure and risk; EPA 1992). Furthermore, this approach assumes that individuals could be affected by multiple exposures simultaneously and at a consistent concentration of COPCs.

The complete and potentially complete exposure pathways evaluated in this HHRA are identified on the CSM (Figure 5) and include the following:

- Residents (adults and children):
  - ingestion of groundwater used as a domestic water source;
  - indoor inhalation of vapors emitted from showering; and
  - dermal contact with groundwater.
- Construction Workers:
  - incidental ingestion of groundwater during daily on-site operations;
  - incidental inhalation of groundwater; and
  - dermal contact with groundwater.
- Commercial Workers:
  - ingestion of groundwater used as a water source at a place of business; and
  - dermal contact with groundwater (hand-washing only).

Neither vapor intrusion nor inhalation of COPCs volatilizing or vaporizing from groundwater to outdoor ambient air were considered to be a complete pathway for any evaluated receptors in this HHRA. The depth to water in the SFB is generally greater than 100 feet bgs, limiting the vertical transport of vapors into an indoor or outdoor breathing space. Furthermore, an attempt to model the potential for indoor air risk using DTSC's HERO Groundwater Screening Model yielded low attenuation factors for soil gas, lower than what is considered reasonable (i.e., less than 6E-05). This is in accordance with DTSC's prediction that most sites will not have attenuation factors less than 6E-05 for soil gas, as indicated by the empirical data in EPA's database (5th percentile of attenuation factors remaining after source strength screen of 500X for exterior soil gas; Cal/EPA 2014b; EPA 2012). Thus, the vapor intrusion and ambient air pathways were not considered further; the incidental inhalation pathway for construction workers was calculated to account for potential exposure during daily activities that involve direct contact with groundwater.

In addition, other residential water uses such as irrigation/sprinklers were determined to be insignificant routes of exposure (e.g., via inhalation of volatile organic compounds [VOCs] or incidental ingestion) and were not evaluated in the HHRA.

3. EXPOSURE ASSESSMENT

Exposure is defined by the EPA as the contact of a receptor with a chemical or physical agent (EPA 1989 and 1992). The goal of the exposure assessment is to identify and quantify known and hypothetical exposure pathways relevant to an assessment of public health risk at a site, and to determine the quantities or concentrations of the risk agents received by potentially exposed populations (National Research Council [NRC] 1983; EPA 1992). The exposure assessment is based on calculating exposure of individuals or small population groups to stressors based on exposure scenario evaluations, not on actual exposure measurements of receptors (EPA 1990 and 1992). Thus, exposure assessment is generally performed by estimating the exposure point concentration (EPC) of chemicals in a medium at a location of interest and linking this information with the time that individuals or populations contact the chemicals (time of contact). Exposure assessment at a contaminated site may also involve estimating human exposures from multiple routes, through a combination of direct measurements and mathematical models (EPA 1989 and 1992).

3.1 Quantification of Exposure

3.1.1 Determination of Exposure Point Concentrations (EPCs)

To support risk calculations for COPCs which were identified as requiring risk characterization, further statistical analysis was carried out to generate EPCs for each relevant constituents using the groundwater data.

The development of EPCs in this HHRA is primarily based on the 95% upper confidence level (95UCL) of the arithmetic means for groundwater quality data. The 95UCL of the arithmetic mean is considered the “true mean”, in that if all possible measurements were retrieved, this value would be the central tendency of the dataset within a 95% confidence limit.

Descriptions of the quantitation steps performed for the NHW Well Field with site-related data are presented in the following sections. The methodology used to determine the EPCs based on production well data and future EPCs based on monitoring well data is described below.

3.1.1.1 EPCs Based on Production Well Data

Exposure Point Concentrations for production well data were generated by using ProUCL software (Version 5.1) developed by the EPA (2015) to calculate a recommended 95UCL for each COPC based on constituent concentrations detected in production well NH-43A. These statistics were calculated by the program using censored data sets, i.e., all detects and non-detects (NDs) were included. Where ProUCL was unable to generate a robust 95UCL (due to a limited number of data points or detections), the maximum detected value for the relevant COPC was used as the EPC. Production well NH-43A was selected because it contained the highest number of detections for COPCs and generally had the highest concentrations of COPCs based on production well data; this should be considered conservative.

3.1.1.2 Future EPCs Based on Monitoring Well Data

Future EPCs for production wells (based on the monitoring well data) were generated as follows:

- Monitoring wells which are contained within the core of each COPC plume (based on monitoring well data) were selected for use in future EPC calculations; this is in line with guidance on determining groundwater exposure point concentrations (EPA, 2014b). This involved selecting wells by constituent on the basis of having at least one sample where the COPC exceeded relevant RSL and/or MCL and/or NL over the analysis period. Monitoring wells that had no RSL, MCL or NL exceedance for the relevant future COPC sampled over the analysis period were omitted from the EPC calculation. This was to ensure uncontaminated wells would not introduce a low bias to the EPC calculation for future COPCs.

- ProUCL software (US EPA, 2015) was then used to calculate a recommended 95UCL for each future COPC using the selected monitoring well data within the individual COPC plume cores. Where ProUCL was unable to generate a robust 95UCL, the maximum detected value for the relevant future COPC plume core was selected.
- The flow-weighted mass balance equation, described in Section 2.2.2 , was then applied to these 95UCL (or maximum) values to generate EPCs for each future COPC based on the average forecasted 30-year flow rate for each production well.
- The production well with the highest flow-weighted concentrations of future COPCs was then used for risk characterization.

Based on comparison of estimated future concentrations for all production wells, NH-45 was selected to carry forward in the risk characterization. NH-45 was selected because it is forecasted to have the highest inflow from the upper model layer (A-Zone) relative to the other wells and therefore, produces the highest constituent concentrations after flow-weighted mass balance equation is applied; this is further discussed in Section 5.4 below. The use of the production well with the highest estimated future concentrations is a conservative assumption.

Table 1 and Table 2 below present the results of the EPC determinations based on production well data and future EPC determinations based on monitoring well data, respectively. Appendix B provides the complete output from the ProUCL statistical analysis for both the production well and monitoring well datasets.

Table 1: Estimate Exposure Point Concentrations Based on Well NH-43A (based on production well data)

CAS RN	COPC	EPC (µg/L)	Type
75-35-4	1,1-DCE	8.7E-01	95% KM (t) UCL
156-59-2	cis-1,2-DCE	4.4E-01	95% KM (t) UCL
123-91-1	1,4-Dioxane	1.9E+01	95% KM (t) UCL
127-18-4	PCE	3.8E+00	95% KM (t) UCL
79-01-6	TCE	6.7E+00	95% KM (t) UCL
7429-90-5	Aluminum	7.8E+01	95% Student's-t UCL
7440-38-2	Arsenic	1.15E+00	95% KM (t) UCL
7440-42-8	Boron	3.1E+02	95% Student's-t UCL
18540-29-9	Chromium VI	2.0E+00	Maximum detection (NH-43A)
7439-89-6	Iron	1.9E+02	95% KM (Chebyshev) UCL
7439-92-1	Lead	3.0E-01	95% KM (t) UCL
7439-96-5	Manganese	2.9E+00	Maximum detection (NH-43A)
7439-97-6	Mercury	NA	No detections in Well
7439-98-7	Molybdenum	2.4E+01	Maximum detection (NH-43A)
14797-55-8 [Combined Nitrate as N and as NO3]	Nitrogen, Nitrate (as N)	5.0E+03	95% Chebyshev (Mean, Sd) UCL
7782-49-2	Selenium	1.2E+01	95% Student's-t UCL
7440-61-1	Uranium, Total	5.0E+00	Maximum detection (NH-43A)
7440-62-2	Vanadium	4.1E+00	95% Student's t UCL

Notes: CAS RN= Chemical Abstracts Service Registry Number. COPC = constituent of potential concern, EPC = exposure point concentration. µg/L = micrograms per liter. UCL = upper confidence limit of the mean. KM = UCL based upon Kaplan-Meier estimates. Chemical abbreviations as described above.

Table 2: Future Estimated Exposure Point Concentrations Based on Well NH-45 (based on monitoring well data)

CAS RN	COPC	EPC (µg/L)	Type
75-34-3	1,1-DCA	3.0E-01	95% KM (Chebyshev) UCL
107-06-2	1,2-DCA	5.2E-01	95% KM (Chebyshev) UCL
75-35-4	1,1-DCE	1.5E-01	KM H-UCL
156-59-2	*cis*-1,2-DCE	6.7E-01	95% KM (Chebyshev) UCL
96-18-4	1,2,3-TCP	6.2E-04	KM H-UCL
123-91-1	1,4-Dioxane	7.5E+00	95% KM (Chebyshev) UCL
71-43-2	Benzene	2.7E-02	95% KM (Chebyshev) UCL
117-81-7	DEHP	9.1E-01	95% KM (Chebyshev) UCL
56-23-5	Carbon tetrachloride	7.2E-02	95% KM (t) UCL
50-00-0	Formaldehyde	8.9E-01	95% KM Adjusted Gamma UCL
76-44-8	Heptachlor	1.1E-03	95% KM (t) UCL
67-63-0	Isopropanol	2.6E+03	Maximum value
1634-04-4	MTBE	9.3E-02	95% KM Approximate Gamma UCL
127-18-4	PCE	2.7E+00	95% KM (Chebyshev) UCL
79-01-6	TCE	6.5E+00	95% KM (Chebyshev) UCL
7429-90-5	Aluminum	2.1E+01	95% KM (Chebyshev) UCL
7440-38-2	Arsenic	3.20E-01	95% KM (Chebyshev) UCL
7440-39-3	Barium	4.2E+01	95% Chebyshev (Mean, Sd) UCL
7440-42-8	Boron	7.7E+01	95% H-UCL
18540-29-9	Chromium VI	9.9E-01	95% KM (Chebyshev) UCL
7440-48-4	Cobalt	1.6E-01	95% KM (Chebyshev) UCL
57-12-5	Cyanide	1.9E+00	95% KM (t) UCL
7439-92-1	Lead	2.2E-01	KM H-UCL
7439-96-5	Manganese	1.5E+01	95% KM (Chebyshev) UCL
7439-98-7	Molybdenum	6.2E+00	95% KM (Chebyshev) UCL
14797-55-8 [Combined Nitrate as N and as NO3]	Nitrogen, Nitrate as N	1.8E+03	95% KM Approximate Gamma UCL
14797-73-0	Perchlorate	8.5E-01	95% KM (Chebyshev) UCL
7782-49-2	Selenium	1.9E+00	95% KM (Chebyshev) UCL
7440-62-2	Vanadium	1.5E+00	95% KM (Chebyshev) UCL

Notes: CAS RN= Chemical Abstracts Service Registry Number. COPC = constituent of potential concern, EPC = exposure point concentration. µg/L = micrograms per liter. UCL = upper confidence limit of the mean. KM = UCL based upon Kaplan-Meier estimates. Chemical abbreviations as described above.

3.1.2 Exposure Equations

The exposure assessment is built on a series of algorithms that mathematically estimate chemical intakes. These algorithms, in turn, are based on patterns of site use including time (e.g. hours/day), frequency (e.g. days/year), and duration (e.g. years) as well as characteristics of the particular receptor being described by the calculation (e.g. ingestion rate (L/day), body size (kg), etc.).

EPA (1989) and DTSC (2014b) risk assessment guidance require the use of a reasonable maximum exposure (RME) for quantification purposes. The estimated EPCs and future EPCs discussed in Section 3.1.1 were used with both central tendency exposure (CTE) and RME exposure factors as per EPA 1992 to calculate exposure estimates for the COPCs. Table 3 below presents the values for the exposure parameters used in this HHRA to evaluate the CTE and RME exposure scenarios.

Table 3: Parameters Used in Central Tendency and Reasonable Maximum Exposure Calculations

	Receptors					
	Residential		**Commercial**		**Construction**	
Exposure Parameters	**RME**	**CTE**	**RME**	**CTE**	**RME**	**CTE**
Body Weight (BW) (kg)						
Adult	80	80	80	80	80	80
Child	15	15	-	-	-	-
Averaging Time (AT) (days)						
Carcinogen	25550	25550	25550	25550	25550	25550
Non-Carcinogen	EDx365	EDx365	EDx365	EDx365	EDx365	EDx365
Exposure Duration (ED) (years)						
Adult	20	20	25	25	1	1
Child	6	6	-	-	-	-
Child -— Mutagenic COPCs	See text, page 34					
Exposure Frequency (EF) (days/year)	350	350	250	250	250	250
Exposure Time (hours/day)	24	24	8	8	8	8
Drinking Water Ingestion Rate (IRw) (L/day)						
Adult	2.5	1.2	2	2	0.002	0.002
Child	0.78	0.38	-	-	-	-
Showering/Bathing						
Skin Surface Area for Water Contact (SA) (cm^2)						
Adult	20900	19652	-	-	-	-
Child	6378	6365	-	-	-	-
Exposure Time (ET) (hours/event)						
Adult	0.710	0.710	-	-	-	-
Child	0.540	0.540	-	-	-	-
Events per Day (events)	1	1	-	-	-	-
Workers Skin Surface Area (SA) (cm^2)	-	-	1185	980	3527	3527

Notes: kg = kilograms, L /day= liters per day. cm^2 = square centimeters.

CTE = central tendency exposure. RME = reasonable maximum exposure.

RME parameters were compiled from DTSC HHRA Note Number 1: Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities (Cal/EPA 2014b) with the exception of commercial workers' skin surface area which is the average of male and female values, hands only from the EPA Exposure Factors Handbook (EPA 2011a).

CTE parameters were compiled from the EPA Exposure Factors Handbook (EPA 2011a) and the EPA Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors (EPA 2014a) where applicable.

In some cases the CTE was equal to the RME when values were cited as weighted averages.

A dash indicates not applicable.

Ingestion

For both potential residents (adults and children) and commercial workers, groundwater was evaluated as a drinking water source. The potential risks associated with the ingestion of a constituent are dictated by the following parameters:

- amount of water ingested per day;
- constituent concentration in the medium;
- exposure frequency or duration.

Mathematically, exposure through the ingestion of constituents in groundwater is demonstrated by:

Ingestion of Groundwater

$$CDI = \frac{C_w \times IR_w \times EF \times ED}{BW \times AT}$$

Where:

CDI	=	Chronic Daily Intake (mg/kg-day);
C_W	=	Constituent concentration in water (mg/L);
IR_W	=	Ingestion rate (L/day);
EF	=	Exposure frequency (days/year);
ED	=	Exposure duration (years);
BW	=	Body weight (kg); and
AT	=	Averaging time (days).

The groundwater scenario assumes an individual (child or adult) ingests only tap water and beverages made from tap water at his/her residence. Likewise, for commercial workers on-site, 100% of the fluid intake that occurs during an 8-hr work day is groundwater. For construction workers, the potential exists for ingestion to occur incidentally during daily on-site activities. For this HHRA, the default exposure duration of one year for construction workers was utilized, although a site-specific value may differ. The ingestion rate of 0.002 L/day was a 10% modification of the parameter suggested by EPA (1995) for incidental surface water ingestion while swimming of 0.02 L/day; this should be considered conservative.

The specific exposure variables used in these calculations and the results are shown on Appendix C Tables. Results and variables of this calculation are presented on Appendix Tables C-1, C-4, C-7 and C-9 for production well data. Results of this calculation are presented on Appendix Tables C-12, C-15, C-18, and C-20 for monitoring well data.

Inhalation of Vapors during Showering

During showering with domestic water, individuals may be exposed to airborne volatile pollutants released from the hot shower water. It would be expected that reductions of pollutant concentrations would occur during processing in the water supply treatment plant (if present) and in transport through the water distribution system to the exposed individuals. However, this analysis was conducted on groundwater “as is”, in the absence of treatment, and therefore, none of the concentrations were reduced.

COPC concentrations in air were estimated by converting the concentration in water (micrograms [µg]/L) to the unit µg/m^3 (a factor of 1000) and multiplying by the respective dimensionless Henry’s Law constant to estimate the potential for volatilization into air. The resultant air concentration was then evaluated for exposure as a function of the time (i.e., minutes spent showering daily), frequency and duration as per EPA (2009), via the following equation:

VOC Inhalation During Showering Equation

$$C_a = C_w \times H' \times CF$$

$$EC = \frac{C_a \times ET \times EF \times ED}{AT}$$

Where:

C_a = Chemical concentration in air (µg/m^3);
Cw = Chemical concentration in water (µg/L);
H’ = Dimensionless Henry’s Law constant;
CF = Conversion factor (1000 L/m^3);
EC = Exposure concentration (µg/m^3);
ET = Exposure time (hours/day);
EF = Exposure frequency (days/year);
ED = Exposure duration (years); and
AT = Averaging time (hours).

The exposure factors used in this equation were as per DTSC HERO (Cal/EPA 2014a). Briefly, adult residents are theoretically exposed for 350 days/year, 0.71 hours/day for 20 years. Child residents are exposed for 350 days/year, 0.54 hours/day for six years.

Results of this calculation are presented in Appendix Tables C-2 and C-5 for production well data. Results of this calculation are presented in Appendix Tables C-13 and C-16 for monitoring well data.

Inhalation of Vapors during Construction Activities

It was assumed that construction workers may also inhale vapors during the performance of daily tasks. The same equation was used as in the scenario for residential inhalation of vapors during showering, with exposure parameters for a construction worker receptor substituted in.

VOC Inhalation during Construction Activities

$$C_a = C_w \times H' \times CF$$

$$EC = \frac{C_a \times ET \times EF \times ED}{AT}$$

Where:

C_a = Constituent concentration in air (µg/m^3);
C_w = Constituent concentration in water (µg/L)
H’ = Dimensionless Henry’s Law constant;
CF = Conversion factor (1000 L/m^3)
EC = Exposure concentration (µg/m^3);

ET = Exposure time (hours/day);
EF = Exposure frequency (days/year);
ED = Exposure duration (years); and
AT = Averaging time (hours).

It was assumed that activities involving contact with groundwater might require two hours per day of a construction worker's time, with an exposure frequency of 250 days per year over exposure duration of one year. Results of this calculation are presented on Appendix Table C-10 for production well data and on Appendix Table C-21 for monitoring well data.

Dermal Contact

The equation used to estimate dermal risk/hazard has two parts.

1. Calculation of the dermal absorbed dose per event (DA_{event}) term.

Dermal Absorbed Dose per Event Equation for Inorganics

$$DA_{event} = K_p \times C_w \times t_{event}$$

Where:
DA_{event} = Absorbed dose per event (mg/cm^2-event);
K_p = Dermal permeability coefficient of compound in water (cm/hr);
C_w = Chemical concentration in water (mg/cm^3); and
t_{event} = Event duration (hr/event).

Dermal Absorbed Dose per Event- Organics in Water where $t_{event} \leq t^*$

$$DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$$

Dermal Absorbed Dose per Event- Organics in Water where $t_{event} > t^*$

$$DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Where:
DA_{event} = Absorbed dose per event (mg/cm^2-event);
FA = Fraction absorbed (dimensionless);
K_p = Dermal permeability coefficient of compound in water (cm/hr);
C_w = Chemical concentration in water (mg/cm^3);
τ_{event} = Lag time per event (hr/event);
t_{event} = Event duration (hr/event);
t* = Time to reach steady-state (hr) = 2.4 τevent; and
B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (dimensionless).

2. Calculation of the dermal absorbed dose (DAD) term.

Dermal Absorbed Dose Equation

$$DAD = \frac{DA_{event} \times EF \times ED \times EV \times SA}{BW \times AT}$$

Where:

DAD	=	Dermal absorbed dose (mg/kg-day);
DA_{event}	=	Absorbed dose per event (mg/cm^2-event);
EF	=	Exposure frequency (days/year);
ED	=	Exposure duration (years);
EV	=	Event frequency (events/day);
SA	=	Skin surface area available for contact (cm^2);
BW	=	Body weight in kilograms (kg); and
AT	=	Averaging time (days).

Default exposure parameters for residents and construction workers were used in this equation. For commercial workers, it was theorized that the majority of the dermal contact would occur during handwashing. One event was estimated to require 30 seconds (i.e., 0.5 minutes) and for conservative purposes, 10 events per day was used for the EV term. The skin surface area (SA) for hands was calculated from the RME and CTE cases presented in the Exposure Factors Handbook (EPA 2011b), and averaged for adult males and females.

Results of the dermal exposure pathway calculations for residents (adults and children), commercial and construction workers are presented in Appendix Tables C-3, C-6, C-8 and C-11 for production well data and on Appendix Tables C-14, C-17, C-19 and C-22 for monitoring well data, respectively.

4. TOXICITY ASSESSMENT

4.1 Introduction

Toxicity assessment is the process of using existing toxicity information from human or animal studies to identify potential health risks at various dose levels in exposed populations (EPA 1989). The purpose of toxicity assessment is to collect and weigh the available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals, and to provide an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. To estimate these potential health risks, the relationship between exposure to a chemical (in terms of intake dose to individuals) and an adverse effect (in terms of bodily response to a specific intake dose level) must be quantified.

The dose response assessment step of the HHRA process involves characterizing the relationship between the administered and/or the absorbed dose of a chemical agent and the magnitude or likelihood of the adverse health effects (EPA 1989). For chemicals that are known or suspected to cause cancer, the dose response assessment process defines the relationship between the dose of the risk agent and the probability of induction of carcinogenic effects in humans or animal species of interest. The resultant toxicity reference value (TRVs) for oral carcinogens is called the slope factor (SF), and has the units $mg/kg\text{-}day^{-1}$; to evaluate inhalation exposure, the metric used is the inhalation unit risk (IUR), in units of $(\mu g/m^3)^{-1}$.

The basis of the SFs is data from lifetime animal bioassays and human epidemiological data whenever available. The SF represents the 95% upper confidence limit of the slope of the linear portion of the dose-response curve for animal data. The excess cancer risk for the experimental animal is then extrapolated to the excess cancer risk expected for humans. The resulting values from this model are more likely to overestimate than to underestimate the potential risk.

For systemic toxicants, or chemicals that give rise to toxic endpoints other than cancer and gene mutations (called non-carcinogenic or threshold effects), the dose response assessment process determines a threshold value below which the adverse non-carcinogenic effects are not expected in the general population, including sensitive subgroups. These metrics are called the reference dose (RfD) for oral toxicants, in the units of mg/kg-day, and for inhalation toxicants, the inhalation reference concentration (RfC) in the units of $\mu g/m^3$. To evaluate constituents that may give rise to dermal toxicity, the oral toxicity values are used, and modified, as appropriate, by an absorption factor. For this HHRA, absorption was assumed to be 100% for organic constituents and therefore, the SFs and RfDs were not adjusted, as per RAGS Part E (EPA 2004).

The basis of an RfD calculation is usually the highest dose level that causes the no-observed-adverse-effect-level (NOAEL) after chronic or sub-chronic exposure in animal experiments. The NOAEL is then divided by uncertainty factors (or safety factors), and occasionally, an additional modifying factor, to obtain the RfD. Uncertainty factors are usually factors of 10 that account for inter-species variation and sensitive human subpopulations. Additional uncertainty factors can be used if the RfD is based on the lowest-observed-adverse-effect-level (LOAEL) instead of the NOAEL, or an experiment that includes a less-than-lifetime exposure.

4.2 Toxicity Reference Values

The TRVs used in this HHRA are presented below on Table 4 and Table 5 and are either per EPA's IRIS online chemical database (EPA 2016a) or California Office of Environmental Health Hazard

Assessment (OEHHA) online chemical database (OEHHA 2016), depending on availability. In general, an effort was made to select the more conservative (i.e. protective) value(s) for the constituent in question. In some cases, other sources such as the EPA Regional Screening Levels (RSL) Tables (EPA 2016b), were used to garner TRVs when none were available from either IRIS or OEHHA; the source of each TRV is noted below.

Table 4: Toxicity Reference Values for Production Well COPCs

COPC	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Source	Chronic Inhalation Reference Concentration (RfC) $(\mu g/m^3)$	Source	Oral Slope Factor (SF) $(mg/kg\text{-}day)^{-1}$	Source	Reference Dose (RfD) (mg/kg-day)	Source
1,1-DCE	-	-	70	OEHHA	-	-	5.0E-02	IRIS
1,4-Dioxane	7.70E-06	DTSC	30	IRIS	1.00E-01	IRIS	3.0E-02	IRIS
Aluminum	-	-	-	-	-	-	200	OEHHA
Arsenic	-	-	-	-	9.5	OEHHA	3E-04	IRIS
Boron	-	-	-	-	-	-	2E-01	IRIS
Chromium VI	-	-	-	-	5.0E-01	OEHHA	3.0E-03	IRIS
cis-1,2-DCE	-	-	8	DTSC	-	-	2.00E-03	IRIS
Iron	-	-	-	-	-	-	7E-01	RSL/PP RTV
Lead	-	-	-	-	-	-	8.5E-03	OEHHA
Manganese	-	-	-	-	-	-	1.4E-01	OEHHA
Manganese child specific reference dose	-	-	-	-	-	-	3E-02	OEHHA
Molybdenum	-	-	-	-	-	-	5E-03	IRIS
Nitrogen, Nitrate as N	-	-	-	-	-	-	1.6E+00	IRIS
Selenium	-	-	-	-	-	-	5E-03	IRIS
PCE	6.1E-06	OEHHA	35	OEHHA	5.40E-01	OEHHA	6.0E-03	IRIS
TCE	4.10E-06	IRIS	2	IRIS	4.60E-02	IRIS	5.0E-04	IRIS
Uranium	-	-	-	-	-	-	3E-03	IRIS
Vanadium	-	-	-	-	-	-	9E-03	IRIS

Notes: COPC = constituent of potential concern, $\mu g/m^3$ = micrograms per cubic meter. mg/kg-day = milligrams per kilogram per day. OEHHA = Office of Environmental Health Hazard Assessment. IRIS = Integrated Risk Information System. NL = Notification Level (OEHHA). PPRTV = Provisional Peer Reviewed Toxicity Values. RSL = Regional Screening Level. CPHG = California Public Health Goal (calculated). DTSC = Department of Toxic Substances Control Note 3 table. A dash indicates not applicable. TRVs for vanadium pentoxide surrogate for Vanadium

Table 5: Toxicity Reference Values for Monitoring Well COPCs

COPC	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Source	Chronic Inhalation Reference Concentration (RfC) $(\mu g/m^3)$	Source	Oral Slope Factor (SF) $(mg/kg\text{-}day)^{-1}$	Source	Reference Dose (RfD) (mg/kg-day)	Source
1,1-DCA	1.6E-06	OEHHA	-	-	5.7E-03	OEHHA	-	-
1,1-DCE	-	-	70	OEHHA	-	-	5.0E-02	IRIS
1,2,3-TCP	-	-	0.3	IRIS	3.0E+01	IRIS	4.0E-03	IRIS
1,2-DCA	2.60E-05	IRIS	400	OEHHA	9.10E-02	IRIS	-	-
cis-1,2-DCE	-	-	8	DTSC	-	-	2.0E-03	IRIS
1,4-Dioxane	7.70E-06	OEHHA	30	IRIS	1.00E-01	IRIS	3.0E-02	IRIS
Aluminum	-	-	-	-			2.25E+01	CPHG
Arsenic	-	-	-	-	9.5E+00	OEHHA	3E-04	IRIS
Barium	-	-	-	-			2E-01	IRIS
Benzene	2.2E-06	IRIS	30	IRIS	1E-01	OEHHA	4E-03	IRIS
Bis(2-ethylhexyl)phthalate	2.4E-06	OEHHA	-	-	1.4E-02	IRIS	2E-02	IRIS
Boron	-	-	-	-	-	-	2E-01	IRIS
Carbon tetrachloride	6E-06	IRIS	100	IRIS	1.5E-01	OEHHA	4E-03	IRIS
Chromium VI	-	-	-	-	5.0E-01	OEHHA	3.0E-03	IRIS
Cobalt	-	-	-	-	-	-	3.0E-04	RSL
Cyanide	-	-	-	-	-	-	1.4E-01	OEHHA

COPC	Inhalation Unit Risk (µg/m^3)$^{-1}$	Source	Chronic Inhalation Reference Concentration (RfC) (µg/m^3)	Source	Oral Slope Factor (SF) (mg/kg-day)$^{-1}$	Source	Reference Dose (RfD) (mg/kg-day)	Source
Formaldehyde	6E-06	OEHHA	-	-	2.1E-02	OEHHA	2E-01	IRIS
Heptachlor	1.3E-03	IRIS	-	-	4.5	IRIS	5E-04	IRIS
Heptachlor, child specific reference dose	-	-	-	-	-	-	3E-05	OEHHA
Isopropanol	-	-	200	RSL/ PPRTV	-	-	2.00E+00	RSL/ PPRTV
Lead	-	-	-	-	8.5E-03	OEHHA	-	-
Manganese	-	-	-	-	-	-	1.4E-01	OEHHA
Manganese, child specific reference dose	-	-	-	-	-	-	3E-02	OEHHA
MTBE	2.6E-07	OEHHA	3	IRIS	1.8E-03	OEHHA	-	-
Molybdenum	-	-	-	-	-	-	5E-03	IRIS
Nitrogen, Nitrate (as N)	-	-	-	-	-	-	1.6E+00	IRIS
Perchlorate	-	-	-	-	-	-	7.0E-04	IRIS
Selenium	-	-	-	-	-	-	5E-03	IRIS
PCE	6.1E-06	OEHHA	35	OEHHA	5.40E-01	OEHHA	6.0E-03	IRIS
TCE	4.1E-06	IRIS	2	IRIS	4.6E-02	IRIS	5.0E-04	IRIS
Vanadium	-	-	-	-	-	-	9E-03	IRIS

Notes: COPC = constituent of potential concern, µg/m^3 = micrograms per cubic meter. mg/kg-day = milligrams per kilogram per day. OEHHA = Office of Environmental Health Hazard Assessment. IRIS = Integrated Risk Information System. A dash indicates not applicable. CPHG = California Public Health Goal (calculated). RSL = EPA Regional Screening Level Table PPRTV = Provisional Peer Reviewed Toxicity Value; DTSC = DTSC Note 3 Table. TRVs for vanadium pentoxide used for Vanadium.

4.3 Adjustment of Toxicity Factors

Dermal contact with contaminants may result in direct toxicity at the site of application and/or contribute to systemic toxicity via percutaneous absorption. In the absence of specific dermal toxicity factors, the EPA requires the use of oral toxicity factors to make a route-to route extrapolation for systemic effects (EPA 2004). Primarily, it accounts for the fact that most oral RfDs and slope factors are expressed as the amount of substance administered per unit time and body weight, whereas exposure estimates for the dermal pathway are expressed as absorbed dose. The process utilizes the dose-response relationship obtained from oral administration studies and makes an adjustment for absorption efficiency to represent the toxicity factor in terms of absorbed dose.

For all the organic COPCs evaluated in this HHRA, the gastrointestinal (GI) absorption is assumed to be 100%, and therefore, no adjustments to toxicity values are required. However, in general, for inorganics, the percent absorption can be much less than 50%. Exhibit 4-1 in RAGS Part E (EPA 2004) provides a summary of the recommendations for adjustment of toxicity factors for specific compounds based on GI absorption. The following equations are used to derive the toxicity factors based on absorbed dose:

$$\frac{Dermal\ Risk}{Ingestion\ Risk} = \frac{1}{ABSgi}$$

Where:

ABS_{GI}	=	Fraction of contaminant absorbed in gastrointestinal tract (dimensionless) in the critical study (chemical specific)

Cancer Slope Factor Based on Absorbed Dose

$$\mathrm{SF}_{ABS} = \frac{SF_O}{ABSgi}$$

Where:

SF_{ABS}	=	Absorbed slope factor
SF_o	=	Oral slope factor $(mg/kg\text{-}day)^{-1}$
ABS_{GI}	=	Fraction of contaminant absorbed in gastrointestinal tract (dimensionless) in the critical study (chemical specific)

Reference Dose Based on Absorbed Dose

$$RfD_{ABS} = RfD_o \times ABS_{GI}$$

Where:

RfD_{ABS}	=	Absorbed reference dose
RfDo	=	Oral reference dose (mg/kg-day)
ABS_{GI}	=	Fraction of contaminant absorbed in gastrointestinal tract (dimensionless) in the critical study (chemical specific)

Only four of the inorganic COPCs had absorption factors listed in Exhibit 4-1 of EPA 2004. The adjusted toxicity factors used in this HHRA for the dermal contact pathways are in Table 6 below.

Table 6: Adjusted Toxicity Factors for Use in Dermal Contact Equations

Constituent	Absorption Factor	SF_o (mg/kg-day)$^{-1}$	SF_{ABS} (mg/kg-day)$^{-1}$	RfD_o (mg/kg-day)	RFD_{ABS} (mg/kg-day)
Chromium VI	2.5%	5.00E-01	2.00E+01	3.00E-03	7.50E-05
Manganese	4%	-	-	1.40E-01	5.60E-03
Manganese, child RfD	4%	-	-	3.00E-02	1.20E-03
Vanadium	2.6%	-	-	9.00E-03	2.34E-04
Barium	7%	-	-	2.00E-01	1.40E-02

4.4 Toxicity Profiles

Briefly, the potential health effects associated with the production well COPCs are as follows; the data presented herein are from IRIS (EPA 2016a) and OEHHA (2016), or both, except where noted.

a. **PCE.** This chemical is used as a dry cleaning agent and metal degreasing solvent. It is also used as a starting material (building block) for making other chemicals and is used in some consumer products. Human exposure may result in nervous system, liver, kidney, and reproductive system effects, and may cause developmental deficits in fetuses. Chronic exposure may also result in hepatic tumors. The EPA (2005a) classifies PCE as “likely to be carcinogenic to humans” based on rodent exposure data. Cal/EPA Proposition 65 List indicates PC “causes cancer”.

   The IUR, the chronic inhalation RfC and the oral SF for PCE used in this HHRA are from OEHHA; the RfD is per IRIS, based on neurological and ocular effects (uncertainty factor [UF] of 1000).

b. **TCE.** The two major uses of TCE are as a degreaser for metal parts and as a precursor chemical, especially in the manufacture of the refrigerant, HFC-134a. TCE has also been used as an extraction solvent for greases, oils, fats, waxes, and tars; by the textile processing industry to scour cotton, wool, and other fabrics; in dry cleaning operations; and as a component of adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners. TCE also occurs in the environment as a breakdown product of PCE via reductive dechlorination. Target organs/systems are cardiovascular, and the immune system. According to EPA (2005a) *Guidelines for Carcinogen Risk Assessment*, TCE is characterized as "carcinogenic to humans" by all routes of exposure. Proposition 65 lists TCE as an oral and inhalation carcinogen, and also listed as causing developmental toxicity and male reproductive toxicity.

The TRVs are per IRIS based on hematologic, hepatic and urinary tumors (carcinogenic effects) and developmental/cardiovascular, and immunological effects in rodents, with UFs ranging from 10 to 1000 (non-carcinogenic effects).

c. **1,1-Dichloroethylene (1,1-DCE)**. 1,1-DCE, also known as vinylidene chloride, is used in the manufacture of packaging materials, flexible films and flame-retardant coatings for fiber and carpet backing. The target organ is the liver, which is affected by exposure via either ingestion or inhalation. 1,1-DCE is considered a possible human carcinogen; the evidence is suggestive of carcinogenicity, but is not sufficient to assess human carcinogenic potential. 1,1-DCE is not included in Proposition 65. The RfC for 1,1-DCE used in this HHRA is per OEHHA; the RfD is from IRIS and is based on fatty changes in the liver (cumulative UF of 100).

d. **1,4-Dioxane.** 1,4-Dioxane is used as a solvent in the manufacture of other chemicals and as a laboratory reagent. It may be a trace contaminant of some chemicals used in cosmetics, detergents, and shampoos. The critical organ systems are liver, respiratory, nervous and urinary systems. EPA characterizes 1,4-dioxane as "likely to be carcinogenic to humans"; potential tumor sites are gastrointestinal, hepatic, reproductive, respiratory and urinary. Proposition 65 lists 1,4-dioxane as causing cancer.

The IUR for 1,4-dioxane is per OEHHA: chronic inhalation RfC is per IRIS based on nervous and respiratory effects in rats (UF of 1000). The RfD is per IRIS based on liver and kidney toxicity in rats (UF of 300). The oral slope factor is per IRIS based on hepatocellular adenoma and carcinoma in multiple species.

e. ***cis*-1,2-dichloroethylene (*cis*-1,2-DCE).** *cis*-1,2-DCE is a compound found as a chemical intermediate in synthesis of chlorinated solvents. It is also a common chemical in refrigerants. cis-1,2-DCE is a nephrotoxin, targeting the kidneys for acute and chronic effects. At the time of this report, there was inadequate information to assess the carcinogenic potential of this compound. It is not included in Proposition 65. The oral RfD is per IRIS based on increased relative kidney weight in male rats (UF of 3000). The RfC is per DTSC.

f. **Chromium, hexavalent (Chromium VI).** Chromium VI exists in the environment naturally and from the production of stainless steel, textile dyes, wood preservatives, leather tanning, anti-corrosion and conversion coatings, and electroplating. It is considered a Group A - known human carcinogen - by the inhalation route according to the EPA, based on epidemiologic studies of lung cancer occurrence in chromium-exposed workers. EPA also provides an RfD based on existing studies in rats and mice but does not consider it a carcinogen via the oral route. However, EPA is reviewing the health effects of Chromium VI. On the other hand, OEHHA lists Chromium VI as a carcinogen via both the inhalation and oral exposure routes, as well as a reproductive toxicant under Proposition 65.

The TRVs for Chromium VI in this HHRA are from OEHHA (oral slope factor of 5E-01) and IRIS (oral reference dose of 3E-03; in rats based on a 1-year drinking water study). Note that as per RAGS Part E (EPA 2004), the dermal contact exposure route was calculated in this HHRA by using the oral TRVs, modified by an absorbance factor of 2.5%. The inhalation TRVs are not relevant for this HHRA.

g. **Nitrate.** Besides natural occurrences, nitrates are mainly produced for use as fertilizers in agriculture. The second major application of nitrates is as oxidizing agents, most notably in explosives. Sodium nitrate is used to remove air bubbles from molten glass and some ceramics. Mixtures of the molten salt are used to harden some metals. The RfD of 1.6 mg/kg-day is as per

IRIS, based on early clinical signs of methemoglobinemia (blue baby syndrome) in human infants; nitrate is non-carcinogenic. Nitrate is not included in Proposition 65.

h. **Aluminum.** Aluminum is the most abundant metal and the third most abundant of all elements in the earth's crust. Domestic water may contain Aluminum naturally or because it has been added as a flocculent in the treatment process. Aluminum is neurotoxic. The RfD used in this HHRA of 22.5 mg/kg-day is from OEHHA's Public Health Goal, based on the human estimated LOAEL for developmental neurotoxicity in premature infants. Aluminum is not included in Proposition 65.

i. **Arsenic.** Arsenic is a naturally occurring element in the earth's crust and is very widely distributed. In certain geographical areas, natural mineral deposits may contain large quantities of arsenic and this may result in higher levels of arsenic in water. The main commercial use of arsenic in the US is in pesticides, mostly herbicides, and in wood preservatives. Toxic effects of ingested arsenic include decreased production of erythrocytes and leukocytes, abnormal cardiac function, blood vessel damage, liver and/or kidney damage and impaired nerve function. The RfD is as per IRIS, based on hyperpigmentation, keratosis and possible vascular complications from human chronic oral exposures. The oral slope factor is as per OEHHA. Arsenic is currently listed in Proposition 65 as causing cancer.

j. **Boron.** Boron occurs on Earth in crustal rocks as the borate minerals. These are mined industrially as evaporites such as borax and kernite. Boron is primarily used as an additive in glass fibers and boron compounds are used as fertilizers and in sodium perchlorate bleaches. Developmental effects are considered the critical effect. The RfD used in this HHRA is per IRIS based on developmental data in rats, mice and rabbits which showed decreased fetal body weights. Boron is not listed in Proposition 65.

k. **Iron.** Iron is the most common element on Earth, forming much of the Earth's outer and inner core. Iron compounds have many uses and iron plays an important role in biology, forming complexes with molecular oxygen in hemoglobin and myoglobin. Neither OEHHA nor IRIS have provided any toxicity values for iron, however, the RfD used in this HHRA is from the RSL table of THQ = 0.1 and is a Provisional Peer Reviewed Toxicity Value (PPRTV). The specific affected organ systems that form the basis of this TRV are not provided. Iron is not included in Proposition 65.

l. **Lead.** Lead is a chemical element that is distinguished by its softness and malleability, as well as its relative inertness. As a result, it has been used in a variety of industrial processes including the manufacture of batteries, electrodes, construction materials, and glazes, and as a radiation shield. Lead is also a component of tobacco smoke. Lead compounds are used as glazes, pigments, anti-knock additives in aviation fuel, semiconductors and ammunition. The neurotoxicity of lead, particularly in children, has been well established, leading to its removal from some of these products, most notably from paints and gasoline. EPA's risk assessment for lead is unique because an RfD value is not available; existing evidence indicates that adverse health effects from exposure to lead can occur at very low exposures. Since the toxicokinetics of lead are well understood, lead is regulated based on blood lead concentration. EPA and the Centers for Disease Control and Prevention (CDC) have determined that childhood blood lead concentrations at or above 10 µg/deciliter (dl; the P10) present risks to children's health. Blood lead concentration can be correlated with both exposure and adverse health effects. To predict blood lead concentration and the probability of a child's exceedance of the P10, the Integrated Exposure Biokinetic and Uptake (IEUBK) model (EPA 1994) was used in this HHRA to evaluate the potential toxicity of lead to children in SFB groundwater. The model accounts for intake and uptake components of lead exposure, and allows the user to input site-specific data (e.g., exposure frequency, sources of lead) and predict blood lead concentrations (PbBs). OEHHA regards lead as both an inhalation and oral carcinogen, and includes it in Proposition 65 for causing cancer.

m. **Manganese.** Manganese is a naturally occurring metal used in steel alloys, corrosion-resistant aluminum alloys, as an additive in unleaded gasoline, as a pigment, in battery cells, matches, fireworks, as a fertilizer, as a reagent in organic chemistry, as an oxidizing agent, and is a component of tobacco smoke. OEHHA provides a child-specific reference dose (chRD) that is used in this HHRA based on neurotoxicity in rodents; because the NOAEL is based on adult data, the chRD has an uncertainty factor of 3 to protect infants and children. Manganese is not included in Proposition 65.

n. **Molybdenum.** Molybdenum does not occur naturally as a free metal on Earth; it is found only in various oxidation states in minerals. It readily forms hard, stable carbides in alloys and is also used in flame-resistant coatings on other metals. IRIS cites an oral RfD that is based on increased uric acid levels (i.e., kidney effects) in humans; Molybdenum is not included in Proposition 65.

o. **Selenium.** Selenium is a chemical element found in metal sulfide ores and is considered an essential element for the thyroid. As such, a deficiency of selenium can cause symptoms of hypothyroidism including extreme fatigue, goiter, cretinism and recurrent miscarriage. Occurrences/uses of selenium cited by OEHHA include power rectifiers and surge protection, photographic toner, anti-dandruff shampoos, the production of glass (tinting), alloys, photoelectric cells, rubber, pharmaceuticals, fungicides, and insecticides, and is naturally occurring in water and some foods. OEHHA classifies selenium as an integumentary toxin; the RfD is from IRIS based on nervous, hematologic and dermal effects in humans. Selenium is not considered a carcinogen and is not listed in Proposition 65.

p. **Uranium.** Uranium is a naturally occurring metal that is often present in phosphate fertilizers and was formerly used in glass and ceramic glazes until 1973. Well known for its radioactive qualities, the species identified for evaluation in this HHRA is soluble salts of uranium (measured with the units µg/L, rather than pCi/L). OEHHA lists the uses of uranium as nuclear power fuel, armor-piercing radiation, x-ray targets, radiation shielding material, counterbalance weights and nuclear weapons. The RfD used in this HHRA is from IRIS based on body weight loss and moderate nephrotoxicity in rabbits. Uranium was considered for inclusion in Proposition 65 but not listed.

q. **Vanadium.** Vanadium is a ductile and malleable transition metal occurring naturally in different minerals and fossil fuel deposits. It is mainly used to produce specialty steel alloys such as high-speed tool steels. The most important industrial vanadium compound, vanadium pentoxide, is used as a catalyst for the production of sulfuric acid. The oral RfD used in this HHRA is for vanadium pentoxide and is from IRIS, based on decreased hair cystine in rats. Vanadium is not included in Proposition 65 and is not considered a carcinogen.

The potential health effects associated with the monitoring well COPCs (not including those described above) are as follows.

a. **1,2-Dichloroethane (1,2-DCA).** The most common use of 1,2-DCA is in the production of vinyl chloride, which is used to make polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, housewares, and automobile parts. 1,2-DCA is also used generally as an intermediate for other organic chemical compounds and as a solvent. 1,2-DCA is a probable human carcinogen based on sufficient evidence of carcinogenicity in animals. OEHHA notes that the chronic target organ is the liver. Proposition 65 lists 1,2-DCA as a carcinogen.

The IUR and oral SF used in this HHRA are from IRIS based on the induction of several tumor types in rats and mice treated by gavage, and lung papillomas in mice after topical application.

b. **Perchlorate.** Perchlorate salts are mainly used for propellants, exploiting properties as powerful oxidizing agents and are present in bleach and some fertilizers. Perchlorates are not considered carcinogens but the chronic target system is endocrine, particularly the thyroid, in that perchlorates can interfere with iodide uptake. Perchlorate was considered for inclusion in Proposition 65 as a reproductive toxicant but is not listed.

The RfD used in this HHRA is per IRIS ("perchlorate and perchlorate salts") based on radioactive iodide uptake inhibition in the thyroid by adult human volunteers.

c. **1,2,3-Trichloropropane (TCP).** 1,2,3-TCP is an intermediate in chemical synthesis and is an industrial solvent and a degreasing agent. Under the Guidelines for Carcinogenic Risk Assessment (EPA 2005a), 1,2,3-TCP is "likely to be carcinogenic to humans", based on a statistically significant and dose-related increase in the formation of multiple tumors (reproductive, ocular, hepatic, and gastrointestinal) in both sexes of rats and mice. Chronic non-carcinogenic effects include increased absolute liver weight in male rats via the oral route and peribronchial lymphoid hyperplasia in male rats via the inhalation route. 1,2,3-TCP is currently listed as a cancer causing agent under Proposition 65. The TRVs used in this HHRA are from IRIS.

d. **Cobalt.** Cobalt is primarily used in the preparation of magnetic, wear-resistant and high-strength alloys. The compounds, cobalt silicate and cobalt(II) aluminate ($CoAl_2O_4$, cobalt blue) give a distinctive deep blue color to glass, ceramics, inks, paints and varnishes. Cobalt occurs naturally as only one stable isotope, Cobalt-59. Cobalt-60 is a commercially important radioisotope, used as a radioactive tracer and for the production of high energy gamma rays. The TRV in this HHRA is as per EPA RSL tables and is a PPRTV; the specific affected organ systems were not provided. Other sources cite cardiomyopathy, central nervous system and thyroid effects. Cobalt is not included in Proposition 65.

e. **Isopropanol.** Isopropanol is better known as isopropyl or "rubbing" alcohol. Other uses are as an antiseptic for hand lotions, rubefacient, dehydrating agent, deicing agent for liquid fuels, synthetic flavoring adjuvant, solvent for gums, oils, creosote, and resins. Isopropanol is a component of quick drying oils and inks, denaturing alcohol, and household products. OEHHA provides a chronic air reference exposure level (REL) based on deleterious effects to kidney development, however, the TRVs used in this HHRA are from EPA RSL because they are more conservative. Specific affected organ systems were central nervous system and kidney. Isopropanol is not included in Proposition 65.

f. **1,1-Dichloroethane (1,1-DCA).** 1,1-DCA is mainly used as a feedstock in chemical synthesis, chiefly of 1,1,1-trichloroethane. It is also used as a solvent for plastics, oils and fats, as a degreaser, as a fumigant in insecticide sprays,, in halon fire extinguishers, and in cementing of rubber. According to the Agency for Toxic Substances and Disease Registry (ATSDR 2015), kidney effects have been observed in cats chronically exposed to 1,1-DCA via inhalation; the results of a study in rats and mice suggest that 1,1-DCA may cause cancer, though the data were not conclusive. Although not assessed under the IRIS program, OEHHA lists 1,1-DCA under Proposition 65 as causing cancer. The TRVs used in this HHRA are from OEHHA.

g. **Barium.** Barium is a naturally occurring element that is a component of paints, soap, paper and rubber alloys and used in the manufacture of ceramics and glass. Barium is also used for medical purposes as a tracer compound. Both chronic and sub-chronic studies in rats identified the kidney as the critical target of barium toxicity; the RfD used in this HHRA is from IRIS. Barium is not classifiable as to human carcinogenicity and is not included in Proposition 65.

h. **Benzene.** Benzene is a multiuse compound most commonly found in gasoline additives, solvents, oil extraction, photogravure printing, veterinary medicine (disinfectant); production of detergents, explosives, pharmaceuticals, and dyestuffs. Toxicological endpoints for acute and chronic effects include reproductive, aplastic anemia and acute myelogenous leukemia. Target organs for acute effects include reproductive, immune system, and hematologic system. Target organs for chronic effects include the nervous system. Benzene is classified as a “known” carcinogen to humans by all routes of exposure. Common carcinogenic endpoints include nonlymphocytic leukemia, chronic nonlymphocytic leukemia, chronic lymphocytic leukemia, hematologic neoplasms, blood disorders such as preleukemia and aplastic anemia, Hodgkin's lymphoma, and myelodysplastic syndrome. Thus, the carcinogenic oral slope factor used in this TRV is per OEHHA based on evidence of leukemia from human occupational data. The noncarcinogenic TRVs are from IRIS based on decreased lymphocyte count (RfD and RfC). Benzene is classified as causing cancer as well as male reproductive toxicity under Proposition 65.

i. **Bis(2-ethylhexylphthalate.** Bis(2-ethylhexyl)phthalate, also referred to as Di(2-ethylhexyl)phthalate (DEHP) is a plasticizer for many resins and elastomers. Additionally, it is a component of tobacco smoke and a known laboratory contaminant of analytical samples. The principal and supporting studies of the oral RfD report DEHP as causing increased relative liver weight in rats and guinea pigs. Although the supporting data for carcinogenicity in humans is considered inadequate, there was a statistically significant increase in hepatocellular carcinomas in female rats and both sexes of mice fed diets containing DEHP. Except for the IUR, the TRVs used in this HHRA are from IRIS; OEHHA includes DEHP as causing cancer from both oral and inhalation routes of exposure.

j. **Carbon tetrachloride.** OEHHA lists various uses for carbon tetrachloride such as a dry cleaning agent, fire extinguisher, solvent, degreaser, refrigerant, and as a chlorofluorocarbon feedstock. Use of carbon tetrachloride as a fumigant was banned in the US in 1986 except for preservation of museum artifacts. The current RfD on IRIS was based on a sub-chronic study that determined increased serum sorbitol dehydrogenase (SDH) activity in rats, which is indicative of liver injury. Carbon tetrachloride is listed as “likely to be carcinogenic to humans” based on liver tumor induction via oral exposure and pheochromocytoma via inhalation exposure. Carbon tetrachloride is included in Proposition 65 for causing cancer. The TRVs used in this HHRA are from IRIS except the oral slope factor (OEHHA).

k. **Cyanide.** Cyanides are naturally occurring compounds produced by certain bacteria, fungi and algae and are found in a number of plants, in particular, in certain seeds and fruit stones. They are used industrially as fumigants. Although well known as asphyxiants, cyanides are not evaluated in that context herein. Cyanide is currently listed in Proposition 65 as a reproductive toxicant via the oral route. The RfD used in this HHRA is from OEHHA based on the Maximum

Allowable Dose Level (MADL) of 9.8 µg/day, which is the LOAEL dose of the cyanide ion that causes reproductive effects in male rats resulting from oral exposure.

l. **Formaldehyde.** Long known as a tissue fixative, formaldehyde is also used as a disinfectant (antibacterial, fungicide), in photography (color negative stabilizer), in textile treatment and as a precursor to polyfunctional alcohols. Formaldehyde features in the production of urea and melamine resins, phenolic resin, plastics, adhesives, preservatives, pressed wood products, automobile components, and is a by-product of combustion and cigarette smoke. Formaldehyde is a "probable human carcinogen" based on nine studies that show statistically significant associations with respiratory neoplasms and exposure to formaldehyde or formaldehyde-containing products. An increased incidence of nasal squamous cell carcinomas was observed in long-term inhalation studies in rats and mice. The oral reference dose from IRIS is based on reduced weight gain and histopathology of the gastrointestinal and urinary tracts in rats. The IUR and oral cancer slope factor used in this HHRA are from OEHHA.

m. **Heptachlor.** Heptachlor is an organochlorine pesticide that was previously used as an insecticide. Since 1988, its use is restricted to controlling fire ants in underground transformers. The critical organ system for heptachlor is the liver; the RfD is based on liver weight increases in male mice. Additionally, heptachlor is a "probable human carcinogen", based on the appearance of both benign and malignant liver tumors in mice of both sexes. The TRVs for heptachlor in this HHRA are from IRIS. OEHHA included heptachlor in Proposition 65 Developmental and Reproductive Toxicant List, for being toxic to the following organ systems that are developing in children: immune, nervous, endocrine and reproductive.

n. **Methyl tert-butyl ether (MTBE).** MTBE is an oxygenate that is added to gasoline to improve octane ratings and reduce pollutant emissions. Highly mobile, MTBE is a relatively volatile chemical and is moderately soluble in water. IRIS cites the occurrence of increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions, increased prostration and swollen periocular tissues in rats as the basis of the inhalation RfC. OEHHA considers MTBE a carcinogen via both the inhalation and oral routes, however, it is not listed in Proposition 65; the IUR and SF in this HHRA are from OEHHA.

5. RISK CHARACTERIZATION

5.1 Introduction

The risk characterization phase of the HHRA compares the estimated exposure levels to chemical-specific toxicity information to determine if the EPCs of COPCs at a site, either individually or in mixtures, present unacceptable health risks under both current and future land use conditions, as applicable.

The excess lifetime cancer risk (ELCR) for carcinogenic compounds is calculated for those compounds considered by EPA and/or DTSC to pose a carcinogenic risk to humans. This value represents the risk, or theoretical probability, of developing cancer from that chemical upon exposure to that medium, as indicated by whether the ELCR exceeds a proscribed risk limit. The hazard quotient (HQ) is the ratio of the estimated dose or concentration from exposure to a compound in a medium, to a value which is believed not to produce adverse health effects.

The Environmental Protection Agency *Guidelines for Carcinogen Risk Assessment* (EPA 2005a) require the consideration of the possibility of risks for cancer from early life stage exposure. In particular, the Guidelines recommend that life-stage specific, cancer slope factors be calculated when the data permit. In the absence of such data, the *Guidelines* specify the application of Age Dependent Adjustment Factors (ADAF) in determining tumorigenic risk for chemicals that have demonstrated a mutagenic mode of action (MOA).

Another document, *The Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (EPA 2005b), recommends that when considering childhood exposure, ADAFs be applied to cancer slope factors calculated from studies that involve only adult exposures. Three age periods are delineated for the ADAFs; each is associated with a numeric value for the increase in risk during that age period (EPA 2011b). These are to be used with age-specific exposure information in the risk characterization. The three age periods and their associated ADAFs are as follows:

- birth to less than age 2 years: a 10-fold increase in slope factor (two year duration);
- age 2 to less than age 16: a 3-fold increase in slope factor (14 year duration); and
- age 16 to 70 years: risk is calculated from the adult only exposure (54 year duration)

The equation for the calculation of risk from exposure to mutagens via each pathway of interest was as described previously in Section 3.1 above. The risk was calculated for each of the three exposure periods with application of its respective ADAF and then added together to obtain the total risk for a 70 year period initiated at birth. The mutagenic constituents in this HHRA are as follows.

- Production wells
  - TCE; and
  - Chromium VI
- Monitoring wells
  - TCE;
  - Chromium VI; and
  - 1,2,3-Trichloropropane.

The mutagenic constituents were evaluated using The Risk Assessment Information System (RAIS) Chemicals Calculator (RAIS 2016, online), which was developed by the Department of Energy's

(DOE's) Oak Ridge Operations Office (ORO) to support the RSL program; the calculated results are presented in Appendix D.

5.2 Risk Equations

Using the information generated during the exposure assessment and toxicity assessment, the potential carcinogenic risk and non-carcinogenic hazard to human health are estimated using the following equations, respectively (EPA 1989):

Excess Lifetime Cancer Risk (ELCR) Equations

$$ELCR = CDIxSF$$

Where:

ELCR	=	Excess lifetime cancer risk (unitless);
CDI	=	Chronic daily intake for carcinogenic effects, averaged over a lifetime of 70 years (mg/kg-day); and
SF	=	Slope factor $(mg/kg\text{-}day)^{-1}$.

For inhalation carcinogens:

$$ELCR = ECxIUR$$

Where:

ELCR	=	Excess lifetime cancer risk (unitless);
EC	=	Exposure concentration for Inhalation ($\mu g/m^3$); and
IUR	=	Inhalation Unit Risk $(\mu g/m^3)^{-1}$.

If the ELCR is greater than 1E-06, meaning that the exposure level may result in an excess probability of 1 in 1 million individuals developing cancer at those concentrations, there is potential for adverse health effects.

Non-Carcinogenic Hazard Quotient (HQ) Equations

$$HQ = \frac{CDI}{RfD}$$

Where:

HQ	=	Hazard quotient (unitless);
CDI	=	Chronic daily intake for non-carcinogenic effects, averaged over a specified exposure duration (in this case, 20 years for adult residents, 6 years for child residents, etc. (mg/kg-day);
RfD	=	Reference dose $(mg/kg\text{-}day)^{-1}$.

For inhalation toxicants:

$$HQ = \frac{EC_{NC}}{RfC}$$

Where:

HQ	=	Hazard quotient (unitless);
EC_{NC}	=	Non-carcinogenic intake concentration for inhalation ($\mu g/m^3$);
RfC	=	Reference concentration ($\mu g/m^3$).

Cumulative Health Risks

Risks from individual constituents may be added together when the same individuals or group of individuals are exposed to multiple chemicals, with the expectation of similar endpoints (e.g., carcinogenic vs. non-carcinogenic effects, etc.). For example, the cancer risk equation below estimates the incremental individual lifetime cancer risk for simultaneous exposure to several carcinogens and is based on EPA's risk assessment guidelines (EPA 1989).

$$Risk_T = \Sigma Risk_i$$

Where:

$Risk_T$	=	The total cancer risk, expressed as a unitless probability; and
$Risk_i$	=	The risk estimate for the i^{th} constituent.

This equation accounts for the joint probabilities of the same individual developing cancer as a consequence of exposure to two or more carcinogens. Additionally, it assumes that intakes of individual substances are small, the action by the compounds involved is independent (i.e., that there are no synergistic or antagonistic chemical interactions), and all chemicals produce the same effect (i.e., cancer).

For non-carcinogenic substances, the hazard index is equal to the sum of the hazard quotients, as described by this equation:

$$\text{Hazard Index} = E_1/RfD_1 + E_2/RfD_2 ... + E_i/.RfD_i$$

Where:

E_i	=	exposure level or intake for the ith constituent; and
RfD_i	=	reference dose for the ith constituent.

If the HQ is greater than unity or one, i.e., the exposure level exceeds the threshold RfD or RfC, a potential may exist for adverse non-carcinogenic health effects. Conversely, if the HQ or HI is equal to or less than one, exposures to the COPCs are not expected to result in a systemic toxic response.

Target Risk Limits

A value below 1E-06 is considered an acceptable cancer risk. A value within the range of 10^{-6} to 10^{-4} does not meet the EPA's definition of *de minimis* cancer risk but is considered within the risk management range for EPA, as discussed in the NCP, 40 CFR 300.430. For non-carcinogenic risk, a hazard quotient (HQ) / hazard index (HI) value exceeding 1 does not meet EPA definition of *de minimis* risk; a value below 1 is within the acceptable risk range defined by EPA.

If the HI is found to be greater than 1.0, EPA and DTSC recommend summing exposure for chemicals which have the same toxic mechanism or affect the same target organ system.

5.3 Results

Chemical-specific and pathway-specific health risks for future on-site residents, commercial workers, and construction workers exposed to groundwater from production wells and monitoring wells are presented in Appendix Tables C1 to C-22. The following sections present the results for the most exposed receptor by constituent and the overall totals for all receptors by pathway.

5.3.1 Exposure to Groundwater from Production Wells

Table 7 and Table 8, below, present the results of the resident exposure to production well groundwater via all summed pathways (i.e., ingestion, inhalation of volatiles during showering, and dermal contact); Table 7 presents the carcinogenic results for the adult and child combined, and Table 8 presents the non-carcinogenic results for the child.

Note that most of the EPCs evaluated in this table have produced carcinogenic risks above 10^{-6} and fall within EPA's risk management range discussed above. The total cancer risks at the RME are above 10^{-5}. Except for PCE, all hazard quotients are below 1.0, and collectively contribute to a HI greater than 1.0.

Table 7: Carcinogenic Risks by Constituent from Exposure to Production Well Groundwater via all Pathways by a Resident (Adults + Children)

Excess Cancer Risk (unitless)				
COPC	**CTE**	**%**	**RME**	**%**
1,1-DCE	--	--	--	--
cis-1,2-DCE	--	--	--	--
1,4-Dioxane	1.2E-05	3.79%	2.4E-05	5.57%
PCE	2.0E-04	62.16%	2.1E-04	48.06%
TCE	3.8E-06	1.21%	6.8E-06	1.55%
Aluminum	--	--	--	--
Arsenic	6.8E-05	21.49%	1.4E-04	31.92%
Boron	--	--	--	--
Chromium VI	3.6E-05	11.34%	5.7E-05	12.89%
Iron	--	--	--	--
Lead	1.6E-08	0.00%	3.2E-08	0.01%
Manganese	--	--	--	--
Molybdenum	--	--	--	--
Nitrogen, Nitrate (as N)	--	--	--	--
Selenium	--	--	--	--
Uranium	--	--	--	--
Vanadium	--	--	--	--
Totals	3.17E-04	100%	4.40E-04	100%

Notes: COPC = constituent of potential concern. CTE = Central Tendency Exposure RME = Reasonable Maximum Exposure A dash indicates not applicable. A zero indicates the result was less than 1%. Resident = Adults + children. See Appendix C for worked calculations and tables.

Table 8: Non-Carcinogenic Risks by Constituent from Exposure to Production Well Groundwater via all Pathways by a Child Resident

Hazard Index (unitless)				
COPC	**CTE**	**%**	**RME**	**%**
1,1-DCE	2.9E-01	9.32%	2.9E-01	7.47%
cis-1,2-DCE	2.1E-01	6.72%	2.1E-01	5.53%
1,4-Dioxane	1.8E-02	0.58%	3.4E-02	0.89%
PCE	1.7E+00	56.91%	1.8E+00	46.01%
TCE	3.4E-01	11.10%	5.8E-01	15.23%
Aluminum	9.6E-06	0.00%	2.0E-05	0.00%
Arsenic	9.4E-02	3.04%	1.9E-01	4.98%
Boron	3.8E-02	1.25%	7.8E-02	2.04%
Chromium VI	2.1E-02	0.67%	3.6E-02	0.94%
Iron	6.5E-03	0.21%	1.3E-02	0.35%
Lead	-	-	-	-
Manganese	2.3E-03	0.08%	4.8E-03	0.13%
Molybdenum	1.2E-01	3.83%	2.4E-01	6.27%
Nitrogen, Nitrate (as N)	7.7E-02	2.50%	1.6E-01	4.08%
Selenium	6.1E-02	1.97%	1.2E-01	3.23%
Uranium	4.1E-02	1.33%	8.3E-02	2.18%
Vanadium	1.5E-02	0.48%	2.6E-02	0.69%
Totals	3.07E+00	100%	3.84E+00	100%

Notes: COPC = constituent of potential concern. CTE = central tendency exposure. RME = reasonable maximum exposure. % = percentage. A dash indicates not applicable. See Appendix C for worked calculations and tables. Hazards from lead exposure are not evaluated here but presented below.

These results warrant further consideration of risk management approaches and confirm the potential health risks from exposure to contaminated groundwater from the production wells.

For illustrative purposes, Table 9 shows the total risks by receptor from exposure to production well groundwater from all routes of exposure.

Table 9: Total Risks by Receptor from Exposure via all Pathways to Production Well Groundwater

	Carcinogenic Risk		Hazard Index	
Receptor	**CTE**	**RME**	**CTE**	**RME**
Residential				
Adults	2.10E-04	2.76E-04	--	--
Children	6.72E-05	9.98E-05	2.71E+00	3.22E+00
Mutagens	3.97E-05	6.35E-05	3.62E-01	6.20E-01
Total	3.17E-04	4.40E-04	3.07E+00	3.84E+00
Commercial Worker	9.92E-05	9.93E-05	5.79E-01	5.80E-01
Construction Worker	--	2.30E-05	--	8.23E+01

Notes: CTE = central tendency exposure. RME = reasonable maximum exposure. See Appendix C for worked calculations and tables. See Appendix D for mutagen results. For construction workers, CTE = RME exposure parameters; only RME results are presented. A dash indicates not applicable. Note that the adult resident noncarcinogenic results were not added to the total hazard index.

Lead

As discussed in Section 4.0 above, children's risk from lead exposure in production well groundwater was evaluated using the IEUBK model. It should be noted that there are currently no corresponding models to calculate risks to adults or fetuses from lead in drinking water; neither the latest version of EPA's Adult Lead Methodology (ALM) nor California DTSC's LeadSpread are designed for any media other than soil and dust. Therefore, lead risks to adults were calculated as above for other COPCs.

The IEUBK model was run with dietary inputs alone to establish the baseline blood level levels (BLL) for children. The results showed that dietary lead inputs accounted for 1.116 µg/day, or a BLL of 0.6 µg/dL for infants, 0.5 to 1 year (most sensitive age group). The model was then run with the production well groundwater lead EPC of 0.3 µg/L plus diet and the results were compared to the BLL target of 10 µg/dL.

As shown in Appendix E, production well groundwater plus diet resulted in a maximum lead intake of 1.145 µg/day for infants (an increase of 0.029 µg/day), which resulted in a blood lead concentration of 0.6 µg/dL. Thus, the lead concentration in production well groundwater is not predicted to result in a hazard to young children via ingestion. See Appendix E for IEUBK model outputs.

5.3.2 Exposure to Groundwater from Monitoring Wells

The monitoring well data were used to estimate future production well concentrations. Table 10 presents the carcinogenic risks for the adult and child resident combined; Table 11 presents the non-carcinogenic risk estimates for the child resident.

Table 10: Carcinogenic Risks by Constituent from Exposure via Summed Pathways to Monitoring Well Groundwater by a Resident (Adults + Children)

	Excess Cancer Risk (unitless)			
COPC	**CTE**	**%**	**RME**	**%**
1,1-DCA	1.1E-06	0.52%	1.1E-06	0.42%
1,2-DCA	6.9E-06	3.25%	7.2E-06	2.75%
1,1-DCE	--	--	--	--
cis-1,2-DCE	--	--	--	--
1,2,3-TCP	7.2E-07	0.34%	1.3E-06	0.51%
1,4-Dioxane	4.8E-06	2.27%	9.8E-06	3.74%
Benzene	1.6E-07	0.07%	1.8E-07	0.07%
DEHP	1.3E-05	6.30%	1.4E-05	5.34%
Carbon tetrachloride	5.0E-06	2.36%	5.0E-06	1.93%
Formaldehyde	1.2E-07	0.06%	2.4E-07	0.09%
Heptachlor	8.0E-07	0.38%	8.6E-07	0.33%
Isopropanol (IPA)	--	--	--	--
MTBE	6.9E-09	0.00%	8.0E-09	0.00%
PCE	1.4E-04	65.14%	1.5E-04	56.47%
TCE	3.8E-06	1.78%	6.4E-06	2.46%
Aluminum	--	--	--	--
Arsenic	1.9E-05	9.01%	3.9E-05	15.01%
Barium	--	--	--	--
Boron	--	--	--	--
Chromium VI	1.8E-05	8.52%	2.8E-05	10.87%
Cobalt	--	--	--	--
Lead	7.7E-09	0.00%	1.6E-08	0.01%
Manganese	--	--	--	--
Molybdenum	--	--	--	--
Nitrogen, Nitrate as N	--	--	--	--
Perchlorate	--	--	--	--
Selenium	--	--	--	--
Vanadium	--	--	--	--
Totals	2.11E-04	100%	2.61E-04	100%

Notes: COPC = constituent of potential concern. CTE = central tendency exposure. RME = reasonable maximum exposure. % = percentage. A dash indicates not applicable. Resident = Adults + children summed. See Appendix D for worked calculations and tables.

Table 11: Non-Carcinogenic Hazards by Constituent from Exposure via Summed Pathways to Monitoring Well Groundwater by a Child Resident

Hazard Index (unitless)				
COPC	**CTE**	**%**	**RME**	**%**
1,1-DCA	--	--	--	--
1,2-DCA	1.4E-03	0.06%	1.4E-03	0.05%
1,1-DCE	5.0E-02	2.11%	5.0E-02	1.77%
cis-1,2-DCE	3.1E-01	13.29%	3.2E-01	11.44%
1,2,3-TCP	5.0E-05	0.00%	5.4E-05	0.00%
1,4-Dioxane	7.2E-03	0.30%	1.4E-02	0.48%
Benzene	4.7E-03	0.20%	4.8E-03	0.17%
DEHP	1.7E-01	7.33%	1.7E-01	6.20%
Carbon tetrachloride	1.8E-02	0.78%	1.9E-02	0.67%
Formaldehyde	1.1E-04	0.00%	2.2E-04	0.01%
Heptachlor	1.9E-03	0.08%	2.8E-03	0.10%
Isopropanol	3.1E-02	1.33%	4.0E-02	1.41%
MTBE	1.6E-02	0.68%	1.6E-02	0.57%
PCE	1.2E+00	51.93%	1.2E+00	43.92%
TCE	3.3E-01	14.17%	5.7E-01	20.32%
Aluminum	2.3E-05	0.00%	4.6E-05	0.00%
Arsenic	2.6E-02	1.11%	5.3E-02	1.90%
Barium	5.7E-03	0.24%	1.1E-02	0.39%
Boron	9.4E-03	0.40%	1.9E-02	0.69%
Chromium VI	1.0E-02	0.44%	1.6E-02	0.58%
Cobalt	1.3E-02	0.54%	2.6E-02	0.93%
Cyanide	3.3E-04	0.01%	6.7E-04	0.02%
Lead	--	--	--	--
Manganese	1.5E-02	0.62%	2.7E-02	0.96%
Molybdenum	3.1E-02	1.30%	6.2E-02	2.22%
Nitrogen, Nitrate as N	2.7E-02	1.16%	5.6E-02	1.99%
Perchlorate	3.0E-02	1.28%	6.1E-02	2.17%
Selenium	9.5E-03	0.41%	1.9E-02	0.69%
Vanadium	5.4E-03	0.23%	9.6E-03	0.34%
Totals	2.35E+00	100%	2.81E+00	100%

Notes: COPC = constituent of potential concern. CTE = central tendency exposure. RME = reasonable maximum exposure % = percentage. A dash indicates not applicable. A zero (0) % indicates a value less than 1%. See Appendix C for worked calculations and tables.

Concentrations of COPCs in monitoring wells used to estimate future production well concentrations also resulted in a cancer risk above 10^{-6}. As with the production well groundwater, the aggregate noncarcinogenic risk is greater than 1.0 (i.e., HI exceeds unity).

Table 12 shows the total risks by receptor from exposure to estimated future production well concentrations (based on monitoring well data) from all routes of exposure.

Table 12: Total Risks by Receptor from Exposure via Summed Pathways to Monitoring Well Groundwater

	Carcinogenic Risk		Hazard Index	
Receptor	**CTE**	**RME**	**CTE**	**RME**
Residential				
Adults	1.46E-04	1.70E-04	--	--
Children	4.31E-05	5.48E-05	2.01E+00	2.22E+00
Mutagens	2.25E-05	3.64E-05	3.43E-01	5.87E-01
Total	2.1E-04	2.6E-04	2.4E+00	2.8E+00
Commercial Worker	3.3E-05	3.4E-05	1.4E-01	1.4E-01
Construction Worker	--	1.1E-05	--	4.3E+00

Notes: CTE = central tendency exposure. RME = reasonable maximum exposure. See Appendix C for worked calculations and tables. See Appendix D for mutagen results. For construction workers, CTE = RME exposure parameters; only RME results are presented. A dash indicates not applicable. Note that the adult resident noncarcinogenic results were not added to the total hazard index.

Lead

As described above, the 95UCL lead concentration of 0.22 µg/L in monitoring well groundwater plus dietary intake was input into the model and the results were compared to the child's BLL of 10 µg/dL.

As shown in Appendix E, lead in monitoring well groundwater plus diet resulted in a maximum intake of 1.137 µg/day or 0.6 µg/dL in infants; the groundwater contribution was determined to be 0.021 µg/day. Thus, the concentration of lead in monitoring well groundwater is not a hazard to young children via ingestion. See Appendix E for IEUBK model outputs.

5.3.3 Mode of Action Analysis

As mentioned above in Section 5.1, if HIs are found to be greater than 1.0, EPA and DTSC recommend summing exposure to all media for chemicals that have the same toxic mechanism or affect the same target organ system. Thus, an analysis of mode of action was conducted, to evaluate which organ/organ systems were most affected by the potential for exposure to these COPCs in production well (Table 13) and monitoring well (Table 14) groundwater.

Table 13: COPCs in Production Wells Grouped by Non-Carcinogenic Effect, Based on the Child's Inhalation Exposure Pathway

Affected Systems	Hepatic	Nervous	Urinary/Renal	Reproductive/ Developmental	Immunologic	Hermatologic
cis-1,2-DCE	2.9E-01	--	--	--	--	--
1,4-Dioxane	--	2.7E-03	--	--	--	--
PCE	1.7E+00	1.7E+00	1.7E+00		1.7E+00	1.7E+00
TCE	7.6E-02	7.6E-02	7.6E-02	7.6E-02	7.6E-02	
Total	2.1E+00	1.8E+00	1.8E+00	7.6E-02	1.8E+00	1.7E+00

Table 14: COPCs in Monitoring Wells Grouped by Non-Carcinogenic Effect, Based on the Child's Inhalation Exposure Pathway

Affected Systems	**Hepatic**	**Nervous**	**Renal**	**Ocular**	**Reproductive/ Developmental**	**Immunologic**	**Hematologic**
1,1-DCA	1.4E-03	--	--	--	--	--	--
1,1-DCE	5.0E-02	--	--	--	--	--	--
cis-1,2-DCE	--	--	3.0E-01	--	--	--	--
1,4-Dioxane	--	1.1E-03	--	--	--	--	--
Benzene	--	--	--	--	--	4.4E-03	--
Carbon tetrachloride	1.8E-02	--	--	--	--	--	--
Isopropanol	--	2.3E-02	--	--	--	--	--
MTBE	1.6E-02	--	1.6E-02	1.6E-02	--	--	--
PCE	1.2E+00	1.2E+00	1.2E+00	--	--	1.2E+00	1.2E+00
TCE	4.4E-02	4.4E-02	4.4E-02	--	4.4E-02	4.4E-02	--
Total	1.3E+00	1.3E+00	1.6E+00	1.6E-02	4.4E-02	1.2E+00	1.2E+00

This analysis was performed using the citations of critical effects in IRIS and/or the OEHHA database that are the basis of most of the toxicity values used in this HHRA. The RME hazard quotient of each non-carcinogenic COPC was tabulated based on which organ systems were most affected as the result of inhalation by a child resident (i.e., the most critical exposure pathway based on the risk characterization and the most sensitive receptor). As shown on Table 13 and Table 14 above, the most affected organ systems from exposure to both production well and monitoring well groundwater are those associated with PCE toxicity – hepatic, renal, nervous immunologic and hematologic – and demonstrate hazard indices greater than 1.0. Based on this analysis, none of the other organ systems would be significantly affected.

5.4 Interpretation

Residential exposure is considered the most conservative due to the exposure time, duration and frequency that individuals spend on-site relative to other populations. Other potential receptors such as commercial works and future construction workers, who would have less overall exposure, are also protected by the evaluation of residents. However, in an effort to be complete, these site workers were also evaluated in this assessment. Additionally, the construction worker scenarios are somewhat theoretical in that it is unlikely that workers would perform excavation and other activities at depth and without protective clothing and equipment.

As expected, residential adults and children have the highest estimated risks of any of the potential receptor populations evaluated in this HHRA. Commercial workers showed calculated risks similar to adult residents due to a comparable daily ingestion rate of on-site water. Construction worker non-carcinogenic hazards are the highest of any receptor evaluated in this HHRA. This is due to the short exposure time/duration and averaging time of one year combined with the relative toxicities of the COPCs. However, construction workers are generally wearing some form of protective clothing and using safety equipment such as respirators during onsite activities and therefore, these risks can be managed by further assessment when these activities commence. Additionally, it is important to keep in mind that the site-wide depth to water, which is over 130 feet bgs, may preclude any realistic exposure by this receptor.

Of note is the use of constituent concentrations in well NH-43A to create representative EPCs for all the production wells. The conceptual site model indicates that risks are derived from exposure to drinking water from individual wells rather than from an aggregate across the Well Field, and thus, evaluating risks from the most contaminated well is conservative and appropriate. However, although VOC concentrations are the highest in NH-43A, this may not be true for other constituents (e.g., some inorganic constituents are present at higher concentrations in NH-07). In that case, risks for some inorganics may be slightly higher by comparison.

6. UNCERTAINTY ANALYSIS

Uncertainty is introduced in a number of areas within the HHRA. Some uncertainties are inherent in the process itself (e.g., toxicity values based on animal data, environmental sampling, laboratory analysis, etc.), whereas some uncertainties are specific to a particular dataset. The analysis presented (Table 15) takes both process uncertainty and site specific uncertainty into account. It should be noted that these uncertainties are within acceptable standards of practice and do not undermine the reasonableness of the output from this analysis.

Table 15: Uncertainty Analysis Performed for the HHRA

Assumption/Source of Uncertainty	Effect on Risk Estimates
PROCESS UNCERTAINTIES	
Published toxicity values	Published toxicity values incorporate uncertainty factors. Conservative effect on risk estimates.
Default exposure parameters used to model potential site use	Conservative effect on risk estimates.
Laboratory data	Laboratory data are subject to uncertainties associated with the analytical methods. Variable effect on risk estimates.
Media sampling	There are a number of potential uncertainties introduced by retrieving environmental samples that may bias the analytical results high or low. Variable effect on risk estimates.
SITE-SPECIFIC UNCERTAINTIES	
Statistical limitations of the input values	Generally, statistical evaluation provides a conservative to realistic estimate of risk. However, robustness of statistical evaluation is limited by the size of the dataset. Some calculations were only based on a low number of observations.
COPCs detected at or below the reporting limit that are included as detections	Constituent concentrations are identified in the dataset as being J-qualified. This indicates that the concentration is an estimate in that it occurs below the reporting limit. EPA guidance requires that in these instances, J-qualified data should be included in risk characterization datasets as detections. This could potentially lead to qualified data contributing significantly to overall risk. Conservative effect on risk estimates.
Substitution of maximum detection or other value	When a UCL value was not available, a maximum detection was used as the EPC. Conservative effect on risk estimates.

Assumption/Source of Uncertainty	Effect on Risk Estimates
The showering scenario was simplified	The water concentration for each COPC was multiplied by the respective Henry's Law constant to arrive at a theoretical concentration in air. There were no other factors applied that might have reduced concentrations such as treatment of various kinds. Additionally, the simplified model likely overestimates the resultant concentration of COPCs in air. Conservative effect on risk estimates.
Exposure parameters for construction workers and commercial workers were theoretical	Construction activities involving contact with groundwater were theorized to occur every day for two hours. Likewise, handwashing exposure frequency and time were approximated. These variables could be under- or overestimates of actual conditions. Variable effect on risk estimates.

7. REFERENCES

AMEC (AMEC Foster Wheeler Environment & Infrastructure, Inc.). 2015. Groundwater Modeling Memorandum, North Hollywood Operable Unit ,Second Interim Remedy, Groundwater Remediation System Design. Proj. Number 8615180350. July, 2015

ATSDR (Agency for Toxic Substances and Disease Registry), 2015. Toxicological Profile for 1,1-Dichloroethane. US Department of Health and Human Services, Public Health Service.

Brown and Caldwell. 2015. Groundwater System Improvement Study Remedial Investigation Report. Prepared for Los Angeles Department of Water and Power; Groundwater System Improvement Study – Agreement No. 47786. February 26, 2015.

Cal/EPA (California Environmental Protection Agency). 2014a. DTSC, Human and Ecological Risk Office (HERO). Human Health Risk Assessment (HHRA) Note Number 1: Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities, 2014.

Cal/EPA (California Environmental Protection Agency). 2014b. DTSC HERO Groundwater Screening Model, March 2014. Online.

City of Los Angeles, 2015. Sustainable City Plan. April 8.

DDW (Division of Drinking Water, California State Water Resources Control Board) 2015. Addressing the Direct Domestic Use of Extremely Impaired Sources. Process Memo 97-005, Initially Established November 5, 1997. Revised March 25, 2015 (draft)

ESI (Environmental Simulations, Inc.). 2011. Guide to Using Groundwater Vistas Version 6. Rumbaugh, PA, 2011.

Harbaugh, A.W. 2005, MODFLOW-2005, The U.S. Geological Survey modular ground-water model—the Ground-Water Flow Process: U.S. Geological Survey Techniques and Methods 6-A16, variously p.

Hazen and Sawyer. 2016. Interim Remedial Investigation/Feasibility Study Report. North Hollywood West Well Field. December 2016.

JMM (James M. Montgomery, Inc.). 1992. Remedial Investigation Report: Remedial Investigation of groundwater Contamination in the Sand Fernando Valley. Prepared for the Los Angeles Department of Water and Power. December 1992.

Hazen (Hazen and Sawyer). 2016. Interim Remedial Investigation / Feasibility Study Report for North Hollywood West Well Field. November 2016

LADWP, 2015. Urban Water Management Plan.

NRC (National Research Council). 1983. Risk Assessment in the Federal Government: Managing the Process. National Academy Press, Washington, D.C.

OEHHA (Office of Environmental Health Hazard Assessment). 2016. OEHHA Chemical Database, online. http://oehha.ca.gov/chemicals. Last accessed September, 2016.

RAIS (Risk Assessment Information System) Chemicals Calculator. Last accessed November, 2016 https://rais.ornl.gov/

Rice, D.W., R.D. Grose, J.C. Michaelsen, B.P. Dooher, D.H. MacQueen, S.J. Cullen, W.E. Kastenberg, L.G. Everett, M.A. Marino, 1995. California leaking underground fuel tank (LUFT) historical case analyses. Lawrence Livermore National Laboratory (LLNL). UCRLAR- 122207. November.

Shih, T., Y. Rong, T. Harmon, and M. Suffet, 2004. Evaluation of the impact of fuel hydrocarbons and oxygenates on groundwater resources. Environmental Science & Technology. Vol. 38, No. 1: 42-48.

EPA (United States Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund (RAGS): Volume I Human Health Evaluation Manual (Part A). EPA/540/1 89/002. December.

EPA (United States Environmental Protection Agency). 1990. National Oil and Hazardous Substances Pollution Contingency Plan. Final Rule. 40 CFR Part 300.

EPA (United States Environmental Protection Agency). 1992. "Guidelines for Exposure Assessment." Notice. Federal Register 57 (104): 22888 22938. 29 May.

EPA (United States Environmental Protection Agency). 1994. IEUBK Model for Lead in Children. https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals#users

EPA (United States Environmental Protection Agency). 1995. Region IV Bulletin. Referenced in Human Health Exposure Parameters (RME), Manual ERD-AG-003, 2006. Protocol to Support the Savannah River Site Environmental Remediation Program, September.

EPA (United States Environmental Protection Agency). 2004. Risk Assessment Guidance for Superfund (RAGS): Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005 OSWER 9285.7-02EP PB99-963312 July.

EPA (United States Environmental Protection Agency). 2005a. Guidelines for Carcinogen Risk Assessment, Risk Assessment Forum U.S. Environmental Protection Agency Washington, EPA/630/P-03/001F, March.

EPA (United States Protection Agency). 2005b. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. EPA/630/R-03/003F. March.

EPA (United States Environmental Protection Agency). 2009. Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), EPA-540-R-070-002, OSWER 9285.7-82, January, 2009.

EPA (United States Environmental Protection Agency). 2011a. Exposure Factors Handbook. EPA/600/R-090/052F, September.

EPA (United States Environmental Protection Agency). 2011b. Age Dependent Adjustment Factor (ADAF) Application. Office of Water Policy Document, Health and Ecological Criteria Division, Washington, DC. March.

EPA (United States Environmental Protection Agency). 2012. EPA's Vapor Intrusion Database: Evaluation and Characterization of Attenuation Factors for Chlorinated Volatile Organic

Compounds and Residential Buildings. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. March 16, 2012. EPA 530-R-10-002.

EPA (United States Environmental Protection Agency). 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1.120.

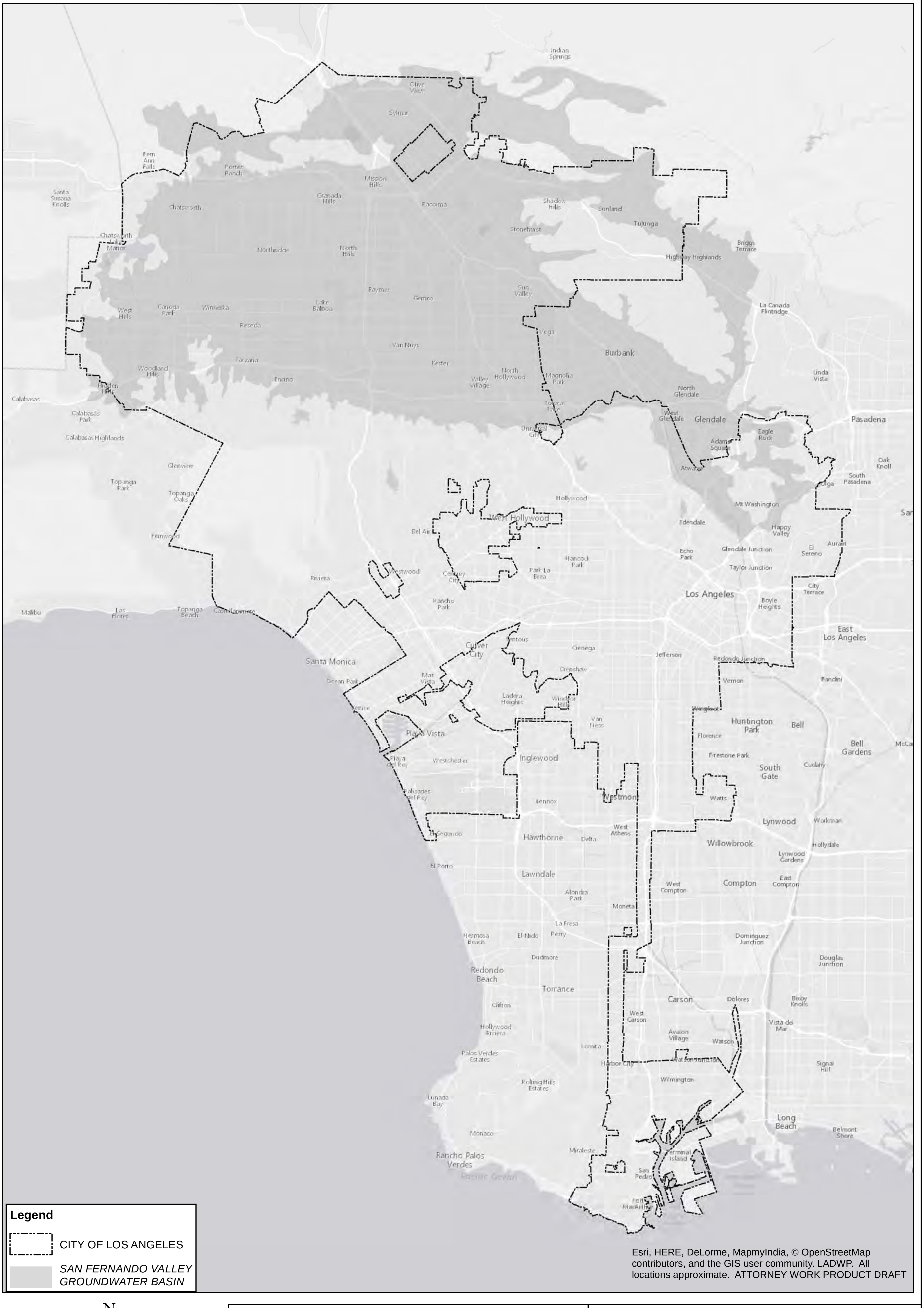
EPA (United States Environmental Protection Agency). 2014b. Determining Groundwater Exposure Point Concentrations. OSWER Directive 9283.1-42, February 2014.

EPA (United States Environmental Protection Agency). 2015. ProUCL Version 5.1. Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. https://www.epa.gov/land-research/proucl-software

EPA (United States Environmental Protection Agency). 2016a. Integrated Risk Information System (IRIS), online. https://www.epa.gov/iris. Last accessed in September, 2016.

EPA (United States Environmental Protection Agency). 2016b. Regional Screening Levels. (https://www.epa.gov/risk/regional-screening-levels-rsls) May 2016.

Figures



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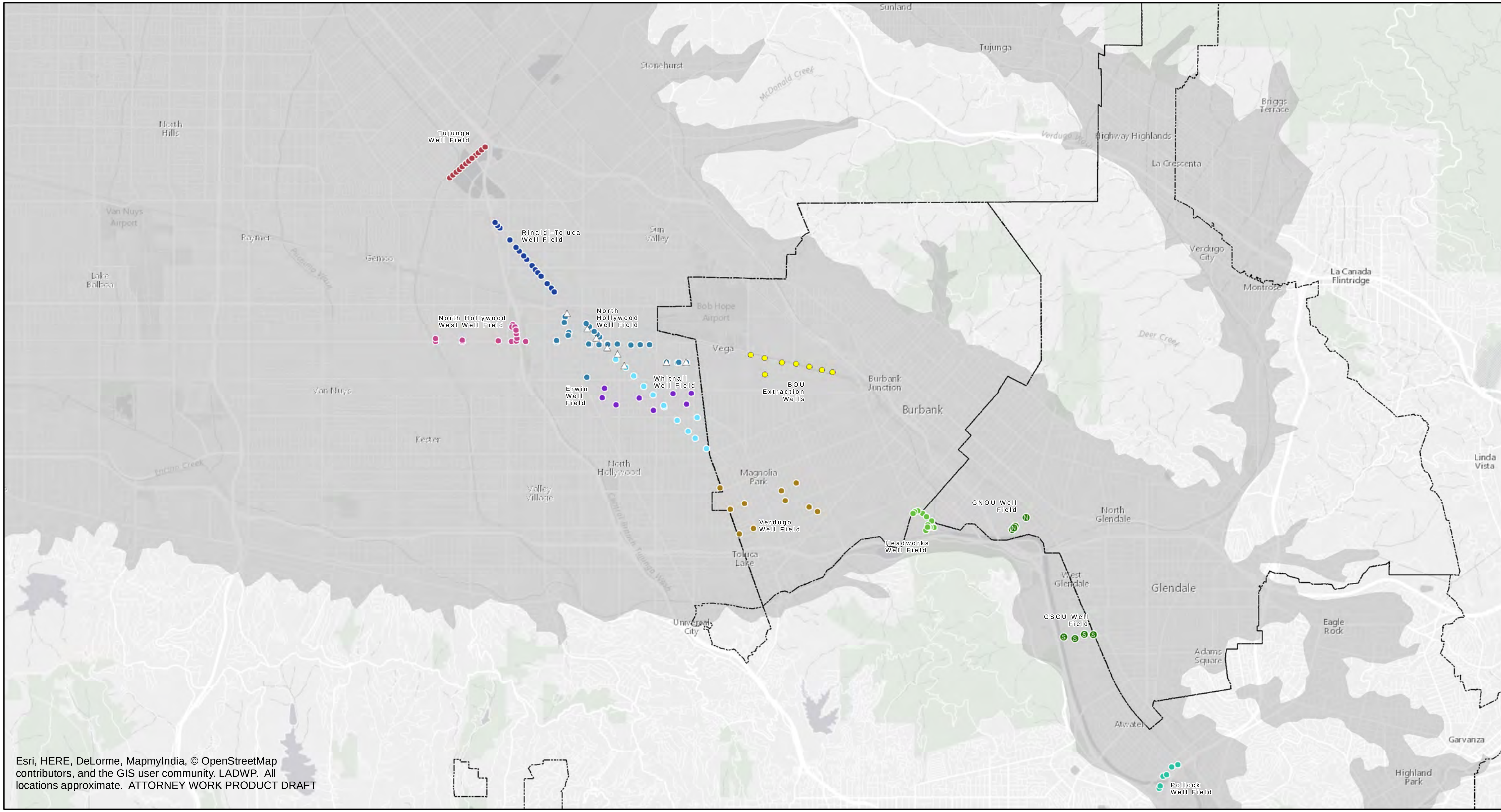
SAN FERNANDO VALLEY
CITY OF LOS ANGELES



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- HEADWORKS
- NORTH HOLLYWOOD
- NORTH HOLLYWOOD OPERABLE UNIT
- NORTH HOLLYWOOD WEST
- POLLOCK
- RINALDI-TOLUCA
- TUJUNGA
- VERDUGO
- WHITNALL

OTHER WELLFIELDS

- BURBANK OPERABLE UNIT
- GLENDALE NORTH OPERABLE UNIT
- GLENDALE SOUTH OPERABLE UNIT

- CITY BOUNDARIES
- SAN FERNANDO VALLEY GROUNDWATER BASIN

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SAN FERNANDO VALLEY GROUNDWATER BASIN WELLFIELDS

SWL	MT	11/16/2016
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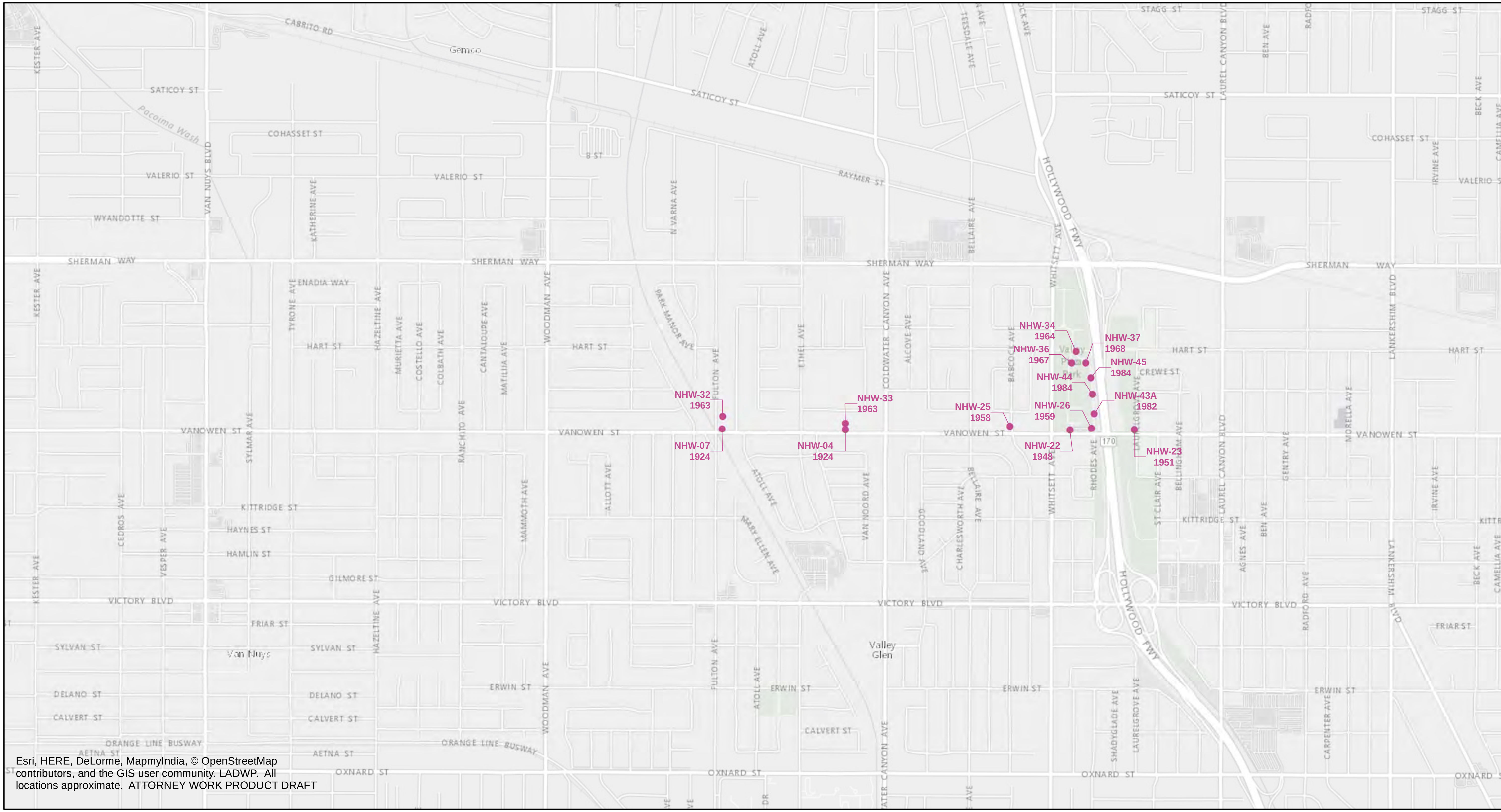

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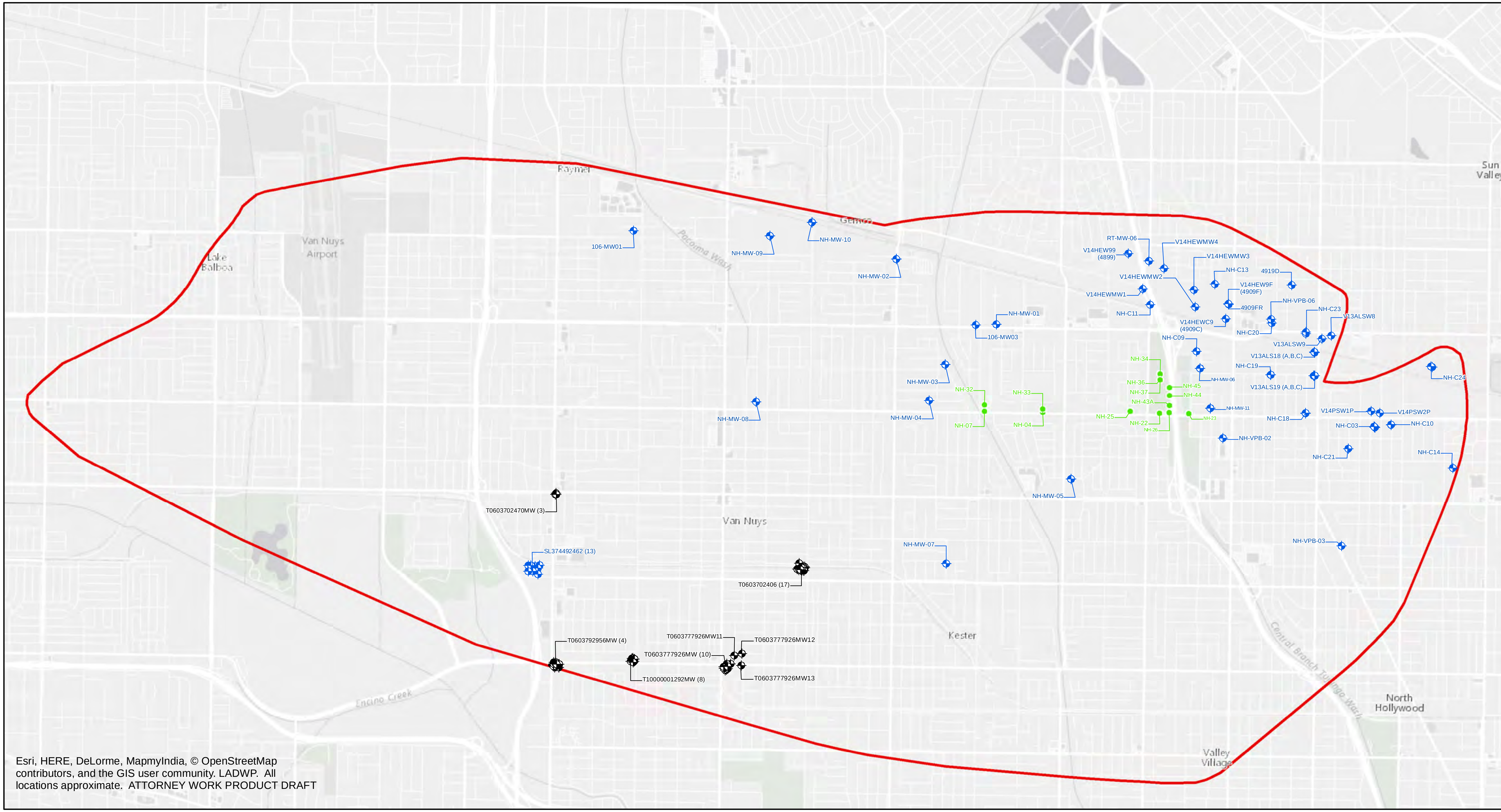
● NORTH HOLLYWOOD WEST

Los Angeles Department of Water & Power

Hazen ARCADIS WorleyParsons

NORTH HOLLYWOOD WEST WELL FIELD

3



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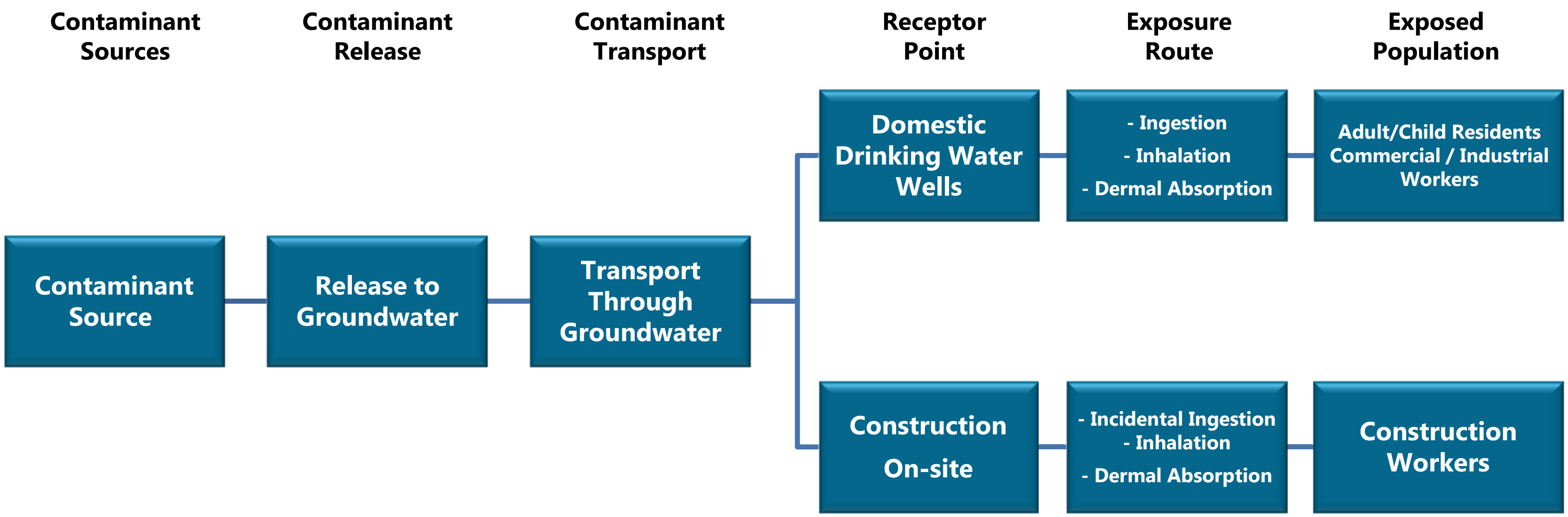
- NHW Monitoring Wells
- Monitoring Wells at RWQCB UST Sites
- NHW Production Wells
- Study Area

Los Angeles LA DWP Department of Water & Power

Hazen ARCADIS WorleyParsons resources & energy

NORTH HOLLYWOOD WEST CAPTURE ZONES AND MONITORING WELL LOCATIONS

4



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CONCEPTUAL SITE MODEL (CSM)

5

Appendix A: Contaminant of Potential Concern Screening and Identification

Appendix A1 - COPC Identification Summary Based on Production Well Data

Notes:
---' = does not apply
MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
PHG = Public Health Goal (CA State Water Resources Control Board)
THQ = Target Hazard Quotient
NL = Notification Level (CA State Water Resources Control Board)
RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
630-20-6	1,1,1,2-Tetrachloroethane	µg/L	5.70E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	5.70E-01	---	Screened Out	Less than 5% Detection Frequency
71-55-6	1,1,1-TRICHLOROETHANE	µg/L	8.00E+02	2.00E+01	2.00E+00	---	---	---	1.00E+03	620	0	0.0%	---	Screened Out	2.00E+00	---	Screened Out	Less than 5% Detection Frequency
79-34-5	1,1,2,2-TETRACHLOROETHANE	µg/L	7.60E-02	1.00E+00	1.00E-01	---	---	---	1.00E-01	620	0	0.0%	---	Screened Out	7.60E-02	---	Screened Out	Less than 5% Detection Frequency
76-13-1	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	µg/L	5.50E+03	1.20E+03	1.20E+02	---	---	---	4.00E+03	6	0	0.0%	---	Screened Out	1.20E+02	---	Screened Out	Less than 5% Detection Frequency
79-00-5	1,1,2-TRICHLOROETHANE	µg/L	4.10E-02	5.00E+00	5.00E-01	---	---	---	3.00E-01	620	0	0.0%	---	Screened Out	4.10E-02	---	Screened Out	Less than 5% Detection Frequency
75-34-3	1,1-Dichloroethane (1,1-DCA)	µg/L	2.80E+00	5.00E+00	5.00E-01	---	---	---	3.00E+00	620	8	1.3%	9.69E-01	Screened Out	5.00E-01	---	Screened Out	Less than 5% Detection Frequency
75-35-4	1,1-Dichloroethene (1,1-DCE)	µg/L	2.80E+01	6.00E+00	6.00E-01	---	---	---	1.00E+01	620	178	28.7%	9.30E+00	Exceeds	6.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
563-58-6	1,1-DICHLOROPROPENE	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
87-61-6	1,2,3-TRICHLOROBENZENE	µg/L	7.00E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	7.00E-01	---	Screened Out	Less than 5% Detection Frequency
96-18-4	1,2,3-TRICHLOROPROPANE	µg/L	7.50E-04	---	---	5.00E-03	5.00E-04	---	7.00E-04	705	7	1.0%	1.08E-02	Screened Out	5.00E-04	---	Screened Out	Less than 5% Detection Frequency
526-73-8	1,2,3-Trimethylbenzene	µg/L	1.00E+00	---	---	---	---	---	---	614	0	0.0%	---	Screened Out	1.00E+00	---	Screened Out	Less than 5% Detection Frequency
120-82-1	1,2,4-TRICHLOROBENZENE	µg/L	4.00E-01	5.00E+00	5.00E-01	---	---	---	5.00E+00	620	0	0.0%	---	Screened Out	4.00E-01	---	Screened Out	Less than 5% Detection Frequency
95-63-6	1,2,4-TRIMETHYLBENZENE	µg/L	1.50E+00	---	---	3.30E+02	3.30E+01	---	---	620	0	0.0%	---	Screened Out	1.50E+00	---	Screened Out	Less than 5% Detection Frequency
106-93-4	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	µg/L	7.50E-03	5.00E-02	5.00E-03	---	---	---	1.00E-02	620	0	0.0%	---	Screened Out	5.00E-03	---	Screened Out	Less than 5% Detection Frequency
95-50-1	1,2-Dichlorobenzene (o-DCB)	µg/L	3.00E+01	6.00E+02	6.00E+01	---	---	---	6.00E+02	620	0	0.0%	---	Screened Out	3.00E+01	---	Screened Out	Less than 5% Detection Frequency
107-06-2	1,2-Dichloroethane (1,2-DCA)	µg/L	1.70E-01	5.00E-01	5.00E-02	---	---	---	4.00E-01	620	1	0.2%	2.73E-01	Screened Out	5.00E-02	---	Screened Out	Less than 5% Detection Frequency
78-87-5	1,2-DICHLOROPROPANE	µg/L	4.40E-01	5.00E+00	5.00E-01	---	---	---	5.00E-01	620	0	0.0%	---	Screened Out	4.40E-01	---	Screened Out	Less than 5% Detection Frequency
108-70-3	1,3,5-Trichlorobenzene	µg/L	---	---	---	---	---	---	---	614	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-67-8	1,3,5-Trimethylbenzene	µg/L	1.20E+01	---	---	3.30E+02	3.30E+01	---	---	620	0	0.0%	---	Screened Out	1.20E+01	---	Screened Out	Less than 5% Detection Frequency
99-35-4	1,3,5-TRINITROBENZENE	µg/L	5.90E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.90E+01	---	Screened Out	Less than 5% Detection Frequency
541-73-1	1,3-Dichlorobenzene (m-DCB)	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
142-28-9	1,3-DICHLOROPROPANE	µg/L	3.70E+01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	3.70E+01	---	Screened Out	Less than 5% Detection Frequency
99-65-0	1,3-DINITROBENZENE	µg/L	2.00E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
106-46-7	1,4-Dichlorobenzene (p-DCB)	µg/L	4.80E-01	5.00E+00	5.00E-01	---	---	---	6.00E+00	620	0	0.0%	---	Screened Out	4.80E-01	---	Screened Out	Less than 5% Detection Frequency
123-91-1	1,4-Dioxane	µg/L	4.60E-01	---	---	1.00E+00	1.00E-01	---	---	200	98	49.0%	3.52E+01	Exceeds	1.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
114-26-1	2-(1-METHYLETHOXY) PHENOL METHYLCARBAMATE	µg/L	7.80E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.80E+00	---	Screened Out	Less than 5% Detection Frequency

Appendix A1 - COPC Identification Summary Based on Production Well Data

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68631-49-2	2,2',4,4',5,5'-HEXABROMODIPHENYL ETHER	µg/L	4.00E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.00E-01	---	Screened Out	Less than 5% Detection Frequency
59080-40-9	2,2',4,4',5-5'-Hexabromobiphenyl (HBB)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
60348-60-9	2,2',4,4',5-PENTABROMODIPHENYL ETHER	µg/L	2.00E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
189084-64-8	2,2',4,4',6-PENTABROMODIPHENYL ETHER	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
5436-43-1	2,2',4,4'-TETRABROMODIPHENYL ETHER	µg/L	2.00E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
594-20-7	2,2-DICHLOROPROPANE	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1746-01-6	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	µg/L	1.20E-07	3.00E-05	3.00E-06	---	---	---	5.00E-08	6	0	0.0%	---	Screened Out	1.20E-07	---	Screened Out	Less than 5% Detection Frequency
94-82-6	2,4-(Dichlorophenoxy)butyric acid	µg/L	1.20E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.20E+01	---	Screened Out	Less than 5% Detection Frequency
88-06-2	2,4,6-TRICHLOROPHENOL	µg/L	1.20E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.20E+00	---	Screened Out	Less than 5% Detection Frequency
118-96-7	2,4,6-TRINITROTOLUENE	µg/L	9.80E-01	---	---	1.00E+00	1.00E-01	---	---	6	0	0.0%	---	Screened Out	1.00E-01	---	Screened Out	Less than 5% Detection Frequency
94-75-7	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/L	1.70E+01	7.00E+01	7.00E+00	---	---	---	2.00E+01	6	0	0.0%	---	Screened Out	7.00E+00	---	Screened Out	Less than 5% Detection Frequency
120-83-2	2,4-DICHLOROPHENOL	µg/L	4.60E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.60E+00	---	Screened Out	Less than 5% Detection Frequency
105-67-9	2,4-DIMETHYLPHENOL	µg/L	3.60E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.60E+01	---	Screened Out	Less than 5% Detection Frequency
121-14-2	2,4-DINITROTOLUENE	µg/L	2.40E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.40E-01	---	Screened Out	Less than 5% Detection Frequency
606-20-2	2,6-DINITROTOLUENE	µg/L	4.90E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.90E-02	---	Screened Out	Less than 5% Detection Frequency
110-75-8	2-CHLOROETHYL VINYL ETHER	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
91-58-7	2-CHLORONAPHTHALENE	µg/L	7.50E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.50E+01	---	Screened Out	Less than 5% Detection Frequency
95-57-8	2-CHLOROPHENOL	µg/L	9.10E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	9.10E+00	---	Screened Out	Less than 5% Detection Frequency
95-49-8	2-CHLOROTOLUENE	µg/L	2.40E+01	---	---	1.40E+02	1.40E+01	---	---	620	0	0.0%	---	Screened Out	1.40E+01	---	Screened Out	Less than 5% Detection Frequency
591-78-6	2-HEXANONE	µg/L	3.80E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.80E+00	---	Screened Out	Less than 5% Detection Frequency
95-48-7	2-METHYLPHENOL (O-CRESOL)	µg/L	9.30E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	9.30E+01	---	Screened Out	Less than 5% Detection Frequency
88-74-4	2-NITROANILINE	µg/L	1.90E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.90E+01	---	Screened Out	Less than 5% Detection Frequency
88-75-5	2-NITROPHENOL	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
330-54-1	3-(3,4-DICHLOROPHENYL)-1,1-DIMETHYLUREA	µg/L	3.60E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.60E+00	---	Screened Out	Less than 5% Detection Frequency
91-94-1	3,3'-DICHLOROBENZIDINE	µg/L	1.30E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.30E-01	---	Screened Out	Less than 5% Detection Frequency
51-36-5	3,5-DICHLOROBENZOIC ACID	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency

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Notes:
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2032-65-7	3,5-DIMETHYL-4-(METHYLTHIO) PHENYL METHYLCARBAMATE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
16655-82-6	3-HYDROXYCARBOFURAN	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
534-52-1	4,6-DINITRO-2-METHYLPHENOL	µg/L	1.50E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.50E-01	---	Screened Out	Less than 5% Detection Frequency
101-55-3	4-BROMOPHENYL PHENYL ETHER	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
59-50-7	4-CHLORO-3-METHYLPHENOL	µg/L	1.40E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.40E+02	---	Screened Out	Less than 5% Detection Frequency
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
106-43-4	4-Chlorotoluene (para-)	µg/L	2.50E+01	---	---	1.40E+02	1.40E+01	---	---	620	0	0.0%	---	Screened Out	1.40E+01	---	Screened Out	Less than 5% Detection Frequency
108-10-1	4-Methyl-2-Pentanone (MIBK)	µg/L	6.30E+02	---	---	1.20E+02	1.20E+01	---	---	620	0	0.0%	---	Screened Out	1.20E+01	---	Screened Out	Less than 5% Detection Frequency
100-02-7	4-NITROPHENOL	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
83-32-9	ACENAPHTHENE	µg/L	5.30E+01	---	---	---	---	---	---	15	0	0.0%	---	Screened Out	5.30E+01	---	Screened Out	Less than 5% Detection Frequency
208-96-8	ACENAPHTHYLENE	µg/L	---	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
75-07-0	ACETALDEHYDE	µg/L	1.90E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.90E+00	---	Screened Out	Less than 5% Detection Frequency
34256-82-1	ACETOCHLOR	µg/L	3.50E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.50E+01	---	Screened Out	Less than 5% Detection Frequency
187022-11-3	Acetochlor ethanesulfonic acid	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
194992-44-4	acetochlor oxanilic acid	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
67-64-1	ACETONE	µg/L	1.40E+03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.40E+03	---	Screened Out	Less than 5% Detection Frequency
75-05-8	ACETONITRILE	µg/L	1.30E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.30E+01	---	Screened Out	Less than 5% Detection Frequency
50594-66-6	ACIFLUORFEN	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
107-02-8	ACROLEIN	µg/L	4.20E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.20E-03	---	Screened Out	Less than 5% Detection Frequency
107-13-1	ACRYLONITRILE	µg/L	5.20E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.20E-02	---	Screened Out	Less than 5% Detection Frequency
AGGI	Aggressive Index	NONE	---	---	---	---	---	---	---	6	6	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
15972-60-8	ALACHLOR	µg/L	1.10E+00	2.00E+00	2.00E-01	---	---	---	4.00E+00	12	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
140939-15-7	ALACHLOR ESA	µg/L	---	2.00E+00	2.00E-01	---	---	---	4.00E+00	6	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
171262-17-2	ALACHLOR OA	µg/L	---	2.00E+00	2.00E-01	---	---	---	4.00E+00	6	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
116-06-3	ALDICARB (SULFIDE, SULFOXIDE, AND SULFONE)	µg/L	2.00E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E+00	---	Screened Out	Less than 5% Detection Frequency
1646-88-4	ALDICARB SULFONE	µg/L	2.00E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E+00	---	Screened Out	Less than 5% Detection Frequency

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Notes:
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MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
1646-87-3	ALDICARB SULFOXIDE	µg/L		---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
309-00-2	ALDRIN	µg/L	9.20E-04	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	9.20E-04	---	Screened Out	Less than 5% Detection Frequency
107-05-1	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/L	2.10E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.10E-01	---	Screened Out	Less than 5% Detection Frequency
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	µg/L	7.20E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.20E-03	---	Screened Out	Less than 5% Detection Frequency
959-98-8	ALPHA ENDOSULFAN	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
12587-46-1	ALPHA, GROSS	pCi/L	---	1.50E+01	1.50E+00	---	---	---	---	6	6	100.0%	5.87E+00	Exceeds	1.50E+00	Exceeds	Screened out	Considered to be made up of Uranium and Radium 226/228.
5103-71-9	ALPHA-CHLORDANE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7429-90-5	ALUMINUM	µg/L	2.00E+03	1.00E+03	1.00E+02	---	---	5.00E+01	6.00E+02	36	20	55.6%	1.15E+02	Exceeds	1.00E+02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7664-41-7	AMMONIA	µg/L		---	---	---	---	---	---	7	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
26787-78-0	Amoxicillin	µg/L	---	---	---	---	---	---	---	6	1	16.7%	5.00E-03	Exceeds	0.00E+00	---	Screened out	A typical prescribed dose of 50 mg/ml equals 5E+07 ug/L; the screening concentration of 5E-03 ug/L is several orders of magnitude lower
120-12-7	ANTHRACENE	µg/L	1.80E+02	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	1.80E+02	---	Screened Out	Less than 5% Detection Frequency
7440-36-0	ANTIMONY	µg/L	7.80E-01	6.00E+00	6.00E-01	---	---	---	7.00E-01	33	7	21.2%	2.50E-01	Exceeds	6.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
7440-38-2	ARSENIC	µg/L	5.20E-02	1.00E+01	1.00E+00	---	---	---	4.00E-03	36	21	58.3%	1.80E+00	Exceeds	5.20E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
22541-54-4	Arsenic(III)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
17428-41-0	Arsenic(V)	µg/L	---	---	---	---	---	---	---	11	11	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. Arsenic toxicity is not differentiated by valence; total arsenic will capture this data since total arsenic should be sum of 3+ and 5+.
1332-21-4	ASBESTOS	MFL	---	7.00E+00	7.00E-01	---	---	---	7.00E+00	6	0	0.0%	---	Screened Out	7.00E-01	---	Screened Out	Less than 5% Detection Frequency
1912-24-9	ATRAZINE	µg/L	3.00E-01	1.00E+00	1.00E-01	---	---	---	1.50E-01	12	0	0.0%	---	Screened Out	1.00E-01	---	Screened Out	Less than 5% Detection Frequency
83905-01-5	Azithromycin	µg/L	---	---	---	---	---	---	---	6	2	33.3%	3.00E-02	Exceeds	0.00E+00	---	Screened out	A typical prescribed dose of 40 mg/ml equals 4E+07 ug/L; the screening concentration of 3E-02 ug/L is several orders of magnitude lower
103-33-3	AZOBENZENE	µg/L	1.20E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.20E-01	---	Screened Out	Less than 5% Detection Frequency
7440-39-3	BARIUM	µg/L	3.80E+02	1.00E+03	1.00E+02	---	---	---	2.00E+03	32	32	100.0%	8.31E+01	Exceeds	1.00E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
25057-89-0	BENTAZON	µg/L	5.70E+01	1.80E+01	1.80E+00	---	---	---	2.00E+02	6	0	0.0%	---	Screened Out	1.80E+00	---	Screened Out	Less than 5% Detection Frequency
71-43-2	BENZENE	µg/L	4.60E-01	1.00E+00	1.00E-01	---	---	---	1.50E-01	620	0	0.0%	---	Screened Out	1.00E-01	---	Screened Out	Less than 5% Detection Frequency
92-87-5	BENZIDINE	µg/L	1.10E-04	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.10E-04	---	Screened Out	Less than 5% Detection Frequency
56-55-3	BENZO(A)ANTHRACENE	µg/L	1.20E-02	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	1.20E-02	---	Screened Out	Less than 5% Detection Frequency
50-32-8	BENZO(A)PYRENE	µg/L	3.40E-03	2.00E-01	2.00E-02	---	---	---	7.00E-03	13	0	0.0%	---	Screened Out	3.40E-03	---	Screened Out	Less than 5% Detection Frequency
205-99-2	BENZO(B)FLUORANTHENE	µg/L	3.40E-02	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	3.40E-02	---	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
191-24-2	BENZO(G,H,I)PERYLENE	µg/L	---	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
207-08-9	BENZO(K)FLUORANTHENE	µg/L	3.40E-01	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	3.40E-01	---	Screened Out	Less than 5% Detection Frequency
85-68-7	BENZYL BUTYL PHTHALATE	µg/L	1.60E+01	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	1.60E+01	---	Screened Out	Less than 5% Detection Frequency
7440-41-7	BERYLLIUM	µg/L	2.50E+00	4.00E+00	4.00E-01	---	---	---	1.00E+00	29	0	0.0%	---	Screened Out	4.00E-01	---	Screened Out	Less than 5% Detection Frequency
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	µg/L	2.50E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.50E-02	---	Screened Out	Less than 5% Detection Frequency
33213-65-9	BETA ENDOSULFAN	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
12587-47-2	BETA, GROSS	pCi/L	---	5.00E+01	5.00E+00	---	---	---	---	6	6	100.0%	1.00E+01	Exceeds	5.00E+00	Exceeds	Screened out	Gross samples are used as a method to screen for relative levels of radioactivity. A combination of beta emitters that are all below individual screening levels
BOD	BIOLOGIC OXYGEN DEMAND, FIVE DAY	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
111-91-1	BIS(2-CHLOROETHOXY) METHANE	µg/L	5.90E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.90E+00	---	Screened Out	Less than 5% Detection Frequency
111-44-4	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	µg/L	1.40E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.40E-02	---	Screened Out	Less than 5% Detection Frequency
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	µg/L	7.10E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.10E+01	---	Screened Out	Less than 5% Detection Frequency
80-05-7	BISPHENOL A	µg/L	7.70E+01	---	---	---	---	---	---	6	5	83.3%	1.40E-02	Exceeds	7.70E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
7440-42-8	BORON	µg/L	4.00E+02	---	---	1.00E+03	1.00E+02	---	---	31	31	100.0%	4.86E+02	Exceeds	1.00E+02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
314-40-9	BROMACIL	µg/L	---	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
15541-45-4	Bromate	µg/L	1.10E-01	1.00E+01	1.00E+00	---	---	---	1.00E-01	7	1	14.3%	5.20E-01	Exceeds	1.10E-01	Exceeds	Screened out	Disinfection byproduct
24959-67-9	BROMIDE	µg/L	---	---	---	---	---	---	---	34	34	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
108-86-1	BROMOBENZENE	µg/L	6.20E+00	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	6.20E+00	---	Screened Out	Less than 5% Detection Frequency
5589-96-8	Bromochloroacetic Acid (BCAA)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
74-97-5	BROMOCHLOROMETHANE	µg/L	8.30E+00	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	8.30E+00	---	Screened Out	Less than 5% Detection Frequency
75-27-4	BROMODICHLOROMETHANE	µg/L	1.30E-01	---	---	---	---	---	---	620	1	0.2%	7.55E-01	Screened Out	1.30E-01	---	Screened Out	Less than 5% Detection Frequency
75-25-2	BROMOFORM	µg/L	3.30E+00	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	3.30E+00	---	Screened Out	Less than 5% Detection Frequency
74-83-9	BROMOMETHANE	µg/L	7.50E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	7.50E-01	---	Screened Out	Less than 5% Detection Frequency
23184-66-9	BUTACHLOR	µg/L	---	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7440-43-9	CADMIUM	µg/L		5.00E+00	5.00E-01	---	---	---	4.00E-02	33	8	24.2%	1.50E-01	Exceeds	5.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
58-08-2	CAFFEINE	µg/L	---	---	---	---	---	---	---	6	4	66.7%	5.70E-03	Exceeds	0.00E+00	---	Screened out	A typical cup of coffee contains 285 mg/L caffeine (100 mg per 12 ounces) or 285000 ug/L; the screening concentration of 5.7E-03 ug/L is several orders of magnitude lower

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
7440-70-2	CALCIUM	µg/L	---	---	---	---	---	---	---	6	6	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
298-46-4	CARBAMAZEPINE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1563-66-2	CARBOFURAN	µg/L	9.40E+00	1.80E+01	1.80E+00	---	---	---	1.70E+00	6	0	0.0%	---	Screened Out	1.80E+00	---	Screened Out	Less than 5% Detection Frequency
75-15-0	Carbon Disulfide (CS2)	µg/L	8.10E+01	---	---	1.60E+02	1.60E+01	---	---	620	0	0.0%	---	Screened Out	1.60E+01	---	Screened Out	Less than 5% Detection Frequency
56-23-5	CARBON TETRACHLORIDE	µg/L	4.60E-01	5.00E-01	5.00E-02	---	---	---	1.00E-01	620	0	0.0%	---	Screened Out	5.00E-02	---	Screened Out	Less than 5% Detection Frequency
3812-32-6	CARBONATE (AS CO3)	µg/L	---	---	---	---	---	---	---	27	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
14866-68-3	CHLORATE	µg/L	---	---	---	8.00E+02	8.00E+01	---	---	6	6	100.0%	1.90E+02	Exceeds	8.00E+01	Exceeds	Screened out	Disinfection byproduct
57-74-9	CHLORDANE	µg/L	---	1.00E-01	1.00E-02	---	---	---	3.00E-02	12	0	0.0%	---	Screened Out	1.00E-02	---	Screened Out	Less than 5% Detection Frequency
16887-00-6	CHLORIDE (AS CL)	µg/L	---	---	---	---	---	2.50E+05	---	41	41	100.0%	7.00E+04	Exceeds	0.00E+00	---	Screened out	Below Secondary MCL which is aesthetic only. This requires voluntary testing only under EPA regulations although it is enforceable in California in Community Water Systems. Below health-based limit for acute health effects.
7782-50-5	CHLORINE	µg/L	3.00E-02	---	---	---	---	---	---	8	2	25.0%	1.60E+02	Exceeds	3.00E-02	Exceeds	Screened out	Screening value of 160 ug/L is below the Maximum Residual Disinfectant Level of 4 mg/L
7782-50-5F	Chlorine Residual, Free	µg/L	---	---	---	---	---	---	---	9	3	33.3%	1.30E+02	Exceeds	0.00E+00	---	Screened out	Screening value of 130 ug/L is below the Maximum Residual Disinfectant Level of 4 mg/L
14998-27-7	Chlorite (Sodium Salt)	µg/L	---	1.00E+03	1.00E+02	---	---	---	5.00E+01	6	0	0.0%	---	Screened Out	1.00E+02	---	Screened Out	Less than 5% Detection Frequency
79-11-8	CHLOROACETIC ACID	µg/L		---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-90-7	CHLOROBENZENE	µg/L	7.80E+00	7.00E+01	7.00E+00	---	---	---	7.00E+01	620	0	0.0%	---	Screened Out	7.00E+00	---	Screened Out	Less than 5% Detection Frequency
75-00-3	CHLOROETHANE	µg/L	2.10E+03	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	2.10E+03	---	Screened Out	Less than 5% Detection Frequency
67-66-3	CHLOROFORM	µg/L	2.20E-01	---	---	---	---	---	---	620	78	12.6%	2.21E+00	Exceeds	2.20E-01	Exceeds	Screened out	Disinfection byproduct
74-87-3	CHLOROMETHANE	µg/L	1.90E+01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	1.90E+01	---	Screened Out	Less than 5% Detection Frequency
1897-45-6	CHLOROTHALONIL	µg/L	2.20E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.20E+01	---	Screened Out	Less than 5% Detection Frequency
18540-29-9	CHROMIUM, HEXAVALENT (Cr+6)	µg/L	3.50E-02	1.00E+01	1.00E+00	---	---	---	2.00E-02	27	23	85.2%	4.38E+00	Exceeds	3.50E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7440-47-3	CHROMIUM, TOTAL	µg/L	3.50E-02	5.00E+01	5.00E+00	---	---	---	---	36	29	80.6%	6.60E+00	Exceeds	3.50E-02	Exceeds	Screened out	Chromium (VI) will be evaluated in the HHRA
218-01-9	CHRYSENE	µg/L	3.40E+00	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	3.40E+00	---	Screened Out	Less than 5% Detection Frequency
85721-33-1	Ciprofloxacin	µg/L	---	---	---	---	---	---	---	6	3	50.0%	9.60E-03	Exceeds	0.00E+00	---	Screened out	A typical prescribed dose of 10 mg/ml equals 1E+07 ug/L; the screening concentration of 9.6E-03 ug/L is several orders of magnitude lower
156-59-2	CIS-1,2-DICHLOROETHYLENE	µg/L	3.60E+00	6.00E+00	6.00E-01	---	---	---	1.00E+02	620	47	7.6%	1.80E+00	Exceeds	6.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
10061-01-5	CIS-1,3-DICHLOROPROPENE	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7440-48-4	COBALT	µg/L	6.00E-01	---	---	---	---	---	---	10	10	100.0%	2.70E-01	Exceeds	6.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL

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RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
COLIF [Combined Coliform data - MPN/100ml]	COLIFORM	MPN/100ml	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
COLOR	COLOR	COLOR UNIT	---	---	---	---	---	1.50E+01	---	34	28	82.4%	3.00E+02	Exceeds	0.00E+00	---	Screened out	Below Secondary MCL which is aesthetic only. This requires voluntary testing only under EPA regulations although it is enforceable in California in Community Water Systems.
GIS-210-011	CONDUCTIVITY	µS/cm	---	---	---	---	---	---	---	6	6	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-50-8	COPPER	µg/L	8.00E+01	1.30E+03	1.30E+02	---	---	1.00E+03	3.00E+02	36	18	50.0%	1.36E+01	Exceeds	8.00E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
57-12-5	CYANIDE	µg/L	1.50E-01	1.50E+02	1.50E+01	---	---	---	1.50E+02	29	0	0.0%	---	Screened Out	1.50E-01	---	Screened Out	Less than 5% Detection Frequency
121-82-4	Cyclonite	µg/L	7.00E-01	---	---	3.00E-01	3.00E-02	---	---	6	0	0.0%	---	Screened Out	3.00E-02	---	Screened Out	Less than 5% Detection Frequency
75-99-0	DALAPON	µg/L	6.00E+01	2.00E+02	2.00E+01	---	---	---	7.90E+02	6	0	0.0%	---	Screened Out	2.00E+01	---	Screened Out	Less than 5% Detection Frequency
METABOLITES	DCPA ACID METABOLITES (A)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
103-23-1	Di(2-ethylhexyl)adipate (DEHA)	µg/L	---	4.00E+02	4.00E+01	---	---	---	2.00E+02	6	0	0.0%	---	Screened Out	4.00E+01	---	Screened Out	Less than 5% Detection Frequency
117-81-7	Di(2-ethylhexyl)phthalate	µg/L	5.60E+00	4.00E+00	4.00E-01	---	---	---	1.20E+01	51	0	0.0%	---	Screened Out	4.00E-01	---	Screened Out	Less than 5% Detection Frequency
333-41-5	DIAZINON	µg/L	1.00E+00	---	---	1.20E+00	1.20E-01	---	---	8	0	0.0%	---	Screened Out	1.20E-01	---	Screened Out	Less than 5% Detection Frequency
53-70-3	DIBENZ(A,H)ANTHRACENE	µg/L	3.40E-03	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	3.40E-03	---	Screened Out	Less than 5% Detection Frequency
631-64-1	Dibromoacetic Acid	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
124-48-1	DIBROMOCHLOROMETHANE	µg/L	8.70E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	8.70E-01	---	Screened Out	Less than 5% Detection Frequency
96-12-8	Dibromochloropropane (DBCP)	µg/L	3.30E-04	2.00E-01	2.00E-02	---	---	---	1.70E-03	620	0	0.0%	---	Screened Out	3.30E-04	---	Screened Out	Less than 5% Detection Frequency
74-95-3	DIBROMOMETHANE	µg/L	8.30E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	8.30E-01	---	Screened Out	Less than 5% Detection Frequency
1918-00-9	DICAMBA	µg/L	5.70E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.70E+01	---	Screened Out	Less than 5% Detection Frequency
3400-09-7	Dichloramine	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
79-43-6	DICHLOROACETIC ACID	µg/L	1.50E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.50E+00	---	Screened Out	Less than 5% Detection Frequency
75-71-8	DICHLORODIFLUOROMETHA NE	µg/L	2.00E+01	---	---	1.00E+03	1.00E+02	---	---	620	110	17.7%	4.90E+00	Exceeds	2.00E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
120-36-5	DICHLOROPROP	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
60-57-1	DIELDRIN	µg/L	1.80E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.80E-03	---	Screened Out	Less than 5% Detection Frequency
84-66-2	DIETHYL PHTHALATE	µg/L	1.50E+03	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	1.50E+03	---	Screened Out	Less than 5% Detection Frequency
60-51-5	DIMETHOATE	µg/L	4.00E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.00E-01	---	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
131-11-3	DIMETHYL PHTHALATE	µg/L	---	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
84-74-2	DI-N-BUTYL PHTHALATE	µg/L	9.00E+01	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	9.00E+01	---	Screened Out	Less than 5% Detection Frequency
117-84-0	DI-N-OCTYLPHTHALATE	µg/L	2.00E+01	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	2.00E+01	---	Screened Out	Less than 5% Detection Frequency
88-85-7	DINOSEB	µg/L	1.50E+00	7.00E+00	7.00E-01	---	---	---	1.40E+01	6	0	0.0%	---	Screened Out	7.00E-01	---	Screened Out	Less than 5% Detection Frequency
123-79-5	DIOCTYL ADIPATE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
2764-72-9	DIQUAT	µg/L	---	2.00E+01	2.00E+00	---	---	---	1.50E+01	6	0	0.0%	---	Screened Out	2.00E+00	---	Screened Out	Less than 5% Detection Frequency
1031-07-8	ENDOSULFAN SULFATE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
145-73-3	ENDOTHAL	µg/L	3.80E+01	1.00E+02	1.00E+01	---	---	---	9.40E+01	6	0	0.0%	---	Screened Out	1.00E+01	---	Screened Out	Less than 5% Detection Frequency
72-20-8	ENDRIN	µg/L	2.30E-01	2.00E+00	2.00E-01	---	---	---	1.80E+00	6	0	0.0%	---	Screened Out	2.00E-01	---	Screened Out	Less than 5% Detection Frequency
7421-93-4	ENDRIN ALDEHYDE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
68583-22-2	Escherichia coli	MPN/100mL	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
64-17-5	ETHANOL	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
563-12-2	ETHION	µg/L	4.30E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.30E-01	---	Screened Out	Less than 5% Detection Frequency
97-63-2	ETHYL METHACRYLATE	µg/L	6.30E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	6.30E+01	---	Screened Out	Less than 5% Detection Frequency
100-41-4	ETHYLBENZENE	µg/L	1.50E+00	3.00E+02	3.00E+01	---	---	---	3.00E+02	620	0	0.0%	---	Screened Out	1.50E+00	---	Screened Out	Less than 5% Detection Frequency
107-21-1	ETHYLENE GLYCOL	µg/L	4.00E+03	---	---	1.40E+04	1.40E+03	---	---	6	0	0.0%	---	Screened Out	1.40E+03	---	Screened Out	Less than 5% Detection Frequency
637-92-3	Ethyl-tert-Butyl Ether(ETBE)	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
FECCOLIFORM [Combined Fecal Coliform data - MPN/100ml]	FECAL COLIFORM	MPN/100ml	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
206-44-0	FLUORANTHENE	µg/L	8.00E+01	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	8.00E+01	---	Screened Out	Less than 5% Detection Frequency
86-73-7	FLUORENE	µg/L	2.90E+01	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	2.90E+01	---	Screened Out	Less than 5% Detection Frequency
16984-48-8	FLUORIDE	µg/L	8.00E+01	2.00E+03	2.00E+02	---	---	---	1.00E+03	39	39	100.0%	4.46E+02	Exceeds	8.00E+01	Exceeds	Screened out	Below the California Water Fluoridation Standards control range of 0.6 mg/L to 1.2 mg/L
944-22-9	Fonofos	µg/L	2.40E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.40E+00	---	Screened Out	Less than 5% Detection Frequency
50-00-0	FORMALDEHYDE	µg/L	4.30E-01	---	---	1.00E+02	1.00E+01	---	---	6	0	0.0%	---	Screened Out	4.30E-01	---	Screened Out	Less than 5% Detection Frequency
58-89-9	GAMMA BHC (LINDANE)	µg/L	4.20E-02	2.00E-01	2.00E-02	---	---	---	3.20E-02	6	0	0.0%	---	Screened Out	2.00E-02	---	Screened Out	Less than 5% Detection Frequency
GASCOMP	GASOLINE COMPONENTS	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
25812-30-0	GEMFIBROZIL	µg/L	---	---	---	---	---	---	---	6	1	16.7%	5.00E-04	Exceeds	0.00E+00	---	Screened out	A typical prescribed dose of 20 mg/ml equals 2E+07 ug/L; the screening concentration of 5.0E-04 ug/L is several orders of magnitude lower

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
107-22-2	GLYOXAL	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1071-83-6	GLYPHOSATE	µg/L	2.00E+02	7.00E+02	7.00E+01	---	---	---	9.00E+02	6	0	0.0%	---	Screened Out	7.00E+01	---	Screened Out	Less than 5% Detection Frequency
76-44-8	HEPTACHLOR	µg/L	1.40E-03	1.00E-02	1.00E-03	---	---	---	8.00E-03	6	0	0.0%	---	Screened Out	1.00E-03	---	Screened Out	Less than 5% Detection Frequency
1024-57-3	HEPTACHLOR EPOXIDE	µg/L	1.40E-03	1.00E-02	1.00E-03	---	---	---	6.00E-03	6	0	0.0%	---	Screened Out	1.00E-03	---	Screened Out	Less than 5% Detection Frequency
HPC	Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	6	4	66.7%	1.60E+02	Exceeds	0.00E+00	---	Screened out	Microbial Indicator
118-74-1	HEXACHLOROBENZENE	µg/L	9.80E-03	1.00E+00	1.00E-01	---	---	---	3.00E-02	12	0	0.0%	---	Screened Out	9.80E-03	---	Screened Out	Less than 5% Detection Frequency
87-68-3	HEXACHLOROBUTADIENE	µg/L	1.40E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	1.40E-01	---	Screened Out	Less than 5% Detection Frequency
77-47-4	HEXACHLOROCYCLOPENTADIENE	µg/L	4.10E-02	5.00E+01	5.00E+00	---	---	---	2.00E+00	12	0	0.0%	---	Screened Out	4.10E-02	---	Screened Out	Less than 5% Detection Frequency
67-72-1	HEXACHLOROETHANE	µg/L	3.30E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.30E-01	---	Screened Out	Less than 5% Detection Frequency
302-01-2	HYDRAZINE	µg/L	1.10E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.10E-03	---	Screened Out	Less than 5% Detection Frequency
14280-30-9	Hydroxide (OH)	µg/L	---	---	---	---	---	---	---	27	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
15687-27-1	IBUPROFEN	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
193-39-5	INDENO(1,2,3-C,D)PYRENE	µg/L	3.40E-02	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	3.40E-02	---	Screened Out	Less than 5% Detection Frequency
20461-54-5	IODIDE (AS I)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
74-88-4	IODOMETHANE (METHYL IODIDE)	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7439-89-6	IRON	µg/L	1.40E+03	---	---	---	---	3.00E+02	---	82	52	63.4%	1.50E+04	Exceeds	1.40E+03	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
78-59-1	ISOPHORONE	µg/L	7.80E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.80E+01	---	Screened Out	Less than 5% Detection Frequency
67-63-0	ISOPROPANOL	µg/L	4.10E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.10E+01	---	Screened Out	Less than 5% Detection Frequency
108-20-3	ISOPROPYL ETHER	µg/L	1.50E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.50E+02	---	Screened Out	Less than 5% Detection Frequency
98-82-8	ISOPROPYLBENZENE (CUMENE)	µg/L	4.50E+01	---	---	7.70E+02	7.70E+01	---	---	620	0	0.0%	---	Screened Out	4.50E+01	---	Screened Out	Less than 5% Detection Frequency
LAI20	Langelier Index at 20 C	NONE	---	---	---	---	---	---	---	6	6	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
LAI60	Langelier Index at 60 degrees C	NONE	---	---	---	---	---	---	---	6	6	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
LAI	Langelier Index Source Temp,Thermometer	NONE	---	---	---	---	---	---	---	23	23	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7439-92-1	LEAD	µg/L	1.50E+01	1.50E+01	1.50E+00	---	---	---	2.00E-01	34	13	38.2%	1.60E+00	Exceeds	1.50E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7439-93-2	LITHIUM	µg/L	4.00E+00	---	---	---	---	---	---	12	12	100.0%	---	Exceeds	4.00E+00	Exceeds	Screened Out	Not applicable. General water quality parameter.
179601-23-1	m,p-Xylene	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency

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7439-95-4	MAGNESIUM	µg/L	---	---	---	---	---	---	---	37	37	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7439-96-5	MANGANESE	µg/L	4.30E+01	---	---	5.00E+02	5.00E+01	5.00E+01	---	66	54	81.8%	3.71E+02	Exceeds	4.30E+01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7439-97-6	MERCURY	µg/L	6.30E-02	2.00E+00	2.00E-01	---	---	---	1.20E+00	30	7	23.3%	5.50E-01	Exceeds	6.30E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
76-99-3	Methadone	µg/L	---	---	---	---	---	---	---	6	1	16.7%	5.00E-04	Exceeds	0.00E+00	---	Screened out	A typical prescribed dose of 10 mg/ml equals 1E+07 ug/L; the screening concentration of 5.0E-04 ug/L is several orders of magnitude lower
67-56-1	METHANOL	µg/L	2.00E+03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E+03	---	Screened Out	Less than 5% Detection Frequency
16752-77-5	Methomyl	µg/L	5.00E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.00E+01	---	Screened Out	Less than 5% Detection Frequency
72-43-5	METHOXYCHLOR	µg/L	3.70E+00	3.00E+01	3.00E+00	---	---	---	9.00E-02	6	0	0.0%	---	Screened Out	3.00E+00	---	Screened Out	Less than 5% Detection Frequency
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	µg/L	5.60E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.60E+02	---	Screened Out	Less than 5% Detection Frequency
80-62-6	METHYL METHACRYLATE	µg/L	1.40E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.40E+02	---	Screened Out	Less than 5% Detection Frequency
1634-04-4	Methyl Tert-butyl ether (MTBE)	µg/L	1.40E+01	1.30E+01	1.30E+00	---	---	5.00E+00	1.30E+01	620	0	0.0%	---	Screened Out	1.30E+00	---	Screened Out	Less than 5% Detection Frequency
126-98-7	METHYLACRYLONITRILE	µg/L	1.90E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.90E-01	---	Screened Out	Less than 5% Detection Frequency
MBAS	METHYLENE BLUE ACTIVE SUBSTANCES	µg/L	---	---	---	---	---	5.00E+02	---	28	2	7.1%	1.30E+02	Exceeds	0.00E+00	---	Screened out	Not a constituent, including a group of foaming agents. Below Secondary MCL which is aesthetic only.
75-09-2	METHYLENE CHLORIDE	µg/L	1.10E+01	5.00E+00	5.00E-01	---	---	---	4.00E+00	620	0	0.0%	---	Screened Out	5.00E-01	---	Screened Out	Less than 5% Detection Frequency
51218-45-2	METOLACHLOR	µg/L	2.70E+02	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	2.70E+02	---	Screened Out	Less than 5% Detection Frequency
171118-09-5	METOLACHLOR ESA	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
152019-73-3	Metolachlor oxanilic acid	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
21087-64-9	METRIBUZIN	µg/L	4.90E+01	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	4.90E+01	---	Screened Out	Less than 5% Detection Frequency
2212-67-1	MOLINATE	µg/L	3.00E+00	2.00E+01	2.00E+00	---	---	---	1.00E+00	12	0	0.0%	---	Screened Out	2.00E+00	---	Screened Out	Less than 5% Detection Frequency
7439-98-7	MOLYBDENUM	µg/L	1.00E+01	---	---	---	---	---	---	11	11	100.0%	6.00E+01	Exceeds	1.00E+01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
79-08-3	MONOBROMOACETIC ACID	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
10599-90-3	Monochloramine	µg/L	2.00E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.00E+02	---	Screened Out	Less than 5% Detection Frequency
57-27-2	Morphine	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
91-20-3	NAPHTHALENE	µg/L	1.70E-01	---	---	1.70E+01	1.70E+00	---	---	629	0	0.0%	---	Screened Out	1.70E-01	---	Screened Out	Less than 5% Detection Frequency
104-51-8	N-BUTYLBENZENE	µg/L	1.00E+02	---	---	2.60E+02	2.60E+01	---	---	620	0	0.0%	---	Screened Out	2.60E+01	---	Screened Out	Less than 5% Detection Frequency
7440-02-0	NICKEL	µg/L	3.90E+01	1.00E+02	1.00E+01	---	---	---	1.20E+01	34	19	55.9%	4.60E+00	Exceeds	1.00E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
NN [Combined Nitrate & Nitrite as N data]	Nitrate + Nitrite (as N)	µg/L	---	1.00E+04	1.00E+03	---	---	---	1.00E+04	32	32	100.0%	8.08E+03	Exceeds	1.00E+03	Exceeds	Screened out	Evaluated separately.

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
14797-65-0 [Combined Nitrite as N and as NO2]	Nitrite (as N) ,IC	µg/L	---	1.00E+03	1.00E+02	---	---	---	1.00E+03	33	1	3.0%	7.50E+01	Screened Out	1.00E+02	---	Screened Out	Less than 5% Detection Frequency
98-95-3	NITROBENZENE	µg/L	1.40E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.40E-01	---	Screened Out	Less than 5% Detection Frequency
14797-55-8 [Combined Nitrate as N and as NO3]	NITROGEN, NITRATE (AS N)	µg/L	---	1.00E+04	1.00E+03	---	---	---	1.00E+04	576	575	99.8%	1.00E+04	Exceeds	1.00E+03	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
10595-95-6	NITROSOMETHYLETHYLAMINE	µg/L	7.10E-04	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.10E-04	---	Screened Out	Less than 5% Detection Frequency
55-18-5	N-NITROSODIETHYLAMINE	µg/L	1.70E-04	---	---	1.00E-02	1.00E-03	---	---	6	0	0.0%	---	Screened Out	1.70E-04	---	Screened Out	Less than 5% Detection Frequency
62-75-9	N-NITROSODIMETHYLAMINE	µg/L	1.10E-04	---	---	1.00E-02	1.00E-03	---	3.00E-03	6	0	0.0%	---	Screened Out	1.10E-04	---	Screened Out	Less than 5% Detection Frequency
924-16-3	N-NITROSO-DI-N-BUTYLAMINE	µg/L	2.70E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.70E-03	---	Screened Out	Less than 5% Detection Frequency
621-64-7	N-NITROSODI-N-PROPYLAMINE	µg/L	1.10E-02	---	---	1.00E-02	1.00E-03	---	---	6	0	0.0%	---	Screened Out	1.00E-03	---	Screened Out	Less than 5% Detection Frequency
86-30-6	N-NITROSODIPHENYLAMINE	µg/L	1.20E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.20E+01	---	Screened Out	Less than 5% Detection Frequency
100-75-4	N-NITROSOPIPERIDINE	µg/L	8.20E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	8.20E-03	---	Screened Out	Less than 5% Detection Frequency
930-55-2	N-NITROSOPYRROLIDINE	µg/L	3.70E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.70E-02	---	Screened Out	Less than 5% Detection Frequency
25154-52-3	NONYLPHENOL	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
103-65-1	N-PROPYLBENZENE	µg/L	6.60E+01	---	---	2.60E+02	2.60E+01	---	---	620	0	0.0%	---	Screened Out	2.60E+01	---	Screened Out	Less than 5% Detection Frequency
2691-41-0	OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE	µg/L	1.00E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.00E+02	---	Screened Out	Less than 5% Detection Frequency
ODOR	ODOR	T.O.N.	---	---	---	---	---	3.00E+00	---	29	10	34.5%	2.00E+00	Exceeds	0.00E+00	---	Screened out	Below Secondary MCL which is aesthetic only. This requires voluntary testing only under EPA regulations although it is enforceable in California in Community Water Systems. Below health-based limit for acute health effects.
OILGREASE	OIL & GREASE, TOTAL REC	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
23135-22-0	Oxamyl	µg/L	5.00E+01	5.00E+01	5.00E+00	---	---	---	2.60E+01	6	0	0.0%	---	Screened Out	5.00E+00	---	Screened Out	Less than 5% Detection Frequency
ORP	OXIDATION-REDUCTION POTENTIAL	MILLIVOLTS	---	---	---	---	---	---	---	6	6	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
DISS_OXYGEN	Oxygen, Dissolved	µg/L	---	---	---	---	---	---	---	12	12	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
95-47-6	o-Xylene	µg/L	1.90E+01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	1.90E+01	---	Screened Out	Less than 5% Detection Frequency
72-54-8	P,P'-DDD	µg/L	3.20E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	3.20E-02	---	Screened Out	Less than 5% Detection Frequency
72-55-9	P,P'-DDE	µg/L	4.60E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.60E-02	---	Screened Out	Less than 5% Detection Frequency
50-29-3	P,P'-DDT	µg/L	2.30E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.30E-01	---	Screened Out	Less than 5% Detection Frequency
1910-42-5	PARAQUAT	µg/L	9.00E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	9.00E+00	---	Screened Out	Less than 5% Detection Frequency
1336-36-3	PCB, TOTAL	µg/L		5.00E-01	5.00E-02	---	---	---	9.00E-02	6	0	0.0%	---	Screened Out	5.00E-02	---	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
12674-11-2	PCB-1016 (AROCLOR 1016)	µg/L	1.40E-01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.40E-01	---	Screened Out	Less than 5% Detection Frequency
11104-28-2	PCB-1221 (AROCLOR 1221)	µg/L	4.70E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.70E-03	---	Screened Out	Less than 5% Detection Frequency
11141-16-5	PCB-1232 (AROCLOR 1232)	µg/L	4.70E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.70E-03	---	Screened Out	Less than 5% Detection Frequency
53469-21-9	PCB-1242 (AROCLOR 1242)	µg/L	7.80E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.80E-03	---	Screened Out	Less than 5% Detection Frequency
12672-29-6	PCB-1248 (AROCLOR 1248)	µg/L	7.80E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.80E-03	---	Screened Out	Less than 5% Detection Frequency
11097-69-1	PCB-1254 (AROCLOR 1254)	µg/L	7.80E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.80E-03	---	Screened Out	Less than 5% Detection Frequency
11096-82-5	PCB-1260 (AROCLOR 1260)	µg/L	7.80E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	7.80E-03	---	Screened Out	Less than 5% Detection Frequency
76-01-7	PENTACHLOROETHANE	µg/L	6.50E-01	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	6.50E-01	---	Screened Out	Less than 5% Detection Frequency
87-86-5	PENTACHLOROPHENOL	µg/L	4.10E-02	1.00E+00	1.00E-01	---	---	---	3.00E-01	12	0	0.0%	---	Screened Out	4.10E-02	---	Screened Out	Less than 5% Detection Frequency
14797-73-0	PERCHLORATE	µg/L	1.40E+00	6.00E+00	6.00E-01	---	---	---	1.00E+00	86	0	0.0%	---	Screened Out	6.00E-01	---	Screened Out	Less than 5% Detection Frequency
PH	pH	pH UNITS	---	---	---	---	---	8.50E+00	---	309	309	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
85-01-8	PHENANTHRENE	µg/L	---	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-95-2	PHENOL	µg/L	5.80E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	5.80E+02	---	Screened Out	Less than 5% Detection Frequency
98059-61-1	Phosphate (as P)	µg/L	---	---	---	---	---	---	---	21	21	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
14265-44-2	Phosphate (as PO4)	µg/L	---	---	---	---	---	---	---	27	27	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7723-14-0	PHOSPHORUS, DISSOLVED (AS P)	µg/L	---	---	---	---	---	---	---	10	10	100.0%	1.08E+02	Exceeds	0.00E+00	---	Screened out	Not applicable. General water quality parameter.
1918-02-1	PICLORAM	µg/L	1.40E+02	5.00E+02	5.00E+01	---	---	---	5.00E+02	6	0	0.0%	---	Screened Out	5.00E+01	---	Screened Out	Less than 5% Detection Frequency
99-87-6	p-Isopropyltoluene (p-Cymene)	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7440-09-7	POTASSIUM	µg/L	---	---	---	---	---	---	---	32	32	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7287-19-6	PROMETRYN	µg/L	6.00E+00	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	6.00E+00	---	Screened Out	Less than 5% Detection Frequency
1918-16-7	PROPACHLOR	µg/L	2.50E+01	---	---	9.00E+01	9.00E+00	---	---	14	0	0.0%	---	Screened Out	9.00E+00	---	Screened Out	Less than 5% Detection Frequency
139-40-2	Propazine	µg/L	---	---	---	---	---	---	---	2	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
129-00-0	PYRENE	µg/L	1.20E+01	---	---	---	---	---	---	9	0	0.0%	---	Screened Out	1.20E+01	---	Screened Out	Less than 5% Detection Frequency
13982-63-3	RADIUM-226	pCi/L	---	---	---	---	---	---	5.00E-02	6	5	83.3%	3.14E-01	Exceeds	0.00E+00	---	Screened out	EPA Radionuclides Rule: Combined radium 226/228 below 5 pCi/L
425	Radium-226/228	pCi/L	---	5.00E+00	5.00E-01	---	---	---	---	5	5	100.0%	3.14E-01	Exceeds	5.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
15262-20-1	RADIUM-228	pCi/L	---	---	---	---	---	---	1.90E-02	6	1	16.7%	1.30E-02	Exceeds	0.00E+00	---	Screened out	EPA Radionuclides Rule: Combined radium 226/228 below 5 pCi/L

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69-72-7	Salicylic Acid	µg/L	---	---	---	---	---	---	---	6	2	33.3%	2.50E-02	Exceeds	0.00E+00	---	Screened out	A typical prescribed dose of 250 mg/ml = 2.5E+08 ug/L; the screening concentration of 2.5E-02 ug/L is several orders of magnitude lower
135-98-8	SEC-BUTYLBENZENE	µg/L	2.00E+02	---	---	2.60E+02	2.60E+01	---	---	620	0	0.0%	---	Screened Out	2.60E+01	---	Screened Out	Less than 5% Detection Frequency
7782-49-2	SELENIUM	µg/L	1.00E+01	5.00E+01	5.00E+00	---	---	---	3.00E+01	35	35	100.0%	2.50E+01	Exceeds	5.00E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
63-25-2	SEVIN (CARBARYL)	µg/L	1.80E+02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.80E+02	---	Screened Out	Less than 5% Detection Frequency
7631-86-9	SILICA	µg/L		---	---	---	---	---	---	32	32	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-22-4	SILVER	µg/L	9.40E+00	---	---	---	---	1.00E+02	---	31	3	9.7%	1.30E+00	Exceeds	9.40E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
93-72-1	SILVEX (2,4,5-TP)	µg/L	1.10E+01	5.00E+01	5.00E+00	---	---	---	3.00E+00	6	0	0.0%	---	Screened Out	5.00E+00	---	Screened Out	Less than 5% Detection Frequency
122-34-9	SIMAZINE	µg/L	6.10E-01	4.00E+00	4.00E-01	---	---	---	4.00E+00	12	1	8.3%	5.00E-01	Exceeds	4.00E-01	Exceeds	Screened out	Only one detection which is below RSL and only slightly above 10% of MCL
7440-23-5	SODIUM	µg/L	---	---	---	---	---	---	---	17	17	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
SC	SPECIFIC CONDUCTANCE	µS/cm	---	---	---	---	---	9.00E+02	---	41	41	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
10098-97-2	STRONTIUM-90	pCi/L	---	8.00E+00	8.00E-01	---	---	---	3.50E-01	6	4	66.7%	3.30E-01	Exceeds	8.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
100-42-5	STYRENE	µg/L	1.20E+02	1.00E+02	1.00E+01	---	---	---	5.00E-01	620	0	0.0%	---	Screened Out	1.00E+01	---	Screened Out	Less than 5% Detection Frequency
18496-25-8	SULFIDE, DISSOLVED	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
CLO3-d	Surrogate (DCA, 1000 ug/L)	µg/L	---	---	---	---	---	---	---	1	1	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. Surrogate to assess data quality.
TEMP	TEMPERATURE	DEG C	---	---	---	---	---	---	---	305	305	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
5902-51-2	TERBACIL	µg/L	2.50E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.50E+01	---	Screened Out	Less than 5% Detection Frequency
13071-79-9	TERBUFOS	µg/L	2.40E-02	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.40E-02	---	Screened Out	Less than 5% Detection Frequency
56070-16-7	TERBUFOS SULFONE	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
994-05-8	tert-Amyl Methyl Ether(TAME)	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
75-65-0	TERT-BUTYL ALCOHOL	µg/L	---	---	---	1.20E+01	1.20E+00	---	---	5	0	0.0%	---	Screened Out	1.20E+00	---	Screened Out	Less than 5% Detection Frequency
98-06-6	tert-Butylbenzene	µg/L	6.90E+01	---	---	2.60E+02	2.60E+01	---	---	620	0	0.0%	---	Screened Out	2.60E+01	---	Screened Out	Less than 5% Detection Frequency
127-18-4	Tetrachloroethylene (PCE)	µg/L	4.10E+00	5.00E+00	5.00E-01	---	---	---	6.00E-02	620	240	38.7%	1.56E+01	Exceeds	5.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7440-28-0	THALLIUM	µg/L	2.00E-02	2.00E+00	2.00E-01	---	---	---	1.00E-01	29	0	0.0%	---	Screened Out	2.00E-02	---	Screened Out	Less than 5% Detection Frequency
28249-77-6	Thiobencarb	µg/L	1.60E+01	7.00E+01	7.00E+00	---	---	1.00E+00	7.00E+01	51	0	0.0%	---	Screened Out	7.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-88-3	TOLUENE	µg/L	1.10E+02	1.50E+02	1.50E+01	---	---	---	1.50E+02	620	0	0.0%	---	Screened Out	1.50E+01	---	Screened Out	Less than 5% Detection Frequency
542-75-6	Total 1,3-Dichloropropene	µg/L	4.70E-01	5.00E-01	5.00E-02	---	---	---	2.00E-01	620	0	0.0%	---	Screened Out	5.00E-02	---	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
ANIONSTOTAL	Total Anions	MEQ/L	---	---	---	---	---	---	---	28	28	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
TOTCATIONS	Total Cations	MEQ/L	---	---	---	---	---	---	---	29	29	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
HAA5	TOTAL HALOACETIC ACIDS	µg/L	---	6.00E+01	6.00E+00	---	---	---	---	6	0	0.0%	---	Screened Out	6.00E+00	---	Screened Out	Less than 5% Detection Frequency
TOC	TOTAL ORGANIC CARBON	µg/L	---	---	---	---	---	---	---	35	33	94.3%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7723-14-0C	Total Phosphorus, Colorimetry-Calc	µg/L	---	---	---	---	---	---	---	10	10	100.0%	3.31E+02	Exceeds	0.00E+00	---	Screened out	Not applicable. General water quality parameter.
TSS	Total Settlable Solids	ML/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
TSS	TOTAL SUSPENDED SOLIDS	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
THM	TOTAL TRIHALOMETHANES	µg/L	---	8.00E+01	8.00E+00	---	---	---	8.00E-01	620	77	12.4%	2.97E+00	Exceeds	8.00E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
1330-20-7	TOTAL XYLENES	µg/L	1.90E+01	1.75E+03	1.75E+02	---	---	---	1.80E+03	620	0	0.0%	---	Screened Out	1.90E+01	---	Screened Out	Less than 5% Detection Frequency
8001-35-2	TOXAPHENE	µg/L	7.10E-02	3.00E+00	3.00E-01	---	---	---	3.00E-02	6	0	0.0%	---	Screened Out	7.10E-02	---	Screened Out	Less than 5% Detection Frequency
156-60-5	TRANS-1,2-DICHLOROETHENE	µg/L	3.60E+01	1.00E+01	1.00E+00	---	---	---	6.00E+01	620	0	0.0%	---	Screened Out	1.00E+00	---	Screened Out	Less than 5% Detection Frequency
10061-02-6	TRANS-1,3-DICHLOROPROPENE	µg/L	---	---	---	---	---	---	---	620	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
110-57-6	TRANS-1,4-DICHLORO-2-BUTENE	µg/L	1.30E-03	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.30E-03	---	Screened Out	Less than 5% Detection Frequency
76-03-9	Trichloroacetic Acid	µg/L	1.10E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	1.10E+00	---	Screened Out	Less than 5% Detection Frequency
79-01-6	TRICHLOROETHYLENE (TCE)	µg/L	2.80E-01	5.00E+00	5.00E-01	---	---	---	1.70E+00	620	282	45.5%	3.51E+01	Exceeds	2.80E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
75-69-4	TRICHLOROFLUOROMETHANE	µg/L	5.20E+02	1.50E+02	1.50E+01	---	---	---	1.30E+03	620	6	1.0%	7.27E-01	Screened Out	1.50E+01	---	Screened Out	Less than 5% Detection Frequency
26523-64-8	Trichlorotrifluoroethane(F113)	µg/L	---	1.20E+03	1.20E+02	---	---	---	4.00E+03	614	0	0.0%	---	Screened Out	1.20E+02	---	Screened Out	Less than 5% Detection Frequency
3380-34-5	Triclosan	µg/L	---	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1582-09-8	TRIFLURALIN	µg/L	2.60E+00	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	2.60E+00	---	Screened Out	Less than 5% Detection Frequency
10028-17-8	TRITIUM (HYDROGEN-3)	pCi/L	---	2.00E+04	2.00E+03	---	---	---	4.00E+02	6	5	83.3%	2.53E+02	Exceeds	2.00E+03	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
TURB	TURBIDITY	NTU	---	---	---	---	---	5.00E+00	---	748	741	99.1%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-61-1	URANIUM, TOTAL	PCI/L	6.00E+00	2.00E+01	2.00E+00	---	---	---	4.30E-01	35	35	100.0%	7.30E+00	Exceeds	2.00E+00	Exceeds	Screened out	URANIUM, TOTAL in µg/L will be evaluated against regulatory limits
7440-61-1	URANIUM, TOTAL	µg/L	6.00E+00	3.00E+01	3.00E+00	---	---	---	---	29	29	100.0%	1.09E+01	Exceeds	3.00E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
UVA254SPEC	UV Absorbance at 254 nm Spectrophoto	1/CM	---	---	---	---	---	---	---	6	3	50.0%	---	---	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
UVA254SPEC	UV Absorbance at 254 nm Spectrophoto	Abs/cm	---	---	---	---	---	---	---	2	0	0.0%	---	---	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-62-2	VANADIUM	µg/L	8.60E+00	---	---	5.00E+01	5.00E+00	---	---	94	85	90.4%	8.50E+00	Exceeds	5.00E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels

Appendix A1 - COPC Identification Summary Based on Production Well Data

Notes:
---' = does not apply
MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
PHG = Public Health Goal (CA State Water Resources Control Board)
THQ = Target Hazard Quotient
NL = Notification Level (CA State Water Resources Control Board)
RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL	COPC Evaluation Result	COPC Evaluation Rationale
108-05-4	VINYL ACETATE	µg/L	4.10E+01	---	---	---	---	---	---	6	0	0.0%	---	Screened Out	4.10E+01	---	Screened Out	Less than 5% Detection Frequency
75-01-4	Vinyl Chloride (VC)	µg/L	1.90E-02	5.00E-01	5.00E-02	---	---	---	5.00E-02	620	0	0.0%	---	Screened Out	1.90E-02	---	Screened Out	Less than 5% Detection Frequency
7440-66-6	ZINC	µg/L	6.00E+02	---	---	---	---	5.00E+03	---	35	22	62.9%	2.15E+01	Exceeds	6.00E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL

Appendix A2 - COPC Identification Summary Based on Monitoring Well Data

Notes:
---' = does not apply
MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
PHG = Public Health Goal (CA State Water Resources Control Board)
NL = Notification Level (CA State Water Resources Control Board)
RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
630-20-6	1,1,1,2-TETRACHLORO ETHANE	µg/L	5.70E-01	---	---	---	---	---	---	154	0	0.0%	---	Screened Out	5.70E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
71-55-6	1,1,1-TRICHLOROETHANE	µg/L	8.00E+02	2.00E+01	2.00E+00	---	---	---	1.00E+03	219	53	24.2%	6.21E-01	Exceeds	2.00E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
79-34-5	1,1,2,2-TETRACHLOROETHANE	µg/L	7.60E-02	1.00E+00	1.00E-01	---	---	---	1.00E-01	180	0	0.0%	---	Screened Out	7.60E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
76-13-1	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	µg/L	5.50E+03	1.20E+03	1.20E+02	---	---	---	4.00E+03	170	5	2.9%	2.48E+00	Screened Out	1.20E+02	Screened Out	Screened Out	Less than 5% Detection Frequency
79-00-5	1,1,2-TRICHLOROETHANE	µg/L	4.10E-02	5.00E+00	5.00E-01	---	---	---	3.00E-01	190	2	1.1%	1.37E-01	Screened Out	4.10E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
75-34-3	1,1-DICHLOROETHANE	µg/L	2.80E+00	5.00E+00	5.00E-01	---	---	---	3.00E+00	250	141	56.4%	4.47E+00	Exceeds	5.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
75-35-4	1,1-DICHLOROETHENE	µg/L	2.80E+01	6.00E+00	6.00E-01	---	---	---	1.00E+01	239	112	46.9%	1.47E+00	Exceeds	6.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
563-58-6	1,1-DICHLOROPROPENE	µg/L	---	---	---	---	---	---	---	154	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
87-61-6	1,2,3-TRICHLOROBENZENE	µg/L	7.00E-01	---	---	---	---	---	---	180	0	0.0%	---	Screened Out	7.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
96-18-4	1,2,3-TRICHLOROPROPANE	µg/L	7.50E-04	---	---	5.00E-03	5.00E-04	---	7.00E-04	271	16	5.9%	5.22E-03	Exceeds	5.00E-04	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
526-73-8	1,2,3-TRIMETHYL BENZENE	µg/L	1.00E+00	---	---	---	---	---	---	11	0	0.0%	---	Screened Out	1.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
120-82-1	1,2,4-TRICHLOROBENZENE	µg/L	4.00E-01	5.00E+00	5.00E-01	---	---	---	5.00E+00	180	0	0.0%	---	Screened Out	4.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
95-63-6	1,2,4-TRIMETHYLBENZENE	µg/L	1.50E+00	---	---	3.30E+02	3.30E+01	---	---	159	6	3.8%	2.48E-01	Screened Out	1.50E+00	Screened Out	Screened Out	Less than 5% Detection Frequency
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	µg/L	3.30E-04	2.00E-01	2.00E-02	---	---	---	1.70E-03	178	0	0.0%	---	Screened Out	3.30E-04	Exceeds	Screened Out	Less than 5% Detection Frequency
106-93-4	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	µg/L	7.50E-03	5.00E-02	5.00E-03	---	---	---	1.00E-02	178	6	3.4%	7.20E-03	Screened Out	5.00E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
95-50-1	1,2-DICHLOROBENZENE	µg/L	3.00E+01	6.00E+02	6.00E+01	---	---	---	6.00E+02	185	8	4.3%	6.21E-01	Screened Out	3.00E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
107-06-2	1,2-DICHLOROETHANE	µg/L	1.70E-01	5.00E-01	5.00E-02	---	---	---	4.00E-01	231	75	32.5%	1.12E+01	Exceeds	5.00E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
78-87-5	1,2-DICHLOROPROPANE	µg/L	4.40E-01	5.00E+00	5.00E-01	---	---	---	5.00E-01	198	18	9.1%	2.73E-01	Exceeds	4.40E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
108-70-3	1,3,5-Trichlorobenzene	µg/L	---	---	---	---	---	---	---	11	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-67-8	1,3,5-TRIMETHYLBENZENE (MESITYLENE)	µg/L	1.20E+01	---	---	3.30E+02	3.30E+01	---	---	155	1	0.6%	2.48E-01	Screened Out	1.20E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
99-35-4	1,3,5-TRINITROBENZENE	µg/L	5.90E+01	---	---	---	---	---	---	61	0	0.0%	---	Screened Out	5.90E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
541-73-1	1,3-DICHLOROBENZENE	µg/L	---	---	---	---	---	---	---	180	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
142-28-9	1,3-DICHLOROPROPANE	µg/L	3.70E+01	---	---	---	---	---	---	154	0	0.0%	---	Screened Out	3.70E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
99-65-0	1,3-DINITROBENZENE	µg/L	2.00E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
106-46-7	1,4-DICHLOROBENZENE	µg/L	4.80E-01	5.00E+00	5.00E-01	---	---	---	6.00E+00	190	1	0.5%	6.21E-01	Screened Out	4.80E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
123-91-1	1,4-DIOXANE (P-DIOXANE)	µg/L	4.60E-01	---	---	1.00E+00	1.00E-01	---	---	219	99	45.2%	1.47E+02	Exceeds	1.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
114-26-1	2-(1-METHYLETHOXY) PHENOL METHYLCARBAMATE	µg/L	7.80E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.80E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
68631-49-2	2,2',4,4',5,5'-HEXABROMODIPHENYL ETHER	µg/L	4.00E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
59080-40-9	2,2',4,4',5-5'-Hexabromobiphenyl (HBB)	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
60348-60-9	2,2',4,4',5-PENTABROMODIPHENYL ETHER	µg/L	2.00E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
189084-64-8	2,2',4,4',6-PENTABROMODIPHENYL ETHER	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
5436-43-1	2,2',4,4'-TETRABROMODIPHENYL ETHER	µg/L	2.00E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
594-20-7	2,2-DICHLOROPROPANE	µg/L	---	---	---	---	---	---	---	154	1	0.6%	2.48E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency

Appendix A2 - COPC Identification Summary Based on Monitoring Well Data

Notes:
---' = does not apply
MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
PHG = Public Health Goal (CA State Water Resources Control Board)
NL = Notification Level (CA State Water Resources Control Board)
RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
1746-01-6	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	µg/L	1.20E-07	3.00E-05	3.00E-06	---	---	---	5.00E-08	37	0	0.0%	---	Screened Out	1.20E-07	Exceeds	Screened Out	Less than 5% Detection Frequency
94-82-6	2,4-(Dichlorophenoxy)butyric acid	µg/L	1.20E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.20E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
88-06-2	2,4,6-TRICHLOROPHENOL	µg/L	1.20E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.20E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
118-96-7	2,4,6-TRINITROTOLUENE	µg/L	9.80E-01	---	---	1.00E+00	1.00E-01	---	---	37	0	0.0%	---	Screened Out	1.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
94-75-7	2,4-D (DICHLOROPHENOXYACETIC ACID)	µg/L	1.70E+01	7.00E+01	7.00E+00	---	---	---	2.00E+01	37	0	0.0%	---	Screened Out	7.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
120-83-2	2,4-DICHLOROPHENOL	µg/L	4.60E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.60E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
105-67-9	2,4-DIMETHYLPHENOL	µg/L	3.60E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.60E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
121-14-2	2,4-DINITROTOLUENE	µg/L	2.40E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.40E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
606-20-2	2,6-DINITROTOLUENE	µg/L	4.90E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.90E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
110-75-8	2-CHLOROETHYL VINYL ETHER	µg/L	---	---	---	---	---	---	---	39	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
91-58-7	2-CHLORONAPHTHALENE	µg/L	7.50E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.50E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
95-57-8	2-CHLOROPHENOL	µg/L	9.10E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	9.10E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
95-49-8	2-CHLOROTOLUENE	µg/L	2.40E+01	---	---	1.40E+02	1.40E+01	---	---	154	1	0.6%	2.48E-01	Screened Out	1.40E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
591-78-6	2-HEXANONE	µg/L	3.80E+00	---	---	---	---	---	---	163	3	1.8%	2.48E+00	Screened Out	3.80E+00	Screened Out	Screened Out	Less than 5% Detection Frequency
95-48-7	2-METHYLPHENOL (O-CRESOL)	µg/L	9.30E+01	---	---	---	---	---	---	37	1	2.7%	1.24E-01	Screened Out	9.30E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
88-74-4	2-NITROANILINE	µg/L	1.90E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.90E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
88-75-5	2-NITROPHENOL	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
330-54-1	3-(3,4-DICHLOROPHENYL)-1,1-DIMETHYLUREA	µg/L	3.60E+00	---	---	---	---	---	---	37	2	5.4%	1.24E-01	Exceeds	3.60E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
91-94-1	3,3'-DICHLOROBENZIDINE	µg/L	1.30E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.30E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
51-36-5	3,5-DICHLOROBENZOIC ACID	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
2032-65-7	3,5-DIMETHYL-4-(METHYLTHIO) PHENYL METHYLCARBAMATE	µg/L	---	---	---	---	---	---	---	37	1	2.7%	4.22E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
16655-82-6	3-HYDROXYCARBOFURAN	µg/L	---	---	---	---	---	---	---	37	1	2.7%	3.48E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
534-52-1	4,6-DINITRO-2-METHYLPHENOL	µg/L	1.50E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.50E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
101-55-3	4-BROMOPHENYL PHENYL ETHER	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
59-50-7	4-CHLORO-3-METHYLPHENOL	µg/L	1.40E+02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.40E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
106-43-4	4-CHLOROTOLUENE	µg/L	2.50E+01	---	---	1.40E+02	1.40E+01	---	---	154	1	0.6%	2.48E-01	Screened Out	1.40E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
3744-02-3	4-METHYL-4-PENTEN-2-ONE	µg/L	---	---	---	---	---	---	---	15	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
100-02-7	4-NITROPHENOL	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
83-32-9	ACENAPHTHENE	µg/L	5.30E+01	---	---	---	---	---	---	74	0	0.0%	---	Screened Out	5.30E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
208-96-8	ACENAPHTHYLENE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
75-07-0	ACETALDEHYDE	µg/L	1.90E+00	---	---	---	---	---	---	37	2	5.4%	4.47E-01	Exceeds	1.90E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
34256-82-1	ACETOCHLOR	µg/L	3.50E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.50E+01	Exceeds	Screened Out	Less than 5% Detection Frequency

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MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
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RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
187022-11-3	Acetochlor ethanesulfonic acid	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
194992-44-4	acetochlor oxanilic acid	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
67-64-1	ACETONE	µg/L	1.40E+03	---	---	---	---	---	---	194	45	23.2%	1.24E+01	Exceeds	1.40E+03	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
75-05-8	ACETONITRILE	µg/L	1.30E+01	---	---	---	---	---	---	39	0	0.0%	---	Screened Out	1.30E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
50594-66-6	ACIFLUORFEN	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
107-02-8	ACROLEIN	µg/L	4.20E-03	---	---	---	---	---	---	39	0	0.0%	---	Screened Out	4.20E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
107-13-1	ACRYLONITRILE	µg/L	5.20E-02	---	---	---	---	---	---	85	0	0.0%	---	Screened Out	5.20E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
AGGI	Aggressive Index	NONE	---	---	---	---	---	---	---	37	37	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
15972-60-8	ALACHLOR	µg/L	1.10E+00	2.00E+00	2.00E-01	---	---	---	4.00E+00	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
140939-15-7	ALACHLOR ESA	µg/L	---	2.00E+00	2.00E-01	---	---	---	4.00E+00	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
171262-17-2	ALACHLOR OA	µg/L	---	2.00E+00	2.00E-01	---	---	---	4.00E+00	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
116-06-3	ALDICARB (SULFIDE, SULFOXIDE, AND SULFONE)	µg/L	2.00E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
1646-88-4	ALDICARB SULFONE	µg/L	2.00E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
1646-87-3	ALDICARB SULFOXIDE	µg/L	---	---	---	---	---	---	---	37	1	2.7%	2.48E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
309-00-2	ALDRIN	µg/L	9.20E-04	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	9.20E-04	Exceeds	Screened Out	Less than 5% Detection Frequency
14280-30-9	ALKALINITY, HYDROXIDE (AS CACO3)	µg/L	---	---	---	---	---	---	---	42	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
ALK	ALKALINITY, TOTAL (AS CACO3)	µg/L	---	---	---	---	---	---	---	1	1	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
107-05-1	ALLYL CHLORIDE (3-CHLOROPROPENE)	µg/L	2.10E-01	---	---	---	---	---	---	85	0	0.0%	---	Screened Out	2.10E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
319-84-6	ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	µg/L	7.20E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.20E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
115-29-7	ALPHA ENDOSULFAN	µg/L	1.00E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
ALPHA	ALPHA, GROSS	pCi/L	---	1.50E+01	1.50E+00	---	---	---	---	38	36	94.7%	2.29E+00	Exceeds	1.50E+00	Exceeds	Screened Out	Considered to be made up of Uranium and Radium 226/228.
5103-71-9	ALPHA-CHLORDANE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7429-90-5	ALUMINUM	µg/L	2.00E+03	1.00E+03	1.00E+02	---	---	5.00E+01	6.00E+02	99	84	84.8%	1.54E+02	Exceeds	1.00E+02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
26787-78-0	Amoxicillin	µg/L	---	---	---	---	---	---	---	37	1	2.7%	2.19E-03	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
ANIONSTOTAL	Anions Sum	MEQ/L	---	---	---	---	---	---	---	38	38	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
120-12-7	ANTHRACENE	µg/L	1.80E+02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.80E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
7440-36-0	ANTIMONY	µg/L	7.80E-01	6.00E+00	6.00E-01	---	---	---	7.00E-01	162	91	56.2%	4.97E-01	Exceeds	6.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
7440-38-2	ARSENIC	µg/L	5.20E-02	1.00E+01	1.00E+00	---	---	---	4.00E-03	174	138	79.3%	1.99E+00	Exceeds	5.20E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
22569-72-8	Arsenic(III)	µg/L	---	---	---	---	---	---	---	39	1	2.6%	---	Screened Out	0.00E+00	---	Screened Out	Not applicable. Arsenic toxicity is not differentiated by valence; total arsenic will capture this data since total arsenic should be sum of 3+ and 5+.
17428-41-0	Arsenic(V)	µg/L	---	---	---	---	---	---	---	69	69	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. Arsenic toxicity is not differentiated by valence; total arsenic will capture this data since total arsenic should be sum of 3+ and 5+.
1332-21-4	ASBESTOS	MFL	---	7.00E+00	7.00E-01	---	---	---	7.00E+00	37	0	0.0%	---	Screened Out	7.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
1912-24-9	ATRAZINE	µg/L	3.00E-01	1.00E+00	1.00E-01	---	---	---	1.50E-01	37	1	2.7%	3.73E-02	Screened Out	1.00E-01	Screened Out	Screened Out	Less than 5% Detection Frequency
83905-01-5	Azithromycin	µg/L	---	---	---	---	---	---	---	38	7	18.4%	2.11E-02	Exceeds	0.00E+00	---	Screened Out	A typical prescribed dose of 50 mg/ml equals 5E+07 ug/L; the screening concentration of 2.1E-02 ug/L is several orders of magnitude lower
103-33-3	AZOBENZENE	µg/L	1.20E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.20E-01	Exceeds	Screened Out	A typical prescribed dose of 40 mg/ml equals 4E+07 ug/L; the screening concentration of 3E-02 ug/L is several orders of magnitude lower
7440-39-3	BARIUM	µg/L	3.80E+02	1.00E+03	1.00E+02	---	---	---	2.00E+03	162	162	100.0%	2.28E+02	Exceeds	1.00E+02	Exceeds	To be included in Risk Calculations	A typical cup of coffee contains 285 mg/L caffeine (100 mg per 12 ounces) or 285000 ug/L; the screening concentration of 5.7E-03 ug/L is several orders of magnitude lower
BAROP	BAROMETRIC PRESSURE	MBAR	---	---	---	---	---	---	---	3	3	100.0%	---	Exceeds	0.00E+00	---	Screened Out	A typical prescribed dose of 10 mg/ml equals 1E+07 ug/L; the screening concentration of 9.6E-03 ug/L is several orders of magnitude lower
25057-89-0	BENTAZON	µg/L	5.70E+01	1.80E+01	1.80E+00	---	---	---	2.00E+02	37	0	0.0%	---	Screened Out	1.80E+00	Exceeds	Screened Out	A typical prescribed dose of 20 mg/ml equals 2E+07 ug/L; the screening concentration of 5.0E-04 ug/L is several orders of magnitude lower
71-43-2	BENZENE	µg/L	4.60E-01	1.00E+00	1.00E-01	---	---	---	1.50E-01	206	22	10.7%	3.73E-01	Exceeds	1.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
92-87-5	BENZIDINE	µg/L	1.10E-04	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.10E-04	Exceeds	Screened Out	Less than 5% Detection Frequency
56-55-3	BENZO(A)ANTHRACENE	µg/L	1.20E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.20E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
50-32-8	BENZO(A)PYRENE	µg/L	3.40E-03	2.00E-01	2.00E-02	---	---	---	7.00E-03	37	0	0.0%	---	Screened Out	3.40E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
205-99-2	BENZO(B)FLUORANTHENE	µg/L	3.40E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.40E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
191-24-2	BENZO(G,H,I)PERYLENE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
207-08-9	BENZO(K)FLUORANTHENE	µg/L	3.40E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.40E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
85-68-7	BENZYL BUTYL PHTHALATE	µg/L	1.60E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.60E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
7440-41-7	BERYLLIUM	µg/L	2.50E+00	4.00E+00	4.00E-01	---	---	---	1.00E+00	123	9	7.3%	2.48E-01	Exceeds	4.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
319-85-7	BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	µg/L	2.50E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.50E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
33213-65-9	BETA ENDOSULFAN	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
BETA	BETA, GROSS	pCi/L	---	5.00E+01	5.00E+00	---	---	---	---	38	38	100.0%	5.71E+00	Exceeds	5.00E+00	Exceeds	Screened Out	Gross samples are used as a method to screen for relative levels of radioactivity. A combination of beta emitters that are all below individual screening levels
144-55-8	BICARBONATE	µg/L	---	---	---	---	---	---	---	1	1	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
BOD	BIOLOGIC OXYGEN DEMAND, FIVE DAY	µg/L	---	---	---	---	---	---	---	37	2	5.4%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
111-91-1	BIS(2-CHLOROETHOXY) METHANE	µg/L	5.90E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	5.90E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
111-44-4	BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	µg/L	1.40E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.40E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
108-60-1	BIS(2-CHLOROISOPROPYL) ETHER	µg/L	7.10E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.10E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	µg/L	5.60E+00	4.00E+00	4.00E-01	---	---	---	1.20E+01	37	2	5.4%	3.48E+00	Exceeds	4.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
80-05-7	BISPHENOL A	µg/L	7.70E+01	---	---	---	---	---	---	37	18	48.6%	8.69E-01	Exceeds	7.70E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
7440-42-8	BORON	µg/L	4.00E+02	---	---	1.00E+03	1.00E+02	---	---	60	60	100.0%	2.48E+02	Exceeds	1.00E+02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
314-40-9	BROMACIL	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
15541-45-4	Bromate	µg/L	1.10E-01	1.00E+01	1.00E+00	---	---	---	1.00E-01	37	4	10.8%	6.46E-01	Exceeds	1.10E-01	Exceeds	Screened Out	Disinfection byproduct

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
24959-67-9	BROMIDE	µg/L	---	---	---	---	---	---	---	44	44	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
108-86-1	BROMOBENZENE	µg/L	6.20E+00	---	---	---	---	---	---	154	0	0.0%	---	Screened Out	6.20E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
5589-96-8	Bromochloroacetic Acid (BCAA)	µg/L	---	---	---	---	---	---	---	37	2	5.4%	5.22E-01	Exceeds	0.00E+00	---	Screened Out	Disinfection byproduct
74-97-5	BROMOCHLOROMETHANE	µg/L	8.30E+00	---	---	---	---	---	---	190	0	0.0%	---	Screened Out	8.30E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
75-27-4	BROMODICHLOROMETHANE	µg/L	1.30E-01	---	---	---	---	---	---	205	51	24.9%	1.24E+00	Exceeds	1.30E-01	Exceeds	Screened Out	Disinfection byproduct
75-25-2	BROMOFORM	µg/L	3.30E+00	---	---	---	---	---	---	180	13	7.2%	1.86E+00	Exceeds	3.30E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
74-83-9	BROMOMETHANE	µg/L	7.50E-01	---	---	---	---	---	---	180	0	0.0%	---	Screened Out	7.50E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
23184-66-9	BUTACHLOR	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7440-43-9	CADMIUM	µg/L	9.20E-01	5.00E+00	5.00E-01	---	---	---	4.00E-02	152	77	50.7%	2.48E-01	Exceeds	5.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
58-08-2	CAFFEINE	µg/L	---	---	---	---	---	---	---	38	18	47.4%	5.96E-03	Exceeds	0.00E+00	---	Screened Out	A typical cup of coffee contains 285 mg/L caffeine (100 mg per 12 ounces) or 285000 ug/L; the screening concentration of 5.96E-03 ug/L is several orders of magnitude lower
7440-70-2	CALCIUM	µg/L	---	---	---	---	---	---	---	117	117	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
298-46-4	CARBAMAZEPINE	µg/L	---	---	---	---	---	---	---	37	6	16.2%	9.69E-04	Exceeds	0.00E+00	---	Screened Out	Screening value of ug/L is several orders of magnitude below the prescribed dose of 100 mg
1563-66-2	CARBOFURAN	µg/L	9.40E+00	1.80E+01	1.80E+00	---	---	---	1.70E+00	37	0	0.0%	---	Screened Out	1.80E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
75-15-0	CARBON DISULFIDE	µg/L	8.10E+01	---	---	1.60E+02	1.60E+01	---	---	180	9	5.0%	2.48E+00	Exceeds	1.60E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
56-23-5	CARBON TETRACHLORIDE	µg/L	4.60E-01	5.00E-01	5.00E-02	---	---	---	1.00E-01	204	38	18.6%	1.32E-01	Exceeds	5.00E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
3812-32-6	CARBONATE (AS CO3)	µg/L	---	---	---	---	---	---	---	67	1	1.5%	---	Screened Out	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
TOTCATIONS	Cation Sum	MEQ/L	---	---	---	---	---	---	---	38	38	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
14866-68-3	CHLORATE	µg/L	---	---	---	8.00E+02	8.00E+01	---	---	37	21	56.8%	3.48E+02	Exceeds	8.00E+01	Exceeds	Screened Out	Disinfection byproduct
57-74-9	CHLORDANE	µg/L	---	1.00E-01	1.00E-02	---	---	---	3.00E-02	37	0	0.0%	---	Screened Out	1.00E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
16887-00-6	CHLORIDE (AS CL)	µg/L	---	---	---	---	---	2.50E+05	---	172	172	100.0%	1.81E+04	Exceeds	0.00E+00	---	Screened Out	Below Secondary MCL which is aesthetic only. This requires voluntary testing only under EPA regulations although it is enforceable in California in Community Water Systems. Below health-based limit for acute health effects.
7782-50-5	CHLORINE	µg/L	3.00E-02	---	---	---	---	---	---	54	22	40.7%	1.12E+02	Exceeds	3.00E-02	Exceeds	Screened Out	Screening value of 111 ug/L is below the Maximum Residual Disinfectant Level of 4 mg/L
14998-27-7	Chlorite (Sodium Salt)	µg/L	---	1.00E+03	1.00E+02	---	---	---	5.00E+01	37	0	0.0%	---	Screened Out	1.00E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
79-11-8	CHLOROACETIC ACID	µg/L	---	---	---	---	---	---	---	37	1	2.7%	7.20E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-90-7	CHLOROBENZENE	µg/L	7.80E+00	7.00E+01	7.00E+00	---	---	---	7.00E+01	190	3	1.6%	6.21E-01	Screened Out	7.00E+00	Screened Out	Screened Out	Less than 5% Detection Frequency
75-00-3	CHLOROETHANE	µg/L	2.10E+03	---	---	---	---	---	---	186	7	3.8%	1.24E+00	Screened Out	2.10E+03	Screened Out	Screened Out	Less than 5% Detection Frequency
67-66-3	CHLOROFORM	µg/L	2.20E-01	---	---	---	---	---	---	246	167	67.9%	6.71E+00	Exceeds	2.20E-01	Exceeds	Screened Out	Disinfection byproduct
74-87-3	CHLOROMETHANE	µg/L	1.90E+01	---	---	---	---	---	---	204	18	8.8%	2.48E+00	Exceeds	1.90E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
1897-45-6	CHLOROTHALONIL	µg/L	2.20E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.20E+01	Exceeds	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
18540-29-9	CHROMIUM, HEXAVALENT	µg/L	3.50E-02	1.00E+01	1.00E+00	---	---	---	2.00E-02	242	207	85.5%	1.66E+01	Exceeds	3.50E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7440-47-3	CHROMIUM, TOTAL	µg/L	3.50E-02	5.00E+01	5.00E+00	---	---	---	---	270	237	87.8%	1.68E+01	Exceeds	3.50E-02	Exceeds	Screened Out	Chromium (VI) will be evaluated in the HHRA
218-01-9	CHRYSENE	µg/L	3.40E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.40E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
85721-33-1	Ciprofloxacin	µg/L	---	---	---	---	---	---	---	38	18	47.4%	1.09E-02	Exceeds	0.00E+00	---	Screened Out	A typical prescribed dose of 10 mg/ml equals 1E+07 ug/L; the screening concentration of 1.09E-02 ug/L is several orders of magnitude lower
156-59-2	CIS-1,2-DICHLOROETHYLENE	µg/L	3.60E+00	6.00E+00	6.00E-01	---	---	---	1.00E+02	243	150	61.7%	3.97E+00	Exceeds	6.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
10061-01-5	CIS-1,3-DICHLOROPROPENE	µg/L	---	---	---	---	---	---	---	180	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7440-48-4	COBALT	µg/L	6.00E-01	---	---	---	---	---	---	159	120	75.5%	2.48E+00	Exceeds	6.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
COLIF	COLIFORM	MPN/100mL	---	---	---	---	---	---	---	37	3	8.1%	5.96E+02	Exceeds	0.00E+00	---	Screened Out	Microbial Indicator
COLOR	COLOR	COLOR UNIT	---	---	---	---	---	1.50E+01	---	37	1	2.7%	7.45E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
GIS-210-011	CONDUCTIVITY	µS/cm	---	---	---	---	---	---	---	111	111	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-50-8	COPPER	µg/L	8.00E+01	1.30E+03	1.30E+02	---	---	1.00E+03	3.00E+02	173	169	97.7%	7.70E+00	Exceeds	8.00E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
57-12-5	CYANIDE	µg/L	1.50E-01	1.50E+02	1.50E+01	---	---	---	1.50E+02	37	3	8.1%	6.46E+00	Exceeds	1.50E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
110-82-7	CYCLOHEXANE	µg/L	1.30E+03	---	---	---	---	---	---	26	0	0.0%	---	Screened Out	1.30E+03	Exceeds	Screened Out	Less than 5% Detection Frequency
121-82-4	Cyclonite	µg/L	7.00E-01	---	---	3.00E-01	3.00E-02	---	---	37	0	0.0%	---	Screened Out	3.00E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
25155-15-1	CYMENE	µg/L	---	---	---	---	---	---	---	105	1	1.0%	2.48E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
75-99-0	DALAPON	µg/L	6.00E+01	2.00E+02	2.00E+01	---	---	---	7.90E+02	37	1	2.7%	1.47E-01	Screened Out	2.00E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
METABOLITES	DCPA ACID METABOLITES (A)	µg/L	---	---	---	---	---	---	---	37	2	5.4%	1.89E-01	Exceeds	0.00E+00	---	Screened Out	not a constituent
319-86-8	DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
DENSITY	DENSITY	g/cm3	---	---	---	---	---	---	---	3	3	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
DEPTH	Depth of Sample	M	---	---	---	---	---	---	---	24	24	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. Not a qater quality constituent.
333-41-5	DIAZINON	µg/L	1.00E+00	---	---	1.20E+00	1.20E-01	---	---	37	0	0.0%	---	Screened Out	1.20E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
53-70-3	DIBENZ(A,H)ANTHRACENE	µg/L	3.40E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.40E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
631-64-1	Dibromoacetic Acid	µg/L	---	---	---	---	---	---	---	37	9	24.3%	6.46E-01	Exceeds	0.00E+00	---	Screened Out	Disinfection byproduct
124-48-1	DIBROMOCHLOROMETHANE	µg/L	8.70E-01	---	---	---	---	---	---	180	16	8.9%	1.79E+00	Exceeds	8.70E-01	Exceeds	Screened Out	Disinfection byproduct
74-95-3	DIBROMOMETHANE	µg/L	8.30E-01	---	---	---	---	---	---	154	1	0.6%	2.48E-01	Screened Out	8.30E-01	Screened Out	Screened Out	Less than 5% Detection Frequency
1918-00-9	DICAMBA	µg/L	5.70E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	5.70E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
3400-09-7	Dichloramine	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
79-43-6	DICHLOROACETIC ACID	µg/L	1.50E+00	---	---	---	---	---	---	37	8	21.6%	3.97E+00	Exceeds	1.50E+00	Exceeds	Screened Out	Disinfection byproduct
75-71-8	DICHLORODIFLUOROMETHANE	µg/L	2.00E+01	---	---	1.00E+03	1.00E+02	---	---	246	132	53.7%	6.61E+00	Exceeds	2.00E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
120-36-5	DICHLOROPROP	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
60-57-1	DIELDRIN	µg/L	1.80E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.80E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
60-29-7	DIETHYL ETHER (ETHYL ETHER)	µg/L	3.90E+02	---	---	---	---	---	---	48	4	8.3%	2.09E-01	Exceeds	3.90E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
84-66-2	DIETHYL PHTHALATE	µg/L	1.50E+03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.50E+03	Exceeds	Screened Out	Less than 5% Detection Frequency
60-51-5	DIMETHOATE	µg/L	4.00E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
131-11-3	DIMETHYL PHTHALATE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
84-74-2	DI-N-BUTYL PHTHALATE	µg/L	9.00E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	9.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
117-84-0	DI-N-OCTYLPHTHALATE	µg/L	2.00E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
88-85-7	DINOSEB	µg/L	1.50E+00	7.00E+00	7.00E-01	---	---	---	1.40E+01	37	0	0.0%	---	Screened Out	7.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
123-79-5	DIOCTYL ADIPATE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
2764-72-9	DIQUAT	µg/L	---	2.00E+01	2.00E+00	---	---	---	1.50E+01	37	0	0.0%	---	Screened Out	2.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
DISS_OXYGEN	DISSOLVED OXYGEN	µg/L	---	---	---	---	---	---	---	158	158	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
1031-07-8	ENDOSULFAN SULFATE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
145-73-3	ENDOTHAL	µg/L	3.80E+01	1.00E+02	1.00E+01	---	---	---	9.40E+01	37	0	0.0%	---	Screened Out	1.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
72-20-8	ENDRIN	µg/L	2.30E-01	2.00E+00	2.00E-01	---	---	---	1.80E+00	37	0	0.0%	---	Screened Out	2.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
7421-93-4	ENDRIN ALDEHYDE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
ECOLI	Escherichia coli	MPN/100mL	---	---	---	---	---	---	---	37	2	5.4%	1.24E+01	Exceeds	0.00E+00	---	Screened Out	Microbial Indicator
64-17-5	ETHANOL	µg/L	---	---	---	---	---	---	---	91	2	2.2%	1.24E+03	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
563-12-2	ETHION	µg/L	4.30E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.30E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
97-63-2	ETHYL METHACRYLATE	µg/L	6.30E+01	---	---	---	---	---	---	85	0	0.0%	---	Screened Out	6.30E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
100-41-4	ETHYLBENZENE	µg/L	1.50E+00	3.00E+02	3.00E+01	---	---	---	3.00E+02	181	5	2.8%	6.21E-01	Screened Out	1.50E+00	Screened Out	Screened Out	Less than 5% Detection Frequency
107-21-1	ETHYLENE GLYCOL	µg/L	4.00E+03	---	---	1.40E+04	1.40E+03	---	---	37	1	2.7%	2.04E+03	Screened Out	1.40E+03	Exceeds	Screened Out	Less than 5% Detection Frequency
FECCOLIFORM	FECAL COLIFORM	MPN/100mL	---	---	---	---	---	---	---	37	2	5.4%	1.24E+01	Exceeds	0.00E+00	---	Screened Out	Microbial Indicator
206-44-0	FLUORANTHENE	µg/L	8.00E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	8.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
86-73-7	FLUORENE	µg/L	2.90E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.90E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
16984-48-8	FLUORIDE	µg/L	8.00E+01	2.00E+03	2.00E+02	---	---	---	1.00E+03	44	43	97.7%	1.37E+02	Exceeds	8.00E+01	Exceeds	Screened Out	Less than California Water Fluoridation Standards control range of 0.6 mg/L to 1.2 mg/L
944-22-9	Fonofos	µg/L	2.40E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.40E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
50-00-0	FORMALDEHYDE	µg/L	4.30E-01	---	---	1.00E+02	1.00E+01	---	---	37	19	51.4%	3.48E+00	Exceeds	4.30E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
58-89-9	GAMMA BHC (LINDANE)	µg/L	4.20E-02	2.00E-01	2.00E-02	---	---	---	3.20E-02	37	0	0.0%	---	Screened Out	2.00E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
GASCOMP	GASOLINE COMPONENTS	µg/L	---	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
GRO	Gasoline Range Organics	µg/L	1.30E+02	---	---	---	---	---	---	37	5	13.5%	2.98E+01	Exceeds	1.30E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
25812-30-0	GEMFIBROZIL	µg/L	---	---	---	---	---	---	---	37	2	5.4%	1.24E-04	Exceeds	0.00E+00	---	Screened Out	A typical prescribed dose of 20 mg/ml equals 2E+07 ug/L; the screening concentration of 1.24E-04 ug/L is several orders of magnitude lower
107-22-2	GLYOXAL	µg/L	---	---	---	---	---	---	---	38	1	2.6%	2.48E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1071-83-6	GLYPHOSATE	µg/L	2.00E+02	7.00E+02	7.00E+01	---	---	---	9.00E+02	37	0	0.0%	---	Screened Out	7.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
76-44-8	HEPTACHLOR	µg/L	1.40E-03	1.00E-02	1.00E-03	---	---	---	8.00E-03	37	4	10.8%	1.47E-03	Exceeds	1.00E-03	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
1024-57-3	HEPTACHLOR EPOXIDE	µg/L	1.40E-03	1.00E-02	1.00E-03	---	---	---	6.00E-03	37	0	0.0%	---	Screened Out	1.00E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
HPC	Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	38	33	86.8%	1.42E+03	Exceeds	0.00E+00	---	Screened Out	Microbial Indicator
118-74-1	HEXACHLOROBENZENE	µg/L	9.80E-03	1.00E+00	1.00E-01	---	---	---	3.00E-02	74	5	6.8%	6.21E-03	Exceeds	9.80E-03	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
87-68-3	HEXACHLOROBUTADIENE	µg/L	1.40E-01	---	---	---	---	---	---	102	0	0.0%	---	Screened Out	1.40E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
77-47-4	HEXACHLOROCYCLOPENTADIENE	µg/L	4.10E-02	5.00E+01	5.00E+00	---	---	---	2.00E+00	74	0	0.0%	---	Screened Out	4.10E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
67-72-1	HEXACHLOROETHANE	µg/L	3.30E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.30E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
302-01-2	HYDRAZINE	µg/L	1.10E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.10E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
15687-27-1	IBUPROFEN	µg/L	---	---	---	---	---	---	---	37	4	10.8%	7.45E-04	Exceeds	0.00E+00	---	Screened Out	A typical prescribed dose of 250 mg/ml equals 2.5E+08 ug/L; the screening concentration of 7.45E-04 ug/L is several orders of magnitude lower
193-39-5	INDENO(1,2,3-C,D)PYRENE	µg/L	3.40E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.40E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
20461-54-5	IODIDE (AS I)	µg/L	---	---	---	---	---	---	---	38	13	34.2%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
74-88-4	IODOMETHANE (METHYL IODIDE)	µg/L	---	---	---	---	---	---	---	86	1	1.2%	2.48E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7439-89-6	IRON	µg/L	1.40E+03	---	---	---	---	3.00E+02	---	220	110	50.0%	1.13E+03	Exceeds	1.40E+03	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
78-59-1	ISOPHORONE	µg/L	7.80E+01	---	---	---	---	---	---	37	1	2.7%	5.71E-01	Screened Out	7.80E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
67-63-0	ISOPROPANOL	µg/L	4.10E+01	---	---	---	---	---	---	37	3	8.1%	1.24E+03	Exceeds	4.10E+01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
108-20-3	ISOPROPYL ETHER	µg/L	1.50E+02	---	---	---	---	---	---	46	0	0.0%	---	Screened Out	1.50E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
98-82-8	ISOPROPYLBENZENE (CUMENE)	µg/L	4.50E+01	---	---	7.70E+02	7.70E+01	---	---	180	0	0.0%	---	Screened Out	4.50E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
LAI20	Langelier Index at 20 C	NONE	---	---	---	---	---	---	---	38	38	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
LAI60	Langelier Index at 60 degrees C	NONE	---	---	---	---	---	---	---	38	38	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7439-92-1	LEAD	µg/L	1.50E+01	1.50E+01	1.50E+00	---	---	---	2.00E-01	161	96	59.6%	2.98E+00	Exceeds	1.50E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7439-93-2	LITHIUM	µg/L	4.00E+00	---	---	---	---	---	---	65	48	73.8%	---	Exceeds	4.00E+00	Exceeds	Screened Out	Not applicable. General water quality parameter.
179601-23-1	M, P XYLENES	µg/L	---	---	---	---	---	---	---	180	4	2.2%	6.21E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
7439-95-4	MAGNESIUM	µg/L	---	---	---	---	---	---	---	249	249	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7439-96-5	MANGANESE	µg/L	4.30E+01	---	---	5.00E+02	5.00E+01	5.00E+01	---	181	149	82.3%	1.13E+02	Exceeds	4.30E+01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
7439-97-6	MERCURY	µg/L	6.30E-02	2.00E+00	2.00E-01	---	---	---	1.20E+00	94	46	48.9%	2.04E-01	Exceeds	6.30E-02	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
76-99-3	Methadone	µg/L	---	---	---	---	---	---	---	37	1	2.7%	1.24E-04	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
67-56-1	METHANOL	µg/L	2.00E+03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.00E+03	Exceeds	Screened Out	Less than 5% Detection Frequency
16752-77-5	Methomyl	µg/L	5.00E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	5.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
72-43-5	METHOXYCHLOR	µg/L	3.70E+00	3.00E+01	3.00E+00	---	---	---	9.00E-02	37	0	0.0%	---	Screened Out	3.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
79-20-9	METHYL ACETATE	µg/L	2.00E+03	---	---	---	---	---	---	26	0	0.0%	---	Screened Out	2.00E+03	Exceeds	Screened Out	Less than 5% Detection Frequency
78-93-3	METHYL ETHYL KETONE (2-BUTANONE)	µg/L	5.60E+02	---	---	---	---	---	---	165	3	1.8%	3.97E+00	Screened Out	5.60E+02	Screened Out	Screened Out	Less than 5% Detection Frequency
108-10-1	METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	µg/L	6.30E+02	---	---	1.20E+02	1.20E+01	---	---	164	0	0.0%	---	Screened Out	1.20E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
80-62-6	METHYL METHACRYLATE	µg/L	1.40E+02	---	---	---	---	---	---	85	1	1.2%	6.21E-01	Screened Out	1.40E+02	Screened Out	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
126-98-7	METHYLACRYLONITRILE	µg/L	1.90E-01	---	---	---	---	---	---	85	0	0.0%	---	Screened Out	1.90E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
108-87-2	METHYLCYCLOHEXANE	µg/L	---	---	---	---	---	---	---	26	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
MBAS	METHYLENE BLUE ACTIVE SUBSTANCES	µg/L	---	---	---	---	---	5.00E+02	---	37	2	5.4%	1.81E+01	Exceeds	0.00E+00	---	Screened Out	Not a single constituent, inclding a group of foaming agents. Below Secondary MCL which is aesthetic only.
75-09-2	METHYLENE CHLORIDE	µg/L	1.10E+01	5.00E+00	5.00E-01	---	---	---	4.00E+00	205	23	11.2%	6.46E-02	Exceeds	5.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
51218-45-2	METOLACHLOR	µg/L	2.70E+02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.70E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
171118-09-5	METOLACHLOR ESA	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
152019-73-3	Metolachlor oxanilic acid	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
21087-64-9	METRIBUZIN	µg/L	4.90E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.90E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
2212-67-1	MOLINATE	µg/L	3.00E+00	2.00E+01	2.00E+00	---	---	---	1.00E+00	37	0	0.0%	---	Screened Out	2.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
7439-98-7	MOLYBDENUM	µg/L	1.00E+01	---	---	---	---	---	---	145	144	99.3%	4.22E+01	Exceeds	1.00E+01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
79-08-3	MONOBROMOACETIC ACID	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
10599-90-3	Monochloramine	µg/L	2.00E+02	---	---	---	---	---	---	37	1	2.7%	3.73E+01	Screened Out	2.00E+02	Screened Out	Screened Out	Less than 5% Detection Frequency
57-27-2	Morphine	µg/L	---	---	---	---	---	---	---	37	2	5.4%	2.48E-04	Exceeds	0.00E+00	---	Screened Out	Lowest prescribed dose is 2E+06 ug/L; screening concentration of 2.48E-04 ug/L is several orders of magnitude lower
91-20-3	NAPHTHALENE	µg/L	1.70E-01	---	---	1.70E+01	1.70E+00	---	---	156	3	1.9%	2.48E+00	Screened Out	1.70E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
104-51-8	N-BUTYLBENZENE	µg/L	1.00E+02	---	---	2.60E+02	2.60E+01	---	---	155	1	0.6%	2.48E-01	Screened Out	2.60E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
7440-02-0	NICKEL	µg/L	3.90E+01	1.00E+02	1.00E+01	---	---	---	1.20E+01	174	172	98.9%	4.47E+00	Exceeds	1.00E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
98-95-3	NITROBENZENE	µg/L	1.40E-01	---	---	---	---	---	---	61	0	0.0%	---	Screened Out	1.40E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
7664-41-7	NITROGEN, AMMONIA (AS N)	µg/L	---	---	---	---	---	---	---	37	1	2.7%	2.73E+01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
14797-55-8 [Combined Nitrate as N and as NO3]	NITROGEN, NITRATE (AS N)	µg/L	---	1.00E+04	1.00E+03	---	---	---	1.00E+04	245	230	93.9%	7.70E+03	Exceeds	1.00E+03	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
NN	NITROGEN, NITRATE-NITRITE	µg/L	---	1.00E+04	1.00E+03	---	---	---	1.00E+04	38	35	92.1%	3.73E+03	Exceeds	1.00E+03	Exceeds	Screened out	Evaluated separately.
14797-65-0 [Combined Nitrite as N and as NO2]	NITROGEN, NITRITE	µg/L	---	1.00E+03	1.00E+02	---	---	---	1.00E+03	155	35	22.6%	3.23E+01	Exceeds	1.00E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
10595-95-6	NITROSOMETHYLETHYLAMINE	µg/L	7.10E-04	---	---	---	---	---	---	77	0	0.0%	---	Screened Out	7.10E-04	Exceeds	Screened Out	Less than 5% Detection Frequency
55-18-5	N-NITROSODIETHYLAMINE	µg/L	1.70E-04	---	---	1.00E-02	1.00E-03	---	---	84	18	21.4%	1.07E-03	Exceeds	1.70E-04	Exceeds	Screened Out	Disinfection byproduct
62-75-9	N-NITROSODIMETHYLAMINE	µg/L	1.10E-04	---	---	1.00E-02	1.00E-03	---	3.00E-03	113	15	13.3%	1.51E-03	Exceeds	1.10E-04	Exceeds	Screened Out	Disinfection byproduct
924-16-3	N-NITROSO-DI-N-BUTYLAMINE	µg/L	2.70E-03	---	---	---	---	---	---	80	5	6.3%	6.95E-04	Exceeds	2.70E-03	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
621-64-7	N-NITROSODI-N-PROPYLAMINE	µg/L	1.10E-02	---	---	1.00E-02	1.00E-03	---	---	78	1	1.3%	4.47E-04	Screened Out	1.00E-03	Screened Out	Screened Out	Less than 5% Detection Frequency
86-30-6	N-NITROSODIPHENYLAMINE	µg/L	1.20E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.20E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
59-89-2	N-NITROSOMORPHOLINE	µg/L	1.20E-02	---	---	---	---	---	---	54	40	74.1%	7.70E-03	Exceeds	1.20E-02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
100-75-4	N-NITROSOPIPERIDINE	µg/L	8.20E-03	---	---	---	---	---	---	77	0	0.0%	---	Screened Out	8.20E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
930-55-2	N-NITROSOPYRROLIDINE	µg/L	3.70E-02	---	---	---	---	---	---	77	0	0.0%	---	Screened Out	3.70E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
25154-52-3	NONYLPHENOL	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
103-65-1	N-PROPYLBENZENE	µg/L	6.60E+01	---	---	2.60E+02	2.60E+01	---	---	154	1	0.6%	2.48E-01	Screened Out	2.60E+01	Screened Out	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
2691-41-0	OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZOCINE	µg/L	1.00E+02	---	---	---	---	---	---	37	2	5.4%	1.24E-01	Exceeds	1.00E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
OILGREASE	OIL & GREASE, TOTAL REC	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Not applicable. Cannot be assessed and is covered by detailed hydrocarbon analysis.
23135-22-0	Oxamyl	µg/L	5.00E+01	5.00E+01	5.00E+00	---	---	---	2.60E+01	37	0	0.0%	---	Screened Out	5.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
ORP	OXIDATION-REDUCTION POTENTIAL	MILLIVOLTS	---	---	---	---	---	---	---	149	149	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7782-44-7	OXYGEN	µg/L	---	---	---	---	---	---	---	42	37	88.1%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
95-47-6	O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	1.90E+01	---	---	---	---	---	---	183	7	3.8%	6.21E-01	Screened Out	1.90E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
72-54-8	P,P'-DDD	µg/L	3.20E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	3.20E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
72-55-9	P,P'-DDE	µg/L	4.60E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.60E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
50-29-3	P,P'-DDT	µg/L	2.30E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.30E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
1910-42-5	PARAQUAT	µg/L	9.00E+00	---	---	---	---	---	---	37	3	8.1%	4.97E-01	Exceeds	9.00E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
1336-36-3	PCB, TOTAL	µg/L	4.40E-02	5.00E-01	5.00E-02	---	---	---	9.00E-02	37	0	0.0%	---	Screened Out	4.40E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
12674-11-2	PCB-1016 (AROCLOR 1016)	µg/L	1.40E-01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.40E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
11104-28-2	PCB-1221 (AROCLOR 1221)	µg/L	4.70E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.70E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
11141-16-5	PCB-1232 (AROCLOR 1232)	µg/L	4.70E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	4.70E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
53469-21-9	PCB-1242 (AROCLOR 1242)	µg/L	7.80E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.80E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
12672-29-6	PCB-1248 (AROCLOR 1248)	µg/L	7.80E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.80E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
11097-69-1	PCB-1254 (AROCLOR 1254)	µg/L	7.80E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.80E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
11096-82-5	PCB-1260 (AROCLOR 1260)	µg/L	7.80E-03	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	7.80E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
99-87-6	P-CYMENE (P-ISOPROPYLTOLUENE)	µg/L	---	---	---	---	---	---	---	50	1	2.0%	1.27E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
76-01-7	PENTACHLOROETHANE	µg/L	6.50E-01	---	---	---	---	---	---	50	0	0.0%	---	Screened Out	6.50E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
87-86-5	PENTACHLOROPHENOL	µg/L	4.10E-02	1.00E+00	1.00E-01	---	---	---	3.00E-01	74	0	0.0%	---	Screened Out	4.10E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
14797-73-0	PERCHLORATE	µg/L	1.40E+00	6.00E+00	6.00E-01	---	---	---	1.00E+00	177	32	18.1%	1.79E+01	Exceeds	6.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
PH	PH	pH UNITS	---	---	---	---	---	8.50E+00	---	211	211	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
85-01-8	PHENANTHRENE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
108-95-2	PHENOL	µg/L	5.80E+02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	5.80E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
98059-61-1	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)	µg/L	---	---	---	---	---	---	---	43	38	88.4%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
14265-44-2	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS PO4)	µg/L	---	---	---	---	---	---	---	74	73	98.6%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
1918-02-1	PICLORAM	µg/L	1.40E+02	5.00E+02	5.00E+01	---	---	---	5.00E+02	37	0	0.0%	---	Screened Out	5.00E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
7440-09-7	POTASSIUM	µg/L	---	---	---	---	---	---	---	215	215	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7287-19-6	PROMETRYN	µg/L	6.00E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	6.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
1918-16-7	PROPACHLOR	µg/L	2.50E+01	---	---	9.00E+01	9.00E+00	---	---	74	0	0.0%	---	Screened Out	9.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
129-00-0	PYRENE	µg/L	1.20E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.20E+01	Exceeds	Screened Out	Less than 5% Detection Frequency

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CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
13982-63-3	RADIUM-226	pCi/L	---	---	---	---	---	---	5.00E-02	38	19	50.0%	8.97E-02	Exceeds	0.00E+00	---	Screened Out	EPA Radionuclides Rule: Combined radium 226/228 below 5 pCi/L
425	Radium-226/228	pCi/L	---	5.00E+00	5.00E-01	---	---	---	---	21	21	100.0%	8.97E-02	Exceeds	5.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
15262-20-1	RADIUM-228	pCi/L	---	---	---	---	---	---	1.90E-02	38	10	26.3%	5.79E-02	Exceeds	0.00E+00	---	Screened Out	EPA Radionuclides Rule: Combined radium 226/228 below 5 pCi/L
RESIST	RESISTIVITY	ohm-cm	---	---	---	---	---	---	---	3	3	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
69-72-7	Salicylic Acid	µg/L	---	---	---	---	---	---	---	38	14	36.8%	3.97E-02	Exceeds	0.00E+00	---	Screened Out	A typical prescribed dose of 250 mg/ml equals 2.5E+08 ug/L; the screening concentration of 3.97E-02 ug/L is several orders of magnitude lower
SAL	SALINITY	PSU	---	---	---	---	---	---	---	3	3	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
135-98-8	SEC-BUTYLBENZENE	µg/L	2.00E+02	---	---	2.60E+02	2.60E+01	---	---	154	0	0.0%	---	Screened Out	2.60E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
7782-49-2	SELENIUM	µg/L	1.00E+01	5.00E+01	5.00E+00	---	---	---	3.00E+01	163	121	74.2%	8.44E+00	Exceeds	5.00E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
SETSOL	Settleable solids	mL/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
63-25-2	SEVIN (CARBARYL)	µg/L	1.80E+02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	1.80E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
7631-86-9	SILICA	µg/L	---	---	---	---	---	---	---	54	54	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-21-3	SILICON	µg/L	---	---	---	---	---	---	---	1	1	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-22-4	SILVER	µg/L	9.40E+00	---	---	---	---	1.00E+02	---	144	45	31.3%	1.24E+00	Exceeds	9.40E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
93-72-1	SILVEX (2,4,5-TP)	µg/L	1.10E+01	5.00E+01	5.00E+00	---	---	---	3.00E+00	37	0	0.0%	---	Screened Out	5.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
122-34-9	SIMAZINE	µg/L	6.10E-01	4.00E+00	4.00E-01	---	---	---	4.00E+00	37	0	0.0%	---	Screened Out	4.00E-01	Exceeds	Screened Out	Less than 5% Detection Frequency
7440-23-5	SODIUM	µg/L	---	---	---	---	---	---	---	182	182	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
SC	SPECIFIC CONDUCTANCE	µS/cm	---	---	---	---	---	9.00E+02	---	87	87	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
10098-97-2	STRONTIUM-90	pCi/L	---	8.00E+00	8.00E-01	---	---	---	3.50E-01	38	34	89.5%	2.43E-01	Exceeds	8.00E-01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
100-42-5	STYRENE	µg/L	1.20E+02	1.00E+02	1.00E+01	---	---	---	5.00E-01	180	1	0.6%	6.95E-02	Screened Out	1.00E+01	Screened Out	Screened Out	Less than 5% Detection Frequency
14808-79-8	SULFATE (AS SO4)	µg/L	---	---	---	---	---	2.50E+05	---	148	148	100.0%	2.46E+04	Exceeds	0.00E+00	---	Screened Out	Below Secondary MCL. No other screening levels.
18496-25-8	SULFIDE, DISSOLVED	µg/L	---	---	---	---	---	---	---	82	1	1.2%	5.22E+03	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
98-06-6	T-BUTYLBENZENE	µg/L	6.90E+01	---	---	2.60E+02	2.60E+01	---	---	154	0	0.0%	---	Screened Out	2.60E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
TEMP	TEMPERATURE	DEG C	---	---	---	---	---	---	---	175	175	100.0%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
5902-51-2	TERBACIL	µg/L	2.50E+01	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.50E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
13071-79-9	TERBUFOS	µg/L	2.40E-02	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.40E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
56070-16-7	TERBUFOS SULFONE	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
994-05-8	TERT-AMYL METHYL ETHER	µg/L	---	---	---	---	---	---	---	57	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
75-65-0	TERT-BUTYL ALCOHOL	µg/L	---	---	---	1.20E+01	1.20E+00	---	---	46	1	2.2%	6.21E+00	Screened Out	1.20E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
637-92-3	TERT-BUTYL ETHYL ETHER	µg/L	---	---	---	---	---	---	---	57	1	1.8%	4.97E-01	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1634-04-4	TERT-BUTYL METHYL ETHER	µg/L	1.40E+01	1.30E+01	1.30E+00	---	---	5.00E+00	1.30E+01	179	9	5.0%	1.54E+00	Exceeds	1.30E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
127-18-4	TETRACHLOROETHYLENE(PCE)	µg/L	4.10E+00	5.00E+00	5.00E-01	---	---	---	6.00E-02	253	198	78.3%	3.33E+01	Exceeds	5.00E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
109-99-9	TETRAHYDROFURAN	µg/L	3.40E+02	---	---	---	---	---	---	58	15	25.9%	6.95E-01	Exceeds	3.40E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL

Appendix A2 - COPC Identification Summary Based on Monitoring Well Data

Notes:
---' = does not apply
MCL = Maximum Contaminant Level (CA State Water Resources Control Board)
PHG = Public Health Goal (CA State Water Resources Control Board)
NL = Notification Level (CA State Water Resources Control Board)
RSL - Regional Screening Level (United States Environmental Protection Agency)

CasNo	Analyte	Unit	Tapwater RSL THQ = 0.1	MCL	10% of MCL	NL	10% of NL	Secondary MCL	PHG	Total Number of Records For Well Population	Total Number of Detections For Well Population	% of Detections For Well Population	Screening Concentration	Less than 5% Detection Frequency	Lowest of RSL, 10% MCL, 10%NL	Exceeds Lowest of RSL, 10% MCL, 10%NL?	COPC Evaluation Result	COPC Evaluation Rationale
7440-28-0	THALLIUM	µg/L	2.00E-02	2.00E+00	2.00E-01	---	---	---	1.00E-01	116	0	0.0%	2.48E-01	Screened Out	2.00E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
28249-77-6	Thiobencarb	µg/L	1.60E+01	7.00E+01	7.00E+00	---	---	1.00E+00	7.00E+01	37	0	0.0%	---	Screened Out	7.00E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
108-88-3	TOLUENE	µg/L	1.10E+02	1.50E+02	1.50E+01	---	---	---	1.50E+02	197	39	19.8%	2.98E+00	Exceeds	1.50E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
764-41-0	TOTAL 1,4-DICHLORO-2-BUTENE	µg/L	1.30E-03	---	---	---	---	---	---	46	0	0.0%	---	Screened Out	1.30E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
HAA5	TOTAL HALOACETIC ACIDS	µg/L	---	6.00E+01	6.00E+00	---	---	---	---	37	11	29.7%	9.44E+00	Exceeds	6.00E+00	Exceeds	Screened Out	Disinfection byproduct
TOC	TOTAL ORGANIC CARBON	µg/L	---	---	---	---	---	---	---	72	67	93.1%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
TSS	Total Settlable Solids	ML/L	---	---	---	---	---	---	---	8	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
TSS	TOTAL SUSPENDED SOLIDS	µg/L	---	---	---	---	---	---	---	38	6	15.8%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
THM	TOTAL TRIHALOMETHANES	µg/L	---	8.00E+01	8.00E+00	---	---	---	8.00E-01	50	18	36.0%	5.46E+00	Exceeds	8.00E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
542-75-6	TOTAL, 1,3-DICHLOROPROPENE (CIS AND TRANS)	µg/L	4.70E-01	5.00E-01	5.00E-02	---	---	---	2.00E-01	50	0	0.0%	---	Screened Out	5.00E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
8001-35-2	TOXAPHENE	µg/L	7.10E-02	3.00E+00	3.00E-01	---	---	---	3.00E-02	37	0	0.0%	---	Screened Out	7.10E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
156-60-5	TRANS-1,2-DICHLOROETHENE	µg/L	3.60E+01	1.00E+01	1.00E+00	---	---	---	6.00E+01	200	20	10.0%	6.21E-01	Exceeds	1.00E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
10061-02-6	TRANS-1,3-DICHLOROPROPENE	µg/L	---	---	---	---	---	---	---	180	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
110-57-6	TRANS-1,4-DICHLORO-2-BUTENE	µg/L	1.30E-03	---	---	---	---	---	---	40	0	0.0%	---	Screened Out	1.30E-03	Exceeds	Screened Out	Less than 5% Detection Frequency
76-03-9	Trichloroacetic Acid	µg/L	1.10E+00	---	---	---	---	---	---	37	11	29.7%	4.72E+00	Exceeds	1.10E+00	Exceeds	Screened Out	Disinfection byproduct
79-01-6	TRICHLOROETHYLENE (TCE)	µg/L	2.80E-01	5.00E+00	5.00E-01	---	---	---	1.70E+00	260	213	81.9%	6.11E+01	Exceeds	2.80E-01	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
75-69-4	TRICHLOROFLUOROMETHANE	µg/L	5.20E+02	1.50E+02	1.50E+01	---	---	---	1.30E+03	225	73	32.4%	2.48E+00	Exceeds	1.50E+01	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
26523-64-8	Trichlorotrifluoroethane(F113)	µg/L	---	1.20E+03	1.20E+02	---	---	---	4.00E+03	11	0	0.0%	---	Screened Out	1.20E+02	Exceeds	Screened Out	Less than 5% Detection Frequency
3380-34-5	Triclosan	µg/L	---	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	0.00E+00	---	Screened Out	Less than 5% Detection Frequency
1582-09-8	TRIFLURALIN	µg/L	2.60E+00	---	---	---	---	---	---	37	0	0.0%	---	Screened Out	2.60E+00	Exceeds	Screened Out	Less than 5% Detection Frequency
10028-17-8	TRITIUM (HYDROGEN-3)	pCi/L	---	2.00E+04	2.00E+03	---	---	---	4.00E+02	37	19	51.4%	9.56E+01	Exceeds	2.00E+03	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
TURB	TURBIDITY	NTU	---	---	---	---	---	5.00E+00	---	185	178	96.2%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-61-1	Uranium (U), ICP/MS	µg/L	6.00E+00	3.00E+01	3.00E+00	---	---	---	---	1	1	100.0%	1.39E+00	Exceeds	3.00E+00	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL
7440-61-1	URANIUM, TOTAL	PCI/L	6.00E+00	2.00E+01	2.00E+00	---	---	---	4.30E-01	38	38	100.0%	2.48E+00	Exceeds	2.00E+00	Exceeds	Screened Out	URANIUM, TOTAL in µg/L will be evaluated against regulatory limits
UV254	UV absorbance at 254 nm	1/CM	---	---	---	---	---	---	---	37	36	97.3%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
UVA254SPEC	UV Absorbance at 254 nm Spectrophoto	1/CM	---	---	---	---	---	---	---	12	11	91.7%	---	Exceeds	0.00E+00	---	Screened Out	Not applicable. General water quality parameter.
7440-62-2	VANADIUM	µg/L	8.60E+00	---	---	5.00E+01	5.00E+00	---	---	178	159	89.3%	1.36E+01	Exceeds	5.00E+00	Exceeds	To be included in Risk Calculations	Exceeds Screening Levels
108-05-4	VINYL ACETATE	µg/L	4.10E+01	---	---	---	---	---	---	91	0	0.0%	---	Screened Out	4.10E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
75-01-4	VINYL CHLORIDE	µg/L	1.90E-02	5.00E-01	5.00E-02	---	---	---	5.00E-02	190	1	0.5%	1.42E-01	Screened Out	1.90E-02	Exceeds	Screened Out	Less than 5% Detection Frequency
1330-20-7	Xylenes	µg/L	1.90E+01	1.75E+03	1.75E+02	---	---	---	1.80E+03	64	0	0.0%	---	Screened Out	1.90E+01	Exceeds	Screened Out	Less than 5% Detection Frequency
7440-66-6	ZINC	µg/L	6.00E+02	---	---	---	---	5.00E+03	---	165	163	98.8%	1.44E+02	Exceeds	6.00E+02	Screened Out	Screened Out	Below Minimum 'RSL, 10% MCL, 10%NL

Appendix B: Exposure Point Concentration Summaries and ProUCL Statistical Analysis Output

Appendix B1 - Exposure Point Concentration (EPC) Summary for Production Well Data (Well NH-43A)

Well - Constituent (CasNo)[unit]	Suggested 95UCL Method From ProUCL Output	Suggested 95UCL Value From ProUCL Output	Notes	Value Used As EPC
NH-43A - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]	95% KM (t) UCL	8.69E-01	---	8.69E-01
NH-43A - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]	95% KM (t) UCL	1.88E+01	---	1.88E+01
NH-43A - ALUMINUM (CasNo: 7429-90-5) [µg/L]	95% Student's-t UCL	7.82E+01	---	7.82E+01
NH-43A - ARSENIC (CasNo: 7440-38-2) [µg/L]	95% KM (t) UCL	1.15E+00	---	1.15E+00
NH-43A - BORON (CasNo: 7440-42-8) [µg/L]	95% Student's-t UCL	3.13E+02	---	3.13E+02
NH-43A - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]	95% Student's-t UCL	2.62E+00	Recommended UCL exceeds the maximum observation. Will use max value.	2.00E+00
NH-43A - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]	95% KM (t) UCL	4.44E-01	---	4.44E-01
NH-43A - IRON (CasNo: 7439-89-6) [µg/L]	95% KM (Chebyshev) UCL	1.86E+02	---	1.86E+02
NH-43A - LEAD (CasNo: 7439-92-1) [µg/L]	95% KM (t) UCL	2.97E-01	---	2.97E-01
NH-43A - MANGANESE (CasNo: 7439-96-5) [µg/L]	95% Student's-t UCL	3.07E+00	Recommended UCL exceeds the maximum observation. Will use max value.	2.90E+00
NH-43A - MERCURY (CasNo: 7439-97-6) [µg/L]	Data all NDs or data set is too small to compute reliable and meaningful statistics and estimates!	0.00E+00	Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! No detections, Will not be evaluated in well NH-43a.	ND
NH-43A - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]	Data all NDs or data set is too small to compute reliable and meaningful statistics and estimates!	0.00E+00	Warning: This data set only has 2 observations! Data set is too small to compute reliable and meaningful statistics and estimates! Will use max value.	2.40E+01
NH-43A - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]	95% Chebyshev (Mean, Sd) UCL	4.98E+03	---	4.98E+03
NH-43A - SELENIUM (CasNo: 7782-49-2) [µg/L]	95% Student's-t UCL	1.24E+01	---	1.24E+01
NH-43A - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]	95% KM (t) UCL	3.85E+00	---	3.85E+00
NH-43A - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]	95% KM (t) UCL	6.65E+00	---	6.65E+00
NH-43A - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]	Data all NDs or data set is too small to compute reliable and meaningful statistics and estimates!	0.00E+00	Warning: This data set only has 2 observations! Data set is too small to compute reliable and meaningful statistics and estimates! Will use max value.	5.00E+00
NH-43A - VANADIUM (CasNo: 7440-62-2) [µg/L]	95% Student's-t UCL	4.08E+00	---	4.08E+00

Notes: KM = Kaplan-Meier; UCL = upper confidence limit

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/4/2016 4:30:30 PM
From File	20161104_Draft_HHRA_ProUCL_Data_PW.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

NH-44 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	7
Number of Detects	5	Number of Non-Detects	8
Number of Distinct Detects	5	Number of Distinct Non-Detects	2
Minimum Detect	0.079	Minimum Non-Detect	0.5
Maximum Detect	2.2	Maximum Non-Detect	1
Variance Detects	0.846	Percent Non-Detects	61.54%
Mean Detects	1.287	SD Detects	0.92
Median Detects	1.76	CV Detects	0.715
Skewness Detects	-0.602	Kurtosis Detects	-2.273
Mean of Logged Detects	-0.235	SD of Logged Detects	1.401

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	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	0.553	KM Standard Error of Mean	0.241
KM SD	0.775	95% KM (BCA) UCL	1.197
95% KM (t) UCL	0.983	95% KM (Percentile Bootstrap) UCL	1.073
95% KM (z) UCL	0.95	95% KM Bootstrap t UCL	0.923
90% KM Chebyshev UCL	1.277	95% KM Chebyshev UCL	1.605
97.5% KM Chebyshev UCL	2.06	99% KM Chebyshev UCL	2.954

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.538	Anderson-Darling GOF Test
5% A-D Critical Value	0.69	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.346	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.364	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)	1.165	k star (bias corrected MLE)	0.599
Theta hat (MLE)	1.105	Theta star (bias corrected MLE)	2.148
nu hat (MLE)	11.65	nu star (bias corrected)	5.992
Mean (detects)	1.287		

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	0.599
Maximum	2.2	Median	0.305
SD	0.791	CV	1.319
k hat (MLE)	0.469	k star (bias corrected MLE)	0.412
Theta hat (MLE)	1.279	Theta star (bias corrected MLE)	1.456

nu hat (MLE)	12.18	nu star (bias corrected)	10.7
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (10.70, α)	4.387	Adjusted Chi Square Value (10.70, β)	3.827
95% Gamma Approximate UCL (use when n>=50)	1.462	95% Gamma Adjusted UCL (use when n<50)	1.676
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.553	SD (KM)	0.775
Variance (KM)	0.601	SE of Mean (KM)	0.241
k hat (KM)	0.508	k star (KM)	0.442
nu hat (KM)	13.2	nu star (KM)	11.49
theta hat (KM)	1.088	theta star (KM)	1.251
80% gamma percentile (KM)	0.901	90% gamma percentile (KM)	1.532
95% gamma percentile (KM)	2.218	99% gamma percentile (KM)	3.923
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (11.49, α)	4.892	Adjusted Chi Square Value (11.49, β)	4.295
95% Gamma Approximate KM-UCL (use when n>=50)	1.298	95% Gamma Adjusted KM-UCL (use when n<50)	1.478
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.799	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.316	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	0.571	Mean in Log Scale	-1.57
SD in Original Scale	0.796	SD in Log Scale	1.529
95% t UCL (assumes normality of ROS data)	0.964	95% Percentile Bootstrap UCL	0.947
95% BCA Bootstrap UCL	1.012	95% Bootstrap t UCL	1.081
95% H-UCL (Log ROS)	3.645		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-1.615	KM Geo Mean	0.199
KM SD (logged)	1.365	95% Critical H Value (KM-Log)	3.52
KM Standard Error of Mean (logged)	0.432	95% H-UCL (KM -Log)	2.023
KM SD (logged)	1.365	95% Critical H Value (KM-Log)	3.52
KM Standard Error of Mean (logged)	0.432		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.687	Mean in Log Scale	-0.837
SD in Original Scale	0.73	SD in Log Scale	0.98
95% t UCL (Assumes normality)	1.048	95% H-Stat UCL	1.551
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	0.983		

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.

NH-34 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics			
Total Number of Observations	18	Number of Distinct Observations	12
Number of Detects	10	Number of Non-Detects	8

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	1.17	Minimum Non-Detect	0.5
Maximum Detect	3.17	Maximum Non-Detect	1
Variance Detects	0.36	Percent Non-Detects	44.44%
Mean Detects	1.886	SD Detects	0.6
Median Detects	1.725	CV Detects	0.318
Skewness Detects	1.029	Kurtosis Detects	1.044
Mean of Logged Detects	0.592	SD of Logged Detects	0.303

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.924	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	1.27	KM Standard Error of Mean	0.201
KM SD	0.809	95% KM (BCA) UCL	1.595
95% KM (t) UCL	1.62	95% KM (Percentile Bootstrap) UCL	1.593
95% KM (z) UCL	1.601	95% KM Bootstrap t UCL	1.669
90% KM Chebyshev UCL	1.873	95% KM Chebyshev UCL	2.146
97.5% KM Chebyshev UCL	2.525	99% KM Chebyshev UCL	3.27

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.226	Anderson-Darling GOF Test	
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161	Kolmogorov-Smirnov GOF	
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 on Detected Data Only

k hat (MLE)	11.96	k star (bias corrected MLE)	8.439
Theta hat (MLE)	0.158	Theta star (bias corrected MLE)	0.223
nu hat (MLE)	239.2	nu star (bias corrected)	168.8
Mean (detects)	1.886		

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	1.259
Maximum	3.17	Median	1.25
SD	0.866	CV	0.688
k hat (MLE)	1.25	k star (bias corrected MLE)	1.079
Theta hat (MLE)	1.007	Theta star (bias corrected MLE)	1.167
nu hat (MLE)	45	nu star (bias corrected)	38.83
Adjusted Level of Significance (β)	0.0357		
Approximate Chi Square Value (38.83, α)	25.56	Adjusted Chi Square Value (38.83, β)	24.53
95% Gamma Approximate UCL (use when n>=50)	1.913	95% Gamma Adjusted UCL (use when n<50)	1.993

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.27	SD (KM)	0.809
Variance (KM)	0.655	SE of Mean (KM)	0.201
k hat (KM)	2.464	k star (KM)	2.091
nu hat (KM)	88.71	nu star (KM)	75.26
theta hat (KM)	0.515	theta star (KM)	0.607
80% gamma percentile (KM)	1.891	90% gamma percentile (KM)	2.444
95% gamma percentile (KM)	2.971	99% gamma percentile (KM)	4.135

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (75.26, α)	56.28	Adjusted Chi Square Value (75.26, β)	54.7
95% Gamma Approximate KM-UCL (use when n>=50)	1.698	95% Gamma Adjusted KM-UCL (use when n<50)	1.747

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.402	Mean in Log Scale	0.217
SD in Original Scale	0.717	SD in Log Scale	0.509
95% t UCL (assumes normality of ROS data)	1.696	95% Percentile Bootstrap UCL	1.665
95% BCA Bootstrap UCL	1.709	95% Bootstrap t UCL	1.749
95% H-UCL (Log ROS)	1.816		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0209	KM Geo Mean	1.021
KM SD (logged)	0.674	95% Critical H Value (KM-Log)	2.207
KM Standard Error of Mean (logged)	0.167	95% H-UCL (KM -Log)	1.837
KM SD (logged)	0.674	95% Critical H Value (KM-Log)	2.207
KM Standard Error of Mean (logged)	0.167		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.173	Mean in Log Scale	-0.249
SD in Original Scale	0.931	SD in Log Scale	1.004
95% t UCL (Assumes normality)	1.555	95% H-Stat UCL	2.459

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	1.62

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.

NH-36 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	11	Number of Distinct Observations	5
Number of Detects	3	Number of Non-Detects	8
Number of Distinct Detects	3	Number of Distinct Non-Detects	2
Minimum Detect	0.752	Minimum Non-Detect	0.5
Maximum Detect	1.34	Maximum Non-Detect	1
Variance Detects	0.0908	Percent Non-Detects	72.73%
Mean Detects	1.084	SD Detects	0.301
Median Detects	1.16	CV Detects	0.278
Skewness Detects	-1.063	Kurtosis Detects	N/A
Mean of Logged Detects	0.052	SD of Logged Detects	0.301

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	0.952	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.266	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	0.662	KM Standard Error of Mean	0.107
KM SD	0.29	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.857	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.839	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.984	95% KM Chebyshev UCL	1.13
97.5% KM Chebyshev UCL	1.333	99% KM Chebyshev UCL	1.731
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	17.63	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0615	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	105.8	nu star (bias corrected)	N/A
Mean (detects)	1.084		
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	0.427
Maximum	1.34	Median	0.237
SD	0.47	CV	1.103
k hat (MLE)	0.598	k star (bias corrected MLE)	0.496
Theta hat (MLE)	0.713	Theta star (bias corrected MLE)	0.86
nu hat (MLE)	13.16	nu star (bias corrected)	10.91
Adjusted Level of Significance (β)	0.0278		
Approximate Chi Square Value (10.91, α)	4.516	Adjusted Chi Square Value (10.91, β)	3.868
95% Gamma Approximate UCL (use when n>=50)	1.03	95% Gamma Adjusted UCL (use when n<50)	N/A
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.662	SD (KM)	0.29
Variance (KM)	0.084	SE of Mean (KM)	0.107
k hat (KM)	5.222	k star (KM)	3.859
nu hat (KM)	114.9	nu star (KM)	84.89
theta hat (KM)	0.127	theta star (KM)	0.172
80% gamma percentile (KM)	0.917	90% gamma percentile (KM)	1.114
95% gamma percentile (KM)	1.296	99% gamma percentile (KM)	1.685
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (84.89, α)	64.65	Adjusted Chi Square Value (84.89, β)	61.78
95% Gamma Approximate KM-UCL (use when n>=50)	0.869	95% Gamma Adjusted KM-UCL (use when n<50)	0.91
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.292	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.567	Mean in Log Scale	-0.749
SD in Original Scale	0.375	SD in Log Scale	0.623

95% t UCL (assumes normality of ROS data)	0.772	95% Percentile Bootstrap UCL	0.765
95% BCA Bootstrap UCL	0.793	95% Bootstrap t UCL	0.938
95% H-UCL (Log ROS)	0.911		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.485	KM Geo Mean	0.616
KM SD (logged)	0.356	95% Critical H Value (KM-Log)	2.006
KM Standard Error of Mean (logged)	0.132	95% H-UCL (KM -Log)	0.822
KM SD (logged)	0.356	95% Critical H Value (KM-Log)	2.006
KM Standard Error of Mean (logged)	0.132		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.5	Mean in Log Scale	-0.931
SD in Original Scale	0.405	SD in Log Scale	0.677
95% t UCL (Assumes normality)	0.722	95% H-Stat UCL	0.834

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	0.857

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.

NH-37 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	34
Number of Detects	35	Number of Non-Detects	9
Number of Distinct Detects	32	Number of Distinct Non-Detects	2
Minimum Detect	0.614	Minimum Non-Detect	0.5
Maximum Detect	16.1	Maximum Non-Detect	1
Variance Detects	20.96	Percent Non-Detects	20.45%
Mean Detects	9.384	SD Detects	4.578
Median Detects	9.76	CV Detects	0.488
Skewness Detects	-0.346	Kurtosis Detects	-0.792
Mean of Logged Detects	2.029	SD of Logged Detects	0.794

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0908	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	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	7.567	KM Standard Error of Mean	0.824
KM SD	5.388	95% KM (BCA) UCL	8.846
95% KM (t) UCL	8.952	95% KM (Percentile Bootstrap) UCL	8.877
95% KM (z) UCL	8.923	95% KM Bootstrap t UCL	8.92
90% KM Chebyshev UCL	10.04	95% KM Chebyshev UCL	11.16
97.5% KM Chebyshev UCL	12.71	99% KM Chebyshev UCL	15.77

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.595	Anderson-Darling GOF Test
5% A-D Critical Value	0.756	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	Kolmogorov-Smirnov GOF

5% K-S Critical Value	0.15	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)	2.54	k star (bias corrected MLE)	2.341
Theta hat (MLE)	3.695	Theta star (bias corrected MLE)	4.008
nu hat (MLE)	177.8	nu star (bias corrected)	163.9
Mean (detects)	9.384		
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	0.614	Mean	8.02
Maximum	16.1	Median	7.94
SD	4.907	CV	0.612
k hat (MLE)	1.995	k star (bias corrected MLE)	1.874
Theta hat (MLE)	4.019	Theta star (bias corrected MLE)	4.278
nu hat (MLE)	175.6	nu star (bias corrected)	164.9
Adjusted Level of Significance (β)	0.0445		
Approximate Chi Square Value (164.95, α)	136.3	Adjusted Chi Square Value (164.95, β)	135.4
95% Gamma Approximate UCL (use when n>=50)	9.709	95% Gamma Adjusted UCL (use when n<50)	9.772
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	7.567	SD (KM)	5.388
Variance (KM)	29.03	SE of Mean (KM)	0.824
k hat (KM)	1.972	k star (KM)	1.853
nu hat (KM)	173.6	nu star (KM)	163.1
theta hat (KM)	3.837	theta star (KM)	4.084
80% gamma percentile (KM)	11.43	90% gamma percentile (KM)	14.99
95% gamma percentile (KM)	18.39	99% gamma percentile (KM)	25.98
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (163.06, α)	134.5	Adjusted Chi Square Value (163.06, β)	133.7
95% Gamma Approximate KM-UCL (use when n>=50)	9.171	95% Gamma Adjusted KM-UCL (use when n<50)	9.232
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.8	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.207	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.148	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	7.817	Mean in Log Scale	1.717
SD in Original Scale	5.137	SD in Log Scale	0.952
95% t UCL (assumes normality of ROS data)	9.119	95% Percentile Bootstrap UCL	9.12
95% BCA Bootstrap UCL	9.111	95% Bootstrap t UCL	9.092
95% H-UCL (Log ROS)	12.25		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.473	KM Geo Mean	4.362
KM SD (logged)	1.301	95% Critical H Value (KM-Log)	2.724
KM Standard Error of Mean (logged)	0.199	95% H-UCL (KM -Log)	17.45
KM SD (logged)	1.301	95% Critical H Value (KM-Log)	2.724
KM Standard Error of Mean (logged)	0.199		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	7.521	Mean in Log Scale	1.346

SD in Original Scale	5.512	SD in Log Scale	1.538
95% t UCL (Assumes normality)	8.918	95% H-Stat UCL	25.52

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	8.952

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.

NH-45 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	32	Number of Distinct Observations	24
Number of Detects	23	Number of Non-Detects	9
Number of Distinct Detects	22	Number of Distinct Non-Detects	2
Minimum Detect	0.541	Minimum Non-Detect	0.5
Maximum Detect	7.59	Maximum Non-Detect	1
Variance Detects	2.821	Percent Non-Detects	28.13%
Mean Detects	2.163	SD Detects	1.68
Median Detects	1.85	CV Detects	0.777
Skewness Detects	2.089	Kurtosis Detects	4.969
Mean of Logged Detects	0.542	SD of Logged Detects	0.68

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.764	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.242	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	1.698	KM Standard Error of Mean	0.285
KM SD	1.578	95% KM (BCA) UCL	2.249
95% KM (t) UCL	2.182	95% KM (Percentile Bootstrap) UCL	2.183
95% KM (z) UCL	2.168	95% KM Bootstrap t UCL	2.446
90% KM Chebyshev UCL	2.554	95% KM Chebyshev UCL	2.942
97.5% KM Chebyshev UCL	3.48	99% KM Chebyshev UCL	4.537

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.558	Anderson-Darling GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.152	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.183	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)	2.336	k star (bias corrected MLE)	2.061
Theta hat (MLE)	0.926	Theta star (bias corrected MLE)	1.049
nu hat (MLE)	107.5	nu star (bias corrected)	94.79
Mean (detects)	2.163		

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	1.557
Maximum	7.59	Median	1.115
SD	1.723	CV	1.107
k hat (MLE)	0.476	k star (bias corrected MLE)	0.452
Theta hat (MLE)	3.271	Theta star (bias corrected MLE)	3.443
nu hat (MLE)	30.47	nu star (bias corrected)	28.94
Adjusted Level of Significance (β)	0.0416		
Approximate Chi Square Value (28.94, α)	17.66	Adjusted Chi Square Value (28.94, β)	17.19
95% Gamma Approximate UCL (use when n>=50)	2.551	95% Gamma Adjusted UCL (use when n<50)	2.622

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.698	SD (KM)	1.578
Variance (KM)	2.491	SE of Mean (KM)	0.285
k hat (KM)	1.158	k star (KM)	1.07
nu hat (KM)	74.09	nu star (KM)	68.48
theta hat (KM)	1.467	theta star (KM)	1.587
80% gamma percentile (KM)	2.718	90% gamma percentile (KM)	3.846
95% gamma percentile (KM)	4.968	99% gamma percentile (KM)	7.561

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (68.48, α)	50.43	Adjusted Chi Square Value (68.48, β)	49.6
95% Gamma Approximate KM-UCL (use when n>=50)	2.306	95% Gamma Adjusted KM-UCL (use when n<50)	2.345

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.123	Lilliefors GOF Test
5% Lilliefors Critical Value	0.18	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	1.663	Mean in Log Scale	0.103
SD in Original Scale	1.633	SD in Log Scale	0.937
95% t UCL (assumes normality of ROS data)	2.152	95% Percentile Bootstrap UCL	2.187
95% BCA Bootstrap UCL	2.211	95% Bootstrap t UCL	2.413
95% H-UCL (Log ROS)	2.558		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.2	KM Geo Mean	1.221
KM SD (logged)	0.787	95% Critical H Value (KM-Log)	2.195
KM Standard Error of Mean (logged)	0.142	95% H-UCL (KM -Log)	2.271
KM SD (logged)	0.787	95% Critical H Value (KM-Log)	2.195
KM Standard Error of Mean (logged)	0.142		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.632	Mean in Log Scale	0.0215
SD in Original Scale	1.657	SD in Log Scale	1.028
95% t UCL (Assumes normality)	2.129	95% H-Stat UCL	2.733

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	2.345	95% GROS Adjusted Gamma UCL	2.622

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.

NH-43A - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics			
Total Number of Observations	10	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	3
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	0.65	Minimum Non-Detect	0.5
Maximum Detect	35.2	Maximum Non-Detect	1
Variance Detects	213.4	Percent Non-Detects	30%
Mean Detects	14.92	SD Detects	14.61
Median Detects	12.3	CV Detects	0.979
Skewness Detects	0.317	Kurtosis Detects	-2.041
Mean of Logged Detects	1.837	SD of Logged Detects	1.7

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	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	10.6	KM Standard Error of Mean	4.474
KM SD	13.1	95% KM (BCA) UCL	17.62
95% KM (t) UCL	18.8	95% KM (Percentile Bootstrap) UCL	17.93
95% KM (z) UCL	17.96	95% KM Bootstrap t UCL	21.12
90% KM Chebyshev UCL	24.02	95% KM Chebyshev UCL	30.1
97.5% KM Chebyshev UCL	38.54	99% KM Chebyshev UCL	55.12

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.546	Anderson-Darling GOF Test	
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.255	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.324	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)	0.698	k star (bias corrected MLE)	0.494
Theta hat (MLE)	21.37	Theta star (bias corrected MLE)	30.19
nu hat (MLE)	9.777	nu star (bias corrected)	6.92
Mean (detects)	14.92		

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	10.45
Maximum	35.2	Median	1.4
SD	13.93	CV	1.334
k hat (MLE)	0.285	k star (bias corrected MLE)	0.266
Theta hat (MLE)	36.69	Theta star (bias corrected MLE)	39.28
nu hat (MLE)	5.696	nu star (bias corrected)	5.32
Adjusted Level of Significance (β)	0.0267		
Approximate Chi Square Value (5.32, α)	1.303	Adjusted Chi Square Value (5.32, β)	0.992
95% Gamma Approximate UCL (use when n>=50)	42.66	95% Gamma Adjusted UCL (use when n<50)	56.02

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	10.6	SD (KM)	13.1
Variance (KM)	171.6	SE of Mean (KM)	4.474

k hat (KM)	0.655	k star (KM)	0.525
nu hat (KM)	13.1	nu star (KM)	10.5
theta hat (KM)	16.19	theta star (KM)	20.19
80% gamma percentile (KM)	17.44	90% gamma percentile (KM)	28.39
95% gamma percentile (KM)	40.02	99% gamma percentile (KM)	68.49

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.50, α)	4.257	Adjusted Chi Square Value (10.50, β)	3.592
95% Gamma Approximate KM-UCL (use when n>=50)	26.15	95% Gamma Adjusted KM-UCL (use when n<50)	30.98

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.847	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	10.49	Mean in Log Scale	0.685
SD in Original Scale	13.9	SD in Log Scale	2.34
95% t UCL (assumes normality of ROS data)	18.55	95% Percentile Bootstrap UCL	17.59
95% BCA Bootstrap UCL	18.53	95% Bootstrap t UCL	21.38
95% H-UCL (Log ROS)	3952		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.087	KM Geo Mean	2.965
KM SD (logged)	1.747	95% Critical H Value (KM-Log)	4.787
KM Standard Error of Mean (logged)	0.597	95% H-UCL (KM -Log)	221.2
KM SD (logged)	1.747	95% Critical H Value (KM-Log)	4.787
KM Standard Error of Mean (logged)	0.597		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	10.55	Mean in Log Scale	0.939
SD in Original Scale	13.85	SD in Log Scale	2.013
95% t UCL (Assumes normality)	18.58	95% H-Stat UCL	740.9

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	18.8

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.

NH-22 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	3
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

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 NH-22 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L] was not processed!

NH-25 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	11	Number of Distinct Observations	3
Number of Detects	1	Number of Non-Detects	10
Number of Distinct Detects	1	Number of Distinct Non-Detects	2

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 NH-25 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L] was not processed!

NH-04 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	10	Number of Distinct Observations	3
Number of Detects	0	Number of Non-Detects	10
Number of Distinct Detects	0	Number of Distinct Non-Detects	3

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 NH-04 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L] was not processed!

NH-32 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	9	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	9
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

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 NH-32 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L] was not processed!

NH-33 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	9	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	9
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

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 NH-33 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L] was not processed!

NH-23 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	14	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	4
Number of Distinct Detects	10	Number of Distinct Non-Detects	1

Minimum Detect	0.674	Minimum Non-Detect	0.5
Maximum Detect	7.6	Maximum Non-Detect	0.5
Variance Detects	7.246	Percent Non-Detects	28.57%
Mean Detects	2.844	SD Detects	2.692
Median Detects	1.4	CV Detects	0.946
Skewness Detects	1.094	Kurtosis Detects	-0.276
Mean of Logged Detects	0.632	SD of Logged Detects	0.958

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.785	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.262	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	2.174	KM Standard Error of Mean	0.677
KM SD	2.404	95% KM (BCA) UCL	3.312
95% KM (t) UCL	3.374	95% KM (Percentile Bootstrap) UCL	3.332
95% KM (z) UCL	3.288	95% KM Bootstrap t UCL	4.259
90% KM Chebyshev UCL	4.206	95% KM Chebyshev UCL	5.127
97.5% KM Chebyshev UCL	6.404	99% KM Chebyshev UCL	8.913

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.681	Anderson-Darling GOF Test	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.257	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.272	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)	1.353	k star (bias corrected MLE)	1.014
Theta hat (MLE)	2.102	Theta star (bias corrected MLE)	2.806
nu hat (MLE)	27.06	nu star (bias corrected)	20.27
Mean (detects)	2.844		

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	2.034
Maximum	7.6	Median	0.902
SD	2.604	CV	1.28
k hat (MLE)	0.415	k star (bias corrected MLE)	0.374
Theta hat (MLE)	4.897	Theta star (bias corrected MLE)	5.439
nu hat (MLE)	11.63	nu star (bias corrected)	10.47
Adjusted Level of Significance (β)	0.0312		
Approximate Chi Square Value (10.47, α)	4.239	Adjusted Chi Square Value (10.47, β)	3.728
95% Gamma Approximate UCL (use when n>=50)	5.026	95% Gamma Adjusted UCL (use when n<50)	5.716

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.174	SD (KM)	2.404
Variance (KM)	5.78	SE of Mean (KM)	0.677
k hat (KM)	0.818	k star (KM)	0.69
nu hat (KM)	22.9	nu star (KM)	19.33
theta hat (KM)	2.658	theta star (KM)	3.15
80% gamma percentile (KM)	3.576	90% gamma percentile (KM)	5.476
95% gamma percentile (KM)	7.438	99% gamma percentile (KM)	12.13

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (19.33, α)	10.36	Adjusted Chi Square Value (19.33, β)	9.497
95% Gamma Approximate KM-UCL (use when n>=50)	4.057	95% Gamma Adjusted KM-UCL (use when n<50)	4.426

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.868	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.232	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.087	Mean in Log Scale	-0.0464
SD in Original Scale	2.562	SD in Log Scale	1.395
95% t UCL (assumes normality of ROS data)	3.299	95% Percentile Bootstrap UCL	3.236
95% BCA Bootstrap UCL	3.378	95% Bootstrap t UCL	4.068
95% H-UCL (Log ROS)	9.745		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.254	KM Geo Mean	1.289
KM SD (logged)	0.974	95% Critical H Value (KM-Log)	2.749
KM Standard Error of Mean (logged)	0.274	95% H-UCL (KM -Log)	4.351
KM SD (logged)	0.974	95% Critical H Value (KM-Log)	2.749
KM Standard Error of Mean (logged)	0.274		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.103	Mean in Log Scale	0.0555
SD in Original Scale	2.549	SD in Log Scale	1.237
95% t UCL (Assumes normality)	3.309	95% H-Stat UCL	6.821

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	3.374

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.

NH-26 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	11	Number of Distinct Observations	6
Number of Detects	4	Number of Non-Detects	7
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	0.948	Minimum Non-Detect	0.5
Maximum Detect	2.31	Maximum Non-Detect	1
Variance Detects	0.442	Percent Non-Detects	63.64%
Mean Detects	1.524	SD Detects	0.665
Median Detects	1.42	CV Detects	0.436
Skewness Detects	0.41	Kurtosis Detects	-3.632
Mean of Logged Detects	0.348	SD of Logged Detects	0.444

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.875	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	

Lilliefors Test Statistic	0.285	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	0.883	KM Standard Error of Mean	0.21
KM SD	0.6	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.264	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.229	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.514	95% KM Chebyshev UCL	1.799
97.5% KM Chebyshev UCL	2.196	99% KM Chebyshev UCL	2.975

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.438	Anderson-Darling GOF Test	
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.319	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.396	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)	6.979	k star (bias corrected MLE)	1.911
Theta hat (MLE)	0.218	Theta star (bias corrected MLE)	0.797
nu hat (MLE)	55.83	nu star (bias corrected)	15.29
Mean (detects)	1.524		

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	0.621
Maximum	2.31	Median	0.178
SD	0.812	CV	1.308
k hat (MLE)	0.429	k star (bias corrected MLE)	0.373
Theta hat (MLE)	1.446	Theta star (bias corrected MLE)	1.665
nu hat (MLE)	9.443	nu star (bias corrected)	8.201
Adjusted Level of Significance (β)	0.0278		
Approximate Chi Square Value (8.20, α)	2.852	Adjusted Chi Square Value (8.20, β)	2.363
95% Gamma Approximate UCL (use when n>=50)	1.785	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.883	SD (KM)	0.6
Variance (KM)	0.36	SE of Mean (KM)	0.21
k hat (KM)	2.166	k star (KM)	1.636
nu hat (KM)	47.64	nu star (KM)	35.98
theta hat (KM)	0.408	theta star (KM)	0.54
80% gamma percentile (KM)	1.353	90% gamma percentile (KM)	1.802
95% gamma percentile (KM)	2.236	99% gamma percentile (KM)	3.209

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (35.98, α)	23.26	Adjusted Chi Square Value (35.98, β)	21.6
95% Gamma Approximate KM-UCL (use when n>=50)	1.367	95% Gamma Adjusted KM-UCL (use when n<50)	1.471

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.864	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.284	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	0.811	Mean in Log Scale	-0.501
SD in Original Scale	0.684	SD in Log Scale	0.794
95% t UCL (assumes normality of ROS data)	1.184	95% Percentile Bootstrap UCL	1.153
95% BCA Bootstrap UCL	1.232	95% Bootstrap t UCL	1.555
95% H-UCL (Log ROS)	1.604		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.299	KM Geo Mean	0.741
KM SD (logged)	0.55	95% Critical H Value (KM-Log)	2.244
KM Standard Error of Mean (logged)	0.194	95% H-UCL (KM -Log)	1.275
KM SD (logged)	0.55	95% Critical H Value (KM-Log)	2.244
KM Standard Error of Mean (logged)	0.194		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.736	Mean in Log Scale	-0.693
SD in Original Scale	0.727	SD in Log Scale	0.884
95% t UCL (Assumes normality)	1.133	95% H-Stat UCL	1.608

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	1.264

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.

NH-07 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	5	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	5
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 NH-07 - 1,4-Dioxane (CasNo: 123-91-1) [µg/L] was not processed!

NH-23 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	38	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	1.04	Mean	5.22
Maximum	15.2	Median	4.495
SD	3.353	Std. Error of Mean	0.544
Coefficient of Variation	0.642	Skewness	1.29

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	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	6.138	95% Adjusted-CLT UCL (Chen-1995)	6.237
		95% Modified-t UCL (Johnson-1978)	6.157
Gamma GOF Test			
A-D Test Statistic	0.256	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0804	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.144	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.62	k star (bias corrected MLE)	2.431
Theta hat (MLE)	1.992	Theta star (bias corrected MLE)	2.148
nu hat (MLE)	199.1	nu star (bias corrected)	184.7
MLE Mean (bias corrected)	5.22	MLE Sd (bias corrected)	3.348
		Approximate Chi Square Value (0.05)	154.3
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	153.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	6.25	95% Adjusted Gamma UCL (use when n<50)	6.297
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.0392	Mean of logged Data	1.45
Maximum of Logged Data	2.721	SD of logged Data	0.673
Assuming Lognormal Distribution			
95% H-UCL	6.715	90% Chebyshev (MVUE) UCL	7.19
95% Chebyshev (MVUE) UCL	8.043	97.5% Chebyshev (MVUE) UCL	9.226
99% Chebyshev (MVUE) UCL	11.55		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.115	95% Jackknife UCL	6.138
95% Standard Bootstrap UCL	6.1	95% Bootstrap-t UCL	6.326
95% Hall's Bootstrap UCL	6.323	95% Percentile Bootstrap UCL	6.154
95% BCA Bootstrap UCL	6.213		
90% Chebyshev(Mean, Sd) UCL	6.852	95% Chebyshev(Mean, Sd) UCL	7.591
97.5% Chebyshev(Mean, Sd) UCL	8.617	99% Chebyshev(Mean, Sd) UCL	10.63
Suggested UCL to Use			
95% Adjusted Gamma UCL	6.297		

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.

NH-26 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Total Number of Observations	31	Number of Distinct Observations	19
Number of Detects	18	Number of Non-Detects	13
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	0.876	Minimum Non-Detect	0.5
Maximum Detect	3.53	Maximum Non-Detect	0.5
Variance Detects	0.389	Percent Non-Detects	41.94%
Mean Detects	1.537	SD Detects	0.624
Median Detects	1.47	CV Detects	0.406
Skewness Detects	1.97	Kurtosis Detects	5.581
Mean of Logged Detects	0.367	SD of Logged Detects	0.353

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.82	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.193	Lilliefors GOF Test
5% Lilliefors Critical Value	0.202	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	1.102	KM Standard Error of Mean	0.127
KM SD	0.689	95% KM (BCA) UCL	1.314
95% KM (t) UCL	1.318	95% KM (Percentile Bootstrap) UCL	1.318
95% KM (z) UCL	1.312	95% KM Bootstrap t UCL	1.355
90% KM Chebyshev UCL	1.484	95% KM Chebyshev UCL	1.658
97.5% KM Chebyshev UCL	1.898	99% KM Chebyshev UCL	2.37

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.407	Anderson-Darling GOF Test
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.139	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.204	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)	8.087	k star (bias corrected MLE)	6.776
Theta hat (MLE)	0.19	Theta star (bias corrected MLE)	0.227
nu hat (MLE)	291.1	nu star (bias corrected)	243.9
Mean (detects)	1.537		

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	1.016
Maximum	3.53	Median	0.936
SD	0.795	CV	0.783
k hat (MLE)	0.918	k star (bias corrected MLE)	0.85
Theta hat (MLE)	1.107	Theta star (bias corrected MLE)	1.195
nu hat (MLE)	56.89	nu star (bias corrected)	52.72
Adjusted Level of Significance (β)	0.0413		
Approximate Chi Square Value (52.72, α)	37.04	Adjusted Chi Square Value (52.72, β)	36.31
95% Gamma Approximate UCL (use when n>=50)	1.446	95% Gamma Adjusted UCL (use when n<50)	1.475

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.102	SD (KM)	0.689
Variance (KM)	0.475	SE of Mean (KM)	0.127
k hat (KM)	2.557	k star (KM)	2.331
nu hat (KM)	158.5	nu star (KM)	144.5
theta hat (KM)	0.431	theta star (KM)	0.473
80% gamma percentile (KM)	1.62	90% gamma percentile (KM)	2.069

95% gamma percentile (KM)	2.493	99% gamma percentile (KM)	3.425
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (144.51, α)	117.7	Adjusted Chi Square Value (144.51, β)	116.4
95% Gamma Approximate KM-UCL (use when n>=50)	1.353	95% Gamma Adjusted KM-UCL (use when n<50)	1.369
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.117	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.142	Mean in Log Scale	-0.0201
SD in Original Scale	0.674	SD in Log Scale	0.565
95% t UCL (assumes normality of ROS data)	1.347	95% Percentile Bootstrap UCL	1.345
95% BCA Bootstrap UCL	1.383	95% Bootstrap t UCL	1.397
95% H-UCL (Log ROS)	1.41		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.0777	KM Geo Mean	0.925
KM SD (logged)	0.585	95% Critical H Value (KM-Log)	1.997
KM Standard Error of Mean (logged)	0.108	95% H-UCL (KM -Log)	1.358
KM SD (logged)	0.585	95% Critical H Value (KM-Log)	1.997
KM Standard Error of Mean (logged)	0.108		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.997	Mean in Log Scale	-0.368
SD in Original Scale	0.798	SD in Log Scale	0.919
95% t UCL (Assumes normality)	1.241	95% H-Stat UCL	1.56
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	1.318		

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.

NH-43A - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics			
Total Number of Observations	50	Number of Distinct Observations	25
Number of Detects	24	Number of Non-Detects	26
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	0.527	Minimum Non-Detect	0.5
Maximum Detect	15.6	Maximum Non-Detect	0.5
Variance Detects	20.16	Percent Non-Detects	52%
Mean Detects	5.489	SD Detects	4.49
Median Detects	4.025	CV Detects	0.818
Skewness Detects	1.16	Kurtosis Detects	0.426
Mean of Logged Detects	1.345	SD of Logged Detects	0.937

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.855	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.176	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	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	2.895	KM Standard Error of Mean	0.569
KM SD	3.935	95% KM (BCA) UCL	3.821
95% KM (t) UCL	3.848	95% KM (Percentile Bootstrap) UCL	3.881
95% KM (z) UCL	3.83	95% KM Bootstrap t UCL	4.081
90% KM Chebyshev UCL	4.6	95% KM Chebyshev UCL	5.373
97.5% KM Chebyshev UCL	6.445	99% KM Chebyshev UCL	8.551

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.324	Anderson-Darling GOF Test	
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.105	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.181	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)	1.543	k star (bias corrected MLE)	1.378
Theta hat (MLE)	3.558	Theta star (bias corrected MLE)	3.984
nu hat (MLE)	74.05	nu star (bias corrected)	66.13
Mean (detects)	5.489		

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	2.641
Maximum	15.6	Median	0.0298
SD	4.136	CV	1.566
k hat (MLE)	0.262	k star (bias corrected MLE)	0.26
Theta hat (MLE)	10.07	Theta star (bias corrected MLE)	10.16
nu hat (MLE)	26.22	nu star (bias corrected)	25.98
Adjusted Level of Significance (β)	0.0452		
Approximate Chi Square Value (25.98, α)	15.36	Adjusted Chi Square Value (25.98, β)	15.12
95% Gamma Approximate UCL (use when n>=50)	4.465	95% Gamma Adjusted UCL (use when n<50)	4.537

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.895	SD (KM)	3.935
Variance (KM)	15.49	SE of Mean (KM)	0.569
k hat (KM)	0.541	k star (KM)	0.522
nu hat (KM)	54.11	nu star (KM)	52.19
theta hat (KM)	5.35	theta star (KM)	5.546
80% gamma percentile (KM)	4.762	90% gamma percentile (KM)	7.762
95% gamma percentile (KM)	10.95	99% gamma percentile (KM)	18.76

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (52.19, α)	36.6	Adjusted Chi Square Value (52.19, β)	36.21
95% Gamma Approximate KM-UCL (use when n>=50)	4.128	95% Gamma Adjusted KM-UCL (use when n<50)	4.172

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.127	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	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	2.858	Mean in Log Scale	0.0418
SD in Original Scale	4.004	SD in Log Scale	1.558
95% t UCL (assumes normality of ROS data)	3.807	95% Percentile Bootstrap UCL	3.852
95% BCA Bootstrap UCL	4.026	95% Bootstrap t UCL	4.113
95% H-UCL (Log ROS)	6.874		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.285	KM Geo Mean	1.33
KM SD (logged)	1.2	95% Critical H Value (KM-Log)	2.57
KM Standard Error of Mean (logged)	0.173	95% H-UCL (KM -Log)	4.247
KM SD (logged)	1.2	95% Critical H Value (KM-Log)	2.57
KM Standard Error of Mean (logged)	0.173		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.765	Mean in Log Scale	-0.0753
SD in Original Scale	4.056	SD in Log Scale	1.521
95% t UCL (Assumes normality)	3.726	95% H-Stat UCL	5.616

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	3.848

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.

NH-34 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	50	Number of Distinct Observations	20
Number of Detects	21	Number of Non-Detects	29
Number of Distinct Detects	19	Number of Distinct Non-Detects	1
Minimum Detect	0.752	Minimum Non-Detect	0.5
Maximum Detect	3.13	Maximum Non-Detect	0.5
Variance Detects	0.592	Percent Non-Detects	58%
Mean Detects	1.467	SD Detects	0.77
Median Detects	1.07	CV Detects	0.525
Skewness Detects	1.148	Kurtosis Detects	-0.0383
Mean of Logged Detects	0.271	SD of Logged Detects	0.469

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.814	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.221	Lilliefors GOF Test
5% Lilliefors Critical Value	0.188	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	0.906	KM Standard Error of Mean	0.0988
KM SD	0.682	95% KM (BCA) UCL	1.069
95% KM (t) UCL	1.072	95% KM (Percentile Bootstrap) UCL	1.069

95% KM (z) UCL	1.069	95% KM Bootstrap t UCL	1.107
90% KM Chebyshev UCL	1.203	95% KM Chebyshev UCL	1.337
97.5% KM Chebyshev UCL	1.523	99% KM Chebyshev UCL	1.889

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.064	Anderson-Darling GOF Test
5% A-D Critical Value	0.746	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.209	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.19	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)	4.595	k star (bias corrected MLE)	3.971
Theta hat (MLE)	0.319	Theta star (bias corrected MLE)	0.37
nu hat (MLE)	193	nu star (bias corrected)	166.8
Mean (detects)	1.467		

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	0.667
Maximum	3.13	Median	0.282
SD	0.852	CV	1.278
k hat (MLE)	0.41	k star (bias corrected MLE)	0.399
Theta hat (MLE)	1.627	Theta star (bias corrected MLE)	1.673
nu hat (MLE)	40.99	nu star (bias corrected)	39.87
Adjusted Level of Significance (β)	0.0452		
Approximate Chi Square Value (39.87, α)	26.4	Adjusted Chi Square Value (39.87, β)	26.07
95% Gamma Approximate UCL (use when n>=50)	1.007	95% Gamma Adjusted UCL (use when n<50)	1.02

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.906	SD (KM)	0.682
Variance (KM)	0.465	SE of Mean (KM)	0.0988
k hat (KM)	1.767	k star (KM)	1.674
nu hat (KM)	176.7	nu star (KM)	167.4
theta hat (KM)	0.513	theta star (KM)	0.541
80% gamma percentile (KM)	1.385	90% gamma percentile (KM)	1.839
95% gamma percentile (KM)	2.277	99% gamma percentile (KM)	3.258

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (167.39, α)	138.5	Adjusted Chi Square Value (167.39, β)	137.7
95% Gamma Approximate KM-UCL (use when n>=50)	1.096	95% Gamma Adjusted KM-UCL (use when n<50)	1.102

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.894	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.191	Lilliefors GOF Test
5% Lilliefors Critical Value	0.188	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	0.825	Mean in Log Scale	-0.551
SD in Original Scale	0.75	SD in Log Scale	0.868
95% t UCL (assumes normality of ROS data)	1.003	95% Percentile Bootstrap UCL	0.993
95% BCA Bootstrap UCL	1.026	95% Bootstrap t UCL	1.045
95% H-UCL (Log ROS)	1.104		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.288	KM Geo Mean	0.75

KM SD (logged)	0.561	95% Critical H Value (KM-Log)	1.935
KM Standard Error of Mean (logged)	0.0812	95% H-UCL (KM -Log)	1.024
KM SD (logged)	0.561	95% Critical H Value (KM-Log)	1.935
KM Standard Error of Mean (logged)	0.0812		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.761	Mean in Log Scale	-0.69
SD in Original Scale	0.781	SD in Log Scale	0.879
95% t UCL (Assumes normality)	0.946	95% H-Stat UCL	0.975

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	1.072	KM H-UCL	1.024
95% KM (BCA) UCL	1.083		

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.

NH-36 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	57	Number of Distinct Observations	25
Number of Detects	26	Number of Non-Detects	31
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	0.513	Minimum Non-Detect	0.5
Maximum Detect	1.67	Maximum Non-Detect	0.5
Variance Detects	0.0892	Percent Non-Detects	54.39%
Mean Detects	0.905	SD Detects	0.299
Median Detects	0.817	CV Detects	0.33
Skewness Detects	1.355	Kurtosis Detects	1.582
Mean of Logged Detects	-0.145	SD of Logged Detects	0.298

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.867	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.92	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.162	Lilliefors GOF Test
5% Lilliefors Critical Value	0.17	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	0.685	KM Standard Error of Mean	0.0382
KM SD	0.283	95% KM (BCA) UCL	0.746
95% KM (t) UCL	0.749	95% KM (Percentile Bootstrap) UCL	0.751
95% KM (z) UCL	0.748	95% KM Bootstrap t UCL	0.761
90% KM Chebyshev UCL	0.799	95% KM Chebyshev UCL	0.851
97.5% KM Chebyshev UCL	0.923	99% KM Chebyshev UCL	1.065

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.632	Anderson-Darling GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.138	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.171	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)	11.18	k star (bias corrected MLE)	9.916

Theta hat (MLE)	0.081	Theta star (bias corrected MLE)	0.0913
nu hat (MLE)	581.4	nu star (bias corrected)	515.6
Mean (detects)	0.905		

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	0.532
Maximum	1.67	Median	0.466
SD	0.417	CV	0.785
k hat (MLE)	0.94	k star (bias corrected MLE)	0.903
Theta hat (MLE)	0.565	Theta star (bias corrected MLE)	0.589
nu hat (MLE)	107.2	nu star (bias corrected)	102.9
Adjusted Level of Significance (β)	0.0458		
Approximate Chi Square Value (102.91, α)	80.5	Adjusted Chi Square Value (102.91, β)	79.99
95% Gamma Approximate UCL (use when n>=50)	0.68	95% Gamma Adjusted UCL (use when n<50)	0.684

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.685	SD (KM)	0.283
Variance (KM)	0.0799	SE of Mean (KM)	0.0382
k hat (KM)	5.873	k star (KM)	5.575
nu hat (KM)	669.5	nu star (KM)	635.6
theta hat (KM)	0.117	theta star (KM)	0.123
80% gamma percentile (KM)	0.91	90% gamma percentile (KM)	1.073
95% gamma percentile (KM)	1.221	99% gamma percentile (KM)	1.532

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (635.58, α)	578.1	Adjusted Chi Square Value (635.58, β)	576.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.753	95% Gamma Adjusted KM-UCL (use when n<50)	0.755

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.92	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.17	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	0.62	Mean in Log Scale	-0.616
SD in Original Scale	0.34	SD in Log Scale	0.533
95% t UCL (assumes normality of ROS data)	0.696	95% Percentile Bootstrap UCL	0.697
95% BCA Bootstrap UCL	0.703	95% Bootstrap t UCL	0.707
95% H-UCL (Log ROS)	0.713		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.443	KM Geo Mean	0.642
KM SD (logged)	0.337	95% Critical H Value (KM-Log)	1.723
KM Standard Error of Mean (logged)	0.0455	95% H-UCL (KM -Log)	0.734
KM SD (logged)	0.337	95% Critical H Value (KM-Log)	1.723
KM Standard Error of Mean (logged)	0.0455		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.549	Mean in Log Scale	-0.82
SD in Original Scale	0.385	SD in Log Scale	0.655
95% t UCL (Assumes normality)	0.634	95% H-Stat UCL	0.65

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	0.749

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.

NH-37 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	65	Number of Distinct Observations	35
Number of Detects	35	Number of Non-Detects	30
Number of Distinct Detects	34	Number of Distinct Non-Detects	1
Minimum Detect	0.666	Minimum Non-Detect	0.5
Maximum Detect	8.54	Maximum Non-Detect	0.5
Variance Detects	3.455	Percent Non-Detects	46.15%
Mean Detects	3.688	SD Detects	1.859
Median Detects	3.94	CV Detects	0.504
Skewness Detects	0.492	Kurtosis Detects	0.677
Mean of Logged Detects	1.144	SD of Logged Detects	0.638

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.101	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	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	2.216	KM Standard Error of Mean	0.262
KM SD	2.082	95% KM (BCA) UCL	2.668
95% KM (t) UCL	2.654	95% KM (Percentile Bootstrap) UCL	2.643
95% KM (z) UCL	2.647	95% KM Bootstrap t UCL	2.677
90% KM Chebyshev UCL	3.002	95% KM Chebyshev UCL	3.358
97.5% KM Chebyshev UCL	3.852	99% KM Chebyshev UCL	4.823

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.84	Anderson-Darling GOF Test
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.15	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)	3.259	k star (bias corrected MLE)	2.999
Theta hat (MLE)	1.132	Theta star (bias corrected MLE)	1.23
nu hat (MLE)	228.1	nu star (bias corrected)	209.9
Mean (detects)	3.688		

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	2.2

Maximum	8.54	Median	1.342
SD	2.137	CV	0.972
k hat (MLE)	0.549	k star (bias corrected MLE)	0.534
Theta hat (MLE)	4.007	Theta star (bias corrected MLE)	4.12
nu hat (MLE)	71.36	nu star (bias corrected)	69.4
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (69.40, α)	51.23	Adjusted Chi Square Value (69.40, β)	50.87
95% Gamma Approximate UCL (use when n>=50)	2.98	95% Gamma Adjusted UCL (use when n<50)	3.001

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.216	SD (KM)	2.082
Variance (KM)	4.333	SE of Mean (KM)	0.262
k hat (KM)	1.134	k star (KM)	1.092
nu hat (KM)	147.4	nu star (KM)	141.9
theta hat (KM)	1.955	theta star (KM)	2.03
80% gamma percentile (KM)	3.541	90% gamma percentile (KM)	4.994
95% gamma percentile (KM)	6.438	99% gamma percentile (KM)	9.769

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (141.94, α)	115.4	Adjusted Chi Square Value (141.94, β)	114.9
95% Gamma Approximate KM-UCL (use when n>=50)	2.726	95% Gamma Adjusted KM-UCL (use when n<50)	2.739

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.895	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.176	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	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	2.349	Mean in Log Scale	0.454
SD in Original Scale	2.003	SD in Log Scale	0.949
95% t UCL (assumes normality of ROS data)	2.764	95% Percentile Bootstrap UCL	2.78
95% BCA Bootstrap UCL	2.789	95% Bootstrap t UCL	2.817
95% H-UCL (Log ROS)	3.215		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.296	KM Geo Mean	1.344
KM SD (logged)	1.026	95% Critical H Value (KM-Log)	2.261
KM Standard Error of Mean (logged)	0.129	95% H-UCL (KM -Log)	3.039
KM SD (logged)	1.026	95% Critical H Value (KM-Log)	2.261
KM Standard Error of Mean (logged)	0.129		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.101	Mean in Log Scale	-0.0239
SD in Original Scale	2.195	SD in Log Scale	1.354
95% t UCL (Assumes normality)	2.556	95% H-Stat UCL	3.57

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	2.654

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.

NH-45 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	58	Number of Distinct Observations	22
Number of Detects	21	Number of Non-Detects	37
Number of Distinct Detects	21	Number of Distinct Non-Detects	1
Minimum Detect	0.504	Minimum Non-Detect	0.5
Maximum Detect	2.31	Maximum Non-Detect	0.5
Variance Detects	0.319	Percent Non-Detects	63.79%
Mean Detects	1.297	SD Detects	0.565
Median Detects	1.38	CV Detects	0.435
Skewness Detects	0.134	Kurtosis Detects	-0.873
Mean of Logged Detects	0.154	SD of Logged Detects	0.498

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.946	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.908	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.132	Lilliefors GOF Test
5% Lilliefors Critical Value	0.188	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	0.789	KM Standard Error of Mean	0.0682
KM SD	0.507	95% KM (BCA) UCL	0.903
95% KM (t) UCL	0.903	95% KM (Percentile Bootstrap) UCL	0.903
95% KM (z) UCL	0.901	95% KM Bootstrap t UCL	0.92
90% KM Chebyshev UCL	0.993	95% KM Chebyshev UCL	1.086
97.5% KM Chebyshev UCL	1.215	99% KM Chebyshev UCL	1.467

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.557	Anderson-Darling GOF Test
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.152	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.19	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)	4.848	k star (bias corrected MLE)	4.187
Theta hat (MLE)	0.268	Theta star (bias corrected MLE)	0.31
nu hat (MLE)	203.6	nu star (bias corrected)	175.8
Mean (detects)	1.297		

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	0.562
Maximum	2.31	Median	0.314
SD	0.668	CV	1.189
k hat (MLE)	0.468	k star (bias corrected MLE)	0.455
Theta hat (MLE)	1.2	Theta star (bias corrected MLE)	1.234
nu hat (MLE)	54.3	nu star (bias corrected)	52.82
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (52.82, α)	37.13	Adjusted Chi Square Value (52.82, β)	36.79
95% Gamma Approximate UCL (use when n>=50)	0.799	95% Gamma Adjusted UCL (use when n<50)	0.807

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.789	SD (KM)	0.507
Variance (KM)	0.257	SE of Mean (KM)	0.0682
k hat (KM)	2.422	k star (KM)	2.308
nu hat (KM)	280.9	nu star (KM)	267.7

theta hat (KM)	0.326	theta star (KM)	0.342
80% gamma percentile (KM)	1.161	90% gamma percentile (KM)	1.484
95% gamma percentile (KM)	1.789	99% gamma percentile (KM)	2.461

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (267.75, α)	230.9	Adjusted Chi Square Value (267.75, β)	230
95% Gamma Approximate KM-UCL (use when n>=50)	0.915	95% Gamma Adjusted KM-UCL (use when n<50)	0.918

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.906	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.156	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.188	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	0.666	Mean in Log Scale	-0.789
SD in Original Scale	0.597	SD in Log Scale	0.903
95% t UCL (assumes normality of ROS data)	0.797	95% Percentile Bootstrap UCL	0.799
95% BCA Bootstrap UCL	0.812	95% Bootstrap t UCL	0.818
95% H-UCL (Log ROS)	0.892		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.387	KM Geo Mean	0.679
KM SD (logged)	0.501	95% Critical H Value (KM-Log)	1.887
KM Standard Error of Mean (logged)	0.0674	95% H-UCL (KM -Log)	0.873
KM SD (logged)	0.501	95% Critical H Value (KM-Log)	1.887
KM Standard Error of Mean (logged)	0.0674		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.629	Mean in Log Scale	-0.829
SD in Original Scale	0.608	SD in Log Scale	0.803
95% t UCL (Assumes normality)	0.763	95% H-Stat UCL	0.756

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	0.903

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.

NH-22 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	34
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.53	Minimum Non-Detect	0.5
Maximum Detect	1.53	Maximum Non-Detect	0.5
Variance Detects	0.174	Percent Non-Detects	77.27%
Mean Detects	0.934	SD Detects	0.418
Median Detects	0.696	CV Detects	0.447
Skewness Detects	0.508	Kurtosis Detects	-1.997
Mean of Logged Detects	-0.157	SD of Logged Detects	0.439

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.79	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.315	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	0.599	KM Standard Error of Mean	0.0416
KM SD	0.262	95% KM (BCA) UCL	0.67
95% KM (t) UCL	0.669	95% KM (Percentile Bootstrap) UCL	0.668
95% KM (z) UCL	0.667	95% KM Bootstrap t UCL	0.711
90% KM Chebyshev UCL	0.723	95% KM Chebyshev UCL	0.78
97.5% KM Chebyshev UCL	0.859	99% KM Chebyshev UCL	1.013
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.993	Anderson-Darling GOF Test	
5% A-D Critical Value	0.729	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.303	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.267	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)	5.816	k star (bias corrected MLE)	4.138
Theta hat (MLE)	0.161	Theta star (bias corrected MLE)	0.226
nu hat (MLE)	116.3	nu star (bias corrected)	82.76
Mean (detects)	0.934		
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	0.253
Maximum	1.53	Median	0.01
SD	0.428	CV	1.687
k hat (MLE)	0.384	k star (bias corrected MLE)	0.373
Theta hat (MLE)	0.66	Theta star (bias corrected MLE)	0.68
nu hat (MLE)	33.79	nu star (bias corrected)	32.82
Adjusted Level of Significance (β)	0.0445		
Approximate Chi Square Value (32.82, α)	20.73	Adjusted Chi Square Value (32.82, β)	20.4
95% Gamma Approximate UCL (use when n>=50)	0.401	95% Gamma Adjusted UCL (use when n<50)	0.408
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.599	SD (KM)	0.262
Variance (KM)	0.0687	SE of Mean (KM)	0.0416
k hat (KM)	5.215	k star (KM)	4.875
nu hat (KM)	458.9	nu star (KM)	429
theta hat (KM)	0.115	theta star (KM)	0.123
80% gamma percentile (KM)	0.807	90% gamma percentile (KM)	0.962
95% gamma percentile (KM)	1.103	99% gamma percentile (KM)	1.401
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (428.99, α)	382	Adjusted Chi Square Value (428.99, β)	380.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.672	95% Gamma Adjusted KM-UCL (use when n<50)	0.675
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.812	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.28	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.262	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	0.359	Mean in Log Scale	-1.493
SD in Original Scale	0.383	SD in Log Scale	0.993
95% t UCL (assumes normality of ROS data)	0.456	95% Percentile Bootstrap UCL	0.453
95% BCA Bootstrap UCL	0.467	95% Bootstrap t UCL	0.482
95% H-UCL (Log ROS)	0.525		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.571	KM Geo Mean	0.565
KM SD (logged)	0.3	95% Critical H Value (KM-Log)	1.777
KM Standard Error of Mean (logged)	0.0476	95% H-UCL (KM -Log)	0.641
KM SD (logged)	0.3	95% Critical H Value (KM-Log)	1.777
KM Standard Error of Mean (logged)	0.0476		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.405	Mean in Log Scale	-1.107
SD in Original Scale	0.347	SD in Log Scale	0.558
95% t UCL (Assumes normality)	0.493	95% H-Stat UCL	0.456

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	0.669	KM H-UCL	0.641
95% KM (BCA) UCL	0.668		

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.

NH-25 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	49	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	48
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 NH-25 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L] was not processed!

NH-04 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	19
Number of Detects	19	Number of Non-Detects	25
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	0.509	Minimum Non-Detect	0.5
Maximum Detect	1.68	Maximum Non-Detect	0.5
Variance Detects	0.108	Percent Non-Detects	56.82%
Mean Detects	0.765	SD Detects	0.329
Median Detects	0.596	CV Detects	0.43
Skewness Detects	1.663	Kurtosis Detects	2.145
Mean of Logged Detects	-0.337	SD of Logged Detects	0.36

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.758	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.263	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	0.614	KM Standard Error of Mean	0.0384
KM SD	0.248	95% KM (BCA) UCL	0.68
95% KM (t) UCL	0.679	95% KM (Percentile Bootstrap) UCL	0.678
95% KM (z) UCL	0.677	95% KM Bootstrap t UCL	0.715
90% KM Chebyshev UCL	0.73	95% KM Chebyshev UCL	0.782
97.5% KM Chebyshev UCL	0.854	99% KM Chebyshev UCL	0.996

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.499	Anderson-Darling GOF Test	
5% A-D Critical Value	0.742	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.227	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.199	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)	7.409	k star (bias corrected MLE)	6.274
Theta hat (MLE)	0.103	Theta star (bias corrected MLE)	0.122
nu hat (MLE)	281.5	nu star (bias corrected)	238.4
Mean (detects)	0.765		

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	0.383
Maximum	1.68	Median	0.26
SD	0.406	CV	1.061
k hat (MLE)	0.59	k star (bias corrected MLE)	0.565
Theta hat (MLE)	0.649	Theta star (bias corrected MLE)	0.678
nu hat (MLE)	51.9	nu star (bias corrected)	49.7
Adjusted Level of Significance (β)	0.0445		
Approximate Chi Square Value (49.70, α)	34.51	Adjusted Chi Square Value (49.70, β)	34.08
95% Gamma Approximate UCL (use when n>=50)	0.552	95% Gamma Adjusted UCL (use when n<50)	0.558

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.614	SD (KM)	0.248
Variance (KM)	0.0615	SE of Mean (KM)	0.0384
k hat (KM)	6.136	k star (KM)	5.732
nu hat (KM)	539.9	nu star (KM)	504.5
theta hat (KM)	0.1	theta star (KM)	0.107
80% gamma percentile (KM)	0.813	90% gamma percentile (KM)	0.957
95% gamma percentile (KM)	1.088	99% gamma percentile (KM)	1.362

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (504.45, α)	453.4	Adjusted Chi Square Value (504.45, β)	451.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.683	95% Gamma Adjusted KM-UCL (use when n<50)	0.686

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.831	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.197	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	0.479	Mean in Log Scale	-0.946
SD in Original Scale	0.337	SD in Log Scale	0.657
95% t UCL (assumes normality of ROS data)	0.565	95% Percentile Bootstrap UCL	0.562
95% BCA Bootstrap UCL	0.577	95% Bootstrap t UCL	0.578
95% H-UCL (Log ROS)	0.59		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.54	KM Geo Mean	0.583
KM SD (logged)	0.29	95% Critical H Value (KM-Log)	1.766
KM Standard Error of Mean (logged)	0.0449	95% H-UCL (KM -Log)	0.657
KM SD (logged)	0.29	95% Critical H Value (KM-Log)	1.766
KM Standard Error of Mean (logged)	0.0449		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.472	Mean in Log Scale	-0.933
SD in Original Scale	0.334	SD in Log Scale	0.575
95% t UCL (Assumes normality)	0.557	95% H-Stat UCL	0.551

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	0.679	KM H-UCL	0.657
95% KM (BCA) UCL	0.677		

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.

NH-32 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	42	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	42
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 NH-32 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L] was not processed!

NH-07 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	13	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	3
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.52	Minimum Non-Detect	0.5
Maximum Detect	1.64	Maximum Non-Detect	0.5
Variance Detects	0.159	Percent Non-Detects	23.08%
Mean Detects	1.005	SD Detects	0.399
Median Detects	0.984	CV Detects	0.397
Skewness Detects	0.198	Kurtosis Detects	-1.074
Mean of Logged Detects	-0.0726	SD of Logged Detects	0.427

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.916	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	0.889	KM Standard Error of Mean	0.115
KM SD	0.394	95% KM (BCA) UCL	1.072
95% KM (t) UCL	1.094	95% KM (Percentile Bootstrap) UCL	1.071
95% KM (z) UCL	1.078	95% KM Bootstrap t UCL	1.13
90% KM Chebyshev UCL	1.234	95% KM Chebyshev UCL	1.391
97.5% KM Chebyshev UCL	1.609	99% KM Chebyshev UCL	2.036
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.46	Anderson-Darling GOF Test	
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogorov-Smirnov GOF	
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 on Detected Data Only			
k hat (MLE)	6.591	k star (bias corrected MLE)	4.68
Theta hat (MLE)	0.153	Theta star (bias corrected MLE)	0.215
nu hat (MLE)	131.8	nu star (bias corrected)	93.61
Mean (detects)	1.005		
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	0.0981	Mean	0.824
Maximum	1.64	Median	0.946
SD	0.49	CV	0.595
k hat (MLE)	2.25	k star (bias corrected MLE)	1.782
Theta hat (MLE)	0.366	Theta star (bias corrected MLE)	0.462
nu hat (MLE)	58.5	nu star (bias corrected)	46.33
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (46.33, α)	31.71	Adjusted Chi Square Value (46.33, β)	30
95% Gamma Approximate UCL (use when n>=50)	1.204	95% Gamma Adjusted UCL (use when n<50)	1.273
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.889	SD (KM)	0.394
Variance (KM)	0.156	SE of Mean (KM)	0.115
k hat (KM)	5.077	k star (KM)	3.957
nu hat (KM)	132	nu star (KM)	102.9
theta hat (KM)	0.175	theta star (KM)	0.225
80% gamma percentile (KM)	1.227	90% gamma percentile (KM)	1.487
95% gamma percentile (KM)	1.727	99% gamma percentile (KM)	2.24
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (102.88, α)	80.48	Adjusted Chi Square Value (102.88, β)	77.66
95% Gamma Approximate KM-UCL (use when n>=50)	1.136	95% Gamma Adjusted KM-UCL (use when n<50)	1.177
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.891	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.216	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.852	Mean in Log Scale	-0.306
SD in Original Scale	0.452	SD in Log Scale	0.584
95% t UCL (assumes normality of ROS data)	1.076	95% Percentile Bootstrap UCL	1.053
95% BCA Bootstrap UCL	1.059	95% Bootstrap t UCL	1.092
95% H-UCL (Log ROS)	1.268		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.216	KM Geo Mean	0.806
KM SD (logged)	0.441	95% Critical H Value (KM-Log)	2.046
KM Standard Error of Mean (logged)	0.129	95% H-UCL (KM -Log)	1.153
KM SD (logged)	0.441	95% Critical H Value (KM-Log)	2.046
KM Standard Error of Mean (logged)	0.129		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.831	Mean in Log Scale	-0.376
SD in Original Scale	0.479	SD in Log Scale	0.685
95% t UCL (Assumes normality)	1.068	95% H-Stat UCL	1.381

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	1.094

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.

NH-33 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	36	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	36
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 NH-33 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L] was not processed!

NH-44 - Tetrachloroethylene (PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	43	Number of Distinct Observations	18
Number of Detects	17	Number of Non-Detects	26
Number of Distinct Detects	17	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	0.5
Maximum Detect	1.88	Maximum Non-Detect	0.5
Variance Detects	0.166	Percent Non-Detects	60.47%
Mean Detects	0.969	SD Detects	0.407
Median Detects	0.945	CV Detects	0.42
Skewness Detects	0.425	Kurtosis Detects	0.591
Mean of Logged Detects	-0.135	SD of Logged Detects	0.512

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.977	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.108	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	0.504	KM Standard Error of Mean	0.0708
KM SD	0.45	95% KM (BCA) UCL	0.788
95% KM (t) UCL	0.623	95% KM (Percentile Bootstrap) UCL	0.747
95% KM (z) UCL	0.62	95% KM Bootstrap t UCL	0.616
90% KM Chebyshev UCL	0.716	95% KM Chebyshev UCL	0.813
97.5% KM Chebyshev UCL	0.946	99% KM Chebyshev UCL	1.208
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.28	Anderson-Darling GOF Test	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.116	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.21	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)	5.029	k star (bias corrected MLE)	4.181
Theta hat (MLE)	0.193	Theta star (bias corrected MLE)	0.232
nu hat (MLE)	171	nu star (bias corrected)	142.1
Mean (detects)	0.969		
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	0.496
Maximum	1.88	Median	0.369
SD	0.482	CV	0.973
k hat (MLE)	0.672	k star (bias corrected MLE)	0.64
Theta hat (MLE)	0.738	Theta star (bias corrected MLE)	0.774
nu hat (MLE)	57.76	nu star (bias corrected)	55.06
Adjusted Level of Significance (β)	0.0444		
Approximate Chi Square Value (55.06, α)	39.01	Adjusted Chi Square Value (55.06, β)	38.54
95% Gamma Approximate UCL (use when n>=50)	0.7	95% Gamma Adjusted UCL (use when n<50)	0.708
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.504	SD (KM)	0.45
Variance (KM)	0.203	SE of Mean (KM)	0.0708
k hat (KM)	1.251	k star (KM)	1.179
nu hat (KM)	107.6	nu star (KM)	101.4
theta hat (KM)	0.403	theta star (KM)	0.427
80% gamma percentile (KM)	0.799	90% gamma percentile (KM)	1.114
95% gamma percentile (KM)	1.425	99% gamma percentile (KM)	2.138
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (101.43, α)	79.19	Adjusted Chi Square Value (101.43, β)	78.51
95% Gamma Approximate KM-UCL (use when n>=50)	0.645	95% Gamma Adjusted KM-UCL (use when n<50)	0.651
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.15	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.551	Mean in Log Scale	-0.897
SD in Original Scale	0.435	SD in Log Scale	0.806
95% t UCL (assumes normality of ROS data)	0.663	95% Percentile Bootstrap UCL	0.658
95% BCA Bootstrap UCL	0.671	95% Bootstrap t UCL	0.674
95% H-UCL (Log ROS)	0.738		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.026	KM Geo Mean	0.358
KM SD (logged)	0.786	95% Critical H Value (KM-Log)	2.141
KM Standard Error of Mean (logged)	0.124	95% H-UCL (KM -Log)	0.632
KM SD (logged)	0.786	95% Critical H Value (KM-Log)	2.141
KM Standard Error of Mean (logged)	0.124		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.534	Mean in Log Scale	-0.891
SD in Original Scale	0.435	SD in Log Scale	0.695
95% t UCL (Assumes normality)	0.646	95% H-Stat UCL	0.651

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	0.623

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.

NH-25 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	47	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	1500	Mean	3768
Maximum	4925	Median	3908
SD	1007	Std. Error of Mean	146.8
Coefficient of Variation	0.267	Skewness	-0.884

Normal GOF Test

Shapiro Wilk Test Statistic	0.876	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.154	Lilliefors GOF Test
5% Lilliefors Critical Value	0.128	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	4015	95% Adjusted-CLT UCL (Chen-1995)	3989
		95% Modified-t UCL (Johnson-1978)	4012

Gamma GOF Test

A-D Test Statistic	2.595	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.2	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)	11.11	k star (bias corrected MLE)	10.42
Theta hat (MLE)	339.1	Theta star (bias corrected MLE)	361.7
nu hat (MLE)	1045	nu star (bias corrected)	979.4
MLE Mean (bias corrected)	3768	MLE Sd (bias corrected)	1167
		Approximate Chi Square Value (0.05)	907.7
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	905.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4066	95% Adjusted Gamma UCL (use when n<50)	4075

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.811	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.128	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.313	Mean of logged Data	8.189
Maximum of Logged Data	8.502	SD of logged Data	0.328

Assuming Lognormal Distribution

95% H-UCL	4142	90% Chebyshev (MVUE) UCL	4352
95% Chebyshev (MVUE) UCL	4604	97.5% Chebyshev (MVUE) UCL	4955
99% Chebyshev (MVUE) UCL	5643		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	4010	95% Jackknife UCL	4015
95% Standard Bootstrap UCL	4007	95% Bootstrap-t UCL	4007
95% Hall's Bootstrap UCL	3999	95% Percentile Bootstrap UCL	4001
95% BCA Bootstrap UCL	3989		
90% Chebyshev(Mean, Sd) UCL	4209	95% Chebyshev(Mean, Sd) UCL	4408
97.5% Chebyshev(Mean, Sd) UCL	4685	99% Chebyshev(Mean, Sd) UCL	5229

Suggested UCL to Use

95% Student's-t UCL	4015	or 95% Modified-t UCL	4012

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.

NH-37 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	58	Number of Distinct Observations	51
		Number of Missing Observations	0
Minimum	1220	Mean	3212
Maximum	5580	Median	2297
SD	1599	Std. Error of Mean	210
Coefficient of Variation	0.498	Skewness	0.331

Normal GOF Test			
Shapiro Wilk Test Statistic	0.802	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	3.26E-10	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.25	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.116	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	3563	95% Adjusted-CLT UCL (Chen-1995)	3567
		95% Modified-t UCL (Johnson-1978)	3565
Gamma GOF Test			
A-D Test Statistic	3.799	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.226	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.117	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.049	k star (bias corrected MLE)	3.851
Theta hat (MLE)	793.3	Theta star (bias corrected MLE)	834.1
nu hat (MLE)	469.7	nu star (bias corrected)	446.7
MLE Mean (bias corrected)	3212	MLE Sd (bias corrected)	1637
		Approximate Chi Square Value (0.05)	398.7
Adjusted Level of Significance	0.0459	Adjusted Chi Square Value	397.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3599	95% Adjusted Gamma UCL (use when n<50)	3609
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.842	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	3.99E-08	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.209	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.116	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.107	Mean of logged Data	7.946
Maximum of Logged Data	8.627	SD of logged Data	0.517
Assuming Lognormal Distribution			
95% H-UCL	3676	90% Chebyshev (MVUE) UCL	3911
95% Chebyshev (MVUE) UCL	4224	97.5% Chebyshev (MVUE) UCL	4659
99% Chebyshev (MVUE) UCL	5512		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3557	95% Jackknife UCL	3563
95% Standard Bootstrap UCL	3555	95% Bootstrap-t UCL	3567
95% Hall's Bootstrap UCL	3548	95% Percentile Bootstrap UCL	3579
95% BCA Bootstrap UCL	3557		
90% Chebyshev(Mean, Sd) UCL	3842	95% Chebyshev(Mean, Sd) UCL	4127
97.5% Chebyshev(Mean, Sd) UCL	4523	99% Chebyshev(Mean, Sd) UCL	5301
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	4127		

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.

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

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.

NH-44 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	35
		Number of Missing Observations	0
Minimum	973.7	Mean	1984
Maximum	3118	Median	1982
SD	772.1	Std. Error of Mean	122.1
Coefficient of Variation	0.389	Skewness	-0.00932
Normal GOF Test			
Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.182	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.139	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	2190	95% Adjusted-CLT UCL (Chen-1995)	2185
		95% Modified-t UCL (Johnson-1978)	2190
Gamma GOF Test			
A-D Test Statistic	1.991	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.185	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.175	k star (bias corrected MLE)	5.729
Theta hat (MLE)	321.3	Theta star (bias corrected MLE)	346.3
nu hat (MLE)	494	nu star (bias corrected)	458.3
MLE Mean (bias corrected)	1984	MLE Sd (bias corrected)	829
		Approximate Chi Square Value (0.05)	409.6
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	407.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2220	95% Adjusted Gamma UCL (use when n<50)	2229
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.845	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.181	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.139	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.881	Mean of logged Data	7.51
Maximum of Logged Data	8.045	SD of logged Data	0.425
Assuming Lognormal Distribution			
95% H-UCL	2269	90% Chebyshev (MVUE) UCL	2410
95% Chebyshev (MVUE) UCL	2598	97.5% Chebyshev (MVUE) UCL	2860
99% Chebyshev (MVUE) UCL	3374		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			

Nonparametric Distribution Free UCLs			
95% CLT UCL	2185	95% Jackknife UCL	2190
95% Standard Bootstrap UCL	2185	95% Bootstrap-t UCL	2183
95% Hall's Bootstrap UCL	2180	95% Percentile Bootstrap UCL	2183
95% BCA Bootstrap UCL	2193		
90% Chebyshev(Mean, Sd) UCL	2350	95% Chebyshev(Mean, Sd) UCL	2516
97.5% Chebyshev(Mean, Sd) UCL	2746	99% Chebyshev(Mean, Sd) UCL	3199

Suggested UCL to Use			
95% Student's-t UCL	2190	or 95% Modified-t UCL	2190

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.

NH-43A - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	51	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	1462	Mean	3668
Maximum	7545	Median	3027
SD	2152	Std. Error of Mean	301.4
Coefficient of Variation	0.587	Skewness	0.423

Normal GOF Test			
Shapiro Wilk Test Statistic	0.822	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	6.06E-08	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.23	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	4174	95% Adjusted-CLT UCL (Chen-1995)	4183
		95% Modified-t UCL (Johnson-1978)	4177

Gamma GOF Test			
A-D Test Statistic	3.161	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.217	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.125	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	2.906	k star (bias corrected MLE)	2.748
Theta hat (MLE)	1262	Theta star (bias corrected MLE)	1335
nu hat (MLE)	296.4	nu star (bias corrected)	280.3
MLE Mean (bias corrected)	3668	MLE Sd (bias corrected)	2213
		Approximate Chi Square Value (0.05)	242.5
Adjusted Level of Significance	0.0453	Adjusted Chi Square Value	241.5

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4240	95% Adjusted Gamma UCL (use when n<50)	4258

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.824	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	7.16E-08	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.203	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	7.287	Mean of logged Data	8.026
Maximum of Logged Data	8.929	SD of logged Data	0.617

Assuming Lognormal Distribution

95% H-UCL	4391	90% Chebyshev (MVUE) UCL	4711
95% Chebyshev (MVUE) UCL	5177	97.5% Chebyshev (MVUE) UCL	5822
99% Chebyshev (MVUE) UCL	7091		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	4164	95% Jackknife UCL	4174
95% Standard Bootstrap UCL	4156	95% Bootstrap-t UCL	4212
95% Hall's Bootstrap UCL	4171	95% Percentile Bootstrap UCL	4163
95% BCA Bootstrap UCL	4180		
90% Chebyshev(Mean, Sd) UCL	4573	95% Chebyshev(Mean, Sd) UCL	4982
97.5% Chebyshev(Mean, Sd) UCL	5551	99% Chebyshev(Mean, Sd) UCL	6667

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4982

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.

NH-04 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	40	Number of Distinct Observations	34
Number of Detects	39	Number of Non-Detects	1
Number of Distinct Detects	33	Number of Distinct Non-Detects	1
Minimum Detect	824.6	Minimum Non-Detect	113
Maximum Detect	3931	Maximum Non-Detect	113
Variance Detects	412979	Percent Non-Detects	2.50%
Mean Detects	2509	SD Detects	642.6
Median Detects	2575	CV Detects	0.256
Skewness Detects	0.0647	Kurtosis Detects	0.211
Mean of Logged Detects	7.792	SD of Logged Detects	0.285

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.954	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.939	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.131	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.14	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	2450	KM Standard Error of Mean	116.9
KM SD	729.6	95% KM (BCA) UCL	2649
95% KM (t) UCL	2646	95% KM (Percentile Bootstrap) UCL	2637
95% KM (z) UCL	2642	95% KM Bootstrap t UCL	2635
90% KM Chebyshev UCL	2800	95% KM Chebyshev UCL	2959
97.5% KM Chebyshev UCL	3179	99% KM Chebyshev UCL	3612

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.8	Anderson-Darling GOF Test	
5% A-D Critical Value	0.748	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.121	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.141	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)	14.04	k star (bias corrected MLE)	12.98
Theta hat (MLE)	178.8	Theta star (bias corrected MLE)	193.4
nu hat (MLE)	1095	nu star (bias corrected)	1012
Mean (detects)	2509		
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	824.6	Mean	2476
Maximum	3931	Median	2575
SD	668.1	CV	0.27
k hat (MLE)	12.47	k star (bias corrected MLE)	11.55
Theta hat (MLE)	198.6	Theta star (bias corrected MLE)	214.4
nu hat (MLE)	997.6	nu star (bias corrected)	924.1
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (924.08, α)	854.5	Adjusted Chi Square Value (924.08, β)	852
95% Gamma Approximate UCL (use when n>=50)	2678	95% Gamma Adjusted UCL (use when n<50)	2686
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	2450	SD (KM)	729.6
Variance (KM)	532317	SE of Mean (KM)	116.9
k hat (KM)	11.27	k star (KM)	10.44
nu hat (KM)	901.8	nu star (KM)	835.5
theta hat (KM)	217.3	theta star (KM)	234.6
80% gamma percentile (KM)	3054	90% gamma percentile (KM)	3457
95% gamma percentile (KM)	3815	99% gamma percentile (KM)	4548
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (835.47, α)	769.4	Adjusted Chi Square Value (835.47, β)	767
95% Gamma Approximate KM-UCL (use when n>=50)	2660	95% Gamma Adjusted KM-UCL (use when n<50)	2668
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.939	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.133	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.14	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	2477	Mean in Log Scale	7.775
SD in Original Scale	666.1	SD in Log Scale	0.302
95% t UCL (assumes normality of ROS data)	2655	95% Percentile Bootstrap UCL	2647
95% BCA Bootstrap UCL	2648	95% Bootstrap t UCL	2646
95% H-UCL (Log ROS)	2716		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	7.715	KM Geo Mean	2242
KM SD (logged)	0.553	95% Critical H Value (KM-Log)	1.963
KM Standard Error of Mean (logged)	0.0886	95% H-UCL (KM -Log)	3110
KM SD (logged)	0.553	95% Critical H Value (KM-Log)	1.963

KM Standard Error of Mean (logged)	0.0886		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2448	Mean in Log Scale	7.698
SD in Original Scale	743.5	SD in Log Scale	0.657
95% t UCL (Assumes normality)	2646	95% H-Stat UCL	3395

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	2646

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.

NH-23 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	35	Number of Distinct Observations	32
		Number of Missing Observations	0
Minimum	4247	Mean	6869
Maximum	10008	Median	6732
SD	1452	Std. Error of Mean	245.4
Coefficient of Variation	0.211	Skewness	0.089

Normal GOF Test

Shapiro Wilk Test Statistic	0.969	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0906	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	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	7284	95% Adjusted-CLT UCL (Chen-1995)	7277
		95% Modified-t UCL (Johnson-1978)	7285

Gamma GOF Test

A-D Test Statistic	0.424	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.107	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.148	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	22.29	k star (bias corrected MLE)	20.4
Theta hat (MLE)	308.2	Theta star (bias corrected MLE)	336.8
nu hat (MLE)	1560	nu star (bias corrected)	1428
MLE Mean (bias corrected)	6869	MLE Sd (bias corrected)	1521
		Approximate Chi Square Value (0.05)	1341
Adjusted Level of Significance	0.0425	Adjusted Chi Square Value	1337

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7314	95% Adjusted Gamma UCL (use when n<50)	7336

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.934	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.148	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.354	Mean of logged Data	8.812
Maximum of Logged Data	9.211	SD of logged Data	0.219
Assuming Lognormal Distribution			
95% H-UCL	7347	90% Chebyshev (MVUE) UCL	7643
95% Chebyshev (MVUE) UCL	7991	97.5% Chebyshev (MVUE) UCL	8475
99% Chebyshev (MVUE) UCL	9424		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7273	95% Jackknife UCL	7284
95% Standard Bootstrap UCL	7277	95% Bootstrap-t UCL	7284
95% Hall's Bootstrap UCL	7291	95% Percentile Bootstrap UCL	7281
95% BCA Bootstrap UCL	7250		
90% Chebyshev(Mean, Sd) UCL	7606	95% Chebyshev(Mean, Sd) UCL	7939
97.5% Chebyshev(Mean, Sd) UCL	8402	99% Chebyshev(Mean, Sd) UCL	9311
Suggested UCL to Use			
95% Student's-t UCL	7284		

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.

NH-23 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	16
Number of Detects	15	Number of Non-Detects	23
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	0.511	Minimum Non-Detect	0.5
Maximum Detect	0.905	Maximum Non-Detect	0.5
Variance Detects	0.0164	Percent Non-Detects	60.53%
Mean Detects	0.672	SD Detects	0.128
Median Detects	0.699	CV Detects	0.191
Skewness Detects	0.227	Kurtosis Detects	-1.108
Mean of Logged Detects	-0.415	SD of Logged Detects	0.192
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.188	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.22	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	0.568	KM Standard Error of Mean	0.0192
KM SD	0.114	95% KM (BCA) UCL	0.601
95% KM (t) UCL	0.6	95% KM (Percentile Bootstrap) UCL	0.6
95% KM (z) UCL	0.599	95% KM Bootstrap t UCL	0.606
90% KM Chebyshev UCL	0.625	95% KM Chebyshev UCL	0.651
97.5% KM Chebyshev UCL	0.688	99% KM Chebyshev UCL	0.759

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.569	Anderson-Darling GOF Test	
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.192	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.221	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)	29.47	k star (bias corrected MLE)	23.62
Theta hat (MLE)	0.0228	Theta star (bias corrected MLE)	0.0284
nu hat (MLE)	884	nu star (bias corrected)	708.5
Mean (detects)	0.672		
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	0.0529	Mean	0.455
Maximum	0.905	Median	0.438
SD	0.215	CV	0.472
k hat (MLE)	3.675	k star (bias corrected MLE)	3.402
Theta hat (MLE)	0.124	Theta star (bias corrected MLE)	0.134
nu hat (MLE)	279.3	nu star (bias corrected)	258.6
Adjusted Level of Significance (β)	0.0434		
Approximate Chi Square Value (258.55, α)	222.3	Adjusted Chi Square Value (258.55, β)	220.9
95% Gamma Approximate UCL (use when n>=50)	0.53	95% Gamma Adjusted UCL (use when n<50)	0.533
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.568	SD (KM)	0.114
Variance (KM)	0.0131	SE of Mean (KM)	0.0192
k hat (KM)	24.65	k star (KM)	22.72
nu hat (KM)	1873	nu star (KM)	1727
theta hat (KM)	0.023	theta star (KM)	0.025
80% gamma percentile (KM)	0.665	90% gamma percentile (KM)	0.725
95% gamma percentile (KM)	0.777	99% gamma percentile (KM)	0.881
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, α)	1631	Adjusted Chi Square Value (N/A, β)	1627
95% Gamma Approximate KM-UCL (use when n>=50)	0.601	95% Gamma Adjusted KM-UCL (use when n<50)	0.602
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.914	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.191	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.22	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	0.492	Mean in Log Scale	-0.773
SD in Original Scale	0.178	SD in Log Scale	0.36
95% t UCL (assumes normality of ROS data)	0.54	95% Percentile Bootstrap UCL	0.539
95% BCA Bootstrap UCL	0.541	95% Bootstrap t UCL	0.546
95% H-UCL (Log ROS)	0.549		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.583	KM Geo Mean	0.558
KM SD (logged)	0.179	95% Critical H Value (KM-Log)	1.727
KM Standard Error of Mean (logged)	0.03	95% H-UCL (KM -Log)	0.596
KM SD (logged)	0.179	95% Critical H Value (KM-Log)	1.727

KM Standard Error of Mean (logged)	0.03		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.416	Mean in Log Scale	-1.003
SD in Original Scale	0.223	SD in Log Scale	0.495
95% t UCL (Assumes normality)	0.477	95% H-Stat UCL	0.484

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	0.6

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.

NH-26 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	31	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	31
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 NH-26 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-43A - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	50	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	42
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.21	Minimum Non-Detect	0.5
Maximum Detect	1.8	Maximum Non-Detect	0.5
Variance Detects	0.343	Percent Non-Detects	84%
Mean Detects	1.067	SD Detects	0.586
Median Detects	1.134	CV Detects	0.549
Skewness Detects	-0.215	Kurtosis Detects	-1.68
Mean of Logged Detects	-0.128	SD of Logged Detects	0.741

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.182	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	0.347	KM Standard Error of Mean	0.0579
KM SD	0.383	95% KM (BCA) UCL	0.665
95% KM (t) UCL	0.444	95% KM (Percentile Bootstrap) UCL	0.64
95% KM (z) UCL	0.442	95% KM Bootstrap t UCL	0.456
90% KM Chebyshev UCL	0.521	95% KM Chebyshev UCL	0.599
97.5% KM Chebyshev UCL	0.709	99% KM Chebyshev UCL	0.923

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.426	Anderson-Darling GOF Test	
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.218	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)	2.746	k star (bias corrected MLE)	1.799
Theta hat (MLE)	0.389	Theta star (bias corrected MLE)	0.593
nu hat (MLE)	43.93	nu star (bias corrected)	28.79
Mean (detects)	1.067		
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	0.307
Maximum	1.8	Median	0.091
SD	0.449	CV	1.461
k hat (MLE)	0.451	k star (bias corrected MLE)	0.437
Theta hat (MLE)	0.681	Theta star (bias corrected MLE)	0.702
nu hat (MLE)	45.11	nu star (bias corrected)	43.74
Adjusted Level of Significance (β)	0.0452		
Approximate Chi Square Value (43.74, α)	29.57	Adjusted Chi Square Value (43.74, β)	29.23
95% Gamma Approximate UCL (use when n>=50)	0.454	95% Gamma Adjusted UCL (use when n<50)	0.46
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.347	SD (KM)	0.383
Variance (KM)	0.147	SE of Mean (KM)	0.0579
k hat (KM)	0.821	k star (KM)	0.785
nu hat (KM)	82.13	nu star (KM)	78.53
theta hat (KM)	0.423	theta star (KM)	0.442
80% gamma percentile (KM)	0.568	90% gamma percentile (KM)	0.848
95% gamma percentile (KM)	1.133	99% gamma percentile (KM)	1.809
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (78.53, α)	59.12	Adjusted Chi Square Value (78.53, β)	58.62
95% Gamma Approximate KM-UCL (use when n>=50)	0.461	95% Gamma Adjusted KM-UCL (use when n<50)	0.465
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.212	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.362	Mean in Log Scale	-1.487
SD in Original Scale	0.408	SD in Log Scale	0.979
95% t UCL (assumes normality of ROS data)	0.459	95% Percentile Bootstrap UCL	0.458
95% BCA Bootstrap UCL	0.47	95% Bootstrap t UCL	0.495
95% H-UCL (Log ROS)	0.505		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-1.331	KM Geo Mean	0.264
KM SD (logged)	0.594	95% Critical H Value (KM-Log)	1.961
KM Standard Error of Mean (logged)	0.0898	95% H-UCL (KM -Log)	0.372
KM SD (logged)	0.594	95% Critical H Value (KM-Log)	1.961

KM Standard Error of Mean (logged)	0.0898		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.381	Mean in Log Scale	-1.185
SD in Original Scale	0.375	SD in Log Scale	0.544
95% t UCL (Assumes normality)	0.47	95% H-Stat UCL	0.411

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	0.444

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.

NH-34 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	50	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	48
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.511	Minimum Non-Detect	0.5
Maximum Detect	0.512	Maximum Non-Detect	0.5
Variance Detects	5.00E-07	Percent Non-Detects	96%
Mean Detects	0.512	SD Detects	7.07E-04
Median Detects	0.512	CV Detects	0.00138
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.67	SD of Logged Detects	0.00138

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	0.5	KM Standard Error of Mean	4.51E-04
KM SD	0.00226	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.501	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.501	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.502	95% KM Chebyshev UCL	0.502
97.5% KM Chebyshev UCL	0.503	99% KM Chebyshev UCL	0.505

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1046529	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.89E-07	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4186115	nu star (bias corrected)	N/A
Mean (detects)	0.512		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.5	SD (KM)	0.00226
Variance (KM)	5.09E-06	SE of Mean (KM)	4.51E-04
k hat (KM)	49222	k star (KM)	46269

nu hat (KM)	4922180	nu star (KM)	4626851
theta hat (KM)	1.02E-05	theta star (KM)	1.08E-05
80% gamma percentile (KM)	0.502	90% gamma percentile (KM)	0.503
95% gamma percentile (KM)	0.504	99% gamma percentile (KM)	0.506

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0452
Approximate Chi Square Value (N/A, α)	4621848	Adjusted Chi Square Value (N/A, β)	4621701
95% Gamma Approximate KM-UCL (use when n>=50)	0.501	95% Gamma Adjusted KM-UCL (use when n<50)	0.501

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	0.504	Mean in Log Scale	-0.685
SD in Original Scale	0.00332	SD in Log Scale	0.00657
95% t UCL (assumes normality of ROS data)	0.505	95% Percentile Bootstrap UCL	0.505
95% BCA Bootstrap UCL	0.505	95% Bootstrap t UCL	0.505
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.692	KM Geo Mean	0.5
KM SD (logged)	0.00446	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	8.92E-04	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.00446	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	8.92E-04		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.26	Mean in Log Scale	-1.358
SD in Original Scale	0.0518	SD in Log Scale	0.142
95% t UCL (Assumes normality)	0.273	95% H-Stat UCL	0.269

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	0.501	KM H-UCL	N/A
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.

NH-36 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	57	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	57
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 NH-36 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-37 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

General Statistics

Total Number of Observations	65	Number of Distinct Observations	23
Number of Detects	22	Number of Non-Detects	43
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	0.46	Minimum Non-Detect	0.5
Maximum Detect	1.24	Maximum Non-Detect	0.5
Variance Detects	0.0646	Percent Non-Detects	66.15%
Mean Detects	0.808	SD Detects	0.254
Median Detects	0.715	CV Detects	0.314
Skewness Detects	0.5	Kurtosis Detects	-1.163
Mean of Logged Detects	-0.259	SD of Logged Detects	0.31

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.905	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.188	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.184	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	0.578	KM Standard Error of Mean	0.0278
KM SD	0.219	95% KM (BCA) UCL	0.653
95% KM (t) UCL	0.624	95% KM (Percentile Bootstrap) UCL	0.638
95% KM (z) UCL	0.624	95% KM Bootstrap t UCL	0.624
90% KM Chebyshev UCL	0.661	95% KM Chebyshev UCL	0.699
97.5% KM Chebyshev UCL	0.752	99% KM Chebyshev UCL	0.855

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.629	Anderson-Darling GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.169	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.185	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)	10.96	k star (bias corrected MLE)	9.5
Theta hat (MLE)	0.0737	Theta star (bias corrected MLE)	0.0851
nu hat (MLE)	482.4	nu star (bias corrected)	418
Mean (detects)	0.808		

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	0.439
Maximum	1.24	Median	0.401
SD	0.335	CV	0.763
k hat (MLE)	1.062	k star (bias corrected MLE)	1.023
Theta hat (MLE)	0.413	Theta star (bias corrected MLE)	0.429
nu hat (MLE)	138.1	nu star (bias corrected)	133.1
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (133.05, α)	107.4	Adjusted Chi Square Value (133.05, β)	106.9
95% Gamma Approximate UCL (use when n>=50)	0.544	95% Gamma Adjusted UCL (use when n<50)	0.546

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.578	SD (KM)	0.219
Variance (KM)	0.048	SE of Mean (KM)	0.0278
k hat (KM)	6.952	k star (KM)	6.641
nu hat (KM)	903.8	nu star (KM)	863.4

theta hat (KM)	0.0831	theta star (KM)	0.087
80% gamma percentile (KM)	0.753	90% gamma percentile (KM)	0.877
95% gamma percentile (KM)	0.989	99% gamma percentile (KM)	1.223

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (863.39, α)	796.2	Adjusted Chi Square Value (863.39, β)	794.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.627	95% Gamma Adjusted KM-UCL (use when n<50)	0.628

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.151	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.184	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	0.513	Mean in Log Scale	-0.795
SD in Original Scale	0.274	SD in Log Scale	0.508
95% t UCL (assumes normality of ROS data)	0.57	95% Percentile Bootstrap UCL	0.568
95% BCA Bootstrap UCL	0.574	95% Bootstrap t UCL	0.572
95% H-UCL (Log ROS)	0.579		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.601	KM Geo Mean	0.548
KM SD (logged)	0.302	95% Critical H Value (KM-Log)	1.756
KM Standard Error of Mean (logged)	0.0383	95% H-UCL (KM -Log)	0.613
KM SD (logged)	0.302	95% Critical H Value (KM-Log)	1.756
KM Standard Error of Mean (logged)	0.0383		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.439	Mean in Log Scale	-1.005
SD in Original Scale	0.303	SD in Log Scale	0.566
95% t UCL (Assumes normality)	0.502	95% H-Stat UCL	0.492

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 Approximate Gamma UCL	0.627	95% GROS Approximate Gamma UCL	0.544

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.

NH-45 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	58	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	58
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 NH-45 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-22 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	44
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 NH-22 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-25 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	49	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	49
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 NH-25 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-04 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	44
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 NH-04 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-32 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	42	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	42
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 NH-32 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-07 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	13	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	13
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 NH-07 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-33 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	36	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	36
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 NH-33 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-44 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics

Total Number of Observations	43	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	43
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 NH-44 - CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L] was not processed!

NH-07 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	1	Number of Non-Detects	2
Number of Distinct Detects	1	Number of Distinct Non-Detects	2

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 NH-07 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

NH-25 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	0.85	Mean	1.225
Maximum	1.6	Median	1.225

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-25 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-37 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	2.77	Mean	2.935
Maximum	3.1	Median	2.935

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-37 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	1.17	Minimum Non-Detect	0.1
Maximum Detect	1.29	Maximum Non-Detect	0.1
Variance Detects	0.0039	Percent Non-Detects	25%
Mean Detects	1.22	SD Detects	0.0624
Median Detects	1.2	CV Detects	0.0512
Skewness Detects	1.293	Kurtosis Detects	N/A
Mean of Logged Detects	0.198	SD of Logged Detects	0.0507

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	0.923	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.292	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	0.94	KM Standard Error of Mean	0.298
KM SD	0.487	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.642	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.431	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.835	95% KM Chebyshev UCL	2.24
97.5% KM Chebyshev UCL	2.802	99% KM Chebyshev UCL	3.907

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	580.4	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0021	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3483	nu star (bias corrected)	N/A
Mean (detects)	1.22		

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	1.049	Mean	1.177
Maximum	1.29	Median	1.185
SD	0.0996	CV	0.0846
k hat (MLE)	183	k star (bias corrected MLE)	45.92
Theta hat (MLE)	0.00643	Theta star (bias corrected MLE)	0.0256
nu hat (MLE)	1464	nu star (bias corrected)	367.4
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (367.37, α)	324	Adjusted Chi Square Value (367.37, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	1.335	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.94	SD (KM)	0.487
Variance (KM)	0.237	SE of Mean (KM)	0.298
k hat (KM)	3.726	k star (KM)	1.098
nu hat (KM)	29.81	nu star (KM)	8.785
theta hat (KM)	0.252	theta star (KM)	0.856
80% gamma percentile (KM)	1.501	90% gamma percentile (KM)	2.115
95% gamma percentile (KM)	2.725	99% gamma percentile (KM)	4.131

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.79, α)	3.198	Adjusted Chi Square Value (8.79, β)	1.653
95% Gamma Approximate KM-UCL (use when n>=50)	2.582	95% Gamma Adjusted KM-UCL (use when n<50)	4.997

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.928	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.288	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.179	Mean in Log Scale	0.163
SD in Original Scale	0.0958	SD in Log Scale	0.0821
95% t UCL (assumes normality of ROS data)	1.292	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.427	KM Geo Mean	0.652
KM SD (logged)	1.083	95% Critical H Value (KM-Log)	7.198
KM Standard Error of Mean (logged)	0.663	95% H-UCL (KM -Log)	105.9
KM SD (logged)	1.083	95% Critical H Value (KM-Log)	7.198
KM Standard Error of Mean (logged)	0.663		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.928	Mean in Log Scale	-0.6
SD in Original Scale	0.587	SD in Log Scale	1.597
95% t UCL (Assumes normality)	1.618	95% H-Stat UCL	31623

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 1.642
Warning: Recommended UCL exceeds the maximum observation

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.

NH-43A - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.993	Mean	1.654
Maximum	2	Median	1.97
SD	0.573	Std. Error of Mean	0.331
Coefficient of Variation	0.346	Skewness	-1.727

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	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.376	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	2.62	95% Adjusted-CLT UCL (Chen-1995)	1.846
		95% Modified-t UCL (Johnson-1978)	2.565

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	10.44	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.159	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	62.61	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.766	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.378	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.00702	Mean of logged Data	0.455
Maximum of Logged Data	0.693	SD of logged Data	0.4

Assuming Lognormal Distribution

95% H-UCL	7.469	90% Chebyshev (MVUE) UCL	2.789
95% Chebyshev (MVUE) UCL	3.3	97.5% Chebyshev (MVUE) UCL	4.009
99% Chebyshev (MVUE) UCL	5.403		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.198	95% Jackknife UCL	2.62
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.647	95% Chebyshev(Mean, Sd) UCL	3.096
97.5% Chebyshev(Mean, Sd) UCL	3.72	99% Chebyshev(Mean, Sd) UCL	4.946

Suggested UCL to Use

95% Student's-t UCL	2.62

Recommended UCL exceeds the maximum observation

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.

NH-04 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	0.204	Mean	0.332
Maximum	0.46	Median	0.332

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-04 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-23 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	1.6	Mean	1.947
Maximum	2.57	Median	1.67
SD	0.541	Std. Error of Mean	0.312
Coefficient of Variation	0.278	Skewness	1.699

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

Shapiro Wilk Test Statistic	0.804	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.362	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	2.859	95% Adjusted-CLT UCL (Chen-1995)	2.788
		95% Modified-t UCL (Johnson-1978)	2.91

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	21.11	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0922	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	126.7	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.817	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.356	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.47	Mean of logged Data	0.642
Maximum of Logged Data	0.944	SD of logged Data	0.262

Assuming Lognormal Distribution

95% H-UCL	3.956	90% Chebyshev (MVUE) UCL	2.82
95% Chebyshev (MVUE) UCL	3.216	97.5% Chebyshev (MVUE) UCL	3.767
99% Chebyshev (MVUE) UCL	4.848		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.46	95% Jackknife UCL	2.859
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.884	95% Chebyshev(Mean, Sd) UCL	3.308
97.5% Chebyshev(Mean, Sd) UCL	3.897	99% Chebyshev(Mean, Sd) UCL	5.054

Suggested UCL to Use

95% Student's-t UCL	2.859

Recommended UCL exceeds the maximum observation

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.

NH-22 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	1.32	Mean	1.32
Maximum	1.32	Median	1.32

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-26 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	1.19	Mean	1.47
Maximum	1.75	Median	1.47

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	2.47	Mean	2.47
Maximum	2.47	Median	2.47

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	3.4	Mean	3.4

Maximum	3.4	Median	3.4

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	4.38	Mean	4.38
Maximum	4.38	Median	4.38

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	0.423	Mean	0.423
Maximum	0.423	Median	0.423

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - CHROMIUM, HEXAVALENT (Cr+6) (CasNo: 18540-29-9) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	15.6	Mean	56.53
Maximum	115	Median	39
SD	51.97	Std. Error of Mean	30
Coefficient of Variation	0.919	Skewness	1.345

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	0.915	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.299	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	144.1	95% Adjusted-CLT UCL (Chen-1995)	130.8
		95% Modified-t UCL (Johnson-1978)	148

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.729	k star (bias corrected MLE)	N/A
Theta hat (MLE)	32.7	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	10.37	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.189	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.747	Mean of logged Data	3.719
Maximum of Logged Data	4.745	SD of logged Data	1

Assuming Lognormal Distribution

95% H-UCL	690854	90% Chebyshev (MVUE) UCL	143
95% Chebyshev (MVUE) UCL	182.3	97.5% Chebyshev (MVUE) UCL	236.9
99% Chebyshev (MVUE) UCL	344.1		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	105.9	95% Jackknife UCL	144.1
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A

95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	146.5	95% Chebyshev(Mean, Sd) UCL	187.3
97.5% Chebyshev(Mean, Sd) UCL	243.9	99% Chebyshev(Mean, Sd) UCL	355.1

Suggested UCL to Use

95% Student's-t UCL	144.1

Recommended UCL exceeds the maximum observation

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.

NH-22 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4.1	Mean	19.18
Maximum	53.6	Median	9.5
SD	23.41	Std. Error of Mean	11.7
Coefficient of Variation	1.221	Skewness	1.782

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	0.771	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.334	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	46.72	95% Adjusted-CLT UCL (Chen-1995)	49.57
		95% Modified-t UCL (Johnson-1978)	48.46

Gamma GOF Test

A-D Test Statistic	0.424	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.666	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.402	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.044	k star (bias corrected MLE)	0.428
Theta hat (MLE)	18.36	Theta star (bias corrected MLE)	44.83
nu hat (MLE)	8.354	nu star (bias corrected)	3.422
MLE Mean (bias corrected)	19.18	MLE Sd (bias corrected)	29.32
		Approximate Chi Square Value (0.05)	0.508
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	129.3	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.896	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.411	Mean of logged Data	2.404
Maximum of Logged Data	3.982	SD of logged Data	1.188

Assuming Lognormal Distribution

95% H-UCL	4944	90% Chebyshev (MVUE) UCL	46.73
95% Chebyshev (MVUE) UCL	59.78	97.5% Chebyshev (MVUE) UCL	77.89
99% Chebyshev (MVUE) UCL	113.5		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	38.43	95% Jackknife UCL	46.72
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	54.29	95% Chebyshev(Mean, Sd) UCL	70.19
97.5% Chebyshev(Mean, Sd) UCL	92.26	99% Chebyshev(Mean, Sd) UCL	135.6

Suggested UCL to Use

95% Student's-t UCL	46.72

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.

NH-23 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	3.5	Minimum Non-Detect	10
Maximum Detect	19	Maximum Non-Detect	10
Variance Detects	73.08	Percent Non-Detects	25%
Mean Detects	9.167	SD Detects	8.549
Median Detects	5	CV Detects	0.933
Skewness Detects	1.672	Kurtosis Detects	N/A
Mean of Logged Detects	1.936	SD of Logged Detects	0.892

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	0.822	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.354	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	7.938	KM Standard Error of Mean	3.941
KM SD	6.42	95% KM (BCA) UCL	N/A
95% KM (t) UCL	17.21	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	14.42	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	19.76	95% KM Chebyshev UCL	25.12
97.5% KM Chebyshev UCL	32.55	99% KM Chebyshev UCL	47.15

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.936	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.736	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.61	nu star (bias corrected)	N/A
Mean (detects)	9.167		

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	3.5	Mean	7.97
Maximum	19	Median	4.69
SD	7.379	CV	0.926
k hat (MLE)	2.114	k star (bias corrected MLE)	0.695
Theta hat (MLE)	3.77	Theta star (bias corrected MLE)	11.46
nu hat (MLE)	16.91	nu star (bias corrected)	5.562
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (5.56, α)	1.42	Adjusted Chi Square Value (5.56, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	31.21	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	7.938	SD (KM)	6.42
Variance (KM)	41.21	SE of Mean (KM)	3.941
k hat (KM)	1.529	k star (KM)	0.549
nu hat (KM)	12.23	nu star (KM)	4.391
theta hat (KM)	5.192	theta star (KM)	14.46
80% gamma percentile (KM)	13.07	90% gamma percentile (KM)	21.05
95% gamma percentile (KM)	29.49	99% gamma percentile (KM)	50.06

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.39, α)	0.882	Adjusted Chi Square Value (4.39, β)	0.298
95% Gamma Approximate KM-UCL (use when n>=50)	39.52	95% Gamma Adjusted KM-UCL (use when n<50)	116.8

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.9	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.309	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	7.975	Mean in Log Scale	1.822
SD in Original Scale	7.376	SD in Log Scale	0.763
95% t UCL (assumes normality of ROS data)	16.65	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	81.06		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.809	KM Geo Mean	6.107
KM SD (logged)	0.673	95% Critical H Value (KM-Log)	4.639
KM Standard Error of Mean (logged)	0.418	95% H-UCL (KM -Log)	46.48
KM SD (logged)	0.673	95% Critical H Value (KM-Log)	4.639
KM Standard Error of Mean (logged)	0.418		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	8.125	Mean in Log Scale	1.854
SD in Original Scale	7.284	SD in Log Scale	0.746
95% t UCL (Assumes normality)	16.7	95% H-Stat UCL	75.28
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	17.21		

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.

NH-43A - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	8.8	Mean	38.43
Maximum	82.2	Median	31.35
SD	33.81	Std. Error of Mean	16.9
Coefficient of Variation	0.88	Skewness	0.791

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	0.912	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.256	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	78.2	95% Adjusted-CLT UCL (Chen-1995)	73.37
		95% Modified-t UCL (Johnson-1978)	79.32
Gamma GOF Test			
A-D Test Statistic	0.294	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.662	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	0.399	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.536	k star (bias corrected MLE)	0.551
Theta hat (MLE)	25.01	Theta star (bias corrected MLE)	69.77
nu hat (MLE)	12.29	nu star (bias corrected)	4.406
MLE Mean (bias corrected)	38.43	MLE Sd (bias corrected)	51.78
		Approximate Chi Square Value (0.05)	0.888
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	190.6	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.214	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.175	Mean of logged Data	3.289
Maximum of Logged Data	4.409	SD of logged Data	1.027
Assuming Lognormal Distribution			
95% H-UCL	2629	90% Chebyshev (MVUE) UCL	94.02
95% Chebyshev (MVUE) UCL	119.1	97.5% Chebyshev (MVUE) UCL	153.8
99% Chebyshev (MVUE) UCL	222		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	66.23	95% Jackknife UCL	78.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	89.13	95% Chebyshev(Mean, Sd) UCL	112.1
97.5% Chebyshev(Mean, Sd) UCL	144	99% Chebyshev(Mean, Sd) UCL	206.6
Suggested UCL to Use			
95% Student's-t UCL	78.2		

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.

NH-25 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3

Number of Detects	1	Number of Non-Detects	2
Number of Distinct Detects	1	Number of Distinct Non-Detects	2

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 NH-25 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

NH-37 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	4.2	Mean	10.53
Maximum	17.8	Median	9.6
SD	6.848	Std. Error of Mean	3.954
Coefficient of Variation	0.65	Skewness	0.602

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	0.986	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.221	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	22.08	95% Adjusted-CLT UCL (Chen-1995)	18.5
		95% Modified-t UCL (Johnson-1978)	22.31

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	3.233	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.258	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	19.4	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.993	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.435	Mean of logged Data	2.192
Maximum of Logged Data	2.879	SD of logged Data	0.725

Assuming Lognormal Distribution

95% H-UCL	1469	90% Chebyshev (MVUE) UCL	23.08
95% Chebyshev (MVUE) UCL	28.74	97.5% Chebyshev (MVUE) UCL	36.59
99% Chebyshev (MVUE) UCL	52.01		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	17.04	95% Jackknife UCL	22.08
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	22.39	95% Chebyshev(Mean, Sd) UCL	27.77
97.5% Chebyshev(Mean, Sd) UCL	35.22	99% Chebyshev(Mean, Sd) UCL	49.87

Suggested UCL to Use

95% Student's-t UCL	22.08

Recommended UCL exceeds the maximum observation

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.

NH-04 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	4.7	Minimum Non-Detect	5
Maximum Detect	84.2	Maximum Non-Detect	10
Variance Detects	3160	Percent Non-Detects	50%
Mean Detects	44.45	SD Detects	56.21
Median Detects	44.45	CV Detects	1.265
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	2.99	SD of Logged Detects	2.04

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	24.58	KM Standard Error of Mean	24.34
KM SD	34.42	95% KM (BCA) UCL	N/A
95% KM (t) UCL	81.86	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	64.61	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	97.6	95% KM Chebyshev UCL	130.7
97.5% KM Chebyshev UCL	176.6	99% KM Chebyshev UCL	266.8

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.745	k star (bias corrected MLE)	N/A
Theta hat (MLE)	59.65	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2.981	nu star (bias corrected)	N/A
Mean (detects)	44.45		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	24.58	SD (KM)	34.42
Variance (KM)	1185	SE of Mean (KM)	24.34
k hat (KM)	0.51	k star (KM)	0.294
nu hat (KM)	4.077	nu star (KM)	2.353
theta hat (KM)	48.22	theta star (KM)	83.57
80% gamma percentile (KM)	37.5	90% gamma percentile (KM)	72.65
95% gamma percentile (KM)	113.1	99% gamma percentile (KM)	218.6

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (2.35, α)	0.21	Adjusted Chi Square Value (2.35, β)	0.0561
95% Gamma Approximate KM-UCL (use when n>=50)	275.7	95% Gamma Adjusted KM-UCL (use when n<50)	1031

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	24.58	Mean in Log Scale	2.269
SD in Original Scale	39.75	SD in Log Scale	1.443
95% t UCL (assumes normality of ROS data)	71.35	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	75165		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.269	KM Geo Mean	9.669
KM SD (logged)	1.25	95% Critical H Value (KM-Log)	8.262
KM Standard Error of Mean (logged)	0.884	95% H-UCL (KM -Log)	8183
KM SD (logged)	1.25	95% Critical H Value (KM-Log)	8.262
KM Standard Error of Mean (logged)	0.884		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	24.1	Mean in Log Scale	2.127
SD in Original Scale	40.08	SD in Log Scale	1.569
95% t UCL (Assumes normality)	71.26	95% H-Stat UCL	330778

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

KM Bootstrap t UCL	N/A

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.

NH-32 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-26 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - ALUMINUM (CasNo: 7429-90-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-23 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	27	Number of Distinct Observations	19
Number of Detects	17	Number of Non-Detects	10
Number of Distinct Detects	17	Number of Distinct Non-Detects	2
Minimum Detect	23.5	Minimum Non-Detect	10
Maximum Detect	312	Maximum Non-Detect	20
Variance Detects	5298	Percent Non-Detects	37.04%
Mean Detects	71.38	SD Detects	72.79
Median Detects	48.1	CV Detects	1.02
Skewness Detects	2.752	Kurtosis Detects	7.863
Mean of Logged Detects	3.991	SD of Logged Detects	0.678

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.613	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.351	Lilliefors GOF Test
5% Lilliefors Critical Value	0.207	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	48.65	KM Standard Error of Mean	12.58
KM SD	63.39	95% KM (BCA) UCL	74.11
95% KM (t) UCL	70.1	95% KM (Percentile Bootstrap) UCL	71.62
95% KM (z) UCL	69.33	95% KM Bootstrap t UCL	93.58
90% KM Chebyshev UCL	86.37	95% KM Chebyshev UCL	103.5
97.5% KM Chebyshev UCL	127.2	99% KM Chebyshev UCL	173.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.271	Anderson-Darling GOF Test
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.212	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)	1.955	k star (bias corrected MLE)	1.65
Theta hat (MLE)	36.51	Theta star (bias corrected MLE)	43.27
nu hat (MLE)	66.48	nu star (bias corrected)	56.08

Mean (detects)	71.38		

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	44.95
Maximum	312	Median	32.5
SD	67.04	CV	1.491
k hat (MLE)	0.239	k star (bias corrected MLE)	0.237
Theta hat (MLE)	188.3	Theta star (bias corrected MLE)	189.8
nu hat (MLE)	12.89	nu star (bias corrected)	12.79
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (12.79, α)	5.752	Adjusted Chi Square Value (12.79, β)	5.451
95% Gamma Approximate UCL (use when n>=50)	99.95	95% Gamma Adjusted UCL (use when n<50)	105.5

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	48.65	SD (KM)	63.39
Variance (KM)	4018	SE of Mean (KM)	12.58
k hat (KM)	0.589	k star (KM)	0.548
nu hat (KM)	31.8	nu star (KM)	29.6
theta hat (KM)	82.6	theta star (KM)	88.74
80% gamma percentile (KM)	80.13	90% gamma percentile (KM)	129.1
95% gamma percentile (KM)	180.8	99% gamma percentile (KM)	307

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (29.60, α)	18.18	Adjusted Chi Square Value (29.60, β)	17.61
95% Gamma Approximate KM-UCL (use when n>=50)	79.21	95% Gamma Adjusted KM-UCL (use when n<50)	81.79

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.886	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	Lilliefors GOF Test
5% Lilliefors Critical Value	0.207	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	48.94	Mean in Log Scale	3.362
SD in Original Scale	64.47	SD in Log Scale	1.029
95% t UCL (assumes normality of ROS data)	70.11	95% Percentile Bootstrap UCL	70.84
95% BCA Bootstrap UCL	79.69	95% Bootstrap t UCL	99.35
95% H-UCL (Log ROS)	82		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.366	KM Geo Mean	28.95
KM SD (logged)	0.968	95% Critical H Value (KM-Log)	2.48
KM Standard Error of Mean (logged)	0.192	95% H-UCL (KM -Log)	74.09
KM SD (logged)	0.968	95% Critical H Value (KM-Log)	2.48
KM Standard Error of Mean (logged)	0.192		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	48.46	Mean in Log Scale	3.34
SD in Original Scale	64.72	SD in Log Scale	1.024
95% t UCL (Assumes normality)	69.71	95% H-Stat UCL	79.55

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	74.09		

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.

NH-07 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	87.1	Mean	5379
Maximum	15000	Median	1050
SD	8346	Std. Error of Mean	4819
Coefficient of Variation	1.552	Skewness	1.706

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	0.798	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.365	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	19449	95% Adjusted-CLT UCL (Chen-1995)	18376
		95% Modified-t UCL (Johnson-1978)	20240

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics			
k hat (MLE)	0.415	k star (bias corrected MLE)	N/A
Theta hat (MLE)	12968	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2.489	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test			
Shapiro Wilk Test Statistic	1	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	4.467	Mean of logged Data	7.013
Maximum of Logged Data	9.616	SD of logged Data	2.575

Assuming Lognormal Distribution

95% H-UCL	1.28E+31	90% Chebyshev (MVUE) UCL	19463
95% Chebyshev (MVUE) UCL	25875	97.5% Chebyshev (MVUE) UCL	34774
99% Chebyshev (MVUE) UCL	52256		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	13305	95% Jackknife UCL	19449
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	19835	95% Chebyshev(Mean, Sd) UCL	26382
97.5% Chebyshev(Mean, Sd) UCL	35471	99% Chebyshev(Mean, Sd) UCL	53323

Suggested UCL to Use

95% Student's-t UCL	19449

Recommended UCL exceeds the maximum observation

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.

NH-22 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	39	Mean	60.25
Maximum	81.5	Median	60.25

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	28	Number of Distinct Observations	20
Number of Detects	18	Number of Non-Detects	10
Number of Distinct Detects	18	Number of Distinct Non-Detects	2
Minimum Detect	32	Minimum Non-Detect	10
Maximum Detect	902	Maximum Non-Detect	20
Variance Detects	49772	Percent Non-Detects	35.71%
Mean Detects	191.5	SD Detects	223.1
Median Detects	98.7	CV Detects	1.165
Skewness Detects	2.279	Kurtosis Detects	5.614
Mean of Logged Detects	4.785	SD of Logged Detects	0.947

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.704	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.273	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	126.7	KM Standard Error of Mean	37.8
KM SD	194.4	95% KM (BCA) UCL	198.5
95% KM (t) UCL	191	95% KM (Percentile Bootstrap) UCL	194.9
95% KM (z) UCL	188.8	95% KM Bootstrap t UCL	244.2
90% KM Chebyshev UCL	240	95% KM Chebyshev UCL	291.4
97.5% KM Chebyshev UCL	362.7	99% KM Chebyshev UCL	502.7
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.829	Anderson-Darling GOF Test	
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.184	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.209	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)	1.204	k star (bias corrected MLE)	1.041
Theta hat (MLE)	159	Theta star (bias corrected MLE)	184
nu hat (MLE)	43.35	nu star (bias corrected)	37.46
Mean (detects)	191.5		
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	123.1
Maximum	902	Median	58.35
SD	200.2	CV	1.626
k hat (MLE)	0.215	k star (bias corrected MLE)	0.216
Theta hat (MLE)	572.1	Theta star (bias corrected MLE)	570.1
nu hat (MLE)	12.05	nu star (bias corrected)	12.09
Adjusted Level of Significance (β)	0.0404		
Approximate Chi Square Value (12.09, α)	5.287	Adjusted Chi Square Value (12.09, β)	5.01
95% Gamma Approximate UCL (use when n>=50)	281.5	95% Gamma Adjusted UCL (use when n<50)	297
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	126.7	SD (KM)	194.4
Variance (KM)	37779	SE of Mean (KM)	37.8
k hat (KM)	0.425	k star (KM)	0.403
nu hat (KM)	23.78	nu star (KM)	22.56
theta hat (KM)	298.3	theta star (KM)	314.3
80% gamma percentile (KM)	204.6	90% gamma percentile (KM)	357.3
95% gamma percentile (KM)	524.9	99% gamma percentile (KM)	946.1
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (22.56, α)	12.76	Adjusted Chi Square Value (22.56, β)	12.31
95% Gamma Approximate KM-UCL (use when n>=50)	223.9	95% Gamma Adjusted KM-UCL (use when n<50)	232.2
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.168	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	127.6	Mean in Log Scale	3.924
SD in Original Scale	197.4	SD in Log Scale	1.446
95% t UCL (assumes normality of ROS data)	191.1	95% Percentile Bootstrap UCL	193.4

95% BCA Bootstrap UCL	210.5	95% Bootstrap t UCL	244.6
95% H-UCL (Log ROS)	336.7		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.899	KM Geo Mean	49.33
KM SD (logged)	1.4	95% Critical H Value (KM-Log)	2.986
KM Standard Error of Mean (logged)	0.272	95% H-UCL (KM -Log)	293.8
KM SD (logged)	1.4	95% Critical H Value (KM-Log)	2.986
KM Standard Error of Mean (logged)	0.272		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	126.5	Mean in Log Scale	3.874
SD in Original Scale	198	SD in Log Scale	1.46
95% t UCL (Assumes normality)	190.2	95% H-Stat UCL	331.2

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	232.2	95% GROS Adjusted Gamma UCL	297

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.

NH-43A - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	21.4	Minimum Non-Detect	10
Maximum Detect	100	Maximum Non-Detect	10
Variance Detects	3089	Percent Non-Detects	33.33%
Mean Detects	60.7	SD Detects	55.58
Median Detects	60.7	CV Detects	0.916
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	3.834	SD of Logged Detects	1.09

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	43.8	KM Standard Error of Mean	32.67
KM SD	40.01	95% KM (BCA) UCL	N/A
95% KM (t) UCL	139.2	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	97.54	95% KM Bootstrap t UCL	N/A

90% KM Chebyshev UCL	141.8	95% KM Chebyshev UCL	186.2
97.5% KM Chebyshev UCL	247.8	99% KM Chebyshev UCL	368.9

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.991	k star (bias corrected MLE)	N/A
Theta hat (MLE)	30.49	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7.964	nu star (bias corrected)	N/A
Mean (detects)	60.7		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	43.8	SD (KM)	40.01
Variance (KM)	1601	SE of Mean (KM)	32.67
k hat (KM)	1.198	k star (KM)	N/A
nu hat (KM)	7.19	nu star (KM)	N/A
theta hat (KM)	36.55	theta star (KM)	N/A
80% gamma percentile (KM)	N/A	90% gamma percentile (KM)	N/A
95% gamma percentile (KM)	N/A	99% gamma percentile (KM)	N/A

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (N/A, α)	N/A	Adjusted Chi Square Value (N/A, β)	N/A
95% Gamma Approximate KM-UCL (use when n>=50)	N/A	95% Gamma Adjusted KM-UCL (use when n<50)	N/A

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	40.93	Mean in Log Scale	2.667
SD in Original Scale	52.12	SD in Log Scale	2.164
95% t UCL (assumes normality of ROS data)	128.8	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	9.35E+20		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.324	KM Geo Mean	27.76
KM SD (logged)	0.958	95% Critical H Value (KM-Log)	12.5
KM Standard Error of Mean (logged)	0.782	95% H-UCL (KM -Log)	208527
KM SD (logged)	0.958	95% Critical H Value (KM-Log)	12.5
KM Standard Error of Mean (logged)	0.782		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	42.13	Mean in Log Scale	3.093
SD in Original Scale	50.78	SD in Log Scale	1.498
95% t UCL (Assumes normality)	127.7	95% H-Stat UCL	6.85E+10

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	186.2

Warning: Recommended UCL exceeds the maximum observation

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.

NH-25 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	1
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-25 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-37 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	14	Mean	25.88
Maximum	39.9	Median	24.8
SD	10.67	Std. Error of Mean	5.333
Coefficient of Variation	0.412	Skewness	0.592

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	0.956	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.26	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	38.43	95% Adjusted-CLT UCL (Chen-1995)	36.33
		95% Modified-t UCL (Johnson-1978)	38.69

Gamma GOF Test			
A-D Test Statistic	0.269	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.217	Kolmogorov-Smirnov Gamma GOF Test	
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			
k hat (MLE)	7.653	k star (bias corrected MLE)	2.08
Theta hat (MLE)	3.381	Theta star (bias corrected MLE)	12.44
nu hat (MLE)	61.22	nu star (bias corrected)	16.64
MLE Mean (bias corrected)	25.88	MLE Sd (bias corrected)	17.94
		Approximate Chi Square Value (0.05)	8.415
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	51.16	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.639	Mean of logged Data	3.187
Maximum of Logged Data	3.686	SD of logged Data	0.429

Assuming Lognormal Distribution

95% H-UCL	60.24	90% Chebyshev (MVUE) UCL	42.37
95% Chebyshev (MVUE) UCL	49.82	97.5% Chebyshev (MVUE) UCL	60.17
99% Chebyshev (MVUE) UCL	80.49		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	34.65	95% Jackknife UCL	38.43
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	41.87	95% Chebyshev(Mean, Sd) UCL	49.12
97.5% Chebyshev(Mean, Sd) UCL	59.18	99% Chebyshev(Mean, Sd) UCL	78.94

Suggested UCL to Use

95% Student's-t UCL	38.43

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.

NH-04 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	49	Minimum Non-Detect	10
Maximum Detect	204	Maximum Non-Detect	20
Variance Detects	12013	Percent Non-Detects	50%
Mean Detects	126.5	SD Detects	109.6
Median Detects	126.5	CV Detects	0.866
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	4.605	SD of Logged Detects	1.009

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	68.25	KM Standard Error of Mean	56.55

KM SD	79.98	95% KM (BCA) UCL	N/A
95% KM (t) UCL	201.3	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	161.3	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	237.9	95% KM Chebyshev UCL	314.8
97.5% KM Chebyshev UCL	421.4	99% KM Chebyshev UCL	630.9

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.278	k star (bias corrected MLE)	N/A
Theta hat (MLE)	55.53	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	9.112	nu star (bias corrected)	N/A
Mean (detects)	126.5		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	68.25	SD (KM)	79.98
Variance (KM)	6396	SE of Mean (KM)	56.55
k hat (KM)	0.728	k star (KM)	0.349
nu hat (KM)	5.826	nu star (KM)	2.79
theta hat (KM)	93.72	theta star (KM)	195.7
80% gamma percentile (KM)	108	90% gamma percentile (KM)	197.2
95% gamma percentile (KM)	297.1	99% gamma percentile (KM)	552.3

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (2.79, α)	0.313	Adjusted Chi Square Value (2.79, β)	0.0847
95% Gamma Approximate KM-UCL (use when n>=50)	608.4	95% Gamma Adjusted KM-UCL (use when n<50)	2249

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	64.55	Mean in Log Scale	2.78
SD in Original Scale	95.51	SD in Log Scale	2.186
95% t UCL (assumes normality of ROS data)	176.9	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.25E+10		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.454	KM Geo Mean	31.62
KM SD (logged)	1.257	95% Critical H Value (KM-Log)	8.309
KM Standard Error of Mean (logged)	0.889	95% H-UCL (KM -Log)	28921
KM SD (logged)	1.257	95% Critical H Value (KM-Log)	8.309
KM Standard Error of Mean (logged)	0.889		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	67	Mean in Log Scale	3.28
SD in Original Scale	93.43	SD in Log Scale	1.661
95% t UCL (Assumes normality)	176.9	95% H-Stat UCL	3695978

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	314.8

Warning: Recommended UCL exceeds the maximum observation

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.

NH-26 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	34.4	Mean	101.7
Maximum	169	Median	101.7

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - IRON (CasNo: 7439-89-6) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	31.4	Mean	31.4
Maximum	31.4	Median	31.4

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - IRON (CasNo: 7439-89-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	2
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 NH-07 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

NH-22 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	0.5
Maximum Detect	0.22	Maximum Non-Detect	0.5
Variance Detects	0.00605	Percent Non-Detects	50%
Mean Detects	0.165	SD Detects	0.0778
Median Detects	0.165	CV Detects	0.471
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-1.861	SD of Logged Detects	0.49

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	0.165	KM Standard Error of Mean	0.055
KM SD	0.055	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.294	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.255	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.33	95% KM Chebyshev UCL	0.405
97.5% KM Chebyshev UCL	0.508	99% KM Chebyshev UCL	0.712

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	8.653	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0191	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	34.61	nu star (bias corrected)	N/A
Mean (detects)	0.165		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.165	SD (KM)	0.055
Variance (KM)	0.00303	SE of Mean (KM)	0.055
k hat (KM)	9	k star (KM)	2.417
nu hat (KM)	72	nu star (KM)	19.33
theta hat (KM)	0.0183	theta star (KM)	0.0683
80% gamma percentile (KM)	0.242	90% gamma percentile (KM)	0.307
95% gamma percentile (KM)	0.369	99% gamma percentile (KM)	0.505

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (19.33, α)	10.36	Adjusted Chi Square Value (19.33, β)	7.036
95% Gamma Approximate KM-UCL (use when n>=50)	0.308	95% Gamma Adjusted KM-UCL (use when n<50)	0.453

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	0.165	Mean in Log Scale	-1.861
SD in Original Scale	0.0635	SD in Log Scale	0.4
95% t UCL (assumes normality of ROS data)	0.24	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.351		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.861	KM Geo Mean	0.156
KM SD (logged)	0.347	95% Critical H Value (KM-Log)	2.952
KM Standard Error of Mean (logged)	0.347	95% H-UCL (KM -Log)	0.298
KM SD (logged)	0.347	95% Critical H Value (KM-Log)	2.952
KM Standard Error of Mean (logged)	0.347		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.208	Mean in Log Scale	-1.623
SD in Original Scale	0.0665	SD in Log Scale	0.394
95% t UCL (Assumes normality)	0.286	95% H-Stat UCL	0.436

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	0.294	KM H-UCL	0.298
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-23 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.15	Minimum Non-Detect	0.5
Maximum Detect	0.22	Maximum Non-Detect	0.5
Variance Detects	0.00245	Percent Non-Detects	50%
Mean Detects	0.185	SD Detects	0.0495
Median Detects	0.185	CV Detects	0.268
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-1.706	SD of Logged Detects	0.271

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	0.185	KM Standard Error of Mean	0.035

KM SD	0.035	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.267	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.243	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.29	95% KM Chebyshev UCL	0.338
97.5% KM Chebyshev UCL	0.404	99% KM Chebyshev UCL	0.533

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	27.6	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0067	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	110.4	nu star (bias corrected)	N/A
Mean (detects)	0.185		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.185	SD (KM)	0.035
Variance (KM)	0.00123	SE of Mean (KM)	0.035
k hat (KM)	27.94	k star (KM)	7.151
nu hat (KM)	223.5	nu star (KM)	57.21
theta hat (KM)	0.00662	theta star (KM)	0.0259
80% gamma percentile (KM)	0.239	90% gamma percentile (KM)	0.277
95% gamma percentile (KM)	0.312	99% gamma percentile (KM)	0.383

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (57.21, α)	40.82	Adjusted Chi Square Value (57.21, β)	33.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.259	95% Gamma Adjusted KM-UCL (use when n<50)	0.317

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	0.185	Mean in Log Scale	-1.706
SD in Original Scale	0.0404	SD in Log Scale	0.221
95% t UCL (assumes normality of ROS data)	0.233	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.257		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.706	KM Geo Mean	0.182
KM SD (logged)	0.191	95% Critical H Value (KM-Log)	2.44
KM Standard Error of Mean (logged)	0.191	95% H-UCL (KM -Log)	0.242
KM SD (logged)	0.191	95% Critical H Value (KM-Log)	2.44
KM Standard Error of Mean (logged)	0.191		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.218	Mean in Log Scale	-1.546
SD in Original Scale	0.0472	SD in Log Scale	0.242
95% t UCL (Assumes normality)	0.273	95% H-Stat UCL	0.315

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	0.267	KM H-UCL	0.242
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

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.

NH-43A - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.18	Minimum Non-Detect	0.5
Maximum Detect	0.25	Maximum Non-Detect	0.5
Variance Detects	0.00245	Percent Non-Detects	50%
Mean Detects	0.215	SD Detects	0.0495
Median Detects	0.215	CV Detects	0.23
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-1.551	SD of Logged Detects	0.232

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	0.215	KM Standard Error of Mean	0.035
KM SD	0.035	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.297	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.273	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.32	95% KM Chebyshev UCL	0.368
97.5% KM Chebyshev UCL	0.434	99% KM Chebyshev UCL	0.563

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	37.4	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00575	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	149.6	nu star (bias corrected)	N/A
Mean (detects)	0.215		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.215	SD (KM)	0.035
Variance (KM)	0.00123	SE of Mean (KM)	0.035
k hat (KM)	37.73	k star (KM)	9.6
nu hat (KM)	301.9	nu star (KM)	76.8
theta hat (KM)	0.0057	theta star (KM)	0.0224
80% gamma percentile (KM)	0.27	90% gamma percentile (KM)	0.307
95% gamma percentile (KM)	0.34	99% gamma percentile (KM)	0.408

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (76.80, α)	57.62	Adjusted Chi Square Value (76.80, β)	48.62
95% Gamma Approximate KM-UCL (use when n>=50)	0.287	95% Gamma Adjusted KM-UCL (use when n<50)	0.34

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	0.215	Mean in Log Scale	-1.551
SD in Original Scale	0.0404	SD in Log Scale	0.19
95% t UCL (assumes normality of ROS data)	0.263	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.282		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.551	KM Geo Mean	0.212
KM SD (logged)	0.164	95% Critical H Value (KM-Log)	2.368
KM Standard Error of Mean (logged)	0.164	95% H-UCL (KM -Log)	0.269
KM SD (logged)	0.164	95% Critical H Value (KM-Log)	2.368
KM Standard Error of Mean (logged)	0.164		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.233	Mean in Log Scale	-1.468
SD in Original Scale	0.035	SD in Log Scale	0.164
95% t UCL (Assumes normality)	0.274	95% H-Stat UCL	0.292

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	0.297	KM H-UCL	0.269
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-25 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	1
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-25 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-37 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.6	Mean	0.93
Maximum	1.2	Median	0.99
SD	0.304	Std. Error of Mean	0.176

Coefficient of Variation	0.327	Skewness	-0.852

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	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.245	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	1.443	95% Adjusted-CLT UCL (Chen-1995)	1.127
		95% Modified-t UCL (Johnson-1978)	1.429

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	12.58	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0739	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	75.46	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.28	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.511	Mean of logged Data	-0.113
Maximum of Logged Data	0.182	SD of logged Data	0.358

Assuming Lognormal Distribution

95% H-UCL	3.14	90% Chebyshev (MVUE) UCL	1.5
95% Chebyshev (MVUE) UCL	1.758	97.5% Chebyshev (MVUE) UCL	2.115
99% Chebyshev (MVUE) UCL	2.817		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	1.219	95% Jackknife UCL	1.443
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.457	95% Chebyshev(Mean, Sd) UCL	1.696
97.5% Chebyshev(Mean, Sd) UCL	2.028	99% Chebyshev(Mean, Sd) UCL	2.679

Suggested UCL to Use

95% Student's-t UCL	1.443

Recommended UCL exceeds the maximum observation

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.

NH-04 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.089	Minimum Non-Detect	0.5
Maximum Detect	0.1	Maximum Non-Detect	0.5
Variance Detects	6.05E-05	Percent Non-Detects	50%
Mean Detects	0.0945	SD Detects	0.00778
Median Detects	0.0945	CV Detects	0.0823
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-2.361	SD of Logged Detects	0.0824

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	0.0945	KM Standard Error of Mean	0.0055
KM SD	0.0055	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.107	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.104	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.111	95% KM Chebyshev UCL	0.118
97.5% KM Chebyshev UCL	0.129	99% KM Chebyshev UCL	0.149

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	294.9	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.20E-04	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1180	nu star (bias corrected)	N/A
Mean (detects)	0.0945		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0945	SD (KM)	0.0055
Variance (KM)	3.03E-05	SE of Mean (KM)	0.0055
k hat (KM)	295.2	k star (KM)	73.97
nu hat (KM)	2362	nu star (KM)	591.8
theta hat (KM)	3.20E-04	theta star (KM)	0.00128
80% gamma percentile (KM)	0.104	90% gamma percentile (KM)	0.109
95% gamma percentile (KM)	0.113	99% gamma percentile (KM)	0.122

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (591.76, α)	536.3	Adjusted Chi Square Value (591.76, β)	506.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.104	95% Gamma Adjusted KM-UCL (use when n<50)	0.11

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	0.0945	Mean in Log Scale	-2.361
SD in Original Scale	0.00635	SD in Log Scale	0.0673
95% t UCL (assumes normality of ROS data)	0.102	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.361	KM Geo Mean	0.0943
KM SD (logged)	0.0583	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0583	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0583	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0583		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.172	Mean in Log Scale	-1.874
SD in Original Scale	0.0899	SD in Log Scale	0.565
95% t UCL (Assumes normality)	0.278	95% H-Stat UCL	0.665

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	0.107	KM H-UCL	N/A
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-26 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics

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

Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - LEAD (CasNo: 7439-92-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	28	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	41.9	Mean	51.97
Maximum	108	Median	46.05
SD	15.97	Std. Error of Mean	3.017
Coefficient of Variation	0.307	Skewness	2.558

Normal GOF Test

Shapiro Wilk Test Statistic	0.57	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.924	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.362	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.164	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	57.11	95% Adjusted-CLT UCL (Chen-1995)	58.49
		95% Modified-t UCL (Johnson-1978)	57.35

Gamma GOF Test

A-D Test Statistic	4.752	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.346	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.165	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	15.51	k star (bias corrected MLE)	13.88
Theta hat (MLE)	3.35	Theta star (bias corrected MLE)	3.745
nu hat (MLE)	868.8	nu star (bias corrected)	777.1
MLE Mean (bias corrected)	51.97	MLE Sd (bias corrected)	13.95
		Approximate Chi Square Value (0.05)	713.4
Adjusted Level of Significance	0.0404	Adjusted Chi Square Value	709.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	56.61	95% Adjusted Gamma UCL (use when n<50)	56.91

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.63	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.924	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.333	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.164	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	3.735	Mean of logged Data	3.918
Maximum of Logged Data	4.682	SD of logged Data	0.239

Assuming Lognormal Distribution

95% H-UCL	56.15	90% Chebyshev (MVUE) UCL	58.79
95% Chebyshev (MVUE) UCL	62	97.5% Chebyshev (MVUE) UCL	66.45
99% Chebyshev (MVUE) UCL	75.2		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	56.93	95% Jackknife UCL	57.11
95% Standard Bootstrap UCL	56.71	95% Bootstrap-t UCL	60.53
95% Hall's Bootstrap UCL	57.4	95% Percentile Bootstrap UCL	57.13
95% BCA Bootstrap UCL	58.64		
90% Chebyshev(Mean, Sd) UCL	61.02	95% Chebyshev(Mean, Sd) UCL	65.12
97.5% Chebyshev(Mean, Sd) UCL	70.81	99% Chebyshev(Mean, Sd) UCL	81.99

Suggested UCL to Use

95% Student's-t UCL	57.11	or 95% Modified-t UCL	57.35

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.

NH-07 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	14.5	Mean	171.6
Maximum	371	Median	166
SD	160.1	Std. Error of Mean	71.61
Coefficient of Variation	0.933	Skewness	0.201

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	0.895	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.234	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	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	324.3	95% Adjusted-CLT UCL (Chen-1995)	296.3
		95% Modified-t UCL (Johnson-1978)	325.3

Gamma GOF Test

A-D Test Statistic	0.493	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.274	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.366	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.832	k star (bias corrected MLE)	0.466
Theta hat (MLE)	206.3	Theta star (bias corrected MLE)	368.3

nu hat (MLE)	8.316	nu star (bias corrected)	4.66
MLE Mean (bias corrected)	171.6	MLE Sd (bias corrected)	251.4
		Approximate Chi Square Value (0.05)	0.998
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	0.446

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	800.9	95% Adjusted Gamma UCL (use when n<50)	1792

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.815	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.266	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.674	Mean of logged Data	4.435
Maximum of Logged Data	5.916	SD of logged Data	1.576

Assuming Lognormal Distribution

95% H-UCL	104906	90% Chebyshev (MVUE) UCL	579.5
95% Chebyshev (MVUE) UCL	750.9	97.5% Chebyshev (MVUE) UCL	988.8
99% Chebyshev (MVUE) UCL	1456		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	289.4	95% Jackknife UCL	324.3
95% Standard Bootstrap UCL	277.4	95% Bootstrap-t UCL	357.9
95% Hall's Bootstrap UCL	242.1	95% Percentile Bootstrap UCL	272.8
95% BCA Bootstrap UCL	272.8		
90% Chebyshev(Mean, Sd) UCL	386.4	95% Chebyshev(Mean, Sd) UCL	483.7
97.5% Chebyshev(Mean, Sd) UCL	618.8	99% Chebyshev(Mean, Sd) UCL	884.1

Suggested UCL to Use

95% Student's-t UCL	324.3

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.

NH-22 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	1
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - MANGANESE (CasNo: 7439-96-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.87	Mean	6.868
Maximum	19.9	Median	3.35
SD	8.957	Std. Error of Mean	4.479
Coefficient of Variation	1.304	Skewness	1.673

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	0.795	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.306	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	17.41	95% Adjusted-CLT UCL (Chen-1995)	18.24
		95% Modified-t UCL (Johnson-1978)	18.03
Gamma GOF Test			
A-D Test Statistic	0.378	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.67	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.299	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.405	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.784	k star (bias corrected MLE)	0.363
Theta hat (MLE)	8.763	Theta star (bias corrected MLE)	18.94
nu hat (MLE)	6.269	nu star (bias corrected)	2.901
MLE Mean (bias corrected)	6.868	MLE Sd (bias corrected)	11.41
		Approximate Chi Square Value (0.05)	0.344
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	57.97	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.905	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.267	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.139	Mean of logged Data	1.167
Maximum of Logged Data	2.991	SD of logged Data	1.471
Assuming Lognormal Distribution			
95% H-UCL	35362	90% Chebyshev (MVUE) UCL	18.89
95% Chebyshev (MVUE) UCL	24.48	97.5% Chebyshev (MVUE) UCL	32.25
99% Chebyshev (MVUE) UCL	47.5		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	14.23	95% Jackknife UCL	17.41
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	20.3	95% Chebyshev(Mean, Sd) UCL	26.39
97.5% Chebyshev(Mean, Sd) UCL	34.84	99% Chebyshev(Mean, Sd) UCL	51.43

Suggested UCL to Use

95% Student's-t UCL	17.41

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.

NH-23 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.54	Minimum Non-Detect	2
Maximum Detect	4.5	Maximum Non-Detect	2
Variance Detects	4.593	Percent Non-Detects	25%
Mean Detects	2.047	SD Detects	2.143
Median Detects	1.1	CV Detects	1.047
Skewness Detects	1.6	Kurtosis Detects	N/A
Mean of Logged Detects	0.328	SD of Logged Detects	1.079

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	0.854	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.337	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	1.74	KM Standard Error of Mean	0.993
KM SD	1.612	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.076	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.373	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.718	95% KM Chebyshev UCL	6.067
97.5% KM Chebyshev UCL	7.939	99% KM Chebyshev UCL	11.62

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.431	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.43	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	8.585	nu star (bias corrected)	N/A
Mean (detects)	2.047		

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	0.54	Mean	1.74
Maximum	4.5	Median	0.96
SD	1.854	CV	1.065
k hat (MLE)	1.544	k star (bias corrected MLE)	0.553
Theta hat (MLE)	1.127	Theta star (bias corrected MLE)	3.149
nu hat (MLE)	12.35	nu star (bias corrected)	4.421
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (4.42, α)	0.895	Adjusted Chi Square Value (4.42, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	8.599	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.74	SD (KM)	1.612
Variance (KM)	2.598	SE of Mean (KM)	0.993
k hat (KM)	1.165	k star (KM)	0.458
nu hat (KM)	9.323	nu star (KM)	3.664
theta hat (KM)	1.493	theta star (KM)	3.799
80% gamma percentile (KM)	2.844	90% gamma percentile (KM)	4.792
95% gamma percentile (KM)	6.895	99% gamma percentile (KM)	12.11

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (3.66, α)	0.594	Adjusted Chi Square Value (3.66, β)	0.178
95% Gamma Approximate KM-UCL (use when n>=50)	10.74	95% Gamma Adjusted KM-UCL (use when n<50)	35.78

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.252	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.734	Mean in Log Scale	0.188
SD in Original Scale	1.858	SD in Log Scale	0.924
95% t UCL (assumes normality of ROS data)	3.92	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	50.29		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.181	KM Geo Mean	1.198
KM SD (logged)	0.824	95% Critical H Value (KM-Log)	5.562
KM Standard Error of Mean (logged)	0.522	95% H-UCL (KM -Log)	23.7
KM SD (logged)	0.824	95% Critical H Value (KM-Log)	5.562
KM Standard Error of Mean (logged)	0.522		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.785	Mean in Log Scale	0.246
SD in Original Scale	1.826	SD in Log Scale	0.896
95% t UCL (Assumes normality)	3.934	95% H-Stat UCL	42.9

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	4.076

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.

NH-43A - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.31	Mean	1.543
Maximum	2.9	Median	1.48
SD	1.299	Std. Error of Mean	0.65
Coefficient of Variation	0.842	Skewness	0.0947

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	0.862	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.275	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	3.071	95% Adjusted-CLT UCL (Chen-1995)	2.644
		95% Modified-t UCL (Johnson-1978)	3.076

Gamma GOF Test

A-D Test Statistic	0.428	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.663	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.3	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.4	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.439	k star (bias corrected MLE)	0.526
Theta hat (MLE)	1.072	Theta star (bias corrected MLE)	2.93
nu hat (MLE)	11.51	nu star (bias corrected)	4.211
MLE Mean (bias corrected)	1.543	MLE Sd (bias corrected)	2.126
		Approximate Chi Square Value (0.05)	0.807
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8.051	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.881	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.275	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.171	Mean of logged Data	0.0473
Maximum of Logged Data	1.065	SD of logged Data	1.095

Assuming Lognormal Distribution

95% H-UCL	190	90% Chebyshev (MVUE) UCL	3.976
95% Chebyshev (MVUE) UCL	5.058	97.5% Chebyshev (MVUE) UCL	6.56
99% Chebyshev (MVUE) UCL	9.51		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.611	95% Jackknife UCL	3.071
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.491	95% Chebyshev(Mean, Sd) UCL	4.374
97.5% Chebyshev(Mean, Sd) UCL	5.599	99% Chebyshev(Mean, Sd) UCL	8.005

Suggested UCL to Use

95% Student's-t UCL	3.071

Recommended UCL exceeds the maximum observation

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.

NH-25 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.44	Minimum Non-Detect	2
Maximum Detect	0.49	Maximum Non-Detect	2
Variance Detects	0.00125	Percent Non-Detects	33.33%
Mean Detects	0.465	SD Detects	0.0354
Median Detects	0.465	CV Detects	0.076
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.767	SD of Logged Detects	0.0761

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	0.465	KM Standard Error of Mean	0.025
KM SD	0.025	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.538	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.506	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.54	95% KM Chebyshev UCL	0.574
97.5% KM Chebyshev UCL	0.621	99% KM Chebyshev UCL	0.714

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	345.6	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00135	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1383	nu star (bias corrected)	N/A
Mean (detects)	0.465		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.465	SD (KM)	0.025
Variance (KM)	6.25E-04	SE of Mean (KM)	0.025
k hat (KM)	346	k star (KM)	N/A
nu hat (KM)	2076	nu star (KM)	N/A
theta hat (KM)	0.00134	theta star (KM)	N/A
80% gamma percentile (KM)	N/A	90% gamma percentile (KM)	N/A
95% gamma percentile (KM)	N/A	99% gamma percentile (KM)	N/A

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (N/A, α)	N/A	Adjusted Chi Square Value (N/A, β)	N/A
95% Gamma Approximate KM-UCL (use when n>=50)	N/A	95% Gamma Adjusted KM-UCL (use when n<50)	N/A

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	0.465	Mean in Log Scale	-0.767
SD in Original Scale	0.025	SD in Log Scale	0.0538
95% t UCL (assumes normality of ROS data)	0.507	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.767	KM Geo Mean	0.464
KM SD (logged)	0.0538	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0538	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0538	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0538		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.643	Mean in Log Scale	-0.511
SD in Original Scale	0.31	SD in Log Scale	0.446
95% t UCL (Assumes normality)	1.166	95% H-Stat UCL	4.114

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	0.538	KM H-UCL	N/A
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-37 - MANGANESE (CasNo: 7439-96-5) [µg/L]

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	1	Minimum Non-Detect	2
Maximum Detect	2.2	Maximum Non-Detect	2
Variance Detects	0.373	Percent Non-Detects	25%
Mean Detects	1.533	SD Detects	0.611
Median Detects	1.4	CV Detects	0.398
Skewness Detects	0.935	Kurtosis Detects	N/A
Mean of Logged Detects	0.375	SD of Logged Detects	0.396

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	0.964	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	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	1.45	KM Standard Error of Mean	0.295
KM SD	0.466	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.145	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.936	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.336	95% KM Chebyshev UCL	2.737
97.5% KM Chebyshev UCL	3.294	99% KM Chebyshev UCL	4.388

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	9.693	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.158	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	58.16	nu star (bias corrected)	N/A
Mean (detects)	1.533		

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	1	Mean	1.451
Maximum	2.2	Median	1.301
SD	0.526	CV	0.362
k hat (MLE)	11.36	k star (bias corrected MLE)	3.006
Theta hat (MLE)	0.128	Theta star (bias corrected MLE)	0.483
nu hat (MLE)	90.86	nu star (bias corrected)	24.05
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (24.05, α)	13.89	Adjusted Chi Square Value (24.05, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	2.512	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.45	SD (KM)	0.466
Variance (KM)	0.218	SE of Mean (KM)	0.295
k hat (KM)	9.667	k star (KM)	2.583
nu hat (KM)	77.33	nu star (KM)	20.67
theta hat (KM)	0.15	theta star (KM)	0.561
80% gamma percentile (KM)	2.106	90% gamma percentile (KM)	2.659
95% gamma percentile (KM)	3.179	99% gamma percentile (KM)	4.316

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (20.67, α)	11.34	Adjusted Chi Square Value (20.67, β)	7.829
95% Gamma Approximate KM-UCL (use when n>=50)	2.642	95% Gamma Adjusted KM-UCL (use when n<50)	3.828

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.993	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.447	Mean in Log Scale	0.324
SD in Original Scale	0.528	SD in Log Scale	0.339
95% t UCL (assumes normality of ROS data)	2.068	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	2.593		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.323	KM Geo Mean	1.382
KM SD (logged)	0.306	95% Critical H Value (KM-Log)	2.797
KM Standard Error of Mean (logged)	0.197	95% H-UCL (KM -Log)	2.371
KM SD (logged)	0.306	95% Critical H Value (KM-Log)	2.797
KM Standard Error of Mean (logged)	0.197		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.4	Mean in Log Scale	0.281
SD in Original Scale	0.566	SD in Log Scale	0.374
95% t UCL (Assumes normality)	2.066	95% H-Stat UCL	2.749

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 2.145

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.

NH-04 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	1.7	Minimum Non-Detect	2
Maximum Detect	4.5	Maximum Non-Detect	2
Variance Detects	2.043	Percent Non-Detects	25%
Mean Detects	2.933	SD Detects	1.429
Median Detects	2.6	CV Detects	0.487

Skewness Detects	0.992	Kurtosis Detects	N/A
Mean of Logged Detects	0.997	SD of Logged Detects	0.488

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	0.959	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.259	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	2.625	KM Standard Error of Mean	0.7
KM SD	1.143	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.272	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.776	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.725	95% KM Chebyshev UCL	5.676
97.5% KM Chebyshev UCL	6.997	99% KM Chebyshev UCL	9.59

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	6.459	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.454	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	38.76	nu star (bias corrected)	N/A
Mean (detects)	2.933		

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	1.492	Mean	2.573
Maximum	4.5	Median	2.15
SD	1.372	CV	0.533
k hat (MLE)	5.289	k star (bias corrected MLE)	1.489
Theta hat (MLE)	0.486	Theta star (bias corrected MLE)	1.728
nu hat (MLE)	42.31	nu star (bias corrected)	11.91
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (11.91, α)	5.169	Adjusted Chi Square Value (11.91, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	5.929	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.625	SD (KM)	1.143
Variance (KM)	1.307	SE of Mean (KM)	0.7
k hat (KM)	5.273	k star (KM)	1.485
nu hat (KM)	42.18	nu star (KM)	11.88
theta hat (KM)	0.498	theta star (KM)	1.768
80% gamma percentile (KM)	4.066	90% gamma percentile (KM)	5.484
95% gamma percentile (KM)	6.861	99% gamma percentile (KM)	9.974

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.88, α)	5.147	Adjusted Chi Square Value (11.88, β)	3.016
95% Gamma Approximate KM-UCL (use when n>=50)	6.058	95% Gamma Adjusted KM-UCL (use when n<50)	10.34

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.995	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.2	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.605	Mean in Log Scale	0.868
SD in Original Scale	1.339	SD in Log Scale	0.474
95% t UCL (assumes normality of ROS data)	4.181	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	7.001		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.88	KM Geo Mean	2.411
KM SD (logged)	0.4	95% Critical H Value (KM-Log)	3.174
KM Standard Error of Mean (logged)	0.245	95% H-UCL (KM -Log)	5.434
KM SD (logged)	0.4	95% Critical H Value (KM-Log)	3.174
KM Standard Error of Mean (logged)	0.245		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.45	Mean in Log Scale	0.748
SD in Original Scale	1.515	SD in Log Scale	0.638
95% t UCL (Assumes normality)	4.233	95% H-Stat UCL	13.24

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	4.272

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.

NH-26 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - MANGANESE (CasNo: 7439-96-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2

Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - MANGANESE (CasNo: 7439-96-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - MANGANESE (CasNo: 7439-96-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - MANGANESE (CasNo: 7439-96-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	1
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - MANGANESE (CasNo: 7439-96-5) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.324	Minimum Non-Detect	0.2

Maximum Detect	0.367	Maximum Non-Detect	0.2
Variance Detects	9.25E-04	Percent Non-Detects	33.33%
Mean Detects	0.346	SD Detects	0.0304
Median Detects	0.346	CV Detects	0.088
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-1.065	SD of Logged Detects	0.0881

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	0.297	KM Standard Error of Mean	0.0578
KM SD	0.0708	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.466	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.392	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.47	95% KM Chebyshev UCL	0.549
97.5% KM Chebyshev UCL	0.658	99% KM Chebyshev UCL	0.872

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	257.9	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00134	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1032	nu star (bias corrected)	N/A
Mean (detects)	0.346		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.297	SD (KM)	0.0708
Variance (KM)	0.00501	SE of Mean (KM)	0.0578
k hat (KM)	17.6	k star (KM)	N/A
nu hat (KM)	105.6	nu star (KM)	N/A
theta hat (KM)	0.0169	theta star (KM)	N/A
80% gamma percentile (KM)	N/A	90% gamma percentile (KM)	N/A
95% gamma percentile (KM)	N/A	99% gamma percentile (KM)	N/A

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (N/A, α)	N/A	Adjusted Chi Square Value (N/A, β)	N/A
95% Gamma Approximate KM-UCL (use when n>=50)	N/A	95% Gamma Adjusted KM-UCL (use when n<50)	N/A

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	0.317	Mean in Log Scale	-1.159
SD in Original Scale	0.0539	SD in Log Scale	0.175
95% t UCL (assumes normality of ROS data)	0.408	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.469		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.246	KM Geo Mean	0.288

KM SD (logged)	0.262	95% Critical H Value (KM-Log)	3.766
KM Standard Error of Mean (logged)	0.214	95% H-UCL (KM -Log)	0.598
KM SD (logged)	0.262	95% Critical H Value (KM-Log)	3.766
KM Standard Error of Mean (logged)	0.214		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.264	Mean in Log Scale	-1.477
SD in Original Scale	0.143	SD in Log Scale	0.717
95% t UCL (Assumes normality)	0.505	95% H-Stat UCL	33.86

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	0.466	KM H-UCL	0.598
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-22 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	1	Number of Non-Detects	2
Number of Distinct Detects	1	Number of Distinct Non-Detects	2

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 NH-44 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

NH-23 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.071	Minimum Non-Detect	0.05
Maximum Detect	0.26	Maximum Non-Detect	0.2

Variance Detects	0.0179	Percent Non-Detects	50%
Mean Detects	0.166	SD Detects	0.134
Median Detects	0.166	CV Detects	0.808
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-1.996	SD of Logged Detects	0.918

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	0.11	KM Standard Error of Mean	0.0616
KM SD	0.0869	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.255	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.212	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.295	95% KM Chebyshev UCL	0.379
97.5% KM Chebyshev UCL	0.495	99% KM Chebyshev UCL	0.723

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.689	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0615	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	10.76	nu star (bias corrected)	N/A
Mean (detects)	0.166		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.11	SD (KM)	0.0869
Variance (KM)	0.00755	SE of Mean (KM)	0.0616
k hat (KM)	1.615	k star (KM)	0.57
nu hat (KM)	12.92	nu star (KM)	4.563
theta hat (KM)	0.0684	theta star (KM)	0.194
80% gamma percentile (KM)	0.182	90% gamma percentile (KM)	0.29
95% gamma percentile (KM)	0.404	99% gamma percentile (KM)	0.682

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (4.56, α)	0.956	Adjusted Chi Square Value (4.56, β)	0.332
95% Gamma Approximate KM-UCL (use when n>=50)	0.527	95% Gamma Adjusted KM-UCL (use when n<50)	1.515

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	0.0968	Mean in Log Scale	-2.817
SD in Original Scale	0.111	SD in Log Scale	1.128
95% t UCL (assumes normality of ROS data)	0.227	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	14.75		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.452	KM Geo Mean	0.0861
KM SD (logged)	0.656	95% Critical H Value (KM-Log)	4.534

KM Standard Error of Mean (logged)	0.47	95% H-UCL (KM -Log)	0.594
KM SD (logged)	0.656	95% Critical H Value (KM-Log)	4.534
KM Standard Error of Mean (logged)	0.47		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.114	Mean in Log Scale	-2.496
SD in Original Scale	0.102	SD in Log Scale	0.967
95% t UCL (Assumes normality)	0.234	95% H-Stat UCL	4.828

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	0.379

Warning: Recommended UCL exceeds the maximum observation

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.

NH-43A - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	3
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

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 NH-43A - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

NH-25 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-25 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-37 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-37 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-04 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
Number of Detects	0	Number of Non-Detects	3
Number of Distinct Detects	0	Number of Distinct Non-Detects	2

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 NH-04 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

NH-26 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	0.405	Mean	0.478
Maximum	0.55	Median	0.478

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - MERCURY (CasNo: 7439-97-6) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - MERCURY (CasNo: 7439-97-6) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-25 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	32	Mean	32.5
Maximum	33	Median	32.5

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-25 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-37 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	2.7	Mean	2.75
Maximum	2.8	Median	2.75

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-37 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	38	Mean	39
Maximum	40	Median	39

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-44 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-43A - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	23	Mean	23.5
Maximum	24	Median	23.5

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-43A - MOLYBDENUM (CasNo: 7439-98-7) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-04 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	57	Mean	58.5

Maximum	60	Median	58.5

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-04 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-23 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	12	Mean	12
Maximum	12	Median	12

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-23 - MOLYBDENUM (CasNo: 7439-98-7) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	1.3	Minimum Non-Detect	1
Maximum Detect	1.8	Maximum Non-Detect	1
Variance Detects	0.125	Percent Non-Detects	33.33%
Mean Detects	1.55	SD Detects	0.354
Median Detects	1.55	CV Detects	0.228
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.425	SD of Logged Detects	0.23

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	1.367	KM Standard Error of Mean	0.269
KM SD	0.33	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.153	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.81	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.175	95% KM Chebyshev UCL	2.541
97.5% KM Chebyshev UCL	3.049	99% KM Chebyshev UCL	4.047

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	38.1	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0407	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	152.4	nu star (bias corrected)	N/A
Mean (detects)	1.55		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.367	SD (KM)	0.33
Variance (KM)	0.109	SE of Mean (KM)	0.269
k hat (KM)	17.15	k star (KM)	N/A
nu hat (KM)	102.9	nu star (KM)	N/A
theta hat (KM)	0.0797	theta star (KM)	N/A
80% gamma percentile (KM)	N/A	90% gamma percentile (KM)	N/A
95% gamma percentile (KM)	N/A	99% gamma percentile (KM)	N/A

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (N/A, α)	N/A	Adjusted Chi Square Value (N/A, β)	N/A
95% Gamma Approximate KM-UCL (use when n>=50)	N/A	95% Gamma Adjusted KM-UCL (use when n<50)	N/A

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	1.277	Mean in Log Scale	0.179
SD in Original Scale	0.535	SD in Log Scale	0.457
95% t UCL (assumes normality of ROS data)	2.179	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	8.988		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.283	KM Geo Mean	1.328
KM SD (logged)	0.24	95% Critical H Value (KM-Log)	3.592
KM Standard Error of Mean (logged)	0.196	95% H-UCL (KM -Log)	2.517
KM SD (logged)	0.24	95% Critical H Value (KM-Log)	3.592
KM Standard Error of Mean (logged)	0.196		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.2	Mean in Log Scale	0.0523
SD in Original Scale	0.656	SD in Log Scale	0.666
95% t UCL (Assumes normality)	2.305	95% H-Stat UCL	77.95

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	2.153	KM H-UCL	2.517
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-22 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	1.4	Mean	1.45
Maximum	1.5	Median	1.45

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	5	Number of Distinct Observations	3
Number of Detects	3	Number of Non-Detects	2
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.79	Minimum Non-Detect	1
Maximum Detect	1	Maximum Non-Detect	1
Variance Detects	0.0114	Percent Non-Detects	40%
Mean Detects	0.907	SD Detects	0.107
Median Detects	0.93	CV Detects	0.118
Skewness Detects	-0.935	Kurtosis Detects	N/A
Mean of Logged Detects	-0.103	SD of Logged Detects	0.121

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	0.964	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	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	0.888	KM Standard Error of Mean	0.0574
KM SD	0.084	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.01	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.982	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.06	95% KM Chebyshev UCL	1.138
97.5% KM Chebyshev UCL	1.246	99% KM Chebyshev UCL	1.459

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	104.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00866	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	628.1	nu star (bias corrected)	N/A
Mean (detects)	0.907		

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	0.79	Mean	0.885
Maximum	1	Median	0.888
SD	0.085	CV	0.096
k hat (MLE)	136.5	k star (bias corrected MLE)	54.73
Theta hat (MLE)	0.00648	Theta star (bias corrected MLE)	0.0162
nu hat (MLE)	1365	nu star (bias corrected)	547.3
Adjusted Level of Significance (β)	0.0086		
Approximate Chi Square Value (547.32, α)	494.1	Adjusted Chi Square Value (547.32, β)	471.6
95% Gamma Approximate UCL (use when n>=50)	0.98	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.888	SD (KM)	0.084
Variance (KM)	0.00706	SE of Mean (KM)	0.0574
k hat (KM)	111.8	k star (KM)	44.84
nu hat (KM)	1118	nu star (KM)	448.4
theta hat (KM)	0.00795	theta star (KM)	0.0198
80% gamma percentile (KM)	0.997	90% gamma percentile (KM)	1.062
95% gamma percentile (KM)	1.117	99% gamma percentile (KM)	1.225

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (448.35, α)	400.3	Adjusted Chi Square Value (448.35, β)	380.1
95% Gamma Approximate KM-UCL (use when n>=50)	0.995	95% Gamma Adjusted KM-UCL (use when n<50)	1.047

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.265	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.884	Mean in Log Scale	-0.127
SD in Original Scale	0.0854	SD in Log Scale	0.0961
95% t UCL (assumes normality of ROS data)	0.965	95% Percentile Bootstrap UCL	0.94
95% BCA Bootstrap UCL	0.94	95% Bootstrap t UCL	0.974
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.123	KM Geo Mean	0.884
KM SD (logged)	0.0955	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0658	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0955	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0658		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.744	Mean in Log Scale	-0.339
SD in Original Scale	0.235	SD in Log Scale	0.334
95% t UCL (Assumes normality)	0.968	95% H-Stat UCL	1.141

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	1.01

Warning: Recommended UCL exceeds the maximum observation

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.

NH-23 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.48	Minimum Non-Detect	1
Maximum Detect	0.65	Maximum Non-Detect	1
Variance Detects	0.0145	Percent Non-Detects	50%
Mean Detects	0.565	SD Detects	0.12
Median Detects	0.565	CV Detects	0.213
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.582	SD of Logged Detects	0.214

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	0.565	KM Standard Error of Mean	0.085
KM SD	0.085	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.765	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.705	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.82	95% KM Chebyshev UCL	0.936
97.5% KM Chebyshev UCL	1.096	99% KM Chebyshev UCL	1.411

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	43.85	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0129	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	175.4	nu star (bias corrected)	N/A
Mean (detects)	0.565		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.565	SD (KM)	0.085
Variance (KM)	0.00723	SE of Mean (KM)	0.085
k hat (KM)	44.18	k star (KM)	11.21
nu hat (KM)	353.5	nu star (KM)	89.7
theta hat (KM)	0.0128	theta star (KM)	0.0504
80% gamma percentile (KM)	0.7	90% gamma percentile (KM)	0.789
95% gamma percentile (KM)	0.868	99% gamma percentile (KM)	1.03

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (89.70, α)	68.86	Adjusted Chi Square Value (89.70, β)	58.94

95% Gamma Approximate KM-UCL (use when n>=50)	0.736	95% Gamma Adjusted KM-UCL (use when n<50)	0.86

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	0.565	Mean in Log Scale	-0.582
SD in Original Scale	0.0981	SD in Log Scale	0.175
95% t UCL (assumes normality of ROS data)	0.68	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.723		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.582	KM Geo Mean	0.559
KM SD (logged)	0.152	95% Critical H Value (KM-Log)	2.337
KM Standard Error of Mean (logged)	0.152	95% H-UCL (KM -Log)	0.693
KM SD (logged)	0.152	95% Critical H Value (KM-Log)	2.337
KM Standard Error of Mean (logged)	0.152		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.533	Mean in Log Scale	-0.638
SD in Original Scale	0.0789	SD in Log Scale	0.139
95% t UCL (Assumes normality)	0.625	95% H-Stat UCL	0.642

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	0.765	KM H-UCL	0.693
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-43A - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.75	Minimum Non-Detect	1
Maximum Detect	1.2	Maximum Non-Detect	1
Variance Detects	0.0646	Percent Non-Detects	25%
Mean Detects	0.907	SD Detects	0.254
Median Detects	0.77	CV Detects	0.28
Skewness Detects	1.72	Kurtosis Detects	N/A
Mean of Logged Detects	-0.122	SD of Logged Detects	0.264

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	0.783	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	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	0.87	KM Standard Error of Mean	0.117
KM SD	0.191	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.145	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.062	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.221	95% KM Chebyshev UCL	1.379
97.5% KM Chebyshev UCL	1.6	99% KM Chebyshev UCL	2.033
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	20.77	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0436	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	124.6	nu star (bias corrected)	N/A
Mean (detects)	0.907		
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	0.75	Mean	0.874
Maximum	1.2	Median	0.773
SD	0.217	CV	0.249
k hat (MLE)	24.71	k star (bias corrected MLE)	6.343
Theta hat (MLE)	0.0354	Theta star (bias corrected MLE)	0.138
nu hat (MLE)	197.6	nu star (bias corrected)	50.74
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (50.74, α)	35.39	Adjusted Chi Square Value (50.74, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	1.254	95% Gamma Adjusted UCL (use when n<50)	N/A
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.87	SD (KM)	0.191
Variance (KM)	0.0364	SE of Mean (KM)	0.117
k hat (KM)	20.81	k star (KM)	5.369
nu hat (KM)	166.5	nu star (KM)	42.95
theta hat (KM)	0.0418	theta star (KM)	0.162
80% gamma percentile (KM)	1.16	90% gamma percentile (KM)	1.372
95% gamma percentile (KM)	1.565	99% gamma percentile (KM)	1.971
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (42.95, α)	28.92	Adjusted Chi Square Value (42.95, β)	22.82
95% Gamma Approximate KM-UCL (use when n>=50)	1.292	95% Gamma Adjusted KM-UCL (use when n<50)	1.638
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.368	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			
Lognormal ROS Statistics Using Imputed Non-Detects			

Mean in Original Scale	0.874	Mean in Log Scale	-0.155
SD in Original Scale	0.217	SD in Log Scale	0.225
95% t UCL (assumes normality of ROS data)	1.13	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.222		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.16	KM Geo Mean	0.852
KM SD (logged)	0.198	95% Critical H Value (KM-Log)	2.458
KM Standard Error of Mean (logged)	0.121	95% H-UCL (KM -Log)	1.151
KM SD (logged)	0.198	95% Critical H Value (KM-Log)	2.458
KM Standard Error of Mean (logged)	0.121		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.805	Mean in Log Scale	-0.265
SD in Original Scale	0.291	SD in Log Scale	0.358
95% t UCL (Assumes normality)	1.147	95% H-Stat UCL	1.519

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	1.145

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.

NH-25 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.66	Mean	0.913
Maximum	1.4	Median	0.68
SD	0.422	Std. Error of Mean	0.243
Coefficient of Variation	0.462	Skewness	1.728

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	0.77	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.377	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	1.624	95% Adjusted-CLT UCL (Chen-1995)	1.573
		95% Modified-t UCL (Johnson-1978)	1.665

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	7.945	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.115	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	47.67	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.78	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.373	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.416	Mean of logged Data	-0.155
Maximum of Logged Data	0.336	SD of logged Data	0.426

Assuming Lognormal Distribution

95% H-UCL	4.962	90% Chebyshev (MVUE) UCL	1.565
95% Chebyshev (MVUE) UCL	1.862	97.5% Chebyshev (MVUE) UCL	2.274
99% Chebyshev (MVUE) UCL	3.084		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	1.314	95% Jackknife UCL	1.624
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.644	95% Chebyshev(Mean, Sd) UCL	1.974
97.5% Chebyshev(Mean, Sd) UCL	2.433	99% Chebyshev(Mean, Sd) UCL	3.335

Suggested UCL to Use

95% Student's-t UCL	1.624

Recommended UCL exceeds the maximum observation

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.

NH-37 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.69	Minimum Non-Detect	1
Maximum Detect	0.76	Maximum Non-Detect	1
Variance Detects	0.00245	Percent Non-Detects	33.33%
Mean Detects	0.725	SD Detects	0.0495
Median Detects	0.725	CV Detects	0.0683
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.323	SD of Logged Detects	0.0683

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	0.725	KM Standard Error of Mean	0.035
KM SD	0.035	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.827	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.783	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.83	95% KM Chebyshev UCL	0.878
97.5% KM Chebyshev UCL	0.944	99% KM Chebyshev UCL	1.073

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	428.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00169	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1715	nu star (bias corrected)	N/A
Mean (detects)	0.725		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.725	SD (KM)	0.035
Variance (KM)	0.00123	SE of Mean (KM)	0.035
k hat (KM)	429.1	k star (KM)	N/A
nu hat (KM)	2574	nu star (KM)	N/A
theta hat (KM)	0.00169	theta star (KM)	N/A
80% gamma percentile (KM)	N/A	90% gamma percentile (KM)	N/A
95% gamma percentile (KM)	N/A	99% gamma percentile (KM)	N/A

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (N/A, α)	N/A	Adjusted Chi Square Value (N/A, β)	N/A
95% Gamma Approximate KM-UCL (use when n>=50)	N/A	95% Gamma Adjusted KM-UCL (use when n<50)	N/A

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	0.725	Mean in Log Scale	-0.323
SD in Original Scale	0.035	SD in Log Scale	0.0483
95% t UCL (assumes normality of ROS data)	0.784	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.323	KM Geo Mean	0.724
KM SD (logged)	0.0483	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0483	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0483	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0483		

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed

Mean in Original Scale	0.65	Mean in Log Scale	-0.446
SD in Original Scale	0.135	SD in Log Scale	0.219
95% t UCL (Assumes normality)	0.877	95% H-Stat UCL	1.116

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	0.827	KM H-UCL	N/A
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.

NH-04 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.93	Minimum Non-Detect	1
Maximum Detect	1.2	Maximum Non-Detect	1
Variance Detects	0.0196	Percent Non-Detects	25%
Mean Detects	1.043	SD Detects	0.14
Median Detects	1	CV Detects	0.134
Skewness Detects	1.259	Kurtosis Detects	N/A
Mean of Logged Detects	0.0366	SD of Logged Detects	0.131

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	0.928	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.288	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	1.015	KM Standard Error of Mean	0.0677
KM SD	0.111	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.174	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.126	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.218	95% KM Chebyshev UCL	1.31
97.5% KM Chebyshev UCL	1.438	99% KM Chebyshev UCL	1.689

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	85.83	k star (bias corrected MLE)	N/A

Theta hat (MLE)	0.0122	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	515	nu star (bias corrected)	N/A
Mean (detects)	1.043		

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	0.906	Mean	1.009
Maximum	1.2	Median	0.965
SD	0.133	CV	0.132
k hat (MLE)	80.9	k star (bias corrected MLE)	20.39
Theta hat (MLE)	0.0125	Theta star (bias corrected MLE)	0.0495
nu hat (MLE)	647.2	nu star (bias corrected)	163.1
Adjusted Level of Significance (β)	0.00498		
Approximate Chi Square Value (163.14, α)	134.6	Adjusted Chi Square Value (163.14, β)	N/A
95% Gamma Approximate UCL (use when n>=50)	1.223	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.015	SD (KM)	0.111
Variance (KM)	0.0122	SE of Mean (KM)	0.0677
k hat (KM)	84.27	k star (KM)	21.23
nu hat (KM)	674.2	nu star (KM)	169.9
theta hat (KM)	0.012	theta star (KM)	0.0478
80% gamma percentile (KM)	1.194	90% gamma percentile (KM)	1.306
95% gamma percentile (KM)	1.402	99% gamma percentile (KM)	1.596

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (169.88, α)	140.7	Adjusted Chi Square Value (169.88, β)	126.1
95% Gamma Approximate KM-UCL (use when n>=50)	1.225	95% Gamma Adjusted KM-UCL (use when n<50)	1.367

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.942	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.276	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.01	Mean in Log Scale	0.00411
SD in Original Scale	0.132	SD in Log Scale	0.125
95% t UCL (assumes normality of ROS data)	1.166	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.193		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0093	KM Geo Mean	1.009
KM SD (logged)	0.104	95% Critical H Value (KM-Log)	2.231
KM Standard Error of Mean (logged)	0.0638	95% H-UCL (KM -Log)	1.161
KM SD (logged)	0.104	95% Critical H Value (KM-Log)	2.231
KM Standard Error of Mean (logged)	0.0638		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.908	Mean in Log Scale	-0.146
SD in Original Scale	0.295	SD in Log Scale	0.38
95% t UCL (Assumes normality)	1.254	95% H-Stat UCL	1.831

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 1.174

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.

NH-26 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	1
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	2
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics

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

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - ARSENIC (CasNo: 7440-38-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	210	Mean	224.7
Maximum	254	Median	210
SD	25.4	Std. Error of Mean	14.67
Coefficient of Variation	0.113	Skewness	1.732

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	0.75	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	267.5	95% Adjusted-CLT UCL (Chen-1995)	264.5
		95% Modified-t UCL (Johnson-1978)	269.9

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	122.1	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.84	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	732.5	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.347	Mean of logged Data	5.411
Maximum of Logged Data	5.537	SD of logged Data	0.11

Assuming Lognormal Distribution

95% H-UCL	279.6	90% Chebyshev (MVUE) UCL	267.3
95% Chebyshev (MVUE) UCL	286.6	97.5% Chebyshev (MVUE) UCL	313.5
99% Chebyshev (MVUE) UCL	366.2		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	248.8	95% Jackknife UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	268.7	95% Chebyshev(Mean, Sd) UCL	288.6
97.5% Chebyshev(Mean, Sd) UCL	316.3	99% Chebyshev(Mean, Sd) UCL	370.6

Suggested UCL to Use

95% Student's-t UCL	267.5

Recommended UCL exceeds the maximum observation

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.

NH-22 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	213	Mean	241
Maximum	269	Median	241

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	300	Mean	362.3
Maximum	416	Median	371
SD	58.48	Std. Error of Mean	33.77
Coefficient of Variation	0.161	Skewness	-0.652

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	0.984	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	460.9	95% Adjusted-CLT UCL (Chen-1995)	404.3
		95% Modified-t UCL (Johnson-1978)	458.8

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	55.67	k star (bias corrected MLE)	N/A
Theta hat (MLE)	6.508	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	334	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.704	Mean of logged Data	5.884
Maximum of Logged Data	6.031	SD of logged Data	0.166

Assuming Lognormal Distribution

95% H-UCL	522.4	90% Chebyshev (MVUE) UCL	466.1
95% Chebyshev (MVUE) UCL	513.1	97.5% Chebyshev (MVUE) UCL	578.4
99% Chebyshev (MVUE) UCL	706.5		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	417.9	95% Jackknife UCL	460.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	463.6	95% Chebyshev(Mean, Sd) UCL	509.5
97.5% Chebyshev(Mean, Sd) UCL	573.2	99% Chebyshev(Mean, Sd) UCL	698.3

Suggested UCL to Use

95% Student's-t UCL	460.9

Recommended UCL exceeds the maximum observation

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.

NH-23 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	180	Mean	202.7
Maximum	218	Median	210
SD	20.03	Std. Error of Mean	11.57
Coefficient of Variation	0.0988	Skewness	-1.427

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	0.899	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.31	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	236.4	95% Adjusted-CLT UCL (Chen-1995)	211.5
		95% Modified-t UCL (Johnson-1978)	234.9

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	148.3	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.367	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	889.6	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.89	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.316	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.193	Mean of logged Data	5.308
Maximum of Logged Data	5.384	SD of logged Data	0.102

Assuming Lognormal Distribution

95% H-UCL	247.5	90% Chebyshev (MVUE) UCL	238.3
95% Chebyshev (MVUE) UCL	254.4	97.5% Chebyshev (MVUE) UCL	276.8
99% Chebyshev (MVUE) UCL	320.7		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	221.7	95% Jackknife UCL	236.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	237.4	95% Chebyshev(Mean, Sd) UCL	253.1
97.5% Chebyshev(Mean, Sd) UCL	274.9	99% Chebyshev(Mean, Sd) UCL	317.7

Suggested UCL to Use

95% Student's-t UCL	236.4

Recommended UCL exceeds the maximum observation

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.

NH-43A - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	230	Mean	257
Maximum	294	Median	247
SD	33.15	Std. Error of Mean	19.14

Coefficient of Variation	0.129	Skewness	1.234

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	0.932	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.285	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	312.9	95% Adjusted-CLT UCL (Chen-1995)	303.1
		95% Modified-t UCL (Johnson-1978)	315.2

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	92.87	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.767	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	557.2	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.274	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	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	5.544
Maximum of Logged Data	5.684	SD of logged Data	0.126

Assuming Lognormal Distribution

95% H-UCL	332.9	90% Chebyshev (MVUE) UCL	313.1
95% Chebyshev (MVUE) UCL	338.5	97.5% Chebyshev (MVUE) UCL	373.8
99% Chebyshev (MVUE) UCL	443		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	288.5	95% Jackknife UCL	312.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	314.4	95% Chebyshev(Mean, Sd) UCL	340.4
97.5% Chebyshev(Mean, Sd) UCL	376.5	99% Chebyshev(Mean, Sd) UCL	447.4

Suggested UCL to Use

95% Student's-t UCL	312.9

Recommended UCL exceeds the maximum observation

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.

NH-25 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	250	Mean	258
Maximum	264	Median	260
SD	7.211	Std. Error of Mean	4.163
Coefficient of Variation	0.028	Skewness	-1.152

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	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.276	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	270.2	95% Adjusted-CLT UCL (Chen-1995)	261.9
		95% Modified-t UCL (Johnson-1978)	269.7

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1906	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.135	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11435	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.278	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.521	Mean of logged Data	5.553
Maximum of Logged Data	5.576	SD of logged Data	0.0281

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	270.6
95% Chebyshev (MVUE) UCL	276.2	97.5% Chebyshev (MVUE) UCL	284.1
99% Chebyshev (MVUE) UCL	299.7		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	264.8	95% Jackknife UCL	270.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	270.5	95% Chebyshev(Mean, Sd) UCL	276.1
97.5% Chebyshev(Mean, Sd) UCL	284	99% Chebyshev(Mean, Sd) UCL	299.4

Suggested UCL to Use

95% Student's-t UCL	270.2

Recommended UCL exceeds the maximum observation

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.

NH-37 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	150	Mean	177
Maximum	204	Median	177

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-37 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-04 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	190	Mean	225.3
Maximum	300	Median	205.5
SD	50.5	Std. Error of Mean	25.25
Coefficient of Variation	0.224	Skewness	1.843

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	0.777	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.369	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	284.7	95% Adjusted-CLT UCL (Chen-1995)	291.6
		95% Modified-t UCL (Johnson-1978)	288.6
Gamma GOF Test			
A-D Test Statistic	0.583	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.374	Kolmogorov-Smirnov Gamma GOF Test	
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			
Gamma Statistics			
k hat (MLE)	29.74	k star (bias corrected MLE)	7.602
Theta hat (MLE)	7.574	Theta star (bias corrected MLE)	29.63
nu hat (MLE)	237.9	nu star (bias corrected)	60.81
MLE Mean (bias corrected)	225.3	MLE Sd (bias corrected)	81.7
		Approximate Chi Square Value (0.05)	43.88
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	312.2	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.807	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.352	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.247	Mean of logged Data	5.4
Maximum of Logged Data	5.704	SD of logged Data	0.206
Assuming Lognormal Distribution			
95% H-UCL	304.1	90% Chebyshev (MVUE) UCL	294.5
95% Chebyshev (MVUE) UCL	325.9	97.5% Chebyshev (MVUE) UCL	369.6
99% Chebyshev (MVUE) UCL	455.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	266.8	95% Jackknife UCL	284.7
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	301	95% Chebyshev(Mean, Sd) UCL	335.3
97.5% Chebyshev(Mean, Sd) UCL	382.9	99% Chebyshev(Mean, Sd) UCL	476.5
Suggested UCL to Use			
95% Student's-t UCL	284.7		

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.

NH-26 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	225	Mean	236.5
Maximum	248	Median	236.5

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	469	Mean	477.5
Maximum	486	Median	477.5

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	226	Mean	226
Maximum	226	Median	226

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	200	Mean	200
Maximum	200	Median	200

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	169	Mean	169
Maximum	169	Median	169

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	304	Mean	304
Maximum	304	Median	304

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - BORON (CasNo: 7440-42-8) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5.9	Mean	8.267
Maximum	10.9	Median	8
SD	2.511	Std. Error of Mean	1.45
Coefficient of Variation	0.304	Skewness	0.473

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	0.992	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.209	Lilliefors GOF Test

5% Lilliefors Critical Value	0.425	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	12.5	95% Adjusted-CLT UCL (Chen-1995)	11.07
		95% Modified-t UCL (Johnson-1978)	12.57
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	16.2	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.51	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	97.21	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	1	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.175	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.775	Mean of logged Data	2.081
Maximum of Logged Data	2.389	SD of logged Data	0.307
Assuming Lognormal Distribution			
95% H-UCL	20.79	90% Chebyshev (MVUE) UCL	12.61
95% Chebyshev (MVUE) UCL	14.58	97.5% Chebyshev (MVUE) UCL	17.31
99% Chebyshev (MVUE) UCL	22.67		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	10.65	95% Jackknife UCL	12.5
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	12.62	95% Chebyshev(Mean, Sd) UCL	14.58
97.5% Chebyshev(Mean, Sd) UCL	17.32	99% Chebyshev(Mean, Sd) UCL	22.69
Suggested UCL to Use			
95% Student's-t UCL	12.5		

Recommended UCL exceeds the maximum observation

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.

NH-22 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	4.9	Mean	5.4
Maximum	5.9	Median	5.4

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	3.1	Mean	3.45
Maximum	3.8	Median	3.45

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-44 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-23 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	4.5	Mean	4.8
Maximum	5.1	Median	4.8

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-23 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-43A - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	3.7	Mean	4.35
Maximum	5	Median	4.35

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-43A - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-26 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	6	Mean	6.367
Maximum	6.9	Median	6.2
SD	0.473	Std. Error of Mean	0.273
Coefficient of Variation	0.0742	Skewness	1.39

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	0.907	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.304	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	7.163	95% Adjusted-CLT UCL (Chen-1995)	7.049
		95% Modified-t UCL (Johnson-1978)	7.2

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	278	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0229	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1668	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.299	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.792	Mean of logged Data	1.849
Maximum of Logged Data	1.932	SD of logged Data	0.0731

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	7.172
95% Chebyshev (MVUE) UCL	7.537	97.5% Chebyshev (MVUE) UCL	8.043
99% Chebyshev (MVUE) UCL	9.038		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6.815	95% Jackknife UCL	7.163
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.185	95% Chebyshev(Mean, Sd) UCL	7.556
97.5% Chebyshev(Mean, Sd) UCL	8.071	99% Chebyshev(Mean, Sd) UCL	9.081

Suggested UCL to Use

95% Student's-t UCL	7.163

Recommended UCL exceeds the maximum observation

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.

NH-36 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	5.4	Mean	5.45
Maximum	5.5	Median	5.45

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-04 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5.6	Mean	7.3
Maximum	8	Median	7.8
SD	1.14	Std. Error of Mean	0.57
Coefficient of Variation	0.156	Skewness	-1.93

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	0.726	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.387	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	8.642	95% Adjusted-CLT UCL (Chen-1995)	7.65
		95% Modified-t UCL (Johnson-1978)	8.55

Gamma GOF Test

A-D Test Statistic	0.75	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.414	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.394	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	48.7	k star (bias corrected MLE)	12.34
Theta hat (MLE)	0.15	Theta star (bias corrected MLE)	0.591
nu hat (MLE)	389.6	nu star (bias corrected)	98.74
MLE Mean (bias corrected)	7.3	MLE Sd (bias corrected)	2.078
		Approximate Chi Square Value (0.05)	76.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.383	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.712	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.395	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.723	Mean of logged Data	1.978
Maximum of Logged Data	2.079	SD of logged Data	0.171

Assuming Lognormal Distribution

95% H-UCL	9.272	90% Chebyshev (MVUE) UCL	9.17
95% Chebyshev (MVUE) UCL	10.01	97.5% Chebyshev (MVUE) UCL	11.19
99% Chebyshev (MVUE) UCL	13.49		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	8.238	95% Jackknife UCL	8.642
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	9.01	95% Chebyshev(Mean, Sd) UCL	9.785
97.5% Chebyshev(Mean, Sd) UCL	10.86	99% Chebyshev(Mean, Sd) UCL	12.97

Suggested UCL to Use

95% Student's-t UCL	8.642	or 95% Modified-t UCL	8.55

Recommended UCL exceeds the maximum observation

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.

NH-33 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	3.9	Mean	4.05
Maximum	4.2	Median	4.05

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	5.6	Mean	5.65
Maximum	5.7	Median	5.65

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-37 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	5.3	Mean	5.3
Maximum	5.3	Median	5.3

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-37 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	5.6	Mean	5.6
Maximum	5.6	Median	5.6

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-25 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	5	Mean	5.5
Maximum	6	Median	5.5

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-25 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	6.3	Mean	6.3
Maximum	6.3	Median	6.3

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - URANIUM, TOTAL (CasNo: 7440-61-1) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-07 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.1	Mean	4.925
Maximum	8.5	Median	4.05
SD	2.442	Std. Error of Mean	1.221
Coefficient of Variation	0.496	Skewness	1.723

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	0.819	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	7.798	95% Adjusted-CLT UCL (Chen-1995)	8.057
		95% Modified-t UCL (Johnson-1978)	7.974

Gamma GOF Test		
A-D Test Statistic	0.429	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.309	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	6.493	k star (bias corrected MLE)	1.79
Theta hat (MLE)	0.758	Theta star (bias corrected MLE)	2.751
nu hat (MLE)	51.95	nu star (bias corrected)	14.32
MLE Mean (bias corrected)	4.925	MLE Sd (bias corrected)	3.681
		Approximate Chi Square Value (0.05)	6.791
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	10.39	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.897	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.281	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	1.131	Mean of logged Data	1.515
Maximum of Logged Data	2.14	SD of logged Data	0.44

Assuming Lognormal Distribution			
95% H-UCL	11.78	90% Chebyshev (MVUE) UCL	8.072
95% Chebyshev (MVUE) UCL	9.514	97.5% Chebyshev (MVUE) UCL	11.51
99% Chebyshev (MVUE) UCL	15.45		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	6.933	95% Jackknife UCL	7.798
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	8.588	95% Chebyshev(Mean, Sd) UCL	10.25
97.5% Chebyshev(Mean, Sd) UCL	12.55	99% Chebyshev(Mean, Sd) UCL	17.07

Suggested UCL to Use	
95% Student's-t UCL	7.798

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.

NH-26 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Total Number of Observations	7	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.1	Mean	3.414
Maximum	3.7	Median	3.4
SD	0.177	Std. Error of Mean	0.067
Coefficient of Variation	0.0519	Skewness	-0.297

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	0.867	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.325	Lilliefors GOF Test
5% Lilliefors Critical Value	0.304	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	3.544	95% Adjusted-CLT UCL (Chen-1995)	3.516
		95% Modified-t UCL (Johnson-1978)	3.543

Gamma GOF Test

A-D Test Statistic	0.669	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.329	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.311	Data Not Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	428.1	k star (bias corrected MLE)	244.7
Theta hat (MLE)	0.00798	Theta star (bias corrected MLE)	0.014
nu hat (MLE)	5994	nu star (bias corrected)	3426
MLE Mean (bias corrected)	3.414	MLE Sd (bias corrected)	0.218
		Approximate Chi Square Value (0.05)	3291
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	3251

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.554	95% Adjusted Gamma UCL (use when n<50)	3.599

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.334	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.304	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.131	Mean of logged Data	1.227
Maximum of Logged Data	1.308	SD of logged Data	0.0524

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	3.617
95% Chebyshev (MVUE) UCL	3.709	97.5% Chebyshev (MVUE) UCL	3.836
99% Chebyshev (MVUE) UCL	4.087		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.525	95% Jackknife UCL	3.544
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.615	95% Chebyshev(Mean, Sd) UCL	3.706
97.5% Chebyshev(Mean, Sd) UCL	3.833	99% Chebyshev(Mean, Sd) UCL	4.081

Suggested UCL to Use
95% Student's-t UCL 3.544

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.

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.

NH-22 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	6	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	5
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 NH-22 - VANADIUM (CasNo: 7440-62-2) [µg/L] was not processed!

NH-36 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	7	Number of Distinct Observations	6
Number of Detects	6	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	3.1	Minimum Non-Detect	3
Maximum Detect	4.9	Maximum Non-Detect	3
Variance Detects	0.382	Percent Non-Detects	14.29%
Mean Detects	3.883	SD Detects	0.618
Median Detects	3.95	CV Detects	0.159
Skewness Detects	0.586	Kurtosis Detects	0.957
Mean of Logged Detects	1.346	SD of Logged Detects	0.157

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	0.933	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.258	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	3.757	KM Standard Error of Mean	0.251

KM SD	0.607	95% KM (BCA) UCL	4.114
95% KM (t) UCL	4.245	95% KM (Percentile Bootstrap) UCL	4.143
95% KM (z) UCL	4.17	95% KM Bootstrap t UCL	4.308
90% KM Chebyshev UCL	4.511	95% KM Chebyshev UCL	4.852
97.5% KM Chebyshev UCL	5.326	99% KM Chebyshev UCL	6.257

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.319	Anderson-Darling GOF Test
5% A-D Critical Value	0.697	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)	48.41	k star (bias corrected MLE)	24.32
Theta hat (MLE)	0.0802	Theta star (bias corrected MLE)	0.16
nu hat (MLE)	580.9	nu star (bias corrected)	291.8
Mean (detects)	3.883		

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	2.471	Mean	3.682
Maximum	4.9	Median	3.9
SD	0.777	CV	0.211
k hat (MLE)	25.02	k star (bias corrected MLE)	14.39
Theta hat (MLE)	0.147	Theta star (bias corrected MLE)	0.256
nu hat (MLE)	350.3	nu star (bias corrected)	201.5
Adjusted Level of Significance (β)	0.0158		
Approximate Chi Square Value (201.48, α)	169.6	Adjusted Chi Square Value (201.48, β)	160.8
95% Gamma Approximate UCL (use when n>=50)	4.373	95% Gamma Adjusted UCL (use when n<50)	4.613

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.757	SD (KM)	0.607
Variance (KM)	0.368	SE of Mean (KM)	0.251
k hat (KM)	38.34	k star (KM)	22
nu hat (KM)	536.8	nu star (KM)	308.1
theta hat (KM)	0.098	theta star (KM)	0.171
80% gamma percentile (KM)	4.409	90% gamma percentile (KM)	4.813
95% gamma percentile (KM)	5.164	99% gamma percentile (KM)	5.867

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (308.07, α)	268.4	Adjusted Chi Square Value (308.07, β)	257.2
95% Gamma Approximate KM-UCL (use when n>=50)	4.312	95% Gamma Adjusted KM-UCL (use when n<50)	4.501

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.233	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	3.701	Mean in Log Scale	1.291
SD in Original Scale	0.743	SD in Log Scale	0.206
95% t UCL (assumes normality of ROS data)	4.246	95% Percentile Bootstrap UCL	4.143
95% BCA Bootstrap UCL	4.157	95% Bootstrap t UCL	4.23
95% H-UCL (Log ROS)	4.392		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.311	KM Geo Mean	3.71
KM SD (logged)	0.159	95% Critical H Value (KM-Log)	1.934
KM Standard Error of Mean (logged)	0.0657	95% H-UCL (KM -Log)	4.258
KM SD (logged)	0.159	95% Critical H Value (KM-Log)	1.934
KM Standard Error of Mean (logged)	0.0657		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.543	Mean in Log Scale	1.212
SD in Original Scale	1.063	SD in Log Scale	0.383
95% t UCL (Assumes normality)	4.323	95% H-Stat UCL	5.169

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	4.245

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.

NH-43A - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	3.1	Mean	3.8
Maximum	4.4	Median	3.8
SD	0.414	Std. Error of Mean	0.146
Coefficient of Variation	0.109	Skewness	-0.242

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	0.989	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.109	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	4.077	95% Adjusted-CLT UCL (Chen-1995)	4.027
		95% Modified-t UCL (Johnson-1978)	4.075

Gamma GOF Test

A-D Test Statistic	0.15	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	0.113	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)	94.03	k star (bias corrected MLE)	58.85

Theta hat (MLE)	0.0404	Theta star (bias corrected MLE)	0.0646
nu hat (MLE)	1504	nu star (bias corrected)	941.6
MLE Mean (bias corrected)	3.8	MLE Sd (bias corrected)	0.495
		Approximate Chi Square Value (0.05)	871.4
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	854.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.106	95% Adjusted Gamma UCL (use when n<50)	4.189

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.119	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	1.131	Mean of logged Data	1.33
Maximum of Logged Data	1.482	SD of logged Data	0.111

Assuming Lognormal Distribution

95% H-UCL	4.112	90% Chebyshev (MVUE) UCL	4.248
95% Chebyshev (MVUE) UCL	4.451	97.5% Chebyshev (MVUE) UCL	4.733
99% Chebyshev (MVUE) UCL	5.287		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.041	95% Jackknife UCL	4.077
95% Standard Bootstrap UCL	4.025	95% Bootstrap-t UCL	4.054
95% Hall's Bootstrap UCL	4.027	95% Percentile Bootstrap UCL	4.025
95% BCA Bootstrap UCL	4.013		
90% Chebyshev(Mean, Sd) UCL	4.239	95% Chebyshev(Mean, Sd) UCL	4.438
97.5% Chebyshev(Mean, Sd) UCL	4.714	99% Chebyshev(Mean, Sd) UCL	5.257

Suggested UCL to Use

95% Student's-t UCL	4.077

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.

NH-33 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	6	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5.9	Mean	6.15
Maximum	6.6	Median	6
SD	0.281	Std. Error of Mean	0.115
Coefficient of Variation	0.0457	Skewness	1.094

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

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Normal GOF Test			
Shapiro Wilk Test Statistic	0.801	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.37	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.325	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	6.381	95% Adjusted-CLT UCL (Chen-1995)	6.394
		95% Modified-t UCL (Johnson-1978)	6.39
Gamma GOF Test			
A-D Test Statistic	0.744	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.696	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.386	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.332	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	586.8	k star (bias corrected MLE)	293.5
Theta hat (MLE)	0.0105	Theta star (bias corrected MLE)	0.021
nu hat (MLE)	7041	nu star (bias corrected)	3522
MLE Mean (bias corrected)	6.15	MLE Sd (bias corrected)	0.359
		Approximate Chi Square Value (0.05)	3385
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	3336
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.399	95% Adjusted Gamma UCL (use when n<50)	6.493
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.804	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.369	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.775	Mean of logged Data	1.816
Maximum of Logged Data	1.887	SD of logged Data	0.045
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	6.489
95% Chebyshev (MVUE) UCL	6.642	97.5% Chebyshev (MVUE) UCL	6.855
99% Chebyshev (MVUE) UCL	7.274		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.339	95% Jackknife UCL	6.381
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6.494	95% Chebyshev(Mean, Sd) UCL	6.65
97.5% Chebyshev(Mean, Sd) UCL	6.867	99% Chebyshev(Mean, Sd) UCL	7.292
Suggested UCL to Use			
95% Student's-t UCL	6.381		

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.

NH-25 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	8	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	3	Mean	3.375
Maximum	4.5	Median	3.25
SD	0.477	Std. Error of Mean	0.169
Coefficient of Variation	0.141	Skewness	2.318

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	0.705	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.354	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	3.695	95% Adjusted-CLT UCL (Chen-1995)	3.8
		95% Modified-t UCL (Johnson-1978)	3.718

Gamma GOF Test

A-D Test Statistic	0.944	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.715	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.335	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.293	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	65.69	k star (bias corrected MLE)	41.14
Theta hat (MLE)	0.0514	Theta star (bias corrected MLE)	0.082
nu hat (MLE)	1051	nu star (bias corrected)	658.3
MLE Mean (bias corrected)	3.375	MLE Sd (bias corrected)	0.526
		Approximate Chi Square Value (0.05)	599.7
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	585.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.704	95% Adjusted Gamma UCL (use when n<50)	3.794

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.328	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	1.099	Mean of logged Data	1.209

Maximum of Logged Data	1.504	SD of logged Data	0.128

Assuming Lognormal Distribution

95% H-UCL	3.696	90% Chebyshev (MVUE) UCL	3.83
95% Chebyshev (MVUE) UCL	4.037	97.5% Chebyshev (MVUE) UCL	4.325
99% Chebyshev (MVUE) UCL	4.889		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	3.653	95% Jackknife UCL	3.695
95% Standard Bootstrap UCL	3.633	95% Bootstrap-t UCL	4.17
95% Hall's Bootstrap UCL	4.756	95% Percentile Bootstrap UCL	3.688
95% BCA Bootstrap UCL	3.738		
90% Chebyshev(Mean, Sd) UCL	3.881	95% Chebyshev(Mean, Sd) UCL	4.111
97.5% Chebyshev(Mean, Sd) UCL	4.429	99% Chebyshev(Mean, Sd) UCL	5.054

Suggested UCL to Use

95% Student's-t UCL	3.695	or 95% Modified-t UCL	3.718

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.

NH-32 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5.3	Mean	5.75
Maximum	6.2	Median	5.75
SD	0.42	Std. Error of Mean	0.21
Coefficient of Variation	0.0731	Skewness	0

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	0.931	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.224	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	6.245	95% Adjusted-CLT UCL (Chen-1995)	6.096
		95% Modified-t UCL (Johnson-1978)	6.245

Gamma GOF Test

A-D Test Statistic	0.322	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	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	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	249.1	k star (bias corrected MLE)	62.43
Theta hat (MLE)	0.0231	Theta star (bias corrected MLE)	0.0921
nu hat (MLE)	1992	nu star (bias corrected)	499.4
MLE Mean (bias corrected)	5.75	MLE Sd (bias corrected)	0.728
		Approximate Chi Square Value (0.05)	448.6
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.401	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.931	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.229	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.668	Mean of logged Data	1.747
Maximum of Logged Data	1.825	SD of logged Data	0.0732

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	6.381
95% Chebyshev (MVUE) UCL	6.667	97.5% Chebyshev (MVUE) UCL	7.064
99% Chebyshev (MVUE) UCL	7.844		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6.096	95% Jackknife UCL	6.245
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6.38	95% Chebyshev(Mean, Sd) UCL	6.666
97.5% Chebyshev(Mean, Sd) UCL	7.062	99% Chebyshev(Mean, Sd) UCL	7.841

Suggested UCL to Use

95% Student's-t UCL	6.245

Recommended UCL exceeds the maximum observation

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.

NH-45 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	3.9	Mean	4.233
Maximum	4.9	Median	4.05
SD	0.388	Std. Error of Mean	0.158
Coefficient of Variation	0.0917	Skewness	1.285

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	0.788	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.301	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.325	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	4.553	95% Adjusted-CLT UCL (Chen-1995)	4.583
		95% Modified-t UCL (Johnson-1978)	4.566
Gamma GOF Test			
A-D Test Statistic	0.574	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.308	Kolmogorov-Smirnov Gamma GOF Test	
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			
k hat (MLE)	149.6	k star (bias corrected MLE)	74.92
Theta hat (MLE)	0.0283	Theta star (bias corrected MLE)	0.0565
nu hat (MLE)	1795	nu star (bias corrected)	899
MLE Mean (bias corrected)	4.233	MLE Sd (bias corrected)	0.489
		Approximate Chi Square Value (0.05)	830.4
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	806.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4.583	95% Adjusted Gamma UCL (use when n<50)	4.72
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.844	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.294	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.361	Mean of logged Data	1.44
Maximum of Logged Data	1.589	SD of logged Data	0.0886
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4.692
95% Chebyshev (MVUE) UCL	4.9	97.5% Chebyshev (MVUE) UCL	5.189
99% Chebyshev (MVUE) UCL	5.756		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.494	95% Jackknife UCL	4.553
95% Standard Bootstrap UCL	4.474	95% Bootstrap-t UCL	5.501
95% Hall's Bootstrap UCL	6.495	95% Percentile Bootstrap UCL	4.483
95% BCA Bootstrap UCL	4.5		
90% Chebyshev(Mean, Sd) UCL	4.709	95% Chebyshev(Mean, Sd) UCL	4.924
97.5% Chebyshev(Mean, Sd) UCL	5.223	99% Chebyshev(Mean, Sd) UCL	5.81
Suggested UCL to Use			
95% Student's-t UCL	4.553		

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.

NH-37 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	9	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	3.5	Mean	4.133
Maximum	4.4	Median	4.2
SD	0.296	Std. Error of Mean	0.0986
Coefficient of Variation	0.0716	Skewness	-1.312

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	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	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	4.317	95% Adjusted-CLT UCL (Chen-1995)	4.249
		95% Modified-t UCL (Johnson-1978)	4.309

Gamma GOF Test

A-D Test Statistic	0.62	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	0.267	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	208	k star (bias corrected MLE)	138.7
Theta hat (MLE)	0.0199	Theta star (bias corrected MLE)	0.0298
nu hat (MLE)	3743	nu star (bias corrected)	2497
MLE Mean (bias corrected)	4.133	MLE Sd (bias corrected)	0.351
		Approximate Chi Square Value (0.05)	2382
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	2358

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.333	95% Adjusted Gamma UCL (use when n<50)	4.377

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.833	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.264	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.253	Mean of logged Data	1.417
Maximum of Logged Data	1.482	SD of logged Data	0.0746

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4.442
95% Chebyshev (MVUE) UCL	4.582	97.5% Chebyshev (MVUE) UCL	4.776
99% Chebyshev (MVUE) UCL	5.157		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4.296	95% Jackknife UCL	4.317
95% Standard Bootstrap UCL	4.283	95% Bootstrap-t UCL	4.278
95% Hall's Bootstrap UCL	4.263	95% Percentile Bootstrap UCL	4.278
95% BCA Bootstrap UCL	4.256		
90% Chebyshev(Mean, Sd) UCL	4.429	95% Chebyshev(Mean, Sd) UCL	4.563
97.5% Chebyshev(Mean, Sd) UCL	4.749	99% Chebyshev(Mean, Sd) UCL	5.114

Suggested UCL to Use

95% Student's-t UCL	4.317

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.

NH-34 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	3	Mean	3.783
Maximum	4.6	Median	3.8
SD	0.546	Std. Error of Mean	0.223
Coefficient of Variation	0.144	Skewness	0.102

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	0.974	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	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	4.232	95% Adjusted-CLT UCL (Chen-1995)	4.16
		95% Modified-t UCL (Johnson-1978)	4.234

Gamma GOF Test

A-D Test Statistic	0.227	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	Kolmogorov-Smirnov Gamma GOF Test
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

k hat (MLE)	57.12	k star (bias corrected MLE)	28.67
Theta hat (MLE)	0.0662	Theta star (bias corrected MLE)	0.132
nu hat (MLE)	685.4	nu star (bias corrected)	344
MLE Mean (bias corrected)	3.783	MLE Sd (bias corrected)	0.707
		Approximate Chi Square Value (0.05)	302
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	287.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.309	95% Adjusted Gamma UCL (use when n<50)	4.524

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.171	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.099	Mean of logged Data	1.322
Maximum of Logged Data	1.526	SD of logged Data	0.146

Assuming Lognormal Distribution

95% H-UCL	4.317	90% Chebyshev (MVUE) UCL	4.459
95% Chebyshev (MVUE) UCL	4.765	97.5% Chebyshev (MVUE) UCL	5.19
99% Chebyshev (MVUE) UCL	6.024		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.15	95% Jackknife UCL	4.232
95% Standard Bootstrap UCL	4.119	95% Bootstrap-t UCL	4.251
95% Hall's Bootstrap UCL	4.275	95% Percentile Bootstrap UCL	4.133
95% BCA Bootstrap UCL	4.133		
90% Chebyshev(Mean, Sd) UCL	4.452	95% Chebyshev(Mean, Sd) UCL	4.754
97.5% Chebyshev(Mean, Sd) UCL	5.174	99% Chebyshev(Mean, Sd) UCL	6

Suggested UCL to Use

95% Student's-t UCL	4.232

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.

NH-04 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
Number of Detects	6	Number of Non-Detects	2
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	3	Minimum Non-Detect	3
Maximum Detect	4.6	Maximum Non-Detect	3
Variance Detects	0.378	Percent Non-Detects	25%
Mean Detects	3.683	SD Detects	0.615
Median Detects	3.65	CV Detects	0.167
Skewness Detects	0.447	Kurtosis Detects	-1.242
Mean of Logged Detects	1.292	SD of Logged Detects	0.165

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).

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

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	0.915	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.234	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	3.513	KM Standard Error of Mean	0.22
KM SD	0.569	95% KM (BCA) UCL	3.85
95% KM (t) UCL	3.93	95% KM (Percentile Bootstrap) UCL	3.863
95% KM (z) UCL	3.875	95% KM Bootstrap t UCL	4.055
90% KM Chebyshev UCL	4.173	95% KM Chebyshev UCL	4.473
97.5% KM Chebyshev UCL	4.888	99% KM Chebyshev UCL	5.705
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.372	Anderson-Darling GOF Test	
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	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)	43.91	k star (bias corrected MLE)	22.07
Theta hat (MLE)	0.0839	Theta star (bias corrected MLE)	0.167
nu hat (MLE)	526.9	nu star (bias corrected)	264.8
Mean (detects)	3.683		
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	2.052	Mean	3.32
Maximum	4.6	Median	3.25
SD	0.855	CV	0.258
k hat (MLE)	16.32	k star (bias corrected MLE)	10.28
Theta hat (MLE)	0.203	Theta star (bias corrected MLE)	0.323
nu hat (MLE)	261.1	nu star (bias corrected)	164.5
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (164.51, α)	135.9	Adjusted Chi Square Value (164.51, β)	129.3
95% Gamma Approximate UCL (use when n>=50)	4.02	95% Gamma Adjusted UCL (use when n<50)	4.226
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	3.513	SD (KM)	0.569
Variance (KM)	0.324	SE of Mean (KM)	0.22
k hat (KM)	38.13	k star (KM)	23.91
nu hat (KM)	610	nu star (KM)	382.6
theta hat (KM)	0.0921	theta star (KM)	0.147
80% gamma percentile (KM)	4.098	90% gamma percentile (KM)	4.459
95% gamma percentile (KM)	4.771	99% gamma percentile (KM)	5.396
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (382.60, α)	338.3	Adjusted Chi Square Value (382.60, β)	327.7
95% Gamma Approximate KM-UCL (use when n>=50)	3.973	95% Gamma Adjusted KM-UCL (use when n<50)	4.101
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.225	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	3.361	Mean in Log Scale	1.187
SD in Original Scale	0.794	SD in Log Scale	0.242
95% t UCL (assumes normality of ROS data)	3.893	95% Percentile Bootstrap UCL	3.8
95% BCA Bootstrap UCL	3.824	95% Bootstrap t UCL	3.938
95% H-UCL (Log ROS)	4.046		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.244	KM Geo Mean	3.469
KM SD (logged)	0.155	95% Critical H Value (KM-Log)	1.898
KM Standard Error of Mean (logged)	0.0601	95% H-UCL (KM -Log)	3.925
KM SD (logged)	0.155	95% Critical H Value (KM-Log)	1.898
KM Standard Error of Mean (logged)	0.0601		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.138	Mean in Log Scale	1.071
SD in Original Scale	1.136	SD in Log Scale	0.434
95% t UCL (Assumes normality)	3.899	95% H-Stat UCL	4.631
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	3.93		

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.

NH-44 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics			
Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	4.2	Mean	5.2
Maximum	6.5	Median	5.1
SD	0.859	Std. Error of Mean	0.304
Coefficient of Variation	0.165	Skewness	0.661

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	0.893	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.204	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	5.775	95% Adjusted-CLT UCL (Chen-1995)	5.775

		95% Modified-t UCL (Johnson-1978)	5.787

Gamma GOF Test

A-D Test Statistic	0.394	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	0.18	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)	43.53	k star (bias corrected MLE)	27.29
Theta hat (MLE)	0.119	Theta star (bias corrected MLE)	0.191
nu hat (MLE)	696.5	nu star (bias corrected)	436.7
MLE Mean (bias corrected)	5.2	MLE Sd (bias corrected)	0.995
		Approximate Chi Square Value (0.05)	389.2
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	377.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.834	95% Adjusted Gamma UCL (use when n<50)	6.01

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.915	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.175	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	1.435	Mean of logged Data	1.637
Maximum of Logged Data	1.872	SD of logged Data	0.161

Assuming Lognormal Distribution

95% H-UCL	5.847	90% Chebyshev (MVUE) UCL	6.088
95% Chebyshev (MVUE) UCL	6.491	97.5% Chebyshev (MVUE) UCL	7.05
99% Chebyshev (MVUE) UCL	8.148		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5.699	95% Jackknife UCL	5.775
95% Standard Bootstrap UCL	5.668	95% Bootstrap-t UCL	5.972
95% Hall's Bootstrap UCL	6.3	95% Percentile Bootstrap UCL	5.675
95% BCA Bootstrap UCL	5.725		
90% Chebyshev(Mean, Sd) UCL	6.111	95% Chebyshev(Mean, Sd) UCL	6.523
97.5% Chebyshev(Mean, Sd) UCL	7.096	99% Chebyshev(Mean, Sd) UCL	8.22

Suggested UCL to Use

95% Student's-t UCL	5.775

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.

NH-23 - VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	7	Number of Distinct Observations	4
Number of Detects	6	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	3	Minimum Non-Detect	3

Maximum Detect	3.6	Maximum Non-Detect	3
Variance Detects	0.0577	Percent Non-Detects	14.29%
Mean Detects	3.183	SD Detects	0.24
Median Detects	3.1	CV Detects	0.0754
Skewness Detects	1.201	Kurtosis Detects	0.847
Mean of Logged Detects	1.156	SD of Logged Detects	0.0735

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	0.824	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.277	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	3.157	KM Standard Error of Mean	0.0881
KM SD	0.213	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.328	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.302	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3.422	95% KM Chebyshev UCL	3.541
97.5% KM Chebyshev UCL	3.708	99% KM Chebyshev UCL	4.034

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.559	Anderson-Darling GOF Test
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.301	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)	218.7	k star (bias corrected MLE)	109.5
Theta hat (MLE)	0.0146	Theta star (bias corrected MLE)	0.0291
nu hat (MLE)	2624	nu star (bias corrected)	1313
Mean (detects)	3.183		

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	2.623	Mean	3.103
Maximum	3.6	Median	3
SD	0.305	CV	0.0982
k hat (MLE)	120.6	k star (bias corrected MLE)	69.02
Theta hat (MLE)	0.0257	Theta star (bias corrected MLE)	0.045
nu hat (MLE)	1689	nu star (bias corrected)	966.3
Adjusted Level of Significance (β)	0.0158		
Approximate Chi Square Value (966.35, α)	895.2	Adjusted Chi Square Value (966.35, β)	874.3
95% Gamma Approximate UCL (use when n>=50)	3.35	95% Gamma Adjusted UCL (use when n<50)	3.43

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.157	SD (KM)	0.213
Variance (KM)	0.0453	SE of Mean (KM)	0.0881
k hat (KM)	220	k star (KM)	125.8
nu hat (KM)	3080	nu star (KM)	1761
theta hat (KM)	0.0144	theta star (KM)	0.0251

80% gamma percentile (KM)	3.391	90% gamma percentile (KM)	3.523
95% gamma percentile (KM)	3.634	99% gamma percentile (KM)	3.849

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1665	Adjusted Chi Square Value (N/A, β)	1636
95% Gamma Approximate KM-UCL (use when n>=50)	3.34	95% Gamma Adjusted KM-UCL (use when n<50)	3.399

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.83	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.281	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	3.108	Mean in Log Scale	1.13
SD in Original Scale	0.295	SD in Log Scale	0.0949
95% t UCL (assumes normality of ROS data)	3.325	95% Percentile Bootstrap UCL	3.286
95% BCA Bootstrap UCL	3.294	95% Bootstrap t UCL	3.362
95% H-UCL (Log ROS)	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.147	KM Geo Mean	3.15
KM SD (logged)	0.0652	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.027	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0652	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.027		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.943	Mean in Log Scale	1.048
SD in Original Scale	0.673	SD in Log Scale	0.291
95% t UCL (Assumes normality)	3.437	95% H-Stat UCL	3.863

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	3.328

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.

NH-23 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	38	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	27
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.529	Minimum Non-Detect	0.5
Maximum Detect	0.778	Maximum Non-Detect	0.5
Variance Detects	0.00757	Percent Non-Detects	71.05%
Mean Detects	0.628	SD Detects	0.087
Median Detects	0.613	CV Detects	0.138
Skewness Detects	0.629	Kurtosis Detects	-0.806
Mean of Logged Detects	-0.473	SD of Logged Detects	0.135

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test

5% Shapiro Wilk Critical Value	0.85	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.134	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.251	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	0.537	KM Standard Error of Mean	0.0125
KM SD	0.0734	95% KM (BCA) UCL	0.559
95% KM (t) UCL	0.558	95% KM (Percentile Bootstrap) UCL	0.558
95% KM (z) UCL	0.558	95% KM Bootstrap t UCL	0.564
90% KM Chebyshev UCL	0.575	95% KM Chebyshev UCL	0.592
97.5% KM Chebyshev UCL	0.615	99% KM Chebyshev UCL	0.661
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.326	Anderson-Darling GOF Test	
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.145	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.255	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)	59.42	k star (bias corrected MLE)	43.28
Theta hat (MLE)	0.0106	Theta star (bias corrected MLE)	0.0145
nu hat (MLE)	1307	nu star (bias corrected)	952.1
Mean (detects)	0.628		
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	0.0801	Mean	0.415
Maximum	0.778	Median	0.405
SD	0.173	CV	0.418
k hat (MLE)	4.966	k star (bias corrected MLE)	4.592
Theta hat (MLE)	0.0836	Theta star (bias corrected MLE)	0.0904
nu hat (MLE)	377.5	nu star (bias corrected)	349
Adjusted Level of Significance (β)	0.0434		
Approximate Chi Square Value (348.99, α)	306.7	Adjusted Chi Square Value (348.99, β)	305.1
95% Gamma Approximate UCL (use when n>=50)	0.473	95% Gamma Adjusted UCL (use when n<50)	0.475
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.537	SD (KM)	0.0734
Variance (KM)	0.00539	SE of Mean (KM)	0.0125
k hat (KM)	53.58	k star (KM)	49.37
nu hat (KM)	4072	nu star (KM)	3752
theta hat (KM)	0.01	theta star (KM)	0.0109
80% gamma percentile (KM)	0.6	90% gamma percentile (KM)	0.637
95% gamma percentile (KM)	0.669	99% gamma percentile (KM)	0.731
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, α)	3610	Adjusted Chi Square Value (N/A, β)	3605
95% Gamma Approximate KM-UCL (use when n>=50)	0.558	95% Gamma Adjusted KM-UCL (use when n<50)	0.559
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.133	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.251	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	0.454	Mean in Log Scale	-0.833
SD in Original Scale	0.137	SD in Log Scale	0.298
95% t UCL (assumes normality of ROS data)	0.492	95% Percentile Bootstrap UCL	0.491
95% BCA Bootstrap UCL	0.492	95% Bootstrap t UCL	0.494
95% H-UCL (Log ROS)	0.496		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.629	KM Geo Mean	0.533
KM SD (logged)	0.122	95% Critical H Value (KM-Log)	1.705
KM Standard Error of Mean (logged)	0.0207	95% H-UCL (KM -Log)	0.555
KM SD (logged)	0.122	95% Critical H Value (KM-Log)	1.705
KM Standard Error of Mean (logged)	0.0207		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.36	Mean in Log Scale	-1.122
SD in Original Scale	0.18	SD in Log Scale	0.426
95% t UCL (Assumes normality)	0.409	95% H-Stat UCL	0.406

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	0.558

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.

NH-26 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	31	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	28
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.687	Minimum Non-Detect	0.5
Maximum Detect	2.02	Maximum Non-Detect	0.5
Variance Detects	0.571	Percent Non-Detects	90.32%
Mean Detects	1.559	SD Detects	0.756
Median Detects	1.97	CV Detects	0.485
Skewness Detects	-1.724	Kurtosis Detects	N/A
Mean of Logged Detects	0.335	SD of Logged Detects	0.616

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	0.778	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.373	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	0.602	KM Standard Error of Mean	0.0808
KM SD	0.367	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.74	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.735	95% KM Bootstrap t UCL	N/A

90% KM Chebyshev UCL	0.845	95% KM Chebyshev UCL	0.955
97.5% KM Chebyshev UCL	1.107	99% KM Chebyshev UCL	1.406

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	4.756	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.328	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	28.53	nu star (bias corrected)	N/A
Mean (detects)	1.559		

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	0.171
Maximum	2.02	Median	0.01
SD	0.504	CV	2.946
k hat (MLE)	0.312	k star (bias corrected MLE)	0.303
Theta hat (MLE)	0.55	Theta star (bias corrected MLE)	0.565
nu hat (MLE)	19.32	nu star (bias corrected)	18.78
Adjusted Level of Significance (β)	0.0413		
Approximate Chi Square Value (18.78, α)	9.957	Adjusted Chi Square Value (18.78, β)	9.6
95% Gamma Approximate UCL (use when n>=50)	0.323	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.602	SD (KM)	0.367
Variance (KM)	0.135	SE of Mean (KM)	0.0808
k hat (KM)	2.692	k star (KM)	2.453
nu hat (KM)	166.9	nu star (KM)	152.1
theta hat (KM)	0.224	theta star (KM)	0.246
80% gamma percentile (KM)	0.88	90% gamma percentile (KM)	1.118
95% gamma percentile (KM)	1.342	99% gamma percentile (KM)	1.832

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (152.06, α)	124.6	Adjusted Chi Square Value (152.06, β)	123.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.736	95% Gamma Adjusted KM-UCL (use when n<50)	0.744

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.767	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.378	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.235	Mean in Log Scale	-2.903
SD in Original Scale	0.495	SD in Log Scale	1.803
95% t UCL (assumes normality of ROS data)	0.386	95% Percentile Bootstrap UCL	0.39
95% BCA Bootstrap UCL	0.438	95% Bootstrap t UCL	0.67
95% H-UCL (Log ROS)	0.888		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.594	KM Geo Mean	0.552
KM SD (logged)	0.342	95% Critical H Value (KM-Log)	1.818
KM Standard Error of Mean (logged)	0.0752	95% H-UCL (KM -Log)	0.656
KM SD (logged)	0.342	95% Critical H Value (KM-Log)	1.818
KM Standard Error of Mean (logged)	0.0752		

DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.377	Mean in Log Scale	-1.22
SD in Original Scale	0.439	SD in Log Scale	0.541
95% t UCL (Assumes normality)	0.511	95% H-Stat UCL	0.415

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	0.74

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.

NH-43A - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics			
Total Number of Observations	50	Number of Distinct Observations	20
Number of Detects	20	Number of Non-Detects	30
Number of Distinct Detects	19	Number of Distinct Non-Detects	1
Minimum Detect	0.581	Minimum Non-Detect	0.5
Maximum Detect	1.96	Maximum Non-Detect	0.5
Variance Detects	0.174	Percent Non-Detects	60%
Mean Detects	1.169	SD Detects	0.417
Median Detects	1.125	CV Detects	0.357
Skewness Detects	0.402	Kurtosis Detects	-1.088
Mean of Logged Detects	0.094	SD of Logged Detects	0.363

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.928	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.198	Lilliefors GOF Test
5% Lilliefors Critical Value	0.192	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	0.767	KM Standard Error of Mean	0.0604
KM SD	0.416	95% KM (BCA) UCL	0.866
95% KM (t) UCL	0.869	95% KM (Percentile Bootstrap) UCL	0.866
95% KM (z) UCL	0.867	95% KM Bootstrap t UCL	0.88
90% KM Chebyshev UCL	0.949	95% KM Chebyshev UCL	1.031
97.5% KM Chebyshev UCL	1.145	99% KM Chebyshev UCL	1.369

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.56	Anderson-Darling GOF Test
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.186	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.194	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)	8.261	k star (bias corrected MLE)	7.055
Theta hat (MLE)	0.141	Theta star (bias corrected MLE)	0.166
nu hat (MLE)	330.4	nu star (bias corrected)	282.2
Mean (detects)	1.169		

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	0.595
Maximum	1.96	Median	0.468
SD	0.563	CV	0.946
k hat (MLE)	0.648	k star (bias corrected MLE)	0.623
Theta hat (MLE)	0.918	Theta star (bias corrected MLE)	0.956
nu hat (MLE)	64.84	nu star (bias corrected)	62.28
Adjusted Level of Significance (β)	0.0452		
Approximate Chi Square Value (62.28, α)	45.13	Adjusted Chi Square Value (62.28, β)	44.7
95% Gamma Approximate UCL (use when n>=50)	0.821	95% Gamma Adjusted UCL (use when n<50)	0.829

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.767	SD (KM)	0.416
Variance (KM)	0.173	SE of Mean (KM)	0.0604
k hat (KM)	3.396	k star (KM)	3.205
nu hat (KM)	339.6	nu star (KM)	320.5
theta hat (KM)	0.226	theta star (KM)	0.239
80% gamma percentile (KM)	1.086	90% gamma percentile (KM)	1.342
95% gamma percentile (KM)	1.58	99% gamma percentile (KM)	2.095

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (320.55, α)	280.1	Adjusted Chi Square Value (320.55, β)	278.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.878	95% Gamma Adjusted KM-UCL (use when n<50)	0.882

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.941	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.192	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	0.706	Mean in Log Scale	-0.562
SD in Original Scale	0.475	SD in Log Scale	0.67
95% t UCL (assumes normality of ROS data)	0.819	95% Percentile Bootstrap UCL	0.816
95% BCA Bootstrap UCL	0.821	95% Bootstrap t UCL	0.83
95% H-UCL (Log ROS)	0.865		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.378	KM Geo Mean	0.685
KM SD (logged)	0.446	95% Critical H Value (KM-Log)	1.851
KM Standard Error of Mean (logged)	0.0647	95% H-UCL (KM -Log)	0.851
KM SD (logged)	0.446	95% Critical H Value (KM-Log)	1.851
KM Standard Error of Mean (logged)	0.0647		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.617	Mean in Log Scale	-0.794
SD in Original Scale	0.524	SD in Log Scale	0.767
95% t UCL (Assumes normality)	0.742	95% H-Stat UCL	0.763

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	0.869

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

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

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.

NH-34 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	50	Number of Distinct Observations	23
Number of Detects	22	Number of Non-Detects	28
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	0.514	Minimum Non-Detect	0.5
Maximum Detect	4.69	Maximum Non-Detect	0.5
Variance Detects	1.51	Percent Non-Detects	56%
Mean Detects	1.775	SD Detects	1.229
Median Detects	1.44	CV Detects	0.692
Skewness Detects	1.311	Kurtosis Detects	1.049
Mean of Logged Detects	0.367	SD of Logged Detects	0.653

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.846	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors GOF Test
5% Lilliefors Critical Value	0.184	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	1.061	KM Standard Error of Mean	0.147
KM SD	1.017	95% KM (BCA) UCL	1.328
95% KM (t) UCL	1.308	95% KM (Percentile Bootstrap) UCL	1.3
95% KM (z) UCL	1.303	95% KM Bootstrap t UCL	1.381
90% KM Chebyshev UCL	1.503	95% KM Chebyshev UCL	1.703
97.5% KM Chebyshev UCL	1.981	99% KM Chebyshev UCL	2.526

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.403	Anderson-Darling GOF Test
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.104	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.187	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)	2.569	k star (bias corrected MLE)	2.249
Theta hat (MLE)	0.691	Theta star (bias corrected MLE)	0.789
nu hat (MLE)	113	nu star (bias corrected)	98.97
Mean (detects)	1.775		

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	0.794
Maximum	4.69	Median	0.0356
SD	1.191	CV	1.5
k hat (MLE)	0.333	k star (bias corrected MLE)	0.326
Theta hat (MLE)	2.387	Theta star (bias corrected MLE)	2.435
nu hat (MLE)	33.28	nu star (bias corrected)	32.62
Adjusted Level of Significance (β)	0.0452		

Approximate Chi Square Value (32.62, α)	20.56	Adjusted Chi Square Value (32.62, β)	20.28
95% Gamma Approximate UCL (use when n>=50)	1.26	95% Gamma Adjusted UCL (use when n<50)	1.278

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.061	SD (KM)	1.017
Variance (KM)	1.035	SE of Mean (KM)	0.147
k hat (KM)	1.088	k star (KM)	1.036
nu hat (KM)	108.8	nu star (KM)	103.6
theta hat (KM)	0.975	theta star (KM)	1.024
80% gamma percentile (KM)	1.703	90% gamma percentile (KM)	2.422
95% gamma percentile (KM)	3.139	99% gamma percentile (KM)	4.8

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (103.59, α)	81.1	Adjusted Chi Square Value (103.59, β)	80.51
95% Gamma Approximate KM-UCL (use when n>=50)	1.355	95% Gamma Adjusted KM-UCL (use when n<50)	1.365

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0873	Lilliefors GOF Test
5% Lilliefors Critical Value	0.184	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	0.926	Mean in Log Scale	-0.714
SD in Original Scale	1.113	SD in Log Scale	1.186
95% t UCL (assumes normality of ROS data)	1.19	95% Percentile Bootstrap UCL	1.192
95% BCA Bootstrap UCL	1.229	95% Bootstrap t UCL	1.276
95% H-UCL (Log ROS)	1.523		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.227	KM Geo Mean	0.797
KM SD (logged)	0.675	95% Critical H Value (KM-Log)	2.02
KM Standard Error of Mean (logged)	0.0978	95% H-UCL (KM -Log)	1.217
KM SD (logged)	0.675	95% Critical H Value (KM-Log)	2.02
KM Standard Error of Mean (logged)	0.0978		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.921	Mean in Log Scale	-0.615
SD in Original Scale	1.11	SD in Log Scale	0.978
95% t UCL (Assumes normality)	1.184	95% H-Stat UCL	1.205

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	1.308

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.

NH-36 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	57	Number of Distinct Observations	32

Number of Detects	31	Number of Non-Detects	26
Number of Distinct Detects	31	Number of Distinct Non-Detects	1
Minimum Detect	0.658	Minimum Non-Detect	0.5
Maximum Detect	9.3	Maximum Non-Detect	0.5
Variance Detects	4.022	Percent Non-Detects	45.61%
Mean Detects	2.816	SD Detects	2.006
Median Detects	2.22	CV Detects	0.712
Skewness Detects	1.581	Kurtosis Detects	2.78
Mean of Logged Detects	0.813	SD of Logged Detects	0.682

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.847	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.929	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.167	Lilliefors GOF Test
5% Lilliefors Critical Value	0.156	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	1.759	KM Standard Error of Mean	0.25
KM SD	1.857	95% KM (BCA) UCL	2.155
95% KM (t) UCL	2.178	95% KM (Percentile Bootstrap) UCL	2.17
95% KM (z) UCL	2.171	95% KM Bootstrap t UCL	2.278
90% KM Chebyshev UCL	2.509	95% KM Chebyshev UCL	2.849
97.5% KM Chebyshev UCL	3.321	99% KM Chebyshev UCL	4.247

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.38	Anderson-Darling GOF Test
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.1	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.159	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)	2.405	k star (bias corrected MLE)	2.194
Theta hat (MLE)	1.171	Theta star (bias corrected MLE)	1.283
nu hat (MLE)	149.1	nu star (bias corrected)	136
Mean (detects)	2.816		

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	1.549
Maximum	9.3	Median	0.832
SD	2.026	CV	1.308
k hat (MLE)	0.354	k star (bias corrected MLE)	0.347
Theta hat (MLE)	4.382	Theta star (bias corrected MLE)	4.469
nu hat (MLE)	40.3	nu star (bias corrected)	39.51
Adjusted Level of Significance (β)	0.0458		
Approximate Chi Square Value (39.51, α)	26.11	Adjusted Chi Square Value (39.51, β)	25.83
95% Gamma Approximate UCL (use when n>=50)	2.344	95% Gamma Adjusted UCL (use when n<50)	2.37

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.759	SD (KM)	1.857
Variance (KM)	3.447	SE of Mean (KM)	0.25
k hat (KM)	0.898	k star (KM)	0.862
nu hat (KM)	102.4	nu star (KM)	98.32
theta hat (KM)	1.959	theta star (KM)	2.04
80% gamma percentile (KM)	2.863	90% gamma percentile (KM)	4.201
95% gamma percentile (KM)	5.556	99% gamma percentile (KM)	8.737

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (98.32, α)	76.45	Adjusted Chi Square Value (98.32, β)	75.95
95% Gamma Approximate KM-UCL (use when n>=50)	2.263	95% Gamma Adjusted KM-UCL (use when n<50)	2.278

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.929	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0991	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.156	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	1.731	Mean in Log Scale	-0.00447
SD in Original Scale	1.898	SD in Log Scale	1.108
95% t UCL (assumes normality of ROS data)	2.152	95% Percentile Bootstrap UCL	2.163
95% BCA Bootstrap UCL	2.217	95% Bootstrap t UCL	2.246
95% H-UCL (Log ROS)	2.663		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.126	KM Geo Mean	1.134
KM SD (logged)	0.899	95% Critical H Value (KM-Log)	2.222
KM Standard Error of Mean (logged)	0.121	95% H-UCL (KM -Log)	2.219
KM SD (logged)	0.899	95% Critical H Value (KM-Log)	2.222
KM Standard Error of Mean (logged)	0.121		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.645	Mean in Log Scale	-0.19
SD in Original Scale	1.954	SD in Log Scale	1.213
95% t UCL (Assumes normality)	2.078	95% H-Stat UCL	2.667

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 Approximate Gamma UCL	2.263	95% GROS Approximate Gamma UCL	2.344

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.

NH-37 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	65	Number of Distinct Observations	29
Number of Detects	29	Number of Non-Detects	36
Number of Distinct Detects	28	Number of Distinct Non-Detects	1
Minimum Detect	0.518	Minimum Non-Detect	0.5
Maximum Detect	2.9	Maximum Non-Detect	0.5
Variance Detects	0.332	Percent Non-Detects	55.38%
Mean Detects	1.163	SD Detects	0.576
Median Detects	0.993	CV Detects	0.496
Skewness Detects	1.696	Kurtosis Detects	3.118
Mean of Logged Detects	0.0542	SD of Logged Detects	0.433

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.828	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.166	Lilliefors GOF Test	

5% Lilliefors Critical Value	0.161	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	0.796	KM Standard Error of Mean	0.0633
KM SD	0.502	95% KM (BCA) UCL	0.897
95% KM (t) UCL	0.902	95% KM (Percentile Bootstrap) UCL	0.906
95% KM (z) UCL	0.9	95% KM Bootstrap t UCL	0.923
90% KM Chebyshev UCL	0.986	95% KM Chebyshev UCL	1.072
97.5% KM Chebyshev UCL	1.191	99% KM Chebyshev UCL	1.426
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.626	Anderson-Darling GOF Test	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.119	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.163	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)	5.319	k star (bias corrected MLE)	4.792
Theta hat (MLE)	0.219	Theta star (bias corrected MLE)	0.243
nu hat (MLE)	308.5	nu star (bias corrected)	277.9
Mean (detects)	1.163		
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	0.575
Maximum	2.9	Median	0.343
SD	0.662	CV	1.152
k hat (MLE)	0.49	k star (bias corrected MLE)	0.478
Theta hat (MLE)	1.174	Theta star (bias corrected MLE)	1.204
nu hat (MLE)	63.69	nu star (bias corrected)	62.08
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (62.08, α)	44.96	Adjusted Chi Square Value (62.08, β)	44.63
95% Gamma Approximate UCL (use when n>=50)	0.794	95% Gamma Adjusted UCL (use when n<50)	0.8
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.796	SD (KM)	0.502
Variance (KM)	0.252	SE of Mean (KM)	0.0633
k hat (KM)	2.516	k star (KM)	2.41
nu hat (KM)	327.1	nu star (KM)	313.3
theta hat (KM)	0.316	theta star (KM)	0.33
80% gamma percentile (KM)	1.165	90% gamma percentile (KM)	1.482
95% gamma percentile (KM)	1.782	99% gamma percentile (KM)	2.438
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (313.31, α)	273.3	Adjusted Chi Square Value (313.31, β)	272.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.912	95% Gamma Adjusted KM-UCL (use when n<50)	0.915
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.926	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0991	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.161	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	0.703	Mean in Log Scale	-0.64

SD in Original Scale	0.573	SD in Log Scale	0.773
95% t UCL (assumes normality of ROS data)	0.821	95% Percentile Bootstrap UCL	0.819
95% BCA Bootstrap UCL	0.837	95% Bootstrap t UCL	0.837
95% H-UCL (Log ROS)	0.868		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.36	KM Geo Mean	0.698
KM SD (logged)	0.468	95% Critical H Value (KM-Log)	1.845
KM Standard Error of Mean (logged)	0.0591	95% H-UCL (KM -Log)	0.867
KM SD (logged)	0.468	95% Critical H Value (KM-Log)	1.845
KM Standard Error of Mean (logged)	0.0591		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.657	Mean in Log Scale	-0.744
SD in Original Scale	0.595	SD in Log Scale	0.776
95% t UCL (Assumes normality)	0.781	95% H-Stat UCL	0.786

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 Approximate Gamma UCL	0.912	95% GROS Approximate Gamma UCL	0.794

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.

NH-45 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	58	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	53
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.647	Minimum Non-Detect	0.5
Maximum Detect	0.787	Maximum Non-Detect	0.5
Variance Detects	0.00358	Percent Non-Detects	91.38%
Mean Detects	0.705	SD Detects	0.0598
Median Detects	0.7	CV Detects	0.0849
Skewness Detects	0.46	Kurtosis Detects	-1.517
Mean of Logged Detects	-0.352	SD of Logged Detects	0.0842

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.217	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	0.518	KM Standard Error of Mean	0.00876
KM SD	0.0597	95% KM (BCA) UCL	0.532
95% KM (t) UCL	0.532	95% KM (Percentile Bootstrap) UCL	0.532
95% KM (z) UCL	0.532	95% KM Bootstrap t UCL	0.524
90% KM Chebyshev UCL	0.544	95% KM Chebyshev UCL	0.556
97.5% KM Chebyshev UCL	0.572	99% KM Chebyshev UCL	0.605

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.312	Anderson-Darling GOF Test
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.246	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			
Gamma Statistics on Detected Data Only			
k hat (MLE)	175.7	k star (bias corrected MLE)	70.41
Theta hat (MLE)	0.00401	Theta star (bias corrected MLE)	0.01
nu hat (MLE)	1757	nu star (bias corrected)	704.1
Mean (detects)	0.705		
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	0.361
Maximum	0.787	Median	0.355
SD	0.181	CV	0.5
k hat (MLE)	2.671	k star (bias corrected MLE)	2.544
Theta hat (MLE)	0.135	Theta star (bias corrected MLE)	0.142
nu hat (MLE)	309.8	nu star (bias corrected)	295.1
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (295.10, α)	256.3	Adjusted Chi Square Value (295.10, β)	255.4
95% Gamma Approximate UCL (use when n>=50)	0.416	95% Gamma Adjusted UCL (use when n<50)	0.417
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.518	SD (KM)	0.0597
Variance (KM)	0.00356	SE of Mean (KM)	0.00876
k hat (KM)	75.2	k star (KM)	71.32
nu hat (KM)	8723	nu star (KM)	8273
theta hat (KM)	0.00688	theta star (KM)	0.00726
80% gamma percentile (KM)	0.568	90% gamma percentile (KM)	0.598
95% gamma percentile (KM)	0.622	99% gamma percentile (KM)	0.671
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, α)	8063	Adjusted Chi Square Value (N/A, β)	8057
95% Gamma Approximate KM-UCL (use when n>=50)	0.531	95% Gamma Adjusted KM-UCL (use when n<50)	0.532
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.92	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.22	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	0.438	Mean in Log Scale	-0.864
SD in Original Scale	0.124	SD in Log Scale	0.278
95% t UCL (assumes normality of ROS data)	0.465	95% Percentile Bootstrap UCL	0.465
95% BCA Bootstrap UCL	0.468	95% Bootstrap t UCL	0.467
95% H-UCL (Log ROS)	0.467		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.664	KM Geo Mean	0.515
KM SD (logged)	0.0982	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0144	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0982	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0144		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	

Mean in Original Scale	0.289	Mean in Log Scale	-1.297
SD in Original Scale	0.13	SD in Log Scale	0.294
95% t UCL (Assumes normality)	0.318	95% H-Stat UCL	0.305

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 0.532

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.

NH-22 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	37
Number of Detects	37	Number of Non-Detects	7
Number of Distinct Detects	36	Number of Distinct Non-Detects	1
Minimum Detect	0.519	Minimum Non-Detect	0.5
Maximum Detect	7.1	Maximum Non-Detect	0.5
Variance Detects	2.836	Percent Non-Detects	15.91%
Mean Detects	2.208	SD Detects	1.684
Median Detects	1.72	CV Detects	0.763
Skewness Detects	1.788	Kurtosis Detects	2.658
Mean of Logged Detects	0.566	SD of Logged Detects	0.665

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.773	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.936	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.222	Lilliefors GOF Test
5% Lilliefors Critical Value	0.144	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	1.936	KM Standard Error of Mean	0.252
KM SD	1.646	95% KM (BCA) UCL	2.372
95% KM (t) UCL	2.359	95% KM (Percentile Bootstrap) UCL	2.343
95% KM (z) UCL	2.35	95% KM Bootstrap t UCL	2.455
90% KM Chebyshev UCL	2.691	95% KM Chebyshev UCL	3.033
97.5% KM Chebyshev UCL	3.507	99% KM Chebyshev UCL	4.439

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.845	Anderson-Darling GOF Test
5% A-D Critical Value	0.757	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.135	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.147	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)	2.367	k star (bias corrected MLE)	2.193
Theta hat (MLE)	0.933	Theta star (bias corrected MLE)	1.007
nu hat (MLE)	175.1	nu star (bias corrected)	162.3
Mean (detects)	2.208		

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	1.858
Maximum	7.1	Median	1.5
SD	1.742	CV	0.937
k hat (MLE)	0.705	k star (bias corrected MLE)	0.672
Theta hat (MLE)	2.637	Theta star (bias corrected MLE)	2.766
nu hat (MLE)	62.01	nu star (bias corrected)	59.12
Adjusted Level of Significance (β)	0.0445		
Approximate Chi Square Value (59.12, α)	42.44	Adjusted Chi Square Value (59.12, β)	41.96
95% Gamma Approximate UCL (use when n>=50)	2.589	95% Gamma Adjusted UCL (use when n<50)	2.618

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.936	SD (KM)	1.646
Variance (KM)	2.71	SE of Mean (KM)	0.252
k hat (KM)	1.383	k star (KM)	1.304
nu hat (KM)	121.7	nu star (KM)	114.7
theta hat (KM)	1.4	theta star (KM)	1.485
80% gamma percentile (KM)	3.04	90% gamma percentile (KM)	4.175
95% gamma percentile (KM)	5.288	99% gamma percentile (KM)	7.824

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (114.73, α)	91	Adjusted Chi Square Value (114.73, β)	90.28
95% Gamma Approximate KM-UCL (use when n>=50)	2.441	95% Gamma Adjusted KM-UCL (use when n<50)	2.46

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.936	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0885	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.144	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	1.919	Mean in Log Scale	0.323
SD in Original Scale	1.681	SD in Log Scale	0.838
95% t UCL (assumes normality of ROS data)	2.345	95% Percentile Bootstrap UCL	2.377
95% BCA Bootstrap UCL	2.417	95% Bootstrap t UCL	2.438
95% H-UCL (Log ROS)	2.598		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.366	KM Geo Mean	1.441
KM SD (logged)	0.757	95% Critical H Value (KM-Log)	2.12
KM Standard Error of Mean (logged)	0.116	95% H-UCL (KM -Log)	2.453
KM SD (logged)	0.757	95% Critical H Value (KM-Log)	2.12
KM Standard Error of Mean (logged)	0.116		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.896	Mean in Log Scale	0.255
SD in Original Scale	1.702	SD in Log Scale	0.944
95% t UCL (Assumes normality)	2.328	95% H-Stat UCL	2.811

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	2.46	95% GROS Adjusted Gamma UCL	2.618

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.

NH-25 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	49	Number of Distinct Observations	16
Number of Detects	16	Number of Non-Detects	33
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	0.538	Minimum Non-Detect	0.5
Maximum Detect	2.2	Maximum Non-Detect	0.5
Variance Detects	0.259	Percent Non-Detects	67.35%
Mean Detects	1.491	SD Detects	0.509
Median Detects	1.665	CV Detects	0.341
Skewness Detects	-0.89	Kurtosis Detects	-0.145
Mean of Logged Detects	0.321	SD of Logged Detects	0.448

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.885	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.167	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	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	0.823	KM Standard Error of Mean	0.0801
KM SD	0.543	95% KM (BCA) UCL	0.961
95% KM (t) UCL	0.958	95% KM (Percentile Bootstrap) UCL	0.954
95% KM (z) UCL	0.955	95% KM Bootstrap t UCL	0.974
90% KM Chebyshev UCL	1.064	95% KM Chebyshev UCL	1.173
97.5% KM Chebyshev UCL	1.324	99% KM Chebyshev UCL	1.621

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.29	Anderson-Darling GOF Test
5% A-D Critical Value	0.741	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.222	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.216	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)	6.577	k star (bias corrected MLE)	5.386
Theta hat (MLE)	0.227	Theta star (bias corrected MLE)	0.277
nu hat (MLE)	210.5	nu star (bias corrected)	172.3
Mean (detects)	1.491		

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	0.723
Maximum	2.2	Median	0.56
SD	0.657	CV	0.908
k hat (MLE)	0.715	k star (bias corrected MLE)	0.685
Theta hat (MLE)	1.012	Theta star (bias corrected MLE)	1.056
nu hat (MLE)	70.05	nu star (bias corrected)	67.09
Adjusted Level of Significance (β)	0.0451		
Approximate Chi Square Value (67.09, α)	49.24	Adjusted Chi Square Value (67.09, β)	48.78
95% Gamma Approximate UCL (use when n>=50)	0.985	95% Gamma Adjusted UCL (use when n<50)	0.995

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.823	SD (KM)	0.543
Variance (KM)	0.295	SE of Mean (KM)	0.0801
k hat (KM)	2.299	k star (KM)	2.172
nu hat (KM)	225.3	nu star (KM)	212.9
theta hat (KM)	0.358	theta star (KM)	0.379
80% gamma percentile (KM)	1.221	90% gamma percentile (KM)	1.571
95% gamma percentile (KM)	1.903	99% gamma percentile (KM)	2.637

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (212.85, α)	180.1	Adjusted Chi Square Value (212.85, β)	179.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.973	95% Gamma Adjusted KM-UCL (use when n<50)	0.978

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.783	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.253	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	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	0.791	Mean in Log Scale	-0.501
SD in Original Scale	0.59	SD in Log Scale	0.748
95% t UCL (assumes normality of ROS data)	0.933	95% Percentile Bootstrap UCL	0.922
95% BCA Bootstrap UCL	0.936	95% Bootstrap t UCL	0.94
95% H-UCL (Log ROS)	1.003		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.362	KM Geo Mean	0.696
KM SD (logged)	0.536	95% Critical H Value (KM-Log)	1.915
KM Standard Error of Mean (logged)	0.0791	95% H-UCL (KM -Log)	0.932
KM SD (logged)	0.536	95% Critical H Value (KM-Log)	1.915
KM Standard Error of Mean (logged)	0.0791		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.655	Mean in Log Scale	-0.829
SD in Original Scale	0.653	SD in Log Scale	0.847
95% t UCL (Assumes normality)	0.811	95% H-Stat UCL	0.816

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	0.958

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.

NH-04 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	44
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 NH-04 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L] was not processed!

NH-32 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	42	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	42
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 NH-32 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L] was not processed!

NH-07 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	13	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	13
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 NH-07 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L] was not processed!

NH-33 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	36	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	36
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 NH-33 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L] was not processed!

NH-44 - 1,1-Dichloroethene (1,1-DCE) (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	43	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	39
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.37	Minimum Non-Detect	0.5
Maximum Detect	0.747	Maximum Non-Detect	0.5
Variance Detects	0.028	Percent Non-Detects	90.70%
Mean Detects	0.598	SD Detects	0.167
Median Detects	0.638	CV Detects	0.28
Skewness Detects	-1.088	Kurtosis Detects	0.489

Mean of Logged Detects	-0.549	SD of Logged Detects	0.316
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.219	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	0.391	KM Standard Error of Mean	0.014
KM SD	0.0796	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.415	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.414	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.433	95% KM Chebyshev UCL	0.452
97.5% KM Chebyshev UCL	0.479	99% KM Chebyshev UCL	0.531
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.37	Anderson-Darling GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.251	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)	14.67	k star (bias corrected MLE)	3.835
Theta hat (MLE)	0.0408	Theta star (bias corrected MLE)	0.156
nu hat (MLE)	117.4	nu star (bias corrected)	30.68
Mean (detects)	0.598		
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	0.139	Mean	0.384
Maximum	0.747	Median	0.37
SD	0.135	CV	0.352
k hat (MLE)	8.027	k star (bias corrected MLE)	7.482
Theta hat (MLE)	0.0479	Theta star (bias corrected MLE)	0.0513
nu hat (MLE)	690.3	nu star (bias corrected)	643.5
Adjusted Level of Significance (β)	0.0444		
Approximate Chi Square Value (643.46, α)	585.6	Adjusted Chi Square Value (643.46, β)	583.7
95% Gamma Approximate UCL (use when n>=50)	0.422	95% Gamma Adjusted UCL (use when n<50)	N/A
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.391	SD (KM)	0.0796
Variance (KM)	0.00634	SE of Mean (KM)	0.014
k hat (KM)	24.15	k star (KM)	22.48
nu hat (KM)	2077	nu star (KM)	1933
theta hat (KM)	0.0162	theta star (KM)	0.0174
80% gamma percentile (KM)	0.458	90% gamma percentile (KM)	0.5
95% gamma percentile (KM)	0.536	99% gamma percentile (KM)	0.608
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, α)	1832	Adjusted Chi Square Value (N/A, β)	1829
95% Gamma Approximate KM-UCL (use when n>=50)	0.413	95% Gamma Adjusted KM-UCL (use when n<50)	0.414
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.881	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.255	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	0.394	Mean in Log Scale	-0.976
SD in Original Scale	0.12	SD in Log Scale	0.297
95% t UCL (assumes normality of ROS data)	0.424	95% Percentile Bootstrap UCL	0.424
95% BCA Bootstrap UCL	0.428	95% Bootstrap t UCL	0.428
95% H-UCL (Log ROS)	0.427		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.953	KM Geo Mean	0.386
KM SD (logged)	0.154	95% Critical H Value (KM-Log)	1.695
KM Standard Error of Mean (logged)	0.0271	95% H-UCL (KM -Log)	0.406
KM SD (logged)	0.154	95% Critical H Value (KM-Log)	1.695
KM Standard Error of Mean (logged)	0.0271		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.282	Mean in Log Scale	-1.308
SD in Original Scale	0.112	SD in Log Scale	0.26
95% t UCL (Assumes normality)	0.311	95% H-Stat UCL	0.3

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	0.415

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.

NH-07 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	18.6	Mean	19.97
Maximum	22.4	Median	18.9
SD	2.113	Std. Error of Mean	1.22
Coefficient of Variation	0.106	Skewness	1.693

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	0.809	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.36	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	23.53	95% Adjusted-CLT UCL (Chen-1995)	23.25

		95% Modified-t UCL (Johnson-1978)	23.73

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	139	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.144	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	833.7	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.814	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.357	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.923	Mean of logged Data	2.99
Maximum of Logged Data	3.109	SD of logged Data	0.103

Assuming Lognormal Distribution

95% H-UCL	24.46	90% Chebyshev (MVUE) UCL	23.52
95% Chebyshev (MVUE) UCL	25.13	97.5% Chebyshev (MVUE) UCL	27.37
99% Chebyshev (MVUE) UCL	31.77		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	21.97	95% Jackknife UCL	23.53
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	23.63	95% Chebyshev(Mean, Sd) UCL	25.28
97.5% Chebyshev(Mean, Sd) UCL	27.58	99% Chebyshev(Mean, Sd) UCL	32.1

Suggested UCL to Use

95% Student's-t UCL	23.53

Recommended UCL exceeds the maximum observation

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.

NH-22 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	17.6	Mean	21.3
Maximum	25	Median	21.3

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-22 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-44 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5.5	Mean	7.5
Maximum	10	Median	7.25
SD	2.121	Std. Error of Mean	1.061
Coefficient of Variation	0.283	Skewness	0.367

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	0.913	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.26	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	9.996	95% Adjusted-CLT UCL (Chen-1995)	9.452
		95% Modified-t UCL (Johnson-1978)	10.03

Gamma GOF Test

A-D Test Statistic	0.35	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	Kolmogorov-Smirnov Gamma GOF Test
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

Gamma Statistics

k hat (MLE)	16.77	k star (bias corrected MLE)	4.359
Theta hat (MLE)	0.447	Theta star (bias corrected MLE)	1.721
nu hat (MLE)	134.2	nu star (bias corrected)	34.87
MLE Mean (bias corrected)	7.5	MLE Sd (bias corrected)	3.592
		Approximate Chi Square Value (0.05)	22.36
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.7	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.252	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.705	Mean of logged Data	1.985
Maximum of Logged Data	2.303	SD of logged Data	0.283

Assuming Lognormal Distribution

95% H-UCL	11.82	90% Chebyshev (MVUE) UCL	10.67
95% Chebyshev (MVUE) UCL	12.1	97.5% Chebyshev (MVUE) UCL	14.09
99% Chebyshev (MVUE) UCL	18		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.245	95% Jackknife UCL	9.996
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	10.68	95% Chebyshev(Mean, Sd) UCL	12.12
97.5% Chebyshev(Mean, Sd) UCL	14.12	99% Chebyshev(Mean, Sd) UCL	18.05

Suggested UCL to Use

95% Student's-t UCL	9.996

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.

NH-23 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.4	Mean	4.65
Maximum	7.3	Median	3.95
SD	1.808	Std. Error of Mean	0.904
Coefficient of Variation	0.389	Skewness	1.743

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	0.798	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.327	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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	6.778	95% Adjusted-CLT UCL (Chen-1995)	6.979
		95% Modified-t UCL (Johnson-1978)	6.909

Gamma GOF Test

A-D Test Statistic	0.497	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.307	Kolmogorov-Smirnov Gamma GOF Test
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

k hat (MLE)	10.35	k star (bias corrected MLE)	2.755
Theta hat (MLE)	0.449	Theta star (bias corrected MLE)	1.688
nu hat (MLE)	82.83	nu star (bias corrected)	22.04
MLE Mean (bias corrected)	4.65	MLE Sd (bias corrected)	2.801
		Approximate Chi Square Value (0.05)	12.37
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8.286	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.847	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.224	Mean of logged Data	1.488
Maximum of Logged Data	1.988	SD of logged Data	0.348

Assuming Lognormal Distribution

95% H-UCL	8.523	90% Chebyshev (MVUE) UCL	7.027
95% Chebyshev (MVUE) UCL	8.113	97.5% Chebyshev (MVUE) UCL	9.619
99% Chebyshev (MVUE) UCL	12.58		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6.137	95% Jackknife UCL	6.778
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.362	95% Chebyshev(Mean, Sd) UCL	8.591
97.5% Chebyshev(Mean, Sd) UCL	10.3	99% Chebyshev(Mean, Sd) UCL	13.65

Suggested UCL to Use

95% Student's-t UCL	6.778

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.

NH-43A - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	8.2	Mean	10.03
Maximum	12.8	Median	9.55
SD	1.991	Std. Error of Mean	0.995
Coefficient of Variation	0.199	Skewness	1.225

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

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.255	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	12.37	95% Adjusted-CLT UCL (Chen-1995)	12.31
		95% Modified-t UCL (Johnson-1978)	12.47

Gamma GOF Test

A-D Test Statistic	0.291	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	Kolmogorov-Smirnov Gamma GOF Test	
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

Gamma Statistics

k hat (MLE)	35.95	k star (bias corrected MLE)	9.154
Theta hat (MLE)	0.279	Theta star (bias corrected MLE)	1.095
nu hat (MLE)	287.6	nu star (bias corrected)	73.24
MLE Mean (bias corrected)	10.03	MLE Sd (bias corrected)	3.313
		Approximate Chi Square Value (0.05)	54.53
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	13.46	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.104	Mean of logged Data	2.291
Maximum of Logged Data	2.549	SD of logged Data	0.19

Assuming Lognormal Distribution

95% H-UCL	13.16	90% Chebyshev (MVUE) UCL	12.87
95% Chebyshev (MVUE) UCL	14.17	97.5% Chebyshev (MVUE) UCL	15.96
99% Chebyshev (MVUE) UCL	19.48		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	11.66	95% Jackknife UCL	12.37
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.01	95% Chebyshev(Mean, Sd) UCL	14.36
97.5% Chebyshev(Mean, Sd) UCL	16.24	99% Chebyshev(Mean, Sd) UCL	19.93

Suggested UCL to Use

95% Student's-t UCL	12.37

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.

NH-25 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	16	Mean	17.2
Maximum	18.6	Median	17
SD	1.311	Std. Error of Mean	0.757
Coefficient of Variation	0.0762	Skewness	0.67

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	0.983	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.227	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	19.41	95% Adjusted-CLT UCL (Chen-1995)	18.76
		95% Modified-t UCL (Johnson-1978)	19.46

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	260.4	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0661	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1562	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.987	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	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	2.843
Maximum of Logged Data	2.923	SD of logged Data	0.0758

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	19.46
95% Chebyshev (MVUE) UCL	20.48	97.5% Chebyshev (MVUE) UCL	21.89
99% Chebyshev (MVUE) UCL	24.68		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	18.45	95% Jackknife UCL	19.41
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	19.47	95% Chebyshev(Mean, Sd) UCL	20.5
97.5% Chebyshev(Mean, Sd) UCL	21.93	99% Chebyshev(Mean, Sd) UCL	24.73

Suggested UCL to Use

95% Student's-t UCL	19.41

Recommended UCL exceeds the maximum observation

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.

NH-37 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5.4	Mean	6.5
Maximum	7.5	Median	6.6
SD	1.054	Std. Error of Mean	0.608
Coefficient of Variation	0.162	Skewness	-0.423

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	0.993	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.204	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	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	8.276	95% Adjusted-CLT UCL (Chen-1995)	7.342
		95% Modified-t UCL (Johnson-1978)	8.251

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	55.65	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.117	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	333.9	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.984	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.225	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.425	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	1.863
Maximum of Logged Data	2.015	SD of logged Data	0.166
Assuming Lognormal Distribution			
95% H-UCL	9.363	90% Chebyshev (MVUE) UCL	8.359
95% Chebyshev (MVUE) UCL	9.201	97.5% Chebyshev (MVUE) UCL	10.37
99% Chebyshev (MVUE) UCL	12.66		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.501	95% Jackknife UCL	8.276
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	8.325	95% Chebyshev(Mean, Sd) UCL	9.151
97.5% Chebyshev(Mean, Sd) UCL	10.3	99% Chebyshev(Mean, Sd) UCL	12.55
Suggested UCL to Use			
95% Student's-t UCL	8.276		

Recommended UCL exceeds the maximum observation

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.

NH-04 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	15.4	Mean	17.5
Maximum	21.6	Median	16.5
SD	2.812	Std. Error of Mean	1.406
Coefficient of Variation	0.161	Skewness	1.684

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	0.827	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	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)	21.08
		95% Modified-t UCL (Johnson-1978)	21.01

Gamma GOF Test

A-D Test Statistic	0.479	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.318	Kolmogorov-Smirnov Gamma GOF Test
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

Gamma Statistics

k hat (MLE)	55.81	k star (bias corrected MLE)	14.12
Theta hat (MLE)	0.314	Theta star (bias corrected MLE)	1.239
nu hat (MLE)	446.5	nu star (bias corrected)	113
MLE Mean (bias corrected)	17.5	MLE Sd (bias corrected)	4.657
		Approximate Chi Square Value (0.05)	89.43
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	22.11	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.302	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.734	Mean of logged Data	2.853
Maximum of Logged Data	3.073	SD of logged Data	0.152

Assuming Lognormal Distribution

95% H-UCL	21.54	90% Chebyshev (MVUE) UCL	21.47
95% Chebyshev (MVUE) UCL	23.27	97.5% Chebyshev (MVUE) UCL	25.78
99% Chebyshev (MVUE) UCL	30.69		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	19.81	95% Jackknife UCL	20.81
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	21.72	95% Chebyshev(Mean, Sd) UCL	23.63
97.5% Chebyshev(Mean, Sd) UCL	26.28	99% Chebyshev(Mean, Sd) UCL	31.49

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.

NH-26 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	10.3	Mean	12.9
Maximum	15.5	Median	12.9

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-26 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-33 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	4.7	Mean	4.9
Maximum	5.1	Median	4.9

Warning: This data set only has 2 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-33 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-45 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	8.5	Mean	8.5
Maximum	8.5	Median	8.5

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-45 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-36 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	14.6	Mean	14.6
Maximum	14.6	Median	14.6

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-36 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-34 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	8.3	Mean	8.3
Maximum	8.3	Median	8.3

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-34 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-32 - SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	6.6	Mean	6.6
Maximum	6.6	Median	6.6

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable NH-32 - SELENIUM (CasNo: 7782-49-2) [µg/L] was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

NH-23 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	38	Number of Distinct Observations	35
		Number of Missing Observations	0
Minimum	5.06	Mean	20.53
Maximum	35.1	Median	20.1
SD	6.685	Std. Error of Mean	1.084
Coefficient of Variation	0.326	Skewness	-0.129

Normal GOF Test

Shapiro Wilk Test Statistic	0.99	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0775	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	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	22.36	95% Adjusted-CLT UCL (Chen-1995)	22.29
		95% Modified-t UCL (Johnson-1978)	22.36

Gamma GOF Test

A-D Test Statistic	0.583	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	0.128	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	7.855	k star (bias corrected MLE)	7.252
Theta hat (MLE)	2.614	Theta star (bias corrected MLE)	2.831
nu hat (MLE)	597	nu star (bias corrected)	551.2
MLE Mean (bias corrected)	20.53	MLE Sd (bias corrected)	7.625
		Approximate Chi Square Value (0.05)	497.7
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	495.6

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	22.74	95% Adjusted Gamma UCL (use when n<50)	22.83

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.906	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	1.621	Mean of logged Data	2.957
Maximum of Logged Data	3.558	SD of logged Data	0.396

Assuming Lognormal Distribution			
95% H-UCL	23.46	90% Chebyshev (MVUE) UCL	24.88
95% Chebyshev (MVUE) UCL	26.75	97.5% Chebyshev (MVUE) UCL	29.34
99% Chebyshev (MVUE) UCL	34.42		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	22.32	95% Jackknife UCL	22.36
95% Standard Bootstrap UCL	22.3	95% Bootstrap-t UCL	22.39
95% Hall's Bootstrap UCL	22.39	95% Percentile Bootstrap UCL	22.17
95% BCA Bootstrap UCL	22.28		
90% Chebyshev(Mean, Sd) UCL	23.79	95% Chebyshev(Mean, Sd) UCL	25.26
97.5% Chebyshev(Mean, Sd) UCL	27.31	99% Chebyshev(Mean, Sd) UCL	31.32

Suggested UCL to Use	
95% Student's-t UCL	22.36

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.

NH-26 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics			
Total Number of Observations	31	Number of Distinct Observations	21
Number of Detects	20	Number of Non-Detects	11
Number of Distinct Detects	20	Number of Distinct Non-Detects	1
Minimum Detect	0.651	Minimum Non-Detect	0.5
Maximum Detect	9.61	Maximum Non-Detect	0.5

Variance Detects	3.816	Percent Non-Detects	35.48%
Mean Detects	3.402	SD Detects	1.954
Median Detects	3.065	CV Detects	0.574
Skewness Detects	1.567	Kurtosis Detects	4.582
Mean of Logged Detects	1.057	SD of Logged Detects	0.642

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	Lilliefors GOF Test
5% Lilliefors Critical Value	0.192	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	2.372	KM Standard Error of Mean	0.381
KM SD	2.066	95% KM (BCA) UCL	3.014
95% KM (t) UCL	3.018	95% KM (Percentile Bootstrap) UCL	3.013
95% KM (z) UCL	2.998	95% KM Bootstrap t UCL	3.199
90% KM Chebyshev UCL	3.514	95% KM Chebyshev UCL	4.031
97.5% KM Chebyshev UCL	4.749	99% KM Chebyshev UCL	6.159

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.465	Anderson-Darling GOF Test
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	Kolmogorov-Smirnov GOF
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 on Detected Data Only

k hat (MLE)	3.144	k star (bias corrected MLE)	2.706
Theta hat (MLE)	1.082	Theta star (bias corrected MLE)	1.257
nu hat (MLE)	125.8	nu star (bias corrected)	108.2
Mean (detects)	3.402		

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	2.282
Maximum	9.61	Median	2.08
SD	2.192	CV	0.961
k hat (MLE)	0.556	k star (bias corrected MLE)	0.524
Theta hat (MLE)	4.102	Theta star (bias corrected MLE)	4.355
nu hat (MLE)	34.49	nu star (bias corrected)	32.49
Adjusted Level of Significance (β)	0.0413		
Approximate Chi Square Value (32.49, α)	20.46	Adjusted Chi Square Value (32.49, β)	19.93
95% Gamma Approximate UCL (use when n>=50)	3.623	95% Gamma Adjusted UCL (use when n<50)	3.72

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.372	SD (KM)	2.066
Variance (KM)	4.267	SE of Mean (KM)	0.381
k hat (KM)	1.319	k star (KM)	1.213
nu hat (KM)	81.77	nu star (KM)	75.19
theta hat (KM)	1.799	theta star (KM)	1.956
80% gamma percentile (KM)	3.752	90% gamma percentile (KM)	5.208
95% gamma percentile (KM)	6.643	99% gamma percentile (KM)	9.929

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (75.19, α)	56.22	Adjusted Chi Square Value (75.19, β)	55.3
95% Gamma Approximate KM-UCL (use when n>=50)	3.173	95% Gamma Adjusted KM-UCL (use when n<50)	3.225

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.904	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.154	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.192	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	2.449	Mean in Log Scale	0.537
SD in Original Scale	2.036	SD in Log Scale	0.91
95% t UCL (assumes normality of ROS data)	3.07	95% Percentile Bootstrap UCL	3.075
95% BCA Bootstrap UCL	3.169	95% Bootstrap t UCL	3.215
95% H-UCL (Log ROS)	3.808		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.436	KM Geo Mean	1.546
KM SD (logged)	0.977	95% Critical H Value (KM-Log)	2.396
KM Standard Error of Mean (logged)	0.18	95% H-UCL (KM -Log)	3.82
KM SD (logged)	0.977	95% Critical H Value (KM-Log)	2.396
KM Standard Error of Mean (logged)	0.18		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.283	Mean in Log Scale	0.19
SD in Original Scale	2.183	SD in Log Scale	1.294
95% t UCL (Assumes normality)	2.949	95% H-Stat UCL	5.402

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	3.018

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.

NH-43A - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	50	Number of Distinct Observations	29
Number of Detects	28	Number of Non-Detects	22
Number of Distinct Detects	28	Number of Distinct Non-Detects	1
Minimum Detect	0.505	Minimum Non-Detect	0.5
Maximum Detect	25.5	Maximum Non-Detect	0.5
Variance Detects	50.45	Percent Non-Detects	44%
Mean Detects	8.641	SD Detects	7.103
Median Detects	7.045	CV Detects	0.822
Skewness Detects	0.838	Kurtosis Detects	0.119
Mean of Logged Detects	1.671	SD of Logged Detects	1.166

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.137	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.164	Detected Data appear Normal at 5% Significance Level	

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	5.059	KM Standard Error of Mean	0.951
KM SD	6.601	95% KM (BCA) UCL	6.787
95% KM (t) UCL	6.653	95% KM (Percentile Bootstrap) UCL	6.658
95% KM (z) UCL	6.623	95% KM Bootstrap t UCL	6.828
90% KM Chebyshev UCL	7.911	95% KM Chebyshev UCL	9.203
97.5% KM Chebyshev UCL	11	99% KM Chebyshev UCL	14.52

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.476	Anderson-Darling GOF Test
5% A-D Critical Value	0.77	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.132	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.17	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)	1.167	k star (bias corrected MLE)	1.066
Theta hat (MLE)	7.401	Theta star (bias corrected MLE)	8.104
nu hat (MLE)	65.38	nu star (bias corrected)	59.71
Mean (detects)	8.641		

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	4.852
Maximum	25.5	Median	0.943
SD	6.815	CV	1.405
k hat (MLE)	0.274	k star (bias corrected MLE)	0.271
Theta hat (MLE)	17.73	Theta star (bias corrected MLE)	17.93
nu hat (MLE)	27.37	nu star (bias corrected)	27.06
Adjusted Level of Significance (β)	0.0452		
Approximate Chi Square Value (27.06, α)	16.2	Adjusted Chi Square Value (27.06, β)	15.95
95% Gamma Approximate UCL (use when n>=50)	8.105	95% Gamma Adjusted UCL (use when n<50)	8.232

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.059	SD (KM)	6.601
Variance (KM)	43.57	SE of Mean (KM)	0.951
k hat (KM)	0.587	k star (KM)	0.565
nu hat (KM)	58.73	nu star (KM)	56.54
theta hat (KM)	8.614	theta star (KM)	8.947
80% gamma percentile (KM)	8.336	90% gamma percentile (KM)	13.33
95% gamma percentile (KM)	18.6	99% gamma percentile (KM)	31.4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (56.54, α)	40.26	Adjusted Chi Square Value (56.54, β)	39.85
95% Gamma Approximate KM-UCL (use when n>=50)	7.105	95% Gamma Adjusted KM-UCL (use when n<50)	7.178

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.909	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.924	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.161	Lilliefors GOF Test
5% Lilliefors Critical Value	0.164	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	5.032	Mean in Log Scale	0.425
SD in Original Scale	6.69	SD in Log Scale	1.773

95% t UCL (assumes normality of ROS data)	6.618	95% Percentile Bootstrap UCL	6.661
95% BCA Bootstrap UCL	6.947	95% Bootstrap t UCL	6.893
95% H-UCL (Log ROS)	17.03		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.631	KM Geo Mean	1.879
KM SD (logged)	1.453	95% Critical H Value (KM-Log)	2.881
KM Standard Error of Mean (logged)	0.209	95% H-UCL (KM -Log)	9.82
KM SD (logged)	1.453	95% Critical H Value (KM-Log)	2.881
KM Standard Error of Mean (logged)	0.209		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.949	Mean in Log Scale	0.326
SD in Original Scale	6.746	SD in Log Scale	1.76
95% t UCL (Assumes normality)	6.548	95% H-Stat UCL	14.91

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	6.653

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.

NH-34 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	50	Number of Distinct Observations	26
Number of Detects	27	Number of Non-Detects	23
Number of Distinct Detects	25	Number of Distinct Non-Detects	1
Minimum Detect	0.697	Minimum Non-Detect	0.5
Maximum Detect	10.5	Maximum Non-Detect	0.5
Variance Detects	7.366	Percent Non-Detects	46%
Mean Detects	3.524	SD Detects	2.714
Median Detects	2.59	CV Detects	0.77
Skewness Detects	1.069	Kurtosis Detects	0.183
Mean of Logged Detects	0.973	SD of Logged Detects	0.785

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.864	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.2	Lilliefors GOF Test
5% Lilliefors Critical Value	0.167	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	2.133	KM Standard Error of Mean	0.356
KM SD	2.47	95% KM (BCA) UCL	2.75
95% KM (t) UCL	2.73	95% KM (Percentile Bootstrap) UCL	2.697
95% KM (z) UCL	2.718	95% KM Bootstrap t UCL	2.839
90% KM Chebyshev UCL	3.201	95% KM Chebyshev UCL	3.684
97.5% KM Chebyshev UCL	4.356	99% KM Chebyshev UCL	5.675

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.518	Anderson-Darling GOF Test	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.126	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.171	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)	1.893	k star (bias corrected MLE)	1.707
Theta hat (MLE)	1.861	Theta star (bias corrected MLE)	2.064
nu hat (MLE)	102.2	nu star (bias corrected)	92.2
Mean (detects)	3.524		

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	1.911
Maximum	10.5	Median	0.889
SD	2.65	CV	1.387
k hat (MLE)	0.316	k star (bias corrected MLE)	0.311
Theta hat (MLE)	6.04	Theta star (bias corrected MLE)	6.15
nu hat (MLE)	31.64	nu star (bias corrected)	31.07
Adjusted Level of Significance (β)	0.0452		
Approximate Chi Square Value (31.07, α)	19.34	Adjusted Chi Square Value (31.07, β)	19.06
95% Gamma Approximate UCL (use when n>=50)	3.071	95% Gamma Adjusted UCL (use when n<50)	3.115

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.133	SD (KM)	2.47
Variance (KM)	6.101	SE of Mean (KM)	0.356
k hat (KM)	0.746	k star (KM)	0.714
nu hat (KM)	74.55	nu star (KM)	71.41
theta hat (KM)	2.861	theta star (KM)	2.986
80% gamma percentile (KM)	3.503	90% gamma percentile (KM)	5.329
95% gamma percentile (KM)	7.207	99% gamma percentile (KM)	11.68

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (71.41, α)	52.96	Adjusted Chi Square Value (71.41, β)	52.49
95% Gamma Approximate KM-UCL (use when n>=50)	2.876	95% Gamma Adjusted KM-UCL (use when n<50)	2.902

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.923	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.103	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.167	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	2.087	Mean in Log Scale	0.012
SD in Original Scale	2.53	SD in Log Scale	1.288
95% t UCL (assumes normality of ROS data)	2.687	95% Percentile Bootstrap UCL	2.709
95% BCA Bootstrap UCL	2.792	95% Bootstrap t UCL	2.838
95% H-UCL (Log ROS)	3.795		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.206	KM Geo Mean	1.229
KM SD (logged)	1.005	95% Critical H Value (KM-Log)	2.349
KM Standard Error of Mean (logged)	0.145	95% H-UCL (KM -Log)	2.853
KM SD (logged)	1.005	95% Critical H Value (KM-Log)	2.349
KM Standard Error of Mean (logged)	0.145		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.018	Mean in Log Scale	-0.112
SD in Original Scale	2.574	SD in Log Scale	1.318
95% t UCL (Assumes normality)	2.628	95% H-Stat UCL	3.549

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 Approximate Gamma UCL	2.876	95% GROS Approximate Gamma UCL	3.071

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.

NH-36 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	57	Number of Distinct Observations	33
Number of Detects	32	Number of Non-Detects	25
Number of Distinct Detects	32	Number of Distinct Non-Detects	1
Minimum Detect	0.836	Minimum Non-Detect	0.5
Maximum Detect	17.8	Maximum Non-Detect	0.5
Variance Detects	14.41	Percent Non-Detects	43.86%
Mean Detects	5.104	SD Detects	3.796
Median Detects	4.235	CV Detects	0.744
Skewness Detects	1.781	Kurtosis Detects	3.574
Mean of Logged Detects	1.392	SD of Logged Detects	0.717

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.829	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.217	Lilliefors GOF Test
5% Lilliefors Critical Value	0.154	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	3.085	KM Standard Error of Mean	0.486
KM SD	3.613	95% KM (BCA) UCL	3.918
95% KM (t) UCL	3.898	95% KM (Percentile Bootstrap) UCL	3.948
95% KM (z) UCL	3.885	95% KM Bootstrap t UCL	4.084
90% KM Chebyshev UCL	4.544	95% KM Chebyshev UCL	5.204
97.5% KM Chebyshev UCL	6.121	99% KM Chebyshev UCL	7.923

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.371	Anderson-Darling GOF Test
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.137	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.157	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)	2.252	k star (bias corrected MLE)	2.062
Theta hat (MLE)	2.266	Theta star (bias corrected MLE)	2.475
nu hat (MLE)	144.1	nu star (bias corrected)	132
Mean (detects)	5.104		

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	2.884
Maximum	17.8	Median	1.61
SD	3.795	CV	1.316
k hat (MLE)	0.32	k star (bias corrected MLE)	0.315
Theta hat (MLE)	9.001	Theta star (bias corrected MLE)	9.148
nu hat (MLE)	36.53	nu star (bias corrected)	35.94
Adjusted Level of Significance (β)	0.0458		
Approximate Chi Square Value (35.94, α)	23.22	Adjusted Chi Square Value (35.94, β)	22.96
95% Gamma Approximate UCL (use when n>=50)	4.464	95% Gamma Adjusted UCL (use when n<50)	4.516

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.085	SD (KM)	3.613
Variance (KM)	13.06	SE of Mean (KM)	0.486
k hat (KM)	0.729	k star (KM)	0.702
nu hat (KM)	83.09	nu star (KM)	80.05
theta hat (KM)	4.232	theta star (KM)	4.393
80% gamma percentile (KM)	5.07	90% gamma percentile (KM)	7.738
95% gamma percentile (KM)	10.49	99% gamma percentile (KM)	17.05

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (80.05, α)	60.44	Adjusted Chi Square Value (80.05, β)	59.99
95% Gamma Approximate KM-UCL (use when n>=50)	4.086	95% Gamma Adjusted KM-UCL (use when n<50)	4.116

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.93	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0917	Lilliefors GOF Test
5% Lilliefors Critical Value	0.154	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	3.198	Mean in Log Scale	0.592
SD in Original Scale	3.574	SD in Log Scale	1.13
95% t UCL (assumes normality of ROS data)	3.989	95% Percentile Bootstrap UCL	3.963
95% BCA Bootstrap UCL	4.143	95% Bootstrap t UCL	4.156
95% H-UCL (Log ROS)	5.022		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.477	KM Geo Mean	1.612
KM SD (logged)	1.162	95% Critical H Value (KM-Log)	2.591
KM Standard Error of Mean (logged)	0.156	95% H-UCL (KM -Log)	4.734
KM SD (logged)	1.162	95% Critical H Value (KM-Log)	2.591
KM Standard Error of Mean (logged)	0.156		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.975	Mean in Log Scale	0.173
SD in Original Scale	3.726	SD in Log Scale	1.49
95% t UCL (Assumes normality)	3.8	95% H-Stat UCL	6.653

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 Approximate Gamma UCL	4.086	95% GROS Approximate Gamma UCL	4.464

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.

NH-37 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	65	Number of Distinct Observations	36
Number of Detects	35	Number of Non-Detects	30
Number of Distinct Detects	35	Number of Distinct Non-Detects	1
Minimum Detect	0.737	Minimum Non-Detect	0.5
Maximum Detect	14.3	Maximum Non-Detect	0.5
Variance Detects	11.64	Percent Non-Detects	46.15%
Mean Detects	4.8	SD Detects	3.411
Median Detects	3.95	CV Detects	0.711
Skewness Detects	1.307	Kurtosis Detects	1.376
Mean of Logged Detects	1.326	SD of Logged Detects	0.733

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.159	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	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	2.816	KM Standard Error of Mean	0.411
KM SD	3.269	95% KM (BCA) UCL	3.568
95% KM (t) UCL	3.502	95% KM (Percentile Bootstrap) UCL	3.547
95% KM (z) UCL	3.492	95% KM Bootstrap t UCL	3.593
90% KM Chebyshev UCL	4.05	95% KM Chebyshev UCL	4.609
97.5% KM Chebyshev UCL	5.384	99% KM Chebyshev UCL	6.908

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.224	Anderson-Darling GOF Test
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0745	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.15	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)	2.209	k star (bias corrected MLE)	2.038
Theta hat (MLE)	2.173	Theta star (bias corrected MLE)	2.355
nu hat (MLE)	154.6	nu star (bias corrected)	142.7
Mean (detects)	4.8		

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	2.615
Maximum	14.3	Median	1.18
SD	3.443	CV	1.316
k hat (MLE)	0.322	k star (bias corrected MLE)	0.317
Theta hat (MLE)	8.124	Theta star (bias corrected MLE)	8.242
nu hat (MLE)	41.85	nu star (bias corrected)	41.25
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (41.25, α)	27.53	Adjusted Chi Square Value (41.25, β)	27.27
95% Gamma Approximate UCL (use when n>=50)	3.918	95% Gamma Adjusted UCL (use when n<50)	3.955

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.816	SD (KM)	3.269
Variance (KM)	10.68	SE of Mean (KM)	0.411
k hat (KM)	0.742	k star (KM)	0.718
nu hat (KM)	96.47	nu star (KM)	93.35
theta hat (KM)	3.794	theta star (KM)	3.921
80% gamma percentile (KM)	4.624	90% gamma percentile (KM)	7.025
95% gamma percentile (KM)	9.496	99% gamma percentile (KM)	15.38

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (93.35, α)	72.06	Adjusted Chi Square Value (93.35, β)	71.64
95% Gamma Approximate KM-UCL (use when n>=50)	3.647	95% Gamma Adjusted KM-UCL (use when n<50)	3.669

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.107	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	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	2.895	Mean in Log Scale	0.45
SD in Original Scale	3.247	SD in Log Scale	1.178
95% t UCL (assumes normality of ROS data)	3.567	95% Percentile Bootstrap UCL	3.586
95% BCA Bootstrap UCL	3.658	95% Bootstrap t UCL	3.672
95% H-UCL (Log ROS)	4.363		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.394	KM Geo Mean	1.483
KM SD (logged)	1.138	95% Critical H Value (KM-Log)	2.255
KM Standard Error of Mean (logged)	0.143	95% H-UCL (KM -Log)	3.902
KM SD (logged)	1.138	95% Critical H Value (KM-Log)	2.255
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.7	Mean in Log Scale	0.0739
SD in Original Scale	3.378	SD in Log Scale	1.464
95% t UCL (Assumes normality)	3.399	95% H-Stat UCL	4.857

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 Approximate Gamma UCL	3.647	95% GROS Approximate Gamma UCL	3.918

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.

NH-45 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	58	Number of Distinct Observations	25
Number of Detects	25	Number of Non-Detects	33
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	0.708	Minimum Non-Detect	0.5
Maximum Detect	5.9	Maximum Non-Detect	0.5
Variance Detects	3.517	Percent Non-Detects	56.90%
Mean Detects	3.265	SD Detects	1.875

Median Detects	3.06	CV Detects	0.574
Skewness Detects	-0.0334	Kurtosis Detects	-1.733
Mean of Logged Detects	0.969	SD of Logged Detects	0.72

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.872	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.172	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	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	1.692	KM Standard Error of Mean	0.245
KM SD	1.825	95% KM (BCA) UCL	2.098
95% KM (t) UCL	2.101	95% KM (Percentile Bootstrap) UCL	2.095
95% KM (z) UCL	2.094	95% KM Bootstrap t UCL	2.164
90% KM Chebyshev UCL	2.425	95% KM Chebyshev UCL	2.758
97.5% KM Chebyshev UCL	3.219	99% KM Chebyshev UCL	4.125

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.26	Anderson-Darling GOF Test	
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.176	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)	2.493	k star (bias corrected MLE)	2.22
Theta hat (MLE)	1.31	Theta star (bias corrected MLE)	1.47
nu hat (MLE)	124.6	nu star (bias corrected)	111
Mean (detects)	3.265		

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	1.545
Maximum	5.9	Median	0.735
SD	1.958	CV	1.267
k hat (MLE)	0.378	k star (bias corrected MLE)	0.37
Theta hat (MLE)	4.083	Theta star (bias corrected MLE)	4.172
nu hat (MLE)	43.88	nu star (bias corrected)	42.95
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (42.95, α)	28.92	Adjusted Chi Square Value (42.95, β)	28.63
95% Gamma Approximate UCL (use when n>=50)	2.294	95% Gamma Adjusted UCL (use when n<50)	2.317

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.692	SD (KM)	1.825
Variance (KM)	3.33	SE of Mean (KM)	0.245
k hat (KM)	0.859	k star (KM)	0.826
nu hat (KM)	99.69	nu star (KM)	95.87
theta hat (KM)	1.968	theta star (KM)	2.047
80% gamma percentile (KM)	2.759	90% gamma percentile (KM)	4.081
95% gamma percentile (KM)	5.424	99% gamma percentile (KM)	8.587

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (95.87, α)	74.28	Adjusted Chi Square Value (95.87, β)	73.8
95% Gamma Approximate KM-UCL (use when n>=50)	2.183	95% Gamma Adjusted KM-UCL (use when n<50)	2.197

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.192	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	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	1.68	Mean in Log Scale	-0.121
SD in Original Scale	1.86	SD in Log Scale	1.195
95% t UCL (assumes normality of ROS data)	2.089	95% Percentile Bootstrap UCL	2.087
95% BCA Bootstrap UCL	2.124	95% Bootstrap t UCL	2.142
95% H-UCL (Log ROS)	2.765		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.0235	KM Geo Mean	1.024
KM SD (logged)	0.945	95% Critical H Value (KM-Log)	2.276
KM Standard Error of Mean (logged)	0.127	95% H-UCL (KM -Log)	2.126
KM SD (logged)	0.945	95% Critical H Value (KM-Log)	2.276
KM Standard Error of Mean (logged)	0.127		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.549	Mean in Log Scale	-0.371
SD in Original Scale	1.936	SD in Log Scale	1.266
95% t UCL (Assumes normality)	1.975	95% H-Stat UCL	2.467
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	2.101		

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.

NH-22 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	37
Number of Detects	37	Number of Non-Detects	7
Number of Distinct Detects	36	Number of Distinct Non-Detects	1
Minimum Detect	0.507	Minimum Non-Detect	0.5
Maximum Detect	12.3	Maximum Non-Detect	0.5
Variance Detects	9.47	Percent Non-Detects	15.91%
Mean Detects	3.372	SD Detects	3.077
Median Detects	2.44	CV Detects	0.913
Skewness Detects	1.94	Kurtosis Detects	3.262
Mean of Logged Detects	0.876	SD of Logged Detects	0.849
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.742	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.936	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.239	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.144	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	2.915	KM Standard Error of Mean	0.455
KM SD	2.975	95% KM (BCA) UCL	3.732
95% KM (t) UCL	3.679	95% KM (Percentile Bootstrap) UCL	3.688
95% KM (z) UCL	3.663	95% KM Bootstrap t UCL	3.87
90% KM Chebyshev UCL	4.279	95% KM Chebyshev UCL	4.897
97.5% KM Chebyshev UCL	5.754	99% KM Chebyshev UCL	7.439
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.839	Anderson-Darling GOF Test	
5% A-D Critical Value	0.765	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.136	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.147	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)	1.622	k star (bias corrected MLE)	1.508
Theta hat (MLE)	2.079	Theta star (bias corrected MLE)	2.235
nu hat (MLE)	120	nu star (bias corrected)	111.6
Mean (detects)	3.372		
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	2.837
Maximum	12.3	Median	2.295
SD	3.078	CV	1.085
k hat (MLE)	0.596	k star (bias corrected MLE)	0.57
Theta hat (MLE)	4.762	Theta star (bias corrected MLE)	4.975
nu hat (MLE)	52.42	nu star (bias corrected)	50.18
Adjusted Level of Significance (β)	0.0445		
Approximate Chi Square Value (50.18, α)	34.92	Adjusted Chi Square Value (50.18, β)	34.48
95% Gamma Approximate UCL (use when n>=50)	4.077	95% Gamma Adjusted UCL (use when n<50)	4.128
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	2.915	SD (KM)	2.975
Variance (KM)	8.851	SE of Mean (KM)	0.455
k hat (KM)	0.96	k star (KM)	0.91
nu hat (KM)	84.46	nu star (KM)	80.04
theta hat (KM)	3.037	theta star (KM)	3.205
80% gamma percentile (KM)	4.725	90% gamma percentile (KM)	6.87
95% gamma percentile (KM)	9.031	99% gamma percentile (KM)	14.08
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (80.04, α)	60.42	Adjusted Chi Square Value (80.04, β)	59.85
95% Gamma Approximate KM-UCL (use when n>=50)	3.861	95% Gamma Adjusted KM-UCL (use when n<50)	3.898
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.936	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.102	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.144	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	2.895	Mean in Log Scale	0.572
SD in Original Scale	3.027	SD in Log Scale	1.061
95% t UCL (assumes normality of ROS data)	3.662	95% Percentile Bootstrap UCL	3.662
95% BCA Bootstrap UCL	3.82	95% Bootstrap t UCL	3.841

95% H-UCL (Log ROS)	4.613		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.627	KM Geo Mean	1.871
KM SD (logged)	0.959	95% Critical H Value (KM-Log)	2.322
KM Standard Error of Mean (logged)	0.147	95% H-UCL (KM -Log)	4.163
KM SD (logged)	0.959	95% Critical H Value (KM-Log)	2.322
KM Standard Error of Mean (logged)	0.147		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.875	Mean in Log Scale	0.516
SD in Original Scale	3.043	SD in Log Scale	1.142
95% t UCL (Assumes normality)	3.646	95% H-Stat UCL	5.001

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	3.898	95% GROS Adjusted Gamma UCL	4.128

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.

NH-25 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	49	Number of Distinct Observations	13
Number of Detects	13	Number of Non-Detects	36
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	1.3	Minimum Non-Detect	0.5
Maximum Detect	2.49	Maximum Non-Detect	0.5
Variance Detects	0.202	Percent Non-Detects	73.47%
Mean Detects	1.82	SD Detects	0.449
Median Detects	1.66	CV Detects	0.247
Skewness Detects	0.243	Kurtosis Detects	-1.607
Mean of Logged Detects	0.571	SD of Logged Detects	0.248

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.883	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors GOF Test
5% Lilliefors Critical Value	0.234	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	0.85	KM Standard Error of Mean	0.0927
KM SD	0.624	95% KM (BCA) UCL	1.002
95% KM (t) UCL	1.006	95% KM (Percentile Bootstrap) UCL	0.999
95% KM (z) UCL	1.003	95% KM Bootstrap t UCL	1.024
90% KM Chebyshev UCL	1.128	95% KM Chebyshev UCL	1.254
97.5% KM Chebyshev UCL	1.429	99% KM Chebyshev UCL	1.773

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.595	Anderson-Darling GOF Test
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.178	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.236	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)	17.82	k star (bias corrected MLE)	13.76
Theta hat (MLE)	0.102	Theta star (bias corrected MLE)	0.132
nu hat (MLE)	463.3	nu star (bias corrected)	357.7
Mean (detects)	1.82		
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	0.83
Maximum	2.49	Median	0.706
SD	0.727	CV	0.876
k hat (MLE)	0.685	k star (bias corrected MLE)	0.656
Theta hat (MLE)	1.212	Theta star (bias corrected MLE)	1.265
nu hat (MLE)	67.09	nu star (bias corrected)	64.32
Adjusted Level of Significance (β)	0.0451		
Approximate Chi Square Value (64.32, α)	46.87	Adjusted Chi Square Value (64.32, β)	46.42
95% Gamma Approximate UCL (use when n>=50)	1.139	95% Gamma Adjusted UCL (use when n<50)	1.15
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.85	SD (KM)	0.624
Variance (KM)	0.389	SE of Mean (KM)	0.0927
k hat (KM)	1.858	k star (KM)	1.758
nu hat (KM)	182.1	nu star (KM)	172.3
theta hat (KM)	0.458	theta star (KM)	0.484
80% gamma percentile (KM)	1.292	90% gamma percentile (KM)	1.705
95% gamma percentile (KM)	2.102	99% gamma percentile (KM)	2.989
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (172.28, α)	142.9	Adjusted Chi Square Value (172.28, β)	142.1
95% Gamma Approximate KM-UCL (use when n>=50)	1.025	95% Gamma Adjusted KM-UCL (use when n<50)	1.031
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.887	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.166	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.042	Mean in Log Scale	-0.0971
SD in Original Scale	0.569	SD in Log Scale	0.533
95% t UCL (assumes normality of ROS data)	1.178	95% Percentile Bootstrap UCL	1.18
95% BCA Bootstrap UCL	1.19	95% Bootstrap t UCL	1.201
95% H-UCL (Log ROS)	1.212		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.358	KM Geo Mean	0.699
KM SD (logged)	0.571	95% Critical H Value (KM-Log)	1.941
KM Standard Error of Mean (logged)	0.0849	95% H-UCL (KM -Log)	0.966
KM SD (logged)	0.571	95% Critical H Value (KM-Log)	1.941
KM Standard Error of Mean (logged)	0.0849		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	

Mean in Original Scale	0.667	Mean in Log Scale	-0.867
SD in Original Scale	0.735	SD in Log Scale	0.882
95% t UCL (Assumes normality)	0.843	95% H-Stat UCL	0.822

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	1.006

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.

NH-04 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	44	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	44
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 NH-04 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L] was not processed!

NH-32 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	42	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	42
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 NH-32 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L] was not processed!

NH-07 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	13	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	13
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 NH-07 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L] was not processed!

NH-33 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	36	Number of Distinct Observations	1

Number of Detects	0	Number of Non-Detects	36
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 NH-33 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L] was not processed!

NH-44 - TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	43	Number of Distinct Observations	28
Number of Detects	27	Number of Non-Detects	16
Number of Distinct Detects	27	Number of Distinct Non-Detects	1
Minimum Detect	0.538	Minimum Non-Detect	0.5
Maximum Detect	5.67	Maximum Non-Detect	0.5
Variance Detects	2.853	Percent Non-Detects	37.21%
Mean Detects	2.699	SD Detects	1.689
Median Detects	2.52	CV Detects	0.626
Skewness Detects	0.295	Kurtosis Detects	-1.293
Mean of Logged Detects	0.75	SD of Logged Detects	0.763

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.139	Lilliefors GOF Test
5% Lilliefors Critical Value	0.167	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	1.881	KM Standard Error of Mean	0.263
KM SD	1.69	95% KM (BCA) UCL	2.308
95% KM (t) UCL	2.323	95% KM (Percentile Bootstrap) UCL	2.321
95% KM (z) UCL	2.313	95% KM Bootstrap t UCL	2.367
90% KM Chebyshev UCL	2.669	95% KM Chebyshev UCL	3.025
97.5% KM Chebyshev UCL	3.521	99% KM Chebyshev UCL	4.494

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.666	Anderson-Darling GOF Test
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.17	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)	2.213	k star (bias corrected MLE)	1.992
Theta hat (MLE)	1.22	Theta star (bias corrected MLE)	1.355
nu hat (MLE)	119.5	nu star (bias corrected)	107.5
Mean (detects)	2.699		

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	1.752
Maximum	5.67	Median	0.94
SD	1.825	CV	1.042
k hat (MLE)	0.503	k star (bias corrected MLE)	0.483

Theta hat (MLE)	3.484	Theta star (bias corrected MLE)	3.625
nu hat (MLE)	43.25	nu star (bias corrected)	41.57
Adjusted Level of Significance (β)	0.0444		
Approximate Chi Square Value (41.57, α)	27.79	Adjusted Chi Square Value (41.57, β)	27.4
95% Gamma Approximate UCL (use when n>=50)	2.621	95% Gamma Adjusted UCL (use when n<50)	2.659

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.881	SD (KM)	1.69
Variance (KM)	2.855	SE of Mean (KM)	0.263
k hat (KM)	1.239	k star (KM)	1.168
nu hat (KM)	106.6	nu star (KM)	100.5
theta hat (KM)	1.518	theta star (KM)	1.61
80% gamma percentile (KM)	2.986	90% gamma percentile (KM)	4.168
95% gamma percentile (KM)	5.336	99% gamma percentile (KM)	8.018

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (100.47, α)	78.34	Adjusted Chi Square Value (100.47, β)	77.66
95% Gamma Approximate KM-UCL (use when n>=50)	2.412	95% Gamma Adjusted KM-UCL (use when n<50)	2.433

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.91	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.134	Lilliefors GOF Test
5% Lilliefors Critical Value	0.167	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	1.839	Mean in Log Scale	0.0723
SD in Original Scale	1.748	SD in Log Scale	1.124
95% t UCL (assumes normality of ROS data)	2.288	95% Percentile Bootstrap UCL	2.255
95% BCA Bootstrap UCL	2.292	95% Bootstrap t UCL	2.329
95% H-UCL (Log ROS)	3.123		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.213	KM Geo Mean	1.238
KM SD (logged)	0.916	95% Critical H Value (KM-Log)	2.271
KM Standard Error of Mean (logged)	0.142	95% H-UCL (KM -Log)	2.595
KM SD (logged)	0.916	95% Critical H Value (KM-Log)	2.271
KM Standard Error of Mean (logged)	0.142		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.788	Mean in Log Scale	-0.0447
SD in Original Scale	1.789	SD in Log Scale	1.205
95% t UCL (Assumes normality)	2.247	95% H-Stat UCL	3.206

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	2.323

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.

NH-26 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	28	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	2395	Mean	4707
Maximum	9217	Median	4755
SD	1366	Std. Error of Mean	258.2
Coefficient of Variation	0.29	Skewness	1.181
Normal GOF Test			
Shapiro Wilk Test Statistic	0.814	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.924	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.283	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.164	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	5147	95% Adjusted-CLT UCL (Chen-1995)	5193
		95% Modified-t UCL (Johnson-1978)	5156
Gamma GOF Test			
A-D Test Statistic	1.998	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.249	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.165	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	12.73	k star (bias corrected MLE)	11.39
Theta hat (MLE)	369.8	Theta star (bias corrected MLE)	413.3
nu hat (MLE)	712.7	nu star (bias corrected)	637.7
MLE Mean (bias corrected)	4707	MLE Sd (bias corrected)	1395
		Approximate Chi Square Value (0.05)	580.1
Adjusted Level of Significance	0.0404	Adjusted Chi Square Value	576.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5174	95% Adjusted Gamma UCL (use when n<50)	5204
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.843	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.924	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.164	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.781	Mean of logged Data	8.417
Maximum of Logged Data	9.129	SD of logged Data	0.292
Assuming Lognormal Distribution			
95% H-UCL	5220	90% Chebyshev (MVUE) UCL	5503
95% Chebyshev (MVUE) UCL	5861	97.5% Chebyshev (MVUE) UCL	6358
99% Chebyshev (MVUE) UCL	7335		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5132	95% Jackknife UCL	5147
95% Standard Bootstrap UCL	5118	95% Bootstrap-t UCL	5225

95% Hall's Bootstrap UCL	5492	95% Percentile Bootstrap UCL	5137
95% BCA Bootstrap UCL	5197		
90% Chebyshev(Mean, Sd) UCL	5482	95% Chebyshev(Mean, Sd) UCL	5832
97.5% Chebyshev(Mean, Sd) UCL	6320	99% Chebyshev(Mean, Sd) UCL	7276

Suggested UCL to Use

95% Student's-t UCL	5147	or 95% Modified-t UCL	5156

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.

NH-34 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	46	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	1401	Mean	3466
Maximum	6438	Median	3050
SD	1845	Std. Error of Mean	272
Coefficient of Variation	0.532	Skewness	0.307

Normal GOF Test

Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.237	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.129	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	3923	95% Adjusted-CLT UCL (Chen-1995)	3927
		95% Modified-t UCL (Johnson-1978)	3925

Gamma GOF Test

A-D Test Statistic	2.872	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.231	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.131	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.474	k star (bias corrected MLE)	3.262
Theta hat (MLE)	997.7	Theta star (bias corrected MLE)	1063
nu hat (MLE)	319.6	nu star (bias corrected)	300.1
MLE Mean (bias corrected)	3466	MLE Sd (bias corrected)	1919
		Approximate Chi Square Value (0.05)	261
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	259.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3986	95% Adjusted Gamma UCL (use when n<50)	4004

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.83	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.245	Mean of logged Data	8
Maximum of Logged Data	8.77	SD of logged Data	0.564

Assuming Lognormal Distribution

95% H-UCL	4112	90% Chebyshev (MVUE) UCL	4405
95% Chebyshev (MVUE) UCL	4823	97.5% Chebyshev (MVUE) UCL	5403
99% Chebyshev (MVUE) UCL	6543		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	3914	95% Jackknife UCL	3923
95% Standard Bootstrap UCL	3900	95% Bootstrap-t UCL	3941
95% Hall's Bootstrap UCL	3902	95% Percentile Bootstrap UCL	3900
95% BCA Bootstrap UCL	3923		
90% Chebyshev(Mean, Sd) UCL	4282	95% Chebyshev(Mean, Sd) UCL	4652
97.5% Chebyshev(Mean, Sd) UCL	5165	99% Chebyshev(Mean, Sd) UCL	6173

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4652

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.

NH-36 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	54	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	1421	Mean	3622
Maximum	7319	Median	3886
SD	1834	Std. Error of Mean	249.6
Coefficient of Variation	0.506	Skewness	0.16

Normal GOF Test

Shapiro Wilk Test Statistic	0.843	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	1.87E-07	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.248	Lilliefors GOF Test
5% Lilliefors Critical Value	0.12	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	4040	95% Adjusted-CLT UCL (Chen-1995)	4039
		95% Modified-t UCL (Johnson-1978)	4041

Gamma GOF Test

A-D Test Statistic	3.882	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.621	k star (bias corrected MLE)	3.432
Theta hat (MLE)	1000	Theta star (bias corrected MLE)	1055
nu hat (MLE)	391.1	nu star (bias corrected)	370.7
MLE Mean (bias corrected)	3622	MLE Sd (bias corrected)	1955

		Approximate Chi Square Value (0.05)	327
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	325.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4105	95% Adjusted Gamma UCL (use when n<50)	4119

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.815	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	8.13E-09	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.249	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.12	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.259	Mean of logged Data	8.05
Maximum of Logged Data	8.898	SD of logged Data	0.559

Assuming Lognormal Distribution

95% H-UCL	4249	90% Chebyshev (MVUE) UCL	4540
95% Chebyshev (MVUE) UCL	4942	97.5% Chebyshev (MVUE) UCL	5499
99% Chebyshev (MVUE) UCL	6594		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	4033	95% Jackknife UCL	4040
95% Standard Bootstrap UCL	4023	95% Bootstrap-t UCL	4045
95% Hall's Bootstrap UCL	4030	95% Percentile Bootstrap UCL	4021
95% BCA Bootstrap UCL	4025		
90% Chebyshev(Mean, Sd) UCL	4371	95% Chebyshev(Mean, Sd) UCL	4710
97.5% Chebyshev(Mean, Sd) UCL	5181	99% Chebyshev(Mean, Sd) UCL	6106

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4710

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.

NH-45 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	54	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	1281	Mean	2201
Maximum	3253	Median	1907
SD	657	Std. Error of Mean	89.41
Coefficient of Variation	0.299	Skewness	0.28

Normal GOF Test

Shapiro Wilk Test Statistic	0.869	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	3.57E-06	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.191	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.12	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	2350	95% Adjusted-CLT UCL (Chen-1995)	2351

		95% Modified-t UCL (Johnson-1978)	2351
Gamma GOF Test			
A-D Test Statistic	2.047	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.121	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	11.43	k star (bias corrected MLE)	10.8
Theta hat (MLE)	192.6	Theta star (bias corrected MLE)	203.7
nu hat (MLE)	1234	nu star (bias corrected)	1167
MLE Mean (bias corrected)	2201	MLE Sd (bias corrected)	669.5
		Approximate Chi Square Value (0.05)	1089
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	1086
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2359	95% Adjusted Gamma UCL (use when n<50)	2364
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	3.25E-05	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.149	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.12	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.155	Mean of logged Data	7.652
Maximum of Logged Data	8.087	SD of logged Data	0.302
Assuming Lognormal Distribution			
95% H-UCL	2365	90% Chebyshev (MVUE) UCL	2478
95% Chebyshev (MVUE) UCL	2604	97.5% Chebyshev (MVUE) UCL	2778
99% Chebyshev (MVUE) UCL	3120		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2348	95% Jackknife UCL	2350
95% Standard Bootstrap UCL	2346	95% Bootstrap-t UCL	2361
95% Hall's Bootstrap UCL	2349	95% Percentile Bootstrap UCL	2348
95% BCA Bootstrap UCL	2348		
90% Chebyshev(Mean, Sd) UCL	2469	95% Chebyshev(Mean, Sd) UCL	2591
97.5% Chebyshev(Mean, Sd) UCL	2759	99% Chebyshev(Mean, Sd) UCL	3090
Suggested UCL to Use			
95% Student's-t UCL	2350	or 95% Modified-t UCL	2351

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.

NH-22 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	3569	Mean	5577

Maximum	9104	Median	5297
SD	1429	Std. Error of Mean	215.4
Coefficient of Variation	0.256	Skewness	1.075

Normal GOF Test

Shapiro Wilk Test Statistic	0.891	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.166	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.132	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	5939	95% Adjusted-CLT UCL (Chen-1995)	5968
		95% Modified-t UCL (Johnson-1978)	5945

Gamma GOF Test

A-D Test Statistic	0.834	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.131	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.133	Detected data appear Gamma Distributed at 5% Significance Level	

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

Gamma Statistics

k hat (MLE)	17.32	k star (bias corrected MLE)	16.16
Theta hat (MLE)	321.9	Theta star (bias corrected MLE)	345.2
nu hat (MLE)	1524	nu star (bias corrected)	1422
MLE Mean (bias corrected)	5577	MLE Sd (bias corrected)	1387
		Approximate Chi Square Value (0.05)	1335
Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	1332

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	5938	95% Adjusted Gamma UCL (use when n<50)	5951

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.944	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.117	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.132	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.18	Mean of logged Data	8.597
Maximum of Logged Data	9.116	SD of logged Data	0.239

Assuming Lognormal Distribution

95% H-UCL	5936	90% Chebyshev (MVUE) UCL	6181
95% Chebyshev (MVUE) UCL	6457	97.5% Chebyshev (MVUE) UCL	6841
99% Chebyshev (MVUE) UCL	7594		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5931	95% Jackknife UCL	5939
95% Standard Bootstrap UCL	5925	95% Bootstrap-t UCL	5967
95% Hall's Bootstrap UCL	5971	95% Percentile Bootstrap UCL	5925
95% BCA Bootstrap UCL	5947		
90% Chebyshev(Mean, Sd) UCL	6223	95% Chebyshev(Mean, Sd) UCL	6516
97.5% Chebyshev(Mean, Sd) UCL	6922	99% Chebyshev(Mean, Sd) UCL	7720

Suggested UCL to Use

95% Adjusted Gamma UCL	5951		

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.

NH-32 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	311.7	Mean	914.5
Maximum	1191	Median	1051
SD	308.9	Std. Error of Mean	48.84
Coefficient of Variation	0.338	Skewness	-1.228
Normal GOF Test			
Shapiro Wilk Test Statistic	0.699	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.139	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	996.8	95% Adjusted-CLT UCL (Chen-1995)	984.7
		95% Modified-t UCL (Johnson-1978)	995.2
Gamma GOF Test			
A-D Test Statistic	6.278	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.337	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.955	k star (bias corrected MLE)	5.525
Theta hat (MLE)	153.6	Theta star (bias corrected MLE)	165.5
nu hat (MLE)	476.4	nu star (bias corrected)	442
MLE Mean (bias corrected)	914.5	MLE Sd (bias corrected)	389
		Approximate Chi Square Value (0.05)	394.3
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	392.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1025	95% Adjusted Gamma UCL (use when n<50)	1030
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.647	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.355	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.139	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.742	Mean of logged Data	6.732
Maximum of Logged Data	7.082	SD of logged Data	0.468

Assuming Lognormal Distribution

95% H-UCL	1079	90% Chebyshev (MVUE) UCL	1149
95% Chebyshev (MVUE) UCL	1247	97.5% Chebyshev (MVUE) UCL	1383
99% Chebyshev (MVUE) UCL	1650		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	994.8	95% Jackknife UCL	996.8
95% Standard Bootstrap UCL	993.9	95% Bootstrap-t UCL	987
95% Hall's Bootstrap UCL	986.4	95% Percentile Bootstrap UCL	991
95% BCA Bootstrap UCL	988		
90% Chebyshev(Mean, Sd) UCL	1061	95% Chebyshev(Mean, Sd) UCL	1127
97.5% Chebyshev(Mean, Sd) UCL	1219	99% Chebyshev(Mean, Sd) UCL	1400

Suggested UCL to Use

95% Student's-t UCL	996.8	or 95% Modified-t UCL	995.2

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.

NH-07 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	2666	Mean	3307
Maximum	5783	Median	3118
SD	1023	Std. Error of Mean	361.6
Coefficient of Variation	0.309	Skewness	2.585

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	0.602	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.431	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	3992	95% Adjusted-CLT UCL (Chen-1995)	4255
		95% Modified-t UCL (Johnson-1978)	4047

Gamma GOF Test

A-D Test Statistic	1.314	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.716	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.412	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)	16.07	k star (bias corrected MLE)	10.13
Theta hat (MLE)	205.7	Theta star (bias corrected MLE)	326.4
nu hat (MLE)	257.2	nu star (bias corrected)	162.1
MLE Mean (bias corrected)	3307	MLE Sd (bias corrected)	1039
		Approximate Chi Square Value (0.05)	133.6
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	127.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4010	95% Adjusted Gamma UCL (use when n<50)	4216
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.672	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.396	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	7.888	Mean of logged Data	8.072
Maximum of Logged Data	8.663	SD of logged Data	0.249
Assuming Lognormal Distribution			
95% H-UCL	3990	90% Chebyshev (MVUE) UCL	4166
95% Chebyshev (MVUE) UCL	4562	97.5% Chebyshev (MVUE) UCL	5111
99% Chebyshev (MVUE) UCL	6189		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3902	95% Jackknife UCL	3992
95% Standard Bootstrap UCL	3868	95% Bootstrap-t UCL	5350
95% Hall's Bootstrap UCL	6653	95% Percentile Bootstrap UCL	4013
95% BCA Bootstrap UCL	4312		
90% Chebyshev(Mean, Sd) UCL	4392	95% Chebyshev(Mean, Sd) UCL	4883
97.5% Chebyshev(Mean, Sd) UCL	5565	99% Chebyshev(Mean, Sd) UCL	6905
Suggested UCL to Use			
95% Student's-t UCL	3992	or 95% Modified-t UCL	4047

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.

NH-33 - NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	31	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	350.2	Mean	931.1
Maximum	1281	Median	912.7
SD	206.9	Std. Error of Mean	37.16
Coefficient of Variation	0.222	Skewness	-0.798
Normal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.929	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.109	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.156	Data appear Normal at 5% Significance Level	

Appendix B2 - ProUCL Version 5.1 Output - Production Well Data

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	994.2	95% Adjusted-CLT UCL (Chen-1995)	986.5
		95% Modified-t UCL (Johnson-1978)	993.3

Gamma GOF Test

A-D Test Statistic	0.955	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.146	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.158	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	16.61	k star (bias corrected MLE)	15.02
Theta hat (MLE)	56.05	Theta star (bias corrected MLE)	61.97
nu hat (MLE)	1030	nu star (bias corrected)	931.5
MLE Mean (bias corrected)	931.1	MLE Sd (bias corrected)	240.2
		Approximate Chi Square Value (0.05)	861.7
Adjusted Level of Significance	0.0413	Adjusted Chi Square Value	858

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1007	95% Adjusted Gamma UCL (use when n<50)	1011

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.833	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.929	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.171	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.156	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.859	Mean of logged Data	6.806
Maximum of Logged Data	7.155	SD of logged Data	0.27

Assuming Lognormal Distribution

95% H-UCL	1022	90% Chebyshev (MVUE) UCL	1073
95% Chebyshev (MVUE) UCL	1136	97.5% Chebyshev (MVUE) UCL	1223
99% Chebyshev (MVUE) UCL	1393		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	992.2	95% Jackknife UCL	994.2
95% Standard Bootstrap UCL	991.1	95% Bootstrap-t UCL	988.2
95% Hall's Bootstrap UCL	989.2	95% Percentile Bootstrap UCL	990.6
95% BCA Bootstrap UCL	983.1		
90% Chebyshev(Mean, Sd) UCL	1043	95% Chebyshev(Mean, Sd) UCL	1093
97.5% Chebyshev(Mean, Sd) UCL	1163	99% Chebyshev(Mean, Sd) UCL	1301

Suggested UCL to Use

95% Student's-t UCL	994.2

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.

Appendix B3 - Future Exposure Point Concentration (EPC) Summary for Monitoring Well Data

Constituent/CasNo/unit	Suggested 95UCL Method From ProUCL Output	Suggested 95UCL Value From ProUCL Output	Flow-Weighted 95UCL Value	Notes	Value Used As EPC
1,1-DICHLOROETHANE (CasNo: 75-34-3) [µg/L]	95% KM (Chebyshev) UCL	1.18E+00	2.96E-01	---	2.96E-01
1,1-DICHLOROETHENE (CasNo: 75-35-4) [µg/L]	KM H-UCL	6.03E-01	1.51E-01	---	1.51E-01
1,2,3-TRICHLOROPROPANE (CasNo: 96-18-4) [µg/L]	KM H-UCL	2.48E-03	6.20E-04	---	6.20E-04
1,2-DICHLOROETHANE (CasNo: 107-06-2) [µg/L]	95% KM (Chebyshev) UCL	2.10E+00	5.24E-01	---	5.24E-01
1,4-DIOXANE (P-DIOXANE) (CasNo: 123-91-1) [µg/L]	95% KM (Chebyshev) UCL	3.00E+01	7.50E+00	---	7.50E+00
ALUMINUM (CasNo: 7429-90-5) [µg/L]	95% KM (Chebyshev) UCL	8.35E+01	2.09E+01	---	2.09E+01
ARSENIC (CasNo: 7440-38-2) [µg/L]	95% KM (Chebyshev) UCL	1.28E+00	3.20E-01	---	3.20E-01
BARIUM (CasNo: 7440-39-3) [µg/L]	95% Chebyshev (Mean, Sd) UCL	1.67E+02	4.17E+01	---	4.17E+01
BENZENE (CasNo: 71-43-2) [µg/L]	95% KM (Chebyshev) UCL	1.09E-01	2.73E-02	---	2.73E-02
BIS(2-ETHYLHEXYL) PHTHALATE (CasNo: 117-81-7) [µg/L]	95% KM (Chebyshev) UCL	3.65E+00	9.12E-01	---	9.12E-01
BORON (CasNo: 7440-42-8) [µg/L]	95% H-UCL	3.08E+02	7.71E+01	---	7.71E+01
CARBON TETRACHLORIDE (CasNo: 56-23-5) [µg/L]	95% KM (t) UCL	2.89E-01	7.23E-02	---	7.23E-02
CHROMIUM, HEXAVALENT (CasNo: 18540-29-9) [µg/L]	95% KM (Chebyshev) UCL	3.94E+00	9.85E-01	---	9.85E-01
CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]	95% KM (Chebyshev) UCL	2.69E+00	6.73E-01	---	6.73E-01
COBALT (CasNo: 7440-48-4) [µg/L]	95% KM (Chebyshev) UCL	6.25E-01	1.56E-01	---	1.56E-01
CYANIDE (CasNo: 57-12-5) [µg/L]	95% KM (t) UCL	7.52E+00	1.88E+00	Warning: Data set has only 3 Detected Values.	1.88E+00
FORMALDEHYDE (CasNo: 50-00-0) [µg/L]	95% KM Adjusted Gamma UCL	3.55E+00	8.88E-01	---	8.88E-01
HEPTACHLOR (CasNo: 76-44-8) [µg/L]	95% KM (t) UCL	4.50E-03	1.13E-03	---	1.13E-03
ISOPROPANOL (CasNo: 67-63-0) [µg/L]	95% KM (t) UCL	2.84E+03	7.10E+02	Warning: Data set has only 3 Detected Values. Warning: Recommended UCL exceeds the maximum observation. Will use flow weighted average of max value.	6.50E+02
LEAD (CasNo: 7439-92-1) [µg/L]	KM H-UCL	8.77E-01	2.19E-01	---	2.19E-01
MANGANESE (CasNo: 7439-96-5) [µg/L]	95% KM (Chebyshev) UCL	5.85E+01	1.46E+01	---	1.46E+01
MOLYBDENUM (CasNo: 7439-98-7) [µg/L]	95% KM (Chebyshev) UCL	2.49E+01	6.24E+00	---	6.24E+00
NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]	95% KM Approximate Gamma UCL	7.13E+03	1.78E+03	---	1.78E+03
PERCHLORATE (CasNo: 14797-73-0) [µg/L]	95% KM (Chebyshev) UCL	3.38E+00	8.45E-01	---	8.45E-01
SELENIUM (CasNo: 7782-49-2) [µg/L]	95% KM (Chebyshev) UCL	7.78E+00	1.94E+00	---	1.94E+00
TERT-BUTYL METHYL ETHER (CasNo: 1634-04-4) [µg/L]	95% KM Approximate Gamma UCL	3.73E-01	9.33E-02	---	9.33E-02
TETRACHLOROETHYLENE(PCE) (CasNo: 127-18-4) [µg/L]	95% KM (Chebyshev) UCL	1.08E+01	2.69E+00	---	2.69E+00
TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]	95% KM (Chebyshev) UCL	2.62E+01	6.54E+00	---	6.54E+00
VANADIUM (CasNo: 7440-62-2) [µg/L]	95% KM (Chebyshev) UCL	5.93E+00	1.48E+00	---	1.48E+00

Notes: KM = Kaplan-Meier; H = H statistic; UCL = upper confidence limit

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/6/2016 12:57:09 PM
From File	20161106_Draft_HHRA_ProUCL_Data_MW.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,1-DICHLOROETHANE (CasNo: 75-34-3) [µg/L]

General Statistics			
Total Number of Observations	250	Number of Distinct Observations	82
Number of Detects	141	Number of Non-Detects	109
Number of Distinct Detects	80	Number of Distinct Non-Detects	5
Minimum Detect	0.036	Minimum Non-Detect	0.37
Maximum Detect	18	Maximum Non-Detect	5
Variance Detects	5.451	Percent Non-Detects	43.60%
Mean Detects	1.022	SD Detects	2.335
Median Detects	0.31	CV Detects	2.284
Skewness Detects	4.876	Kurtosis Detects	26.56
Mean of Logged Detects	-0.916	SD of Logged Detects	1.242
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.408	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.349	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.075	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	0.684	KM Standard Error of Mean	0.114
KM SD	1.795	95% KM (BCA) UCL	0.892
95% KM (t) UCL	0.873	95% KM (Percentile Bootstrap) UCL	0.882
95% KM (z) UCL	0.872	95% KM Bootstrap t UCL	0.947
90% KM Chebyshev UCL	1.027	95% KM Chebyshev UCL	1.183
97.5% KM Chebyshev UCL	1.398	99% KM Chebyshev UCL	1.822
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	7.55	Anderson-Darling GOF Test	
5% A-D Critical Value	0.805	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.173	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0826	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)	0.651	k star (bias corrected MLE)	0.642
Theta hat (MLE)	1.571	Theta star (bias corrected MLE)	1.593
nu hat (MLE)	183.6	nu star (bias corrected)	181
Mean (detects)	1.022		

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	0.663
Maximum	18	Median	0.209
SD	1.816	CV	2.737
k hat (MLE)	0.414	k star (bias corrected MLE)	0.412

Theta hat (MLE)	1.601	Theta star (bias corrected MLE)	1.61
nu hat (MLE)	207.2	nu star (bias corrected)	206
Adjusted Level of Significance (β)	0.049		
Approximate Chi Square Value (206.01, α)	173.8	Adjusted Chi Square Value (206.01, β)	173.6
95% Gamma Approximate UCL (use when n>=50)	0.786	95% Gamma Adjusted UCL (use when n<50)	0.787

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.684	SD (KM)	1.795
Variance (KM)	3.221	SE of Mean (KM)	0.114
k hat (KM)	0.145	k star (KM)	0.146
nu hat (KM)	72.65	nu star (KM)	73.11
theta hat (KM)	4.708	theta star (KM)	4.679
80% gamma percentile (KM)	0.729	90% gamma percentile (KM)	2.021
95% gamma percentile (KM)	3.784	99% gamma percentile (KM)	8.926

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (73.11, α)	54.42	Adjusted Chi Square Value (73.11, β)	54.33
95% Gamma Approximate KM-UCL (use when n>=50)	0.919	95% Gamma Adjusted KM-UCL (use when n<50)	0.921

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.956	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	9.77E-04	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0962	Lilliefors GOF Test
5% Lilliefors Critical Value	0.075	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	0.691	Mean in Log Scale	-1.23
SD in Original Scale	1.796	SD in Log Scale	1.137
95% t UCL (assumes normality of ROS data)	0.878	95% Percentile Bootstrap UCL	0.902
95% BCA Bootstrap UCL	0.964	95% Bootstrap t UCL	0.984
95% H-UCL (Log ROS)	0.657		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.243	KM Geo Mean	0.288
KM SD (logged)	1.116	95% Critical H Value (KM-Log)	2.259
KM Standard Error of Mean (logged)	0.0829	95% H-UCL (KM -Log)	0.631
KM SD (logged)	1.116	95% Critical H Value (KM-Log)	2.259
KM Standard Error of Mean (logged)	0.0829		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.793	Mean in Log Scale	-0.958
SD in Original Scale	1.812	SD in Log Scale	1.026
95% t UCL (Assumes normality)	0.982	95% H-Stat UCL	0.749

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	1.183

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.

1,1-DICHLOROETHENE (CasNo: 75-35-4) [µg/L]

General Statistics

Total Number of Observations	239	Number of Distinct Observations	82
Number of Detects	112	Number of Non-Detects	127
Number of Distinct Detects	81	Number of Distinct Non-Detects	5
Minimum Detect	0.052	Minimum Non-Detect	0.4
Maximum Detect	5.9	Maximum Non-Detect	5
Variance Detects	1.16	Percent Non-Detects	53.14%
Mean Detects	0.882	SD Detects	1.077
Median Detects	0.525	CV Detects	1.22
Skewness Detects	2.547	Kurtosis Detects	6.927
Mean of Logged Detects	-0.668	SD of Logged Detects	1.053

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.683	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.251	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.084	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	0.565	KM Standard Error of Mean	0.0548
KM SD	0.814	95% KM (BCA) UCL	0.655
95% KM (t) UCL	0.655	95% KM (Percentile Bootstrap) UCL	0.655
95% KM (z) UCL	0.655	95% KM Bootstrap t UCL	0.673
90% KM Chebyshev UCL	0.729	95% KM Chebyshev UCL	0.804
97.5% KM Chebyshev UCL	0.907	99% KM Chebyshev UCL	1.11

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.009	Anderson-Darling GOF Test	
5% A-D Critical Value	0.782	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.119	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0888	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)	1.056	k star (bias corrected MLE)	1.033
Theta hat (MLE)	0.836	Theta star (bias corrected MLE)	0.854
nu hat (MLE)	236.5	nu star (bias corrected)	231.5
Mean (detects)	0.882		

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	0.525
Maximum	5.9	Median	0.28
SD	0.838	CV	1.597
k hat (MLE)	0.522	k star (bias corrected MLE)	0.518
Theta hat (MLE)	1.006	Theta star (bias corrected MLE)	1.013
nu hat (MLE)	249.4	nu star (bias corrected)	247.6
Adjusted Level of Significance (β)	0.049		
Approximate Chi Square Value (247.61, α)	212.2	Adjusted Chi Square Value (247.61, β)	212
95% Gamma Approximate UCL (use when n>=50)	0.612	95% Gamma Adjusted UCL (use when n<50)	0.613

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.565	SD (KM)	0.814
Variance (KM)	0.662	SE of Mean (KM)	0.0548
k hat (KM)	0.482	k star (KM)	0.479
nu hat (KM)	230.3	nu star (KM)	228.7
theta hat (KM)	1.172	theta star (KM)	1.18

80% gamma percentile (KM)	0.925	90% gamma percentile (KM)	1.542
95% gamma percentile (KM)	2.203	99% gamma percentile (KM)	3.838

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (228.73, α)	194.7	Adjusted Chi Square Value (228.73, β)	194.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.663	95% Gamma Adjusted KM-UCL (use when n<50)	0.664

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.971	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.124	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0575	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.084	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	0.563	Mean in Log Scale	-1.117
SD in Original Scale	0.808	SD in Log Scale	0.99
95% t UCL (assumes normality of ROS data)	0.649	95% Percentile Bootstrap UCL	0.655
95% BCA Bootstrap UCL	0.665	95% Bootstrap t UCL	0.672
95% H-UCL (Log ROS)	0.613		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.111	KM Geo Mean	0.329
KM SD (logged)	0.971	95% Critical H Value (KM-Log)	2.13
KM Standard Error of Mean (logged)	0.0823	95% H-UCL (KM -Log)	0.603
KM SD (logged)	0.971	95% Critical H Value (KM-Log)	2.13
KM Standard Error of Mean (logged)	0.0823		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.67	Mean in Log Scale	-0.863
SD in Original Scale	0.87	SD in Log Scale	0.878
95% t UCL (Assumes normality)	0.763	95% H-Stat UCL	0.697

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 H-UCL	0.603

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.

1,2,3-TRICHLOROPROPANE (CasNo: 96-18-4) [μg/L]

General Statistics

Total Number of Observations	271	Number of Distinct Observations	23
Number of Detects	16	Number of Non-Detects	255
Number of Distinct Detects	15	Number of Distinct Non-Detects	8
Minimum Detect	0.0012	Minimum Non-Detect	0.0011
Maximum Detect	0.021	Maximum Non-Detect	10
Variance Detects	2.51E-05	Percent Non-Detects	94.10%
Mean Detects	0.00489	SD Detects	0.00501
Median Detects	0.00295	CV Detects	1.026
Skewness Detects	2.649	Kurtosis Detects	7.397
Mean of Logged Detects	-5.615	SD of Logged Detects	0.713

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.639	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.289	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.213	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	0.00239	KM Standard Error of Mean	2.71E-04
KM SD	0.00196	95% KM (BCA) UCL	0.00285
95% KM (t) UCL	0.00284	95% KM (Percentile Bootstrap) UCL	0.00282
95% KM (z) UCL	0.00284	95% KM Bootstrap t UCL	0.00291
90% KM Chebyshev UCL	0.0032	95% KM Chebyshev UCL	0.00357
97.5% KM Chebyshev UCL	0.00408	99% KM Chebyshev UCL	0.00508
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.156	Anderson-Darling GOF Test	
5% A-D Critical Value	0.752	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.244	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.218	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)	1.849	k star (bias corrected MLE)	1.544
Theta hat (MLE)	0.00264	Theta star (bias corrected MLE)	0.00317
nu hat (MLE)	59.16	nu star (bias corrected)	49.4
Mean (detects)	0.00489		
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	0.0097
Maximum	0.021	Median	0.01
SD	0.00169	CV	0.174
k hat (MLE)	17.41	k star (bias corrected MLE)	17.22
Theta hat (MLE)	5.57E-04	Theta star (bias corrected MLE)	5.63E-04
nu hat (MLE)	9438	nu star (bias corrected)	9334
Adjusted Level of Significance (β)	0.0491		
Approximate Chi Square Value (N/A, α)	9111	Adjusted Chi Square Value (N/A, β)	9110
95% Gamma Approximate UCL (use when n>=50)	0.00994	95% Gamma Adjusted UCL (use when n<50)	0.00994
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.00239	SD (KM)	0.00196
Variance (KM)	3.84E-06	SE of Mean (KM)	2.71E-04
k hat (KM)	1.489	k star (KM)	1.475
nu hat (KM)	806.9	nu star (KM)	799.3
theta hat (KM)	0.00161	theta star (KM)	0.00162
80% gamma percentile (KM)	0.00371	90% gamma percentile (KM)	0.00501
95% gamma percentile (KM)	0.00627	99% gamma percentile (KM)	0.00912
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (799.31, α)	734.7	Adjusted Chi Square Value (799.31, β)	734.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.0026	95% Gamma Adjusted KM-UCL (use when n<50)	0.0026
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.194	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.213	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	0.00235	Mean in Log Scale	-6.283
SD in Original Scale	0.00194	SD in Log Scale	0.668
95% t UCL (assumes normality of ROS data)	0.00254	95% Percentile Bootstrap UCL	0.00255
95% BCA Bootstrap UCL	0.00257	95% Bootstrap t UCL	0.00259
95% H-UCL (Log ROS)	0.00252		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.202	KM Geo Mean	0.00203
KM SD (logged)	0.534	95% Critical H Value (KM-Log)	1.815
KM Standard Error of Mean (logged)	0.115	95% H-UCL (KM -Log)	0.00248
KM SD (logged)	0.534	95% Critical H Value (KM-Log)	1.815
KM Standard Error of Mean (logged)	0.115		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.462	Mean in Log Scale	-3.84
SD in Original Scale	0.92	SD in Log Scale	2.828
95% t UCL (Assumes normality)	0.554	95% H-Stat UCL	2.364

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 H-UCL	0.00248

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.

1,2-DICHLOROETHANE (CasNo: 107-06-2) [µg/L]

General Statistics

Total Number of Observations	231	Number of Distinct Observations	57
Number of Detects	75	Number of Non-Detects	156
Number of Distinct Detects	53	Number of Distinct Non-Detects	6
Minimum Detect	0.089	Minimum Non-Detect	0.25
Maximum Detect	45	Maximum Non-Detect	5
Variance Detects	53.05	Percent Non-Detects	67.53%
Mean Detects	2.203	SD Detects	7.284
Median Detects	0.32	CV Detects	3.306
Skewness Detects	4.996	Kurtosis Detects	25.64
Mean of Logged Detects	-0.807	SD of Logged Detects	1.368

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.315	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.41	Lilliefors GOF Test
5% Lilliefors Critical Value	0.102	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	0.875	KM Standard Error of Mean	0.28
KM SD	4.227	95% KM (BCA) UCL	1.477
95% KM (t) UCL	1.337	95% KM (Percentile Bootstrap) UCL	1.349
95% KM (z) UCL	1.336	95% KM Bootstrap t UCL	2.047
90% KM Chebyshev UCL	1.715	95% KM Chebyshev UCL	2.096

97.5% KM Chebyshev UCL	2.625	99% KM Chebyshev UCL	3.663
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	11.69	Anderson-Darling GOF Test	
5% A-D Critical Value	0.839	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.35	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.11	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)	0.41	k star (bias corrected MLE)	0.403
Theta hat (MLE)	5.369	Theta star (bias corrected MLE)	5.469
nu hat (MLE)	61.56	nu star (bias corrected)	60.43
Mean (detects)	2.203		
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	0.986
Maximum	45	Median	0.01
SD	4.294	CV	4.356
k hat (MLE)	0.263	k star (bias corrected MLE)	0.263
Theta hat (MLE)	3.747	Theta star (bias corrected MLE)	3.754
nu hat (MLE)	121.5	nu star (bias corrected)	121.3
Adjusted Level of Significance (β)	0.049		
Approximate Chi Square Value (121.30, α)	96.86	Adjusted Chi Square Value (121.30, β)	96.73
95% Gamma Approximate UCL (use when n>=50)	1.234	95% Gamma Adjusted UCL (use when n<50)	1.236
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.875	SD (KM)	4.227
Variance (KM)	17.87	SE of Mean (KM)	0.28
k hat (KM)	0.0428	k star (KM)	0.0451
nu hat (KM)	19.78	nu star (KM)	20.85
theta hat (KM)	20.43	theta star (KM)	19.38
80% gamma percentile (KM)	0.0807	90% gamma percentile (KM)	1.156
95% gamma percentile (KM)	4.462	99% gamma percentile (KM)	19.79
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (20.85, α)	11.48	Adjusted Chi Square Value (20.85, β)	11.44
95% Gamma Approximate KM-UCL (use when n>=50)	1.588	95% Gamma Adjusted KM-UCL (use when n<50)	1.594
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.811	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	2.59E-13	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.102	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	0.916	Mean in Log Scale	-1.322
SD in Original Scale	4.232	SD in Log Scale	1.124
95% t UCL (assumes normality of ROS data)	1.376	95% Percentile Bootstrap UCL	1.421
95% BCA Bootstrap UCL	1.618	95% Bootstrap t UCL	2.127
95% H-UCL (Log ROS)	0.593		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-1.33	KM Geo Mean	0.265
KM SD (logged)	0.945	95% Critical H Value (KM-Log)	2.106

KM Standard Error of Mean (logged)	0.0778	95% H-UCL (KM -Log)	0.471
KM SD (logged)	0.945	95% Critical H Value (KM-Log)	2.106
KM Standard Error of Mean (logged)	0.0778		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.987	Mean in Log Scale	-1.128
SD in Original Scale	4.244	SD in Log Scale	0.969
95% t UCL (Assumes normality)	1.448	95% H-Stat UCL	0.593

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	2.096

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.

1,4-DIOXANE (P-DIOXANE) (CasNo: 123-91-1) [µg/L]

General Statistics

Total Number of Observations	219	Number of Distinct Observations	86
Number of Detects	99	Number of Non-Detects	120
Number of Distinct Detects	70	Number of Distinct Non-Detects	20
Minimum Detect	0.0152	Minimum Non-Detect	0.056
Maximum Detect	590	Maximum Non-Detect	100
Variance Detects	8995	Percent Non-Detects	54.79%
Mean Detects	23.84	SD Detects	94.84
Median Detects	1.6	CV Detects	3.978
Skewness Detects	4.759	Kurtosis Detects	22.25
Mean of Logged Detects	0.586	SD of Logged Detects	1.884

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.272	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.47	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0893	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	10.88	KM Standard Error of Mean	4.384
KM SD	64.54	95% KM (BCA) UCL	18.99
95% KM (t) UCL	18.13	95% KM (Percentile Bootstrap) UCL	18.76
95% KM (z) UCL	18.1	95% KM Bootstrap t UCL	24.08
90% KM Chebyshev UCL	24.04	95% KM Chebyshev UCL	29.99
97.5% KM Chebyshev UCL	38.26	99% KM Chebyshev UCL	54.51

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	15.14	Anderson-Darling GOF Test
5% A-D Critical Value	0.882	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.332	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0982	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)	0.271	k star (bias corrected MLE)	0.27
Theta hat (MLE)	87.91	Theta star (bias corrected MLE)	88.39

nu hat (MLE)	53.69	nu star (bias corrected)	53.4
Mean (detects)	23.84		

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	10.87
Maximum	590	Median	0.01
SD	64.69	CV	5.949
k hat (MLE)	0.164	k star (bias corrected MLE)	0.165
Theta hat (MLE)	66.11	Theta star (bias corrected MLE)	65.79
nu hat (MLE)	72.04	nu star (bias corrected)	72.39
Adjusted Level of Significance (β)	0.0489		
Approximate Chi Square Value (72.39, α)	53.8	Adjusted Chi Square Value (72.39, β)	53.69
95% Gamma Approximate UCL (use when n>=50)	14.63	95% Gamma Adjusted UCL (use when n<50)	14.66

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	10.88	SD (KM)	64.54
Variance (KM)	4166	SE of Mean (KM)	4.384
k hat (KM)	0.0284	k star (KM)	0.0311
nu hat (KM)	12.46	nu star (KM)	13.62
theta hat (KM)	382.7	theta star (KM)	350.1
80% gamma percentile (KM)	0.154	90% gamma percentile (KM)	6.934
95% gamma percentile (KM)	43.53	99% gamma percentile (KM)	278.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (13.62, α)	6.311	Adjusted Chi Square Value (13.62, β)	6.278
95% Gamma Approximate KM-UCL (use when n>=50)	23.49	95% Gamma Adjusted KM-UCL (use when n<50)	23.61

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.919	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.56E-06	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.131	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0893	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	10.85	Mean in Log Scale	-1.414
SD in Original Scale	64.68	SD in Log Scale	2.488
95% t UCL (assumes normality of ROS data)	18.07	95% Percentile Bootstrap UCL	18.73
95% BCA Bootstrap UCL	20.47	95% Bootstrap t UCL	24.73
95% H-UCL (Log ROS)	10.07		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.348	KM Geo Mean	0.26
KM SD (logged)	2.351	95% Critical H Value (KM-Log)	3.567
KM Standard Error of Mean (logged)	0.2	95% H-UCL (KM -Log)	7.274
KM SD (logged)	2.351	95% Critical H Value (KM-Log)	3.567
KM Standard Error of Mean (logged)	0.2		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	12.29	Mean in Log Scale	-0.512
SD in Original Scale	64.95	SD in Log Scale	2.001
95% t UCL (Assumes normality)	19.54	95% H-Stat UCL	6.806

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	29.99

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.

ALUMINUM (CasNo: 7429-90-5) [µg/L]

General Statistics			
Total Number of Observations	99	Number of Distinct Observations	62
Number of Detects	84	Number of Non-Detects	15
Number of Distinct Detects	62	Number of Distinct Non-Detects	1
Minimum Detect	2.9	Minimum Non-Detect	20
Maximum Detect	620	Maximum Non-Detect	20
Variance Detects	10655	Percent Non-Detects	15.15%
Mean Detects	47.27	SD Detects	103.2
Median Detects	10.5	CV Detects	2.184
Skewness Detects	3.729	Kurtosis Detects	15.28
Mean of Logged Detects	2.759	SD of Logged Detects	1.271

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.471	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.35	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0968	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	41.36	KM Standard Error of Mean	9.662
KM SD	95.55	95% KM (BCA) UCL	58.68
95% KM (t) UCL	57.41	95% KM (Percentile Bootstrap) UCL	58.31
95% KM (z) UCL	57.25	95% KM Bootstrap t UCL	64.49
90% KM Chebyshev UCL	70.35	95% KM Chebyshev UCL	83.48
97.5% KM Chebyshev UCL	101.7	99% KM Chebyshev UCL	137.5

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	8.72	Anderson-Darling GOF Test	
5% A-D Critical Value	0.812	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.264	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.103	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)	0.568	k star (bias corrected MLE)	0.556
Theta hat (MLE)	83.2	Theta star (bias corrected MLE)	85.05
nu hat (MLE)	95.44	nu star (bias corrected)	93.37
Mean (detects)	47.27		

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	41.3
Maximum	620	Median	9.3
SD	96.2	CV	2.329

k hat (MLE)	0.39	k star (bias corrected MLE)	0.385
Theta hat (MLE)	106	Theta star (bias corrected MLE)	107.4
nu hat (MLE)	77.15	nu star (bias corrected)	76.14
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (76.14, α)	57.04	Adjusted Chi Square Value (76.14, β)	56.8
95% Gamma Approximate UCL (use when n>=50)	55.12	95% Gamma Adjusted UCL (use when n<50)	55.36

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	41.36	SD (KM)	95.55
Variance (KM)	9130	SE of Mean (KM)	9.662
k hat (KM)	0.187	k star (KM)	0.188
nu hat (KM)	37.1	nu star (KM)	37.31
theta hat (KM)	220.7	theta star (KM)	219.5
80% gamma percentile (KM)	52.74	90% gamma percentile (KM)	125
95% gamma percentile (KM)	216.4	99% gamma percentile (KM)	470.6

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (37.31, α)	24.32	Adjusted Chi Square Value (37.31, β)	24.17
95% Gamma Approximate KM-UCL (use when n>=50)	63.44	95% Gamma Adjusted KM-UCL (use when n<50)	63.85

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.863	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	9.99E-11	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0968	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	41.76	Mean in Log Scale	2.667
SD in Original Scale	95.93	SD in Log Scale	1.224
95% t UCL (assumes normality of ROS data)	57.77	95% Percentile Bootstrap UCL	59.25
95% BCA Bootstrap UCL	62.89	95% Bootstrap t UCL	65.62
95% H-UCL (Log ROS)	41.44		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.648	KM Geo Mean	14.13
KM SD (logged)	1.204	95% Critical H Value (KM-Log)	2.466
KM Standard Error of Mean (logged)	0.123	95% H-UCL (KM -Log)	39.4
KM SD (logged)	1.204	95% Critical H Value (KM-Log)	2.466
KM Standard Error of Mean (logged)	0.123		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	41.62	Mean in Log Scale	2.69
SD in Original Scale	95.94	SD in Log Scale	1.181
95% t UCL (Assumes normality)	57.63	95% H-Stat UCL	39.59

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	83.48

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.

ARSENIC (CasNo: 7440-38-2) [µg/L]

General Statistics			
Total Number of Observations	174	Number of Distinct Observations	98
Number of Detects	138	Number of Non-Detects	36
Number of Distinct Detects	94	Number of Distinct Non-Detects	5
Minimum Detect	0.13	Minimum Non-Detect	0.4
Maximum Detect	8	Maximum Non-Detect	20
Variance Detects	1.361	Percent Non-Detects	20.69%
Mean Detects	1.031	SD Detects	1.167
Median Detects	0.604	CV Detects	1.132
Skewness Detects	3.19	Kurtosis Detects	12.82
Mean of Logged Detects	-0.314	SD of Logged Detects	0.739
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.608	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.348	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0758	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	0.926	KM Standard Error of Mean	0.0813
KM SD	1.062	95% KM (BCA) UCL	1.071
95% KM (t) UCL	1.06	95% KM (Percentile Bootstrap) UCL	1.066
95% KM (z) UCL	1.059	95% KM Bootstrap t UCL	1.084
90% KM Chebyshev UCL	1.169	95% KM Chebyshev UCL	1.28
97.5% KM Chebyshev UCL	1.433	99% KM Chebyshev UCL	1.734
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	11.86	Anderson-Darling GOF Test	
5% A-D Critical Value	0.769	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.291	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.081	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)	1.599	k star (bias corrected MLE)	1.569
Theta hat (MLE)	0.645	Theta star (bias corrected MLE)	0.657
nu hat (MLE)	441.2	nu star (bias corrected)	432.9
Mean (detects)	1.031		
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	0.914
Maximum	8	Median	0.58
SD	1.082	CV	1.183
k hat (MLE)	1.124	k star (bias corrected MLE)	1.108
Theta hat (MLE)	0.814	Theta star (bias corrected MLE)	0.825
nu hat (MLE)	391	nu star (bias corrected)	385.6
Adjusted Level of Significance (β)	0.0486		
Approximate Chi Square Value (385.63, α)	341.1	Adjusted Chi Square Value (385.63, β)	340.8
95% Gamma Approximate UCL (use when n>=50)	1.034	95% Gamma Adjusted UCL (use when n<50)	1.035
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.926	SD (KM)	1.062
Variance (KM)	1.128	SE of Mean (KM)	0.0813
k hat (KM)	0.76	k star (KM)	0.75
nu hat (KM)	264.3	nu star (KM)	261.1

theta hat (KM)	1.219	theta star (KM)	1.234
80% gamma percentile (KM)	1.517	90% gamma percentile (KM)	2.286
95% gamma percentile (KM)	3.073	99% gamma percentile (KM)	4.941

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (261.09, α)	224.7	Adjusted Chi Square Value (261.09, β)	224.4
95% Gamma Approximate KM-UCL (use when n>=50)	1.076	95% Gamma Adjusted KM-UCL (use when n<50)	1.077

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.873	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0758	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	0.934	Mean in Log Scale	-0.388
SD in Original Scale	1.061	SD in Log Scale	0.705
95% t UCL (assumes normality of ROS data)	1.067	95% Percentile Bootstrap UCL	1.077
95% BCA Bootstrap UCL	1.117	95% Bootstrap t UCL	1.096
95% H-UCL (Log ROS)	0.965		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.397	KM Geo Mean	0.672
KM SD (logged)	0.695	95% Critical H Value (KM-Log)	1.93
KM Standard Error of Mean (logged)	0.0544	95% H-UCL (KM -Log)	0.947
KM SD (logged)	0.695	95% Critical H Value (KM-Log)	1.93
KM Standard Error of Mean (logged)	0.0544		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.975	Mean in Log Scale	-0.392
SD in Original Scale	1.267	SD in Log Scale	0.734
95% t UCL (Assumes normality)	1.134	95% H-Stat UCL	0.987

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	1.28

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.

BARIUM (CasNo: 7440-39-3) [µg/L]

General Statistics

Total Number of Observations	162	Number of Distinct Observations	120
		Number of Missing Observations	0
Minimum	15	Mean	123.4
Maximum	920	Median	84.6
SD	126.4	Std. Error of Mean	9.93
Coefficient of Variation	1.024	Skewness	3.555

Normal GOF Test

Shapiro Wilk Test Statistic	0.671	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	

Lilliefors Test Statistic	0.196	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.07	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	139.9	95% Adjusted-CLT UCL (Chen-1995)	142.7
		95% Modified-t UCL (Johnson-1978)	140.3
Gamma GOF Test			
A-D Test Statistic	2.303	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.77	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0863	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0748	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.556	k star (bias corrected MLE)	1.531
Theta hat (MLE)	79.32	Theta star (bias corrected MLE)	80.6
nu hat (MLE)	504.2	nu star (bias corrected)	496.1
MLE Mean (bias corrected)	123.4	MLE Sd (bias corrected)	99.74
		Approximate Chi Square Value (0.05)	445.5
Adjusted Level of Significance	0.0485	Adjusted Chi Square Value	445.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	137.5	95% Adjusted Gamma UCL (use when n<50)	137.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.955	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	2.81E-04	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.134	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.07	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.708	Mean of logged Data	4.461
Maximum of Logged Data	6.824	SD of logged Data	0.842
Assuming Lognormal Distribution			
95% H-UCL	141.3	90% Chebyshev (MVUE) UCL	151.3
95% Chebyshev (MVUE) UCL	164	97.5% Chebyshev (MVUE) UCL	181.8
99% Chebyshev (MVUE) UCL	216.6		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	139.8	95% Jackknife UCL	139.9
95% Standard Bootstrap UCL	139.8	95% Bootstrap-t UCL	144
95% Hall's Bootstrap UCL	145	95% Percentile Bootstrap UCL	139.9
95% BCA Bootstrap UCL	143.7		
90% Chebyshev(Mean, Sd) UCL	153.2	95% Chebyshev(Mean, Sd) UCL	166.7
97.5% Chebyshev(Mean, Sd) UCL	185.4	99% Chebyshev(Mean, Sd) UCL	222.2
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	166.7		

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.

BENZENE (CasNo: 71-43-2) [µg/L]

General Statistics			
Total Number of Observations	206	Number of Distinct Observations	24
Number of Detects	22	Number of Non-Detects	184
Number of Distinct Detects	19	Number of Distinct Non-Detects	5
Minimum Detect	0.03	Minimum Non-Detect	0.28
Maximum Detect	1.5	Maximum Non-Detect	5
Variance Detects	0.115	Percent Non-Detects	89.32%
Mean Detects	0.164	SD Detects	0.339
Median Detects	0.042	CV Detects	2.074
Skewness Detects	3.375	Kurtosis Detects	12.17
Mean of Logged Detects	-2.725	SD of Logged Detects	1.096
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.447	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.425	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.184	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	0.0617	KM Standard Error of Mean	0.0109
KM SD	0.12	95% KM (BCA) UCL	0.0833
95% KM (t) UCL	0.0797	95% KM (Percentile Bootstrap) UCL	0.0809
95% KM (z) UCL	0.0796	95% KM Bootstrap t UCL	0.101
90% KM Chebyshev UCL	0.0943	95% KM Chebyshev UCL	0.109
97.5% KM Chebyshev UCL	0.13	99% KM Chebyshev UCL	0.17
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	4.059	Anderson-Darling GOF Test	
5% A-D Critical Value	0.79	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.381	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.194	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)	0.666	k star (bias corrected MLE)	0.605
Theta hat (MLE)	0.246	Theta star (bias corrected MLE)	0.27
nu hat (MLE)	29.3	nu star (bias corrected)	26.63
Mean (detects)	0.164		
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	0.094
Maximum	1.5	Median	0.0292
SD	0.16	CV	1.707
k hat (MLE)	0.632	k star (bias corrected MLE)	0.626
Theta hat (MLE)	0.149	Theta star (bias corrected MLE)	0.15
nu hat (MLE)	260.4	nu star (bias corrected)	257.9
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (257.92, α)	221.7	Adjusted Chi Square Value (257.92, β)	221.5
95% Gamma Approximate UCL (use when n>=50)	0.109	95% Gamma Adjusted UCL (use when n<50)	0.109
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.0617	SD (KM)	0.12

Variance (KM)	0.0145	SE of Mean (KM)	0.0109
k hat (KM)	0.263	k star (KM)	0.262
nu hat (KM)	108.2	nu star (KM)	107.9
theta hat (KM)	0.235	theta star (KM)	0.236
80% gamma percentile (KM)	0.0911	90% gamma percentile (KM)	0.185
95% gamma percentile (KM)	0.295	99% gamma percentile (KM)	0.586

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (107.93, α)	84.95	Adjusted Chi Square Value (107.93, β)	84.81
95% Gamma Approximate KM-UCL (use when n>=50)	0.0784	95% Gamma Adjusted KM-UCL (use when n<50)	0.0786

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.682	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.293	Lilliefors GOF Test
5% Lilliefors Critical Value	0.184	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	0.0751	Mean in Log Scale	-2.979
SD in Original Scale	0.122	SD in Log Scale	0.799
95% t UCL (assumes normality of ROS data)	0.0892	95% Percentile Bootstrap UCL	0.0906
95% BCA Bootstrap UCL	0.0976	95% Bootstrap t UCL	0.103
95% H-UCL (Log ROS)	0.0782		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.075	KM Geo Mean	0.0462
KM SD (logged)	0.529	95% Critical H Value (KM-Log)	1.818
KM Standard Error of Mean (logged)	0.0938	95% H-UCL (KM -Log)	0.0568
KM SD (logged)	0.529	95% Critical H Value (KM-Log)	1.818
KM Standard Error of Mean (logged)	0.0938		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.36	Mean in Log Scale	-1.424
SD in Original Scale	0.525	SD in Log Scale	0.792
95% t UCL (Assumes normality)	0.421	95% H-Stat UCL	0.367

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	0.109

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.

BIS(2-ETHYLHEXYL) PHTHALATE (CasNo: 117-81-7) [µg/L]

General Statistics

Total Number of Observations	37	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	35
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	1.2	Minimum Non-Detect	3
Maximum Detect	14	Maximum Non-Detect	3
Variance Detects	81.92	Percent Non-Detects	94.59%
Mean Detects	7.6	SD Detects	9.051
Median Detects	7.6	CV Detects	1.191

Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.411	SD of Logged Detects	1.737

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	1.546	KM Standard Error of Mean	0.483
KM SD	2.076	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.361	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.34	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.994	95% KM Chebyshev UCL	3.649
97.5% KM Chebyshev UCL	4.56	99% KM Chebyshev UCL	6.348

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.942	k star (bias corrected MLE)	N/A
Theta hat (MLE)	8.072	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3.766	nu star (bias corrected)	N/A
Mean (detects)	7.6		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.546	SD (KM)	2.076
Variance (KM)	4.308	SE of Mean (KM)	0.483
k hat (KM)	0.555	k star (KM)	0.528
nu hat (KM)	41.05	nu star (KM)	39.05
theta hat (KM)	2.787	theta star (KM)	2.929
80% gamma percentile (KM)	2.544	90% gamma percentile (KM)	4.135
95% gamma percentile (KM)	5.825	99% gamma percentile (KM)	9.96

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0431
Approximate Chi Square Value (39.05, α)	25.74	Adjusted Chi Square Value (39.05, β)	25.27
95% Gamma Approximate KM-UCL (use when n>=50)	2.346	95% Gamma Adjusted KM-UCL (use when n<50)	2.389

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	2.089	Mean in Log Scale	0.227
SD in Original Scale	2.587	SD in Log Scale	1.02
95% t UCL (assumes normality of ROS data)	2.807	95% Percentile Bootstrap UCL	2.798
95% BCA Bootstrap UCL	3.092	95% Bootstrap t UCL	3.279
95% H-UCL (Log ROS)	3.18		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.249	KM Geo Mean	1.282
KM SD (logged)	0.398	95% Critical H Value (KM-Log)	1.842
KM Standard Error of Mean (logged)	0.0926	95% H-UCL (KM -Log)	1.569
KM SD (logged)	0.398	95% Critical H Value (KM-Log)	1.842
KM Standard Error of Mean (logged)	0.0926		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.83	Mean in Log Scale	0.46

SD in Original Scale	2.057	SD in Log Scale	0.37
95% t UCL (Assumes normality)	2.401	95% H-Stat UCL	1.898

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	3.649

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.

BORON (CasNo: 7440-42-8) [µg/L]

General Statistics

Total Number of Observations	60	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	70	Mean	263.3
Maximum	1000	Median	230
SD	194.5	Std. Error of Mean	25.11
Coefficient of Variation	0.739	Skewness	2.314

Normal GOF Test

Shapiro Wilk Test Statistic	0.753	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	3.75E-13	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.212	Lilliefors GOF Test
5% Lilliefors Critical Value	0.114	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	305.3	95% Adjusted-CLT UCL (Chen-1995)	312.6
		95% Modified-t UCL (Johnson-1978)	306.5

Gamma GOF Test

A-D Test Statistic	1.016	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.116	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.607	k star (bias corrected MLE)	2.488
Theta hat (MLE)	101	Theta star (bias corrected MLE)	105.8
nu hat (MLE)	312.9	nu star (bias corrected)	298.6
MLE Mean (bias corrected)	263.3	MLE Sd (bias corrected)	166.9
		Approximate Chi Square Value (0.05)	259.5
Adjusted Level of Significance	0.046	Adjusted Chi Square Value	258.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	302.9	95% Adjusted Gamma UCL (use when n<50)	303.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.0315	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0891	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.114	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.248	Mean of logged Data	5.369
Maximum of Logged Data	6.908	SD of logged Data	0.63

Assuming Lognormal Distribution

95% H-UCL	308.2	90% Chebyshev (MVUE) UCL	329.7
95% Chebyshev (MVUE) UCL	360.9	97.5% Chebyshev (MVUE) UCL	404.1
99% Chebyshev (MVUE) UCL	489.1		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	304.6	95% Jackknife UCL	305.3
95% Standard Bootstrap UCL	303.8	95% Bootstrap-t UCL	320.6
95% Hall's Bootstrap UCL	318.9	95% Percentile Bootstrap UCL	307.6
95% BCA Bootstrap UCL	314.5		
90% Chebyshev(Mean, Sd) UCL	338.6	95% Chebyshev(Mean, Sd) UCL	372.7
97.5% Chebyshev(Mean, Sd) UCL	420.1	99% Chebyshev(Mean, Sd) UCL	513.1

Suggested UCL to Use

95% H-UCL	308.2

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.

CARBON TETRACHLORIDE (CasNo: 56-23-5) [µg/L]

General Statistics

Total Number of Observations	204	Number of Distinct Observations	31
Number of Detects	38	Number of Non-Detects	166
Number of Distinct Detects	26	Number of Distinct Non-Detects	6
Minimum Detect	0.11	Minimum Non-Detect	0.25
Maximum Detect	0.53	Maximum Non-Detect	5
Variance Detects	0.0124	Percent Non-Detects	81.37%
Mean Detects	0.296	SD Detects	0.111
Median Detects	0.3	CV Detects	0.375
Skewness Detects	0.175	Kurtosis Detects	-1.047
Mean of Logged Detects	-1.292	SD of Logged Detects	0.407

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.938	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.102	Lilliefors GOF Test
5% Lilliefors Critical Value	0.142	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	0.264	KM Standard Error of Mean	0.015
KM SD	0.103	95% KM (BCA) UCL	0.288
95% KM (t) UCL	0.289	95% KM (Percentile Bootstrap) UCL	0.29
95% KM (z) UCL	0.289	95% KM Bootstrap t UCL	0.29

90% KM Chebyshev UCL	0.31	95% KM Chebyshev UCL	0.33
97.5% KM Chebyshev UCL	0.358	99% KM Chebyshev UCL	0.414

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.466	Anderson-Darling GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.108	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.143	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)	6.76	k star (bias corrected MLE)	6.244
Theta hat (MLE)	0.0438	Theta star (bias corrected MLE)	0.0475
nu hat (MLE)	513.8	nu star (bias corrected)	474.5
Mean (detects)	0.296		

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	0.0937	Mean	0.265
Maximum	0.53	Median	0.251
SD	0.0932	CV	0.352
k hat (MLE)	8.138	k star (bias corrected MLE)	8.022
Theta hat (MLE)	0.0326	Theta star (bias corrected MLE)	0.033
nu hat (MLE)	3320	nu star (bias corrected)	3273
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	3141	Adjusted Chi Square Value (N/A, β)	3140
95% Gamma Approximate UCL (use when n>=50)	0.276	95% Gamma Adjusted UCL (use when n<50)	0.276

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.264	SD (KM)	0.103
Variance (KM)	0.0107	SE of Mean (KM)	0.015
k hat (KM)	6.549	k star (KM)	6.456
nu hat (KM)	2672	nu star (KM)	2634
theta hat (KM)	0.0404	theta star (KM)	0.041
80% gamma percentile (KM)	0.346	90% gamma percentile (KM)	0.404
95% gamma percentile (KM)	0.456	99% gamma percentile (KM)	0.565

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	2516	Adjusted Chi Square Value (N/A, β)	2515
95% Gamma Approximate KM-UCL (use when n>=50)	0.277	95% Gamma Adjusted KM-UCL (use when n<50)	0.277

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.112	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	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	0.262	Mean in Log Scale	-1.408
SD in Original Scale	0.0971	SD in Log Scale	0.369
95% t UCL (assumes normality of ROS data)	0.273	95% Percentile Bootstrap UCL	0.273
95% BCA Bootstrap UCL	0.272	95% Bootstrap t UCL	0.273
95% H-UCL (Log ROS)	0.274		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.408	KM Geo Mean	0.245

KM SD (logged)	0.398	95% Critical H Value (KM-Log)	1.754
KM Standard Error of Mean (logged)	0.0606	95% H-UCL (KM -Log)	0.278
KM SD (logged)	0.398	95% Critical H Value (KM-Log)	1.754
KM Standard Error of Mean (logged)	0.0606		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.419	Mean in Log Scale	-1.16
SD in Original Scale	0.513	SD in Log Scale	0.624
95% t UCL (Assumes normality)	0.479	95% H-Stat UCL	0.413

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	0.289

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.

CHROMIUM, HEXAVALENT (CasNo: 18540-29-9) [µg/L]

General Statistics

Total Number of Observations	242	Number of Distinct Observations	119
Number of Detects	207	Number of Non-Detects	35
Number of Distinct Detects	116	Number of Distinct Non-Detects	7
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	67	Maximum Non-Detect	1
Variance Detects	37.64	Percent Non-Detects	14.46%
Mean Detects	2.711	SD Detects	6.135
Median Detects	1.1	CV Detects	2.263
Skewness Detects	7.189	Kurtosis Detects	64.8
Mean of Logged Detects	0.276	SD of Logged Detects	1.077

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.378	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.33	Lilliefors GOF Test
5% Lilliefors Critical Value	0.062	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	2.329	KM Standard Error of Mean	0.37
KM SD	5.736	95% KM (BCA) UCL	3.059
95% KM (t) UCL	2.94	95% KM (Percentile Bootstrap) UCL	2.951
95% KM (z) UCL	2.937	95% KM Bootstrap t UCL	3.416
90% KM Chebyshev UCL	3.438	95% KM Chebyshev UCL	3.941
97.5% KM Chebyshev UCL	4.638	99% KM Chebyshev UCL	6.007

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	11.75	Anderson-Darling GOF Test
5% A-D Critical Value	0.793	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0652	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)	0.82	k star (bias corrected MLE)	0.811

Theta hat (MLE)	3.306	Theta star (bias corrected MLE)	3.342
nu hat (MLE)	339.5	nu star (bias corrected)	335.9
Mean (detects)	2.711		

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	2.321
Maximum	67	Median	0.985
SD	5.751	CV	2.478
k hat (MLE)	0.5	k star (bias corrected MLE)	0.496
Theta hat (MLE)	4.646	Theta star (bias corrected MLE)	4.678
nu hat (MLE)	241.8	nu star (bias corrected)	240.1
Adjusted Level of Significance (β)	0.049		
Approximate Chi Square Value (240.10, α)	205.2	Adjusted Chi Square Value (240.10, β)	205
95% Gamma Approximate UCL (use when n>=50)	2.715	95% Gamma Adjusted UCL (use when n<50)	2.718

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.329	SD (KM)	5.736
Variance (KM)	32.91	SE of Mean (KM)	0.37
k hat (KM)	0.165	k star (KM)	0.166
nu hat (KM)	79.8	nu star (KM)	80.15
theta hat (KM)	14.13	theta star (KM)	14.07
80% gamma percentile (KM)	2.734	90% gamma percentile (KM)	6.985
95% gamma percentile (KM)	12.56	99% gamma percentile (KM)	28.43

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (80.15, α)	60.52	Adjusted Chi Square Value (80.15, β)	60.42
95% Gamma Approximate KM-UCL (use when n>=50)	3.085	95% Gamma Adjusted KM-UCL (use when n<50)	3.09

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.967	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.00426	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.106	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.062	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	2.343	Mean in Log Scale	-0.0462
SD in Original Scale	5.743	SD in Log Scale	1.284
95% t UCL (assumes normality of ROS data)	2.953	95% Percentile Bootstrap UCL	2.964
95% BCA Bootstrap UCL	3.232	95% Bootstrap t UCL	3.385
95% H-UCL (Log ROS)	2.657		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.347	KM Geo Mean	0.707
KM SD (logged)	1.876	95% Critical H Value (KM-Log)	3.037
KM Standard Error of Mean (logged)	0.124	95% H-UCL (KM -Log)	5.932
KM SD (logged)	1.876	95% Critical H Value (KM-Log)	3.037
KM Standard Error of Mean (logged)	0.124		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.337	Mean in Log Scale	-0.126
SD in Original Scale	5.745	SD in Log Scale	1.448
95% t UCL (Assumes normality)	2.947	95% H-Stat UCL	3.198

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	3.941

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.

CIS-1,2-DICHLOROETHYLENE (CasNo: 156-59-2) [µg/L]

General Statistics			
Total Number of Observations	243	Number of Distinct Observations	97
Number of Detects	150	Number of Non-Detects	93
Number of Distinct Detects	96	Number of Distinct Non-Detects	5
Minimum Detect	0.032	Minimum Non-Detect	0.28
Maximum Detect	16	Maximum Non-Detect	5
Variance Detects	9.269	Percent Non-Detects	38.27%
Mean Detects	2.937	SD Detects	3.044
Median Detects	1.65	CV Detects	1.037
Skewness Detects	1.29	Kurtosis Detects	1.418
Mean of Logged Detects	0.353	SD of Logged Detects	1.415
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.83	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.203	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0727	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	1.922	KM Standard Error of Mean	0.176
KM SD	2.722	95% KM (BCA) UCL	2.206
95% KM (t) UCL	2.213	95% KM (Percentile Bootstrap) UCL	2.208
95% KM (z) UCL	2.212	95% KM Bootstrap t UCL	2.235
90% KM Chebyshev UCL	2.45	95% KM Chebyshev UCL	2.69
97.5% KM Chebyshev UCL	3.022	99% KM Chebyshev UCL	3.674
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.148	Anderson-Darling GOF Test	
5% A-D Critical Value	0.792	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0809	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0794	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)	0.817	k star (bias corrected MLE)	0.805
Theta hat (MLE)	3.593	Theta star (bias corrected MLE)	3.646
nu hat (MLE)	245.2	nu star (bias corrected)	241.6
Mean (detects)	2.937		

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	1.902
Maximum	16	Median	0.638

SD	2.742	CV	1.442
k hat (MLE)	0.403	k star (bias corrected MLE)	0.4
Theta hat (MLE)	4.722	Theta star (bias corrected MLE)	4.748
nu hat (MLE)	195.7	nu star (bias corrected)	194.6
Adjusted Level of Significance (β)	0.049		
Approximate Chi Square Value (194.63, α)	163.4	Adjusted Chi Square Value (194.63, β)	163.2
95% Gamma Approximate UCL (use when n>=50)	2.266	95% Gamma Adjusted UCL (use when n<50)	2.268

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.922	SD (KM)	2.722
Variance (KM)	7.411	SE of Mean (KM)	0.176
k hat (KM)	0.499	k star (KM)	0.495
nu hat (KM)	242.3	nu star (KM)	240.7
theta hat (KM)	3.855	theta star (KM)	3.882
80% gamma percentile (KM)	3.156	90% gamma percentile (KM)	5.211
95% gamma percentile (KM)	7.41	99% gamma percentile (KM)	12.82

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (240.67, α)	205.8	Adjusted Chi Square Value (240.67, β)	205.6
95% Gamma Approximate KM-UCL (use when n>=50)	2.248	95% Gamma Adjusted KM-UCL (use when n<50)	2.251

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.934	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	9.00E-08	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0873	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0727	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	1.931	Mean in Log Scale	-0.376
SD in Original Scale	2.716	SD in Log Scale	1.559
95% t UCL (assumes normality of ROS data)	2.219	95% Percentile Bootstrap UCL	2.233
95% BCA Bootstrap UCL	2.234	95% Bootstrap t UCL	2.24
95% H-UCL (Log ROS)	3.03		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.438	KM Geo Mean	0.645
KM SD (logged)	1.596	95% Critical H Value (KM-Log)	2.73
KM Standard Error of Mean (logged)	0.117	95% H-UCL (KM -Log)	3.052
KM SD (logged)	1.596	95% Critical H Value (KM-Log)	2.73
KM Standard Error of Mean (logged)	0.117		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.006	Mean in Log Scale	-0.181
SD in Original Scale	2.695	SD in Log Scale	1.371
95% t UCL (Assumes normality)	2.291	95% H-Stat UCL	2.664

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	2.69

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.

COBALT (CasNo: 7440-48-4) [µg/L]

General Statistics			
Total Number of Observations	159	Number of Distinct Observations	88
Number of Detects	120	Number of Non-Detects	39
Number of Distinct Detects	86	Number of Distinct Non-Detects	3
Minimum Detect	0.033	Minimum Non-Detect	0.14
Maximum Detect	8.5	Maximum Non-Detect	20
Variance Detects	1.017	Percent Non-Detects	24.53%
Mean Detects	0.354	SD Detects	1.009
Median Detects	0.189	CV Detects	2.846
Skewness Detects	7.397	Kurtosis Detects	55.43
Mean of Logged Detects	-1.66	SD of Logged Detects	0.845
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.238	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.391	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0812	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	0.318	KM Standard Error of Mean	0.0706
KM SD	0.881	95% KM (BCA) UCL	0.453
95% KM (t) UCL	0.434	95% KM (Percentile Bootstrap) UCL	0.438
95% KM (z) UCL	0.434	95% KM Bootstrap t UCL	0.842
90% KM Chebyshev UCL	0.529	95% KM Chebyshev UCL	0.625
97.5% KM Chebyshev UCL	0.759	99% KM Chebyshev UCL	1.02
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	9.456	Anderson-Darling GOF Test	
5% A-D Critical Value	0.786	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.213	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.087	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)	0.935	k star (bias corrected MLE)	0.917
Theta hat (MLE)	0.379	Theta star (bias corrected MLE)	0.386
nu hat (MLE)	224.4	nu star (bias corrected)	220.2
Mean (detects)	0.354		
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	0.339
Maximum	8.5	Median	0.16
SD	0.9	CV	2.655
k hat (MLE)	0.722	k star (bias corrected MLE)	0.713
Theta hat (MLE)	0.469	Theta star (bias corrected MLE)	0.476
nu hat (MLE)	229.7	nu star (bias corrected)	226.7
Adjusted Level of Significance (β)	0.0485		
Approximate Chi Square Value (226.71, α)	192.9	Adjusted Chi Square Value (226.71, β)	192.6
95% Gamma Approximate UCL (use when n>=50)	0.399	95% Gamma Adjusted UCL (use when n<50)	0.399
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.318	SD (KM)	0.881
Variance (KM)	0.776	SE of Mean (KM)	0.0706
k hat (KM)	0.13	k star (KM)	0.132

nu hat (KM)	41.35	nu star (KM)	41.91
theta hat (KM)	2.442	theta star (KM)	2.41
80% gamma percentile (KM)	0.308	90% gamma percentile (KM)	0.921
95% gamma percentile (KM)	1.788	99% gamma percentile (KM)	4.378

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (41.91, α)	28.07	Adjusted Chi Square Value (41.91, β)	27.96
95% Gamma Approximate KM-UCL (use when n>=50)	0.474	95% Gamma Adjusted KM-UCL (use when n<50)	0.476

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.921	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	5.64E-08	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0856	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0812	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	0.319	Mean in Log Scale	-1.695
SD in Original Scale	0.881	SD in Log Scale	0.816
95% t UCL (assumes normality of ROS data)	0.435	95% Percentile Bootstrap UCL	0.446
95% BCA Bootstrap UCL	0.508	95% Bootstrap t UCL	0.906
95% H-UCL (Log ROS)	0.293		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.701	KM Geo Mean	0.182
KM SD (logged)	0.81	95% Critical H Value (KM-Log)	2.046
KM Standard Error of Mean (logged)	0.071	95% H-UCL (KM -Log)	0.289
KM SD (logged)	0.81	95% Critical H Value (KM-Log)	2.046
KM Standard Error of Mean (logged)	0.071		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.439	Mean in Log Scale	-1.453
SD in Original Scale	1.164	SD in Log Scale	0.906
95% t UCL (Assumes normality)	0.592	95% H-Stat UCL	0.411

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	0.625

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.

CYANIDE (CasNo: 57-12-5) [µg/L]

General Statistics

Total Number of Observations	37	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	34
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	6	Minimum Non-Detect	5
Maximum Detect	26	Maximum Non-Detect	5
Variance Detects	112	Percent Non-Detects	91.89%
Mean Detects	18	SD Detects	10.58
Median Detects	22	CV Detects	0.588
Skewness Detects	-1.458	Kurtosis Detects	N/A
Mean of Logged Detects	2.714	SD of Logged Detects	0.803

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	0.893	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.314	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	6.054	KM Standard Error of Mean	0.869
KM SD	4.318	95% KM (BCA) UCL	N/A
95% KM (t) UCL	7.522	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	7.484	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	8.662	95% KM Chebyshev UCL	9.844
97.5% KM Chebyshev UCL	11.48	99% KM Chebyshev UCL	14.7

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.985	k star (bias corrected MLE)	N/A
Theta hat (MLE)	6.03	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.91	nu star (bias corrected)	N/A
Mean (detects)	18		

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	26	Median	0.01
SD	5.568	CV	3.791
k hat (MLE)	0.171	k star (bias corrected MLE)	0.176
Theta hat (MLE)	8.568	Theta star (bias corrected MLE)	8.367
nu hat (MLE)	12.68	nu star (bias corrected)	12.99
Adjusted Level of Significance (β)	0.0431		
Approximate Chi Square Value (12.99, α)	5.886	Adjusted Chi Square Value (12.99, β)	5.678
95% Gamma Approximate UCL (use when n>=50)	3.241	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.054	SD (KM)	4.318
Variance (KM)	18.65	SE of Mean (KM)	0.869
k hat (KM)	1.966	k star (KM)	1.824
nu hat (KM)	145.5	nu star (KM)	135
theta hat (KM)	3.08	theta star (KM)	3.319
80% gamma percentile (KM)	9.162	90% gamma percentile (KM)	12.03
95% gamma percentile (KM)	14.79	99% gamma percentile (KM)	20.93

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (135.00, α)	109.2	Adjusted Chi Square Value (135.00, β)	108.1
95% Gamma Approximate KM-UCL (use when n>=50)	7.487	95% Gamma Adjusted KM-UCL (use when n<50)	7.557

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.834	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.348	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			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.851	Mean in Log Scale	-2.124
SD in Original Scale	5.515	SD in Log Scale	2.582
95% t UCL (assumes normality of ROS data)	3.382	95% Percentile Bootstrap UCL	3.503
95% BCA Bootstrap UCL	4.015	95% Bootstrap t UCL	8.473
95% H-UCL (Log ROS)	24.39		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.699	KM Geo Mean	5.468
KM SD (logged)	0.355	95% Critical H Value (KM-Log)	1.816
KM Standard Error of Mean (logged)	0.0714	95% H-UCL (KM -Log)	6.482
KM SD (logged)	0.355	95% Critical H Value (KM-Log)	1.816
KM Standard Error of Mean (logged)	0.0714		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.757	Mean in Log Scale	1.062
SD in Original Scale	4.962	SD in Log Scale	0.532
95% t UCL (Assumes normality)	5.134	95% H-Stat UCL	3.957

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	7.522

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.

FORMALDEHYDE (CasNo: 50-00-0) [µg/L]

General Statistics

Total Number of Observations	37	Number of Distinct Observations	16
Number of Detects	19	Number of Non-Detects	18
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	0.83	Minimum Non-Detect	2
Maximum Detect	14	Maximum Non-Detect	2
Variance Detects	10.89	Percent Non-Detects	48.65%
Mean Detects	3.765	SD Detects	3.3
Median Detects	2.4	CV Detects	0.877
Skewness Detects	1.963	Kurtosis Detects	4.233
Mean of Logged Detects	1.037	SD of Logged Detects	0.758

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.777	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.269	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	2.568	KM Standard Error of Mean	0.449
KM SD	2.62	95% KM (BCA) UCL	3.408
95% KM (t) UCL	3.327	95% KM (Percentile Bootstrap) UCL	3.362

95% KM (z) UCL	3.307	95% KM Bootstrap t UCL	3.83
90% KM Chebyshev UCL	3.916	95% KM Chebyshev UCL	4.526
97.5% KM Chebyshev UCL	5.373	99% KM Chebyshev UCL	7.038

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.518	Anderson-Darling GOF Test	
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.178	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.201	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)	1.884	k star (bias corrected MLE)	1.622
Theta hat (MLE)	1.998	Theta star (bias corrected MLE)	2.321
nu hat (MLE)	71.6	nu star (bias corrected)	61.63
Mean (detects)	3.765		

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	2.278
Maximum	14	Median	1.575
SD	2.856	CV	1.254
k hat (MLE)	0.518	k star (bias corrected MLE)	0.494
Theta hat (MLE)	4.398	Theta star (bias corrected MLE)	4.612
nu hat (MLE)	38.33	nu star (bias corrected)	36.55
Adjusted Level of Significance (β)	0.0431		
Approximate Chi Square Value (36.55, α)	23.72	Adjusted Chi Square Value (36.55, β)	23.27
95% Gamma Approximate UCL (use when n>=50)	3.512	95% Gamma Adjusted UCL (use when n<50)	3.579

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.568	SD (KM)	2.62
Variance (KM)	6.862	SE of Mean (KM)	0.449
k hat (KM)	0.961	k star (KM)	0.901
nu hat (KM)	71.12	nu star (KM)	66.69
theta hat (KM)	2.672	theta star (KM)	2.85
80% gamma percentile (KM)	4.166	90% gamma percentile (KM)	6.066
95% gamma percentile (KM)	7.983	99% gamma percentile (KM)	12.47

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (66.69, α)	48.89	Adjusted Chi Square Value (66.69, β)	48.23
95% Gamma Approximate KM-UCL (use when n>=50)	3.503	95% Gamma Adjusted KM-UCL (use when n<50)	3.551

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.901	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.125	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

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.555	Mean in Log Scale	0.599
SD in Original Scale	2.681	SD in Log Scale	0.785
95% t UCL (assumes normality of ROS data)	3.299	95% Percentile Bootstrap UCL	3.312
95% BCA Bootstrap UCL	3.572	95% Bootstrap t UCL	3.716
95% H-UCL (Log ROS)	3.287		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.646	KM Geo Mean	1.908
KM SD (logged)	0.688	95% Critical H Value (KM-Log)	2.068
KM Standard Error of Mean (logged)	0.131	95% H-UCL (KM -Log)	3.066
KM SD (logged)	0.688	95% Critical H Value (KM-Log)	2.068
KM Standard Error of Mean (logged)	0.131		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.42	Mean in Log Scale	0.533
SD in Original Scale	2.722	SD in Log Scale	0.751
95% t UCL (Assumes normality)	3.175	95% H-Stat UCL	2.946

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	3.551	95% GROS Adjusted Gamma UCL	3.579

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.

HEPTACHLOR (CasNo: 76-44-8) [µg/L]

General Statistics

Total Number of Observations	37	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	33
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	9.20E-04	Minimum Non-Detect	0.01
Maximum Detect	0.0059	Maximum Non-Detect	0.01
Variance Detects	5.02E-06	Percent Non-Detects	89.19%
Mean Detects	0.00261	SD Detects	0.00224
Median Detects	0.0018	CV Detects	0.86
Skewness Detects	1.761	Kurtosis Detects	3.283
Mean of Logged Detects	-6.194	SD of Logged Detects	0.779

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.356	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	0.00261	KM Standard Error of Mean	0.00112
KM SD	0.00194	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0045	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00445	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00597	95% KM Chebyshev UCL	0.00749
97.5% KM Chebyshev UCL	0.0096	99% KM Chebyshev UCL	0.0138

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.373	Anderson-Darling GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.308	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

Gamma Statistics on Detected Data Only

k hat (MLE)	2.203	k star (bias corrected MLE)	0.718
Theta hat (MLE)	0.00118	Theta star (bias corrected MLE)	0.00363
nu hat (MLE)	17.63	nu star (bias corrected)	5.74
Mean (detects)	0.00261		

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	9.20E-04	Mean	0.00921
Maximum	0.0105	Median	0.01
SD	0.00242	CV	0.263
k hat (MLE)	5.805	k star (bias corrected MLE)	5.352
Theta hat (MLE)	0.00159	Theta star (bias corrected MLE)	0.00172
nu hat (MLE)	429.6	nu star (bias corrected)	396.1
Adjusted Level of Significance (β)	0.0431		
Approximate Chi Square Value (396.08, α)	350.9	Adjusted Chi Square Value (396.08, β)	349.1
95% Gamma Approximate UCL (use when n>=50)	0.0104	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00261	SD (KM)	0.00194
Variance (KM)	3.77E-06	SE of Mean (KM)	0.00112
k hat (KM)	1.801	k star (KM)	1.673
nu hat (KM)	133.3	nu star (KM)	123.8
theta hat (KM)	0.00145	theta star (KM)	0.00156
80% gamma percentile (KM)	0.00398	90% gamma percentile (KM)	0.00529
95% gamma percentile (KM)	0.00654	99% gamma percentile (KM)	0.00937

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (123.80, α)	99.1	Adjusted Chi Square Value (123.80, β)	98.14
95% Gamma Approximate KM-UCL (use when n>=50)	0.00325	95% Gamma Adjusted KM-UCL (use when n<50)	0.00329

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.261	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	0.0031	Mean in Log Scale	-6.194
SD in Original Scale	0.00311	SD in Log Scale	0.94
95% t UCL (assumes normality of ROS data)	0.00396	95% Percentile Bootstrap UCL	0.00392
95% BCA Bootstrap UCL	0.00412	95% Bootstrap t UCL	0.00427
95% H-UCL (Log ROS)	0.00457		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.194	KM Geo Mean	0.00204
KM SD (logged)	0.675	95% Critical H Value (KM-Log)	2.056
KM Standard Error of Mean (logged)	0.39	95% H-UCL (KM -Log)	0.00323
KM SD (logged)	0.675	95% Critical H Value (KM-Log)	2.056
KM Standard Error of Mean (logged)	0.39		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00474	Mean in Log Scale	-5.395
SD in Original Scale	9.94E-04	SD in Log Scale	0.361
95% t UCL (Assumes normality)	0.00502	95% H-Stat UCL	0.0054

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	0.0045

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.

ISOPROPANOL (CasNo: 67-63-0) [µg/L]

General Statistics

Total Number of Observations	37	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	34
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	1300	Minimum Non-Detect	10000
Maximum Detect	2600	Maximum Non-Detect	10000
Variance Detects	523333	Percent Non-Detects	91.89%
Mean Detects	2133	SD Detects	723.4
Median Detects	2500	CV Detects	0.339
Skewness Detects	-1.695	Kurtosis Detects	N/A
Mean of Logged Detects	7.619	SD of Logged Detects	0.389

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	0.807	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.361	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	2133	KM Standard Error of Mean	417.7
KM SD	590.7	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2838	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2820	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3386	95% KM Chebyshev UCL	3954
97.5% KM Chebyshev UCL	4742	99% KM Chebyshev UCL	6289

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	10.96	k star (bias corrected MLE)	N/A
Theta hat (MLE)	194.6	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	65.78	nu star (bias corrected)	N/A
Mean (detects)	2133		

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	641.7	Mean	2180

Maximum	4261	Median	2138
SD	860.5	CV	0.395
k hat (MLE)	6.102	k star (bias corrected MLE)	5.626
Theta hat (MLE)	357.2	Theta star (bias corrected MLE)	387.5
nu hat (MLE)	451.6	nu star (bias corrected)	416.3
Adjusted Level of Significance (β)	0.0431		
Approximate Chi Square Value (416.29, α)	370	Adjusted Chi Square Value (416.29, β)	368.1
95% Gamma Approximate UCL (use when n>=50)	2452	95% Gamma Adjusted UCL (use when n<50)	N/A
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	2133	SD (KM)	590.7
Variance (KM)	348889	SE of Mean (KM)	417.7
k hat (KM)	13.04	k star (KM)	12
nu hat (KM)	965.3	nu star (KM)	888.4
theta hat (KM)	163.5	theta star (KM)	177.7
80% gamma percentile (KM)	2627	90% gamma percentile (KM)	2951
95% gamma percentile (KM)	3237	99% gamma percentile (KM)	3820
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (888.37, α)	820.2	Adjusted Chi Square Value (888.37, β)	817.4
95% Gamma Approximate KM-UCL (use when n>=50)	2311	95% Gamma Adjusted KM-UCL (use when n<50)	2319
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.367	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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	2259	Mean in Log Scale	7.619
SD in Original Scale	1063	SD in Log Scale	0.464
95% t UCL (assumes normality of ROS data)	2554	95% Percentile Bootstrap UCL	2544
95% BCA Bootstrap UCL	2562	95% Bootstrap t UCL	2608
95% H-UCL (Log ROS)	2624		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	7.619	KM Geo Mean	2037
KM SD (logged)	0.318	95% Critical H Value (KM-Log)	1.795
KM Standard Error of Mean (logged)	0.225	95% H-UCL (KM -Log)	2356
KM SD (logged)	0.318	95% Critical H Value (KM-Log)	1.795
KM Standard Error of Mean (logged)	0.225		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4768	Mean in Log Scale	8.444
SD in Original Scale	811.4	SD in Log Scale	0.265
95% t UCL (Assumes normality)	4993	95% H-Stat UCL	5205
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	2838		
Warning: Recommended UCL exceeds the maximum observation			

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.

LEAD (CasNo: 7439-92-1) [µg/L]

General Statistics			
Total Number of Observations	161	Number of Distinct Observations	71
Number of Detects	96	Number of Non-Detects	65
Number of Distinct Detects	69	Number of Distinct Non-Detects	3
Minimum Detect	0.013	Minimum Non-Detect	0.17
Maximum Detect	12	Maximum Non-Detect	20
Variance Detects	3.094	Percent Non-Detects	40.37%
Mean Detects	0.899	SD Detects	1.759
Median Detects	0.37	CV Detects	1.956
Skewness Detects	4.453	Kurtosis Detects	22.19
Mean of Logged Detects	-1.096	SD of Logged Detects	1.478
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.483	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.307	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0907	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	0.64	KM Standard Error of Mean	0.112
KM SD	1.401	95% KM (BCA) UCL	0.847
95% KM (t) UCL	0.826	95% KM (Percentile Bootstrap) UCL	0.828
95% KM (z) UCL	0.825	95% KM Bootstrap t UCL	0.923
90% KM Chebyshev UCL	0.977	95% KM Chebyshev UCL	1.13
97.5% KM Chebyshev UCL	1.342	99% KM Chebyshev UCL	1.759
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.772	Anderson-Darling GOF Test	
5% A-D Critical Value	0.807	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.109	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0958	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)	0.621	k star (bias corrected MLE)	0.608
Theta hat (MLE)	1.448	Theta star (bias corrected MLE)	1.478
nu hat (MLE)	119.2	nu star (bias corrected)	116.8
Mean (detects)	0.899		
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	0.632
Maximum	12	Median	0.22
SD	1.417	CV	2.241
k hat (MLE)	0.439	k star (bias corrected MLE)	0.435
Theta hat (MLE)	1.441	Theta star (bias corrected MLE)	1.454
nu hat (MLE)	141.3	nu star (bias corrected)	140
Adjusted Level of Significance (β)	0.0485		
Approximate Chi Square Value (139.99, α)	113.7	Adjusted Chi Square Value (139.99, β)	113.4
95% Gamma Approximate UCL (use when n>=50)	0.779	95% Gamma Adjusted UCL (use when n<50)	0.78
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.64	SD (KM)	1.401

Variance (KM)	1.963	SE of Mean (KM)	0.112
k hat (KM)	0.209	k star (KM)	0.209
nu hat (KM)	67.24	nu star (KM)	67.32
theta hat (KM)	3.066	theta star (KM)	3.062
80% gamma percentile (KM)	0.863	90% gamma percentile (KM)	1.936
95% gamma percentile (KM)	3.26	99% gamma percentile (KM)	6.88

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (67.32, α)	49.43	Adjusted Chi Square Value (67.32, β)	49.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.872	95% Gamma Adjusted KM-UCL (use when n<50)	0.874

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.971	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.173	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0695	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0907	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	0.63	Mean in Log Scale	-1.45
SD in Original Scale	1.402	SD in Log Scale	1.4
95% t UCL (assumes normality of ROS data)	0.813	95% Percentile Bootstrap UCL	0.825
95% BCA Bootstrap UCL	0.883	95% Bootstrap t UCL	0.913
95% H-UCL (Log ROS)	0.828		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.446	KM Geo Mean	0.236
KM SD (logged)	1.431	95% Critical H Value (KM-Log)	2.566
KM Standard Error of Mean (logged)	0.137	95% H-UCL (KM -Log)	0.877
KM SD (logged)	1.431	95% Critical H Value (KM-Log)	2.566
KM Standard Error of Mean (logged)	0.137		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.771	Mean in Log Scale	-1.025
SD in Original Scale	1.56	SD in Log Scale	1.239
95% t UCL (Assumes normality)	0.975	95% H-Stat UCL	0.976

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 H-UCL	0.877

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.

MANGANESE (CasNo: 7439-96-5) [µg/L]

General Statistics

Total Number of Observations	181	Number of Distinct Observations	128
Number of Detects	149	Number of Non-Detects	32
Number of Distinct Detects	127	Number of Distinct Non-Detects	2
Minimum Detect	0.177	Minimum Non-Detect	0.62
Maximum Detect	454	Maximum Non-Detect	1
Variance Detects	7538	Percent Non-Detects	17.68%
Mean Detects	39.39	SD Detects	86.82
Median Detects	7.3	CV Detects	2.204

Skewness Detects	3.283	Kurtosis Detects	11.09
Mean of Logged Detects	1.748	SD of Logged Detects	2.132

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.501	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.334	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.073	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	32.49	KM Standard Error of Mean	5.96
KM SD	79.91	95% KM (BCA) UCL	42.69
95% KM (t) UCL	42.35	95% KM (Percentile Bootstrap) UCL	43.14
95% KM (z) UCL	42.3	95% KM Bootstrap t UCL	44.52
90% KM Chebyshev UCL	50.37	95% KM Chebyshev UCL	58.47
97.5% KM Chebyshev UCL	69.71	99% KM Chebyshev UCL	91.79

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.785	Anderson-Darling GOF Test	
5% A-D Critical Value	0.856	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.152	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0829	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)	0.349	k star (bias corrected MLE)	0.347
Theta hat (MLE)	112.8	Theta star (bias corrected MLE)	113.6
nu hat (MLE)	104.1	nu star (bias corrected)	103.3
Mean (detects)	39.39		

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	32.43
Maximum	454	Median	2
SD	80.16	CV	2.472
k hat (MLE)	0.249	k star (bias corrected MLE)	0.249
Theta hat (MLE)	130.2	Theta star (bias corrected MLE)	130.5
nu hat (MLE)	90.15	nu star (bias corrected)	89.98
Adjusted Level of Significance (β)	0.0487		
Approximate Chi Square Value (89.98, α)	69.11	Adjusted Chi Square Value (89.98, β)	68.97
95% Gamma Approximate UCL (use when n>=50)	42.22	95% Gamma Adjusted UCL (use when n<50)	42.31

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	32.49	SD (KM)	79.91
Variance (KM)	6385	SE of Mean (KM)	5.96
k hat (KM)	0.165	k star (KM)	0.166
nu hat (KM)	59.85	nu star (KM)	60.19
theta hat (KM)	196.5	theta star (KM)	195.4
80% gamma percentile (KM)	38.25	90% gamma percentile (KM)	97.47
95% gamma percentile (KM)	175	99% gamma percentile (KM)	395.7

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (60.19, α)	43.35	Adjusted Chi Square Value (60.19, β)	43.24
95% Gamma Approximate KM-UCL (use when n>=50)	45.11	95% Gamma Adjusted KM-UCL (use when n<50)	45.23

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.94	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.24E-06	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0909	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.073	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	32.52	Mean in Log Scale	1.244
SD in Original Scale	80.12	SD in Log Scale	2.264
95% t UCL (assumes normality of ROS data)	42.36	95% Percentile Bootstrap UCL	42.75
95% BCA Bootstrap UCL	44.7	95% Bootstrap t UCL	44.66
95% H-UCL (Log ROS)	81.48		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.25	KM Geo Mean	3.489
KM SD (logged)	2.214	95% Critical H Value (KM-Log)	3.46
KM Standard Error of Mean (logged)	0.166	95% H-UCL (KM -Log)	71.69
KM SD (logged)	2.214	95% Critical H Value (KM-Log)	3.46
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	32.51	Mean in Log Scale	1.295
SD in Original Scale	80.13	SD in Log Scale	2.169
95% t UCL (Assumes normality)	42.35	95% H-Stat UCL	66.51

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	58.47

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.

METHYLENE CHLORIDE (CasNo: 75-09-2) [µg/L]

General Statistics

Total Number of Observations	205	Number of Distinct Observations	21
Number of Detects	23	Number of Non-Detects	182
Number of Distinct Detects	13	Number of Distinct Non-Detects	8
Minimum Detect	0.12	Minimum Non-Detect	0.5
Maximum Detect	0.26	Maximum Non-Detect	20
Variance Detects	0.00223	Percent Non-Detects	88.78%
Mean Detects	0.173	SD Detects	0.0473
Median Detects	0.16	CV Detects	0.272
Skewness Detects	0.543	Kurtosis Detects	-0.941
Mean of Logged Detects	-1.786	SD of Logged Detects	0.267

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.152	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.18	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	0.173	KM Standard Error of Mean	0.00985

KM SD	0.0462	95% KM (BCA) UCL	0.19
95% KM (t) UCL	0.19	95% KM (Percentile Bootstrap) UCL	0.191
95% KM (z) UCL	0.19	95% KM Bootstrap t UCL	0.192
90% KM Chebyshev UCL	0.203	95% KM Chebyshev UCL	0.216
97.5% KM Chebyshev UCL	0.235	99% KM Chebyshev UCL	0.272

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.624	Anderson-Darling GOF Test
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.181	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)	14.68	k star (bias corrected MLE)	12.79
Theta hat (MLE)	0.0118	Theta star (bias corrected MLE)	0.0136
nu hat (MLE)	675.1	nu star (bias corrected)	588.4
Mean (detects)	0.173		

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	0.0743	Mean	0.174
Maximum	0.314	Median	0.17
SD	0.0473	CV	0.272
k hat (MLE)	13.46	k star (bias corrected MLE)	13.26
Theta hat (MLE)	0.0129	Theta star (bias corrected MLE)	0.0131
nu hat (MLE)	5517	nu star (bias corrected)	5438
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	5267	Adjusted Chi Square Value (N/A, β)	5266
95% Gamma Approximate UCL (use when n>=50)	0.179	95% Gamma Adjusted UCL (use when n<50)	0.179

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.173	SD (KM)	0.0462
Variance (KM)	0.00214	SE of Mean (KM)	0.00985
k hat (KM)	14.09	k star (KM)	13.89
nu hat (KM)	5777	nu star (KM)	5694
theta hat (KM)	0.0123	theta star (KM)	0.0125
80% gamma percentile (KM)	0.211	90% gamma percentile (KM)	0.235
95% gamma percentile (KM)	0.256	99% gamma percentile (KM)	0.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	5520	Adjusted Chi Square Value (N/A, β)	5519
95% Gamma Approximate KM-UCL (use when n>=50)	0.179	95% Gamma Adjusted KM-UCL (use when n<50)	0.179

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	Lilliefors GOF Test
5% Lilliefors Critical Value	0.18	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	0.174	Mean in Log Scale	-1.786
SD in Original Scale	0.0466	SD in Log Scale	0.265
95% t UCL (assumes normality of ROS data)	0.179	95% Percentile Bootstrap UCL	0.179
95% BCA Bootstrap UCL	0.179	95% Bootstrap t UCL	0.179
95% H-UCL (Log ROS)	0.179		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.786	KM Geo Mean	0.168
KM SD (logged)	0.261	95% Critical H Value (KM-Log)	1.703
KM Standard Error of Mean (logged)	0.0556	95% H-UCL (KM -Log)	0.179
KM SD (logged)	0.261	95% Critical H Value (KM-Log)	1.703
KM Standard Error of Mean (logged)	0.0556		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.654	Mean in Log Scale	-0.437
SD in Original Scale	2.112	SD in Log Scale	1.368
95% t UCL (Assumes normality)	1.897	95% H-Stat UCL	2.09

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	0.19

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.

MOLYBDENUM (CasNo: 7439-98-7) [µg/L]

General Statistics

Total Number of Observations	145	Number of Distinct Observations	120
Number of Detects	144	Number of Non-Detects	1
Number of Distinct Detects	119	Number of Distinct Non-Detects	1
Minimum Detect	0.716	Minimum Non-Detect	20
Maximum Detect	170	Maximum Non-Detect	20
Variance Detects	522.2	Percent Non-Detects	0.69%
Mean Detects	16.76	SD Detects	22.85
Median Detects	6.465	CV Detects	1.363
Skewness Detects	2.96	Kurtosis Detects	13.56
Mean of Logged Detects	2.173	SD of Logged Detects	1.097

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.651	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.315	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0742	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	16.69	KM Standard Error of Mean	1.893
KM SD	22.71	95% KM (BCA) UCL	19.68
95% KM (t) UCL	19.82	95% KM (Percentile Bootstrap) UCL	19.77
95% KM (z) UCL	19.8	95% KM Bootstrap t UCL	20.53
90% KM Chebyshev UCL	22.37	95% KM Chebyshev UCL	24.94
97.5% KM Chebyshev UCL	28.51	99% KM Chebyshev UCL	35.52

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.622	Anderson-Darling GOF Test
5% A-D Critical Value	0.788	Detected Data Not Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.22	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0807	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)	0.904	k star (bias corrected MLE)	0.889
Theta hat (MLE)	18.55	Theta star (bias corrected MLE)	18.85
nu hat (MLE)	260.2	nu star (bias corrected)	256.2
Mean (detects)	16.76		
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	0.716	Mean	16.68
Maximum	170	Median	6.45
SD	22.79	CV	1.366
k hat (MLE)	0.905	k star (bias corrected MLE)	0.891
Theta hat (MLE)	18.43	Theta star (bias corrected MLE)	18.73
nu hat (MLE)	262.5	nu star (bias corrected)	258.4
Adjusted Level of Significance (β)	0.0483		
Approximate Chi Square Value (258.35, α)	222.1	Adjusted Chi Square Value (258.35, β)	221.8
95% Gamma Approximate UCL (use when n>=50)	19.4	95% Gamma Adjusted UCL (use when n<50)	19.43
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	16.69	SD (KM)	22.71
Variance (KM)	515.9	SE of Mean (KM)	1.893
k hat (KM)	0.54	k star (KM)	0.533
nu hat (KM)	156.6	nu star (KM)	154.7
theta hat (KM)	30.91	theta star (KM)	31.29
80% gamma percentile (KM)	27.47	90% gamma percentile (KM)	44.54
95% gamma percentile (KM)	62.65	99% gamma percentile (KM)	106.9
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (154.69, α)	126.9	Adjusted Chi Square Value (154.69, β)	126.7
95% Gamma Approximate KM-UCL (use when n>=50)	20.34	95% Gamma Adjusted KM-UCL (use when n<50)	20.38
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.929	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	2.05E-08	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.153	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0742	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	16.69	Mean in Log Scale	2.17
SD in Original Scale	22.79	SD in Log Scale	1.094
95% t UCL (assumes normality of ROS data)	19.82	95% Percentile Bootstrap UCL	19.96
95% BCA Bootstrap UCL	20.55	95% Bootstrap t UCL	20.44
95% H-UCL (Log ROS)	19.62		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	2.169	KM Geo Mean	8.749
KM SD (logged)	1.091	95% Critical H Value (KM-Log)	2.286
KM Standard Error of Mean (logged)	0.0911	95% H-UCL (KM -Log)	19.54
KM SD (logged)	1.091	95% Critical H Value (KM-Log)	2.286
KM Standard Error of Mean (logged)	0.0911		
DL/2 Statistics			

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	16.72	Mean in Log Scale	2.173
SD in Original Scale	22.78	SD in Log Scale	1.093
95% t UCL (Assumes normality)	19.85	95% H-Stat UCL	19.68

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	24.94

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.

NITROGEN, NITRATE (AS N) (CasNo: 14797-55-8 [Combined Nitrate as N and as NO3]) [µg/L]

General Statistics			
Total Number of Observations	245	Number of Distinct Observations	164
Number of Detects	230	Number of Non-Detects	15
Number of Distinct Detects	159	Number of Distinct Non-Detects	5
Minimum Detect	186.1	Minimum Non-Detect	50
Maximum Detect	31000	Maximum Non-Detect	200
Variance Detects	31623658	Percent Non-Detects	6.12%
Mean Detects	6900	SD Detects	5623
Median Detects	6061	CV Detects	0.815
Skewness Detects	1.303	Kurtosis Detects	2.036
Mean of Logged Detects	8.45	SD of Logged Detects	0.984

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.88	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.116	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0588	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	6481	KM Standard Error of Mean	363.6
KM SD	5679	95% KM (BCA) UCL	7075
95% KM (t) UCL	7082	95% KM (Percentile Bootstrap) UCL	7067
95% KM (z) UCL	7079	95% KM Bootstrap t UCL	7108
90% KM Chebyshev UCL	7572	95% KM Chebyshev UCL	8066
97.5% KM Chebyshev UCL	8752	99% KM Chebyshev UCL	10099

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.815	Anderson-Darling GOF Test
5% A-D Critical Value	0.773	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0587	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0614	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)	1.427	k star (bias corrected MLE)	1.412
Theta hat (MLE)	4834	Theta star (bias corrected MLE)	4888
nu hat (MLE)	656.6	nu star (bias corrected)	649.4
Mean (detects)	6900		

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	6484
Maximum	31000	Median	4970
SD	5688	CV	0.877
k hat (MLE)	0.766	k star (bias corrected MLE)	0.76
Theta hat (MLE)	8461	Theta star (bias corrected MLE)	8536
nu hat (MLE)	375.5	nu star (bias corrected)	372.2
Adjusted Level of Significance (β)	0.049		
Approximate Chi Square Value (372.22, α)	328.5	Adjusted Chi Square Value (372.22, β)	328.3
95% Gamma Approximate UCL (use when n>=50)	7347	95% Gamma Adjusted UCL (use when n<50)	7352

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6481	SD (KM)	5679
Variance (KM)	32254695	SE of Mean (KM)	363.6
k hat (KM)	1.302	k star (KM)	1.289
nu hat (KM)	638.1	nu star (KM)	631.6
theta hat (KM)	4977	theta star (KM)	5028
80% gamma percentile (KM)	10190	90% gamma percentile (KM)	14017
95% gamma percentile (KM)	17772	99% gamma percentile (KM)	26337

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (631.64, α)	574.3	Adjusted Chi Square Value (631.64, β)	574
95% Gamma Approximate KM-UCL (use when n>=50)	7128	95% Gamma Adjusted KM-UCL (use when n<50)	7132

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.951	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	1.18E-07	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.109	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0588	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	6510	Mean in Log Scale	8.315
SD in Original Scale	5659	SD in Log Scale	1.093
95% t UCL (assumes normality of ROS data)	7107	95% Percentile Bootstrap UCL	7126
95% BCA Bootstrap UCL	7164	95% Bootstrap t UCL	7164
95% H-UCL (Log ROS)	8672		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	8.173	KM Geo Mean	3543
KM SD (logged)	1.443	95% Critical H Value (KM-Log)	2.572
KM Standard Error of Mean (logged)	0.0924	95% H-UCL (KM -Log)	12735
KM SD (logged)	1.443	95% Critical H Value (KM-Log)	2.572
KM Standard Error of Mean (logged)	0.0924		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6481	Mean in Log Scale	8.177
SD in Original Scale	5691	SD in Log Scale	1.435
95% t UCL (Assumes normality)	7082	95% H-Stat UCL	12607

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	7128	95% GROS Approximate Gamma UCL	7347

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.

N-NITROSODIETHYLAMINE (CasNo: 55-18-5) [µg/L]

General Statistics

Total Number of Observations	84	Number of Distinct Observations	16
Number of Detects	18	Number of Non-Detects	66
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	7.10E-04	Minimum Non-Detect	0.002
Maximum Detect	0.0043	Maximum Non-Detect	0.002
Variance Detects	6.65E-07	Percent Non-Detects	78.57%
Mean Detects	0.00123	SD Detects	8.15E-04
Median Detects	9.65E-04	CV Detects	0.665
Skewness Detects	3.498	Kurtosis Detects	13.38
Mean of Logged Detects	-6.814	SD of Logged Detects	0.417

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.539	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.29	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	0.00108	KM Standard Error of Mean	7.88E-05
KM SD	4.47E-04	95% KM (BCA) UCL	0.00122
95% KM (t) UCL	0.00121	95% KM (Percentile Bootstrap) UCL	0.00122
95% KM (z) UCL	0.00121	95% KM Bootstrap t UCL	0.00129
90% KM Chebyshev UCL	0.00132	95% KM Chebyshev UCL	0.00143
97.5% KM Chebyshev UCL	0.00158	99% KM Chebyshev UCL	0.00187

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.839	Anderson-Darling GOF Test
5% A-D Critical Value	0.743	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.273	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)	4.701	k star (bias corrected MLE)	3.954
Theta hat (MLE)	2.61E-04	Theta star (bias corrected MLE)	3.10E-04
nu hat (MLE)	169.2	nu star (bias corrected)	142.4
Mean (detects)	0.00123		

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	7.10E-04	Mean	0.00812
Maximum	0.01	Median	0.01
SD	0.00364	CV	0.448
k hat (MLE)	2.037	k star (bias corrected MLE)	1.972
Theta hat (MLE)	0.00399	Theta star (bias corrected MLE)	0.00412

nu hat (MLE)	342.2	nu star (bias corrected)	331.3
Adjusted Level of Significance (β)	0.0471		
Approximate Chi Square Value (331.28, α)	290.1	Adjusted Chi Square Value (331.28, β)	289.4
95% Gamma Approximate UCL (use when n>=50)	0.00927	95% Gamma Adjusted UCL (use when n<50)	0.00929

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00108	SD (KM)	4.47E-04
Variance (KM)	2.00E-07	SE of Mean (KM)	7.88E-05
k hat (KM)	5.869	k star (KM)	5.667
nu hat (KM)	986	nu star (KM)	952.1
theta hat (KM)	1.85E-04	theta star (KM)	1.91E-04
80% gamma percentile (KM)	0.00144	90% gamma percentile (KM)	0.00169
95% gamma percentile (KM)	0.00192	99% gamma percentile (KM)	0.00241

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (952.10, α)	881.5	Adjusted Chi Square Value (952.10, β)	880.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.00117	95% Gamma Adjusted KM-UCL (use when n<50)	0.00117

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.77	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	Lilliefors GOF Test
5% Lilliefors Critical Value	0.202	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	0.00113	Mean in Log Scale	-6.857
SD in Original Scale	5.03E-04	SD in Log Scale	0.362
95% t UCL (assumes normality of ROS data)	0.00122	95% Percentile Bootstrap UCL	0.00123
95% BCA Bootstrap UCL	0.00124	95% Bootstrap t UCL	0.00125
95% H-UCL (Log ROS)	0.0012		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.878	KM Geo Mean	0.00103
KM SD (logged)	0.286	95% Critical H Value (KM-Log)	1.735
KM Standard Error of Mean (logged)	0.062	95% H-UCL (KM -Log)	0.00113
KM SD (logged)	0.286	95% Critical H Value (KM-Log)	1.735
KM Standard Error of Mean (logged)	0.062		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00105	Mean in Log Scale	-6.888
SD in Original Scale	3.81E-04	SD in Log Scale	0.193
95% t UCL (Assumes normality)	0.00112	95% H-Stat UCL	0.00108

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	0.00121	KM H-UCL	0.00113
95% KM (BCA) UCL	0.00122		

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.

N-NITROSODIMETHYLAMINE (CasNo: 62-75-9) [µg/L]

General Statistics

Total Number of Observations	113	Number of Distinct Observations	17
Number of Detects	15	Number of Non-Detects	98
Number of Distinct Detects	15	Number of Distinct Non-Detects	3
Minimum Detect	2.90E-04	Minimum Non-Detect	4.80E-04
Maximum Detect	0.0061	Maximum Non-Detect	0.002
Variance Detects	3.97E-06	Percent Non-Detects	86.73%
Mean Detects	0.00219	SD Detects	0.00199
Median Detects	0.0014	CV Detects	0.911
Skewness Detects	0.876	Kurtosis Detects	-0.556
Mean of Logged Detects	-6.599	SD of Logged Detects	1.072

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.857	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.22	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	7.40E-04	KM Standard Error of Mean	1.23E-04
KM SD	9.49E-04	95% KM (BCA) UCL	9.62E-04
95% KM (t) UCL	9.44E-04	95% KM (Percentile Bootstrap) UCL	9.57E-04
95% KM (z) UCL	9.43E-04	95% KM Bootstrap t UCL	0.001
90% KM Chebyshev UCL	0.00111	95% KM Chebyshev UCL	0.00128
97.5% KM Chebyshev UCL	0.00151	99% KM Chebyshev UCL	0.00197

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.438	Anderson-Darling GOF Test	
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.227	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)	1.194	k star (bias corrected MLE)	0.999
Theta hat (MLE)	0.00183	Theta star (bias corrected MLE)	0.00219
nu hat (MLE)	35.81	nu star (bias corrected)	29.98
Mean (detects)	0.00219		

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	2.90E-04	Mean	0.00896
Maximum	0.01	Median	0.01
SD	0.00275	CV	0.307
k hat (MLE)	3.379	k star (bias corrected MLE)	3.295
Theta hat (MLE)	0.00265	Theta star (bias corrected MLE)	0.00272
nu hat (MLE)	763.6	nu star (bias corrected)	744.7
Adjusted Level of Significance (β)	0.0479		
Approximate Chi Square Value (744.71, α)	682.4	Adjusted Chi Square Value (744.71, β)	681.6
95% Gamma Approximate UCL (use when n>=50)	0.00978	95% Gamma Adjusted UCL (use when n<50)	0.00979

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	7.40E-04	SD (KM)	9.49E-04
Variance (KM)	9.01E-07	SE of Mean (KM)	1.23E-04
k hat (KM)	0.608	k star (KM)	0.598
nu hat (KM)	137.4	nu star (KM)	135.1
theta hat (KM)	0.00122	theta star (KM)	0.00124

80% gamma percentile (KM)	0.00122	90% gamma percentile (KM)	0.00193
95% gamma percentile (KM)	0.00267	99% gamma percentile (KM)	0.00446

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (135.05, α)	109.2	Adjusted Chi Square Value (135.05, β)	108.9
95% Gamma Approximate KM-UCL (use when n>=50)	9.15E-04	95% Gamma Adjusted KM-UCL (use when n<50)	9.18E-04

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.134	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.22	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	7.82E-04	Mean in Log Scale	-7.644
SD in Original Scale	9.92E-04	SD in Log Scale	0.969
95% t UCL (assumes normality of ROS data)	9.36E-04	95% Percentile Bootstrap UCL	9.43E-04
95% BCA Bootstrap UCL	9.60E-04	95% Bootstrap t UCL	9.80E-04
95% H-UCL (Log ROS)	9.36E-04		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.556	KM Geo Mean	5.23E-04
KM SD (logged)	0.699	95% Critical H Value (KM-Log)	1.967
KM Standard Error of Mean (logged)	0.151	95% H-UCL (KM -Log)	7.60E-04
KM SD (logged)	0.699	95% Critical H Value (KM-Log)	1.967
KM Standard Error of Mean (logged)	0.151		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00112	Mean in Log Scale	-6.943
SD in Original Scale	8.38E-04	SD in Log Scale	0.514
95% t UCL (Assumes normality)	0.00125	95% H-Stat UCL	0.0012

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	9.44E-04

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.

PERCHLORATE (CasNo: 14797-73-0) [µg/L]

General Statistics

Total Number of Observations	177	Number of Distinct Observations	28
Number of Detects	32	Number of Non-Detects	145
Number of Distinct Detects	25	Number of Distinct Non-Detects	4
Minimum Detect	0.52	Minimum Non-Detect	0.36
Maximum Detect	72	Maximum Non-Detect	4
Variance Detects	155.6	Percent Non-Detects	81.92%
Mean Detects	4.228	SD Detects	12.47
Median Detects	1.55	CV Detects	2.951
Skewness Detects	5.508	Kurtosis Detects	30.8

Mean of Logged Detects	0.611	SD of Logged Detects	0.919
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.267	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.414	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.154	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	1.553	KM Standard Error of Mean	0.419
KM SD	5.388	95% KM (BCA) UCL	2.323
95% KM (t) UCL	2.246	95% KM (Percentile Bootstrap) UCL	2.37
95% KM (z) UCL	2.242	95% KM Bootstrap t UCL	3.683
90% KM Chebyshev UCL	2.81	95% KM Chebyshev UCL	3.38
97.5% KM Chebyshev UCL	4.171	99% KM Chebyshev UCL	5.724
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	4.632	Anderson-Darling GOF Test	
5% A-D Critical Value	0.79	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.324	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.162	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)	0.724	k star (bias corrected MLE)	0.677
Theta hat (MLE)	5.837	Theta star (bias corrected MLE)	6.242
nu hat (MLE)	46.36	nu star (bias corrected)	43.35
Mean (detects)	4.228		
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	1.289
Maximum	72	Median	0.01
SD	5.571	CV	4.321
k hat (MLE)	0.247	k star (bias corrected MLE)	0.246
Theta hat (MLE)	5.23	Theta star (bias corrected MLE)	5.238
nu hat (MLE)	87.27	nu star (bias corrected)	87.13
Adjusted Level of Significance (β)	0.0486		
Approximate Chi Square Value (87.13, α)	66.61	Adjusted Chi Square Value (87.13, β)	66.46
95% Gamma Approximate UCL (use when n>=50)	1.686	95% Gamma Adjusted UCL (use when n<50)	1.69
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	1.553	SD (KM)	5.388
Variance (KM)	29.03	SE of Mean (KM)	0.419
k hat (KM)	0.083	k star (KM)	0.0854
nu hat (KM)	29.39	nu star (KM)	30.23
theta hat (KM)	18.7	theta star (KM)	18.18
80% gamma percentile (KM)	0.835	90% gamma percentile (KM)	3.827
95% gamma percentile (KM)	9.045	99% gamma percentile (KM)	26.65
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (30.23, α)	18.67	Adjusted Chi Square Value (30.23, β)	18.6
95% Gamma Approximate KM-UCL (use when n>=50)	2.513	95% Gamma Adjusted KM-UCL (use when n<50)	2.524
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.827	Shapiro Wilk GOF Test	

5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.154	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	1.542	Mean in Log Scale	-0.125
SD in Original Scale	5.417	SD in Log Scale	0.831
95% t UCL (assumes normality of ROS data)	2.216	95% Percentile Bootstrap UCL	2.338
95% BCA Bootstrap UCL	3.074	95% Bootstrap t UCL	4.639
95% H-UCL (Log ROS)	1.414		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0466	KM Geo Mean	0.954
KM SD (logged)	0.719	95% Critical H Value (KM-Log)	1.948
KM Standard Error of Mean (logged)	0.111	95% H-UCL (KM -Log)	1.374
KM SD (logged)	0.719	95% Critical H Value (KM-Log)	1.948
KM Standard Error of Mean (logged)	0.111		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.579	Mean in Log Scale	0.0718
SD in Original Scale	5.387	SD in Log Scale	0.553
95% t UCL (Assumes normality)	2.249	95% H-Stat UCL	1.352

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	3.38

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.

SELENIUM (CasNo: 7782-49-2) [µg/L]

General Statistics

Total Number of Observations	163	Number of Distinct Observations	97
Number of Detects	121	Number of Non-Detects	42
Number of Distinct Detects	94	Number of Distinct Non-Detects	6
Minimum Detect	0.11	Minimum Non-Detect	0.4
Maximum Detect	34	Maximum Non-Detect	30
Variance Detects	91.95	Percent Non-Detects	25.77%
Mean Detects	6.259	SD Detects	9.589
Median Detects	0.96	CV Detects	1.532
Skewness Detects	1.652	Kurtosis Detects	1.348
Mean of Logged Detects	0.569	SD of Logged Detects	1.629

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.651	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0809	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	4.819	KM Standard Error of Mean	0.679
KM SD	8.609	95% KM (BCA) UCL	5.94

95% KM (t) UCL	5.942	95% KM (Percentile Bootstrap) UCL	5.983
95% KM (z) UCL	5.935	95% KM Bootstrap t UCL	6.114
90% KM Chebyshev UCL	6.855	95% KM Chebyshev UCL	7.778
97.5% KM Chebyshev UCL	9.058	99% KM Chebyshev UCL	11.57

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.147	Anderson-Darling GOF Test
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.233	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0889	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)	0.502	k star (bias corrected MLE)	0.495
Theta hat (MLE)	12.47	Theta star (bias corrected MLE)	12.64
nu hat (MLE)	121.5	nu star (bias corrected)	119.8
Mean (detects)	6.259		

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	4.839
Maximum	34	Median	0.726
SD	8.627	CV	1.783
k hat (MLE)	0.361	k star (bias corrected MLE)	0.358
Theta hat (MLE)	13.42	Theta star (bias corrected MLE)	13.51
nu hat (MLE)	117.6	nu star (bias corrected)	116.7
Adjusted Level of Significance (β)	0.0485		
Approximate Chi Square Value (116.73, α)	92.79	Adjusted Chi Square Value (116.73, β)	92.6
95% Gamma Approximate UCL (use when n>=50)	6.088	95% Gamma Adjusted UCL (use when n<50)	6.1

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.819	SD (KM)	8.609
Variance (KM)	74.11	SE of Mean (KM)	0.679
k hat (KM)	0.313	k star (KM)	0.312
nu hat (KM)	102.1	nu star (KM)	101.6
theta hat (KM)	15.38	theta star (KM)	15.46
80% gamma percentile (KM)	7.457	90% gamma percentile (KM)	14.15
95% gamma percentile (KM)	21.77	99% gamma percentile (KM)	41.51

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (101.60, α)	79.34	Adjusted Chi Square Value (101.60, β)	79.17
95% Gamma Approximate KM-UCL (use when n>=50)	6.17	95% Gamma Adjusted KM-UCL (use when n<50)	6.184

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.87	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	3.33E-16	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0809	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	4.851	Mean in Log Scale	0.264
SD in Original Scale	8.601	SD in Log Scale	1.568
95% t UCL (assumes normality of ROS data)	5.966	95% Percentile Bootstrap UCL	5.961
95% BCA Bootstrap UCL	6.135	95% Bootstrap t UCL	6.114
95% H-UCL (Log ROS)	6.213		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.236	KM Geo Mean	1.266
KM SD (logged)	1.543	95% Critical H Value (KM-Log)	2.683
KM Standard Error of Mean (logged)	0.124	95% H-UCL (KM -Log)	5.761
KM SD (logged)	1.543	95% Critical H Value (KM-Log)	2.683
KM Standard Error of Mean (logged)	0.124		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	5.062	Mean in Log Scale	0.4
SD in Original Scale	8.582	SD in Log Scale	1.525
95% t UCL (Assumes normality)	6.174	95% H-Stat UCL	6.568

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	7.778

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.

TERT-BUTYL METHYL ETHER (CasNo: 1634-04-4) [µg/L]

General Statistics

Total Number of Observations	179	Number of Distinct Observations	13
Number of Detects	9	Number of Non-Detects	170
Number of Distinct Detects	9	Number of Distinct Non-Detects	4
Minimum Detect	0.066	Minimum Non-Detect	0.5
Maximum Detect	6.2	Maximum Non-Detect	5
Variance Detects	6.086	Percent Non-Detects	94.97%
Mean Detects	1.65	SD Detects	2.467
Median Detects	0.39	CV Detects	1.495
Skewness Detects	1.509	Kurtosis Detects	0.564
Mean of Logged Detects	-0.712	SD of Logged Detects	1.745

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.671	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.343	Lilliefors GOF Test
5% Lilliefors Critical Value	0.274	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	0.275	KM Standard Error of Mean	0.0834
KM SD	0.63	95% KM (BCA) UCL	0.43
95% KM (t) UCL	0.412	95% KM (Percentile Bootstrap) UCL	0.426
95% KM (z) UCL	0.412	95% KM Bootstrap t UCL	0.505
90% KM Chebyshev UCL	0.525	95% KM Chebyshev UCL	0.638
97.5% KM Chebyshev UCL	0.795	99% KM Chebyshev UCL	1.104

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.627	Anderson-Darling GOF Test
5% A-D Critical Value	0.769	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.25	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)	0.521	k star (bias corrected MLE)	0.421
Theta hat (MLE)	3.169	Theta star (bias corrected MLE)	3.918
nu hat (MLE)	9.37	nu star (bias corrected)	7.58
Mean (detects)	1.65		
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	0.349
Maximum	6.2	Median	0.01
SD	0.782	CV	2.241
k hat (MLE)	0.34	k star (bias corrected MLE)	0.338
Theta hat (MLE)	1.026	Theta star (bias corrected MLE)	1.032
nu hat (MLE)	121.8	nu star (bias corrected)	121.1
Adjusted Level of Significance (β)	0.0487		
Approximate Chi Square Value (121.10, α)	96.68	Adjusted Chi Square Value (121.10, β)	96.51
95% Gamma Approximate UCL (use when n>=50)	0.437	95% Gamma Adjusted UCL (use when n<50)	0.438
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.275	SD (KM)	0.63
Variance (KM)	0.397	SE of Mean (KM)	0.0834
k hat (KM)	0.19	k star (KM)	0.19
nu hat (KM)	67.96	nu star (KM)	68.16
theta hat (KM)	1.446	theta star (KM)	1.442
80% gamma percentile (KM)	0.352	90% gamma percentile (KM)	0.83
95% gamma percentile (KM)	1.432	99% gamma percentile (KM)	3.106
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (68.16, α)	50.15	Adjusted Chi Square Value (68.16, β)	50.03
95% Gamma Approximate KM-UCL (use when n>=50)	0.373	95% Gamma Adjusted KM-UCL (use when n<50)	0.374
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.171	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	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	0.306	Mean in Log Scale	-1.915
SD in Original Scale	0.657	SD in Log Scale	1.151
95% t UCL (assumes normality of ROS data)	0.388	95% Percentile Bootstrap UCL	0.406
95% BCA Bootstrap UCL	0.422	95% Bootstrap t UCL	0.489
95% H-UCL (Log ROS)	0.349		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-1.864	KM Geo Mean	0.155
KM SD (logged)	0.906	95% Critical H Value (KM-Log)	2.088
KM Standard Error of Mean (logged)	0.365	95% H-UCL (KM -Log)	0.269
KM SD (logged)	0.906	95% Critical H Value (KM-Log)	2.088
KM Standard Error of Mean (logged)	0.365		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.703	Mean in Log Scale	-0.68
SD in Original Scale	0.788	SD in Log Scale	0.749
95% t UCL (Assumes normality)	0.8	95% H-Stat UCL	0.749

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 Approximate Gamma UCL	0.373		

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.

TETRACHLOROETHYLENE(PCE) (CasNo: 127-18-4) [µg/L]

General Statistics

Total Number of Observations	253	Number of Distinct Observations	116
Number of Detects	198	Number of Non-Detects	55
Number of Distinct Detects	116	Number of Distinct Non-Detects	3
Minimum Detect	0.085	Minimum Non-Detect	0.5
Maximum Detect	134	Maximum Non-Detect	1
Variance Detects	354.7	Percent Non-Detects	21.74%
Mean Detects	7.718	SD Detects	18.83
Median Detects	2.2	CV Detects	2.44
Skewness Detects	4.869	Kurtosis Detects	26.12
Mean of Logged Detects	0.883	SD of Logged Detects	1.427

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.403	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.356	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0634	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	6.104	KM Standard Error of Mean	1.065
KM SD	16.9	95% KM (BCA) UCL	7.966
95% KM (t) UCL	7.863	95% KM (Percentile Bootstrap) UCL	7.935
95% KM (z) UCL	7.856	95% KM Bootstrap t UCL	8.338
90% KM Chebyshev UCL	9.3	95% KM Chebyshev UCL	10.75
97.5% KM Chebyshev UCL	12.76	99% KM Chebyshev UCL	16.7

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	10.63	Anderson-Darling GOF Test	
5% A-D Critical Value	0.817	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.187	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0677	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)	0.541	k star (bias corrected MLE)	0.536
Theta hat (MLE)	14.27	Theta star (bias corrected MLE)	14.4
nu hat (MLE)	214.1	nu star (bias corrected)	212.2
Mean (detects)	7.718		

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	6.042
Maximum	134	Median	1.7
SD	16.95	CV	2.806
k hat (MLE)	0.323	k star (bias corrected MLE)	0.322
Theta hat (MLE)	18.7	Theta star (bias corrected MLE)	18.77
nu hat (MLE)	163.5	nu star (bias corrected)	162.9
Adjusted Level of Significance (β)	0.0491		
Approximate Chi Square Value (162.86, α)	134.4	Adjusted Chi Square Value (162.86, β)	134.2
95% Gamma Approximate UCL (use when n>=50)	7.324	95% Gamma Adjusted UCL (use when n<50)	7.332

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.104	SD (KM)	16.9
Variance (KM)	285.6	SE of Mean (KM)	1.065
k hat (KM)	0.13	k star (KM)	0.132
nu hat (KM)	66.01	nu star (KM)	66.57
theta hat (KM)	46.79	theta star (KM)	46.4
80% gamma percentile (KM)	5.901	90% gamma percentile (KM)	17.69
95% gamma percentile (KM)	34.38	99% gamma percentile (KM)	84.22

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (66.57, α)	48.79	Adjusted Chi Square Value (66.57, β)	48.7
95% Gamma Approximate KM-UCL (use when n>=50)	8.328	95% Gamma Adjusted KM-UCL (use when n<50)	8.343

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.967	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.0071	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0679	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0634	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	6.11	Mean in Log Scale	0.392
SD in Original Scale	16.93	SD in Log Scale	1.609
95% t UCL (assumes normality of ROS data)	7.868	95% Percentile Bootstrap UCL	7.862
95% BCA Bootstrap UCL	8.395	95% Bootstrap t UCL	8.638
95% H-UCL (Log ROS)	7.106		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.406	KM Geo Mean	1.5
KM SD (logged)	1.564	95% Critical H Value (KM-Log)	2.649
KM Standard Error of Mean (logged)	0.1	95% H-UCL (KM -Log)	6.615
KM SD (logged)	1.564	95% Critical H Value (KM-Log)	2.649
KM Standard Error of Mean (logged)	0.1		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.108	Mean in Log Scale	0.426
SD in Original Scale	16.93	SD in Log Scale	1.538
95% t UCL (Assumes normality)	7.865	95% H-Stat UCL	6.444

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	10.75

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.

TRICHLOROETHYLENE (TCE) (CasNo: 79-01-6) [µg/L]

General Statistics

Total Number of Observations	260	Number of Distinct Observations	129
Number of Detects	213	Number of Non-Detects	47
Number of Distinct Detects	127	Number of Distinct Non-Detects	3
Minimum Detect	0.13	Minimum Non-Detect	0.3
Maximum Detect	246	Maximum Non-Detect	1
Variance Detects	916.8	Percent Non-Detects	18.08%
Mean Detects	22.39	SD Detects	30.28
Median Detects	11	CV Detects	1.352
Skewness Detects	2.862	Kurtosis Detects	13.99
Mean of Logged Detects	2.114	SD of Logged Detects	1.659

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.72	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.231	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0611	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	18.39	KM Standard Error of Mean	1.78
KM SD	28.63	95% KM (BCA) UCL	21.54
95% KM (t) UCL	21.33	95% KM (Percentile Bootstrap) UCL	21.43
95% KM (z) UCL	21.32	95% KM Bootstrap t UCL	21.67
90% KM Chebyshev UCL	23.73	95% KM Chebyshev UCL	26.15
97.5% KM Chebyshev UCL	29.51	99% KM Chebyshev UCL	36.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.281	Anderson-Darling GOF Test
5% A-D Critical Value	0.809	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0655	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0652	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)	0.618	k star (bias corrected MLE)	0.613
Theta hat (MLE)	36.2	Theta star (bias corrected MLE)	36.53
nu hat (MLE)	263.5	nu star (bias corrected)	261.1
Mean (detects)	22.39		

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	18.34
Maximum	246	Median	6.25
SD	28.72	CV	1.566
k hat (MLE)	0.337	k star (bias corrected MLE)	0.335
Theta hat (MLE)	54.48	Theta star (bias corrected MLE)	54.69
nu hat (MLE)	175.1	nu star (bias corrected)	174.4
Adjusted Level of Significance (β)	0.0491		
Approximate Chi Square Value (174.39, α)	144.9	Adjusted Chi Square Value (174.39, β)	144.7
95% Gamma Approximate UCL (use when n>=50)	22.08	95% Gamma Adjusted UCL (use when n<50)	22.11

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	18.39	SD (KM)	28.63

Variance (KM)	819.9	SE of Mean (KM)	1.78
k hat (KM)	0.412	k star (KM)	0.41
nu hat (KM)	214.5	nu star (KM)	213.3
theta hat (KM)	44.59	theta star (KM)	44.82
80% gamma percentile (KM)	29.76	90% gamma percentile (KM)	51.71
95% gamma percentile (KM)	75.74	99% gamma percentile (KM)	136

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (213.34, α)	180.5	Adjusted Chi Square Value (213.34, β)	180.4
95% Gamma Approximate KM-UCL (use when n>=50)	21.73	95% Gamma Adjusted KM-UCL (use when n<50)	21.75

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.949	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	1.94E-07	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0797	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0611	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	18.43	Mean in Log Scale	1.557
SD in Original Scale	28.66	SD in Log Scale	1.946
95% t UCL (assumes normality of ROS data)	21.37	95% Percentile Bootstrap UCL	21.49
95% BCA Bootstrap UCL	21.87	95% Bootstrap t UCL	21.68
95% H-UCL (Log ROS)	45.6		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.479	KM Geo Mean	4.388
KM SD (logged)	2.027	95% Critical H Value (KM-Log)	3.147
KM Standard Error of Mean (logged)	0.128	95% H-UCL (KM -Log)	50.88
KM SD (logged)	2.027	95% Critical H Value (KM-Log)	3.147
KM Standard Error of Mean (logged)	0.128		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	18.39	Mean in Log Scale	1.499
SD in Original Scale	28.69	SD in Log Scale	1.997
95% t UCL (Assumes normality)	21.33	95% H-Stat UCL	48.44

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	26.15

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.

VANADIUM (CasNo: 7440-62-2) [µg/L]

General Statistics

Total Number of Observations	178	Number of Distinct Observations	99
Number of Detects	159	Number of Non-Detects	19
Number of Distinct Detects	96	Number of Distinct Non-Detects	4
Minimum Detect	0.884	Minimum Non-Detect	1
Maximum Detect	54.8	Maximum Non-Detect	20
Variance Detects	49.53	Percent Non-Detects	10.67%
Mean Detects	3.947	SD Detects	7.038
Median Detects	2.7	CV Detects	1.783

Skewness Detects	6.445	Kurtosis Detects	42.27
Mean of Logged Detects	1.054	SD of Logged Detects	0.584

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.277	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.374	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0707	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	3.746	KM Standard Error of Mean	0.502
KM SD	6.666	95% KM (BCA) UCL	4.647
95% KM (t) UCL	4.575	95% KM (Percentile Bootstrap) UCL	4.619
95% KM (z) UCL	4.571	95% KM Bootstrap t UCL	5.194
90% KM Chebyshev UCL	5.251	95% KM Chebyshev UCL	5.932
97.5% KM Chebyshev UCL	6.878	99% KM Chebyshev UCL	8.736

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	18.06	Anderson-Darling GOF Test	
5% A-D Critical Value	0.769	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.249	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0754	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)	1.714	k star (bias corrected MLE)	1.686
Theta hat (MLE)	2.303	Theta star (bias corrected MLE)	2.341
nu hat (MLE)	545	nu star (bias corrected)	536
Mean (detects)	3.947		

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	3.719
Maximum	54.8	Median	2.68
SD	6.729	CV	1.809
k hat (MLE)	1.065	k star (bias corrected MLE)	1.05
Theta hat (MLE)	3.493	Theta star (bias corrected MLE)	3.541
nu hat (MLE)	379	nu star (bias corrected)	373.9
Adjusted Level of Significance (β)	0.0487		
Approximate Chi Square Value (373.93, α)	330.1	Adjusted Chi Square Value (373.93, β)	329.8
95% Gamma Approximate UCL (use when n>=50)	4.213	95% Gamma Adjusted UCL (use when n<50)	4.217

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.746	SD (KM)	6.666
Variance (KM)	44.43	SE of Mean (KM)	0.502
k hat (KM)	0.316	k star (KM)	0.314
nu hat (KM)	112.4	nu star (KM)	111.9
theta hat (KM)	11.86	theta star (KM)	11.92
80% gamma percentile (KM)	5.807	90% gamma percentile (KM)	10.98
95% gamma percentile (KM)	16.88	99% gamma percentile (KM)	32.12

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (111.85, α)	88.44	Adjusted Chi Square Value (111.85, β)	88.27
95% Gamma Approximate KM-UCL (use when n>=50)	4.737	95% Gamma Adjusted KM-UCL (use when n<50)	4.747

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.799	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0707	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	3.753	Mean in Log Scale	1.004
SD in Original Scale	6.685	SD in Log Scale	0.602
95% t UCL (assumes normality of ROS data)	4.581	95% Percentile Bootstrap UCL	4.683
95% BCA Bootstrap UCL	4.9	95% Bootstrap t UCL	5.338
95% H-UCL (Log ROS)	3.561		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.002	KM Geo Mean	2.724
KM SD (logged)	0.599	95% Critical H Value (KM-Log)	1.869
KM Standard Error of Mean (logged)	0.0458	95% H-UCL (KM -Log)	3.547
KM SD (logged)	0.599	95% Critical H Value (KM-Log)	1.869
KM Standard Error of Mean (logged)	0.0458		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.761	Mean in Log Scale	0.99
SD in Original Scale	6.705	SD in Log Scale	0.645
95% t UCL (Assumes normality)	4.592	95% H-Stat UCL	3.633
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	5.932		

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 C: Risk Estimate Tables

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA INGESTION OF PRODUCTION WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)		
C_w = Chemical Concentration in Water (mg/L)	Table 1	
IR = Ingestion rate (L/day) =	1.2	2.5

	CTE	RME
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	20	20
BW = Body Weight (kg) =	80	80
AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	7300	7300

COC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-04	8.69E-04	3.57E-06	7.44E-06	1.25E-05	2.60E-05	-	5.00E-02	-	-	2.50E-04	5.21E-04
1,4-DIOXANE	1.88E-02	1.88E-02	7.73E-05	1.61E-04	2.70E-04	5.63E-04	1.00E-01	3.00E-02	7.73E-06	1.61E-05	9.01E-03	1.88E-02
NITROGEN, NITRATE (AS N)	4.98E+00	4.98E+00	2.05E-02	4.27E-02	7.17E-02	1.49E-01	-	1.60E+00	-	-	4.48E-02	9.33E-02
TETRACHLOROETHYLENE (PCE)	3.85E-03	3.85E-03	1.58E-05	3.29E-05	5.53E-05	1.15E-04	5.40E-01	6.00E-03	8.54E-06	1.78E-05	9.22E-03	1.92E-02
CIS-1,2-DICHLOROETHYLENE	4.44E-04	4.44E-04	1.82E-06	3.80E-06	6.39E-06	1.33E-05	-	2.00E-03	-	-	3.19E-03	6.65E-03
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	4.60E-02	5.00E-04	-	-	-	-
ALUMINUM	7.82E-02	7.82E-02	3.21E-04	6.70E-04	1.12E-03	2.34E-03	-	2.00E+02	-	-	5.62E-06	1.17E-05
IRON	1.86E-01	1.86E-01	7.65E-04	1.59E-03	2.68E-03	5.58E-03	-	7.00E-01	-	-	3.83E-03	7.97E-03
MANGANESE	2.90E-03	2.90E-03	1.19E-05	2.48E-05	4.17E-05	8.69E-05	-	1.40E-01	-	-	2.98E-04	6.21E-04
ARSENIC	1.15E-03	1.15E-03	4.71E-06	9.80E-06	1.65E-05	3.43E-05	9.50E+00	3.00E-04	4.47E-05	9.31E-05	5.49E-02	1.14E-01
CHROMIUM, HEXAVALENT (Cr+6)	Mutagen Evaluated Separetely		-	-	-	-	5.00E-01	3.00E-03	-	-	-	-
LEAD	2.97E-04	2.97E-04	1.22E-06	2.54E-06	4.27E-06	8.90E-06	8.50E-03	-	1.04E-08	2.16E-08	-	-
MOLYBDENUM	2.40E-02	2.40E-02	9.86E-05	2.05E-04	3.45E-04	7.19E-04	-	5.00E-03	-	-	6.90E-02	1.44E-01
BORON	3.13E-01	3.13E-01	1.29E-03	2.68E-03	4.50E-03	9.38E-03	-	2.00E-01	-	-	2.25E-02	4.69E-02
SELENIUM	1.24E-02	1.24E-02	5.08E-05	1.06E-04	1.78E-04	3.71E-04	-	5.00E-03	-	-	3.56E-02	7.41E-02
URANIUM, TOTAL	5.00E-03	5.00E-03	2.05E-05	4.28E-05	7.19E-05	1.50E-04	-	3.00E-03	-	-	2.40E-02	4.99E-02
VANADIUM	4.08E-03	4.08E-03	1.68E-05	3.49E-05	5.86E-05	1.22E-04	-	9.00E-03	-	-	6.52E-03	1.36E-02
TOTALS									6.10E-05	1.27E-04	2.83E-01	5.90E-01

Notes:
mg/L = milligrams per liter;
L/day = liters per day;
CTE = central tendency exposure
CDI = chronic daily intake
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA INGESTION OF PRODUCTION WELL GROUNDWATER - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{1.9E\text{-}02\ (mg/L) \times 1.2\ (L/day) \times 350\ (days/year) \times 20\ (years)}{80\ (kg) \times 25550\ (days)}$$

$$CDI = 7.7E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{3.8E\text{-}03\ (mg/L) \times 2.5\ (L/day) \times 350\ (days/year) \times 20\ (years)}{80\ (kg) \times 7300\ (days)}$$

$$CDI = 1.2E\text{-}04\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

$$CR = CDI \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$$CR = 7.7E\text{-}05\ (mg/kg\text{-}day) \times 1.0E\text{-}01\ (mg/kg\text{-}day)^{-1}$$

$$\boxed{CR = 7.7E\text{-}06}$$

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{1.2E\text{-}04\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

$$\boxed{HQ = 1.9E\text{-}02}$$

Appendix Table C-2 of 22

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA INHALATION OF VOLATILES IN PRODUCTION WELL GROUNDWATER

VOC Inhalation Equation: EC = (C_A x ET x EF x ED) / AT

	CTE	RME
ET = Exposure Time (hours/day) =	0.71	0.71
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	20	20
ATc = Averaging Time (70 years x 24 hours/day x 365 days/year) =	613,200	613,200
Atnc = Averaging Time (20 years x 24 hours/day x 365 days/year) =	175,200	175,200

COPC	Groundwater Concentration (µg/L)		Henry's Law Constant (H')	Concentration in Air (µg/m3)		Exposure Concentration (EC) Carcinogenic (µg/m3)		Exposure Concentration (EC) Non-Carcinogenic (µg/m3)		Inhalation Unit Risk	Inhalation RfC	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	(unitless)	CTE	RME	CTE	RME	CTE	RME	(µg/m3)-1	(ug/m3)	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-01	8.69E-01	1.07E+00	9.27E+02	9.27E+02	7.52E+00	7.52E+00	2.63E+01	2.63E+01	-	7.00E+01	-	-	3.76E-01	3.76E-01
1,4-DIOXANE	1.88E+01	1.88E+01	1.96E-04	3.69E+00	3.69E+00	2.99E-02	2.99E-02	1.05E-01	1.05E-01	7.70E-06	3.00E+01	2.30E-07	2.30E-07	3.49E-03	3.49E-03
NITROGEN, NITRATE (AS N)	4.98E+03	4.98E+03	-	-	-	-	-	-	-	-	-	-	-	-	-
TETRACHLOROETHYLENE (PCE)	3.85E+00	3.85E+00	7.24E-01	2.78E+03	2.78E+03	2.26E+01	2.26E+01	7.90E+01	7.90E+01	6.10E-06	3.50E+01	1.38E-04	1.38E-04	2.26E+00	2.26E+00
CIS-1,2-DICHLOROETHYLENE	4.44E-01	4.44E-01	1.67E-01	7.41E+01	7.41E+01	6.00E-01	6.00E-01	2.10E+00	2.10E+00	-	8.00E+00	-	-	2.63E-01	2.63E-01
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		4.03E-01	-	-	-	-	-	-	4.10E-06	2.00E+00	-	-	-	-
ALUMINUM	7.82E+01	7.82E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
IRON	1.86E+02	1.86E+02	-	-	-	-	-	-	-	-	-	-	-	-	-
MANGANESE	2.90E+00	2.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
ARSENIC	1.15E+00	1.15E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
CHROMIUM, HEXAVALENT (Cr+6)	Mutagen Evaluated Separetely		-	-	-	-	-	-	-	-	-	-	-	-	-
LEAD	2.97E-01	2.97E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLYBDENUM	2.40E+01	2.40E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
BORON	3.13E+02	3.13E+02	-	-	-	-	-	-	-	-	-	-	-	-	-
SELENIUM	1.24E+01	1.24E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
URANIUM, TOTAL	5.00E+00	5.00E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
VANADIUM	4.08E+00	4.08E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL												**1.38E-04**	**1.38E-04**	**2.90E+00**	**2.90E+00**

Notes:

µg/L = micrograms per Liter
µg/m^3 = micrograms per cubic meter
Henry's Law Constants taken from US EPA RSL Table
RfC = reference concentration
EC = Effects Concentration
CTE = central tendency exposure
C_a = Chemical Concentration in Air (µg/m^3)
H' = Henry's Law Constant (unitless)
RME= reasonable maximum exposure

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA INHALATION OF VOLATILES IN PRODUCTION WELL GROUNDWATER - Worked Equations

CDI Equation

EC = (CA x ET x EF x ED) / AT

EC = ((µg/m3) x (hours/day) x (days/year) x (years)) / (hours)

EC = (µg/m3 x ~~hours~~/~~day~~ x ~~days~~/~~years~~ x ~~years~~) / ~~hours~~

EC = µg / m3

1,4-Dioxane - Carcinogenic CTE EC

ECc = (3.69E+00 (ug/m3) x 0.71 (hours/day) x 350 (days/year) x 20 (years)) / 613,200 (hours)

ECc = 2.99E-02 µg / m3

Tetrachloroethylene - Noncarcinogenic RME EC

Ecnc = (2.78E+03 (ug/m3) x 0.71 (hours/day) x 350 (days/year) x 20 (years)) / 175,200 (hours)

Ecnc = 7.90E+01 µg / m3

Excess Cancer Risk Equation

CR = Ecc x IUR

CR = (µg/m3) x (µg/m3)-1

CR = ~~µg~~/~~m3~~ x ~~m3~~/~~µg~~

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 3.0E-02 (µg/m3) x 7.7E-06 (µg/m3)-1

CR = 2.3E-07

Hazard Quotient Equation

HQ = ECnc / RfC

HQ = ~~(µg/m3)~~ / ~~(µg/m3)~~ = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

HQ = 7.90E+01 (µg/m3) / 35 (µg/m3)

HQ = 2.3E+00

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $DA_{event} = t_{event} \times K_p \times C_w$

Organics in Water where $t_{event} \leq t^*$ $DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$

Organics in Water where $t_{event} > t^*$ $DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

	CTE	RME
tevent = Event Duration (hours/event) =	0.71	0.71
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	20	20
EV = Event frequency (events/day) =	1	1
SA = Skin surface area (cm2) =	19652	20900
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	7300	7300
BW = Body Weight (kg) =	80	80

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (mg/cm²-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-07	8.69E-07	1.4E-08	1.4E-08	9.7E-07	1.0E-06	3.4E-06	3.6E-06	-	5.0E-02	-	-	6.8E-05	7.2E-05
1,4-DIOXANE	1.88E-05	1.88E-05	8.3E-09	8.3E-09	5.6E-07	6.0E-07	2.0E-06	2.1E-06	1.0E-01	3.0E-02	5.6E-08	6.0E-08	6.5E-05	6.9E-05
NITROGEN, NITRATE (AS N)	4.98E-03	4.98E-03	5.9E-06	5.9E-06	3.9E-04	4.2E-04	1.4E-03	1.5E-03	-	1.6E+00	-	-	8.6E-04	9.2E-04
TETRACHLOROETHYLENE (PCE)	3.85E-06	3.85E-06	2.8E-07	2.8E-07	1.9E-05	2.0E-05	6.7E-05	7.1E-05	5.4E-01	6.0E-03	1.0E-05	1.1E-05	1.1E-02	1.2E-02
CIS-1,2-DICHLOROETHYLENE	4.44E-07	4.44E-07	6.9E-09	6.9E-09	4.6E-07	4.9E-07	1.6E-06	1.7E-06	-	2.0E-03	-	-	8.1E-04	8.6E-04
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
ALUMINUM	7.82E-05	7.82E-05	5.6E-08	5.6E-08	3.7E-06	4.0E-06	1.3E-05	1.4E-05	-	2.0E+02	-	-	6.5E-08	7.0E-08
IRON	1.86E-04	1.86E-04	1.3E-07	1.3E-07	8.9E-06	9.5E-06	3.1E-05	3.3E-05	-	7.0E-01	-	-	4.4E-05	4.7E-05
MANGANESE	2.90E-06	2.90E-06	2.1E-09	2.1E-09	1.4E-07	1.5E-07	4.9E-07	5.2E-07	-	5.6E-03	-	-	8.7E-05	9.2E-05
ARSENIC	1.15E-06	1.15E-06	8.1E-10	8.1E-10	5.5E-08	5.8E-08	1.9E-07	2.0E-07	9.5E+00	3.0E-04	5.2E-07	5.5E-07	6.4E-04	6.8E-04
CHROMIUM, HEXAVALENT (Cr+6)	Mutagen Evaluated Separetely		-	-	-	-	-	-	2.0E+01	7.5E-05	-	-	-	-
LEAD	2.97E-07	2.97E-07	2.1E-11	2.1E-11	1.4E-09	1.5E-09	5.0E-09	5.3E-09	8.5E-03	-	1.2E-11	1.3E-11	-	-
MOLYBDENUM	2.40E-05	2.40E-05	1.7E-08	1.7E-08	1.1E-06	1.2E-06	4.0E-06	4.3E-06	-	5.0E-03	-	-	8.0E-04	8.5E-04
BORON	3.13E-04	3.13E-04	2.2E-07	2.2E-07	1.5E-05	1.6E-05	5.2E-05	5.6E-05	-	2.0E-01	-	-	2.6E-04	2.8E-04
SELENIUM	1.24E-05	1.24E-05	8.8E-09	8.8E-09	5.9E-07	6.3E-07	2.1E-06	2.2E-06	-	5.0E-03	-	-	4.1E-04	4.4E-04
URANIUM, TOTAL	5.00E-06	5.00E-06	3.6E-09	3.6E-09	2.4E-07	2.5E-07	8.4E-07	8.9E-07	-	3.0E-03	-	-	2.8E-04	3.0E-04
VANADIUM	4.08E-06	4.08E-06	2.9E-09	2.9E-09	1.9E-07	2.1E-07	6.8E-07	7.3E-07	-	2.3E-04	-	-	2.9E-03	3.1E-03
TOTALS											**1.1E-05**	**1.2E-05**	**1.8E-02**	**2.0E-02**

Notes:
- mg/cm^3 = micrograms per cubic centimeter
- mg/kg-event = milligram per kilogram per event
- hr/event = hours per event
- RME= reasonable maximum exposure
- CTE = central tendency exposure
- hr = hours
- cm/hr centimeters per hour
- g/mol = grams per mol
- mg/kg-day = milligrams per kilogram per day

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Ţevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHYLENE (DCE)	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,4-DIOXANE	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
TETRACHLOROETHYLENE (PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
IRON	1.00E-03	1.00E+00	100.00%	2.87E-03	2.16E-01	5.19E-01
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
CHROMIUM, HEXAVALENT (Cr+6)	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
URANIUM, TOTAL	1.00E-03	1.00E+00	100.00%	5.93E-03	2.26E+00	5.43E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER - Worked Equations

Dermal Absorbed Dose

$$DAD = \frac{DAevent \times EF \times ED \times EV \times SA}{BW \times AT}$$

$$DAD = \frac{(mg/event\text{-}cm2) \times (days/year) \times (years) \times (events/day) \times (cm2)}{(kg) \times (days/year)}$$

$$DAD = \frac{\frac{mg}{\cancel{event\text{-}cm2}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years} \times \frac{\cancel{events}}{\cancel{day}} \times \cancel{cm2}}{kg \times \frac{days}{\cancel{year}}}$$

$$DAD = \frac{mg}{kg\text{-}day}$$

1,4-Dioxane - Carcinogenic CTE DAD

$$DADc = \frac{8.32E\text{-}09\ (mg/event\text{-}cm2) \times 350\ (days/year) \times 20\ (years) \times 1\ (events/day) \times 19652}{80\ (kg) \times 25550\ (days/year)}$$

$$DADc = 5.60E\text{-}07\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME DAD

$$DADnc = \frac{2.83E\text{-}07\ (mg/event\text{-}cm2) \times 350\ (days/year) \times 20\ (years) \times 1\ (events/day) \times 20900}{80\ (kg) \times 7300\ (days/year)}$$

$$DADnc = 7.08E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

$$CR = DAD \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$$CR = 5.6E\text{-}07\ (mg/kg\text{-}day) \times 1.0E\text{-}01\ (mg/kg\text{-}day)^{-1}$$

$$CR = 5.6E\text{-}08$$

Hazard Quotient Equation

$$HQ = \frac{DAD}{RfD}$$

$$HQ = \frac{(mg/kg\text{-}day)}{(mg/kg\text{-}day)} = HQ = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{7.08E\text{-}05\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

$$HQ = 1.2E\text{-}02$$

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA INGESTION OF PRODUCTION WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)		
C_w = Chemical Concentration in Water (mg/L)	Table 1	
IR = Ingestion rate (L/day) =	0.38	0.78

	CTE	RME
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	6	6
BW = Body Weight (kg) =	15	15
AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	2190	2190

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-04	8.69E-04	1.8E-06	3.7E-06	2.1E-05	4.3E-05	-	5.0E-02	-	-	4.2E-04	8.7E-04
1,4-DIOXANE	1.88E-02	1.88E-02	3.9E-05	8.0E-05	4.6E-04	9.4E-04	1.0E-01	3.0E-02	3.9E-06	8.0E-06	1.5E-02	3.1E-02
NITROGEN, NITRATE (AS N)	4.98E+00	4.98E+00	1.0E-02	2.1E-02	1.2E-01	2.5E-01	-	1.6E+00	-	-	7.6E-02	1.6E-01
TETRACHLOROETHYLENE (PCE)	3.85E-03	3.85E-03	8.0E-06	1.6E-05	9.3E-05	1.9E-04	5.4E-01	6.0E-03	4.3E-06	8.9E-06	1.6E-02	3.2E-02
CIS-1,2-DICHLOROETHYLENE	4.44E-04	4.44E-04	9.2E-07	1.9E-06	1.1E-05	2.2E-05	-	2.0E-03	-	-	5.4E-03	1.1E-02
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
ALUMINUM	7.82E-02	7.82E-02	1.6E-04	3.3E-04	1.9E-03	3.9E-03	-	2.0E+02	-	-	9.5E-06	1.9E-05
IRON	1.86E-01	1.86E-01	3.9E-04	8.0E-04	4.5E-03	9.3E-03	-	7.0E-01	-	-	6.5E-03	1.3E-02
MANGANESE	2.90E-03	2.90E-03	6.0E-06	1.2E-05	7.0E-05	1.4E-04	-	3.0E-02	-	-	2.3E-03	4.8E-03
ARSENIC	1.15E-03	1.15E-03	2.4E-06	4.9E-06	2.8E-05	5.7E-05	9.5E+00	3.0E-04	2.3E-05	4.6E-05	9.3E-02	1.9E-01
CHROMIUM, HEXAVALENT (Cr+6)	Mutagen Evaluated Separetely		-	-	-	-	5.0E-01	3.0E-03	-	-	-	-
LEAD	2.97E-04	2.97E-04	6.2E-07	1.3E-06	7.2E-06	1.5E-05	8.5E-03	-	5.3E-09	1.1E-08	-	-
MOLYBDENUM	2.40E-02	2.40E-02	5.0E-05	1.0E-04	5.8E-04	1.2E-03	-	5.0E-03	-	-	1.2E-01	2.4E-01
BORON	3.13E-01	3.13E-01	6.5E-04	1.3E-03	7.6E-03	1.6E-02	-	2.0E-01	-	-	3.8E-02	7.8E-02
SELENIUM	1.24E-02	1.24E-02	2.6E-05	5.3E-05	3.0E-04	6.2E-04	-	5.0E-03	-	-	6.0E-02	1.2E-01
URANIUM, TOTAL	5.00E-03	5.00E-03	1.0E-05	2.1E-05	1.2E-04	2.5E-04	-	3.0E-03	-	-	4.0E-02	8.3E-02
VANADIUM	4.08E-03	4.08E-03	8.5E-06	1.7E-05	9.9E-05	2.0E-04	-	9.0E-03	-	-	1.1E-02	2.3E-02
TOTALS									3.1E-05	6.3E-05	4.8E-01	9.9E-01

Notes:

mg/L = milligrams per liter;
L/day = liters per day;
RME= reasonable maximum exposure
CTE = central tendency exposure
CDI = chronic daily intake
mg/kg-day = milligrams per kilogram per day

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA INGESTION OF PRODUCTION WELL GROUNDWATER - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{1.9E\text{-}02\ (mg/L) \times 0.4\ (L/day) \times 350\ (days/year) \times 6\ (years)}{15\ (kg) \times 25550\ (days)}$$

$$CDI = 3.9E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{3.8E\text{-}03\ (mg/L) \times 0.8\ (L/day) \times 350\ (days/year) \times 6\ (years)}{15\ (kg) \times 2190\ (days)}$$

$$CDI = 1.9E\text{-}04\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

$$CR = CDI \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$$CR = 3.9E\text{-}05\ (mg/kg\text{-}day) \times 1.0E\text{-}01\ (mg/kg\text{-}day)^{-1}$$

$$\boxed{CR = 3.9E\text{-}06}$$

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{1.9E\text{-}04\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

$$\boxed{HQ = 3.2E\text{-}02}$$

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA INHLATION OF VOLATILES IN PRODUCTION WELL GROUNDWATER

VOC Inhalation Equation: EC = (C_A x ET x EF x ED) / AT

	CTE	RME
ET = Exposure Time (hours/day) =	0.54	0.54
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	6	6
ATc = Averaging Time (70 years x 24 hours/day x 365 days/year) =	613,200	613,200
Atnc = Averaging Time (6 years x 24 hours/day x 365 days/year) =	52,560	52,560

COPC	Groundwater Concentration (µg/l)		Henry's Law Constant (H')	Concentration in Air (µg/m3)		Exposure Concentration (EC) Carcinogenic (µg/m3)		Exposure Concentration (EC) Non-Carcinogenic (µg/m3)		Inhalation Unit Risk	Inhalation RfC	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	(unitless)	CTE	RME	CTE	RME	CTE	RME	(µg/m3)-1	(µg/m3)	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-01	8.69E-01	1.07E+00	9.3E+02	9.3E+02	1.7E+00	1.7E+00	2.0E+01	2.0E+01	-	7.0E+01	-	-	2.9E-01	2.9E-01
1,4-DIOXANE	1.88E+01	1.88E+01	1.96E-04	3.7E+00	3.7E+00	6.8E-03	6.8E-03	8.0E-02	8.0E-02	7.7E-06	3.0E+01	5.3E-08	5.3E-08	2.7E-03	2.7E-03
NITROGEN, NITRATE (AS N)	4.98E+03	4.98E+03	-	-	-	-	-	-	-	-	-	-	-	-	-
TETRACHLOROETHYLENE (PCE)	3.85E+00	3.85E+00	7.24E-01	2.8E+03	2.8E+03	5.1E+00	5.1E+00	6.0E+01	6.0E+01	6.1E-06	3.5E+01	3.1E-05	3.1E-05	1.7E+00	1.7E+00
CIS-1,2-DICHLOROETHYLENE	4.44E-01	4.44E-01	1.67E-01	7.4E+01	7.4E+01	1.4E-01	1.4E-01	1.6E+00	1.6E+00	-	8.0E+00	-	-	2.0E-01	2.0E-01
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		4.03E-01	-	-	-	-	-	-	4.1E-06	2.0E+00	-	-	-	-
ALUMINUM	7.82E+01	7.82E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
IRON	1.86E+02	1.86E+02	-	-	-	-	-	-	-	-	-	-	-	-	-
MANGANESE	2.90E+00	2.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
ARSENIC	1.15E+00	1.15E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
CHROMIUM, HEXAVALENT (Cr+6)	Mutagen Evaluated Separetely		-	-	-	-	-	-	-	-	-	-	-	-	-
LEAD	2.97E-01	2.97E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLYBDENUM	2.40E+01	2.40E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
BORON	3.13E+02	3.13E+02	-	-	-	-	-	-	-	-	-	-	-	-	-
SELENIUM	1.24E+01	1.24E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
URANIUM, TOTAL	5.00E+00	5.00E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
VANADIUM	4.08E+00	4.08E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL												**3.1E-05**	**3.1E-05**	**2.2E+00**	**2.2E+00**

Notes:

µg/L = micrograms per Liter
µg/m^3 = micrograms per cubic meter
Henry's Law Constants taken from US EPA RSL Table
RfC = reference concentration
EC = Effects Concentration
H' = Henry's Law Constant (unitless)
CTE = central tendency exposure
RME= reasonable maximum exposure
C_a = Chemical Concentration in Air (µg/m^3)

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA INHLATION OF VOLATILES IN PRODUCTION WELL GROUNDWATER- Worked Equations

CDI Equation

$$EC = \frac{CA \times ET \times EF \times ED}{AT}$$

$$EC = \frac{(\mu g/m3) \times (hours/day) \times (days/year) \times (years)}{(hours)}$$

$$EC = \frac{\frac{\mu g}{m3} \times \frac{\cancel{hours}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{years}} \times \cancel{years}}{\cancel{hours}}$$

$$EC = \frac{\mu g}{m3}$$

1,4-Dioxane - Carcinogenic CTE EC

$$ECc = \frac{3.69E+00\ (ug/m3) \times 0.54\ (hours/day) \times 350\ (days/year) \times 6\ (years)}{613{,}200\ (hours)}$$

$$ECc = 6.82E-03\ \frac{\mu g}{m3}$$

Tetrachloroethylene - Noncarcinogenic RME EC

$$Ecnc = \frac{2.78E+03\ (ug/m3) \times 0.54\ (hours/day) \times 350\ (days/year) \times 6\ (years)}{52{,}560\ (hours)}$$

$$Ecnc = 6.01E+01\ \frac{\mu g}{m3}$$

Excess Cancer Risk Equation

$$CR = Ecc \times IUR$$

$$CR = (\mu g/m3) \times (\mu g/m3)\text{-}1$$

$$CR = \frac{\cancel{\mu g}}{\cancel{m3}} \times \frac{\cancel{m3}}{\cancel{\mu g}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$$CR = 6.8E-03\ (\mu g/m3) \times 7.7E-06\ (\mu g/m3)\text{-}1$$

CR = 5.3E-08

Hazard Quotient Equation

$$HQ = \frac{ECnc}{RfC}$$

$$HQ = \frac{\cancel{(\mu g/m3)}}{\cancel{(\mu g/m3)}} = HQ = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{6.01E+01\ (\mu g/m3)}{35\ (\mu g/m3)}$$

HQ = 1.7E+00

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $DA_{event} = t_{event} \times K_p \times C_w$

Organics in Water where $t_{event} \le t^*$ $DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6T_{event} \times t_{event}}{\pi}}$

Organics in Water where $t_{event} > t^*$ $DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2T_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

	CTE	RME
tevent = Event Duration (hours/event) =	0.54	0.54
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	6	6
EV = Event frequency (events/day) =	1	1
SA = Skin surface area (cm2) =	6365	6378
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	2190	2190
BW = Body Weight (kg) =	15	15

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (DAevent) (mg/cm^2-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-07	8.69E-07	1.3E-08	1.3E-08	4.4E-07	4.4E-07	5.1E-06	5.1E-06	-	5.0E-02	-	-	1.0E-04	1.0E-04
1,4-DIOXANE	1.88E-05	1.88E-05	7.3E-09	7.3E-09	2.5E-07	2.5E-07	3.0E-06	3.0E-06	1.0E-01	3.0E-02	2.5E-08	2.5E-08	9.8E-05	9.9E-05
NITROGEN, NITRATE (AS N)	4.98E-03	4.98E-03	4.9E-06	4.9E-06	1.7E-04	1.7E-04	2.0E-03	2.0E-03	-	1.6E+00	-	-	1.2E-03	1.2E-03
TETRACHLOROETHYLENE (PCE)	3.85E-06	3.85E-06	2.5E-07	2.5E-07	8.6E-06	8.6E-06	1.0E-04	1.0E-04	5.4E-01	6.0E-03	4.6E-06	4.7E-06	1.7E-02	1.7E-02
CIS-1,2-DICHLOROETHYLENE	4.44E-07	4.44E-07	6.0E-09	6.0E-09	2.1E-07	2.1E-07	2.4E-06	2.5E-06	-	2.0E-03	-	-	1.2E-03	1.2E-03
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
ALUMINUM	7.82E-05	7.82E-05	4.2E-08	4.2E-08	1.5E-06	1.5E-06	1.7E-05	1.7E-05	-	2.0E+02	-	-	8.6E-08	8.6E-08
IRON	1.86E-04	1.86E-04	1.0E-07	1.0E-07	3.5E-06	3.5E-06	4.1E-05	4.1E-05	-	7.0E-01	-	-	5.8E-05	5.9E-05
MANGANESE	2.90E-06	2.90E-06	1.6E-09	1.6E-09	5.5E-08	5.5E-08	6.4E-07	6.4E-07	-	1.2E-03	-	-	-	-
ARSENIC	1.15E-06	1.15E-06	6.2E-10	6.2E-10	2.2E-08	2.2E-08	2.5E-07	2.5E-07	9.5E+00	3.0E-04	2.0E-07	2.1E-07	8.4E-04	8.4E-04
CHROMIUM, HEXAVALENT (Cr+6)	Mutagen Evaluated Separetely		-	-	-	-	-	-	2.0E+01	7.5E-05	-	-	-	-
LEAD	2.97E-07	2.97E-07	1.6E-11	1.6E-11	5.6E-10	5.6E-10	6.5E-09	6.5E-09	8.5E-03	-	4.8E-12	4.8E-12	-	-
MOLYBDENUM	2.40E-05	2.40E-05	1.3E-08	1.3E-08	4.5E-07	4.5E-07	5.3E-06	5.3E-06	-	5.0E-03	-	-	1.1E-03	1.1E-03
BORON	3.13E-04	3.13E-04	1.7E-07	1.7E-07	5.9E-06	5.9E-06	6.9E-05	6.9E-05	-	2.0E-01	-	-	3.4E-04	3.4E-04
SELENIUM	1.24E-05	1.24E-05	6.7E-09	6.7E-09	2.3E-07	2.3E-07	2.7E-06	2.7E-06	-	5.0E-03	-	-	5.4E-04	5.4E-04
URANIUM, TOTAL	5.00E-06	5.00E-06	2.7E-09	2.7E-09	9.4E-08	9.4E-08	1.1E-06	1.1E-06	-	3.0E-03	-	-	3.7E-04	3.7E-04
VANADIUM	4.08E-06	4.08E-06	2.2E-09	2.2E-09	7.7E-08	7.7E-08	9.0E-07	9.0E-07	-	2.3E-04	-	-	3.8E-03	3.8E-03
TOTALS											**4.9E-06**	**4.9E-06**	**2.6E-02**	**2.6E-02**

Notes:
mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure
CTE = central tendency exposure
hr = hours
cm/hr centimeters per hour
g/mol = grams per mol
hr/event = hours per event

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Tevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHYLENE (DCE)	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,4-DIOXANE	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
TETRACHLOROETHYLENE (PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
IRON	1.00E-03	1.00E+00	100.00%	2.87E-03	2.16E-01	5.19E-01
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
CHROMIUM, HEXAVALENT (Cr+6)	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
URANIUM, TOTAL	1.00E-03	1.00E+00	100.00%	5.93E-03	2.26E+00	5.43E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER- Worked Equations

Dermal Absorbed Dose

$$DAD = \frac{DAevent \times EF \times ED \times EV \times SA}{BW \times AT}$$

$$DAD = \frac{(mg/event\text{-}cm2) \times (days/year) \times (years) \times (events/day) \times (cm2)}{(kg) \times (days/year)}$$

$$DAD = \frac{\frac{mg}{\cancel{event\text{-}cm2}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years} \times \frac{\cancel{events}}{\cancel{day}} \times \cancel{cm2}}{kg \times \frac{days}{\cancel{year}}}$$

$$DAD = \frac{mg}{kg\text{-}day}$$

1,4-Dioxane - Carcinogenic CTE DAD

$$DADc = \frac{7.26E\text{-}09\ (mg/event\text{-}cm2) \times 350\ (days/year) \times 6\ (years) \times 1\ (events/day) \times 6365}{15\ (kg) \times 25550\ (days/year)}$$

$$DADc = 2.53E\text{-}07\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME DAD

$$DADnc = \frac{2.47E\text{-}07\ (mg/event\text{-}cm2) \times 350\ (days/year) \times 6\ (years) \times 1\ (events/day) \times 6378}{15\ (kg) \times 2190\ (days/year)}$$

$$DADnc = 1.01E\text{-}04\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

CR = DAD x SFo

CR = (mg/kg-day) x $(mg/kg\text{-}day)^{-1}$

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 2.5E-07 (mg/kg-day) x 1.0E-01 $(mg/kg\text{-}day)^{-1}$

CR = 2.5E-08

Hazard Quotient Equation

$$HQ = \frac{DAD}{RfD}$$

$$HQ = \frac{(mg/kg\text{-}day)}{(mg/kg\text{-}day)} = HQ = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{1.01E\text{-}04\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

HQ = 1.7E-02

POTENTIAL HEALTH RISKS TO COMMERCIAL WORKERS VIA INGESTION OF PRODUCTION WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)		
C_w = Chemical Concentration in Water (mg/L)	Table 1	
IR = Ingestion rate (L/day) =	2.00	2.00

	CTE	RME
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	25	25
BW = Body Weight (kg) =	80	80
AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	9125	9125

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-04	8.69E-04	5.3E-06	5.3E-06	1.5E-05	1.5E-05	-	5.0E-02	-	-	3.0E-04	3.0E-04
1,4-DIOXANE	1.88E-02	1.88E-02	1.1E-04	1.1E-04	3.2E-04	3.2E-04	1.0E-01	3.0E-02	1.1E-05	1.1E-05	1.1E-02	1.1E-02
NITROGEN, NITRATE (AS N)	4.98E+00	4.98E+00	3.0E-02	3.0E-02	8.5E-02	8.5E-02	-	1.6E+00	-	-	5.3E-02	5.3E-02
TETRACHLOROETHYLENE (PCE)	3.85E-03	3.85E-03	2.4E-05	2.4E-05	6.6E-05	6.6E-05	5.4E-01	6.0E-03	1.3E-05	1.3E-05	1.1E-02	1.1E-02
CIS-1,2-DICHLOROETHYLENE	4.44E-04	4.44E-04	2.7E-06	2.7E-06	7.6E-06	7.6E-06	-	2.0E-03	-	-	3.8E-03	3.8E-03
TRICHLOROETHYLENE (TCE)	6.65E-03	6.65E-03	4.1E-05	4.1E-05	1.1E-04	1.1E-04	4.6E-02	5.0E-04	1.9E-06	1.9E-06	2.3E-01	2.3E-01
ALUMINUM	7.82E-02	7.82E-02	4.8E-04	4.8E-04	1.3E-03	1.3E-03	-	2.0E+02	-	-	6.7E-06	6.7E-06
IRON	1.86E-01	1.86E-01	1.1E-03	1.1E-03	3.2E-03	3.2E-03	-	7.0E-01	-	-	4.6E-03	4.6E-03
MANGANESE	2.90E-03	2.90E-03	1.8E-05	1.8E-05	5.0E-05	5.0E-05	-	1.4E-01	-	-	3.5E-04	3.5E-04
ARSENIC	1.15E-03	1.15E-03	7.0E-06	7.0E-06	2.0E-05	2.0E-05	9.5E+00	3.0E-04	6.7E-05	6.7E-05	6.5E-02	6.5E-02
CHROMIUM, HEXAVALENT (Cr+6)	1.97E-03	1.97E-03	1.2E-05	1.2E-05	3.4E-05	3.4E-05	5.0E-01	3.0E-03	6.0E-06	6.0E-06	1.1E-02	1.1E-02
LEAD	2.97E-04	2.97E-04	1.8E-06	1.8E-06	5.1E-06	5.1E-06	8.5E-03	-	1.5E-08	1.5E-08	-	-
MOLYBDENUM	2.40E-02	2.40E-02	1.5E-04	1.5E-04	4.1E-04	4.1E-04	-	5.0E-03	-	-	8.2E-02	8.2E-02
BORON	3.13E-01	3.13E-01	1.9E-03	1.9E-03	5.4E-03	5.4E-03	-	2.0E-01	-	-	2.7E-02	2.7E-02
SELENIUM	1.24E-02	1.24E-02	7.6E-05	7.6E-05	2.1E-04	2.1E-04	-	5.0E-03	-	-	4.2E-02	4.2E-02
URANIUM, TOTAL	5.00E-03	5.00E-03	3.1E-05	3.1E-05	8.6E-05	8.6E-05	-	3.0E-03	-	-	2.9E-02	2.9E-02
VANADIUM	4.08E-03	4.08E-03	2.5E-05	2.5E-05	7.0E-05	7.0E-05	-	9.0E-03	-	-	7.8E-03	7.8E-03
TOTALS									9.9E-05	9.9E-05	5.8E-01	5.8E-01

Notes:

mg/L = milligrams per liter;
L/day = liters per day;
mg/kg-day = milligrams per kilogram per day

CDI = chronic daily intake
RME= reasonable maximum exposure
CTE = central tendency exposure

POTENTIAL HEALTH RISKS TO COMMERCIAL WORKERS VIA INGESTION OF PRODUCTION WELL GROUNDWATER - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{1.9E\text{-}02\ (mg/L) \times 2.0\ (L/day) \times 250\ (days/year) \times 25\ (years)}{80\ (kg) \times 25550\ (days)}$$

$$CDI = 1.1E\text{-}04\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{3.8E\text{-}03\ (mg/L) \times 2.0\ (L/day) \times 250\ (days/year) \times 25\ (years)}{80\ (kg) \times 9125\ (days)}$$

$$CDI = 6.6E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

CR = CDI x SFo

CR = (mg/kg-day) x $(mg/kg\text{-}day)^{-1}$

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 1.1E-04 (mg/kg-day) x 1.0E-01 $(mg/kg\text{-}day)^{-1}$

$\boxed{CR = 1.1E\text{-}05}$

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{6.6E\text{-}05\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

$\boxed{HQ = 1.1E\text{-}02}$

POTENTIAL HEALTH RISKS TO COMMERCIAL WORKERS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $$DA_{event} = t_{event} \times K_p \times C_w$$

Organics in Water where $t_{event} \le t^*$ $$DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$$

Organics in Water where $t_{event} > t^*$ $$DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

	CTE	RME
tevent = Event Duration (hours/event) =	0.0083	0.0083
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	25	25
EV = Event frequency (events/day) =	10	10
SA = Skin surface area (cm2) =	980	1185
BW = Body Weight (kg) =	80	80
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	9125	9125

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (mg/cm^2-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	(mg/kg-day)$^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-07	8.69E-07	1.6E-09	1.6E-09	4.6E-08	5.6E-08	1.3E-07	1.6E-07	-	5.0E-02	-	-	2.6E-06	3.1E-06
1,4-DIOXANE	1.88E-05	1.88E-05	9.0E-10	9.0E-10	2.7E-08	3.3E-08	7.5E-08	9.1E-08	1.0E-01	3.0E-02	2.7E-09	3.3E-09	2.5E-06	3.0E-06
NITROGEN, NITRATE (AS N)	4.98E-03	4.98E-03	6.1E-07	6.1E-07	1.8E-05	2.2E-05	5.1E-05	6.2E-05	-	1.6E+00	-	-	3.2E-05	3.8E-05
TETRACHLOROETHYLENE (PCE)	3.85E-06	3.85E-06	3.1E-08	3.1E-08	9.2E-07	1.1E-06	2.6E-06	3.1E-06	5.4E-01	6.0E-03	4.9E-07	6.0E-07	4.3E-04	5.2E-04
CIS-1,2-DICHLOROETHYLENE	4.44E-07	4.44E-07	7.5E-10	7.5E-10	2.2E-08	2.7E-08	6.3E-08	7.6E-08	-	2.0E-03	-	-	3.1E-05	3.8E-05
TRICHLOROETHYLENE (TCE)	6.65E-06	6.65E-06	1.5E-08	1.5E-08	4.4E-07	5.3E-07	1.2E-06	1.5E-06	4.6E-02	5.0E-04	2.0E-08	2.5E-08	2.5E-03	3.0E-03
ALUMINUM	7.82E-05	7.82E-05	6.5E-10	6.5E-10	1.9E-08	2.4E-08	5.4E-08	6.6E-08	-	2.0E+02	-	-	2.7E-10	3.3E-10
IRON	1.86E-04	1.86E-04	1.5E-09	1.5E-09	4.6E-08	5.6E-08	1.3E-07	1.6E-07	-	7.0E-01	-	-	1.9E-07	2.2E-07
MANGANESE	2.90E-06	2.90E-06	2.4E-11	2.4E-11	7.2E-10	8.7E-10	2.0E-09	2.4E-09	-	5.6E-03	-	-	3.6E-07	4.4E-07
ARSENIC	1.15E-06	1.15E-06	9.5E-12	9.5E-12	2.8E-10	3.4E-10	8.0E-10	9.6E-10	9.5E+00	3.0E-04	2.7E-09	3.3E-09	2.7E-06	3.2E-06
CHROMIUM, HEXAVALENT (Cr+6)	1.97E-06	1.97E-06	3.3E-11	3.3E-11	9.8E-10	1.2E-09	2.7E-09	3.3E-09	2.0E+01	7.5E-05	2.0E-08	2.4E-08	3.7E-05	4.4E-05
LEAD	2.97E-07	2.97E-07	2.5E-13	2.5E-13	7.4E-12	8.9E-12	2.1E-11	2.5E-11	8.5E-03	-	6.3E-14	7.6E-14	-	-
MOLYBDENUM	2.40E-05	2.40E-05	2.0E-10	2.0E-10	6.0E-09	7.2E-09	1.7E-08	2.0E-08	-	5.0E-03	-	-	3.3E-06	4.0E-06
BORON	3.13E-04	3.13E-04	2.6E-09	2.6E-09	7.8E-08	9.4E-08	2.2E-07	2.6E-07	-	2.0E-01	-	-	1.1E-06	1.3E-06
SELENIUM	1.24E-05	1.24E-05	1.0E-10	1.0E-10	3.1E-09	3.7E-09	8.6E-09	1.0E-08	-	5.0E-03	-	-	1.7E-06	2.1E-06
URANIUM, TOTAL	5.00E-06	5.00E-06	4.2E-11	4.2E-11	1.2E-09	1.5E-09	3.5E-09	4.2E-09	-	3.0E-03	-	-	1.2E-06	1.4E-06
VANADIUM	4.08E-06	4.08E-06	3.4E-11	3.4E-11	1.0E-09	1.2E-09	2.8E-09	3.4E-09	-	2.3E-04	-	-	1.2E-05	1.5E-05
TOTALS											**5.4E-07**	**6.5E-07**	**3.0E-03**	**3.7E-03**

Notes:
mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure
CTE = central tendency exposure
hr = hours
cm/hr centimeters per hour
g/mol = grams per mol
hr/event = hours per event

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Ţevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHYLENE (DCE)	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,4-DIOXANE	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
TETRACHLOROETHYLENE (PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
IRON	1.00E-03	1.00E+00	100.00%	2.87E-03	2.16E-01	5.19E-01
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
CHROMIUM, HEXAVALENT (Cr+6)	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
URANIUM, TOTAL	1.00E-03	1.00E+00	100.00%	5.93E-03	2.26E+00	5.43E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

POTENTIAL HEALTH RISKS TO COMMERCIAL WORKERS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER - Worked Equations

Dermal Absorbed Dose

$$DAD = \frac{DAevent \times EF \times ED \times EV \times SA}{BW \times AT}$$

$$DAD = \frac{(mg/event\text{-}cm2) \times (days/year) \times (years) \times (events/day) \times (cm2)}{(kg) \times (days/year)}$$

$$DAD = \frac{\dfrac{mg}{\cancel{event\text{-}cm2}} \times \dfrac{\cancel{days}}{\cancel{year}} \times \cancel{years} \times \dfrac{\cancel{events}}{\cancel{day}} \times \cancel{cm2}}{kg \times \dfrac{days}{\cancel{year}}}$$

$$DAD = \frac{mg}{kg\text{-}day}$$

1,4-Dioxane - Carcinogenic CTE DAD

$$DADc = \frac{8.99E\text{-}10\ (mg/event\text{-}cm2) \times 250\ (days/year) \times 25\ (years) \times 10\ (events/day) \times 980}{80\ (kg) \times 25550\ (days/year)}$$

$$DADc = 2.70E\text{-}08\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME DAD

$$DADnc = \frac{3.06E\text{-}08\ (mg/event\text{-}cm2) \times 250\ (days/year) \times 25\ (years) \times 10\ (events/day) \times 1185}{80\ (kg) \times 9125\ (days/year)}$$

$$DADnc = 3.10E\text{-}06\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

CR = DAD x SFo

CR = (mg/kg-day) x (mg/kg-day)$^{-1}$

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 2.7E-08 (mg/kg-day) x 1.0E-01 (mg/kg-day)$^{-1}$

CR = 2.7E-09

Hazard Quotient Equation

$$HQ = \frac{DAD}{RfD}$$

$$HQ = \frac{(mg/kg\text{-}day)}{(mg/kg\text{-}day)} = HQ = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{3.10E\text{-}06\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

HQ = 5.2E-04

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA INGESTION OF PRODUCTION WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)		
C_w = Chemical Concentration in Water (mg/L)	Table 1	
IR = Ingestion rate (L/day) =	0.002	0.002

	CTE	RME
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	1	1
BW = Body Weight (kg) =	80	80
AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	365	365

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-04	8.69E-04	2.1E-10	2.1E-10	1.5E-08	1.5E-08	-	5.0E-02	-	-	3.0E-07	3.0E-07
1,4-DIOXANE	1.88E-02	1.88E-02	4.6E-09	4.6E-09	3.2E-07	3.2E-07	1.0E-01	3.0E-02	4.6E-10	4.6E-10	1.1E-05	1.1E-05
NITROGEN, NITRATE (AS N)	4.98E+00	4.98E+00	1.2E-06	1.2E-06	8.5E-05	8.5E-05	-	1.6E+00	-	-	5.3E-05	5.3E-05
TETRACHLOROETHYLENE (PCE)	3.85E-03	3.85E-03	9.4E-10	9.4E-10	6.6E-08	6.6E-08	5.4E-01	6.0E-03	5.1E-10	5.1E-10	1.1E-05	1.1E-05
CIS-1,2-DICHLOROETHYLENE	4.44E-04	4.44E-04	1.1E-10	1.1E-10	7.6E-09	7.6E-09	-	2.0E-03	-	-	3.8E-06	3.8E-06
TRICHLOROETHYLENE (TCE)	6.65E-03	6.65E-03	1.6E-09	1.6E-09	1.1E-07	1.1E-07	4.6E-02	5.0E-04	7.5E-11	7.5E-11	2.3E-04	2.3E-04
ALUMINUM	7.82E-02	7.82E-02	1.9E-08	1.9E-08	1.3E-06	1.3E-06	-	2.0E+02	-	-	6.7E-09	6.7E-09
IRON	1.86E-01	1.86E-01	4.6E-08	4.6E-08	3.2E-06	3.2E-06	-	7.0E-01	-	-	4.6E-06	4.6E-06
MANGANESE	2.90E-03	2.90E-03	7.1E-10	7.1E-10	5.0E-08	5.0E-08	-	1.4E-01	-	-	3.5E-07	3.5E-07
ARSENIC	1.15E-03	1.15E-03	2.8E-10	2.8E-10	2.0E-08	2.0E-08	9.5E+00	3.0E-04	2.7E-09	2.7E-09	6.5E-05	6.5E-05
CHROMIUM, HEXAVALENT (Cr+6)	1.97E-03	1.97E-03	4.8E-10	4.8E-10	3.4E-08	3.4E-08	5.0E-01	3.0E-03	2.4E-10	2.4E-10	1.1E-05	1.1E-05
LEAD	2.97E-04	2.97E-04	7.3E-11	7.3E-11	5.1E-09	5.1E-09	8.5E-03	-	6.2E-13	6.2E-13	-	-
MOLYBDENUM	2.40E-02	2.40E-02	5.9E-09	5.9E-09	4.1E-07	4.1E-07	-	5.0E-03	-	-	8.2E-05	8.2E-05
BORON	3.13E-01	3.13E-01	7.7E-08	7.7E-08	5.4E-06	5.4E-06	-	2.0E-01	-	-	2.7E-05	2.7E-05
SELENIUM	1.24E-02	1.24E-02	3.0E-09	3.0E-09	2.1E-07	2.1E-07	-	5.0E-03	-	-	4.2E-05	4.2E-05
URANIUM, TOTAL	5.00E-03	5.00E-03	1.2E-09	1.2E-09	8.6E-08	8.6E-08	-	3.0E-03	-	-	2.9E-05	2.9E-05
VANADIUM	4.08E-03	4.08E-03	1.0E-09	1.0E-09	7.0E-08	7.0E-08	-	9.0E-03	-	-	7.8E-06	7.8E-06
TOTALS									3.9E-09	3.9E-09	5.8E-04	5.8E-04

Notes:

mg/L = milligrams per liter;
L/day = liters per day;
CDI = chronic daily intake
CTE = central tendency exposure
mg/kg-day = milligrams per kilogram per
RME= reasonable maximum exposure

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA INGESTION OF PRODUCTION WELL GROUNDWATER - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{1.9E\text{-}02\ (mg/L) \times 0.002\ (L/day) \times 250\ (days/year) \times 1\ (years)}{80\ (kg) \times 25550\ (days)}$$

$$CDI = 4.6E\text{-}09\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{3.8E\text{-}03\ (mg/L) \times 0.002\ (L/day) \times 250\ (days/year) \times 1\ (years)}{80\ (kg) \times 365\ (days)}$$

$$CDI = 6.6E\text{-}08\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

CR = CDI x SFo

CR = (mg/kg-day) x $(mg/kg\text{-}day)^{-1}$

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 4.6E-09 (mg/kg-day) x 1.0E-01 $(mg/kg\text{-}day)^{-1}$

$\boxed{CR = 4.6E\text{-}10}$

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{6.6E\text{-}08\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

$\boxed{HQ = 1.1E\text{-}05}$

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA INHLATION OF VOLATILES IN PRODUCTION WELL GROUNDWATER

VOC Inhalation Equation: EC = (C_A x ET x EF x ED) / AT

	CTE	RME
ET = Exposure Time (hours/day) =	2.00	2.00
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	1	1
ATc = Averaging Time (70 years x 24 hours/day x 365 days/year) =	613,200	613,200
Atnc = Averaging Time (1 years x 24 hours/day x 365 days/year) =	8,760	8,760

COPC	Groundwater Concentration (µg/l)		Henry's Law Constant (H')	Concentration in Air (µg/m3)		Exposure Concentration (EC) Carcinogenic (µg/m3)		Exposure Concentration (EC) Non-Carcinogenic (µg/m3)		Inhalation Unit Risk	Inhalation RfC	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	(unitless)	CTE	RME	CTE	RME	CTE	RME	(µg/m3)-1	(µg/m3)	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-01	8.69E-01	1.07E+00	9.3E+02	9.3E+02	7.6E-01	7.6E-01	5.3E+01	5.3E+01	-	7.0E+01	-	-	7.6E-01	7.6E-01
1,4-DIOXANE	1.88E+01	1.88E+01	1.96E-04	3.7E+00	3.7E+00	3.0E-03	3.0E-03	2.1E-01	2.1E-01	7.7E-06	3.0E+01	2.3E-08	2.3E-08	7.0E-03	7.0E-03
NITROGEN, NITRATE (AS N)	4.98E+03	4.98E+03	-	-	-	-	-	-	-	-	-	-	-	-	-
TETRACHLOROETHYLENE (PCE)	3.85E+00	3.85E+00	7.24E-01	2.8E+03	2.8E+03	2.3E+00	2.3E+00	1.6E+02	1.6E+02	6.1E-06	3.5E+01	1.4E-05	1.4E-05	4.5E+00	4.5E+00
CIS-1,2-DICHLOROETHYLENE	4.44E-01	4.44E-01	1.67E-01	7.4E+01	7.4E+01	6.0E-02	6.0E-02	4.2E+00	4.2E+00	-	8.0E+00	-	-	5.3E-01	5.3E-01
TRICHLOROETHYLENE (TCE)	6.65E+00	6.65E+00	4.03E-01	2.7E+03	2.7E+03	2.2E+00	2.2E+00	1.5E+02	1.5E+02	4.1E-06	2.0E+00	9.0E-06	9.0E-06	7.6E+01	7.6E+01
ALUMINUM	7.82E+01	7.82E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
IRON	1.86E+02	1.86E+02	-	-	-	-	-	-	-	-	-	-	-	-	-
MANGANESE	2.90E+00	2.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
ARSENIC	1.15E+00	1.15E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
CHROMIUM, HEXAVALENT (Cr+6)	1.97E+00	1.97E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
LEAD	2.97E-01	2.97E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLYBDENUM	2.40E+01	2.40E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
BORON	3.13E+02	3.13E+02	-	-	-	-	-	-	-	-	-	-	-	-	-
SELENIUM	1.24E+01	1.24E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
URANIUM, TOTAL	5.00E+00	5.00E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
VANADIUM	4.08E+00	4.08E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL												**2.28E-05**	**2.28E-05**	**8.23E+01**	**8.23E+01**

Notes:

µg/L = micrograms per Liter
µg/m^3 = micrograms per cubic meter
Henry's Law Constants taken from US EPA RSL Table

RfC = reference concentration
EC = Effects Concentration
H' = Henry's Law Constant (unitless)

C_a = Chemical Concentration in Air (µg/m^3)
RME= reasonable maximum exposure
CTE = central tendency exposure

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA INHLATION OF VOLATILES IN PRODUCTION WELL GROUNDWATER - Worked Equations

CDI Equation

EC = (CA x ET x EF x ED) / AT

EC = ((µg/m3) x (hours/day) x (days/year) x (years)) / (hours)

EC = (µg/m3 x ~~hours~~/~~day~~ x ~~days~~/~~years~~ x ~~years~~) / ~~hours~~

EC = µg/m3

1,4-Dioxane - Carcinogenic CTE EC

ECc = (3.69E+00 (ug/m3) x 2.00 (hours/day) x 250 (days/year) x 1 (years)) / (613,200 (hours))

ECc = 3.01E-03 µg/m3

Tetrachloroethylene - Noncarcinogenic RME EC

Ecnc = (2.78E+03 (ug/m3) x 2.00 (hours/day) x 250 (days/year) x 1 (years)) / (8,760 (hours))

Ecnc = 1.59E+02 µg/m3

Excess Cancer Risk Equation

CR = Ecc x IUR

CR = (µg/m3) x (µg/m3)-1

CR = ~~µg~~/~~m3~~ x ~~m3~~/~~µg~~

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 3.0E-03 (µg/m3) x 7.7E-06 (µg/m3)-1

CR = 2.3E-08

Hazard Quotient Equation

HQ = ECnc / RfC

HQ = ~~(µg/m3)~~ / ~~(µg/m3)~~ = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

HQ = 1.59E+02 (µg/m3) / 35 (µg/m3)

HQ = 4.5E+00

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $$DA_{event} = t_{event} \times K_p \times C_w$$

Organics in Water where $t_{event} \leq t^*$ $$DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$$

Organics in Water where $t_{event} > t^*$ $$DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

	CTE	RME
tevent = Event Duration (hours/event) =	2.000	2.000
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	1	1
EV = Event frequency (events/day) =	1	1
SA = Skin surface area (cm2) =	3527	3527
BW = Body Weight (kg) =	80	80
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	365	365

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (mg/cm²-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	(mg/kg-day)$^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHYLENE (DCE)	8.69E-07	8.69E-07	2.7E-08	2.7E-08	1.2E-08	1.2E-08	8.2E-07	8.2E-07	-	5.0E-02	-	-	1.6E-05	1.6E-05
1,4-DIOXANE	1.88E-05	1.88E-05	1.7E-08	1.7E-08	7.1E-09	7.1E-09	5.0E-07	5.0E-07	1.0E-01	3.0E-02	7.1E-10	7.1E-10	1.7E-05	1.7E-05
NITROGEN, NITRATE (AS N)	4.98E-03	4.98E-03	1.2E-05	1.2E-05	5.3E-06	5.3E-06	3.7E-04	3.7E-04	-	1.6E+00	-	-	2.3E-04	2.3E-04
TETRACHLOROETHYLENE (PCE)	3.85E-06	3.85E-06	4.7E-07	4.7E-07	2.0E-07	2.0E-07	1.4E-05	1.4E-05	5.4E-01	6.0E-03	1.1E-07	1.1E-07	2.4E-03	2.4E-03
CIS-1,2-DICHLOROETHYLENE	4.44E-07	4.44E-07	1.3E-08	1.3E-08	5.7E-09	5.7E-09	4.0E-07	4.0E-07	-	2.0E-03	-	-	2.0E-04	2.0E-04
TRICHLOROETHYLENE (TCE)	6.65E-06	6.65E-06	2.4E-07	2.4E-07	1.0E-07	1.0E-07	7.2E-06	7.2E-06	4.6E-02	5.0E-04	4.8E-09	4.8E-09	1.4E-02	1.4E-02
ALUMINUM	7.82E-05	7.82E-05	1.6E-07	1.6E-07	6.7E-08	6.7E-08	4.7E-06	4.7E-06	-	2.0E+02	-	-	2.4E-08	2.4E-08
IRON	1.86E-04	1.86E-04	3.7E-07	3.7E-07	1.6E-07	1.6E-07	1.1E-05	1.1E-05	-	7.0E-01	-	-	1.6E-05	1.6E-05
MANGANESE	2.90E-06	2.90E-06	5.8E-09	5.8E-09	2.5E-09	2.5E-09	1.8E-07	1.8E-07	-	5.6E-03	-	-	3.1E-05	3.1E-05
ARSENIC	1.15E-06	1.15E-06	2.3E-09	2.3E-09	9.9E-10	9.9E-10	6.9E-08	6.9E-08	9.5E+00	3.0E-04	9.4E-09	9.4E-09	2.3E-04	2.3E-04
CHROMIUM, HEXAVALENT (Cr+6)	1.97E-06	1.97E-06	7.9E-09	7.9E-09	3.4E-09	3.4E-09	2.4E-07	2.4E-07	2.0E+01	7.5E-05	6.8E-08	6.8E-08	3.2E-03	3.2E-03
LEAD	2.97E-07	2.97E-07	5.9E-11	5.9E-11	2.6E-11	2.6E-11	1.8E-09	1.8E-09	8.5E-03	-	2.2E-13	2.2E-13	-	-
MOLYBDENUM	2.40E-05	2.40E-05	4.8E-08	4.8E-08	2.1E-08	2.1E-08	1.4E-06	1.4E-06	-	5.0E-03	-	-	2.9E-04	2.9E-04
BORON	3.13E-04	3.13E-04	6.3E-07	6.3E-07	2.7E-07	2.7E-07	1.9E-05	1.9E-05	-	2.0E-01	-	-	9.4E-05	9.4E-05
SELENIUM	1.24E-05	1.24E-05	2.5E-08	2.5E-08	1.1E-08	1.1E-08	7.5E-07	7.5E-07	-	5.0E-03	-	-	1.5E-04	1.5E-04
URANIUM, TOTAL	5.00E-06	5.00E-06	1.0E-08	1.0E-08	4.3E-09	4.3E-09	3.0E-07	3.0E-07	-	3.0E-03	-	-	1.0E-04	1.0E-04
VANADIUM	4.08E-06	4.08E-06	8.2E-09	8.2E-09	3.5E-09	3.5E-09	2.5E-07	2.5E-07	-	2.3E-04	-	-	1.1E-03	1.1E-03
TOTALS											**1.9E-07**	**1.9E-07**	**2.2E-02**	**2.2E-02**

Notes:
mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure
CTE = central tendency exposure
hr = hours
cm/hr centimeters per hour
g/mol = grams per mol
hr/event = hours per event
COPC = Constituent of Potential Concern

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Ţevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHYLENE (DCE)	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,4-DIOXANE	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
TETRACHLOROETHYLENE (PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
IRON	1.00E-03	1.00E+00	100.00%	2.87E-03	2.16E-01	5.19E-01
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
CHROMIUM, HEXAVALENT (Cr+6)	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
URANIUM, TOTAL	1.00E-03	1.00E+00	100.00%	5.93E-03	2.26E+00	5.43E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA DERMAL CONTACT WITH PRODUCTION WELL GROUNDWATER - Worked Equations

Dermal Absorbed Dose

$$DAD = \frac{DAevent \times EF \times ED \times EV \times SA}{BW \times AT}$$

$$DAD = \frac{(mg/event\text{-}cm2) \times (days/year) \times (years) \times (events/day) \times (cm2)}{(kg) \times (days/year)}$$

$$DAD = \frac{\frac{mg}{\cancel{event\text{-}cm2}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years} \times \frac{\cancel{events}}{\cancel{day}} \times \cancel{cm2}}{kg \times \frac{\cancel{days}}{\cancel{year}}}$$

$$DAD = \frac{mg}{kg\text{-}day}$$

1,4-Dioxane - Carcinogenic CTE DAD

$$DADc = \frac{1.66E\text{-}08\ (mg/event\text{-}cm2) \times 250\ (days/year) \times 1\ (years) \times 1\ (events/day) \times 3527}{80\ (kg) \times 25550\ (days/year)}$$

$$DADc = 7.14E\text{-}09\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME DAD

$$DADnc = \frac{4.75E\text{-}07\ (mg/event\text{-}cm2) \times 250\ (days/year) \times 1\ (years) \times 1\ (events/day) \times 3527}{80\ (kg) \times 365\ (days/year)}$$

$$DADnc = 1.43E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

$$CR = DAD \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 7.1E-09 (mg/kg-day) x 1.0E-01 (mg/kg-day)$^{-1}$

CR = 7.1E-10

Hazard Quotient Equation

$$HQ = \frac{DAD}{RfD}$$

$$HQ = \frac{(mg/kg\text{-}day)}{(mg/kg\text{-}day)} = \quad HQ = \text{unitless}$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{1.43E\text{-}05\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

HQ = 2.4E-03

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA INGESTION OF MONITORING WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)		
C_w = Chemical Concentration in Water (mg/L)	Table 1	
IR = Ingestion rate (L/day) =	1.2	2.5

	CTE	RME
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	20	20
BW = Body Weight (kg) =	80	80
AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	7300	7300

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-04	2.96E-04	1.2E-06	2.5E-06	4.3E-06	8.9E-06	5.7E-03	-	6.9E-09	1.4E-08	-	-
1,1-DICHLOROETHENE	1.51E-04	1.51E-04	6.2E-07	1.3E-06	2.2E-06	4.5E-06	-	5.0E-02	-	-	4.3E-05	9.0E-05
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-04	5.24E-04	2.2E-06	4.5E-06	7.5E-06	1.6E-05	9.1E-02	-	2.0E-07	4.1E-07	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-03	7.50E-03	3.1E-05	6.4E-05	1.1E-04	2.2E-04	1.0E-01	3.0E-02	3.1E-06	6.4E-06	3.6E-03	7.5E-03
ALUMINUM	2.09E-02	2.09E-02	8.6E-05	1.8E-04	3.0E-04	6.3E-04	-	2.3E+01	-	-	1.3E-05	2.8E-05
ARSENIC	3.20E-04	3.20E-04	1.3E-06	2.7E-06	4.6E-06	9.6E-06	9.5E+00	3.0E-04	1.2E-05	2.6E-05	1.5E-02	3.2E-02
BARIUM	4.17E-02	4.17E-02	1.7E-04	3.6E-04	6.0E-04	1.2E-03	-	2.0E-01	-	-	3.0E-03	6.2E-03
BENZENE	2.73E-05	2.73E-05	1.1E-07	2.3E-07	3.9E-07	8.2E-07	1.0E-01	4.0E-03	1.1E-08	2.3E-08	9.8E-05	2.0E-04
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-04	9.12E-04	3.7E-06	7.8E-06	1.3E-05	2.7E-05	1.4E-02	2.0E-02	5.2E-08	1.1E-07	6.6E-04	1.4E-03
BORON	7.71E-02	7.71E-02	3.2E-04	6.6E-04	1.1E-03	2.3E-03	-	2.0E-01	-	-	5.5E-03	1.2E-02
CARBON TETRACHLORIDE	7.23E-05	7.23E-05	3.0E-07	6.2E-07	1.0E-06	2.2E-06	1.5E-01	4.0E-03	4.5E-08	9.3E-08	2.6E-04	5.4E-04
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	5.0E-01	3.0E-03	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-04	6.73E-04	2.8E-06	5.8E-06	9.7E-06	2.0E-05	-	2.0E-03	-	-	4.8E-03	1.0E-02
COBALT	1.56E-04	1.56E-04	6.4E-07	1.3E-06	2.2E-06	4.7E-06	-	3.0E-04	-	-	7.5E-03	1.6E-02
CYANIDE	1.88E-03	1.88E-03	7.7E-06	1.6E-05	2.7E-05	5.6E-05	-	1.4E-01	-	-	1.9E-04	4.0E-04
FORMALDEHYDE	8.88E-04	8.88E-04	3.6E-06	7.6E-06	1.3E-05	2.7E-05	2.1E-02	2.0E-01	7.7E-08	1.6E-07	6.4E-05	1.3E-04
HEPTACHLOR	1.13E-06	1.13E-06	4.6E-09	9.6E-09	1.6E-08	3.4E-08	4.5E+00	5.0E-04	2.1E-08	4.3E-08	3.2E-05	6.7E-05
ISOPROPANOL	6.50E-01	6.50E-01	2.7E-03	5.6E-03	9.3E-03	1.9E-02	-	2.0E+00	-	-	4.7E-03	9.7E-03
LEAD	2.19E-04	2.19E-04	9.0E-07	1.9E-06	3.2E-06	6.6E-06	8.5E-03	-	7.7E-09	1.6E-08	-	-
MANGANESE	1.46E-02	1.46E-02	6.0E-05	1.3E-04	2.1E-04	4.4E-04	-	1.4E-01	-	-	1.5E-03	3.1E-03
MOLYBDENUM	6.24E-03	6.24E-03	2.6E-05	5.3E-05	9.0E-05	1.9E-04	-	5.0E-03	-	-	1.8E-02	3.7E-02
NITROGEN, NITRATE (AS N)	1.78E+00	1.78E+00	7.3E-03	1.5E-02	2.6E-02	5.3E-02	-	1.6E+00	-	-	1.6E-02	3.3E-02
PERCHLORATE	8.45E-04	8.45E-04	3.5E-06	7.2E-06	1.2E-05	2.5E-05	-	7.0E-04	-	-	1.7E-02	3.6E-02
SELENIUM	1.94E-03	1.94E-03	8.0E-06	1.7E-05	2.8E-05	5.8E-05	-	5.0E-03	-	-	5.6E-03	1.2E-02
TERT-BUTYL METHYL ETHER	9.33E-05	9.33E-05	3.8E-07	8.0E-07	1.3E-06	2.8E-06	1.8E-03	-	6.9E-10	1.4E-09	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-03	2.69E-03	1.1E-05	2.3E-05	3.9E-05	8.1E-05	5.4E-01	6.0E-03	6.0E-06	1.2E-05	6.4E-03	1.3E-02
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-03	1.48E-03	6.1E-06	1.3E-05	2.1E-05	4.4E-05	-	9.0E-03	-	-	2.4E-03	4.9E-03
TOTALS									2.2E-05	4.6E-05	1.1E-01	2.4E-01

Notes:

mg/L = milligrams per liter;
L/day = liters per day;
mg/kg-day = milligrams per kilogram per day

CDI = chronic daily intake
CTE = central tendency exposure
RME= reasonable maximum exposure

Potential Health Risks to Adult Residents via Ingestion of Domestic Tap Water - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{7.5E\text{-}03 \ (mg/L) \times 1.2 \ (L/day) \times 350 \ (days/year) \times 20 \ (years)}{80 \ (kg) \times 25550 \ (days)}$$

$$CDI = \boxed{3.1E\text{-}05 \ \frac{mg}{kg\text{-}days}}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{2.7E\text{-}03 \ (mg/L) \times 2.5 \ (L/day) \times 350 \ (days/year) \times 20 \ (years)}{80 \ (kg) \times 7300 \ (days)}$$

$$CDI = \boxed{8.1E\text{-}05 \ \frac{mg}{kg\text{-}days}}$$

Excess Cancer Risk Equation

$$CR = CDI \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$$CR = 3.1E\text{-}05 \ (mg/kg\text{-}day) \times 1.0E\text{-}01 \ (mg/kg\text{-}day)^{-1}$$

$$\boxed{CR = 3.1E\text{-}06}$$

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{8.1E\text{-}05 \ (mg/kg\text{-}day)}{6.00E\text{-}03 \ (mg/kg\text{-}day)}$$

$$\boxed{HQ = 1.3E\text{-}02}$$

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA INHALATION OF VOLATILES FROM MONITORING WELL GROUNDWATER

VOC Inhalation Equation: EC = (C_A x ET x EF x ED) / AT

	CTE	RME
ET = Exposure Time (hours/day) =	0.71	0.71
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	20	20
ATc = Averaging Time (70 years x 24 hours/day x 365 days/year) =	613,200	613,200
Atnc = Averaging Time (20 years x 24 hours/day x 365 days/year) =	175,200	175,200

COPC	Groundwater Concentration (µg/l)		Henry's Law Constant (H')	Concentration in Air (µg/m3)		Exposure Concentration (EC) Carcinogenic (µg/m3)		Exposure Concentration (EC) Non-Carcinogenic (µg/m3)		Inhalation Unit Risk	Inhalation RfC	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	(unitless)	CTE	RME	CTE	RME	CTE	RME	(µg/m3)-1	(ug/m3)	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-01	2.96E-01	2.30E-01	6.8E+01	6.8E+01	5.5E-01	5.5E-01	1.9E+00	1.9E+00	1.6E-06	-	8.8E-07	8.8E-07	-	-
1,1-DICHLOROETHENE	1.51E-01	1.51E-01	1.07E+00	1.6E+02	1.6E+02	1.3E+00	1.3E+00	4.6E+00	4.6E+00	-	7.0E+01	-	-	6.5E-02	6.5E-02
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		1.40E-02	-	-	-	-	-	-	-	3.0E-01	-	-	-	-
1,2-DICHLOROETHANE	5.24E-01	5.24E-01	4.82E-02	2.5E+01	2.5E+01	2.0E-01	2.0E-01	7.2E-01	7.2E-01	2.6E-05	4.0E+02	5.3E-06	5.3E-06	1.8E-03	1.8E-03
1,4-DIOXANE (P-DIOXANE)	7.50E+00	7.50E+00	1.96E-04	1.5E+00	1.5E+00	1.2E-02	1.2E-02	4.2E-02	4.2E-02	7.7E-06	3.0E+01	9.2E-08	9.2E-08	1.4E-03	1.4E-03
ALUMINUM	2.09E+01	2.09E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
ARSENIC	3.20E-01	3.20E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
BARIUM	4.17E+01	4.17E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZENE	2.73E-02	2.73E-02	2.27E-01	6.2E+00	6.2E+00	5.0E-02	5.0E-02	1.8E-01	1.8E-01	2.2E-06	3.0E+01	1.1E-07	1.1E-07	5.8E-03	5.8E-03
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-01	9.12E-01	1.10E-05	1.0E-02	1.0E-02	8.1E-05	8.1E-05	2.8E-04	2.8E-04	2.4E-06	-	2.0E-10	2.0E-10	-	-
BORON	7.71E+01	7.71E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON TETRACHLORIDE	7.23E-02	7.23E-02	1.13E+00	8.2E+01	8.2E+01	6.6E-01	6.6E-01	2.3E+00	2.3E+00	6.0E-06	1.0E+02	4.0E-06	4.0E-06	2.3E-02	2.3E-02
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	-	-	-	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-01	6.73E-01	1.67E-01	1.1E+02	1.1E+02	9.1E-01	9.1E-01	3.2E+00	3.2E+00	-	8.0E+00	-	-	4.0E-01	4.0E-01
COBALT	1.56E-01	1.56E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
CYANIDE	1.88E+00	1.88E+00	4.15E-03	7.8E+00	7.8E+00	6.3E-02	6.3E-02	2.2E-01	2.2E-01	-	-	-	-	-	-
FORMALDEHYDE	8.88E-01	8.88E-01	1.38E-05	1.2E-02	1.2E-02	9.9E-05	9.9E-05	3.5E-04	3.5E-04	6.0E-06	-	6.0E-10	6.0E-10	-	-
HEPTACHLOR	1.13E-03	1.13E-03	1.20E-02	1.4E-02	1.4E-02	1.1E-04	1.1E-04	3.8E-04	3.8E-04	1.3E-03	-	1.4E-07	1.4E-07	-	-
ISOPROPANOL	6.50E+02	6.50E+02	3.31E-04	2.2E+02	2.2E+02	1.7E+00	1.7E+00	6.1E+00	6.1E+00	-	2.0E+02	-	-	3.1E-02	3.1E-02
LEAD	2.19E-01	2.19E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
MANGANESE	1.46E+01	1.46E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLYBDENUM	6.24E+00	6.24E+00		-	-	-	-	-	-	-	-	-	-	-	-
NITROGEN, NITRATE (AS N)	1.78E+03	1.78E+03	-	-	-	-	-	-	-	-	-	-	-	-	-
PERCHLORATE	8.45E-01	8.45E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
SELENIUM	1.94E+00	1.94E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL METHYL ETHER	9.33E-02	9.33E-02	2.40E-02	2.2E+00	2.2E+00	1.8E-02	1.8E-02	6.3E-02	6.3E-02	2.6E-07	3.0E+00	4.7E-09	4.7E-09	2.1E-02	2.1E-02
TETRACHLOROETHYLENE(PCE)	2.69E+00	2.69E+00	7.24E-01	1.9E+03	1.9E+03	1.6E+01	1.6E+01	5.5E+01	5.5E+01	6.1E-06	3.5E+01	9.6E-05	9.6E-05	1.6E+00	1.6E+00
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		4.03E-01	-	-	-	-	-	-	4.1E-06	2.0E+00	-	-	-	-
VANADIUM	1.48E+00	1.48E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL												**1.1E-04**	**1.1E-04**	**2.1E+00**	**2.1E+00**

Notes:

µg/L = micrograms per Liter
$\mu g/m^3$ = micrograms per cubic meter
C_a = Chemical Concentration in Air ($\mu g/m^3$)

RfC = reference concentration
EC = Effects Concentration

Henry's Law Constants taken from US EPA RSL Table
H' = Henry's Law Constant (unitless)

CTE = central tendency exposure
RME= reasonable maximum exposure

Potential Health Risks to Adult Residents Via Inhalation of Vapors Emanating from Groundwater - Showering - Worked Equations

CDI Equation

EC = (CA x ET x EF x ED) / AT

EC = [(µg/m3) x (hours/day) x (days/year) x (years)] / (hours)

EC = [µg/m3 x ~~hours/day~~ x ~~days/years~~ x ~~years~~] / ~~hours~~

EC = µg/m3

1,4-Dioxane - Carcinogenic CTE EC

ECc = [1.47E+00 (ug/m3) x 0.71 (hours/day) x 350 (days/year) x 20 (years)] / 613,200 (hours)

ECc = 1.19E-02 µg/m3

Tetrachloroethylene - Noncarcinogenic RME EC

Ecnc = [1.94E+03 (ug/m3) x 0.71 (hours/day) x 350 (days/year) x 20 (years)] / 175,200 (hours)

Ecnc = 5.52E+01 µg/m3

Excess Cancer Risk Equation

CR = Ecc x IUR

CR = (µg/m3) x (µg/m3)-1

CR = ~~µg/m3~~ x ~~m3/µg~~

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 1.2E-02 (µg/m3) x 7.7E-06 (µg/m3)-1

CR = 9.2E-08

Hazard Quotient Equation

HQ = ECnc / RfC

HQ = ~~(µg/m3)~~ / ~~(µg/m3)~~ = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

HQ = 5.52E+01 (µg/m3) / 35 (µg/m3)

HQ = 1.6E+00

POTENTIAL HEALTH RISKS TO ADULT RESIDENTS VIA DIRECT DERMAL CONTACT WITH MONITORING WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $DA_{event} = t_{event} \times K_p \times C_w$

Organics in Water where $t_{event} \leq t^*$ $DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$

Organics in Water where $t_{event} > t^*$ $DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

	CTE	RME
tevent = Event Duration (hours/event) =	0.71	0.71
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	20	20
EV = Event frequency (events/day) =	1	1
SA = Skin surface area (cm2) =	19652	20900
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	7300	7300
BW = Body Weight (kg) =	80	80

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (mg/cm²-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-07	2.96E-07	2.9E-09	2.9E-09	1.9E-07	2.0E-07	6.7E-07	7.1E-07	5.7E-03	-	1.1E-09	1.2E-09	-	-
1,1-DICHLOROETHENE	1.51E-07	1.51E-07	2.5E-09	2.5E-09	1.7E-07	1.8E-07	5.9E-07	6.2E-07	-	5.0E-02	-	-	1.2E-05	1.2E-05
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-07	5.24E-07	3.1E-09	3.1E-09	2.1E-07	2.3E-07	7.4E-07	7.9E-07	9.1E-02	-	1.9E-08	2.0E-08	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-06	7.50E-06	3.3E-09	3.3E-09	2.2E-07	2.4E-07	7.8E-07	8.3E-07	1.0E-01	3.0E-02	2.2E-08	2.4E-08	2.6E-05	2.8E-05
ALUMINUM	2.09E-05	2.09E-05	1.48E-08	1.48E-08	1.0E-06	1.1E-06	3.5E-06	3.7E-06	-	2.3E+01	-	-	1.6E-07	1.6E-07
ARSENIC	3.20E-07	3.20E-07	2.27E-10	2.27E-10	1.5E-08	1.6E-08	5.4E-08	5.7E-08	9.5E+00	3.0E-04	1.5E-07	1.5E-07	1.8E-04	1.9E-04
BARIUM	4.17E-05	4.17E-05	2.96E-08	2.96E-08	2.0E-06	2.1E-06	7.0E-06	7.4E-06	-	1.4E-02	-	-	5.0E-04	5.3E-04
BENZENE	2.73E-08	2.73E-08	5.2E-10	5.2E-10	3.5E-08	3.7E-08	1.2E-07	1.3E-07	1.0E-01	4.0E-03	3.5E-09	3.7E-09	3.1E-05	3.3E-05
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-07	9.12E-07	9.7E-06	9.7E-06	6.5E-04	6.9E-04	2.3E-03	2.4E-03	1.4E-02	2.0E-02	9.1E-06	9.7E-06	1.1E-01	1.2E-01
BORON	7.71E-05	7.71E-05	5.47E-08	5.47E-08	3.7E-06	3.9E-06	1.3E-05	1.4E-05	-	2.0E-01	-	-	6.4E-05	6.9E-05
CARBON TETRACHLORIDE	7.23E-08	7.23E-08	2.4E-09	2.4E-09	1.6E-07	1.7E-07	5.6E-07	6.0E-07	1.5E-01	4.0E-03	2.4E-08	2.6E-08	1.4E-04	1.5E-04
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	2.0E+01	7.5E-05	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-07	6.73E-07	1.0E-08	1.0E-08	7.0E-07	7.5E-07	2.5E-06	2.6E-06	-	2.0E-03	-	-	1.2E-03	1.3E-03
COBALT	1.56E-07	1.56E-07	4.44E-11	4.44E-11	3.0E-09	3.2E-09	1.0E-08	1.1E-08	-	3.0E-04	-	-	3.5E-05	3.7E-05
CYANIDE	1.88E-06	1.88E-06	1.34E-09	1.34E-09	9.0E-08	9.6E-08	3.1E-07	3.3E-07	-	1.4E-01	-	-	2.2E-06	2.4E-06
FORMALDEHYDE	8.88E-07	8.88E-07	1.6E-09	1.6E-09	1.1E-07	1.2E-07	3.9E-07	4.1E-07	2.1E-02	2.0E-01	2.3E-09	2.5E-09	1.9E-06	2.1E-06
HEPTACHLOR	1.13E-09	1.13E-09	1.3E-09	1.3E-09	9.1E-08	9.7E-08	3.2E-07	3.4E-07	4.5E+00	5.0E-04	4.1E-07	4.3E-07	6.4E-04	6.8E-04
ISOPROPANOL	6.50E-04	6.50E-04	5.9E-07	5.9E-07	4.0E-05	4.2E-05	1.4E-04	1.5E-04	-	2.0E+00	-	-	6.9E-05	7.4E-05
LEAD	2.19E-07	2.19E-07	1.56E-11	1.56E-11	1.0E-09	1.1E-09	3.7E-09	3.9E-09	8.5E-03	-	8.9E-12	9.5E-12	-	-
MANGANESE	1.46E-05	1.46E-05	1.04E-08	1.04E-08	7.0E-07	7.4E-07	2.4E-06	2.6E-06	-	5.6E-03	-	-	4.4E-04	4.6E-04
MOLYBDENUM	6.24E-06	6.24E-06	4.43E-09	4.43E-09	3.0E-07	3.2E-07	1.0E-06	1.1E-06	-	5.0E-03	-	-	2.1E-04	2.2E-04
NITROGEN, NITRATE (AS N)	1.78E-03	1.78E-03	1.27E-06	1.27E-06	8.5E-05	9.1E-05	3.0E-04	3.2E-04	-	1.6E+00	-	-	1.9E-04	2.0E-04
PERCHLORATE	8.45E-07	8.45E-07	1.4E-09	1.4E-09	9.2E-08	9.7E-08	3.2E-07	3.4E-07	-	7.0E-04	-	-	4.6E-04	4.9E-04
SELENIUM	1.94E-06	1.94E-06	1.38E-09	1.38E-09	9.3E-08	9.9E-08	3.3E-07	3.5E-07	-	5.0E-03	-	-	6.5E-05	
TERT-BUTYL METHYL ETHER	9.33E-08	9.33E-08	2.6E-10	2.6E-10	1.8E-08	1.9E-08	6.2E-08	6.6E-08	1.8E-03	-	3.2E-11	3.4E-11	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-06	2.69E-06	2.0E-07	2.0E-07	1.3E-05	1.4E-05	4.7E-05	4.9E-05	5.4E-01	6.0E-03	7.2E-06	7.6E-06	7.75E-03	8.24E-03
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-06	1.48E-06	1.05E-09	1.05E-09	7.1E-08	7.5E-08	2.5E-07	2.6E-07	-	2.3E-04	-	-	1.1E-03	1.1E-03
TOTALS											**1.7E-05**	**1.8E-05**	**1.3E-01**	**1.3E-01**

Notes:

mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure
g/mol = grams per mol
hr/event = hours per event
cm/hr centimeters per hour
CTE = central tendency exposure
hr = hours

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Ţevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHANE	6.75E-03	1.00E+00	100.00%	2.58E-02	3.77E-01	9.04E-01
1,1-DICHLOROETHENE	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,2,3-TRICHLOROPROPANE	7.52E-03	1.00E+00	100.00%	3.51E-02	7.04E-01	1.69E+00
1,2-DICHLOROETHANE	4.20E-03	1.00E+00	100.00%	1.61E-02	3.77E-01	9.04E-01
1,4-DIOXANE (P-DIOXANE)	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
BARIUM	1.00E-03	1.00E+00	100.00%	4.54E-03	6.34E-01	1.52E+00
BENZENE	1.49E-02	1.00E+00	100.00%	5.07E-02	2.88E-01	6.91E-01
BIS(2-ETHYLHEXYL) PHTHALATE	1.13E+00	1.00E+00	100.00%	8.59E+00	1.62E+01	7.29E+01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
CARBON TETRACHLORIDE	1.63E-02	1.00E+00	100.00%	7.78E-02	7.64E-01	1.83E+00
CHROMIUM, HEXAVALENT	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
COBALT	4.00E-04	1.00E+00	100.00%	1.18E-03	2.25E-01	5.40E-01
CYANIDE	1.00E-03	1.00E+00	100.00%	1.96E-03	1.47E-01	3.53E-01
FORMALDEHYDE	1.82E-03	1.00E+00	100.00%	3.84E-03	1.55E-01	3.72E-01
HEPTACHLOR	1.43E-01	1.00E+00	100.00%	1.06E+00	1.30E+01	5.01E+01
ISOPROPANOL	7.78E-04	1.00E+00	100.00%	2.32E-03	2.28E-01	5.48E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
PERCHLORATE	1.00E-03	1.00E+00	100.00%	4.17E-03	4.78E-01	1.15E+00
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
TERT-BUTYL METHYL ETHER	2.11E-03	1.00E+00	100.00%	7.62E-03	3.28E-01	7.87E-01
TETRACHLOROETHYLENE(PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

Potential Health Risks to Adult Residents via Direct Dermal Contact with Site Tap Water - Worked Equations

Dermal Absorbed Dose

$$DAD = \frac{DAevent \times EF \times ED \times EV \times SA}{BW \times AT}$$

$$DAD = \frac{(mg/event\text{-}cm2) \times (days/year) \times (years) \times (events/day) \times (cm2)}{(kg) \times (days/year)}$$

$$DAD = \frac{\frac{mg}{\cancel{event\text{-}cm2}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years} \times \frac{\cancel{events}}{\cancel{day}} \times \cancel{cm2}}{kg \times \frac{\cancel{days}}{\cancel{year}}}$$

$$DAD = \frac{mg}{kg\text{-}day}$$

1,4-Dioxane - Carcinogenic CTE DAD

$$DADc = \frac{3.32E\text{-}09\ (mg/event\text{-}cm2) \times 350\ (days/year) \times 20\ (years) \times 1\ (events/day) \times 19652}{80\ (kg) \times 25550\ (days/year)}$$

$$DADc = 2.23E\text{-}07\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME DAD

$$DADnc = \frac{1.97E\text{-}07\ (mg/event\text{-}cm2) \times 350\ (days/year) \times 20\ (years) \times 1\ (events/day) \times 20900}{80\ (kg) \times 7300\ (days/year)}$$

$$DADnc = 4.95E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

$$CR = DAD \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 2.2E-07 (mg/kg-day) x 1.0E-01 $(mg/kg\text{-}day)^{-1}$

CR = 2.2E-08

Hazard Quotient Equation

$$HQ = \frac{DAD}{RfD}$$

$$HQ = \frac{(mg/kg\text{-}day)}{(mg/kg\text{-}day)} = HQ = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{4.95E\text{-}05\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

HQ = 8.24E-03

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA INGESTION OF MONITORING WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME		CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)			EF = Exposure Frequency (days/year) =	350	350
C_w = Chemical Concentration in Water (mg/L)	Table 1		ED = Exposure Duration (years) =	6	6
IR = Ingestion rate (L/day) =	0.38	0.78	BW = Body Weight (kg) =	15	15
			AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
			AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	2190	2190

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-04	2.96E-04	6.2E-07	1.3E-06	7.2E-06	1.5E-05	5.7E-03	-	3.5E-09	7.2E-09	-	-
1,1-DICHLOROETHENE	1.51E-04	1.51E-04	3.1E-07	6.4E-07	3.7E-06	7.5E-06	-	5.0E-02	-	-	7.3E-05	1.5E-04
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-04	5.24E-04	1.1E-06	2.2E-06	1.3E-05	2.6E-05	9.1E-02	-	9.9E-08	2.0E-07	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-03	7.50E-03	1.6E-05	3.2E-05	1.8E-04	3.7E-04	1.0E-01	3.0E-02	1.6E-06	3.2E-06	6.1E-03	1.2E-02
ALUMINUM	2.09E-02	2.09E-02	4.3E-05	8.9E-05	5.1E-04	1.0E-03	-	2.3E+01	-	-	2.3E-05	4.6E-05
ARSENIC	3.20E-04	3.20E-04	6.7E-07	1.4E-06	7.8E-06	1.6E-05	9.5E+00	3.0E-04	6.3E-06	1.3E-05	2.6E-02	5.3E-02
BARIUM	4.17E-02	4.17E-02	8.7E-05	1.8E-04	1.0E-03	2.1E-03	-	2.0E-01	-	-	5.1E-03	1.0E-02
BENZENE	2.73E-05	2.73E-05	5.7E-08	1.2E-07	6.6E-07	1.4E-06	1.0E-01	4.0E-03	5.7E-09	1.2E-08	1.7E-04	3.4E-04
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-04	9.12E-04	1.9E-06	3.9E-06	2.2E-05	4.5E-05	1.4E-02	2.0E-02	2.7E-08	5.5E-08	1.1E-03	2.3E-03
BORON	7.71E-02	7.71E-02	1.6E-04	3.3E-04	1.9E-03	3.8E-03	-	2.0E-01	-	-	9.4E-03	1.9E-02
CARBON TETRACHLORIDE	7.23E-05	7.23E-05	1.5E-07	3.1E-07	1.8E-06	3.6E-06	1.5E-01	4.0E-03	2.3E-08	4.6E-08	4.4E-04	9.0E-04
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	5.0E-01	3.0E-03	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-04	6.73E-04	1.4E-06	2.9E-06	1.6E-05	3.4E-05	-	2.0E-03	-	-	8.2E-03	1.7E-02
COBALT	1.56E-04	1.56E-04	3.3E-07	6.7E-07	3.8E-06	7.8E-06	-	3.0E-04	-	-	1.3E-02	2.6E-02
CYANIDE	1.88E-03	1.88E-03	3.9E-06	8.0E-06	4.6E-05	9.4E-05	-	1.4E-01	-	-	3.3E-04	6.7E-04
FORMALDEHYDE	8.88E-04	8.88E-04	1.8E-06	3.8E-06	2.2E-05	4.4E-05	2.1E-02	2.0E-01	3.9E-08	8.0E-08	1.1E-04	2.2E-04
HEPTACHLOR	1.13E-06	1.13E-06	2.3E-09	4.8E-09	2.7E-08	5.6E-08	4.5E+00	3.0E-05	1.1E-08	2.2E-08	9.1E-04	1.9E-03
ISOPROPANOL	6.50E-01	6.50E-01	1.4E-03	2.8E-03	1.6E-02	3.2E-02	-	2.0E+00	-	-	7.9E-03	1.6E-02
LEAD	Child Risk Evaluated Separetely		-	0.0E+00	-	0.0E+00	8.5E-03	-	-	0.0E+00	-	-
MANGANESE	1.46E-02	1.46E-02	3.0E-05	6.2E-05	3.6E-04	7.3E-04	-	3.0E-02	-	-	1.2E-02	2.4E-02
MOLYBDENUM	6.24E-03	6.24E-03	1.3E-05	2.7E-05	1.5E-04	3.1E-04	-	5.0E-03	-	-	3.0E-02	6.2E-02
NITROGEN, NITRATE (AS N)	1.78E+00	1.78E+00	3.7E-03	7.6E-03	4.3E-02	8.9E-02	-	1.6E+00	-	-	2.7E-02	5.6E-02
PERCHLORATE	8.45E-04	8.45E-04	1.8E-06	3.6E-06	2.1E-05	4.2E-05	-	7.0E-04	-	-	2.9E-02	6.0E-02
SELENIUM	1.94E-03	1.94E-03	4.0E-06	8.3E-06	4.7E-05	9.7E-05	-	5.0E-03	-	-	9.4E-03	1.9E-02
TERT-BUTYL METHYL ETHER	9.33E-05	9.33E-05	1.9E-07	4.0E-07	2.3E-06	4.6E-06	1.8E-03	-	3.5E-10	7.2E-10	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-03	2.69E-03	5.6E-06	1.1E-05	6.5E-05	1.3E-04	5.4E-01	6.0E-03	3.0E-06	6.2E-06	1.1E-02	2.2E-02
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-03	1.48E-03	3.1E-06	6.3E-06	3.6E-05	7.4E-05	-	9.0E-03	-	-	4.0E-03	8.2E-03
TOTALS									1.1E-05	2.3E-05	2.0E-01	4.1E-01

Notes:
mg/L = milligrams per liter;
L/day = liters per day;
mg/kg-day = milligrams per kilogram per day
CDI = chronic daily intake
CTE = central tendency exposure
RME= reasonable maximum exposure

Potential Health Risks to Child Residents via Ingestion of Domestic Tap Water - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{7.5E\text{-}03\ (mg/L) \times 0.4\ (L/day) \times 350\ (days/year) \times 6\ (years)}{15\ (kg) \times 25550\ (days)}$$

$$CDI = 1.6E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{2.7E\text{-}03\ (mg/L) \times 0.8\ (L/day) \times 350\ (days/year) \times 6\ (years)}{15\ (kg) \times 2190\ (days)}$$

$$CDI = 1.3E\text{-}04\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

CR = CDI x SFo

CR = (mg/kg-day) x $(mg/kg\text{-}day)^{-1}$

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 1.6E-05 (mg/kg-day) x 1.0E-01 $(mg/kg\text{-}day)^{-1}$

CR = 1.6E-06

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{1.3E\text{-}04\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

HQ = 2.2E-02

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA INHALATION OF INHALATION OF VOLATILES FROM MONITORING WELL GROUNDWATER

VOC Inhalation Equation: EC = (C_A x ET x EF x ED) / AT

	CTE	RME
ET = Exposure Time (hours/day) =	0.54	0.54
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	6	6
ATc = Averaging Time (70 years x 24 hours/day x 365 days/year) =	613,200	613,200
Atnc = Averaging Time (6 years x 24 hours/day x 365 days/year) =	52,560	52,560

COPC	Groundwater Concentration (µg/l)		Henry's Law Constant (H')	Concentration in Air (µg/m3)		Exposure Concentration (EC) Carcinogenic (µg/m3)		Exposure Concentration (EC) Non-Carcinogenic (µg/m3)		Inhalation Unit Risk	Inhalation RfC	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	(unitless)	CTE	RME	CTE	RME	CTE	RME	(µg/m3)-1	(ug/m3)	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-01	2.96E-01	2.30E-01	6.8E+01	6.8E+01	1.3E-01	1.3E-01	1.5E+00	1.5E+00	1.6E-06	-	2.0E-07	2.0E-07	-	-
1,1-DICHLOROETHENE	1.51E-01	1.51E-01	1.07E+00	1.6E+02	1.6E+02	3.0E-01	3.0E-01	3.5E+00	3.5E+00	-	7.0E+01	-	-	5.0E-02	5.0E-02
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		1.40E-02	-	-	-	-	-	-	-	3.0E-01	-	-	-	-
1,2-DICHLOROETHANE	5.24E-01	5.24E-01	4.82E-02	2.5E+01	2.5E+01	4.7E-02	4.7E-02	5.5E-01	5.5E-01	2.6E-05	4.0E+02	1.2E-06	1.2E-06	1.4E-03	1.4E-03
1,4-DIOXANE (P-DIOXANE)	7.50E+00	7.50E+00	1.96E-04	1.5E+00	1.5E+00	2.7E-03	2.7E-03	3.2E-02	3.2E-02	7.7E-06	3.0E+01	2.1E-08	2.1E-08	1.1E-03	1.1E-03
ALUMINUM	2.09E+01	2.09E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
ARSENIC	3.20E-01	3.20E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
BARIUM	4.17E+01	4.17E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZENE	2.73E-02	2.73E-02	2.27E-01	6.2E+00	6.2E+00	1.1E-02	1.1E-02	1.3E-01	1.3E-01	2.2E-06	3.0E+01	2.5E-08	2.5E-08	4.4E-03	4.4E-03
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-01	9.12E-01	1.10E-05	1.0E-02	1.0E-02	1.9E-05	1.9E-05	2.2E-04	2.2E-04	2.4E-06	-	4.5E-11	4.5E-11	-	-
BORON	7.71E+01	7.71E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON TETRACHLORIDE	7.23E-02	7.23E-02	1.13E+00	8.2E+01	8.2E+01	1.5E-01	1.5E-01	1.8E+00	1.8E+00	6.0E-06	1.0E+02	9.0E-07	9.0E-07	1.8E-02	1.8E-02
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	-	-	-	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-01	6.73E-01	1.67E-01	1.1E+02	1.1E+02	2.1E-01	2.1E-01	2.4E+00	2.4E+00	-	8.0E+00	-	-	3.0E-01	3.0E-01
COBALT	1.56E-01	1.56E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
CYANIDE	1.88E+00	1.88E+00	4.15E-03	7.8E+00	7.8E+00	1.4E-02	1.4E-02	1.7E-01	1.7E-01	-	-	-	-	-	-
FORMALDEHYDE	8.88E-01	8.88E-01	1.38E-05	1.2E-02	1.2E-02	2.3E-05	2.3E-05	2.6E-04	2.6E-04	6.0E-06	-	1.4E-10	1.4E-10	-	-
HEPTACHLOR	1.13E-03	1.13E-03	1.20E-02	1.4E-02	1.4E-02	2.5E-05	2.5E-05	2.9E-04	2.9E-04	1.3E-03	-	3.3E-08	3.3E-08	-	-
ISOPROPANOL	6.50E+02	6.50E+02	3.31E-04	2.2E+02	2.2E+02	4.0E-01	4.0E-01	4.6E+00	4.6E+00	-	2.0E+02	-	-	2.3E-02	2.3E-02
LEAD	Child Risk Evaluated Separetely		-	-	-	-	-	-	-	-	-	-	-	-	-
MANGANESE	1.46E+01	1.46E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLYBDENUM	6.24E+00	6.24E+00		-	-	-	-	-	-	-	-	-	-	-	-
NITROGEN, NITRATE (AS N)	1.78E+03	1.78E+03	-	-	-	-	-	-	-	-	-	-	-	-	-
PERCHLORATE	8.45E-01	8.45E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
SELENIUM	1.94E+00	1.94E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL METHYL ETHER	9.33E-02	9.33E-02	2.40E-02	2.2E+00	2.2E+00	4.1E-03	4.1E-03	4.8E-02	4.8E-02	2.6E-07	3.0E+00	1.1E-09	1.1E-09	1.6E-02	1.6E-02
TETRACHLOROETHYLENE(PCE)	2.69E+00	2.69E+00	7.24E-01	1.9E+03	1.9E+03	3.6E+00	3.6E+00	4.2E+01	4.2E+01	6.1E-06	3.5E+01	2.2E-05	2.2E-05	1.2E+00	1.2E+00
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		4.03E-01	-	0.0E+00	-	0.0E+00	-	0.0E+00	4.1E-06	2.0E+00	-	0.0E+00	-	0.0E+00
VANADIUM	1.48E+00	1.48E+00	-	-	-	-	-	-	-	-	-	-	-		-
TOTAL												**2.4E-05**	**2.4E-05**	**1.6E+00**	**1.6E+00**

Notes:

µg/L = micrograms per Liter
µg/m^3 = micrograms per cubic meter
C_a = Chemical Concentration in Air (µg/m^3)

RfC = reference concentration
EC = Effects Concentration
RME= reasonable maximum exposure

Henry's Law Constants taken from US EPA RSL Table
H' = Henry's Law Constant (unitless)
CTE = central tendency exposure

Potential Health Risks to Child Residents Via Inhalation of Vapors Emanating from Groundwater - Showering - Worked Equations

CDI Equation

EC = CA x ET x EF x ED / AT

EC = (µg/m3) x (hours/day) x (days/year) x (years) / (hours)

EC = ~~µg~~ / m3 x ~~hours~~ / ~~day~~ x ~~days~~ / ~~years~~ x ~~years~~ / ~~hours~~

EC = µg / m3

1,4-Dioxane - Carcinogenic CTE EC

ECc = 1.47E+00 (ug/m3) x 0.54 (hours/day) x 350 (days/year) x 6 (years) / 613,200 (hours)

ECc = 2.72E-03 µg / m3

Tetrachloroethylene - Noncarcinogenic RME EC

Ecnc = 1.94E+03 (ug/m3) x 0.54 (hours/day) x 350 (days/year) x 6 (years) / 52,560 (hours)

Ecnc = 4.20E+01 µg / m3

Excess Cancer Risk Equation

CR = Ecc x IUR

CR = (µg/m3) x (µg/m3)-1

CR = ~~µg~~ / ~~m3~~ x ~~m3~~ / ~~µg~~

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 2.7E-03 (µg/m3) x 7.7E-06 (µg/m3)-1

CR = 2.1E-08

Hazard Quotient Equation

HQ = ECnc / RfC

HQ = ~~(µg/m3)~~ / ~~(µg/m3)~~ = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

HQ = 4.20E+01 (µg/m3) / 35 (µg/m3)

HQ = 1.2E+00

POTENTIAL HEALTH RISKS TO CHILD RESIDENTS VIA DIRECT DERMAL CONTACT WITH MONITORING WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $DA_{event} = t_{event} \times K_p \times C_w$

Organics in Water where $t_{event} \le t^*$ $DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$

Organics in Water where $t_{event} > t^*$ $DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

	CTE	RME
tevent = Event Duration (hours/event) =	0.54	0.54
EF = Exposure Frequency (days/year) =	350	350
ED = Exposure Duration (years) =	6	6
EV = Event frequency (events/day) =	1	1
SA = Skin surface area (cm2) =	6365	6378
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	2190	2190
BW = Body Weight (kg) =	15	15

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (mg/cm²-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	(mg/kg-day)$^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-07	2.96E-07	2.5E-09	2.5E-09	8.7E-08	8.7E-08	1.0E-06	1.0E-06	5.7E-03	-	4.9E-10	5.0E-10	-	-
1,1-DICHLOROETHENE	1.51E-07	1.51E-07	2.2E-09	2.2E-09	7.6E-08	7.6E-08	8.8E-07	8.8E-07	-	5.0E-02	-	-	1.8E-05	1.8E-05
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-07	5.24E-07	2.7E-09	2.7E-09	9.6E-08	9.6E-08	1.1E-06	1.1E-06	9.1E-02	-	8.7E-09	8.7E-09	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-06	7.50E-06	2.9E-09	2.9E-09	1.0E-07	1.0E-07	1.2E-06	1.2E-06	1.0E-01	3.0E-02	1.0E-08	1.0E-08	3.9E-05	3.9E-05
ALUMINUM	2.09E-05	2.09E-05	1.1E-08	1.1E-08	3.9E-07	3.9E-07	4.6E-06	4.6E-06	-	2.3E+01	-	-	2.0E-07	2.0E-07
ARSENIC	3.20E-07	3.20E-07	1.7E-10	1.7E-10	6.0E-09	6.0E-09	7.0E-08	7.0E-08	9.5E+00	3.0E-04	5.7E-08	5.7E-08	2.3E-04	2.3E-04
BARIUM	4.17E-05	4.17E-05	2.3E-08	2.3E-08	7.8E-07	7.9E-07	9.2E-06	9.2E-06	-	1.4E-02	-	-	6.5E-04	6.6E-04
BENZENE	2.73E-08	2.73E-08	4.4E-10	4.4E-10	1.5E-08	1.5E-08	1.8E-07	1.8E-07	1.0E-01	4.0E-03	1.5E-09	1.5E-09	4.5E-05	4.5E-05
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-07	9.12E-07	8.4E-06	8.4E-06	2.9E-04	2.9E-04	3.4E-03	3.4E-03	1.4E-02	2.0E-02	4.1E-06	4.1E-06	1.7E-01	1.7E-01
BORON	7.71E-05	7.71E-05	4.2E-08	4.2E-08	1.5E-06	1.5E-06	1.7E-05	1.7E-05	-	2.0E-01	-	-	8.5E-05	8.5E-05
CARBON TETRACHLORIDE	7.23E-08	7.23E-08	2.1E-09	2.1E-09	7.3E-08	7.3E-08	8.5E-07	8.5E-07	1.5E-01	4.0E-03	1.1E-08	1.1E-08	2.1E-04	2.1E-04
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	2.0E+01	7.5E-05	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-07	6.73E-07	9.1E-09	9.1E-09	3.2E-07	3.2E-07	3.7E-06	3.7E-06	-	2.0E-03	-	-	1.9E-03	1.9E-03
COBALT	1.56E-07	1.56E-07	3.4E-11	3.4E-11	1.2E-09	1.2E-09	1.4E-08	1.4E-08	-	3.0E-04	-	-	4.6E-05	4.6E-05
CYANIDE	1.88E-06	1.88E-06	1.0E-09	1.0E-09	3.5E-08	3.5E-08	4.1E-07	4.1E-07	-	1.4E-01	-	-	3.0E-06	3.0E-06
FORMALDEHYDE	8.88E-07	8.88E-07	1.4E-09	1.4E-09	4.8E-08	4.8E-08	5.6E-07	5.6E-07	2.1E-02	2.0E-01	1.0E-09	1.0E-09	2.8E-06	2.8E-06
HEPTACHLOR	1.13E-09	1.13E-09	1.2E-09	1.2E-09	4.1E-08	4.1E-08	4.8E-07	4.8E-07	4.5E+00	5.0E-04	1.8E-07	1.8E-07	9.6E-04	9.6E-04
ISOPROPANOL	6.50E-04	6.50E-04	4.9E-07	4.9E-07	1.7E-05	1.7E-05	2.0E-04	2.0E-04	-	2.0E+00	-	-	1.0E-04	1.0E-04
LEAD	Child Risk Evaluated Separetely		-	-	-	-	-	-	8.5E-03	-	-	-	-	-
MANGANESE	1.46E-05	1.46E-05	7.9E-09	7.9E-09	2.8E-07	2.8E-07	3.2E-06	3.2E-06	-	1.2E-03	-	-	2.7E-03	2.7E-03
MOLYBDENUM	6.24E-06	6.24E-06	3.4E-09	3.4E-09	1.2E-07	1.2E-07	1.4E-06	1.4E-06	-	5.0E-03	-	-	2.7E-04	2.7E-04
NITROGEN, NITRATE (AS N)	1.78E-03	1.78E-03	9.6E-07	9.6E-07	3.4E-05	3.4E-05	3.9E-04	3.9E-04	-	1.6E+00	-	-	2.4E-04	2.5E-04
PERCHLORATE	8.45E-07	8.45E-07	1.2E-09	1.2E-09	4.1E-08	4.1E-08	4.8E-07	4.8E-07	-	7.0E-04	-	-	6.9E-04	6.9E-04
SELENIUM	1.94E-06	1.94E-06	1.1E-09	1.1E-09	3.7E-08	3.7E-08	4.3E-07	4.3E-07	-	5.0E-03	-	-	8.5E-05	
TERT-BUTYL METHYL ETHER	9.33E-08	9.33E-08	2.3E-10	2.3E-10	8.0E-09	8.0E-09	9.3E-08	9.3E-08	1.8E-03	-	1.4E-11	1.4E-11	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-06	2.69E-06	1.7E-07	1.7E-07	6.0E-06	6.0E-06	7.0E-05	7.0E-05	5.4E-01	6.0E-03	3.2E-06	3.3E-06	1.17E-02	1.17E-02
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-06	1.48E-06	8.0E-10	8.0E-10	2.8E-08	2.8E-08	3.3E-07	3.3E-07	-	2.3E-04	-	-	1.4E-03	1.4E-03
TOTALS											**7.6E-06**	**7.6E-06**	**1.9E-01**	**1.9E-01**

Notes:

mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day

RME= reasonable maximum exposure
CTE = central tendency exposure
hr = hours

cm/hr centimeters per hour
g/mol = grams per mol
hr/event = hours per event

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Tevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHANE	6.75E-03	1.00E+00	100.00%	2.58E-02	3.77E-01	9.04E-01
1,1-DICHLOROETHENE	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,2,3-TRICHLOROPROPANE	7.52E-03	1.00E+00	100.00%	3.51E-02	7.04E-01	1.69E+00
1,2-DICHLOROETHANE	4.20E-03	1.00E+00	100.00%	1.61E-02	3.77E-01	9.04E-01
1,4-DIOXANE (P-DIOXANE)	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
BARIUM	1.00E-03	1.00E+00	100.00%	4.54E-03	6.34E-01	1.52E+00
BENZENE	1.49E-02	1.00E+00	100.00%	5.07E-02	2.88E-01	6.91E-01
BIS(2-ETHYLHEXYL) PHTHALATE	1.13E+00	1.00E+00	100.00%	8.59E+00	1.62E+01	7.29E+01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
CARBON TETRACHLORIDE	1.63E-02	1.00E+00	100.00%	7.78E-02	7.64E-01	1.83E+00
CHROMIUM, HEXAVALENT	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
COBALT	4.00E-04	1.00E+00	100.00%	1.18E-03	2.25E-01	5.40E-01
CYANIDE	1.00E-03	1.00E+00	100.00%	1.96E-03	1.47E-01	3.53E-01
FORMALDEHYDE	1.82E-03	1.00E+00	100.00%	3.84E-03	1.55E-01	3.72E-01
HEPTACHLOR	1.43E-01	1.00E+00	100.00%	1.06E+00	1.30E+01	5.01E+01
ISOPROPANOL	7.78E-04	1.00E+00	100.00%	2.32E-03	2.28E-01	5.48E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
PERCHLORATE	1.00E-03	1.00E+00	100.00%	4.17E-03	4.78E-01	1.15E+00
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
TERT-BUTYL METHYL ETHER	2.11E-03	1.00E+00	100.00%	7.62E-03	3.28E-01	7.87E-01
TETRACHLOROETHYLENE(PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

Potential Health Risks to Child Residents via Direct Dermal Contact with Site Tap Water - Worked Equations

Dermal Absorbed Dose

DAD = (DAevent x EF x ED x EV x SA) / (BW x AT)

DAD = ((mg/event-cm2) x (days/year) x (years) x (events/day) x (cm2)) / ((kg) x (days/year))

DAD = (~~mg~~/~~event-cm2~~ x ~~days~~/~~year~~ x ~~years~~ x ~~events~~/~~day~~ x ~~cm2~~) / (kg x days/~~year~~)

DAD = mg / kg-day

1,4-Dioxane - Carcinogenic CTE DAD

DADc = (2.89E-09 (mg/event-cm2) x 350 (days/year) x 6 (years) x 1 (events/day) x 6365) / (15 (kg) x 25550 (days/year))

DADc = 1.01E-07 mg / kg-days

Tetrachloroethylene - Noncarcinogenic RME DAD

DADnc = (1.72E-07 (mg/event-cm2) x 350 (days/year) x 6 (years) x 1 (events/day) x 6378) / (15 (kg) x 2190 (days/year))

DADnc = 7.02E-05 mg / kg-days

Excess Cancer Risk Equation

CR = DAD x SFo

CR = (mg/kg-day) x (mg/kg-day)$^{-1}$

CR = ~~mg~~/~~kg-day~~ x ~~kg-day~~/~~mg~~

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 1.0E-07 (mg/kg-day) x 1.0E-01 (mg/kg-day)$^{-1}$

CR = 1.0E-08

Hazard Quotient Equation

HQ = DAD / RfD

HQ = (mg/kg-day) / (mg/kg-day) = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

HQ = 7.02E-05 (mg/kg-day) / 6.00E-03 (mg/kg-day)

HQ = 1.17E-02

POTENTIAL HEALTH RISKS TO COMMERCIAL WORKERS VIA INCIDENTAL INGESTION OF MONITORING WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)		
C_w = Chemical Concentration in Water (mg/L)	Table 1	
IR = Ingestion rate (L/day) =	2.00	2.00

	CTE	RME
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	25	25
BW = Body Weight (kg) =	80	80
AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	9125	9125

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg-day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-04	2.96E-04	1.8E-06	1.8E-06	5.1E-06	5.1E-06	5.7E-03	-	1.0E-08	1.0E-08	-	-
1,1-DICHLOROETHENE	1.51E-04	1.51E-04	9.2E-07	9.2E-07	2.6E-06	2.6E-06	-	5.0E-02	-	-	5.2E-05	5.2E-05
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-04	5.24E-04	3.2E-06	3.2E-06	9.0E-06	9.0E-06	9.1E-02	-	2.9E-07	2.9E-07	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-03	7.50E-03	4.6E-05	4.6E-05	1.3E-04	1.3E-04	1.0E-01	3.0E-02	4.6E-06	4.6E-06	4.3E-03	4.3E-03
ALUMINUM	2.09E-02	2.09E-02	1.3E-04	1.3E-04	3.6E-04	3.6E-04	-	2.3E+01	-	-	1.6E-05	1.6E-05
ARSENIC	3.20E-04	3.20E-04	2.0E-06	2.0E-06	5.5E-06	5.5E-06	9.5E+00	3.0E-04	1.9E-05	1.9E-05	1.8E-02	1.8E-02
BARIUM	4.17E-02	4.17E-02	2.5E-04	2.5E-04	7.1E-04	7.1E-04	-	2.0E-01	-	-	3.6E-03	3.6E-03
BENZENE	2.73E-05	2.73E-05	1.7E-07	1.7E-07	4.7E-07	4.7E-07	1.0E-01	4.0E-03	1.7E-08	1.7E-08	1.2E-04	1.2E-04
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-04	9.12E-04	5.6E-06	5.6E-06	1.6E-05	1.6E-05	1.4E-02	2.0E-02	7.8E-08	7.8E-08	7.8E-04	7.8E-04
BORON	7.71E-02	7.71E-02	4.7E-04	4.7E-04	1.3E-03	1.3E-03	-	2.0E-01	-	-	6.6E-03	6.6E-03
CARBON TETRACHLORIDE	7.23E-05	7.23E-05	4.4E-07	4.4E-07	1.2E-06	1.2E-06	1.5E-01	4.0E-03	6.6E-08	6.6E-08	3.1E-04	3.1E-04
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	5.0E-01	3.0E-03	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-04	6.73E-04	4.1E-06	4.1E-06	1.2E-05	1.2E-05	-	2.0E-03	-	-	5.8E-03	5.8E-03
COBALT	1.56E-04	1.56E-04	9.6E-07	9.6E-07	2.7E-06	2.7E-06	-	3.0E-04	-	-	8.9E-03	8.9E-03
CYANIDE	1.88E-03	1.88E-03	1.2E-05	1.2E-05	3.2E-05	3.2E-05	-	1.4E-01	-	-	2.3E-04	2.3E-04
FORMALDEHYDE	8.88E-04	8.88E-04	5.4E-06	5.4E-06	1.5E-05	1.5E-05	2.1E-02	2.0E-01	1.1E-07	1.1E-07	7.6E-05	7.6E-05
HEPTACHLOR	1.13E-06	1.13E-06	6.9E-09	6.9E-09	1.9E-08	1.9E-08	4.5E+00	5.0E-04	3.1E-08	3.1E-08	3.9E-05	3.9E-05
ISOPROPANOL	6.50E-01	6.50E-01	4.0E-03	4.0E-03	1.1E-02	1.1E-02	-	2.0E+00	-	-	5.6E-03	5.6E-03
LEAD	2.19E-04	2.19E-04	1.3E-06	1.3E-06	3.8E-06	3.8E-06	8.5E-03	-	1.1E-08	1.1E-08	-	-
MANGANESE	1.46E-02	1.46E-02	8.9E-05	8.9E-05	2.5E-04	2.5E-04	-	1.4E-01	-	-	1.8E-03	1.8E-03
MOLYBDENUM	6.24E-03	6.24E-03	3.8E-05	3.8E-05	1.1E-04	1.1E-04	-	5.0E-03	-	-	2.1E-02	2.1E-02
NITROGEN, NITRATE (AS N)	1.78E+00	1.78E+00	1.1E-02	1.1E-02	3.1E-02	3.1E-02	-	1.6E+00	-	-	1.9E-02	1.9E-02
PERCHLORATE	8.45E-04	8.45E-04	5.2E-06	5.2E-06	1.4E-05	1.4E-05	-	7.0E-04	-	-	2.1E-02	2.1E-02
SELENIUM	1.94E-03	1.94E-03	1.2E-05	1.2E-05	3.3E-05	3.3E-05	-	5.0E-03	-	-	6.7E-03	6.7E-03
TERT-BUTYL METHYL ETHER	9.33E-05	9.33E-05	5.7E-07	5.7E-07	1.6E-06	1.6E-06	1.8E-03	-	1.0E-09	1.0E-09	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-03	2.69E-03	1.6E-05	1.6E-05	4.6E-05	4.6E-05	5.4E-01	6.0E-03	8.9E-06	8.9E-06	7.7E-03	7.7E-03
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-03	1.48E-03	9.1E-06	9.1E-06	2.5E-05	2.5E-05	-	9.0E-03	-	-	2.8E-03	2.8E-03
TOTALS									3.3E-05	3.3E-05	1.3E-01	1.3E-01

Notes:

mg/L = milligrams per liter;
L/day = liters per day;
mg/kg-day = milligrams per kilogram per day

95thile = 95th percentile
RME= reasonable maximum exposure

CDI = chronic daily intake
CTE = central tendency exposure

Potential Health Risks to Commercial Workers via Ingestion of Domestic Tap Water - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{7.5E\text{-}03\ (mg/L) \times 2.0\ (L/day) \times 250\ (days/year) \times 25\ (years)}{80\ (kg) \times 25550\ (days)}$$

$$CDI = 4.6E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{2.7E\text{-}03\ (mg/L) \times 2.0\ (L/day) \times 250\ (days/year) \times 25\ (years)}{80\ (kg) \times 9125\ (days)}$$

$$CDI = 4.6E\text{-}05\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

CR = CDI x SFo

CR = (mg/kg-day) x $(mg/kg\text{-}day)^{-1}$

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 4.6E-05 (mg/kg-day) x 1.0E-01 $(mg/kg\text{-}day)^{-1}$

CR = 4.6E-06

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{4.6E\text{-}05\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

HQ = 7.7E-03

POTENTIAL HEALTH RISKS TO COMMERCIAL WORKERS VIA DIRECT DERMAL CONTACT WITH MONITORING WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $$DA_{event} = t_{event} \times K_p \times C_w$$

Organics in Water where $t_{event} \leq t^*$ $$DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$$

Organics in Water where $t_{event} > t^*$ $$DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

	CTE	RME
tevent = Event Duration (hours/event) =	0.0083	0.0083
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	25	25
EV = Event frequency (events/day) =	10	10
SA = Skin surface area (cm2) =	980	1185
BW = Body Weight (kg) =	80	80
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	9125	9125

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (DAevent) (mg/cm^2-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	(mg/kg-day)$^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-07	2.96E-07	3.1E-10	3.1E-10	9.2E-09	1.1E-08	2.6E-08	3.1E-08	5.7E-03	-	5.3E-11	6.4E-11	-	-
1,1-DICHLOROETHENE	1.51E-07	1.51E-07	2.7E-10	2.7E-10	8.1E-09	9.7E-09	2.3E-08	2.7E-08	-	5.0E-02	-	-	4.5E-07	5.5E-07
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-07	5.24E-07	3.4E-10	3.4E-10	1.0E-08	1.2E-08	2.9E-08	3.5E-08	9.1E-02	-	9.3E-10	1.1E-09	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-06	7.50E-06	3.6E-10	3.6E-10	1.1E-08	1.3E-08	3.0E-08	3.6E-08	1.0E-01	3.0E-02	1.1E-09	1.3E-09	1.0E-06	1.2E-06
ALUMINUM	2.09E-05	2.09E-05	1.7E-10	1.7E-10	5.2E-09	6.3E-09	1.5E-08	1.8E-08	-	2.3E+01	-	-	6.5E-10	7.8E-10
ARSENIC	3.20E-07	3.20E-07	2.7E-12	2.7E-12	8.0E-11	9.6E-11	2.2E-10	2.7E-10	9.5E+00	3.0E-04	7.6E-10	9.1E-10	7.4E-07	9.0E-07
BARIUM	4.17E-05	4.17E-05	3.5E-10	3.5E-10	1.0E-08	1.3E-08	2.9E-08	3.5E-08	-	1.4E-02	-	-	2.1E-06	2.5E-06
BENZENE	2.73E-08	2.73E-08	5.5E-11	5.5E-11	1.6E-09	2.0E-09	4.6E-09	5.6E-09	1.0E-01	4.0E-03	1.6E-10	2.0E-10	1.2E-06	1.4E-06
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-07	9.12E-07	1.0E-06	1.0E-06	3.1E-05	3.8E-05	8.8E-05	1.1E-04	1.4E-02	2.0E-02	4.4E-07	5.3E-07	4.4E-03	5.3E-03
BORON	7.71E-05	7.71E-05	6.4E-10	6.4E-10	1.9E-08	2.3E-08	5.4E-08	6.5E-08	-	2.0E-01	-	-	2.7E-07	3.2E-07
CARBON TETRACHLORIDE	7.23E-08	7.23E-08	2.6E-10	2.6E-10	7.8E-09	9.4E-09	2.2E-08	2.6E-08	1.5E-01	4.0E-03	1.2E-09	1.4E-09	5.4E-06	6.6E-06
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	2.0E+01	7.5E-05	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-07	6.73E-07	1.1E-09	1.1E-09	3.4E-08	4.1E-08	9.5E-08	1.1E-07	-	2.0E-03	-	-	4.7E-05	5.7E-05
COBALT	1.56E-07	1.56E-07	5.2E-13	5.2E-13	1.6E-11	1.9E-11	4.4E-11	5.3E-11	-	3.0E-04	-	-	1.5E-07	1.8E-07
CYANIDE	1.88E-06	1.88E-06	1.6E-11	1.6E-11	4.7E-10	5.7E-10	1.3E-09	1.6E-09	-	1.4E-01	-	-	9.4E-09	1.1E-08
FORMALDEHYDE	8.88E-07	8.88E-07	1.6E-10	1.6E-10	4.8E-09	5.8E-09	1.3E-08	1.6E-08	2.1E-02	2.0E-01	1.0E-10	1.2E-10	6.7E-08	8.1E-08
HEPTACHLOR	1.13E-09	1.13E-09	1.5E-10	1.5E-10	4.4E-09	5.3E-09	1.2E-08	1.5E-08	4.5E+00	5.0E-04	2.0E-08	2.4E-08	2.4E-05	3.0E-05
ISOPROPANOL	6.50E-04	6.50E-04	6.1E-08	6.1E-08	1.8E-06	2.2E-06	5.1E-06	6.2E-06	-	2.0E+00	-	-	2.6E-06	3.1E-06
LEAD	2.19E-07	2.19E-07	1.8E-13	1.8E-13	5.5E-12	6.6E-12	1.5E-11	1.8E-11	8.5E-03	-	4.6E-14	5.6E-14	-	-
MANGANESE	1.46E-05	1.46E-05	1.2E-10	1.2E-10	3.6E-09	4.4E-09	1.0E-08	1.2E-08	-	5.6E-03	-	-	1.8E-06	2.2E-06
MOLYBDENUM	6.24E-06	6.24E-06	5.2E-11	5.2E-11	1.6E-09	1.9E-09	4.3E-09	5.3E-09	-	5.0E-03	-	-	8.7E-07	1.1E-06
NITROGEN, NITRATE (AS N)	1.78E-03	1.78E-03	1.5E-08	1.5E-08	4.4E-07	5.4E-07	1.2E-06	1.5E-06	-	1.6E+00	-	-	7.8E-07	9.4E-07
PERCHLORATE	8.45E-07	8.45E-07	1.5E-10	1.5E-10	4.4E-09	5.3E-09	1.2E-08	1.5E-08	-	7.0E-04	-	-	1.8E-05	2.1E-05
SELENIUM	1.94E-06	1.94E-06	1.6E-11	1.6E-11	4.8E-10	5.8E-10	1.4E-09	1.6E-09	-	5.0E-03	-	-	2.7E-07	
TERT-BUTYL METHYL ETHER	9.33E-08	9.33E-08	2.8E-11	2.8E-11	8.5E-10	1.0E-09	2.4E-09	2.9E-09	1.8E-03	-	1.5E-12	1.8E-12	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-06	2.69E-06	2.1E-08	2.1E-08	6.4E-07	7.7E-07	1.8E-06	2.2E-06	5.4E-01	6.0E-03	3.5E-07	4.2E-07	3.0E-04	3.6E-04
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-06	1.48E-06	1.2E-11	1.2E-11	3.7E-10	4.5E-10	1.0E-09	1.2E-09	-	2.3E-04	-	-	4.4E-06	5.3E-06
TOTALS											**8.1E-07**	**9.8E-07**	**4.8E-03**	**5.8E-03**

Notes:
mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure
CTE = central tendency exposure
hr = hours
cm/hr centimeters per hour
g/mol = grams per mol
hr/event = hours per event

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Ţevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHANE	6.75E-03	1.00E+00	100.00%	2.58E-02	3.77E-01	9.04E-01
1,1-DICHLOROETHENE	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,2,3-TRICHLOROPROPANE	7.52E-03	1.00E+00	100.00%	3.51E-02	7.04E-01	1.69E+00
1,2-DICHLOROETHANE	4.20E-03	1.00E+00	100.00%	1.61E-02	3.77E-01	9.04E-01
1,4-DIOXANE (P-DIOXANE)	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
BARIUM	1.00E-03	1.00E+00	100.00%	4.54E-03	6.34E-01	1.52E+00
BENZENE	1.49E-02	1.00E+00	100.00%	5.07E-02	2.88E-01	6.91E-01
BIS(2-ETHYLHEXYL) PHTHALATE	1.13E+00	1.00E+00	100.00%	8.59E+00	1.62E+01	7.29E+01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
CARBON TETRACHLORIDE	1.63E-02	1.00E+00	100.00%	7.78E-02	7.64E-01	1.83E+00
CHROMIUM, HEXAVALENT	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
COBALT	4.00E-04	1.00E+00	100.00%	1.18E-03	2.25E-01	5.40E-01
CYANIDE	1.00E-03	1.00E+00	100.00%	1.96E-03	1.47E-01	3.53E-01
FORMALDEHYDE	1.82E-03	1.00E+00	100.00%	3.84E-03	1.55E-01	3.72E-01
HEPTACHLOR	1.43E-01	1.00E+00	100.00%	1.06E+00	1.30E+01	5.01E+01
ISOPROPANOL	7.78E-04	1.00E+00	100.00%	2.32E-03	2.28E-01	5.48E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
PERCHLORATE	1.00E-03	1.00E+00	100.00%	4.17E-03	4.78E-01	1.15E+00
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
TERT-BUTYL METHYL ETHER	2.11E-03	1.00E+00	100.00%	7.62E-03	3.28E-01	7.87E-01
TETRACHLOROETHYLENE(PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

Potential Health Risks to Commerical Workers via Direct Dermal Contact with Site Tap Water - Worked Equations

Dermal Absorbed Dose

DAD =	DAevent	x	EF	x	ED	x	EV	x	SA	
			BW	x			AT			
DAD =	(mg/event-cm2)	x	(days/year)	x	(years)	x	(events/day)	x	(cm2)	
			(kg)	x			(days/year)			
DAD =	mg / ~~event-cm2~~	x	~~days~~ / ~~year~~	x	~~years~~	x	~~events~~ / ~~day~~	x	~~cm2~~	
			kg	x			~~days~~ / ~~year~~			
DAD =	mg / kg-day									

1,4-Dioxane - Carcinogenic CTE DAD

DADc =	3.59E-10	(mg/event-cm2) x	250	(days/year) x	25	(years) x	10	(events/day) x	980	
			80	(kg)	x	25550	(days/year)			
DADc =	1.07E-08	mg / kg-days								

Tetrachloroethylene - Noncarcinogenic RME DAD

DADnc =	2.14E-08	(mg/event-cm2) x	250	(days/year) x	25	(years) x	10	(events/day) x	1185	
			80	(kg)	x	9125	(days/year)			
DADnc =	2.17E-06	mg / kg-days								

Excess Cancer Risk Equation

CR =	DAD	x	SFo	
CR =	(mg/kg-day)	x	(mg/kg-day)$^{-1}$	
CR =	~~mg~~ / ~~kg-day~~	x	~~kg-day~~ / ~~mg~~	
CR =	unitless			

1,4-Dioxane - CTE Excess Cancer Risk

CR =	1.1E-08	(mg/kg-day) x	1.0E-01	(mg/kg-day)$^{-1}$
CR =	1.1E-09			

Hazard Quotient Equation

HQ =	DAD / RfD			
HQ =	(mg/kg-day) / (mg/kg-day)	=	HQ =	unitless

Tetrachloroethylene - RME Hazard Quotient

HQ =	2.17E-06 / 6.00E-03	(mg/kg-day) / (mg/kg-day)
HQ =	3.61E-04	

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA INCIDENTAL INGESTION OF MONITORING WELL GROUNDWATER

Ingestion Equation: CDI (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)

	CTE	RME		CTE	RME
CDI = Chronic Daily Intake (mg/kg-day)			EF = Exposure Frequency (days/year) =	250	250
C_w = Chemical Concentration in Water (mg/L)	Table 1		ED = Exposure Duration (years) =	1	1
IR = Ingestion rate (L/day) =	0.002	0.002	BW = Body Weight (kg) =	80	80
			AT_c = Averaging Time (Carcinogenic Effects) (days) =	25550	25550
			AT_{nc} = Averaging Time (Noncarcinogenic Effects) (days) =	365	365

COPC	Groundwater Concentration (mg/L)		Carcinogenic CDI (mg/kg-day)		Noncarcinogenic CDI (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-04	2.96E-04	7.2E-11	7.2E-11	5.1E-09	5.1E-09	5.7E-03	-	4.1E-13	4.1E-13	-	-
1,1-DICHLOROETHENE	1.51E-04	1.51E-04	3.7E-11	3.7E-11	2.6E-09	2.6E-09	-	5.0E-02	-	-	5.2E-08	5.2E-08
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-04	5.24E-04	1.3E-10	1.3E-10	9.0E-09	9.0E-09	9.1E-02	-	1.2E-11	1.2E-11	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-03	7.50E-03	1.8E-09	1.8E-09	1.3E-07	1.3E-07	1.0E-01	3.0E-02	1.8E-10	1.8E-10	4.3E-06	4.3E-06
ALUMINUM	2.09E-02	2.09E-02	5.1E-09	5.1E-09	3.6E-07	3.6E-07	-	2.3E+01	-	-	1.6E-08	1.6E-08
ARSENIC	3.20E-04	3.20E-04	7.8E-11	7.8E-11	5.5E-09	5.5E-09	9.5E+00	3.0E-04	7.4E-10	7.4E-10	1.8E-05	1.8E-05
BARIUM	4.17E-02	4.17E-02	1.0E-08	1.0E-08	7.1E-07	7.1E-07	-	2.0E-01	-	-	3.6E-06	3.6E-06
BENZENE	2.73E-05	2.73E-05	6.7E-12	6.7E-12	4.7E-10	4.7E-10	1.0E-01	4.0E-03	6.7E-13	6.7E-13	1.2E-07	1.2E-07
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-04	9.12E-04	2.2E-10	2.2E-10	1.6E-08	1.6E-08	1.4E-02	2.0E-02	3.1E-12	3.1E-12	7.8E-07	7.8E-07
BORON	7.71E-02	7.71E-02	1.9E-08	1.9E-08	1.3E-06	1.3E-06	-	2.0E-01	-	-	6.6E-06	6.6E-06
CARBON TETRACHLORIDE	7.23E-05	7.23E-05	1.8E-11	1.8E-11	1.2E-09	1.2E-09	1.5E-01	4.0E-03	2.7E-12	2.7E-12	3.1E-07	3.1E-07
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	5.0E-01	3.0E-03	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-04	6.73E-04	1.6E-10	1.6E-10	1.2E-08	1.2E-08	-	2.0E-03	-	-	5.8E-06	5.8E-06
COBALT	1.56E-04	1.56E-04	3.8E-11	3.8E-11	2.7E-09	2.7E-09	-	3.0E-04	-	-	8.9E-06	8.9E-06
CYANIDE	1.88E-03	1.88E-03	4.6E-10	4.6E-10	3.2E-08	3.2E-08	-	1.4E-01	-	-	2.3E-07	2.3E-07
FORMALDEHYDE	8.88E-04	8.88E-04	2.2E-10	2.2E-10	1.5E-08	1.5E-08	2.1E-02	2.0E-01	4.6E-12	4.6E-12	7.6E-08	7.6E-08
HEPTACHLOR	1.13E-06	1.13E-06	2.8E-13	2.8E-13	1.9E-11	1.9E-11	4.5E+00	5.0E-04	1.2E-12	1.2E-12	3.9E-08	3.9E-08
ISOPROPANOL	6.50E-01	6.50E-01	1.6E-07	1.6E-07	1.1E-05	1.1E-05	-	2.0E+00	-	-	5.6E-06	5.6E-06
LEAD	2.19E-04	2.19E-04	5.4E-11	5.4E-11	3.8E-09	3.8E-09	8.5E-03	-	4.6E-13	4.6E-13	-	-
MANGANESE	1.46E-02	1.46E-02	3.6E-09	3.6E-09	2.5E-07	2.5E-07	-	1.4E-01	-	-	1.8E-06	1.8E-06
MOLYBDENUM	6.24E-03	6.24E-03	1.5E-09	1.5E-09	1.1E-07	1.1E-07	-	5.0E-03	-	-	2.1E-05	2.1E-05
NITROGEN, NITRATE (AS N)	1.78E+00	1.78E+00	4.4E-07	4.4E-07	3.1E-05	3.1E-05	-	1.6E+00	-	-	1.9E-05	1.9E-05
PERCHLORATE	8.45E-04	8.45E-04	2.1E-10	2.1E-10	1.4E-08	1.4E-08	-	7.0E-04	-	-	2.1E-05	2.1E-05
SELENIUM	1.94E-03	1.94E-03	4.8E-10	4.8E-10	3.3E-08	3.3E-08	-	5.0E-03	-	-	6.7E-06	6.7E-06
TERT-BUTYL METHYL ETHER	9.33E-05	9.33E-05	2.3E-11	2.3E-11	1.6E-09	1.6E-09	1.8E-03	-	4.1E-14	4.1E-14	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-03	2.69E-03	6.6E-10	6.6E-10	4.6E-08	4.6E-08	5.4E-01	6.0E-03	3.6E-10	3.6E-10	7.7E-06	7.7E-06
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-03	1.48E-03	3.6E-10	3.6E-10	2.5E-08	2.5E-08	-	9.0E-03	-	-	2.8E-06	2.8E-06
TOTALS									1.3E-09	1.3E-09	1.3E-04	1.3E-04

Notes: mg/L = milligrams per liter; L/day = liters per day; CDI = chronic daily intake; CTE = central tendency exposure; mg/kg-day = milligrams per kilogram per day; RME= reasonable maximum exposure

Potential Health Risks to Construction Workers via Ingestion of Domestic Tap Water - Worked Equations

CDI Equation

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times ATc}$$

$$CDI = \frac{(mg/L) \times (L/day) \times (days/year) \times (years)}{(kg) \times (days)}$$

$$CDI = \frac{\frac{mg}{\cancel{L}} \times \frac{\cancel{L}}{\cancel{day}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years}}{kg\text{-}days}$$

$$CDI = \frac{mg}{kg\text{-}days}$$

1,4-Dioxane - Carcinogenic CTE CDI

$$CDI = \frac{7.5E\text{-}03\ (mg/L) \times 0.002\ (L/day) \times 250\ (days/year) \times 1\ (years)}{80\ (kg) \times 25550\ (days)}$$

$$CDI = 1.8E\text{-}09\ \frac{mg}{kg\text{-}days}$$

Tetrachloroethylene - Noncarcinogenic RME CDI

$$CDI = \frac{2.7E\text{-}03\ (mg/L) \times 0.002\ (L/day) \times 250\ (days/year) \times 1\ (years)}{80\ (kg) \times 365\ (days)}$$

$$CDI = 4.6E\text{-}08\ \frac{mg}{kg\text{-}days}$$

Excess Cancer Risk Equation

$$CR = CDI \times SFo$$

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

$$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$$CR = 1.8E\text{-}09\ (mg/kg\text{-}day) \times 1.0E\text{-}01\ (mg/kg\text{-}day)^{-1}$$

$$\boxed{CR = 1.8E\text{-}10}$$

Hazard Quotient Equation

$$HQ = \frac{CDI}{RF}$$

$$HQ = \frac{\cancel{(mg/kg\text{-}day)}}{\cancel{(mg/kg\text{-}day)}} = unitless$$

Tetrachloroethylene - RME Hazard Quotient

$$HQ = \frac{4.6E\text{-}08\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$$

$$\boxed{HQ = 7.7E\text{-}06}$$

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA INHALATION OF VOLATILES FROM MONITORING WELL GROUNDWATER

VOC Inhalation Equation: EC = (C_A x ET x EF x ED) / AT

	CTE	RME
ET = Exposure Time (hours/day) =	2.00	2.00
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	1	1
ATc = Averaging Time (70 years x 24 hours/day x 365 days/year) =	613,200	613,200
Atnc = Averaging Time (1 years x 24 hours/day x 365 days/year) =	8,760	8,760

COPC	Groundwater Concentration (µg/l)		Henry's Law Constant (H')	Concentration in Air (µg/m3)		Exposure Concentration (EC) Carcinogenic (µg/m3)		Exposure Concentration (EC) Non-Carcinogenic (µg/m3)		Inhalation Unit Risk	Inhalation RfC	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	(unitless)	CTE	RME	CTE	RME	CTE	RME	(µg/m3)-1	(ug/m3)	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-01	2.96E-01	2.30E-01	6.8E+01	6.8E+01	5.5E-02	5.5E-02	3.9E+00	3.9E+00	1.6E-06	-	8.9E-08	8.9E-08	-	-
1,1-DICHLOROETHENE	1.51E-01	1.51E-01	1.07E+00	1.6E+02	1.6E+02	1.3E-01	1.3E-01	9.2E+00	9.2E+00	-	7.0E+01	-	-	1.3E-01	1.3E-01
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		1.40E-02	-	-	-	-	-	-	-	3.0E-01	-	-	-	-
1,2-DICHLOROETHANE	5.24E-01	5.24E-01	4.82E-02	2.5E+01	2.5E+01	2.1E-02	2.1E-02	1.4E+00	1.4E+00	2.6E-05	4.0E+02	5.4E-07	5.4E-07	3.6E-03	3.6E-03
1,4-DIOXANE (P-DIOXANE)	7.50E+00	7.50E+00	1.96E-04	1.5E+00	1.5E+00	1.2E-03	1.2E-03	8.4E-02	8.4E-02	7.7E-06	3.0E+01	9.2E-09	9.2E-09	2.8E-03	2.8E-03
ALUMINUM	2.09E+01	2.09E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
ARSENIC	3.20E-01	3.20E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
BARIUM	4.17E+01	4.17E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
BENZENE	2.73E-02	2.73E-02	2.27E-01	6.2E+00	6.2E+00	5.0E-03	5.0E-03	3.5E-01	3.5E-01	2.2E-06	3.0E+01	1.1E-08	1.1E-08	1.2E-02	1.2E-02
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-01	9.12E-01	1.10E-05	1.0E-02	1.0E-02	8.2E-06	8.2E-06	5.7E-04	5.7E-04	2.4E-06	-	2.0E-11	2.0E-11	-	-
BORON	7.71E+01	7.71E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON TETRACHLORIDE	7.23E-02	7.23E-02	1.13E+00	8.2E+01	8.2E+01	6.6E-02	6.6E-02	4.7E+00	4.7E+00	6.0E-06	1.0E+02	4.0E-07	4.0E-07	4.7E-02	4.7E-02
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	-	-	-	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-01	6.73E-01	1.67E-01	1.1E+02	1.1E+02	9.1E-02	9.1E-02	6.4E+00	6.4E+00	-	8.0E+00	-	-	8.0E-01	8.0E-01
COBALT	1.56E-01	1.56E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
CYANIDE	1.88E+00	1.88E+00	4.15E-03	7.8E+00	7.8E+00	6.4E-03	6.4E-03	4.5E-01	4.5E-01	-	-	-	-	-	-
FORMALDEHYDE	8.88E-01	8.88E-01	1.38E-05	1.2E-02	1.2E-02	1.0E-05	1.0E-05	7.0E-04	7.0E-04	6.0E-06	-	6.0E-11	6.0E-11	-	-
HEPTACHLOR	1.13E-03	1.13E-03	1.20E-02	1.4E-02	1.4E-02	1.1E-05	1.1E-05	7.7E-04	7.7E-04	1.3E-03	-	1.4E-08	1.4E-08	-	-
ISOPROPANOL	6.50E+02	6.50E+02	3.31E-04	2.2E+02	2.2E+02	1.8E-01	1.8E-01	1.2E+01	1.2E+01	-	2.0E+02	-	-	6.1E-02	6.1E-02
LEAD	2.19E-01	2.19E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
MANGANESE	1.46E+01	1.46E+01	-	-	-	-	-	-	-	-	-	-	-	-	-
MOLYBDENUM	6.24E+00	6.24E+00		-	-	-	-	-	-	-	-	-	-	-	-
NITROGEN, NITRATE (AS N)	1.78E+03	1.78E+03	-	-	-	-	-	-	-	-	-	-	-	-	-
PERCHLORATE	8.45E-01	8.45E-01	-	-	-	-	-	-	-	-	-	-	-	-	-
SELENIUM	1.94E+00	1.94E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TERT-BUTYL METHYL ETHER	9.33E-02	9.33E-02	2.40E-02	2.2E+00	2.2E+00	1.8E-03	1.8E-03	1.3E-01	1.3E-01	2.6E-07	3.0E+00	4.7E-10	4.7E-10	4.3E-02	4.3E-02
TETRACHLOROETHYLENE(PCE)	2.69E+00	2.69E+00	7.24E-01	1.9E+03	1.9E+03	1.6E+00	1.6E+00	1.1E+02	1.1E+02	6.1E-06	3.5E+01	9.7E-06	9.7E-06	3.2E+00	3.2E+00
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		4.03E-01	-	-	-	-	-	-	4.1E-06	2.0E+00	-	-	-	-
VANADIUM	1.48E+00	1.48E+00	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL												**1.07E-05**	**1.07E-05**	**4.27E+00**	**4.27E+00**

Notes:

µg/L = micrograms per Liter
µg/m^3 = micrograms per cubic meter
C_a = Chemical Concentration in Air (µg/m^3)

RfC = reference concentration
EC = Effects Concentration
CTE = central tendency exposure

Henry's Law Constants taken from US EPA RSL Table
H' = Henry's Law Constant (unitless)
RME= reasonable maximum exposure

Potential Health Risks to Adult Residents Via Inhalation of Vapors Emanating from Groundwater - Showering - Worked Equations

CDI Equation

EC = (CA x ET x EF x ED) / AT

EC = ((µg/m3) x (hours/day) x (days/year) x (years)) / (hours)

EC = ((µg/m3) x (~~hours~~/~~day~~) x (~~days~~/~~years~~) x ~~years~~) / ~~hours~~

EC = µg/m3

1,4-Dioxane - Carcinogenic CTE EC

ECc = (1.47E+00 (ug/m3) x 2.00 (hours/day) x 250 (days/year) x 1 (years)) / (613,200 (hours))

ECc = 1.20E-03 µg/m3

Tetrachloroethylene - Noncarcinogenic RME EC

Ecnc = (1.94E+03 (ug/m3) x 2.00 (hours/day) x 250 (days/year) x 1 (years)) / (8,760 (hours))

Ecnc = 1.11E+02 µg/m3

Excess Cancer Risk Equation

CR = Ecc x IUR

CR = (µg/m3) x (µg/m3)-1

CR = ~~µg~~/~~m3~~ x ~~m3~~/~~µg~~

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

CR = 1.2E-03 (µg/m3) x 7.7E-06 (µg/m3)-1

CR = 9.2E-09

Hazard Quotient Equation

HQ = ECnc / RfC

HQ = ~~(µg/m3)~~ / ~~(µg/m3)~~ = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

HQ = 1.11E+02 (µg/m3) / 35 (µg/m3)

HQ = 3.2E+00

POTENTIAL HEALTH RISKS TO CONSTRUCTION WORKERS VIA DIRECT DERMAL CONTACT WITH MONITORING WELL GROUNDWATER

DAD = DAevent x EF x ED x EV x SA/BW x AT

Inorganics in Water = $DA_{event} = t_{event} \times K_p \times C_w$

Organics in Water where $t_{event} \le t^*$ $DA_{event} = 2FA \times K_p \times C_w \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$

Organics in Water where $t_{event} > t^*$ $DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

	CTE	RME
tevent = Event Duration (hours/event) =	2.000	2.000
EF = Exposure Frequency (days/year) =	250	250
ED = Exposure Duration (years) =	1	1
EV = Event frequency (events/day) =	1	1
SA = Skin surface area (cm2) =	3527	3527
ATc = Averaging Time (days/yr) =	25550	25550
Atnc = Averaging Time (days/yr) =	365	365
BW = Body Weight (kg) =	80	80

COPC	Groundwater Concentration (mg/cm3)		Absorbed Dose Per Event (mg/cm^2-event)		Dermal Absorbed Dose Carcinogenic (mg/kg-day)		Dermal Absorbed Dose Non-Carcinogenic (mg/kg-day)		Slope Factor (SF_{abs})	Reference Dose (RfD_{abs})	Excess Cancer Risk (unitless)		Hazard Quotient (unitless)	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	CTE	RME	CTE	RME
1,1-DICHLOROETHANE	2.96E-07	2.96E-07	5.4E-09	5.4E-09	2.3E-09	2.3E-09	1.6E-07	1.6E-07	5.7E-03	-	1.3E-11	1.3E-11	-	-
1,1-DICHLOROETHENE	1.51E-07	1.51E-07	4.7E-09	4.7E-09	2.0E-09	2.0E-09	1.4E-07	1.4E-07	-	5.0E-02	-	-	2.9E-06	2.9E-06
1,2,3-TRICHLOROPROPANE	Mutagen Evaluated Separetely		-	-	-	-	-	-	3.0E+01	4.0E-03	-	-	-	-
1,2-DICHLOROETHANE	5.24E-07	5.24E-07	6.0E-09	6.0E-09	2.6E-09	2.6E-09	1.8E-07	1.8E-07	9.1E-02	-	2.4E-10	2.4E-10	-	-
1,4-DIOXANE (P-DIOXANE)	7.50E-06	7.50E-06	6.6E-09	6.6E-09	2.8E-09	2.8E-09	2.0E-07	2.0E-07	1.0E-01	3.0E-02	2.8E-10	2.8E-10	6.6E-06	6.6E-06
ALUMINUM	2.09E-05	2.09E-05	4.2E-08	4.2E-08	1.8E-08	1.8E-08	1.3E-06	1.3E-06	-	2.3E+01	-	-	5.6E-08	5.6E-08
ARSENIC	3.20E-07	3.20E-07	6.4E-10	6.4E-10	2.8E-10	2.8E-10	1.9E-08	1.9E-08	9.5E+00	3.0E-04	2.6E-09	2.6E-09	6.4E-05	6.4E-05
BARIUM	4.17E-05	4.17E-05	8.3E-08	8.3E-08	3.6E-08	3.6E-08	2.5E-06	2.5E-06	-	1.4E-02	-	-	1.8E-04	1.8E-04
BENZENE	2.73E-08	2.73E-08	1.0E-09	1.0E-09	4.4E-10	4.4E-10	3.1E-08	3.1E-08	1.0E-01	4.0E-03	4.4E-11	4.4E-11	7.7E-06	7.7E-06
BIS(2-ETHYLHEXYL) PHTHALATE	9.12E-07	9.12E-07	1.6E-05	1.6E-05	7.0E-06	7.0E-06	4.9E-04	4.9E-04	1.4E-02	2.0E-02	9.8E-08	9.8E-08	2.4E-02	2.4E-02
BORON	7.71E-05	7.71E-05	1.5E-07	1.5E-07	6.6E-08	6.6E-08	4.7E-06	4.7E-06	-	2.0E-01	-	-	2.3E-05	2.3E-05
CARBON TETRACHLORIDE	7.23E-08	7.23E-08	4.1E-09	4.1E-09	1.8E-09	1.8E-09	1.2E-07	1.2E-07	1.5E-01	4.0E-03	2.7E-10	2.7E-10	3.1E-05	3.1E-05
CHROMIUM, HEXAVALENT	Mutagen Evaluated Separetely		-	-	-	-	-	-	2.0E+01	7.5E-05	-	-	-	-
CIS-1,2-DICHLOROETHYLENE	6.73E-07	6.73E-07	2.0E-08	2.0E-08	8.6E-09	8.6E-09	6.0E-07	6.0E-07	-	2.0E-03	-	-	3.0E-04	3.0E-04
COBALT	1.56E-07	1.56E-07	1.3E-10	1.3E-10	5.4E-11	5.4E-11	3.8E-09	3.8E-09	-	3.0E-04	-	-	1.3E-05	1.3E-05
CYANIDE	1.88E-06	1.88E-06	3.8E-09	3.8E-09	1.6E-09	1.6E-09	1.1E-07	1.1E-07	-	1.4E-01	-	-	8.1E-07	8.1E-07
FORMALDEHYDE	8.88E-07	8.88E-07	3.7E-09	3.7E-09	1.6E-09	1.6E-09	1.1E-07	1.1E-07	2.1E-02	2.0E-01	3.4E-11	3.4E-11	5.6E-07	5.6E-07
HEPTACHLOR	1.13E-09	1.13E-09	2.3E-09	2.3E-09	9.8E-10	9.8E-10	6.8E-08	6.8E-08	4.5E+00	5.0E-04	4.4E-09	4.4E-09	1.4E-04	1.4E-04
ISOPROPANOL	6.50E-04	6.50E-04	1.2E-06	1.2E-06	5.4E-07	5.4E-07	3.7E-05	3.7E-05	-	2.0E+00	-	-	1.9E-05	1.9E-05
LEAD	2.19E-07	2.19E-07	4.4E-11	4.4E-11	1.9E-11	1.9E-11	1.3E-09	1.3E-09	8.5E-03	-	1.6E-13	1.6E-13	-	-
MANGANESE	1.46E-05	1.46E-05	2.9E-08	2.9E-08	1.3E-08	1.3E-08	8.8E-07	8.8E-07	-	5.6E-03	-	-	1.6E-04	1.6E-04
MOLYBDENUM	6.24E-06	6.24E-06	1.2E-08	1.2E-08	5.4E-09	5.4E-09	3.8E-07	3.8E-07	-	5.0E-03	-	-	7.5E-05	7.5E-05
NITROGEN, NITRATE (AS N)	1.78E-03	1.78E-03	3.6E-06	3.6E-06	1.5E-06	1.5E-06	1.1E-04	1.1E-04	-	1.6E+00	-	-	6.7E-05	6.7E-05
PERCHLORATE	8.45E-07	8.45E-07	2.5E-09	2.5E-09	1.1E-09	1.1E-09	7.5E-08	7.5E-08	-	7.0E-04	-	-	1.1E-04	1.1E-04
SELENIUM	1.94E-06	1.94E-06	3.9E-09	3.9E-09	1.7E-09	1.7E-09	1.2E-07	1.2E-07	-	5.0E-03	-	-	2.3E-05	
TERT-BUTYL METHYL ETHER	9.33E-08	9.33E-08	5.2E-10	5.2E-10	2.2E-10	2.2E-10	1.6E-08	1.6E-08	1.8E-03	-	4.0E-13	4.0E-13	-	-
TETRACHLOROETHYLENE(PCE)	2.69E-06	2.69E-06	3.3E-07	3.3E-07	1.4E-07	1.4E-07	1.0E-05	1.0E-05	5.4E-01	6.0E-03	7.7E-08	7.7E-08	1.7E-03	1.7E-03
TRICHLOROETHYLENE (TCE)	Mutagen Evaluated Separetely		-	-	-	-	-	-	4.6E-02	5.0E-04	-	-	-	-
VANADIUM	1.48E-06	1.48E-06	3.0E-09	3.0E-09	1.3E-09	1.3E-09	9.0E-08	9.0E-08	-	2.3E-04	-	-	3.8E-04	3.8E-04
TOTALS											**1.8E-07**	**1.8E-07**	**2.8E-02**	**2.8E-02**

Notes:
mg/cm^3 = micrograms per cubic centimeter
mg/kg-event = milligram per kilogram per event
mg/kg-day = milligrams per kilogram per day
RME= reasonable maximum exposure
CTE = central tendency exposure
hr = hours
cm/hr centimeters per hour
g/mol = grams per mol
hr/event = hours per event

Dermal Physicochemical Parameters

COPC	Kp	FA	ABS	B	Ʈevent	t*
	cm/hr	unitless	unitless	unitless	hr/ event	hr
1,1-DICHLOROETHANE	6.75E-03	1.00E+00	100.00%	2.58E-02	3.77E-01	9.04E-01
1,1-DICHLOROETHENE	1.17E-02	1.00E+00	100.00%	4.43E-02	3.67E-01	8.81E-01
1,2,3-TRICHLOROPROPANE	7.52E-03	1.00E+00	100.00%	3.51E-02	7.04E-01	1.69E+00
1,2-DICHLOROETHANE	4.20E-03	1.00E+00	100.00%	1.61E-02	3.77E-01	9.04E-01
1,4-DIOXANE (P-DIOXANE)	3.32E-04	1.00E+00	100.00%	1.20E-03	3.28E-01	7.86E-01
ALUMINUM	1.00E-03	1.00E+00	100.00%	2.00E-03	1.49E-01	3.57E-01
ARSENIC	1.00E-03	1.00E+00	100.00%	3.40E-03	2.87E-01	6.90E-01
BARIUM	1.00E-03	1.00E+00	100.00%	4.54E-03	6.34E-01	1.52E+00
BENZENE	1.49E-02	1.00E+00	100.00%	5.07E-02	2.88E-01	6.91E-01
BIS(2-ETHYLHEXYL) PHTHALATE	1.13E+00	1.00E+00	100.00%	8.59E+00	1.62E+01	7.29E+01
BORON	1.00E-03	1.00E+00	100.00%	1.43E-03	1.26E-01	3.02E-01
CARBON TETRACHLORIDE	1.63E-02	1.00E+00	100.00%	7.78E-02	7.64E-01	1.83E+00
CHROMIUM, HEXAVALENT	2.00E-03	1.00E+00	100.00%	5.55E-03	2.06E-01	4.93E-01
CIS-1,2-DICHLOROETHYLENE	1.10E-02	1.00E+00	100.00%	4.17E-02	3.67E-01	8.81E-01
COBALT	4.00E-04	1.00E+00	100.00%	1.18E-03	2.25E-01	5.40E-01
CYANIDE	1.00E-03	1.00E+00	100.00%	1.96E-03	1.47E-01	3.53E-01
FORMALDEHYDE	1.82E-03	1.00E+00	100.00%	3.84E-03	1.55E-01	3.72E-01
HEPTACHLOR	1.43E-01	1.00E+00	100.00%	1.06E+00	1.30E+01	5.01E+01
ISOPROPANOL	7.78E-04	1.00E+00	100.00%	2.32E-03	2.28E-01	5.48E-01
LEAD	1.00E-04	1.00E+00	100.00%	5.54E-04	1.52E+00	3.65E+00
MANGANESE	1.00E-03	1.00E+00	100.00%	2.85E-03	2.14E-01	5.13E-01
MOLYBDENUM	1.00E-03	1.00E+00	100.00%	3.77E-03	3.62E-01	8.70E-01
NITROGEN, NITRATE (AS N)	1.00E-03	1.00E+00	100.00%	3.03E-03	2.34E-01	5.61E-01
PERCHLORATE	1.00E-03	1.00E+00	100.00%	4.17E-03	4.78E-01	1.15E+00
SELENIUM	1.00E-03	1.00E+00	100.00%	3.42E-03	2.91E-01	6.99E-01
TERT-BUTYL METHYL ETHER	2.11E-03	1.00E+00	100.00%	7.62E-03	3.28E-01	7.87E-01
TETRACHLOROETHYLENE(PCE)	3.34E-02	1.00E+00	100.00%	1.65E-01	8.92E-01	2.14E+00
TRICHLOROETHYLENE (TCE)	1.16E-02	1.00E+00	100.00%	5.11E-02	5.72E-01	1.37E+00
VANADIUM	1.00E-03	1.00E+00	100.00%	2.75E-03	2.03E-01	4.87E-01

Potential Health Risks to Commerical Workers via Direct Dermal Contact with Site Tap Water - Worked Equations

Dermal Absorbed Dose

$$DAD = \frac{DAevent \times EF \times ED \times EV \times SA}{BW \times AT}$$

$$DAD = \frac{(mg/event\text{-}cm2) \times (days/year) \times (years) \times (events/day) \times (cm2)}{(kg) \times (days/year)}$$

$$DAD = \frac{\frac{mg}{\cancel{event\text{-}cm2}} \times \frac{\cancel{days}}{\cancel{year}} \times \cancel{years} \times \frac{\cancel{events}}{day} \times \cancel{cm2}}{kg \times \frac{\cancel{days}}{\cancel{year}}}$$

$$DAD = \boxed{\frac{mg}{kg\text{-}day}}$$

1,4-Dioxane - Carcinogenic CTE DAD

$$DADc = \frac{6.60E\text{-}09\ (mg/event\text{-}cm2) \times 250\ (days/year) \times 1\ (years) \times 1\ (events/day) \times 3527}{80\ (kg) \times 25550\ (days/year)}$$

$$DADc = \boxed{2.85E\text{-}09\ \frac{mg}{kg\text{-}days}}$$

Tetrachloroethylene - Noncarcinogenic RME DAD

$$DADnc = \frac{3.31E\text{-}07\ (mg/event\text{-}cm2) \times 250\ (days/year) \times 1\ (years) \times 1\ (events/day) \times 3527}{80\ (kg) \times 365\ (days/year)}$$

$$DADnc = \boxed{1.00E\text{-}05\ \frac{mg}{kg\text{-}days}}$$

Excess Cancer Risk Equation

$CR = DAD \times SFo$

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

$CR = \frac{\cancel{mg}}{\cancel{kg\text{-}day}} \times \frac{\cancel{kg\text{-}day}}{\cancel{mg}}$

CR = unitless

1,4-Dioxane - CTE Excess Cancer Risk

$CR = 2.8E\text{-}09\ (mg/kg\text{-}day) \times 1.0E\text{-}01\ (mg/kg\text{-}day)^{-1}$

$CR = \boxed{2.8E\text{-}10}$

Hazard Quotient Equation

$HQ = \frac{DAD}{RfD}$

$HQ = \frac{(mg/kg\text{-}day)}{(mg/kg\text{-}day)}$ = HQ = unitless

Tetrachloroethylene - RME Hazard Quotient

$HQ = \frac{1.00E\text{-}05\ (mg/kg\text{-}day)}{6.00E\text{-}03\ (mg/kg\text{-}day)}$

$HQ = \boxed{1.67E\text{-}03}$

Appendix D: Mutagen Risk Estimates

RAIS Risk Exposure Models for Chemicals User's Guide

4.9 Resident Tapwater

4.9.5 Mutagenic

The tapwater CDI equations, presented here, contain the following exposure routes:

ingestion of water:

$$\mathrm{CDI}_{\text{water-mu-ing}}\,(\text{mg/kg-day}) = \frac{C_{\text{g-water}}\left(\frac{\mu g}{L}\right) \times \left(\frac{0.001\text{ mg}}{\mu g}\right) \times \mathrm{IFWM}_{\text{res-adj}}\left(\frac{1019.9\text{ L}}{\text{kg}}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\text{ days}}{\text{year}} \times \mathrm{LT}\,(70\text{ years})\right)}$$

where:

$$\mathrm{IFWM}_{\text{res-adj}}\left(\frac{1019.9\text{ L}}{\text{kg}}\right) = \left(\begin{array}{l} \frac{\mathrm{ED}_{0\text{-}2}\,(2\text{ years}) \times \mathrm{EF}_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{IRW}_{0\text{-}2}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times 10}{\mathrm{BW}_{0\text{-}2}\,(15\text{ kg})} + \\ \frac{\mathrm{ED}_{2\text{-}6}\,(4\text{ years}) \times \mathrm{EF}_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{IRW}_{2\text{-}6}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times 3}{\mathrm{BW}_{2\text{-}6}\,(15\text{ kg})} + \\ \frac{\mathrm{ED}_{6\text{-}16}\,(10\text{ years}) \times \mathrm{EF}_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{IRW}_{6\text{-}16}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times 3}{\mathrm{BW}_{6\text{-}16}\,(80\text{ kg})} + \\ \frac{\mathrm{ED}_{16\text{-}26}\,(10\text{ years}) \times \mathrm{EF}_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{IRW}_{16\text{-}26}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times 1}{\mathrm{BW}_{16\text{-}26}\,(80\text{ kg})} \end{array}\right)$$

dermal contact with water:

FOR INORGANICS:

$$\mathrm{CDI}_{\text{water-mu-der}}\,(\text{mg/kg-day}) = \frac{C_{\text{g-water}}\left(\frac{\mu g}{L}\right) \times \left(\frac{0.001\text{ mg}}{\mu g}\right) \times \mathrm{DFWM}_{\text{res-adj}}\left(\frac{8{,}191{,}633\text{ cm}^2\text{- event}}{\text{kg}}\right) \times \left(\frac{L}{1000\text{ cm}^3}\right) \times K_p\left(\frac{\text{cm}}{\text{hour}}\right) \times \mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.6708\text{ hours}}{\text{event}}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\text{ days}}{\text{year}} \times \mathrm{LT}\,(70\text{ years})\right)}$$

where :

$$\mathrm{DFWM}_{\text{res-adj}}\left(\frac{8{,}191{,}633\text{ cm}^2\text{- event}}{\text{kg}}\right) = \left(\begin{array}{l} \left(\frac{\mathrm{EV}_{0\text{-}2}\left(\frac{1\text{ event}}{\text{day}}\right) \times \mathrm{EF}_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{ED}_{0\text{-}2}\,(2\text{ years}) \times \mathrm{SA}_{0\text{-}2}\left(6{,}365\text{ cm}^2\right) \times 10}{\mathrm{BW}_{0\text{-}2}\,(15\text{ kg})}\right) + \\ \left(\frac{\mathrm{EV}_{2\text{-}6}\left(\frac{1\text{ event}}{\text{day}}\right) \times \mathrm{EF}_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{ED}_{2\text{-}6}\,(4\text{ years}) \times \mathrm{SA}_{2\text{-}6}\left(6{,}365\text{ cm}^2\right) \times 3}{\mathrm{BW}_{2\text{-}6}\,(15\text{ kg})}\right) + \\ \left(\frac{\mathrm{EV}_{6\text{-}16}\left(\frac{1\text{ event}}{\text{day}}\right) \times \mathrm{EF}_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{ED}_{6\text{-}16}\,(10\text{ years}) \times \mathrm{SA}_{6\text{-}16}\left(19{,}652\text{ cm}^2\right) \times 3}{\mathrm{BW}_{6\text{-}16}\,(80\text{ kg})}\right) + \\ \left(\frac{\mathrm{EV}_{16\text{-}26}\left(\frac{1\text{ event}}{\text{day}}\right) \times \mathrm{EF}_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times \mathrm{ED}_{16\text{-}26}\,(10\text{ years}) \times \mathrm{SA}_{16\text{-}26}\left(19{,}652\text{ cm}^2\right) \times 1}{\mathrm{BW}_{16\text{-}26}\,(80\text{ kg})}\right) \end{array}\right)$$

and:

$$\mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.6708\text{ hours}}{\text{event}}\right) = \frac{\left(\begin{array}{l} \mathrm{ET}_{\text{event-res(0-2)}}\left(\frac{0.54\text{ hour}}{\text{event}}\right) \times \mathrm{ED}_{0\text{-}2}\,(2\text{ years}) + \mathrm{ET}_{\text{event-res(2-6)}}\left(\frac{0.54\text{ hour}}{\text{event}}\right) \times \mathrm{ED}_{2\text{-}6}\,(4\text{ years}) + \\ \mathrm{ET}_{\text{event-res(6-16)}}\left(\frac{0.71\text{ hours}}{\text{event}}\right) \times \mathrm{ED}_{6\text{-}16}\,(10\text{ years}) + \mathrm{ET}_{\text{event-res(16-26)}}\left(\frac{0.71\text{ hours}}{\text{event}}\right) \times \mathrm{ED}_{16\text{-}26}\,(10\text{ years}) \end{array}\right)}{\mathrm{ED}_{0\text{-}2}\,(2\text{ years}) + \mathrm{ED}_{2\text{-}6}\,(4\text{ years}) + \mathrm{ED}_{6\text{-}16}\,(10\text{ years}) + \mathrm{ED}_{16\text{-}26}\,(10\text{ years})}$$

FOR ORGANICS:

$$\mathrm{CDI}_{\text{water-mu-der}}\,(\text{mg/kg-day}) = \frac{\mathrm{DA}_{\text{event}}\left(\frac{\text{ug}}{\text{cm}^2\text{- event}}\right) \times \mathrm{DFWM}_{\text{res-adj}}\left(\frac{8{,}191{,}633\text{ cm}^2\text{- event}}{\text{kg}}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\text{ days}}{\text{year}} \times \mathrm{LT}\,(70\text{ years})\right) \times \left(\frac{\mu g}{0.001\text{ mg}}\right)}$$

where:

$$\text{IF } \mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.6708\text{ hours}}{\text{event}}\right) \le t^*\ (\text{hours}),$$

then:

$$\mathrm{DA}_{\text{event}}\left(\frac{\text{ug}}{\text{cm}^2\text{- event}}\right) = 2 \times \mathrm{FA} \times K_p\left(\frac{\text{cm}}{\text{hour}}\right) \times C_{\text{g-water}}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\text{ cm}^3}\right) \times \sqrt{\frac{6 \times \tau_{\text{event}}\left(\frac{\text{hours}}{\text{event}}\right) \times \mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.6708\text{ hours}}{\text{event}}\right)}{\pi}}$$

or:

$$\text{IF } \mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.6708\text{ hours}}{\text{event}}\right) > t^*\ (\text{hours}),$$

then:

$$\mathrm{DA}_{\text{event}}\left(\frac{\text{ug}}{\text{cm}^2\text{- event}}\right) = \mathrm{FA} \times K_p\left(\frac{\text{cm}}{\text{hour}}\right) \times C_{\text{g-water}}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\text{ cm}^3}\right) \times \left[\frac{\mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.6708\text{ hours}}{\text{event}}\right)}{1+B} + 2 \times \tau_{\text{event}}\left(\frac{\text{hours}}{\text{event}}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

inhalation of volatiles:

$$\mathrm{CDI}_{\text{water-mu-inh}}\,(\mu g/m^3) = \frac{C_{\text{g-water}}\left(\frac{\mu g}{L}\right) \times K\left(\frac{0.5\text{ L}}{m^3}\right) \times \left(\frac{1\text{ day}}{24\text{ hours}}\right) \times \mathrm{ET}_{\text{res}}\left(\frac{24\text{ hours}}{\text{day}}\right) \times \left(\begin{array}{l} \left(\mathrm{ED}_{0\text{-}2}\,(2\text{ years}) \times \mathrm{EF}_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times 10\right) + \\ \left(\mathrm{ED}_{2\text{-}6}\,(4\text{ years}) \times \mathrm{EF}_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times 3\right) + \\ \left(\mathrm{ED}_{6\text{-}16}\,(10\text{ years}) \times \mathrm{EF}_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times 3\right) + \\ \left(\mathrm{ED}_{16\text{-}26}\,(10\text{ years}) \times \mathrm{EF}_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times 1\right) \end{array}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\text{ days}}{\text{year}} \times \mathrm{LT}\,(70\text{ years})\right)}$$

4.9.7 Trichloroethylene - Carcinogenic and Mutagenic

The tapwater CDI equations, presented here, contain the following exposure routes:

ingestion of water:

$$CDI_{water\text{-}tce\text{-}ing}\,(\text{mg/kg-day}) = \frac{C_{g\text{-}water}\left(\frac{\mu g}{L}\right) \times \left(\frac{1\ \text{mg}}{1000\ \mu g}\right) \times \left(\left(\left(CAF_o\,(0.804) \times IFW_{res\text{-}adj}\left(\frac{327.95\ \text{L}}{\text{kg}}\right)\right)\right) + \left(MAF_o\,(0.202) \times IFWM_{res\text{-}adj}\left(\frac{1019.9\ \text{L}}{\text{kg}}\right)\right)\right)}{AT_{res}\left(\frac{365\ \text{days}}{\text{year}} \times LT\,(70\ \text{years})\right)}$$

where:

$$IFW_{res\text{-}adj}\left(\frac{327.95\ \text{L}}{\text{kg}}\right) = \left(\frac{ED_{res\text{-}c}\,(6\ \text{years}) \times EF_{res\text{-}c}\left(\frac{350\ \text{days}}{\text{year}}\right) \times IRW_{res\text{-}c}\left(\frac{0.78\ \text{L}}{\text{day}}\right)}{BW_{res\text{-}c}\,(15\ \text{kg})} + \frac{\left(ED_{res}\,(26\ \text{years}) - ED_{res\text{-}c}\,(6\ \text{years})\right) \times EF_{res\text{-}a}\left(\frac{350\ \text{days}}{\text{year}}\right) \times IRW_{res\text{-}a}\left(\frac{2.5\ \text{L}}{\text{day}}\right)}{BW_{res\text{-}a}\,(80\ \text{kg})}\right)$$

where:

$$IFWM_{res\text{-}adj}\text{-}\left(\frac{1019.9\ \text{L}}{\text{kg}}\right) = \left(\begin{array}{l}\frac{ED_{0\text{-}2}\,(2\ \text{years}) \times EF_{0\text{-}2}\left(\frac{350\ \text{days}}{\text{year}}\right) \times IRW_{0\text{-}2}\left(\frac{0.78\ \text{L}}{\text{day}}\right) \times 10}{BW_{0\text{-}2}\,(15\ \text{kg})} + \\ \frac{ED_{2\text{-}6}\,(4\ \text{years}) \times EF_{2\text{-}6}\left(\frac{350\ \text{days}}{\text{year}}\right) \times IRW_{2\text{-}6}\left(\frac{0.78\ \text{L}}{\text{day}}\right) \times 3}{BW_{2\text{-}6}\,(15\ \text{kg})} + \\ \frac{ED_{6\text{-}16}\,(10\ \text{years}) \times EF_{6\text{-}16}\left(\frac{350\ \text{days}}{\text{year}}\right) \times IRW_{6\text{-}16}\left(\frac{2.5\ \text{L}}{\text{day}}\right) \times 3}{BW_{6\text{-}16}\,(80\ \text{kg})} + \\ \frac{ED_{16\text{-}26}\,(10\ \text{years}) \times EF_{16\text{-}26}\left(\frac{350\ \text{days}}{\text{year}}\right) \times IRW_{16\text{-}26}\left(\frac{2.5\ \text{L}}{\text{day}}\right) \times 1}{BW_{16\text{-}26}\,(80\ \text{kg})}\end{array}\right)$$

dermal contact with water:

FOR ORGANICS:

$$CDI_{water\text{-}tce\text{-}der}\,(\text{mg/kg-day}) = \frac{DA_{tce\text{-}event}\left(\frac{\text{ug}}{\text{cm}^2\text{- event}}\right) \times \left(\frac{1\text{mg}}{1000\mu g}\right) \times \left(\left(CAF_o\,(0.804) \times DFW_{res\text{-}adj}\left(\frac{2{,}610{,}650\ \text{cm}^2\text{-event-day}}{\text{kg}}\right)\right) + \left(MAF_o\,(0.202) \times DFWM_{res\text{-}adj}\left(\frac{8{,}191{,}633\ \text{events - cm}^2}{\text{kg}}\right)\right)\right)}{AT_{res}\left(\frac{365\ \text{days}}{\text{year}} \times LT\,(70\ \text{years})\right)}$$

IF $ET_{event\text{-}res\text{-}adj}\left(\frac{\text{hours}}{\text{event}}\right) \leq t^*\,(\text{hours})$,

then:

$$DA_{tce\text{-}event}\left(\frac{\text{ug}}{\text{cm}^2\text{- event}}\right) = C_{g\text{-}water}\left(\frac{\mu g}{L}\right) \times \left(\frac{1\ \text{L}}{1000\ \text{cm}^3}\right) \times 2 \times FA \times K_p\left(\frac{\text{cm}}{\text{hour}}\right)\sqrt{\frac{6 \times \tau_{event}\left(\frac{\text{hours}}{\text{event}}\right) \times ET_{event\text{-}res\text{-}madj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right)}{\pi}}$$

or:

IF $ET_{event\text{-}res\text{-}adj}\left(\frac{\text{hours}}{\text{event}}\right) > t^*\,(\text{hours})$,

then:

$$DA_{tce\text{-}event}\left(\frac{\text{ug}}{\text{cm}^2\text{- event}}\right) = C_{g\text{-}water}\left(\frac{\mu g}{L}\right) \times \left(\frac{1\ \text{L}}{1000\ \text{cm}^3}\right) \times FA \times K_p\left(\frac{\text{cm}}{\text{hour}}\right) \times \left[\frac{ET_{event\text{-}res\text{-}madj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{\text{hours}}{\text{event}}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$DFW_{res\text{-}adj}\left(\frac{2{,}610{,}650\ \text{cm}^2\text{-event-day}}{\text{kg}}\right) = \left(\frac{EV_{res\text{-}c}\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_{res\text{-}c}\,(6\ \text{years}) \times EF_{res\text{-}c}\left(\frac{350\ \text{days}}{\text{year}}\right) \times SA_{res\text{-}c}\left(6{,}365\ \text{cm}^2\right)}{BW_{res\text{-}c}\,(15\ \text{kg})} + \frac{EV_{res\text{-}a}\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_{res\text{-}a}\,(20\ \text{years}) \times EF_{res\text{-}a}\left(\frac{350\ \text{days}}{\text{year}}\right) \times SA_{res\text{-}a}\left(19{,}652\ \text{cm}^2\right)}{BW_{res\text{-}a}\,(80\ \text{kg})}\right)$$

where:

$$DFWM_{res\text{-}adj}\left(\frac{8{,}191{,}633\ \text{events - cm}^2}{\text{kg}}\right) = \left(\begin{array}{l}\left(\frac{EV_{0\text{-}2}\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_{0\text{-}2}\,(2\ \text{years}) \times EF_{0\text{-}2}\left(\frac{350\ \text{days}}{\text{year}}\right) \times SA_{0\text{-}2}\left(6{,}365\ \text{cm}^2\right) \times 10}{BW_{0\text{-}2}\,(15\ \text{kg})}\right) + \\ \left(\frac{EV_{2\text{-}6}\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_{2\text{-}6}\,(4\ \text{years}) \times EF_{2\text{-}6}\left(\frac{350\ \text{days}}{\text{year}}\right) \times SA_{2\text{-}6}\left(6{,}365\ \text{cm}^2\right) \times 3}{BW_{2\text{-}6}\,(15\ \text{kg})}\right) + \\ \left(\frac{EV_{6\text{-}16}\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_{6\text{-}16}\,(10\ \text{years}) \times EF_{6\text{-}16}\left(\frac{350\ \text{days}}{\text{year}}\right) \times SA_{6\text{-}16}\left(19{,}652\ \text{cm}^2\right) \times 3}{BW_{6\text{-}16}\,(80\ \text{kg})}\right) + \\ \left(\frac{EV_{16\text{-}26}\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_{16\text{-}26}\,(10\ \text{years}) \times EF_{16\text{-}26}\left(\frac{350\ \text{days}}{\text{year}}\right) \times SA_{16\text{-}26}\left(19{,}652\ \text{cm}^2\right) \times 1}{BW_{16\text{-}26}\,(80\ \text{kg})}\right)\end{array}\right)$$

and:

$$ET_{event\text{-}res\text{-}madj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right) = \frac{\left(\begin{array}{l}ET_{event\text{-}res(0\text{-}2)}\left(\frac{0.54\ \text{hours}}{\text{event}}\right) \times ED_{0\text{-}2}\,(\text{years}) + ET_{event\text{-}res(2\text{-}6)}\left(\frac{0.54\ \text{hours}}{\text{event}}\right) \times ED_{2\text{-}6}\,(\text{years}) + \\ ET_{event\text{-}res(6\text{-}16)}\left(\frac{0.71\ \text{hours}}{\text{event}}\right) \times ED_{6\text{-}16}\,(\text{years}) + ET_{event\text{-}res(16\text{-}26)}\left(\frac{0.71\ \text{hours}}{\text{event}}\right) \times ED_{16\text{-}26}\,(\text{years})\end{array}\right)}{ED_{0\text{-}2}\,(\text{years}) + ED_{2\text{-}6}\,(\text{years}) + ED_{6\text{-}16}\,(\text{years}) + ED_{16\text{-}26}\,(\text{years})}$$

4.9.7 Trichloroethylene - Carcinogenic and Mutagenic (con't)

The tapwater CDI equations, presented here, contain the following exposure routes (con't):
inhalation of volatiles:

$$CDI_{water\text{-}tce\text{-}inh}\left(\mu g/m^3\right)=\frac{C_{g\text{-}water}\left(\frac{\mu g}{L}\right)\times ET_{res}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times K\left(\frac{0.5\ L}{m^3}\right)\times\left(\begin{array}{l}\left(EF_{res}\left(\frac{350\ days}{year}\right)\times ED_{res}(26\ years)\times CAF_i(0.756)\right)+\\ \left(\begin{array}{l}\left(ED_{0\text{-}2}(2\ years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times MAF_i(0.244)\times 10\right)+\\ \left(ED_{2\text{-}6}(4\ years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times MAF_i(0.244)\times 3\right)+\\ \left(ED_{6\text{-}16}(10\ years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times MAF_i(0.244)\times 3\right)+\\ \left(ED_{16\text{-}26}(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times MAF_i(0.244)\times 1\right)\end{array}\right)\end{array}\right)}{AT_{res}\left(\frac{365\ days}{year}\times LT(70\ years)\right)}$$

Site-specific Risk
Resident Equation Inputs for Tapwater
Appendix Table D1

Variable/Unit	Value
LT (lifetime) year	70
K (volatilization factor of Andelman) L/m^3	0.5
l_{sc} (apparent thickness of stratum corneum) cm	0.001
ED_{res} (exposure duration - resident) year	26
ED_{res-c} (exposure duration - child) year	6
ED_{res-a} (exposure duration - adult) year	20
ED_{0-2} (mutagenic exposure duration first phase) year	2
ED_{2-6} (mutagenic exposure duration second phase) year	4
ED_{6-16} (mutagenic exposure duration third phase) year	10
ED_{16-26} (mutagenic exposure duration fourth phase) year	10
EF_{res} (exposure frequency) day/year	350
EF_{res-c} (exposure frequency - child) day/year	350
EF_{res-a} (exposure frequency - adult) day/year	350
EF_{0-2} (mutagenic exposure frequency first phase) day/year	350
EF_{2-6} (mutagenic exposure frequency second phase) day/year	350
EF_{6-16} (mutagenic exposure frequency third phase) day/year	350
EF_{16-26} (mutagenic exposure frequency fourth phase) day/year	350
$ET_{res-adj}$ (age-adjusted exposure time) hour/event	0.67077
$ET_{res-madj}$ (mutagenic age-adjusted exposure time) hour/event	0.67077
ET_{res} (exposure time) hour/day	0.671
ET_{res-c} (dermal exposure time - child) hour/event	0.54
ET_{res-a} (dermal exposure time - adult) hour/event	0.71
ET_{res-c} (inhalation exposure time - child) hour/day	0.54
ET_{res-a} (inhalation exposure time - adult) hour/day	0.71
ET_{0-2} (mutagenic inhalation exposure time first phase) hour/day	0.54
ET_{2-6} (mutagenic inhalation exposure time second phase) hour/day	0.54
ET_{6-16} (mutagenic inhalation exposure time third phase) hour/day	0.71
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hour/day	0.71
ET_{0-2} (mutagenic dermal exposure time first phase) hour/event	0.54
ET_{2-6} (mutagenic dermal exposure time second phase) hour/event	0.54
ET_{6-16} (mutagenic dermal exposure time third phase) hour/event	0.71
ET_{16-26} (mutagenic dermal exposure time fourth phase) hour/event	0.71
BW_{res-a} (body weight - adult) kg	80
BW_{res-c} (body weight - child) kg	15
BW_{0-2} (mutagenic body weight) kg	15
BW_{2-6} (mutagenic body weight) kg	15
BW_{6-16} (mutagenic body weight) kg	80
BW_{16-26} (mutagenic body weight) kg	80
$IFW_{res-adj}$ (adjusted intake factor) L/kg	158.2
$IFW_{res-adj}$ (adjusted intake factor) L/kg	158.2
$IFWM_{res-adj}$ (mutagenic adjusted intake factor) L/kg	493.733
$IFWM_{res-adj}$ (mutagenic adjusted intake factor) L/kg	493.733
IRW_{res-c} (water intake rate - child) L/day	0.38
IRW_{res-a} (water intake rate - adult) L/day	1.2
IRW_{0-2} (mutagenic water intake rate) L/day	0.38
IRW_{2-6} (mutagenic water intake rate) L/day	0.38

Appendix Table D1 - PW CTE Inputs

IRW_{6-16} (mutagenic water intake rate) L/day	1.2
IRW_{16-26} (mutagenic water intake rate) L/day	1.2
EV_{res-a} (events - adult) per day	1
EV_{res-c} (events - child) per day	1
EV_{0-2} (mutagenic events) per day	1
EV_{2-6} (mutagenic events) per day	1
EV_{6-16} (mutagenic events) per day	1
EV_{16-26} (mutagenic events) per day	1
$DFW_{res-adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650
$DFWM_{res-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633
$DFW_{res-adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650
$DFWM_{res-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633
SA_{res-c} (skin surface area - child) cm^2	6365
SA_{res-a} (skin surface area - adult) cm^2	19652
SA_{0-2} (mutagenic skin surface area) cm^2	6365
SA_{2-6} (mutagenic skin surface area) cm^2	6365
SA_{6-16} (mutagenic skin surface area) cm^2	19652
SA_{16-26} (mutagenic skin surface area) cm^2	19652

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Appendix Table D2 - PW CTE Risk Estimates

Site-specific Risk

Resident RISK for Tapwater

Chemical	**Mutagen?**	**VOC?**	**Chronic RfD (mg/kg-day)**	**RfD Reference**	Chronic RfC (mg/m3)	**RfC Reference**	Ingestion SF (mg/kg-day)-1	**SFO Reference**	Inhalation Unit Risk (µg/m3)-1	**IUR Reference**
Chromium(VI)	Yes	No	0.003	USER	0.0001	USER	0.5	USER	0.084	USER
Trichloroethylene	Yes	Yes	0.0005	USER	0.002	USER	0.046	USER	0.0000041	USER
**Total Risk/HI*			-		-		-		-	

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	ABS_{gi}	Kp	**FA**	**In EPD?**	Carcinogenic Absorbed dose per event (mg/cm^2-event)	Noncancer-child Absorbed dose per event (mg/cm^2-event)	Noncancer-adult Absorbed dose per event (mg/cm^2-event)	Noncancer-adjusted Absorbed dose per event (mg/cm^2-event)	**Tap Concentration (ug/L)**
Chromium(VI)	0.025	0.002	1	Yes	-	0.00000213	0.0000028	0.00000264	1.97
Trichloroethylene	1	0.0116	1	Yes	0.000133	0.000119	0.000137	0.000133	6.7
**Total Risk/HI*	-	-	-		-	-	-	-	-

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	**Child Ingestion Noncarcinogenic CDI**	**Child Inhalation Noncarcinogenic CDI**	**Child Dermal Noncarcinogenic CDI**	**Adult Ingestion Noncarcinogenic CDI**	**Adult Inhalation Noncarcinogenic CDI**	**Adult Dermal Noncarcinogenic CDI**	**Adjusted Ingestion Noncarcinogenic CDI**	**Adjusted Inhalation Noncarcinogenic CDI**	**Adjusted Dermal Noncarcinogenic CDI**	**Ingestion Carcinogenic CDI**
Chromium(VI)	4.8E-05	2.1E-05	8.7E-07	2.8E-05	2.8E-05	6.6E-07	3.3E-05	2.6E-05	7.3E-07	3.8E-05
Trichloroethylene	1.6E-04	7.2E-05	4.9E-05	9.6E-05	9.5E-05	3.2E-05	1.1E-04	9.0E-05	3.7E-05	6.0E-05
**Total Risk/HI*	-	-	-	-	-	-	-	-	-	-

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Chemical	**Inhalation Carcinogenic CDI**	**Dermal Carcinogenic CDI**	**Child Ingestion HQ**	**Child Inhalation HQ**	**Child Dermal HQ**	**Child Total HI**	**Adult Ingestion HQ**	**Adult Inhalation HQ**	**Adult Dermal HQ**	**Adult Total HI**
Chromium(VI)	2.9E-02	8.5E-07	0.016	-	0.0115	0.0275	0.00945	-	0.00879	0.0182
Trichloroethylene	5.1E-02	2.0E-05	0.326	0.0361	0.0972	0.459	0.193	0.0475	0.0645	0.305
**Total Risk/HI*	-	-	*0.341*	*0.0361*	*0.109*	*0.486*	*0.202*	*0.0475*	*0.0733*	*0.323*

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Chemical	**Adult Total HI**	**Adjusted Ingestion HQ**	**Adjusted Inhalation HQ**	**Adjusted Dermal HQ**	**Adjusted Total HI**	**Ingestion Risk**	**Inhalation Risk**	**Dermal Risk**	**Total Risk**
Chromium(VI)	0.0182	0.0109	-	0.00969	0.0206	1.9E-05	-	1.7E-05	3.6E-05
Trichloroethylene	0.305	0.223	0.0449	0.0732	0.342	2.7E-06	2.1E-07	9.0E-07	3.8E-06
**Total Risk/HI*	*0.323*	*0.234*	*0.0449*	*0.0829*	*0.362*	*2.2E-05*	*2.1E-07*	*1.8E-05*	*4.0E-05*

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

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Site-specific Risk

Resident Equation Inputs for Tapwater

Variable/Unit	Value
LT (lifetime) year	70
K (volatilization factor of Andelman) L/m³	0.5
I_{sc} (apparent thickness of stratum corneum) cm	0.001
ED_{res} (exposure duration - resident) year	26
ED_{res-c} (exposure duration - child) year	6
ED_{res-a} (exposure duration - adult) year	20
ED_{0-2} (mutagenic exposure duration first phase) year	2
ED_{2-6} (mutagenic exposure duration second phase) year	4
ED_{6-16} (mutagenic exposure duration third phase) year	10
ED_{16-26} (mutagenic exposure duration fourth phase) year	10
EF_{res} (exposure frequency) day/year	350
EF_{res-c} (exposure frequency - child) day/year	350
EF_{res-a} (exposure frequency - adult) day/year	350
EF_{0-2} (mutagenic exposure frequency first phase) day/year	350
EF_{2-6} (mutagenic exposure frequency second phase) day/year	350
EF_{6-16} (mutagenic exposure frequency third phase) day/year	350
EF_{16-26} (mutagenic exposure frequency fourth phase) day/year	350
$ET_{res-adj}$ (age-adjusted exposure time) hour/event	0.67077
$ET_{res-madj}$ (mutagenic age-adjusted exposure time) hour/event	0.67077
ET_{res} (exposure time) hour/day	0.671
ET_{res-c} (dermal exposure time - child) hour/event	0.54
ET_{res-a} (dermal exposure time - adult) hour/event	0.71
ET_{res-c} (inhalation exposure time - child) hour/day	0.54
ET_{res-a} (inhalation exposure time - adult) hour/day	0.71
ET_{0-2} (mutagenic inhalation exposure time first phase) hour/day	0.54
ET_{2-6} (mutagenic inhalation exposure time second phase) hour/day	0.54
ET_{6-16} (mutagenic inhalation exposure time third phase) hour/day	0.71
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hour/day	0.71
ET_{0-2} (mutagenic dermal exposure time first phase) hour/event	0.54
ET_{2-6} (mutagenic dermal exposure time second phase) hour/event	0.54
ET_{6-16} (mutagenic dermal exposure time third phase) hour/event	0.71
ET_{16-26} (mutagenic dermal exposure time fourth phase) hour/event	0.71
BW_{res-a} (body weight - adult) kg	80
BW_{res-c} (body weight - child) kg	15
BW_{0-2} (mutagenic body weight) kg	15
BW_{2-6} (mutagenic body weight) kg	15
BW_{6-16} (mutagenic body weight) kg	80
BW_{16-26} (mutagenic body weight) kg	80
$IFW_{res-adj}$ (adjusted intake factor) L/kg	327.95

$IFW_{res\text{-}adj}$ (adjusted intake factor) L/kg	327.95
$IFWM_{res\text{-}adj}$ (mutagenic adjusted intake factor) L/kg	1019.9
$IFWM_{res\text{-}adj}$ (mutagenic adjusted intake factor) L/kg	1019.9
$IRW_{res\text{-}c}$ (water intake rate - child) L/day	0.78
$IRW_{res\text{-}a}$ (water intake rate - adult) L/day	2.5
$IRW_{0\text{-}2}$ (mutagenic water intake rate) L/day	0.78
$IRW_{2\text{-}6}$ (mutagenic water intake rate) L/day	0.78
$IRW_{6\text{-}16}$ (mutagenic water intake rate) L/day	2.5
$IRW_{16\text{-}26}$ (mutagenic water intake rate) L/day	2.5
$EV_{res\text{-}a}$ (events - adult) per day	1
$EV_{res\text{-}c}$ (events - child) per day	1
$EV_{0\text{-}2}$ (mutagenic events) per day	1
$EV_{2\text{-}6}$ (mutagenic events) per day	1
$EV_{6\text{-}16}$ (mutagenic events) per day	1
$EV_{16\text{-}26}$ (mutagenic events) per day	1
$DFW_{res\text{-}adj}$ (age-adjusted dermal factor) cm^2-event/kg	2721670
$DFWM_{res\text{-}adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8419740
$DFW_{res\text{-}adj}$ (age-adjusted dermal factor) cm^2-event/kg	2721670
$DFWM_{res\text{-}adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8419740
$SA_{res\text{-}c}$ (skin surface area - child) cm^2	6378
$SA_{res\text{-}a}$ (skin surface area - adult) cm^2	20900
$SA_{0\text{-}2}$ (mutagenic skin surface area) cm^2	6378
$SA_{2\text{-}6}$ (mutagenic skin surface area) cm^2	6378
$SA_{6\text{-}16}$ (mutagenic skin surface area) cm^2	20900
$SA_{16\text{-}26}$ (mutagenic skin surface area) cm^2	20900

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Appendix Table D4 - PW RME Risk Estimates

Site-specific Risk

Resident RISK for Tapwater

Chemical	**Mutagen?**	**VOC?**	**Chronic RfD (mg/kg-day)**	**RfD Reference**	Chronic RfC (mg/m3)	**RfC Reference**	Ingestion SF (mg/kg-day)-1	**SFO Reference**	Inhalation Unit Risk (µg/m3)-1	**IUR Reference**
Chromium(VI)	Yes	No	0.003	USER	0.0001	USER	0.5	USER	0.084	USER
Trichloroethylene	Yes	Yes	0.0005	USER	0.002	USER	0.046	USER	0.0000041	USER
**Total Risk/HI*			-		-		-		-	

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	ABS_{gi}	Kp	**FA**	**In EPD?**	Carcinogenic Absorbed dose per event (mg/cm^2-event)	Noncancer-child Absorbed dose per event (mg/cm^2-event)	Noncancer-adult Absorbed dose per event (mg/cm^2-event)	Noncancer-adjusted Absorbed dose per event (mg/cm^2-event)	**Tap Concentration (ug/L)**
Chromium(VI)	0.025	0.002	1	Yes	-	0.00000213	0.0000028	0.00000264	1.97
Trichloroethylene	1	0.0116	1	Yes	0.000133	0.000119	0.000137	0.000133	6.7
**Total Risk/HI*	-	-	-		-	-	-	-	-

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	**Child Ingestion Noncarcinogenic CDI**	**Child Inhalation Noncarcinogenic CDI**	**Child Dermal Noncarcinogenic CDI**	**Adult Ingestion Noncarcinogenic CDI**	**Adult Inhalation Noncarcinogenic CDI**	**Adult Dermal Noncarcinogenic CDI**	**Adjusted Ingestion Noncarcinogenic CDI**	**Adjusted Inhalation Noncarcinogenic CDI**	**Adjusted Dermal Noncarcinogenic CDI**	**Ingestion Carcinogenic CDI**
Chromium(VI)	0.0000982	0.0000213	0.000000867	5.9E-05	2.8E-05	7.0E-07	6.8E-05	2.6E-05	7.6E-07	7.9E-05
Trichloroethylene	0.000334	0.0000723	0.0000487	2.0E-04	9.5E-05	3.4E-05	2.3E-04	9.0E-05	3.8E-05	1.2E-04
**Total Risk/HI*	-	-	-	-	-	-	-	-	-	-

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Chemical	**Inhalation Carcinogenic CDI**	**Dermal Carcinogenic CDI**	**Child Ingestion HQ**	**Child Inhalation HQ**	**Child Dermal HQ**	**Child Total HI**	**Adult Ingestion HQ**	**Adult Inhalation HQ**	**Adult Dermal HQ**	**Adult Total HI**
Chromium(VI)	2.9E-02	8.7E-07	0.0327	-	0.0116	0.0443	0.0197	-	0.00934	0.029
Trichloroethylene	5.1E-02	2.0E-05	0.668	0.0361	0.0974	0.802	0.402	0.0475	0.0686	0.518
**Total Risk/HI*	-	-	*0.701*	*0.0361*	*0.109*	*0.846*	*0.421*	*0.0475*	*0.078*	*0.547*

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Chemical	**Adjusted Ingestion HQ**	**Adjusted Inhalation HQ**	**Adjusted Dermal HQ**	**Adjusted Total HI**	**Ingestion Risk**	**Inhalation Risk**	**Dermal Risk**	**Total Risk**
Chromium(VI)	0.0227	-	0.0101	0.0328	3.9E-05	-	1.7E-05	5.7E-05
Trichloroethylene	0.463	0.0449	0.0763	0.584	5.7E-06	2.1E-07	9.3E-07	6.8E-06
**Total Risk/HI*	*0.486*	*0.0449*	*0.0864*	*0.617*	*4.5E-05*	*2.1E-07*	***1.8E-05***	***6.4E-05***

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

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Site-specific Risk
Resident Equation Inputs for Tapwater

Variable/Unit	Value
LT (lifetime) year	70
K (volatilization factor of Andelman) L/m³	0.5
I_{sc} (apparent thickness of stratum corneum) cm	0.001
ED_{res} (exposure duration - resident) year	26
ED_{res-c} (exposure duration - child) year	6
ED_{res-a} (exposure duration - adult) year	20
ED_{0-2} (mutagenic exposure duration first phase) year	2
ED_{2-6} (mutagenic exposure duration second phase) year	4
ED_{6-16} (mutagenic exposure duration third phase) year	10
ED_{16-26} (mutagenic exposure duration fourth phase) year	10
EF_{res} (exposure frequency) day/year	350
EF_{res-c} (exposure frequency - child) day/year	350
EF_{res-a} (exposure frequency - adult) day/year	350
EF_{0-2} (mutagenic exposure frequency first phase) day/year	350
EF_{2-6} (mutagenic exposure frequency second phase) day/year	350
EF_{6-16} (mutagenic exposure frequency third phase) day/year	350
EF_{16-26} (mutagenic exposure frequency fourth phase) day/year	350
$ET_{res-adj}$ (age-adjusted exposure time) hour/event	0.67077
$ET_{res-madj}$ (mutagenic age-adjusted exposure time) hour/event	0.67077
ET_{res} (exposure time) hour/day	0.671
ET_{res-c} (dermal exposure time - child) hour/event	0.54
ET_{res-a} (dermal exposure time - adult) hour/event	0.71
ET_{res-c} (inhalation exposure time - child) hour/day	0.54
ET_{res-a} (inhalation exposure time - adult) hour/day	0.71
ET_{0-2} (mutagenic inhalation exposure time first phase) hour/day	0.54
ET_{2-6} (mutagenic inhalation exposure time second phase) hour/day	0.54
ET_{6-16} (mutagenic inhalation exposure time third phase) hour/day	0.71
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hour/day	0.71
ET_{0-2} (mutagenic dermal exposure time first phase) hour/event	0.54

$ET_{2\text{-}6}$ (mutagenic dermal exposure time second phase) hour/event	0.54
$ET_{6\text{-}16}$ (mutagenic dermal exposure time third phase) hour/event	0.71
$ET_{16\text{-}26}$ (mutagenic dermal exposure time fourth phase) hour/event	0.71
$BW_{res\text{-}a}$ (body weight - adult) kg	80
$BW_{res\text{-}c}$ (body weight - child) kg	15
$BW_{0\text{-}2}$ (mutagenic body weight) kg	15
$BW_{2\text{-}6}$ (mutagenic body weight) kg	15
$BW_{6\text{-}16}$ (mutagenic body weight) kg	80
$BW_{16\text{-}26}$ (mutagenic body weight) kg	80
$IFW_{res\text{-}adj}$ (adjusted intake factor) L/kg	158.2
$IFW_{res\text{-}adj}$ (adjusted intake factor) L/kg	158.2
$IFWM_{res\text{-}adj}$ (mutagenic adjusted intake factor) L/kg	493.733
$IFWM_{res\text{-}adj}$ (mutagenic adjusted intake factor) L/kg	493.733
$IRW_{res\text{-}c}$ (water intake rate - child) L/day	0.38
$IRW_{res\text{-}a}$ (water intake rate - adult) L/day	1.2
$IRW_{0\text{-}2}$ (mutagenic water intake rate) L/day	0.38
$IRW_{2\text{-}6}$ (mutagenic water intake rate) L/day	0.38
$IRW_{6\text{-}16}$ (mutagenic water intake rate) L/day	1.2
$IRW_{16\text{-}26}$ (mutagenic water intake rate) L/day	1.2
$EV_{res\text{-}a}$ (events - adult) per day	1
$EV_{res\text{-}c}$ (events - child) per day	1
$EV_{0\text{-}2}$ (mutagenic events) per day	1
$EV_{2\text{-}6}$ (mutagenic events) per day	1
$EV_{6\text{-}16}$ (mutagenic events) per day	1
$EV_{16\text{-}26}$ (mutagenic events) per day	1
$DFW_{res\text{-}adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650
$DFWM_{res\text{-}adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633
$DFW_{res\text{-}adj}$ (age-adjusted dermal factor) cm^2-event/kg	2610650
$DFWM_{res\text{-}adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8191633
$SA_{res\text{-}c}$ (skin surface area - child) cm^2	6365
$SA_{res\text{-}a}$ (skin surface area - adult) cm^2	19652
$SA_{0\text{-}2}$ (mutagenic skin surface area) cm^2	6365
$SA_{2\text{-}6}$ (mutagenic skin surface area) cm^2	6365
$SA_{6\text{-}16}$ (mutagenic skin surface area) cm^2	19652
$SA_{16\text{-}26}$ (mutagenic skin surface area) cm^2	19652

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Appendix Table D6 - MW CTE Risk Estimates

Site-specific Risk

Resident RISK for Tapwater

Chemical	**Mutagen?**	**VOC?**	**Chronic RfD (mg/kg-day)**	**RfD Reference**	Chronic RfC (mg/m3)	**RfC Reference**	Ingestion SF (mg/kg-day)-1	**SFO Reference**	Inhalation Unit Risk (µg/m3)-1
Chromium(VI)	Yes	No	3.00E-03	USER	1.00E-04	USER	5.00E-01	USER	8.40E-02
Trichloroethylene	*Yes*	*Yes*	*5.00E-04*	*USER*	*2.00E-03*	*USER*	*4.60E-02*	*USER*	*4.10E-06*
Trichloropropane, 1,2,3-	Yes	Yes	4.00E-03	USER	3.00E-04	USER	3.00E+01	USER	-
*Total Risk/HI			-		-		-		-

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	ABS_{gi}	Kp	**FA**	**In EPD?**	Carcinogenic Absorbed dose per event (mg/cm^{2}-event)	Noncancer-child Absorbed dose per event (mg/cm^{2}-event)	Noncancer-adult Absorbed dose per event (mg/cm^{2}-event)	Noncancer-adjusted Absorbed dose per event (mg/cm^{2}-event)	**Tap Concentration (ug/L)**
Chromium(VI)	2.50E-02	2.00E-03	1.00E+00	Yes	-	1.06E-06	1.40E-06	1.32E-06	9.85E-01
Trichloroethylene	*1.00E+00*	*1.16E-02*	*1.00E+00*	*Yes*	*1.30E-04*	*1.17E-04*	*1.34E-04*	*1.30E-04*	*6.54E+00*
Trichloropropane, 1,2,3-	1.00E+00	7.52E-03	1.00E+00	Yes	1.43E-08	1.28E-08	1.47E-08	1.43E-08	1.00E-03
*Total Risk/HI	-	-	-		-	-	-	-	-

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	Child Ingestion Noncarcinogenic CDI	Child Inhalation Noncarcinogenic CDI	Child Dermal Noncarcinogenic CDI	Adult Ingestion Noncarcinogenic CDI	Adult Inhalation Noncarcinogenic CDI	Adult Dermal Noncarcinogenic CDI	Adjusted Ingestion Noncarcinogenic CDI	Adjusted Inhalation Noncarcinogenic CDI	Adjusted Dermal Noncarcinogenic CDI
Chromium(VI)	2.39E-05	1.06E-05	4.33E-07	1.42E-05	1.40E-05	3.29E-07	1.64E-05	1.32E-05	3.64E-07
Trichloroethylene	1.59E-04	7.05E-05	4.74E-05	9.40E-05	9.27E-05	3.15E-05	1.09E-04	8.76E-05	3.57E-05
Trichloropropane, 1,2,3-	*2.43E-08*	*1.08E-08*	*5.21E-09*	*1.44E-08*	*1.42E-08*	*3.46E-09*	*1.67E-08*	*1.34E-08*	*3.93E-09*
**Total Risk/HI*	-	-	-	-	-	-	-	-	-

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Chemical	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI	Child Ingestion HQ	Child Inhalation HQ	Child Dermal HQ	Child Total HI	Adult Ingestion HQ	Adult Inhalation HQ	Adult Dermal HQ
Chromium(VI)	1.44E-02	4.24E-07	7.98E-03	-	5.77E-03	1.37E-02	4.72E-03	-	4.39E-03
Trichloroethylene	4.93E-02	1.91E-05	3.18E-01	3.53E-02	9.48E-02	4.48E-01	1.88E-01	4.64E-02	6.30E-02
Trichloropropane, 1,2,3-	*1.46E-05*	*4.58E-09*	*6.07E-06*	*3.60E-05*	1.30E-06	4.33E-05	*3.60E-06*	*4.73E-05*	*8.65E-07*
**Total Risk/HI*	-	-	0.33	*0.04*	0.10	0.46	0.19	0.05	0.07

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Appendix Table D6 - MW CTE Risk Estimates

Chemical	Adjusted Ingestion HQ	Adjusted Inhalation HQ	Adjusted Dermal HQ	Adjusted Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Chromium(VI)	5.47E-03	-	4.85E-03	1.03E-02	9.52E-06	-	8.47E-06	1.80E-05
Trichloroethylene	2.18E-01	4.38E-02	7.15E-02	3.33E-01	*2.67E-06*	*2.02E-07*	*8.78E-07*	*3.75E-06*
Trichloropropane, 1,2,3-	*4.17E-06*	*4.47E-05*	*9.82E-07*	*4.98E-05*	*5.80E-07*	-	*1.37E-07*	*7.17E-07*
**Total Risk/HI*	0.22	0.04	0.08	0.34	*1.3E-05*	*2.0E-07*	9.5E-06	2.2E-05

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

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Site-specific Risk
Resident Equation Inputs for Tapwater

Variable/Unit	Value
LT (lifetime) year	70
K (volatilization factor of Andelman) L/m³	0.5
I_{sc} (apparent thickness of stratum corneum) cm	0.001
ED_{res} (exposure duration - resident) year	26
ED_{res-c} (exposure duration - child) year	6
ED_{res-a} (exposure duration - adult) year	20
ED_{0-2} (mutagenic exposure duration first phase) year	2
ED_{2-6} (mutagenic exposure duration second phase) year	4
ED_{6-16} (mutagenic exposure duration third phase) year	10
ED_{16-26} (mutagenic exposure duration fourth phase) year	10
EF_{res} (exposure frequency) day/year	350
EF_{res-c} (exposure frequency - child) day/year	350
EF_{res-a} (exposure frequency - adult) day/year	350
EF_{0-2} (mutagenic exposure frequency first phase) day/year	350
EF_{2-6} (mutagenic exposure frequency second phase) day/year	350
EF_{6-16} (mutagenic exposure frequency third phase) day/year	350
EF_{16-26} (mutagenic exposure frequency fourth phase) day/year	350
$ET_{res-adj}$ (age-adjusted exposure time) hour/event	0.67077
$ET_{res-madj}$ (mutagenic age-adjusted exposure time) hour/event	0.67077
ET_{res} (exposure time) hour/day	0.671
ET_{res-c} (dermal exposure time - child) hour/event	0.54
ET_{res-a} (dermal exposure time - adult) hour/event	0.71
ET_{res-c} (inhalation exposure time - child) hour/day	0.54
ET_{res-a} (inhalation exposure time - adult) hour/day	0.71
ET_{0-2} (mutagenic inhalation exposure time first phase) hour/day	0.54
ET_{2-6} (mutagenic inhalation exposure time second phase) hour/day	0.54
ET_{6-16} (mutagenic inhalation exposure time third phase) hour/day	0.71
ET_{16-26} (mutagenic inhalation exposure time fourth phase) hour/day	0.71
ET_{0-2} (mutagenic dermal exposure time first phase) hour/event	0.54
ET_{2-6} (mutagenic dermal exposure time second phase) hour/event	0.54
ET_{6-16} (mutagenic dermal exposure time third phase) hour/event	0.71
ET_{16-26} (mutagenic dermal exposure time fourth phase) hour/event	0.71
BW_{res-a} (body weight - adult) kg	80
BW_{res-c} (body weight - child) kg	15
BW_{0-2} (mutagenic body weight) kg	15
BW_{2-6} (mutagenic body weight) kg	15
BW_{6-16} (mutagenic body weight) kg	80
BW_{16-26} (mutagenic body weight) kg	80
$IFW_{res-adj}$ (adjusted intake factor) L/kg	327.95
$IFW_{res-adj}$ (adjusted intake factor) L/kg	327.95
$IFWM_{res-adj}$ (mutagenic adjusted intake factor) L/kg	1019.9
$IFWM_{res-adj}$ (mutagenic adjusted intake factor) L/kg	1019.9

Appendix Table D7 - MW RME Inputs

IRW_{res-c} (water intake rate - child) L/day	0.78
IRW_{res-a} (water intake rate - adult) L/day	2.5
IRW_{0-2} (mutagenic water intake rate) L/day	0.78
IRW_{2-6} (mutagenic water intake rate) L/day	0.78
IRW_{6-16} (mutagenic water intake rate) L/day	2.5
IRW_{16-26} (mutagenic water intake rate) L/day	2.5
EV_{res-a} (events - adult) per day	1
EV_{res-c} (events - child) per day	1
EV_{0-2} (mutagenic events) per day	1
EV_{2-6} (mutagenic events) per day	1
EV_{6-16} (mutagenic events) per day	1
EV_{16-26} (mutagenic events) per day	1
$DFW_{res-adj}$ (age-adjusted dermal factor) cm^2-event/kg	2721670
$DFWM_{res-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8419740
$DFW_{res-adj}$ (age-adjusted dermal factor) cm^2-event/kg	2721670
$DFWM_{res-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	8419740
SA_{res-c} (skin surface area - child) cm^2	6378
SA_{res-a} (skin surface area - adult) cm^2	20900
SA_{0-2} (mutagenic skin surface area) cm^2	6378
SA_{2-6} (mutagenic skin surface area) cm^2	6378
SA_{6-16} (mutagenic skin surface area) cm^2	20900
SA_{16-26} (mutagenic skin surface area) cm^2	20900

Site-specific Risk

Resident RISK for Tapwater

Chemical	Mutagen?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m3)	RfC Reference	Ingestion SF (mg/kg-day)-1	SFO Reference	Inhalation Unit Risk (µg/m3)-1	IUR Reference
Chromium(VI)	Yes	No	0.003	USER	0.0001	USER	0.5	USER	0.084	USER
Trichloroethylene	Yes	Yes	0.0005	USER	0.002	USER	0.046	USER	0.0000041	USER
Trichloropropane, 1,2,3-	Yes	Yes	0.004	USER	0.0003	USER	30	USER	-	
Total Risk/HI			-		-		-		-	

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	ABS_{gi}	Kp	FA	In EPD?	Carcinogenic Absorbed dose per event (mg/cm^2-event)	Noncancer-child Absorbed dose per event (mg/cm^2-event)	Noncancer-adult Absorbed dose per event (mg/cm^2-event)	Noncancer-adjusted Absorbed dose per event (mg/cm^2-event)	Tap Concentration (ug/L)
Chromium(VI)	0.025	0.002	1	Yes	-	0.00000106	0.0000014	0.00000132	0.985
Trichloroethylene	1	0.0116	1	Yes	0.00013	0.000117	0.000134	0.00013	6.538
Trichloropropane, 1,2,3-	1	0.00752	1	Yes	1.43E-08	1.28E-08	1.47E-08	1.43E-08	0.001
Total Risk/HI	-	-	-		-	-	-	-	-

Notes: VOC = Volatile organic compound; RfD = reference dose; RfC = Reference concentration; SFO = oral slope factor; FA = Fraction absorbed; IUR = Inhalation unit risk; Kp = dermal permeability coefficient; ABSgi = gastrointestinal absorption

Chemical	Child Ingestion Noncarcinogenic CDI	Child Inhalation Noncarcinogenic CDI	Child Dermal Noncarcinogenic CDI	Adult Ingestion Noncarcinogenic CDI	Adult Inhalation Noncarcinogenic CDI	Adult Dermal Noncarcinogenic CDI	Adjusted Ingestion Noncarcinogenic CDI	Adjusted Inhalation Noncarcinogenic CDI	Adjusted Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI
Chromium(VI)	4.9E-05	1.1E-05	4.3E-07	3.0E-05	1.4E-05	3.5E-07	3.4E-05	1.3E-05	3.8E-07	3.9E-05
Trichloroethylene	3.3E-04	7.1E-05	4.8E-05	2.0E-04	9.3E-05	3.4E-05	2.3E-04	8.8E-05	3.7E-05	1.2E-04
Trichloropropane, 1,2,3-	4.99E-08	1.08E-08	5.22E-09	0.00000003	1.42E-08	3.68E-09	3.46E-08	1.34E-08	4.1E-09	3.99E-08
Total Risk/HI	-	-	-	-	-	-	-	-	-	-

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Chemical	Dermal Carcinogenic CDI	Child Ingestion HQ	Child Inhalation HQ	Child Dermal HQ	Child Total HI	Adult Ingestion HQ	Adult Inhalation HQ	Adult Dermal HQ	Adult Total HI	Adjusted Ingestion HQ
Chromium(VI)	4.4E-07	0.0164	-	0.00578	0.0222	0.00984	-	0.00467	0.0145	0.0113
Trichloroethylene	2.0E-05	0.652	0.0353	0.095	0.782	0.392	0.0464	0.0669	0.505	0.452
Trichloropropane, 1,2,3-	4.71E-09	0.0000125	0.000036	0.00000131	0.0000497	0.00000749	0.0000473	0.00000092	0.0000557	0.00000864
Total Risk/HI	-	0.67	0.04	0.10	0.80	0.40	0.05	0.07	0.52	0.46

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

Appendix Table D8 - MW RME Risk Estimates

Chemical	Adjusted Inhalation HQ	Adjusted Dermal HQ	Adjusted Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Chromium(VI)	-	0.00505	0.0164	2.0E-05	-	8.7E-06	2.8E-05
Trichloroethylene	0.0438	0.0745	0.57	5.5E-06	2.0E-07	9.1E-07	6.6E-06
Trichloropropane, 1,2,3-	0.0000447	0.00000102	0.0000543	1.2E-06	-	1.4E-07	1.3E-06
**Total Risk/HI*	0.04	0.08	0.59	2.6E-05	2.0E-07	9.8E-06	3.6E-05

Notes: CDI = chronic daily intake; HQ = hazard quotient; HI = hazard index

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Appendix E: Lead Models

DIETARY INTAKE -- BASELINE

LEAD MODEL FOR WINDOWS Version 1.1

==

Model Version: 1.1 Build11

User Name:

Date:

Site Name:

Operable Unit:

Run Mode: Research

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.000
1-2	2.000	3.000	32.000	0.000
2-3	3.000	5.000	32.000	0.000
3-4	4.000	5.000	32.000	0.000
4-5	4.000	5.000	32.000	0.000
5-6	4.000	7.000	32.000	0.000
6-7	4.000	7.000	32.000	0.000

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 0.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 0.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	0.000	0.000
1-2	0.000	0.000
2-3	0.000	0.000
3-4	0.000	0.000
4-5	0.000	0.000
5-6	0.000	0.000
6-7	0.000	0.000

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.000	1.116	0.000	0.000
1-2	0.000	0.972	0.000	0.000
2-3	0.000	1.057	0.000	0.000
3-4	0.000	1.014	0.000	0.000
4-5	0.000	0.970	0.000	0.000
5-6	0.000	1.020	0.000	0.000
6-7	0.000	1.105	0.000	0.000

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	0.000	1.116	0.6
1-2	0.000	0.972	0.4
2-3	0.000	1.057	0.4
3-4	0.000	1.014	0.4
4-5	0.000	0.970	0.3
5-6	0.000	1.020	0.3
6-7	0.000	1.105	0.3

Production Wells

LEAD MODEL FOR WINDOWS Version 1.1

```
==================================================================================
     Model Version: 1.1 Build11
     User Name:
     Date:
     Site Name:
     Operable Unit:
     Run Mode: Research

==================================================================================
```

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.000
1-2	2.000	3.000	32.000	0.000
2-3	3.000	5.000	32.000	0.000
3-4	4.000	5.000	32.000	0.000
4-5	4.000	5.000	32.000	0.000
5-6	4.000	7.000	32.000	0.000
6-7	4.000	7.000	32.000	0.000

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

```
****** Drinking Water ******

Water Consumption:
Age     Water (L/day)
-----------------------------------
.5-1      0.200
1-2       0.500
2-3       0.520
3-4       0.530
4-5       0.550
5-6       0.580
6-7       0.590

Drinking Water Concentration: 0.300 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 0.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor:
0.700
Outdoor airborne lead to indoor household dust lead
concentration: 100.000
Use alternate indoor dust Pb sources? No

Age          Soil (µg Pb/g)       House Dust (µg Pb/g)
--------------------------------------------------------
.5-1                0.000                0.000
1-2                 0.000                0.000
2-3                 0.000                0.000
3-4                 0.000                0.000
4-5                 0.000                0.000
5-6                 0.000                0.000
6-7                 0.000                0.000

****** Alternate Intake ******

Age      Alternate (µg Pb/day)
-----------------------------------
.5-1     0.000
1-2      0.000
2-3      0.000
3-4      0.000
4-5      0.000
5-6      0.000
6-7      0.000
```

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.000	1.116	0.000	0.030
1-2	0.000	0.971	0.000	0.074
2-3	0.000	1.056	0.000	0.077
3-4	0.000	1.013	0.000	0.079
4-5	0.000	0.969	0.000	0.082
5-6	0.000	1.020	0.000	0.087
6-7	0.000	1.104	0.000	0.088

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	0.000	1.145	0.6
1-2	0.000	1.045	0.5
2-3	0.000	1.134	0.4
3-4	0.000	1.092	0.4
4-5	0.000	1.051	0.4
5-6	0.000	1.106	0.3
6-7	0.000	1.192	0.3

Monitoring Wells

LEAD MODEL FOR WINDOWS Version 1.1

==

Model Version: 1.1 Build11
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (μg Pb/m^3)
.5-1	1.000	2.000	32.000	0.000
1-2	2.000	3.000	32.000	0.000
2-3	3.000	5.000	32.000	0.000
3-4	4.000	5.000	32.000	0.000
4-5	4.000	5.000	32.000	0.000
5-6	4.000	7.000	32.000	0.000
6-7	4.000	7.000	32.000	0.000

****** Diet ******

Age	Diet Intake(μg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950

5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 0.220 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 0.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	0.000	0.000
1-2	0.000	0.000
2-3	0.000	0.000
3-4	0.000	0.000
4-5	0.000	0.000
5-6	0.000	0.000
6-7	0.000	0.000

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.000	1.116	0.000	0.022
1-2	0.000	0.971	0.000	0.055
2-3	0.000	1.056	0.000	0.057
3-4	0.000	1.013	0.000	0.058
4-5	0.000	0.970	0.000	0.060
5-6	0.000	1.020	0.000	0.063
6-7	0.000	1.104	0.000	0.065

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	0.000	1.137	0.6
1-2	0.000	1.026	0.5
2-3	0.000	1.113	0.4
3-4	0.000	1.071	0.4
4-5	0.000	1.030	0.3
5-6	0.000	1.083	0.3
6-7	0.000	1.169	0.3


Los Angeles
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Department of Water & Power