FREEPORT-McMoRan

Sierrita Operations
Environment, Land & Water Department
6200 W Duval Mine Road
PO Box 527
Green Valley, AZ 85622-0527

June 7, 2016

Electronic Mail and Hand Delivery

Ms. Joey Pace, Project Manager
Arizona Department of Environmental Quality
Voluntary Remediation Program
1110 W. Washington St.
Phoenix, AZ 85007

Re: Voluntary Remediation Program – VRP Site Code: 100073-03
Freeport-McMoRan Sierrita Inc., Green Valley, AZ
Baseline Human Health Risk Assessment

Dear Ms. Pace:

Enclosed you will find the Baseline Human Health Risk Assessment (BHHRA) for Freeport-McMoRan Sierrita Inc. (Sierrita) as part of the Arizona Department of Environmental Quality's (ADEQ's) Voluntary Remediation Program (VRP). This BHHRA was prepared in accordance with the VRP BHHRA Work Plan (Arcadis 2015) approved by ADEQ, and focuses solely on potential impacts associated with exposure to constituents of potential concern (COPCs; site-related constituents) detected in soil and sediment in the following three specific exposure areas (EAs):

- Former Continuous Liquid Extraction and Regeneration (CLEAR) Plant EA, which is composed of the following subareas:
  - Former CLEAR Plant
  - Former E Pond
  - Former Evaporation Pond
  - Old D Pond
- Former Esperanza Mill EA, which is composed of the following subareas:
  - Former Esperanza Mill
  - Former C Pond and C Pond Spoils
  - Former Laydown Yard
  - Former Raffinate Pond
- Former Rhenium Ponds EA, which is a subarea of the Tailings Impoundment Area.

Based on the conclusions of the BHHRA and upon approval of the BHHRA results by the ADEQ, Sierrita intends to request an unconditional No Further Action for the three areas described above.

Please do not hesitate to contact me at (520) 393-2347 if you have any questions regarding this submittal. Thank you for your assistance and cooperation with our efforts to address environmental issues at this Site.

Sincerely,

Deborah L. Chismar

Deborah Chismar
Sr. Environmental Specialist
Freeport-McMoRan Sierrita Inc.

DLC:dc
2060607_003

Copy:
Diana Kelts, Sierrita
Stuart Brown, Freeport-McMoRan Inc.
Katy Brantingham, ARCADIS

Enclosure:
Voluntary Remediation Program Baseline Human Health Risk Assessment, Sierrita Mine, Green Valley, Arizona

ARCADIS Design & Consultancy for natural and built assets

Freeport-McMoRan Sierrita Inc.

VOLUNTARY REMEDIATION PROGRAM

BASELINE HUMAN HEALTH RISK ASSESSMENT

Site Code: 100073-03

Sierrita Mine
Green Valley, Arizona

June 7, 2016

BASELINE HUMAN HEALTH RISK ASSESSMENT

Sierrita Mine

Green Valley, Arizona

Prepared for:

Freeport-McMoRan Sierrita, Inc.

Prepared by:

Arcadis U.S., Inc.
410 N. 44th Street
Suite 1000
Phoenix
Arizona 85008
Tel 602 438 0883
Fax 602 438 0102

Our Ref.:

AZ001233.0018

Date:

June 7, 2016

Anne Thatcher

Principal Scientist/Risk Assessor

Chris Day

Principal Scientist/Risk Assessor

This document is intended only for the use of the individual or entity for which it was prepared and may contain information that is privileged, confidential and exempt from disclosure under applicable law. Any dissemination, distribution or copying of this document is strictly prohibited.

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

ABS_{GI}	gastrointestinal absorption factor
ACF	area correction factor
ADD	average daily dose
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
AES	atomic emission spectroscopy
ALM	Adult Lead Model
APP	Aquifer Protection Permit
A.R.S.	Arizona Revised Statutes
Arcadis	Arcadis U.S., Inc.
ATSDR	Agency for Toxic Substances and Disease Registry
BC	Brown and Caldwell
bgs	below ground surface
BHHRA	baseline human health risk assessment
CalEPA	California Environmental Protection Agency
CDC	United States Department of Health and Human Services' Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CLEAR	Continuous Liquid Extraction and Regeneration
cm^2	square centimeters
COI	constituent of interest
COPC	constituent of potential concern
cRfC	chronic reference concentration
cRfD	chronic reference dose
CSM	conceptual site model
CVAA	cold vapor atomic absorption
DEUR	declaration of environmental use restriction
EA	exposure area
EC	exposure concentration
ED	exposure duration

ELCR	excess lifetime cancer risk
ELMA	Errol L. Montgomery and Assoicates
EPC	exposure point concentration
°F	degrees Fahrenheit
FCX	Freeport-McMoRan Copper and Gold, Inc.
Ft	feet
ft amsl	feet above mean sea level
GPL	groundwater protection levels
GSF	gamma shielding factor
HI	hazard index
HQ	hazard quotient
ICP	inductively coupled plasma
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
kg	kilogram(s)
kg/mg	kilogram(s) per milligram
LADD	lifetime average daily dose
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
m^3/kg	cubic meter(s) per kilogram
mg/kg	milligram(s) per kilogram
mg/kg-day	milligram(s) per kilogram per day
mg/m^3	milligram(s) per cubic meter
MRL	minimal risk level
MS	mass spectrometry
MS/MSD	matrix spike/matrix spike duplicate
ND	not detected
nr-SRL	non-residential soil remediation level
NFA	no further action
OEHHA	Office of Environmental Health Hazard Assessment
OSF	oral slope factor
PbB	blood lead

pCi/g	picoCuries per gram
PEF	particle emission factor
PPRTV	Provisional Peer-Reviewed Toxicity Value
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
QC	quality control
Ra-226	radium-226
Ra-228	radium-228
RAGS	Risk Assessment Guidance for Superfund
RBA	relative bioavailability
RfC	reference concentration
RfD	reference dose
RME	reasonable maximum exposure
RPD	relative percent difference
r-SRL	residential soil remediation level
SAP	Sampling and Analysis Plan
Sierrita	Freeport-McMoRan Sierrita, Inc.
Site	Freeport-McMoRan Sierrita Copper Mine, Green Valley, Arizona
SPLP	synthetic precipitation leaching procedure
SRE	Screening Risk Evaluation
sRfC	subchronic reference concentration
sRfD	subchronic reference dose
SRL	Arizona Soil Remediation Level
SSCR	Soil and Sediment Characterization Report
STI	Sierrita Tailings Impoundment
U-235	uranium-235
U-238	uranium-238
UCL	upper confidence limit of the mean concentration
URS	URS Corporation
USC	Upper Santa Cruz
USEPA	United States Environmental Protection Agency

µg/dL	micrograms per deciliter
µg/m^3	micrograms per cubic meter
VRP	Voluntary Remediation Program
XRF	x-ray fluorescence

EXECUTIVE SUMMARY

Arcadis U.S., Inc. (Arcadis) has prepared this Baseline Human Health Risk Assessment (BHHRA) on behalf of Freeport-McMoRan Sierrita Inc. (Sierrita) for the Freeport-McMoRan Sierrita Copper Mine, Green Valley, Arizona (the Site) as part of the Arizona Department of Environmental Quality's (ADEQ's) Voluntary Remediation Program (VRP). The results of the BHHRA will be used in the risk management decision making process for the Site, and the outcome of the BHHRA will be in compliance with risk-based remedial goals of Arizona Revised Statutes (A.R.S.) §49-175(B).

This BHHRA was prepared in accordance with the VRP BHHRA Work Plan (Arcadis 2015a) approved by ADEQ, and focuses solely on potential impacts associated with exposure to constituents of potential concern (COPCs; site-related constituents) detected in soil and sediment in the following three specific exposure areas (EAs):

- Former Continuous Liquid Extraction and Regeneration (CLEAR) Plant EA, which is composed of the following subareas:
  - Former CLEAR Plant
  - Former E Pond
  - Former Evaporation Pond
  - Old D Pond
- Former Esperanza Mill EA, which is composed of the following subareas:
  - Former Esperanza Mill
  - Former C Pond and C Pond Spoils
  - Former Laydown Yard
  - Former Raffinate Pond
- Former Rhenium Ponds EA, which is a subarea of the Tailings Impoundment Area.

The objective of the BHHRA is to determine whether there are any potential human health risks associated with current and hypothetical future land uses within the above listed EAs. As described in the Final VRP Soil and Sediment Characterization Report (SSCR; URS Corporation [URS] 2012), the subareas comprising these EAs were identified as the focus of VRP site investigations because they are:

- Facilities that ceased operation and/or were closed prior to implementation of Sierrita's Aquifer Protection Permit (APP) No. P-101679.
- Selected operations exempt from regulation under the APP.
- Operations identified as "to be closed" under the APP.
- Active operations with the potential to release mining-related constituents to groundwater.
- Areas with the potential to have uranium impacts to groundwater.

This BHHRA was prepared consistent with United States Environmental Protection Agency (USEPA) and ADEQ risk assessment guidelines.

Site Background

Sierrita operates an open pit mine and mineral concentration facility located in Pima County, approximately 6 miles northwest of Green Valley, Arizona. Green Valley lies approximately 25 miles south of Tucson, Arizona. The mine produces copper products and co-products of molybdenum and rhenium. Sierrita operations include conventional crushing and flotation followed by differential flotation, leaching and roasting of molybdenum disulfide, rhenium recovery, molybdenum disulfide production and packaging, molybdenum trioxide production and packaging, leach stockpiles, and solution extraction/electrowinning facilities. The mine is capable of producing up to 250 million pounds of copper and 25 million pounds of molybdenum annually.

Human Receptors and Exposure Routes

Consistent with USEPA and ADEQ risk assessment guidelines, soil and sediment data were used to estimate excess lifetime cancer risks (ELCRs) and noncancer hazards (in the form of hazard indices [HIs]) to human receptors currently or in the future. In accordance with the ADEQ-approved BHHRA Work Plan, the BHHRA does not address the potential for exposure to site-related constituents in groundwater or surface water, as groundwater is not currently being used for potable purposes at the Site, nor is it expected to be a potable water source in the future. Surface water drainage features/washes are typically dry at the Site, only containing stormwater for short durations during precipitation events.

The following human receptors were evaluated, as applicable, at each EA:

- Current/future outdoor commercial/industrial worker.
- Hypothetical future construction worker.
- Hypothetical future adolescent trespasser.

Sample depth interval specific datasets were used to evaluate potential receptor exposures at each EA. Shallow soil/sediment datasets (0 to 0.5 feet below ground surface [bgs] or 0 to 2 feet bgs) were used to evaluate potential exposures of outdoor commercial/industrial workers and adolescent trespassers. A shallow and deep soil/sediment dataset (0 to 15 ft bgs) was used to evaluate potential exposures of construction workers, as well as for exposure of future outdoor commercial/industrial workers and adolescent trespassers based on the assumption of a hypothetical future development scenario where soil/sediment up to 15 ft bgs may be excavated and redistributed across the surface of each EA.

The Site is an active open pit mine and mineral concentration facility and, although it is highly unlikely it will ever be redeveloped for residential use, hypothetical future resident receptors were also evaluated for all three EAs specifically to address potential unrestricted future land use for the property. In accordance with A.R.S. §R49-152(B,C) (as cited in the ADEQ-approved BHHRA Work Plan), the hypothetical future resident evaluation is the basis for determining whether a “declaration of environmental use restriction” is required for commercial/industrial land use, or whether unrestricted land use may be suitable for the Site. Details and results of the hypothetical future resident evaluation for the three EAs are presented in Appendix F.

As part of this BHHRA, potentially complete exposure routes were evaluated for on-site receptors, including incidental soil/sediment ingestion, dermal contact with soil/sediment, and inhalation of fugitive dust particulates. External exposure to ionizing radiation was also evaluated.

USEPA and ADEQ recommended default parameters were used to evaluate reasonable maximum exposure (RME) for each of the receptor scenarios, consistent with regulatory guidance. In addition, a separate evaluation of potential outdoor commercial/industrial worker exposures was conducted using site-specific parameters. The site-specific parameters are based on actual worker activities at the Sierrita mine and are considered more representative of potential exposures under the current and foreseeable future land uses at each EA than are the default RME assumptions.

Key Findings

The key findings of this BHHRA are provided below. The results of the ELCR and HI calculations for each EA are summarized in the following table.

Former CLEAR Plant Exposure Area		
	Shallow Soil/Sediment	Shallow and Deep Soil/Sediment
Current Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.2	--
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 7×10^{-5}; HI=0.2	--
Future Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.09	ELCR = 1×10^{-4}; HI=0.08
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 6×10^{-5}; HI=0.09	ELCR = 6×10^{-5}; HI=0.08
Hypothetical Construction Worker	--	ELCR = 7×10^{-6}; HI=0.5
Hypothetical Adolescent Trespasser	ELCR = 2×10^{-6}; HI=0.04	ELCR = 2×10^{-6}; HI=0.03
Former Esperanza Mill Exposure Area		
	Shallow Soil/Sediment	Shallow and Deep Soil/Sediment
Current Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.2	--
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 6×10^{-5}; HI=0.2	--
Future Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.2	ELCR = 1×10^{-4}; HI=0.1
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 6×10^{-5}; HI=0.2	ELCR = 6×10^{-5}; HI=0.1
Hypothetical Construction Worker	--	ELCR = 7×10^{-6}; HI=0.7
Hypothetical Adolescent Trespasser	ELCR = 2×10^{-6}; HI=0.07	ELCR = 2×10^{-6}; HI=0.04

Former Rhenium Ponds Exposure Area		
	Shallow Soil/Sediment	Shallow and Deep Soil/Sediment
Current Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}	--
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 7×10^{-7}	--
Future Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}	ELCR = 1×10^{-4}
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 7×10^{-7}	ELCR = 8×10^{-7}
Hypothetical Construction Worker	--	ELCR = 6×10^{-6}
Hypothetical Adolescent Trespasser	ELCR = 1×10^{-6}	ELCR = 1×10^{-6}

Note:
-- Not applicable.
RME Reasonable maximum exposure.

Lead was identified as a COPC for the former CLEAR Plant and former Esperanza Mill EAs and was evaluated using the USEPA Adult Lead Model (ALM). Based on the ALM, exposure to lead in soil/sediment at the former CLEAR Plant EA or the former Esperanza Mill EA is not likely to result in adverse health effects in current/future outdoor commercial/industrial workers, future trespassers, or future construction workers. Lead was not evaluated for the former Rhenium Ponds EA, as it was not identified as a COPC.

The calculated ELCRs based on RME parameters for the current/future outdoor commercial/industrial worker, future trespasser, and future construction worker receptors are within the Arizona Administrative Code (R18-7-206) and USEPA target cancer risk range of 1×10^{-6} to 1×10^{-4}, and the cumulative HIs are less than the target of 1 for all EAs. The calculated ELCRs based on site-specific parameters for the current/future outdoor commercial/industrial workers at the former CLEAR Plant EA and former Esperanza Mill EA are lower than the RME based ELCRs and are within the target cancer risk range. The calculated ELCRs based on site-specific parameters for the current/future outdoor commercial/industrial workers at the former Rhenium Ponds EA are less than the target cancer risk range. The cumulative HIs based on site-specific parameters for the current/future outdoor commercial/industrial workers are less than the target of 1 for all EAs.

The ELCRs for receptors at the former CLEAR Plant EA and former Esperanza Mill EA are attributable to arsenic and radionuclides (radium-226 [Ra-226], radium-228 [Ra-228], uranium-235 [U-235], and uranium-238 [U-238]) in soil/sediment. The calculated cancer risk from radionuclides at the former CLEAR Plant EA and former Esperanza Mill EA accounts for between 83% (adolescent trespasser) and 99% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The ELCRs for receptors at the former Rhenium Ponds EA are due solely to radionuclides (Ra-226, Ra-228 and U-238) in soil/sediment. The noncancer hazards for receptors at the former CLEAR Plant EA are attributable to arsenic and copper in soil/sediment, and at the former Esperanza Mill EA are due to arsenic and molybdenum in soil/sediment.

Exposure point concentrations (EPCs) for the chemical COPCs in soil/sediment ranged from 9.82 to 30.1 milligrams per kilogram (mg/kg) for arsenic, 6,500 to 12,300 mg/kg for copper, and 1,130 to 1,850 mg/kg for molybdenum. The EPCs for radionuclide COPCs ranged from 2.15 to 2.8 picoCuries per gram (pCi/g) for Ra-226, 1.7 to 2.79 pCi/g for Ra-228, 0.117 to 0.179 pCi/g for U-235, and 2.45 to 3.2 pCi/g for U-238.

It is important to note that radionuclides are naturally present in soils in this part of Arizona. Quaternary alluvium that was sampled for this BHHRA consists of soils and sediments generated from weathered bedrock material. Alluvial sediments in the Sierrita area are generated through erosion of the exposed bedrock of the Sierrita Mountains. Eroded material is transported downslope by gravity (rock falls and other mass movements) and by rain events, which can transport large quantities of sedimentary materials. These materials are deposited in low-lying and flat areas on the valley floor. Because alluvial sediments are derived from bedrock material, their mineralogical and chemical composition are similar to their bedrock source. Surface soil samples collected from the Former CLEAR Plant, Esperanza Mill, and the Rhenium Pond indeed contain Ra-226, Ra-228, U-235, and U-238 that is comparable to or lower than in the source bedrock. The presence of statistical outliers in the plots is a reflection of the variability in material composition. In the Sierrita area, gullies, washes, and shallow, low-lying areas accumulate sediment from large geographic stretches of upslope, exposed bedrock from different formations and geologic units, creating sedimentological variability. Because the alluvial sediments are derived from local bedrock, it is expected that they contain comparable levels of metals and radiological materials as is seen in the Ruby Star Granodiorite, Tinaja Peak Formation, and the Harris Ranch Quartz Monzonite. These data indicate that there is not any increase in radionuclide content of the surface soil as compared to the bedrock material from which the surface soil is sourced.

1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) prepared this Baseline Human Health Risk Assessment (BHHRA) on behalf of Freeport-McMoRan Sierrita Inc. (Sierrita) for the Sierrita Copper Mine, Green Valley, Arizona (the Site; Figure 1-1). Arcadis conducted the BHHRA as part of the Arizona Department of Environmental Quality's (ADEQ's) Voluntary Remediation Program (VRP) to conservatively evaluate whether residual concentrations of Site-related constituents in soil and sediment pose adverse health effects to current and hypothetical future site users in three exposure areas (EAs). The results of the BHHRA will be used in the risk management decision making process for the Site.

The BHHRA was developed based on the results of previous site investigations, evaluation of anticipated site uses (including historical, current, and long-term future land uses), and applicable agency guidance and laws. The risk assessment approach and methodology follow the VRP BHHRA Work Plan (Arcadis 2015a), which was initially submitted to ADEQ on February 28, 2013. ADEQ provided comments on that initial BHHRA Work Plan in a letter dated November 18, 2014. The BHHRA Work Plan was revised; dated April 24, 2015 based on the November 18, 2014 ADEQ comments; and subsequently approved by the ADEQ on May 13, 2015. In accordance with the Work Plan, the BHHRA relies on soil and sediment data collected during field activities performed from 2004 through 2015. The BHHRA evaluates a current/future on-site outdoor commercial/industrial worker, a future on-site construction worker, and a future on-site trespasser for all identified potentially complete exposure pathways, as described in the human health conceptual site model (CSM; see Section 6).

Although it is highly unlikely that the Site will ever be redeveloped for residential use, hypothetical future resident receptors were also evaluated specifically to address potential unrestricted future land use for the property. Per the Arizona Revised Statutes (A.R.S.)§R49-152(B,C) (as cited in the ADEQ-approved BHHRA Work Plan), the hypothetical future resident evaluation is the basis for determining whether a "declaration of environmental use restriction" is required for commercial/industrial land use, or whether unrestricted land use may be suitable for the Site. Details and results of the hypothetical future resident evaluation are presented in an appendix to this BHHRA.

The BHHRA does not address the potential for exposure to Site-related constituents in groundwater or surface water, as groundwater is not currently being used for potable purposes at the Site, nor is it expected to be a potable water source in the future. Surface water-groundwater interactions were described in the VRP Groundwater Investigation Report (Arcadis 2013b) and will be further characterized as part of the ongoing data gaps investigation (Arcadis 2015b). Surface water drainage features are typically dry at the Site, only containing stormwater for short durations during precipitation events.

The remainder of this BHHRA is organized as follows:

Section 2 - Site Background. Provides background information about the Site, including site history, existing facilities, regional and site-specific geology, and hydrogeology.

Section 3 - Previous Investigations and Remedial Activities. Describes previous site investigations and summarizes the relevant findings.

Section 4 - Guidance Documents Used to Conduct the BHHRA. Lists the guidance documents used to develop the approach and methods used in the BHHRA.

Section 5 - Data Used to Conduct the BHHRA. Presents the data used to conduct the BHHRA, identifies the specific exposure areas (EAs) evaluated, and discusses the methods used to estimate constituent concentrations to which a human receptor might be exposed.

Section 6 - Exposure Assessment. Describes the basis for evaluation of certain human receptors and potentially complete exposure routes, as well as methods used to estimate route-specific doses.

Section 7 - Toxicity Assessment. Presents the toxicity values used to estimate impacts to human receptors, including information on the sources of toxicity values, as well as specific approaches used to evaluate certain constituents.

Section 8 - Risk Characterization. Discusses specific methods used to evaluate the potential for adverse human health effects, including the estimation of excess lifetime cancer risks (ELCRs) and calculation of noncancer hazard indices (HIs).

Section 9 - Risk Assessment Results. Presents the results of the BHHRA.

Section 10 - Uncertainties Associated with the BHHRA. Summarizes the key assumptions used in this BHHRA and how each may have affected the results.

Section 11 - Summary and Conclusions. Summarizes the outcome of the BHHRA.

Section 12 - References. Lists the literature cited in this report.

This BHHRA is followed by tables and figures. Supporting information is provided in the appendices, as follows:

Appendix A. Soil and Sediment Data Used to Conduct the Baseline Human Health Risk Assessment.

Appendix B. ProUCL 5.0.00 Input and Output Files.

Appendix C. Excess Lifetime Cancer Risk and Hazard Index Calculations (Chemicals).

Appendix D. Excess Lifetime Cancer Risk Calculations (Radionuclides).

Appendix E. Lead Model Output.

Appendix F. Hypothetical Future Resident Evaluation.

2 SITE BACKGROUND

This section describes the site setting and existing facilities, current and historical site operations, regional and site-specific geology, and hydrogeology.

2.1 Site Location and Description

Sierrita operates an open pit mine and mineral concentration facility located in Pima County, approximately 6 miles northwest of Green Valley, Arizona (Figure 1-1). Green Valley lies approximately 25 miles south of Tucson, Arizona. The mine produces copper products and co-products of molybdenum and rhenium. Sierrita operations include conventional crushing and flotation followed by differential flotation, leaching and roasting of molybdenum disulfide, rhenium recovery, molybdenum disulfide production and packaging, molybdenum trioxide production and packaging, leach stockpiles, and solution extraction/electrowinning facilities. The mine is capable of producing up to 250 million pounds of copper and 25 million pounds of molybdenum annually (ADEQ 2011).

Figure 2-1 shows the general features and facilities at the Site. The Sierrita property consists of three open pits (Sierrita-Esperanza pit, a molybdenum satellite pit, and the Ocotillo pit), a 115,000 ton-per-day concentrator, two molybdenum roasting plants, the rhenium plant, an oxide and low-grade sulfide ore stockpile leaching operation, a copper sulfate plant, and associated support facilities and historical facilities, some of which have been closed and reclaimed.

2.2 Environmental Setting

The mine is situated on the southeast flank of the Sierrita Mountain Range, approximately 7 miles northwest of the Santa Cruz River. Elevations at the Site range from approximately 5,000 feet above mean sea level (ft amsl) on the west side of the Site to approximately 3,000 ft amsl on the east side, as shown on Figure 1-1.

The climate is typical for an arid region, with a wide range in daily temperatures and monsoonal type precipitation patterns. The Western Regional Climate Center reports that the average daily maximum temperature at Green Valley is 84 degrees Fahrenheit (°F), while the average daily minimum temperature is 54°F. Average annual precipitation is 10.86 inches. These statistics were based on a reporting period from 1988 through 2012. The monthly average pan evaporation rates range from 3.25 inches in January to 14.9 inches in June (URS 2008a).

More than one third of the annual precipitation occurs during the months of July and August, and these rain events can produce short, intense downpours; strong winds; and flash floods. Groundwater at Sierrita is derived primarily from mountain front recharge, recharge from ephemeral streamflow, and seepage from the Sierrita Tailings Impoundment (Errol L. Montgomery and Associates [ELMA] and Dames and Moore 1994).

The surface water regime of the Site is divided into four major surface water drainage basins, each associated with one of the four major washes that drain the Site: Demetrie, Amargosa, Esperanza, and Tinaja Washes. The locations of the washes are shown on Figure 2-1. An unnamed drainage (Unnamed Wash) connects with the Tinaja Wash south of the Esperanza Wash. Amargosa, Esperanza, and Tinaja Washes discharge into Demetrie Wash, which is an ephemeral tributary to the Santa Cruz River.

2.3 Site History and Facilities Overview

Mining in the area around Green Valley started in the late 1800s (Freeport-McMoRan Copper & Gold Inc. [FCX] 2011b). At the Sierrita mine, underground mining began in 1907, and open-pit mining began in 1957 (FCX 2011a). The existing 4,316-acre Sierrita Tailings Impoundment (APP No. P-101679) has been used as a final tailings repository since the 1970s (FCX 2011b).

This BHHRA focuses on the potential for exposure to constituents in soil and sediment at three facility areas at the Sierrita mine: 1) the former Continuous Liquid Extraction and Regeneration (CLEAR) Plant; 2) the former Esperanza Mill, and 3) the former Rhenium Ponds. These three EAs encompass nine subareas identified as the focus of VRP site investigations (URS 2012) because they are:

- Facilities that ceased operation and/or were closed prior to implementation of Sierrita's APP.
- Selected operations exempt from regulation under the APP.
- Operations identified as "to be closed" under the APP.
- Active operations with the potential to release mining-related constituents to groundwater.
- Areas with the potential to have uranium impacts to groundwater.

A brief description of each facility is provided in the sections below. Information provided below was taken from the Final VRP SSCR (URS 2012) and the VRP Groundwater Investigation Report (Arcadis 2013b).

2.3.1 Former CLEAR Plant

The CLEAR Plant was historically located in the north-central portion of the Sierrita property (see Figure 2-1). The former CLEAR Plant produced metallic copper from 1977 to 1983 and was demolished in 1995. Copper was initially leached from copper concentrate slurry, which was produced from sodium and potassium chloride brines and sodium hydroxide and ferric chloride reagents. The leached solution was processed through two mixing reactors and a thickener before producing a pregnant solution. The pregnant solution was circulated in electrolytic tanks, and the resulting precipitated copper was filtered, washed, dried, and stored until sold.

The former CLEAR Plant subarea encompasses approximately 60 acres and includes a number of associated impoundments, including the former E Pond, the former Evaporation Pond, and the Old D Pond. The former E Pond is an inactive, backfilled pond. This pond was an unlined impoundment historically used to contain surface water runoff and possibly process solutions from upset conditions at the former CLEAR Plant. The former Evaporation Pond was a lined impoundment that received spent copper solution containing chloride. The Old D Pond was an unlined pond that reportedly received process solutions from the former CLEAR Plant operation. These solutions were recycled and possibly concentrated various constituents including metals and radionuclides. Runoff from the closed CLEAR Plant and Copper Sulfate areas is now contained in the New D Pond, an APP-permitted non-stormwater impoundment.

The topography of the former CLEAR Plant area generally slopes eastward and is incised by north-south and east-west trending drainages. The western portion is cut into granodiorite bedrock, and the remaining area is covered with fill ranging from a few inches to approximately 25 feet (ft) in thickness. The

easternmost portion of the plant area, near Demetrie Wash, is undisturbed and sparsely covered with native vegetation. A large portion of the plant area is covered with gravel or crushed rock, and buried concrete slabs are known to exist below the gravel.

The former CLEAR Plant area is currently used as 1) a training center; 2) an asset recovery yard to store used equipment, machinery, and vehicles; 3) contractor offices and materials storage; 4) a metal fabrication shop; and 5) Sierrita's "Central Accumulation" building, currently used to store environmental sampling supplies and manage hazardous waste. The former CLEAR Plant building is currently used for storage of miscellaneous materials, such as used computers and office equipment, and as a training center. The Crystal Plant is located in the southernmost building, which manufactures copper sulfate pentahydrate, a product that may be sold as fertilizer, pesticide, foot bath, and animal feed.

2.3.1.1 Work Force at the Former CLEAR Plant

Indoor workers (inside at the contractor offices and Crystal Plant) may be present in the former CLEAR Plant area for 8-hour days 5 days a week. Employee training, which takes place indoors at the training center, occurs periodically. Outdoor worker activities, such as storing/retrieving equipment and supplies, typically occur only on an as-needed basis (i.e., less than 8 hours per day).

2.3.2 Former Esperanza Mill

The former Esperanza Mill covers roughly 128 acres in the central portion of the Sierrita property (see Figure 2-1) and includes the former C Pond and C Pond Spoils, former Raffinate Pond, and former Laydown Yard. The former mill processed sulfide ore from 1959 through 1981 (Hydro Geo Chem, Inc. [HGC] 2008) and included a mill, two thickeners, and a raw water pond. Tailings from the mill were conveyed through a pipeline to the Esperanza Tailings Impoundment, located approximately 0.5 mile southeast of the former mill.

The topography of the former mill area slopes gently to the east-southeast. Amargosa Wash borders the mill area to the south, and Demetrie Wash borders the mill area to the east. The Duval Canal Extension trends west-to-east along the north side of the former mill area. The northwestern portion of the area is cut into bedrock with fill extending eastward. A drainage channel extends from near the base of the former thickeners and trends southeast across the former mill area. Numerous work/storage shops, office buildings, and equipment storage areas are located in the northwest portion of the former mill area.

The former C Pond and C Pond Spoils are located within the easternmost portion of the former mill area, near the northwest corner of the confluence of Demetrie and Amargosa Washes. The former C Pond was an unlined pond used to contain surface runoff from the Sierrita Mill, overflow from the old Duval Canal during storm events, and runoff from the Sierrita crusher dust collector area, which had high concentrations of copper. During operations, sediments that accumulated in the former C Pond were periodically dredged, and spoils were placed on the east and west sides of the current Duval Canal Extension (C Pond Spoils). Currently, the former C Pond area is being used by Sierrita for pilot water treatment plants.

The former Raffinate Pond is an inactive, unlined, and backfilled pond located within the central portion of the former Esperanza Mill area. This pond was used in association with a Precipitation Plant (now removed), which was located immediately southeast of the former Esperanza Mill. Its use ended when

Raffinate Pond No. 3 was constructed. The former Raffinate Pond collected surface water runoff from the western portion of the former Esperanza Mill and contained some water most of the year. The central portion of the former Raffinate Pond currently supports a cover of vegetation. Granodiorite bedrock outcrops at the surface along the southwest side of the former pond. The north and east sides of the pond are currently bordered by fill material.

The former Laydown Yard is located in the central portion of the former Esperanza Mill area and was used from the 1960s until the mill was demolished in 2005. During that time, the Laydown Yard was used to store equipment, new drums, and salvage materials from decommissioned site facilities. A subcontractor removed and salvaged the drums and other equipment. The former Laydown Yard is currently used by a contractor for their mobile office and a few pieces of mobile equipment.

2.3.2.1 Work Force at the Former Esperanza Mill

Outdoor workers (general labor crew) convene in the former Esperanza Mill area each morning and disperse throughout the Site (which includes other portions of the Sierrita mine facility). A road maintenance crew may potentially work in the area performing grading, paving, and other maintenance duties. These activities occur as needed. Outdoor workers also work in the Laydown Yard, rental yard, or other outdoor areas. They travel in and out of those areas, as well as indoors and other areas of the Sierrita mine facility, on a daily basis.

2.3.3 Former Rhenium Ponds

The former Rhenium Ponds consisted of three impoundments excavated side-by-side into the surface of the Esperanza Tailings Impoundment (see Figure 2-1). The ponds were used for storage and evaporation of process solutions from the Rhenium Plant. Each pond measured 250 ft long, 65 ft wide, and 10 to 12 ft deep, and was lined with a geosynthetic liner. The ponds operated from 1981 until 1991. In 1998, Cyprus Amax closed the impoundments by excavating sediments from the cells and recycling the material on the heap leach stockpiles. The ponds were then backfilled with tailings. In 1999, the area was capped with 12 inches of growth medium and re-vegetated. Following the seeding, native vegetation typical of the Arizona Upland/Eastern Sonoran Basins ecoregion (e.g., grama grasses, creosote bush, bursage; Griffith et al. 2014) has become established in the former Rhenium Ponds area.

Work Force at the Former Rhenium Ponds

There are no buildings or ongoing activities at the former Rhenium Ponds area; therefore, no workers are present on a routine basis.

2.4 Geology and Hydrogeology

This section summarizes the regional and site-specific geology and hydrogeology, as described in the VRP Groundwater Investigation Report (Arcadis 2013b).

2.4.1 Site Geology

Sierrita is located in the Basin and Range physiographic province, on the west margin of the Santa Cruz Basin and along the east flank of the Sierrita Mountains (ELMA 2001, ELMA and Dames and Moore 1994). The principal geologic/hydrogeologic units at the Site include the alluvial deposits, the basin fill

deposits, and the bedrock complex. The lithology of each of the principal geologic units at the Site is described below.

2.4.1.1 Alluvial Deposits

Unconsolidated Quaternary and late Tertiary deposits cover most of the eastern base (the piedmont) of the Sierrita Mountains. The term “piedmont” is used in the Esperanza Mill Quadrangle (Spencer et al. 2003) and refers to the area east of the immediate mine area. The alluvium was deposited by larger streams that originated in the mountains and then was reworked by smaller streams that originate on the piedmont. Alluvial deposits occur as thin, discontinuous deposits throughout the Site, typically within natural drainage channels including Demetrie Wash, Amargosa Wash, Esperanza Wash, and Tinaja Wash. However, there are unconsolidated deposits across the mine site that overlie bedrock; the soil and sediment samples were collected from the unconsolidated deposits (Arcadis 2013b). The deposits consist of coarse-grained, unconsolidated silty sand and gravel of Quaternary age. Based on investigation work from 2001, the thickness of the alluvial deposits ranges from 0 to 30 feet (ELMA 2001).

2.4.1.2 Basin Fill Deposits

At the Site, basin fill deposits occur generally east of Demetrie Wash, trending from the northwest and extending east below the tailings impoundments, and are not present in the Sierrita pit or plant areas. The basin fill deposits are Tertiary to Quaternary in age and consist of poorly consolidated sand, gravel, silt, and clay in varying proportions. The thickness of the basin fill deposits increases to the east up to more than 1,000 feet near the southeast corner of the Sierrita Tailings Impoundment (STI; ELMA 2001).

2.4.1.3 Bedrock Complex

The Sierrita-Esperanza deposit is composed of igneous rocks; the oldest in the area are the Ox Frame Volcanics. The Ox Frame Volcanics were intruded by the Harris Ranch Quartz Monzonite, which was overlain by the Demetrie Volcanics. Later intrusive rocks, including the Ruby Star Granodiorite, intruded the existing volcanic and intrusive rocks and formed a large batholith. The bedrock complex consists of several formations, including the Tinaja Peak Formation, the Pantano Formation, the Tertiary Intrusives, Ruby Star Granodiorite, Demetrie Volcanics, Harris Ranch Quartz Monzonite, and Ox Frame Volcanics. These formations are discussed in detail in the VRP SSCR and Addendum (URS 2012; Arcadis 2013a).

2.4.2 Site Hydrogeology

Sierrita is located in the Upper Santa Cruz (USC) Basin and Range Lowlands Hydrogeologic Province. The USC Basin is a north-trending alluvial valley drained by the Santa Cruz River (ELMA and Dames and Moore 1994). The Sierrita Mountains are a contributing source of mountain-front recharge to the basin. The Santa Cruz River to the east of the Site is the main surface water drainage. The Santa Cruz River is located approximately 2 miles due east from the eastern boundary of the STI. The principal hydrogeologic units at the Site include the alluvial aquifer, the basin fill aquifer, and the bedrock hydrostratigraphic unit. The hydrogeology of each of the principal units at the Site is described in detail in the Groundwater Investigation Report (Arcadis 2013b).

3 PREVIOUS SITE INVESTIGATIONS

Sierrita submitted an application to enter the Arizona VRP on June 19, 2007 to evaluate certain operations and constituents that are not considered by other regulatory programs, such as the Mitigation Order on Consent, Docket No. P-50-06 and the Sierrita area-wide APP No. P-101679. The characterization goal for the VRP was to assess potential impacts to soil, sediment, and groundwater from historical and active mine operations. The constituents of interest (COIs) for the Site are trace metals and radiological constituents (uranium and radium isotopes).

As stated in Section 1, the BHHRA relies on soil and sediment data collected during field activities performed from 2004 through 2015. The following documents related to previous site investigations were reviewed to compile and verify the soil and sediment data used to conduct this BHHRA:

- Soil, Surface Water, and Groundwater Sampling in the CLEAR Plant and Esperanza Mill Areas, Prepared for Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. April 2008 (HGC 2008)
- Voluntary Remediation Program Investigation Work Plan (URS 2008a)
- Voluntary Remediation Program Investigation Quality Assurance Project Plan (URS 2008b)
- Voluntary Remediation Program Soil and Sediment Characterization Report, Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. Final. December 2012 (URS 2012)
- Voluntary Remediation Program Former CLEAR Plant Area Soil Excavation and Tier I Screening Risk Evaluation Report, Sierrita Mine, Green Valley, Arizona. January 2013 (Arcadis 2013c)
- Voluntary Remediation Program Addendum to the Soil and Sediment Characterization Report, Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. August 2013 (Arcadis 2013a)
- Voluntary Remediation Program Groundwater Investigation Report, Sierrita Mine, Green Valley, Arizona. December 2013 (Arcadis 2013b)
- Voluntary Remediation Program Data Gaps Work Plan, Sierrita Mine, Green Valley, Arizona. June 2015 (Arcadis 2015b)
- Former CLEAR Plant Area Paving Project Soil Excavation and Tier I Screening Risk Evaluation Report, Sierrita Mine, Green Valley, Arizona. July 2015 (Arcadis 2015c)

The remainder of this section briefly summarizes the previous site investigations and relevant findings.

3.1 Soil and Sediment Investigations

3.1.1 HGC 2004 Investigation

From August through October 2004, HGC performed a screening level assessment of environmental conditions in the vicinity of the former CLEAR Plant and former Esperanza Mill. The field investigation included the collection of 54 surface soil samples from 0 to 3 inches below ground surface (bgs) and 39 subsurface soil samples at depths up to 15 feet bgs from 14 backhoe trenches (HGC 2008). Soil samples were initially screened for paste pH (a measure of the potential for soil samples to generate acid solutions), which was used to determine if the sample should be submitted for total metals analysis (HGC 2008). Soil samples were selected for laboratory analysis based on their potential to generate acid,

because of an anomalous appearance due to copper or iron oxide mineralization, or to provide comprehensive geospatial coverage (HGC 2008).

In total, 12 surface soil and 24 subsurface soil samples from the former CLEAR Plant area, and 12 surface soil and 12 subsurface soil samples from the former Esperanza Mill area, were submitted for laboratory analysis of metals and acid-base potential. Detected constituent concentrations were compared to the Arizona Soil Remediation Levels (SRLs) for non-residential land use (Arizona Administrative Code Title 18). The HGC (2008) report indicated that arsenic in soil exceeded the non-residential SRL (nr-SRL) throughout the former CLEAR Plant and former Esperanza Mill areas; however, there was no apparent spatial pattern to arsenic concentrations with respect to historical facilities. Additionally, arsenic concentrations were not necessarily elevated with respect to naturally occurring concentrations in some portions of Arizona and the United States (HGC 2008). Copper was the only other metal detected at concentrations greater than the nr-SRL. The copper concentration in one soil sample was greater than its nr-SRL; this sample was described as being pyritic with a greenish color similar to concentrate.

3.1.2 URS 2008 Investigation

Following the Site's acceptance into the VRP, Sierrita retained URS to prepare and implement a site investigation work plan to characterize soil, sediment, and groundwater at the mine. The investigation activities were conducted by URS, in accordance with the VRP Investigation Work Plan (URS 2008a) and the Addendum to Sampling and Analysis Plan & Quality Assurance Project Plan (SAP & QAPP Addendum; URS 2008b). Both plans were approved by the ADEQ.

The VRP soil and sediment investigation was conducted between June and November 2008 at three general areas and nine subareas: 1) former CLEAR Plant area, including the former plant, former E Pond, former Evaporation Pond, and Old D Pond; 2) former Esperanza Mill area, including the former mill, former C Pond and C Pond Spoils, former Raffinate Pond, and former Laydown Yard; and 3) the STI, which includes the former Rhenium Ponds. The objective of field activities was to assess potential releases of COIs from the specified subareas (URS 2012).

As indicated in the SSCR (URS 2012), the COIs analyzed during the VRP characterization were selected based on a review of groundwater constituents monitored or regulated under Sierrita's APP permit, historical groundwater quality data for the Sierrita mine, and current and historical mining processes and operations. The soil and sediment COIs include mining-related metals (e.g., antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, and zinc), total uranium, uranium isotopes (uranium-234 [U-234], uranium-235 [U-235], and uranium-238 [U-238]), and radium isotopes (radium-226 [Ra-226] and radium-228 [Ra-228]). Many of the COIs also naturally occur in soils, rock, and groundwater at non-mineralized and mineralized mine sites.

3.1.2.1 Relevant Findings for Metals

URS (2012) presented and evaluated the combined analytical results for metals in soil and sediment samples collected by HGC in 2004 and as part of the VRP investigation in 2008. URS reported that 171 soil samples were analyzed from 54 soil borings advanced to the bedrock surface, and 36 sediment samples were collected and analyzed from 18 locations. Detected constituent concentrations were

compared to the Arizona SRLs and Groundwater Protection Levels (GPLs). Non-residential SRLs for the following constituents were exceeded in at least one soil sample at each of these subareas:

- Arsenic, copper, and lead at the former CLEAR Plant
- Arsenic at the Old D Pond
- Arsenic at the former Esperanza Mill
- Arsenic and lead at the former C Pond and C Pond Spoils
- Arsenic and copper at the former Raffinate Pond, and
- Arsenic, lead, and molybdenum at the former Laydown Yard.

As part of the SSCR investigation, the 95 percent upper confidence limit of the mean concentration (95% UCL) was calculated for the above listed constituents using the soil data from each subarea. The 95% UCL concentrations were then also compared to the nr-SRLs. The only COI for which 95% UCLs were still greater than the nr-SRL was arsenic at the former CLEAR plant, former Esperanza Mill, former Raffinate Pond, and former Laydown Yard. The SSCR (URS 2012) recommended that site-specific background concentrations and/or soil remediation standards be developed for arsenic.

Antimony and lead were the only metals detected at concentrations greater than their respective GPLs. Antimony exceeded the GPL in the former CLEAR Plant and former Esperanza Mill subareas. Lead exceeded its GPL in the former CLEAR plant, former C Pond and C Pond Spoils, former Raffinate Pond, and former Laydown Yard (URS 2012). The calculated 95% UCL concentrations were less than corresponding GPLs, except for lead at the former Laydown Yard. However, all detected lead concentrations were less than the alternative GPL (25,556 milligrams per kilogram [mg/kg]) calculated based on site-specific total and synthetic precipitation leaching procedure (SPLP) lead data (URS 2012). No further action was recommended for soil with regard to groundwater protection.

3.1.2.2 Relevant Findings for Radionuclides

Arcadis (2013a) reported the results of the soil and sediment investigation for radionuclides. Uranium and radium isotopes were detected in samples from each subarea. The SSCR Addendum (Arcadis 2013a) did not include a comparison of detected activities to human health risk-based screening levels but indicated that the presence of radionuclides in subarea soils is consistent with the highly mineralized area. The unconsolidated deposits and parent bedrock complex at the Sierrita mine, which contains Ruby Star Granodiorite as well as quartz monzonite porphyry, contain natural levels of radioactivity. The SSCR Addendum noted that rock core samples collected as part of the groundwater investigation (described below) revealed uranium concentrations up to 19 mg/kg in the granodiorite bedrock and at 35 mg/kg in the monzonite bedrock (Arcadis 2013a). Radium-226 activity in the granodiorite has been measured at concentrations up to 5.8 picoCuries per gram (pCi/g) and in the monzonite at up to 11 pCi/g. The SSCR Addendum deferred further evaluation of the soil and sediment radionuclide data to this BHHRA.

3.1.3 Former CLEAR Plant Area Soil Excavation

On May 1 and 2, 2012, Arcadis collected 51 soil samples to support construction of a new training facility building on a 1.3-acre area located north of the former CLEAR Plant building. Previous investigation in

the former CLEAR Plant area had partially defined areas of potential impacts in the surface and subsurface soils. The objectives of the soil excavation sampling were to obtain additional information to support a No Further Action (NFA) determination for soil in the area affected by construction, or to provide analytical data in support of a Declaration of Environmental Use Restriction (DEUR).

Discrete soil samples were collected from the building excavations and parking lot areas to be paved. Based on the previously collected data from the former CLEAR Plant area, the samples were only analyzed for arsenic, copper, and lead. Samples were collected from 0 to 6 inches bgs using either a disposable plastic scoop or a hand auger. Dry soil samples were sieved, field-screened using a handheld x-ray fluorescence (XRF) analyzer, and then packaged for laboratory analysis. Eight of the 51 soil samples were collected from excavated and stockpiled soils, but their analytical results are not relevant, as the materials are not representative of concentrations in residual soils.

Supplemental soil sampling was conducted on May 11 and 21, 2012 in proposed locations that had not been sampled on May 1 and 2, from over-excavated areas where material had since been removed, and from areas where initial soil samples had concentrations above the residential SRL (r-SRL). An additional 38 soil samples were collected using the same methods described above.

Arsenic and lead were detected at concentrations in soil greater than their respective r-SRLs and nr-SRLs. Lead was also detected at concentrations above its GPL. Copper was detected at concentrations greater than its r-SRL but less than the nr-SRL, and there is no GPL available for copper. A Tier 1 Screening Risk Evaluation (SRE) was performed using analytical results from the residual soil samples. The Tier 1 SRE demonstrated that 95% UCL concentrations for all three metals were below the available SRLs and GPLs; therefore, no further action was recommended.

3.1.4 Former CLEAR Plant Area Paving Project

Between May 19 and June 19, 2015, 29 soil samples were collected in support of constructing two paved areas in the former CLEAR Plant area. The paved areas occupy approximately 0.9 acre (0.27 acre and 0.63 acre) located north and southwest of the former CLEAR Plant building, along the western edge of the former CLEAR plant subarea defined in the SSCR (URS 2012).

Two soil samples were collected from a leach field in the southern paving area at 3.5 feet bgs using a hand auger. Eight surface soil samples from the northern paving area and 17 surface soil samples from the southern paving area were collected immediately following the excavation and grading of the areas to be paved. These samples were collected at randomly determined locations within a grid placed over the graded area. Surface soil samples were collected using a disposable plastic scoop and were immediately packaged for laboratory analysis. Two additional discretionary samples were collected from the northern paving area after encountering and excavating visually impacted soils. Grid samples were submitted for laboratory analysis of arsenic, copper, and lead. Ten percent of the grid samples and the discretionary soil samples were submitted for analysis of an extended list of metals constituents (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, thallium, uranium, and zinc).

Arsenic was detected at concentrations in soil greater than its r-SRL and nr-SRL; however, arsenic concentrations in all samples were less than its GPL. Copper was detected at concentrations greater than its r-SRL but less than its nr-SRL, and there is no GPL available for copper. Detected lead concentrations

were below both the r-SRL and nr-SRL, but the lead concentration in one sample was above its GPL. A Tier 1 SRE was performed using analytical results from the paving area samples. The Tier 1 SRE demonstrated that 95% UCL concentrations for all three metals were below the available SRLs and GPLs; therefore, no further action was recommended.

3.2 Data Gaps Investigation

A revised Data Gaps Work Plan (Arcadis 2015b) was submitted to the ADEQ in June 2015. The objective of the data gaps investigation is to collect the remaining data identified by the ADEQ and Sierrita to complete site characterization for the VRP (Arcadis 2015b). The Data Gaps Work Plan primarily addresses groundwater data gaps identified in the Groundwater Investigation Report (Arcadis 2013b) but also proposes that confirmation soil samples be collected from the former CLEAR Plant and former Raffinate Pond, where antimony concentrations in previously collected soil samples exceeded the GPL. These soil samples will be collected at a depth of 0.25 ft bgs and submitted for laboratory analysis of total antimony and SPLP in order to derive a site-specific GPL for antimony.

No other soil or sediment sampling was proposed as part of the data gaps investigation. COI concentrations in soil are not expected to significantly vary on a short-term temporal basis; therefore, no temporal data needs were identified for the soil data collection program.

4 GUIDANCE DOCUMENTS USED TO CONDUCT THE BASELINE HUMAN HEALTH RISK ASSESSMENT

The methods and approach for the BHHRA are based primarily on the following (but not limited to) Arizona and USEPA risk assessment guidance documents:

- Deterministic Risk Assessment Guidance (Arizona Department of Health Services [ADHS] 2003)
- Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual, Part A (U.S. Environmental Protection Agency [USEPA] 1989)
- RAGS, Volume 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (USEPA 2004)
- RAGS, Volume I: Human Health Evaluation Manual, Part F, Supplemental Guidance for Inhalation Risk Assessment (USEPA 2009a)
- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA 2002)
- ProUCL Version 5.0.00. User Guide (USEPA 2013a)
- ProUCL Version 5.0.00. Technical Guide (USEPA 2013b)
- Guidelines for Exposure Assessment (USEPA 1992)
- Exposure Factors Handbook (USEPA 1997, 2011)
- Guidelines for Carcinogen Risk Assessment (USEPA 2005)
- OSWER Directive 9285.7-53, Human Health Toxicity Values in Superfund Risk Assessments (USEPA 2003a)
- Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors (USEPA 2014a)
- Frequently Asked Questions About Update of Standard Default Exposure Factors (USEPA 2014b)
- Soil Screening Guidance for Radionuclides: Technical Background Document (USEPA 2000)
- Preliminary Remediation Goals for Radionuclides. User's Guide (USEPA 2014c).

5 DATA USED TO CONDUCT THE BASELINE HUMAN HEALTH RISK ASSESSMENT

This section discusses the media considered and evaluated, data used, data usability review performed for the data used, definition of EAs, identification of BHHRA datasets, selection of constituents of potential concern (COPCs) for each EA, and derivation of media-specific exposure point concentrations (EPCs) for each EA.

5.1 Media Considered and Evaluated for the Baseline Human Health Risk Assessment

Based on former site operations, previous environmental investigations have focused on potential impacts to soil, sediment, and groundwater. This BHHRA evaluates the potential for adverse human health effects from exposure to site-related constituents in soil and sediment. The available soil and sediment data were combined into a single dataset, termed “soil/sediment”, because the sediment samples were collected from inactive, backfilled ponds or drainage courses that are dry for most of the year. As a result, the potential for human exposure to soil or sediment is the same.

As discussed in the ADEQ approved BHHRA Work Plan (Arcadis 2015a), the potential for adverse human health effects from exposure to groundwater was not evaluated in this BHHRA because groundwater is not currently being used for potable purposes at the Site, nor is it expected to be used as a potable water source in the future. Similarly, surface water was not evaluated because it occurs in on-site drainages only for short durations after precipitation events and is not currently being used for industrial or potable water purposes. In addition, surface water drainage features are typically avoided during and immediately following storm events due to the potential for flash flooding. Finally, the site-related metals are not volatile and are relatively immobile in soil/sediment.

Based on these site conditions, human receptors may be exposed to site-related metals in on-site soil/sediment and fugitive dust. In addition, as discussed in the SSCR Addendum (Arcadis 2013b), the unconsolidated deposits and parent bedrock complex at the Sierrita mine contain natural levels of radioactivity at concentrations and activities consistent with a highly mineralized area. Radionuclides were detected in on-site soil/sediment samples collected as part of the VRP soil and sediment investigation in 2008. Therefore, human receptors may be exposed to radionuclides in addition to the site-related metals.

5.2 Available Soil and Sediment Data

The following soil and sediment data were used to conduct the BHHRA.

- Total metals data from soil samples collected by HGC in 2004 (HGC 2008)
- Total metals and radionuclide data from soil and sediment samples collected by URS in 2008 (URS 2012; Arcadis 2013a)
- Total metals data from soil samples collected in 2012 to support construction of the new training facility near the former CLEAR Plant building (Arcadis 2013c), with the exception of data from stockpiled soils that have since been removed from the Site

- Total metals data from soil samples collected in 2015 to support construction of two paving areas near the former CLEAR Plant building (Arcadis 2015c).

Table 5-1 provides a summary of the available soil/sediment data, including the number of soil and sediment samples collected during each previous site investigation and their selected analyses. Table 5-1 also provides information on sample collection methods and analytical methods in order to facilitate the data review described below.

5.3 Data Usability

Laboratory analytical data used in this BHHRA were subject to a review to verify the data completeness, accuracy, and ultimately the data usability. The key components of the data review are consistent with USEPA (1989, 1992) risk assessment guidance and include:

- Spatial – to ensure that each EA is adequately characterized and data are representative of potential current and future exposures
- Sample size and density – to ensure that EPCs calculated for an exposure area are sufficiently robust and representative of potential current and future exposures
- Temporal applicability – to ensure that data used in the risk assessment are representative of current conditions
- Overall data quality – ascertained through data verification and/or validation
- Evaluation of data qualifiers – specifically with respect to data rejected by the analytical laboratory or during data validation.

Sierrita evaluated the appropriateness of sample locations, adequacy of site characterization (relative to nature and extent), and comprehensiveness of the data collected to date. As part of the exercise, Sierrita evaluated data needed for the risk assessment, constituents that may drive quantitative calculations of risk (e.g., arsenic), and any potential gaps in the data collected to date as they relate to the ability to complete the BHHRA report. Potential data gaps include bioavailability data to assist with the analysis of arsenic as well as background (ambient) soil data to assist with the evaluation of site-related and ambient levels of arsenic and radionuclides. As stated in Section 3.2, concentrations of metals and radionuclides in soil are not expected to significantly vary on a short-term basis; therefore, no temporal data needs were identified for the soil data collection program.

The selection of sample locations contributes to representativeness of the analytical data. Judgmental or biased sampling results in a greater likelihood that analytical data are adequately protective of potential current and future exposures. Most soil and sediment sample locations were chosen based on professional judgment and were biased toward areas identified as potential sources of site-related COIs. Soil samples submitted for laboratory analysis by HGC in 2004 were selected based on their potential to generate acid solutions. In 2008, URS collected judgmental soil samples based on previous sampling results (e.g., locations where COI concentrations in HGC samples exceeded nr-SRLs). Sediment samples were collected from areas of probable sediment accumulation (URS 2012). In 2013, Arcadis collected confirmation soil samples from areas where analytical results from the initial sampling event to support construction of the new training facility revealed metals concentrations greater than r-SRLs; however, for logistical or safety reasons, no additional excavation of material took place.

Gridded sampling also contributes to representativeness of the analytical data. In 2008, URS collected soil samples at randomly selected grid nodes from a system of 200-square-foot grid units placed over the former CLEAR Plant area and former Esperanza Mill area. Gridded collection of soil samples was conducted by Arcadis in 2013 and 2015 as part of the paving of areas in the CLEAR Plant to ensure adequate spatial coverage and collection of a sufficient number of samples to consider the dataset representative for use in the evaluation of potential current and future exposures.

Table 5-1 contains information on the soil and sediment sampling and analytical methods used during different investigations. A variety of sampling methods has been used, including surficial soil sampling using plastic trowels, disposable plastic scoops, and hand augers; backhoe bucket sample collection; and Macrocore sampling from soil and sediment borings installed using direct-push techniques and Geoprobe® tooling. While sampling methods and selected laboratories have varied, the requested analytical methods for metals have remained the same across different investigations (USEPA Method 6020 inductively coupled plasma-mass spectrometry [ICP-MS] or USEPA Method 6010 inductively coupled plasma-atomic emission spectroscopy [ICP-AES], and USEPA Method 7471A cold vapor atomic absorption [CVAA] for mercury). This contributes to the comparability of data from different site investigations.

Soil samples collected by Arcadis to support construction of the new training facility and associated paving areas in the former CLEAR Plant area were evaluated to assess the quality and reliability of the metals data. Laboratory results were subject to Level II data validation per the USEPA Functional Guidelines for Inorganic Data Review, in accordance with criteria specified in the VRP QAPP (URS 2008b). The Level II data validation included a review of the chain of custody and sample receipt, holding times, method blanks, matrix spike/matrix spike duplicate (MS/MSD) recoveries and relative percent difference (RPD), field duplicate RPD, laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries and RPD, and package completeness. Overall, the results were considered usable, and project data objectives specified in the QAPP were met. Analytical results for two soil samples collected to support construction of the new training facility were qualified “J” (estimated) due to the RPD between field duplicate sample pairs being above acceptable limits. Additionally, copper results for 14 soil samples were qualified “J” (estimated) due to MS/MSD recovery being above acceptable limits. The uranium result in one sample collected for the paving areas project was also qualified due to MS/MSD criteria not being met. No analytical results were rejected as a result of data validation. Data validation summaries are provided in Arcadis 2013a and Arcadis 2015b.

It was assumed that historical data quality assessments (i.e., data validation) performed by previous consultants were accurate, and no additional assessments were completed by Arcadis. HGC (2008) indicates that an internal laboratory QC review was performed on their soil data. URS (2012) describes the 100% data verification and 10% Level II data validation performed for the VRP investigation. A data verification memo and summary table, along with data validation reports, are presented in appendices to the SSCR (URS 2012). Overall, all URS data were determined to be usable, with a proportion of the data qualified per Arizona Data Qualifiers, Revision 3.0, September 20, 2007 (URS 2012).

5.4 Exposure Areas

The specific EAs evaluated in this BHHRA, which are consistent with those assessed by URS in 2011 (URS 2012), are listed below:

- Former CLEAR Plant EA, composed of the following subareas:
  - Former CLEAR Plant
  - Former E Pond
  - Former Evaporation Pond
  - Old D Pond
- Former Esperanza Mill EA, composed of the following subareas:
  - Former Esperanza Mill
  - Former C Pond and C Pond Spoils
  - Former Raffinate Pond
  - Former Laydown Yard
- Former Rhenium Ponds EA, a subarea of the STI Area.

Figure 5-1 shows the relative locations of these three EAs. Figures 5-2 through 5-4 show the locations of soil and sediment (if applicable) samples collected at each subarea.

5.5 Identification of Baseline Human Health Risk Assessment Datasets

The following sections describe how the EA-specific datasets were developed for this BHHRA and the handling of field duplicate sample results. Table 5-2 provides an inventory of the soil and sediment samples for each EA, including location subarea, sample depth, applicable dataset(s), and additional sample descriptor. The analytical results of soil and sediment samples used to conduct the BHHRA are presented in Appendix A.

5.5.1 Depth Interval-Specific Datasets

Soil and sediment samples were also grouped into three separate sample intervals (two shallow intervals and one shallow and deep interval) for this BHHRA as follows:

- The shallow soil/sediment interval (0 to 0.5 feet bgs or 0 to 2 feet bgs) datasets were developed to evaluate potential human exposure assuming the continuation of current activities/operations at the Site (i.e., current scenario). In accordance with the BHHRA Work Plan, only one shallow soil/sediment depth interval was evaluated for each EA. The shallow depth range was selected by calculating the total risk posed by the site-related COPCs for both the 0 to 0.5 feet bgs and 0 to 2 feet bgs soil depth intervals and selecting the shallow depth interval with the highest COPC EPCs.
- The shallow and deep soil/sediment interval (0 to 15 feet bgs) dataset was developed to evaluate hypothetical future human exposure to account for potential excavation and redistribution of soil/sediment during on-site development activities (e.g., construction of commercial/industrial structures [i.e., hypothetical future scenario]). This approach is also consistent with ADEQ (2002) guidance in relation to considerations of future unrestricted land use for the property, which is addressed in Appendix F.

Soil and sediment samples with a top or starting sample depth shallower than the bottom or ending depth of the depth interval defined above were included in the dataset for a specific depth interval. As such, a sample with a top depth of 0 foot bgs was included in all three depth-specific datasets; a sample with a top depth of 0.5 foot bgs, 1 foot bgs, or 1.5 feet bgs was included in all except the 0- to 0.5-foot bgs dataset; and a sample with a top depth of 2 feet bgs or greater was only included in the 0- to 15-foot bgs dataset.

5.5.2 Former CLEAR Plant Shallow Soil/Sediment Datasets

In 2012, discrete soil samples were collected from excavations for a new training facility building and associated parking lot areas within the former CLEAR Plant EA. Additional paved areas occupying approximately 0.9 acre were constructed in 2015. Ninety-two samples were identified as being either currently covered with pavement or a building. Therefore, separate shallow soil/sediment datasets were created for the former CLEAR Plant EA to evaluate current and hypothetical future conditions. The current scenario dataset consists of samples that are currently not covered by pavement or buildings (i.e., the soil is exposed and the potential for exposure to receptors exists). The hypothetical future scenario dataset consists of all samples collected from the CLEAR Plant EA. Table 5-2 presents the samples used in each dataset.

Separate current and future scenario shallow soil/sediment datasets were not required for the former Esperanza Mill EA and the former Rhenium Ponds EA. Soil samples were not collected from beneath buildings or pavement in these areas.

5.5.3 Handling of Field Duplicate Results

In accordance with the QAPP Addendum prepared for the Site (URS 2008b) and the ADEQ-approved BHHRA Work Plan (Arcadis 2015a), any field duplicate collected as part of site investigations considered in this BHHRA was treated as a quality control (QC) sample and was not used to characterize the Site. Therefore, the parent analytical result was considered representative of that sample and constituent.

5.6 Selection of Constituents of Potential Concern

The selection of COPCs focuses the BHHRA on the site-related constituents that are most likely to present human health risks. COPCs were selected on an EA-specific basis consistent with the ADEQ-approved BHHRA Work Plan. Constituents detected in at least one soil or sediment sample were considered COPCs unless one of the following criteria was met:

- For metals, the highest detected concentration in soil and sediment was less than the corresponding nr-SRL.
- For radionuclides, the highest detected concentration in soil and sediment was less than the corresponding USEPA Preliminary Remediation Goal (PRG; USEPA 2014c), when available.
- The constituent was detected in less than 5 percent of the soil/sediment samples, and no “hotspots” were identified. ADHS (2003) defines hotspots as areas yielding one or more samples that contain constituent concentrations that exceed the relevant SRL by a factor of 10 or more.

ADHS (2003) also allows for the exclusion of constituents considered at or below ambient conditions. An ambient dataset was not developed for the detected metals or radionuclides; therefore, the COPC selection process did not include an ambient analysis.

Constituents that were not eliminated by the criteria listed above were selected as COPCs for evaluation in this BHHRA for each EA.

Table 5-3 presents the Arizona SRLs and USEPA PRGs used to select COPCs in soil/sediment at the Site. Tables 5-4 through 5 25 provide the results of the COPC selection process for each EA. These tables also provide summary statistics, including the number of detections, number of samples, frequency of detection, minimum and maximum reporting limits and detected concentrations, location of maximum detected concentration, mean detected concentration for each detected constituent, and applicable depth interval (0 to 0.5 foot bgs or 0 to 2 feet bgs and 0 to15 feet bgs). In addition, Tables 5-4 through 5-25 provide the 95% UCL, if calculable, as discussed in Section 5.7 for constituents identified as COPCs. The following COPCs were identified for each EA:

- Former CLEAR Plant EA – arsenic, copper, lead, Ra-226, Ra-228, U-235, and U-238
- Former Esperanza Mill EA – arsenic, lead, molybdenum, Ra-226, Ra-228, U-235, and U-238
- Former Rhenium Ponds EA – Ra-226, Ra-228, and U-238.

5.7 Exposure Point Concentrations

An EPC is the COPC concentration to which a hypothetical receptor might be exposed through potentially complete exposure routes. The sections below describe the basis for the established EPCs in soil/sediment and outdoor air.

5.7.1 Soil/Sediment Exposure Point Concentrations

To estimate exposure to COPCs in soil/sediment, the concentration term in the risk equation was calculated as the average of the concentration that could be contacted at the exposure point or points over the exposure period (USEPA 1989, 1992). The EPC is defined as “the arithmetic average of the concentration that is contacted over the exposure period” (USEPA 1989). The 95% UCL is defined as the value that, when calculated repeatedly for randomly drawn subsets of data, equals or exceeds the true mean 95% of the time (USEPA 1992). Use of the 95% UCL (as representative of the average concentration) is recommended instead of the maximum concentration because it is highly unlikely that a receptor will be exposed to a single (e.g., maximum) concentration over the entire exposure duration. Rather, a receptor will likely be exposed to a range of concentrations in the EA, from not detected to the maximum concentration, over the entire exposure period. In the event that a UCL exceeds the maximum detected concentration, the maximum concentration was used to represent the EPC.

USEPA recommends caution in the use of UCLs for small datasets (e.g., fewer than four detects or 10 total samples) because the performance of the various methods may not be reliable in these cases (USEPA 2013b). Typically, at least five detected concentrations and 10 total samples are necessary to calculate UCLs on the mean concentration (i.e., 95% UCLs; USEPA 2013a). If sufficient data (i.e., at least eight samples with at least five detected concentrations) were available, a conservatively based 95% UCL was estimated using the USEPA-released statistical software ProUCL Version 5.0.00 (ProUCL 5.0)

(USEPA 2013a, 2013b, 2013c). ProUCL 5.0 employs statistical methods to evaluate both full environmental datasets without not detected (ND) values and datasets with below detection limit or ND values (also known as left-censored datasets) without the use of proxy values. Based on the results of ProUCL analyses, the lesser of the UCL (if calculated) or maximum detected concentration of a COPC was selected as the EPC (USEPA 1989). In the event of insufficient data, the maximum detected concentration was used in place of a 95% UCL. ProUCL output results of COPCs for all three EAs are presented in Appendix B.

EPCs were initially developed for three soil depth intervals (two shallow intervals and one shallow and deep interval) for each receptor scenario; however, only two soil depth intervals (one shallow interval and one shallow and deep interval) were evaluated for each EA (see Section 5.5). The rationale for calculating EPCs over multiple depth intervals is to capture the variable sampling depths of the soil dataset, and to meet requirements of A.R.S. § 49-152, which identify up to 15 feet of soil as “surface soil”. Evaluating a 0 to 15 ft bgs depth is consistent with ADEQ guidance (ADEQ 2002) and the ADEQ-approved BHHRA Work Plan (Arcadis 2015a). As a conservative measure, only the shallow depth range (either 0 to 0.5 ft bgs or 0 to 2 ft bgs) with the highest COPC EPCs was selected as the shallow soil depth range used in the BHHRA. The shallow soil depth intervals selected for each EA are presented in Tables 5-26 through 5-30.

Tables 5-26 through 5-30 present the EPCs for COPCs in soil/sediment for the selected shallow soil/sediment depth intervals and the shallow and deep soil/sediment depth intervals.

5.7.2 Air Exposure Point Concentrations

The inhalation of constituents adsorbed to airborne soil dust particles is a potentially complete exposure pathway for all receptors evaluated in this BHHRA. Potential exposure to COPCs adsorbed to soil particles and released to air from wind erosion or during soil invasive activities was evaluated using particulate emission factors (PEFs). In accordance with the ADEQ-approved BHHRA Work Plan (Arcadis 2015a), a default PEF value was used (ADHS 2003; ADEQ 2002) for all receptors in this BHHRA.

6 EXPOSURE ASSESSMENT

Exposure assessment is the process of identifying potential receptors and estimating the type and magnitude of potential human exposure to COPCs at the Site. It includes information regarding the models and parameters necessary to estimate human exposure through ingestion, dermal absorption, inhalation, and other exposure routes evaluated (e.g., external exposure to ionizing radiation). Figure 6-1 presents the human health CSM for the Site and illustrates the potential sources of COPCs in soil/sediment, release and transport mechanisms, potential exposure media, and exposure routes for potential human receptor populations (described in more detail below). The following exposure pathway analysis describes each component of the human health CSM in more detail.

6.1 Exposure Pathway Analysis

An exposure pathway is a mechanism by which receptors may come into contact with site-related COPCs. USEPA (1989) describes a complete exposure pathway in terms of four components:

1. Source and mechanism of COPC release (e.g., discharge of process wastewaters to unlined surface impoundments)
2. Retention or transport medium (e.g., soil or sediment)
3. Receptor at a point of potential exposure to an impacted medium (e.g., outdoor commercial/industrial workers)
4. Complete exposure route (e.g., incidental ingestion) at the point of exposure.

If any of these four components is not present, a potential exposure pathway is considered incomplete and is not evaluated further in this BHHRA. Each of the complete or potentially complete exposure pathways identified in Figure 6-1 was quantitatively evaluated in this BHHRA.

6.1.1 Sources and Mechanisms of COPC Release

The sources and mechanisms of COPC release at the Site are related to processing activities that historically occurred within each EA, which include:

- Historical processes used to refine ore
- Storage of reagents and other solutions
- Accidental spills.

6.1.2 Transport Mechanisms

All of the above listed processes have contributed to deposition of site-related constituents onto surface soils and sediments. Constituents present in the surface may also migrate downward into deeper soils through leaching and to other locations on site through transport of wind-blown dust and surface runoff. The vertical transport of COPCs is driven by precipitation, which occurs during the wet season (mid-June through September), when rapid pulses of water move into the alluvium. Constituent transport in sediment of natural drainage channels at the Site is likewise limited to the wet season and/or significant precipitation events, when flushing occurs (Arcadis 2015a). Finally, constituent concentrations present

between 0 and 15 ft bgs may be redistributed during future construction/development activities should they occur at any of the three EAs. Inclusion of sediment data in this 0 to 15 ft bgs dataset is a conservative approach, as future construction/development activities are not likely to occur in the on-site drainage features.

6.1.3 Potential Receptors

Human receptors evaluated in the BHHRA were chosen based on the current and potential future uses of an EA. Given that the Site is an active mine, the reasonably expected current and future receptors include on-site outdoor commercial/industrial workers, future on-site construction workers, and future on-site trespassers. Further description of each receptor and the basis for selection are discussed below.

6.1.3.1 Current/Future Receptors

The only on-site receptors identified based on the current and most likely future land use of the Site are outdoor commercial/industrial workers, who may be exposed to COPCs present in shallow soil/sediment and particulates in outdoor air when they are storing equipment and supplies at the former CLEAR Plant EA or performing maintenance work and other routine activities at the former Esperanza Mill EA. While workers are not present at the former Rhenium Ponds, outdoor commercial/industrial workers were included as potential receptors because there is no physical barrier (i.e., fence) to prevent them from accessing the EA.

As noted earlier in Section 2.3, buildings (used for training and storage) currently exist in the former CLEAR Plant EA. An indoor commercial/industrial worker was not evaluated, primarily because the vapor intrusion pathway (which could contribute significantly to indoor impacts) is incomplete for the three EAs, as only metals are chemical COPCs. Radionuclides, including Ra-226, were also identified as COPCs; therefore, the potential for radon gas generation was considered. Ra-226 concentrations detected in soil/sediment at the Site are relatively low, with 95% UCLs ranging from 2.41 pCi/g (former CLEAR Plant EA) to 2.43 pCi/g (former Esperanza Mill EA), and may be associated with ambient conditions. These Ra-226 UCLs, which were used as EPCs in this BHHRA, are lower than the 5 pCi/g Ra-226 cleanup criterion established by the USEPA for surface soil at sites with residual radioactive contamination (USEPA 1990b, 40 Code of Federal Regulations [CFR] Part 192). The USEPA criterion of 5 pCi/g was intended to limit gamma radiation exposure and to limit the risk from inhalation of radon decay products in houses built on land containing radioactive tailings. Based on these considerations, the indoor air pathway was not evaluated further.

Because radionuclides are identified as COPCs, potential indoor-related exposures (exposure while in commercial buildings) were evaluated in this BHHRA. If potential impacts estimated for an outdoor commercial/industrial worker (who is expected to be in contact with COPCs in soils/particulates in air throughout the duration of employment) are below agency threshold levels of concern, then it is assumed that impacts will be even lower for an indoor commercial/industrial worker due to the shielding effects of buildings.

6.1.3.2 Hypothetical Future Receptors

Based on the unlikely event that the Site is redeveloped in the future, the following hypothetical future receptors were evaluated:

- Future On-site Construction Worker - A future on-site construction worker was selected because this worker may be exposed to COPCs in the unlikely event that the Site is redeveloped.
- Future On-site Trespasser[1] - A future on-site trespasser was selected because a person could illegally access the property in the future and potentially be exposed to COPCs in soil/sediment. For the purpose of the BHHRA, it is anticipated that, if chronic trespassing were to occur at the Site in the future, it would more likely involve an adolescent aged individual rather than an adult. Therefore, an adolescent trespasser was evaluated under a hypothetical future exposure scenario.

6.1.4 Potentially Complete Exposure Routes

Potential receptors may be exposed to COPCs in soil/sediment through the following exposure routes:

- Incidental ingestion
- Dermal contact
- External exposure (i.e., ionizing radiation)
- Inhalation of particulates (e.g., alpha particles or wind-blown dust particles).

6.2 Exposure Parameters

6.2.1 Reasonable Maximum Exposure

Consistent with ADHS (2003) guidance, potential human receptors were evaluated under reasonable maximum exposure (RME) scenarios based on an appropriate combination of central tendency and upper-bound exposure parameters. The RME evaluation results in risk estimates that exceed central tendency exposure scenarios in all cases. The “high end” exposure estimate or RME is defined as the highest exposure that is reasonably expected to occur at a site but that is still within the range of possibility (USEPA 1989). Such a focus on RME scenarios provides an additional measure of health protectiveness.

Human health exposure parameters for each receptor evaluated in this BHHRA are presented in Table 6-1. The RME parameters provided in this table reflect ADHS- and USEPA-recommended values for chronic and subchronic exposures.

[1] Trespassing is not a viable current exposure scenario, considering the Sierrita mine is privately owned and operated. Access to the Site is strictly controlled, and the Site is not accessible to the public. Under these conditions, a current trespasser exposure scenario is not realistic or practical for making risk management decisions. However, for the former CLEAR Plant EA, trespasser exposure was also evaluated using the current (exposed soil/sediment) dataset in the event that someone could access the Site prior to redevelopment (pavement and vacant buildings remain on site).

6.2.2 Site-Specific Exposure

Table 6-1 also presents site-specific parameters that were used in a separate evaluation of potential outdoor commercial/industrial worker exposures. The site-specific parameters consider actual worker activities and are more representative of potential exposures under the current and foreseeable future land uses at each EA than are the RME parameters.

Typically, outdoor workers do not spend an entire 8-hour workday within the former CLEAR Plant EA or former Esperanza Mill EA. Instead, they travel in and out of these EAs, as well as indoors and other areas of the Sierrita mine facility, throughout the day. An exposure time of 4 hours per day was therefore used in the site-specific evaluation of potential outdoor worker exposures at the former CLEAR Plant EA and former Esperanza Mill EA. All other exposure parameters were the same as used for the RME evaluation.

For the former Rhenium Ponds EA, no workers are typically present because the area is vacant of any infrastructure (e.g., buildings, storage areas, parking areas, road) and there are no work activities conducted at the former Rhenium Ponds. However, because the potential exists for transient exposure to occur, an exposure frequency of 12 days per year (equivalent to 1 day per month) and an exposure time of 1 hour per day were used in the site-specific evaluation of potential outdoor worker exposures at the former Rhenium Ponds EA. All other exposure parameters were the same as used for the RME evaluation.

6.3 Dose (Intake) Estimation

For incidental ingestion and dermal contact with soil/sediment, when evaluating exposure to potential carcinogens, lifetime average daily doses (LADDs) were calculated by averaging exposure over an expected 78-year lifespan. When evaluating exposure to noncarcinogens, doses were estimated as average daily doses (ADDs), calculated as the average exposure for the time the receptor is assumed to be exposed to the COPC. Radionuclide exposures were calculated using the USEPA approach (USEPA 2000; 2014c). Exposures were calculated using the equations recommended by USEPA (1989, 2004) for the potentially complete routes identified in the CSM (Figure 6-1) using the exposure parameters summarized in Table 6-1.

The following sections describe the methods and inputs used to calculate LADDs for carcinogenic COPCs and ADDs for noncarcinogenic COPCs.

6.3.1 Carcinogenic Effects from Chemical COPCs

For chemical constituents with potential carcinogenic effects, the LADD is an estimate of potential daily intake over the course of a lifetime. In accordance with USEPA (1989), the LADD is calculated by averaging the assumed exposure during the receptor's entire lifetime (assumed to be 78 years). For incidental ingestion and dermal exposure, the LADD for each constituent via each route of exposure is multiplied by the oral slope factor (OSF; adjusted by the gastrointestinal absorbance factor [ABS_{GI}] for dermal exposures) to estimate the incremental lifetime cancer risk due to exposure to that constituent via that route of exposure. Consistent with USEPA RAGS Part F (2009a) an inhalation exposure concentration (EC) in place of an LADD was calculated to evaluate inhalation of fugitive dust particles in outdoor air.

6.3.2 Noncarcinogenic Effects from Chemical COPCs

The ADD is an estimate of a receptor's potential daily intake from incidental ingestion and dermal contact with constituents in soil with potential noncarcinogenic effects. The ADD does not represent a true average because the assumptions used to derive it do not represent "averages." In fact, they overestimate the average exposure. According to USEPA (1989), the ADD should be calculated by averaging over the period of time for which the receptor is assumed to be exposed (averaging time = exposure duration [ED] for potential noncarcinogenic risk), not the lifetime. For incidental ingestion and dermal contact with soil exposure routes, the ADD for each constituent via each route of exposure is compared to the respective chronic reference dose (cRfD; adjusted by the ABS_{GI} for dermal exposures) to estimate the potential hazard quotient (HQ) due to exposure to that constituent via that route of exposure. Consistent with USEPA RAGS Part F (2009), an EC, in place of an ADD, was calculated to evaluate inhalation of fugitive dust particles.

If the ED is less than 7 years of a person's lifetime (i.e., for the hypothetical future construction worker), the ADD or EC represents a subchronic exposure, and subchronic toxicity values were used in place of chronic toxicity values (USEPA 1989).

The following sections present the equations used for chemical COPC dose calculations in this BHHRA.

6.3.3 Dose Equations

6.3.3.1 Incidental Ingestion of Soil

The doses of chemical COPCs associated with incidental ingestion of soil were calculated as follows:

Equation 6-1:

$$\text{Dose} = \frac{C_{soil} \times CF \times IR_s \times EF \times ED \times FI}{AT_n \text{ or } AT_c \times BW}$$

Where:

Dose = ADD or LADD (milligrams per kilogram per day [mg/kg day])

C_{soil} = COPC EPC in soil (mg/kg)

CF = conversion factor ($1x10^{-6}$ kilograms per milligram [kg/mg])

IR_s = soil ingestion rate (milligrams per day)

EF = exposure frequency (days per year)

ED = exposure duration (years)

FI = fraction ingested (unitless)

AT_n = averaging time for noncarcinogens (days; ED (years) x 365 days per year)

AT_c = averaging time for carcinogens (days; lifetime (78 years) x 365 days per year)

BW = body weight (kilograms [kg])

6.3.3.2 Dermal Contact with Soil

Absorbed doses of chemical COPCs associated with dermal contact with soil were calculated as follows:

Equation 6 2:

$$\text{Dose} = \frac{C_{soil} \times CF \times SSA \times SAR \times ABS_d \times EF \times ED}{AT_n \text{ or } AT_c \times BW}$$

Where:

Dose = ADD or LADD (mg/kg day)

C_{soil} = COPC EPC in soil (mg/kg)

CF = conversion factor ($1x10^{-6}$ kg/mg)

SSA = exposed skin surface area (square centimeters [cm^2])

SAR = soil-to-skin adherence rate (milligrams per cm^2 per day)

ABS_d = dermal absorption factor (unitless; Table 6-2)

EF = exposure frequency (days per year)

ED = exposure duration (years)

AT_n = averaging time for noncarcinogens (days; ED (years) x 365 days per year)

AT_c = averaging time for carcinogens (days; lifetime (78 years) x 365 days per year)

BW = body weight (kg)

6.3.3.3 Inhalation of Fugitive Dust Particles

Doses associated with the inhalation of chemical COPCs associated with fugitive dust particles from outdoor air were calculated as follows:

Equation 6-3:

and:

$$EC = \frac{C_{ambient\_air} \times ET \times EF \times ED}{AT_n \text{ or } AT_c}$$

Equation 6-4:

$$C_{ambient\_air} = \frac{C_{soil}}{PEF}$$

Where:

EC = exposure concentration (milligrams per cubic meter [mg/m^3])

$C_{ambient\_air}$ = COPC EPC in ambient air (mg/m^3)

ET = exposure time (hours per day)

EF = exposure frequency (days per year)

ED = exposure duration (years)

AT_c = averaging time for carcinogens (hours; lifetime [78 years] x 365 days per year x 24 hours per day)

AT_n = averaging time for noncarcinogens (hours; ED [years] x 365 days per year x 24 hours per day)

C_{soil} = COPC EPC in soil (mg/kg)

PEF = particulate emission factor (cubic meter(s) per kilogram [m^3/kg])

Toxicity values used, along with the chemical COPC doses estimated above, are discussed in Section 7.

6.3.3.4 Bioavailability of Metals

Oral bioavailability reflects the amount of a constituent absorbed into the body following ingestion. The typical assumption when calculating risks to humans is that oral bioavailability is 100%. In the case of lead and arsenic, however, numerous studies that have measured site-specific oral bioavailability indicate that, especially for mine-related materials, the relative bioavailability of lead and arsenic is often much lower than 100% (e.g., Bradham et al. 2011; Drexler and Brattin 2007; USEPA 2010; Casteel et al. 1997; Freeman et al. 1993).

In this BHHRA, bioavailability of all COPCs, with the exception of lead and arsenic, was conservatively set at 100%. The USEPA model used to evaluate lead exposures assumes 30% oral bioavailability (USEPA 2003c). The arsenic oral dose from exposure through incidental ingestion of soil was adjusted using a relative bioavailability (RBA) factor of 0.4 (or 40 percent). This 40 percent RBA is the 'most likely' RBA value from a triangular distribution developed as part of the ADEQ-approved Ajo/Bisbee risk assessment conducted by Brown and Caldwell (BC) (BC 2009). The dataset used to develop that distribution consisted of reported *in vivo* studies on 35 samples from 15 separate sites, including mining and smelting sites (Damian Applied Toxicology LLC, 2015). The same arsenic RBA was subsequently applied in an ADEQ-approved risk assessment for a similar site in Douglas, Arizona (BC 2013), and in the ADEQ-approved risk assessment to support the development of soil remediation levels at the former United Verde copper smelter near Clarkdale, Arizona (Damian Applied Toxicology LLC, 2015). Based on the similarity in constituents of interest and type of activities at these sites (i.e., potential exposure to arsenic [and other metals] in soils at former mining/smelting facilities), the RBA value of 40 percent is considered appropriate for the evaluation of arsenic exposure at the Sierrita mine as well.

The arsenic dose associated with incidental ingestion of soil is adjusted as follows:

Equation 6-5:

$$Dose_{adj} = Dose \times RBA$$

Where:

Dose = ADD or LADD (milligrams per kilogram per day [mg/kg-day]) from Equation 6.1

RBA = Arsenic relative bioavailability (0.4)

6.3.4 Carcinogenic Effects from Radionuclide COPCs

Unlike chemicals, radionuclide exposure is typically expressed in units of activity (e.g., picoCuries) per unit of the exposure medium, rather than mass per unit. Only the carcinogenic effects of radionuclides are considered. Dose equations are provided in the following sections for the exposure pathways evaluated in this BHHRA: direct ingestion of soil, inhalation of fugitive dusts, and external exposure to penetrating radiation (i.e., gamma radiation and X-rays). Dermal absorption is considered an insignificant exposure pathway for radionuclides and generally is not evaluated (USEPA 2000). Radioactive half-lives and decay constants required for calculating radionuclide exposure doses are from the USEPA PRG Summary Table (USEPA 2014c). For external radiation exposure, required parameters include an area correction factor (ACF) and gamma shielding factor (GSF), which were developed using USEPA guidance (USEPA 2000).

The following sections present the equations used for radionuclide COPC dose calculations in this BHHRA.

6.3.4.1 Incidental Ingestion of Soil

The doses of radionuclide COPCs associated with incidental ingestion of soil were calculated as follows:

Equation 6-6:

$$\text{Dose (pCi)} = \frac{\text{EC} \times \text{IR}_S \times \text{EF} \times \text{ED} \times [1 - exp(-\lambda \times \text{ED})]}{(10^3 \times \text{ED} \times \lambda)}$$

Where:

Dose = dose due to internal exposure (pCi)

EC = exposure concentration (pCi/g)

IR_s = ingestion rate of soil (mg/day)

EF = exposure frequency (days/year)

ED = exposure duration (years)

λ = decay constant (1/year)

6.3.4.2 Inhalation of Fugitive Dust Particles

Doses associated with the inhalation of radionuclide COPCs associated with fugitive dust particles from outdoor air were calculated as follows:

Equation 6-7:

$$\text{Dose (pCi)} = \frac{\text{EC} \times 10^3 \times \text{InhR} \times \text{ET} \times \text{CF} \times \text{EF} \times \text{ED} \times [1 - exp(-\lambda \times \text{ED})]}{(\text{PEF} \times \text{ED} \times \lambda)}$$

Where:

Dose = dose due to internal exposure (pCi)

EC = exposure concentration (pCi/g)

λ = decay constant (1/year)

CF = conversion factor (0.042 days /hr)

EF = exposure frequency (days/year)

ED = exposure duration (years)

ET = exposure time (hrs/day)

InhR = inhalation rate (m^3/day)

PEF = Particulate emission factor (m^3/kg)

6.3.4.3 External Exposure

Doses associated with external exposure to radionuclide COPCs were calculated as follows:

Equation 6 8:

$$\text{Dose (pCi)} = \frac{\text{EC} \times \text{ACF} \times [(\text{ET}_o \times \text{CF} \times \text{GSF}_o) + (\text{ET}_i \times \text{CF} \times \text{GSF}_i)] \times \text{EF} \times \text{ED} \times [1 - exp(-\lambda \times \text{ED})]}{(365 \text{ days/year} \times \text{ED} \times \lambda)}$$

Where:

Dose = dose due to external exposure (pCi)

EC = exposure concentration (pCi/g)

ACF = area correction factor for source area (unitless)

λ = decay constant (1/year)

CF = conversion factor (0.042 days /hr)

EF = exposure frequency (days/year)

ED = exposure duration (years)

ET_o = exposure time, outdoor (hrs/day)

ET_i = exposure time, indoor (hrs/day)

GSF_o = gamma shielding factor, outdoor (unitless)

GSF_i = gamma shielding factor, indoor (unitless)

Toxicity values used, along with the radionuclide COPC doses estimated above, are discussed in Section 7.

6.3.5 Lead Exposure

USEPA's Adult Lead Methodology and Adult Lead Model (USEPA 2003b, 2003c, 2009b) were used to evaluate the potential for adverse health effects from exposure to lead in soil and sediment at the Site.

Exposure to lead is typically evaluated in terms of the increase in blood lead (PbB) concentrations following exposure. The United States Department of Health and Human Services' Centers for Disease Control and Prevention (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR) have designated, and the USEPA has adopted, 10 micrograms per deciliter (µg/dL) as a PbB concentration of concern to protect sensitive populations (e.g., neonates, infants, and children). The USEPA's stated goal for lead is that children have no more than a 5% probability of exceeding a PbB concentration of 10 µg/dL. As such, this level is assumed to also provide protection for adults.

For adult workers exposed to lead, the ALM was used to predict PbB concentrations and estimate the probability that target PbB concentrations are exceeded. The ALM may also be used to evaluate exposure to lead for the hypothetical future adolescent trespasser by modifying exposure parameter values (e.g., exposure frequency, soil ingestion rate) input to the model. With the ALM, concern is for a fetus that may be carried by an exposed pregnant female, with the assumption that the results apply to both exposed females and males as well. Default estimates were used for the statistical measures of PbB, including the 95th percentile PbB concentration in fetus, fetal/maternal PbB ratio ($R_{fetal/maternal}$), biokinetic slope factor, geometric standard deviation on the population mean PbB concentration (GSD_i), and baseline PbB concentration. Default values were also used for exposure parameters such as the lead absorption fraction and averaging time.

USEPA-recommended methods and standard parameters were used (e.g., arithmetic mean as the EPC) to run the ALM.

7 TOXICITY ASSESSMENT

The USEPA derives numerical toxicity values for use in risk assessments. Because the impacts associated with exposure to carcinogens are assessed differently than the hazards associated with exposure to noncarcinogens, the toxicity values for carcinogenic health effects and for noncarcinogenic health effects are derived using different assumptions and methods. This section discusses toxicity values used to assess potential carcinogenic risk and noncarcinogenic hazards for this BHHRA. Tables 7-1 and 7-2 present the toxicity values used to evaluate carcinogenic and noncarcinogenic effects for the oral, dermal, and inhalation exposure routes for chemical COPCs, and the slope factors used to evaluate carcinogenic effects for oral, inhalation, and external exposure routes for radionuclide COPCs.

7.1 Toxicity Values for Carcinogenic Chemicals

The current approach to carcinogenic risk assessment used by USEPA (2005) and other United States regulatory agencies assumes, without confirmatory studies, that exposure to any carcinogen poses a finite probability, however small, of producing a carcinogenic response. OSFs are used in this BHHRA to estimate potential cancer risk and represent the upper-bound probability of carcinogenic response per unit daily intake of a substance throughout a lifetime. OSFs are used to assess risks associated with oral and dermal exposures. Inhalation unit risks (IURs) are used in this BHHRA to estimate potential cancer risk and represent the upper-bound probability of carcinogenic response per unit (1 micrograms per cubic meter [µg/m^3] in air) of a substance throughout a lifetime. OSFs and IURs were used in this BHHRA to assess the ELCR for each receptor and were selected from the following sources (listed in order of priority):

- USEPA Integrated Risk Information System (IRIS; USEPA 2015b)
- USEPA Provisional Peer-Reviewed Toxicity Values (PPRTVs; USEPA 2015d)
- California Environmental Protection Agency (CalEPA) Unit Risk and Cancer Potency Factors (Office of Environmental Health Hazard Assessment [OEHHA] 2009)
- USEPA Health Effects Assessment Summary Tables (USEPA 2015e).

7.2 Toxicity Values for Noncarcinogenic Chemicals

Noncarcinogenic toxicity values (reference doses [RfDs] and reference concentrations [RfCs]) are applied in this BHHRA to estimate the potential noncancer hazards associated with chemical exposure. In contrast to the default non-threshold assumption used to assess carcinogenic risk, noncarcinogenic effects are assumed by most regulatory agencies, including USEPA, to exhibit a biological or toxicological threshold below which adverse effects are not expected.

Following USEPA (1989, 2015c) guidance, cRfDs are used in this BHHRA to assess potential noncarcinogenic hazards for receptors with EDs greater than 7 years. RfDs are used to assess hazards associated with oral and dermal exposures. Chronic reference concentrations (cRfCs) for inhalation are used in this BHHRA to assess potential noncarcinogenic hazards by the inhalation exposure route. Subchronic reference doses (sRfDs) are used in this BHHRA to assess potential noncarcinogenic hazards for adult receptors with EDs less than 7 years, and subchronic reference concentrations (sRfCs) are used to assess potential inhalation noncarcinogenic hazards. Whenever an sRfD or sRfC was

unavailable, then (in order of preference) either intermediate minimal risk levels (MRLs)[2] developed by the ATSDR (ATSDR 2014) or the cRfD or cRfC was used.

Chronic and subchronic noncancer RfDs and RfCs used in this BHHRA were selected consistent with USEPA's (2003a) recommended hierarchy as follows:

- Tier 1 – USEPA's (2015b) IRIS
- Tier 2 – USEPA's (2015d) PPRTVs
- Tier 3 – other USEPA and non-USEPA toxicity values (e.g., CalEPA [2015], ATSDR [2014], USEPA's Health Effects Assessment Summary Tables [USEPA 2015e]).

7.3 Toxicity Values for Radionuclides

USEPA classifies all radionuclides as "Group A" or known human carcinogens, based on their property of emitting ionizing radiation and on the extensive weight of evidence provided by epidemiological studies of radiogenic cancers in humans (USEPA 2001; 2014c). Human health risks are evaluated based on the radiotoxicity, rather than on the chemical toxicity, of each radionuclide present (an exception is uranium, where both radiotoxicity and chemical toxicity are normally evaluated; USEPA 2001). Cancer slope factors for radionuclides were obtained from the USEPA PRG Calculator (USEPA 2014c). As seen in Table 7-2, "Adult Only Soil Ingestion" slope factors were used to evaluate trespasser and worker exposure. "Soil Ingestion" slope factors are lifetime values appropriate for evaluating hypothetical future residential exposure at the Site.

[2] The intermediate MRLs were developed for exposure ranging from 15 to 364 days. In this BHHRA, intermediate MRLs were only used for hypothetical future construction workers, for which the ED was 1 year and the EF was 250 days per year.

8 RISK CHARACTERIZATION

Risk characterization integrates the exposure assessment and toxicity information. The cancer risk and/or noncancer hazard was calculated for each COPC and for each medium and potentially complete exposure route.

8.1 Excess Lifetime Cancer Risks

An ELCR was calculated for each constituent identified by ADHS (AAC Title 18 Chapter 7 Appendix B) or USEPA as a potential carcinogen.

The ELCR for incidental ingestion and dermal contact with soil was estimated as shown in the following equation:

Equation 8 1a (metals): ELCR = CSF x LADD

Equation 8 1b (radionuclides, oral only): ELCRo = CSFo x Dose

Equation 8-2 was used to determine the ELCR associated with inhalation of fugitive dust particles in ambient air:

Equation 8 2a (metals): ELCR = IUR x EC

Equation 8 2b (radionuclides): ELCR = CSFi x Dose

Equation 8-3 was used to determine the ELCR associated with external exposure of radionuclides:

Equation 8-3 (radionuclides): ELCR = CSFe x Dose

The total ELCR was calculated by summing the risk for each carcinogen over all exposure media and exposure routes.

8.2 Noncancer Hazards

An HQ was calculated for all chemical COPCs. The HQ is the ratio of the estimated dose from exposure to a constituent in a particular medium to the dose that is not expected to result in adverse noncancer health effects.

The HQ for incidental ingestion and dermal contact is:

Equation 8-4: $$HQ = \frac{ADD}{RfD}$$

Equation 8-5 was used to determine the HQ for inhalation exposures to fugitive dust particles in ambient air:

Equation 8-5: $$HQ = \frac{EC}{RfC}$$

The total HI was calculated by summing the HQs for each noncarcinogen over all exposure media and exposure routes. If the HI exceeds a value of 1, the possibility exists for a noncarcinogenic hazard. The HI is not a mathematical prediction of the severity or incidence of the effects, but rather indicates that a hazard may exist. ADHS (2003) and USEPA (1989) recommend that the total HI not exceed a value of 1. If the resulting total HI is greater than 1, it may be recalculated by summing only HQs for constituents with a similar mechanism of action or toxic endpoints (USEPA 1989).

9 RISK CHARACTERIZATION RESULTS

This section presents the estimated ELCRs and HIs from COPCs in soil/sediment for each receptor at the three EAs evaluated in this BHHRA. The results for each EA are presented in Tables 9-1 through 9-3. Exposure and receptor-specific estimated ELCR and HI tables are presented in Appendix C (Excess Lifetime Cancer Risk and Hazard Index Calculations [Chemicals]) and Appendix D (Excess Lifetime Cancer Risk Calculations [Radionuclides]). The results are also discussed in Section 9.1.

Results of the ALM used to evaluate the potential for adverse health effects from exposure to lead are presented in Appendix E and summarized in Section 9.2.

9.1 ELCR and HI Results for Current and Future Scenarios

This section presents the results of the BHHRA by EA under the current and future scenarios.

ELCR and HI results are summarized in the following table:

Former CLEAR Plant Exposure Area		
	Shallow Soil/Sediment	Shallow and Deep Soil/Sediment
Current Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.2	--
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 7×10^{-5}; HI=0.2	--
Future Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.09	ELCR = 1×10^{-4}; HI=0.08
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 6×10^{-5}; HI=0.09	ELCR = 6×10^{-5}; HI=0.08
Hypothetical Construction Worker	--	ELCR = 7×10^{-6}; HI=0.5
Hypothetical Adolescent Trespasser	ELCR = 2×10^{-6}; HI=0.04	ELCR = 2×10^{-6}; HI=0.03
Former Esperanza Mill Exposure Area		
	Shallow Soil/Sediment	Shallow and Deep Soil/Sediment
Current Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.2	--
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 6×10^{-5}; HI=0.2	--
Future Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}; HI=0.2	ELCR = 1×10^{-4}; HI=0.1
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 6×10^{-5}; HI=0.2	ELCR = 6×10^{-5}; HI=0.1
Hypothetical Construction Worker	--	ELCR = 7×10^{-6}; HI=0.7
Hypothetical Adolescent Trespasser	ELCR = 2×10^{-6}; HI=0.07	ELCR = 2×10^{-6}; HI=0.04

Former Rhenium Ponds Exposure Area		
	Shallow Soil/Sediment	Shallow and Deep Soil/Sediment
Current Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}	--
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 7×10^{-7}	--
Future Scenario		
RME Outdoor Commercial/Industrial Worker	ELCR = 1×10^{-4}	ELCR = 1×10^{-4}
Site-Specific Outdoor Commercial/Industrial Worker	ELCR = 7×10^{-7}	ELCR = 8×10^{-7}
Hypothetical Construction Worker	--	ELCR = 6×10^{-6}
Hypothetical Adolescent Trespasser	ELCR = 1×10^{-6}	ELCR = 1×10^{-6}

Notes:
-- Not applicable.

9.1.1 Current/Future Scenario – Shallow Soil/Sediment Exposures

9.1.1.1 Former CLEAR Plant EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The ELCR is attributable to arsenic and radionuclides (Ra-226, Ra-228, and U-238) in shallow soil/sediment, with the cancer risk from radionuclides accounting for 95% of the total ELCR. The cumulative HI for the RME outdoor commercial/industrial worker is 0.2, which is below the target HI (1) for noncancer effects. The noncancer hazard is due to arsenic and copper in shallow soil/sediment.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 7×10^{-5}, which is also within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The ELCR is attributable to arsenic and radionuclides, with the cancer risk from radionuclides accounting for 92% of the total ELCR. The cumulative HI for the site-specific outdoor commercial/industrial worker is 0.2, which is below the target HI (1) for noncancer effects.

9.1.1.2 Former Esperanza Mill EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The ELCR is attributable to arsenic and radionuclides (Ra-226, Ra-228, and U-238) in shallow soil/sediment, with the cancer risk from radionuclides accounting for 97% of the total ELCR. The cumulative HI for the RME outdoor commercial/industrial worker is 0.2, which is below the target HI (1) for noncancer effects. The noncancer hazard is due to arsenic and molybdenum in shallow soil/sediment.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 6×10^{-5}, which is also within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The ELCR is attributable to arsenic and radionuclides, with the cancer risk from radionuclides accounting for 95%

of the total ELCR. The cumulative HI for the site-specific outdoor commercial/industrial worker is 0.2, which is below the target HI (1) for noncancer effects.

9.1.1.3 Former Rhenium Ponds EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The ELCR is attributable to Ra-226 and Ra-228 in shallow soil/sediment.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 7×10^{-7}, which is less than the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks.

9.1.2 Future Scenarios – Shallow Soil/Sediment Exposures

9.1.2.1 Former CLEAR Plant EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the RME outdoor commercial/industrial worker is 0.09, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 6×10^{-5}, which is also within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the site-specific outdoor commercial/industrial worker is 0.09, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the adolescent trespasser is 2×10^{-6}, which is at the lower end of the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the adolescent trespasser is 0.04, which is below the target HI (1) for noncancer effects.
- A second future scenario was evaluated for the trespasser using the current scenario shallow soil/sediment dataset (i.e., exposed soil/sediment) in the event that an adolescent trespasser could access the former CLEAR Plant EA while vacant prior to redevelopment (current pavement and buildings remain). For this scenario, the cumulative ELCR for the adolescent trespasser is 2×10^{-6}, which is at the lower end of the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the adolescent trespasser is 0.06, which is below the target HI (1) for noncancer effects.

The ELCRs for the outdoor commercial/industrial worker and adolescent trespasser are attributable to arsenic and radionuclides (Ra-226, Ra-228, U-235, and U-238) in shallow soil/sediment. The ELCR for the trespasser using the current scenario shallow soil/sediment dataset is attributable to arsenic and radionuclides (Ra-226, Ra-228, and U-238). The calculated cancer risk from radionuclides accounts for between 88% (adolescent trespasser) and 98% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The noncancer hazards for all receptors are due to arsenic and copper in shallow soil/sediment.

9.1.2.2 Former Esperanza Mill EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the RME outdoor commercial/industrial worker is 0.2, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 6×10^{-5}, which is also within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the site-specific outdoor commercial/industrial worker is 0.2, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the adolescent trespasser is 2×10^{-6}, which is at the lower end of the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the adolescent trespasser is 0.07, which is below the target HI (1) for noncancer effects.

The ELCRs for all three receptors are attributable to arsenic and radionuclides (Ra-226, Ra-228, and U-238) in shallow soil/sediment. The calculated cancer risk from radionuclides accounts for between 83% (adolescent trespasser) and 97% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The noncancer hazards are due to arsenic and molybdenum in shallow soil/sediment.

9.1.2.3 Former Rhenium Ponds EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 7×10^{-7}, which is less than the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks.
- The cumulative ELCR for the adolescent trespasser is 1×10^{-6}, which is at the lower end of the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks.

The ELCRs for all three receptors are attributable to Ra-226 and Ra-228 in shallow soil/sediment.

9.1.3 Future Scenarios – Shallow and Deep Soil/Sediment Exposures

9.1.3.1 Former CLEAR Plant EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1×10^{-4}, which is within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the RME outdoor commercial/industrial worker is 0.08, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 6×10^{-5}, which is also within the target risk range (1×10^{-6} to 1×10^{-4}) for excess lifetime cancer risks. The cumulative HI for the site-specific outdoor commercial/industrial worker is 0.08, which is below the target HI (1) for noncancer effects.

- The cumulative ELCR for the adolescent trespasser is 2 x 10^{-6}, which is at the lower end of the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks. The cumulative HI for the outdoor commercial/industrial worker is 0.03 which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the construction worker is 7 x 10^{-6}, which is within the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks. The cumulative HI for the construction worker is 0.5, which is below the target HI (1) for noncancer effects.

The ELCRs for all receptors are attributable to arsenic and radionuclides (Ra-226, Ra-228, U-235, and U-238) in shallow and deep soil/sediment. The calculated cancer risk from radionuclides accounts for between 90% (adolescent trespasser) and 99% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The noncancer hazards are due to arsenic and copper in shallow and deep soil/sediment.

9.1.3.2 Former Esperanza Mill EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1 x 10^{-4}, which is within the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks. The cumulative HI for the RME outdoor commercial/industrial worker is 0.1, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 6 x 10^{-5}, which is also within the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks. The cumulative HI for the site-specific outdoor commercial/industrial worker is 0.1, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the adolescent trespasser is 2 x 10^{-6}, which is at the lower end of the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks. The cumulative HI for the adolescent trespasser is 0.04, which is below the target HI (1) for noncancer effects.
- The cumulative ELCR for the construction worker is 7 x 10^{-6}, which is within the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks. The cumulative HI for the construction worker is 0.7, which is below the target HI (1) for noncancer effects.

The ELCRs for all receptors are attributable to arsenic and radionuclides (Ra-226, Ra-228, U-235, and U-238) in shallow and deep soil/sediment. The calculated cancer risk from radionuclides accounts for between 90% (adolescent trespasser) and 99% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The noncancer hazards are due to arsenic and molybdenum in shallow and deep soil/sediment.

9.1.3.3 Former Rhenium Ponds EA

- The cumulative ELCR for the RME outdoor commercial/industrial worker is 1 x 10^{-4}, which is within the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks.
- The cumulative ELCR for the site-specific outdoor commercial/industrial worker is 8 x 10^{-7}, which is less than the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks.

- The cumulative ELCR for the adolescent trespasser is 1 x 10^{-6}, which is at the lower end of the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks.
- The cumulative ELCR for the construction worker is 6 x 10^{-6}, which is within the target risk range (1 x 10^{-6} to 1 x 10^{-4}) for excess lifetime cancer risks.

The ELCRs for all receptors are attributable solely to radionuclides (Ra-226, Ra-228, and U-238) in shallow and deep soil/sediment.

9.1.4 Summary of ELCRs and HIs

The calculated ELCRs based on RME parameters for the current/future outdoor commercial/industrial worker, future trespasser, and future construction worker receptors are within the Arizona Administrative Code (R18-7-206) and USEPA target cancer risk range of 1×10^{-6} to 1×10^{-4}, and the cumulative HIs are less than the target of 1 for all EAs. The calculated ELCRs based on site-specific parameters for the current/future outdoor commercial/industrial workers at the former CLEAR Plant EA and former Esperanza Mill EA are lower than the RME based ELCRs and are within the target cancer risk range. The calculated ELCRs based on site-specific parameters for the current/future outdoor commercial/industrial workers at the former Rhenium Ponds EA are less than the target cancer risk range. The cumulative HIs based on site-specific parameters for the current/future outdoor commercial/industrial workers are less than the target of 1 for all EAs.

The ELCRs for receptors at the former CLEAR Plant EA and former Esperanza Mill EA are attributable to arsenic and radionuclides (Ra-226, Ra-228, U-235, and U-238) in soil/sediment. The calculated cancer risk from radionuclides at the former CLEAR Plant EA and former Esperanza Mill EA accounts for between 83% (adolescent trespasser) and 99% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The ELCRs for receptors at the former Rhenium Ponds EA are due solely to radionuclides (Ra-226, Ra-228 and U-238) in soil/sediment. The noncancer hazards for receptors at the former CLEAR Plant EA are attributable to arsenic and copper in soil/sediment, and at the former Esperanza Mill EA are due to arsenic and molybdenum in soil/sediment.

It is important to note that radionuclides are naturally present in soils in this part of Arizona. Due to its size and charge, uranium is found at higher concentrations in silica-rich magmas such as rhyolites and granites (USEPA 2008). In Arizona, uranium is often found in minerals associated with porphyry copper deposits (USEPA 1990a, 1999, 2008), and it most commonly occurs in granitic rocks associated with Precambrian outcrops and Laramide intrusives (ADEQ 1989). The porphyry copper deposit at the Sierrita mine is part of the Laramide physiographic province, and in the vicinity of the Sierrita mine, the bedrock units include a variety of silica-rich igneous units (see Arcadis 2013 for a summary of the individual units). Uranium activities measured in Arizona rock formations range from 0.80 pCi/g in the Wilderness Granite near the Santa Catalina Mountains to 378.3 pCi/g in the Lawler Peak Granite (ADEQ 1989), and a map published by the Arizona Geological Survey showed that uranium activities around the Sierrita mine range from 1.7 pCi/g to 3.4 pCi/g (AZGS 2002; data converted from ppm to pCi/g). In the Sierrita area, there appears to be a band of uranium-bearing minerals that runs across the Sierrita Mountains, and uranium has been found in minerals associated with a number of mines in the region (USEPA 1999).

As part of a geochemical investigation of the Sierrita Batholith that included the Sierrita deposit, samples were collected of different lithologies and analyzed for total uranium. Total uranium in pulverized samples

averaged 1.0 pCi/g in the leucoadamellite, 1.6 pCi/g in the biotite granodiorite and miscellaneous granite, and 2.9 pCi/g in the hornblende-biotite granodiorite (Conoco 1981; data converted from ppm to pCi/g). Additionally, a study to improve the geochronology of the Pima Mining District included uranium-lead dating. Uranium concentrations were measured in zircons separated from four different lithologic units; for example, activities of uranium ranged from 754 pCi/g to 2,237 pCi/g in the fractions of zircons separated from the Ruby Star Granodiorite (Herrmann 2001; data converted from ppm to pCi/g).

Previous work has shown that uranium is present in bedrock at Sierrita, specifically in minerals present in the Harris Ranch Quartz Monzonite (uranium concentrations ranged from 2.5 to 35 mg/kg, with an average of 7.42 mg/kg [2.79 pCi/g U-238]; average activity measured in 10 rock samples from one core) (Arcadis 2013b). Other bedrock units, including the Ruby Star Granodiorite and Tinaja Peak Formation, also contain naturally occurring uranium (Table 9-4). The Ruby Star Granodiorite average activity was 2.68 pCi/g (19 rock samples from two cores), and the average activity in the Tinaja Peak was 1.37 pCi/g (four rock samples from one core). Radium-226 in the granodiorite has been measured at activities up to 5.8 pCi/g, and in the monzonite at up to 11 pCi/g (Arcadis 2013).

Quaternary alluvium that was sampled for this BHHRA consists of soils and sediments generated from weathered bedrock material. Alluvial sediments in the Sierrita area are generated through erosion of the exposed bedrock of the Sierrita Mountains. Eroded material is transported downslope by gravity (rock falls and other mass movements) and by rain events, which can transport large quantities of sedimentary materials. These materials are deposited in low-lying and flat areas on the valley floor. Because alluvial sediments are derived from bedrock material, their mineralogical and chemical composition are similar to their bedrock source. Surface soil samples collected from the Former CLEAR Plant, Esperanza Mill, and the Rhenium Pond indeed contain Ra-226, Ra-228, U-235, and U-238 that is comparable to or lower than in the source bedrock (Figure 9-1). The presence of statistical outliers in the plots (Figure 9-1) is a reflection of the variability in material composition. In the Sierrita area, gullies, washes, and shallow, low-lying areas accumulate sediment from large geographic stretches of upslope, exposed bedrock from different formations and geologic units, creating sedimentological variability. Because the alluvial sediments are derived from local bedrock, it is expected that they contain comparable levels of metals and radiological materials as is seen in the Ruby Star Granodiorite, Tinaja Peak Formation, and the Harris Ranch Quartz Monzonite. These data indicate that there is not any increase in radionuclide content of the surface soil as compared to the bedrock material from which the surface soil is sourced.

9.2 Lead Exposure Evaluation

Lead was identified as a COPC in soil and sediment at the former CLEAR Plant and former Esperanza Mill EAs. USEPA's ALM (USEPA 2003b, 2003c, 2009b) was used to evaluate the potential for adverse health effects from exposure to lead in soil and sediment. The ALM worksheets are provided in Appendix E. Lead was not evaluated for the Rhenium Ponds EA, as it was not identified as a COPC. The tables below summarize the results of the lead evaluation by EA using RME parameters for all receptors under the current and future scenarios.

9.2.1 Current/Future Scenario – Shallow Soil Exposures

Former CLEAR Plant EA

Exposure Medium	Receptor Population	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>10µg/dL (%)
Shallow Soil/Sediment (0-0.5 ft bgs)	Outdoor Commercial/ Industrial Worker	87	1.1	2.7	0.005

Former Esperanza Mill EA

Exposure Medium	Receptor Population	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>10µg/dL (%)
Shallow Soil/Sediment (0-2 ft bgs)	Outdoor Commercial/ Industrial Worker	116	1.2	2.8	0.006

9.2.2 Future Scenario – Shallow Soil Exposures

Former CLEAR Plant

Exposure Medium	Receptor Population	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>10µg/dL (%)
Shallow Soil/Sediment (0-0.5 ft bgs), All sample locations	Outdoor Commercial/ Industrial Worker	136	1.2	2.8	0.008
Shallow Soil/Sediment (0-0.5 ft bgs), All sample locations	Adolescent Trespasser	136	1.0	2.5	0.003
Shallow Soil/Sediment (0-0.5 ft bgs), Exposed sample locations only	Adolescent Trespasser	87	1.0	2.4	0.003

Former Esperanza Mill

Exposure Medium	Receptor Population	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>10µg/dL (%)
Shallow Soil/Sediment (0-2 ft bgs)	Adolescent Trespasser	116	1.0	2.5	0.003

9.2.3 Future Scenario – Shallow and Deep Soil Exposures

Former CLEAR Plant

Exposure Medium	Receptor Population	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>10µg/dL (%)
Shallow and Deep Soil/Sediment (0-15 feet bgs)	Outdoor Commercial/ Industrial Worker	100	1.1	2.7	0.006
	Adolescent Trespasser	100	1.0	2.4	0.003
	Construction Worker	100	2.1	4.9	0.2

Former Esperanza Mill

Exposure Medium	Receptor Population	EPC_{Pb} (mg/kg)	$PbB_{adult,central}$ (µg/dL)	$PbB_{fetal,0.95}$ (µg/dL)	Probability PbB_{fetal}>10µg/dL (%)
Shallow and Deep Soil/Sediment (0-15 feet bgs)	Outdoor Commercial/ Industrial Worker	116	1.2	2.8	0.006
	Adolescent Trespasser	116	1.0	2.5	0.003
	Construction Worker	116	2.3	5.3	0.3

9.2.4 Summary of Lead Evaluation

Based on the results of the ALM, exposure to lead in soil/sediment at the former CLEAR Plant and former Esperanza Mill EAs are not likely to result in adverse health effects in current/future outdoor commercial/industrial workers, future trespassers, or future construction workers.

10 UNCERTAINTIES ASSOCIATED WITH THE BASELINE HUMAN HEALTH RISK ASSESSMENT

This section discusses uncertainties associated with the BHHRA. The BHHRA was conducted to evaluate the potential for adverse health effects associated with exposure to COPCs at the Site. To this end, the assumptions used in this BHHRA reflect estimates based on upper-bound exposure (or RME) estimates. Because standard default assumptions for the potential receptors were used, the risk estimates and HIs calculated for the BHHRA are not absolute and are conservative overestimates of true risks. This section discusses key uncertainties associated with conducting the BHHRA and the potential impacts on the outcome.

10.1 Sampling and Analysis

The selection of COPCs was based upon the results of the sampling and analytical program established for the Site. The factors that contribute to uncertainties associated with the identification of COPCs are inherent in the data collection and data evaluation processes, including appropriate sample locations, adequate sample quantities, laboratory analyses, data validation, and treatment of validated sample results.

A comparison of maximum detected concentrations to ADEQ nr-SRLs for chemicals and USEPA PRGs for radionuclides was conducted. Constituents with maximum concentrations below their respective screening levels were not carried through the assessment. It is unlikely that this screening would have excluded constituents that would be of concern, based on the conservative exposure assumptions and toxicity criteria that are the basis of the screening levels. Although following this methodology does not provide a quantitative risk estimate for all constituents, it focuses the assessment on the constituents accounting for the greatest potential for risk, and the overall cumulative risk estimates would not be expected to be greater than these conservative screening values.

10.2 Receptors Evaluated and Potentially Complete Exposure Routes

Arcadis conducted a comprehensive assessment of potential human receptors that are likely to be present at the Site. Based on potential use scenarios and future plans for the Site, other possible receptors are unlikely to be more potentially exposed to site-related COPCs than the receptors evaluated in this BHHRA. Exposure pathways considered complete were evaluated for these receptors.

10.3 Exposure Assumptions and Intake/Dose Models

The exposure assessment relied on several different exposure intake assumptions, many of which were based on statistical analyses of human populations. An RME is the “highest exposure that is reasonably expected to occur at the Site” (USEPA 1989). In some cases, EPCs were based on maximum detected concentrations, which will result in an overestimate of the ELCR and/or HI.

10.4 Toxicity Assessment: Constituents of Potential Concern without Toxicity Values

RfCs are not available for some of the COPCs identified (i.e., copper, lead and molybdenum). Because USEPA (2009, 2015f) no longer allows extrapolating oral toxicity values to inhalation toxicity values, HQs

for the inhalation exposure route could not be estimated for these COPCs. The inability to estimate inhalation HQs for COPCs lacking RfCs is likely to result in an underestimate of the HI.

It is important to note that toxicity values used to conduct this BHHRA were derived using methods that are designed to overestimate toxicity, resulting in an overestimate of ELCRs and/or HIs.

11 SUMMARY AND CONCLUSIONS

11.1 Summary

This BHHRA was conducted to evaluate potential risks to human health under current and future exposure scenarios. Available data were reviewed, and it was determined that potential receptors may be exposed to constituents present in soil/sediment at the Site. Three EAs (former CLEAR Plant, former Esperanza Mill, and former Rhenium Ponds) based on current and potential future scenarios were identified, datasets for each EA were compiled, and COPCs were selected:

- Former CLEAR Plant EA – arsenic, copper, lead, Ra-226, Ra-228, U-235, and U-238
- Former Esperanza Mill EA – arsenic, lead, molybdenum, Ra-226, Ra-228, U-235, and U-238
- Former Rhenium Ponds EA – Ra-226, Ra-228, and U-238.

Following COPC selection, EPCs were calculated. An exposure evaluation was completed, and specific receptors and potentially complete exposure pathways and routes were evaluated.

Potential cancer risks and noncancer hazards were characterized by estimated ELCRs and HIs for the potentially complete exposure routes for current and future receptors. Lead was evaluated separately using the ALM. Results are discussed below.

11.1.1 Cancer Risk and Noncancer Hazard Summary

Tables 9-1 through 9-3 summarize the ELCRs and HIs for each of the receptors evaluated at the Site in this BHHRA. The risks and hazards shown in Tables 9-1 through 9-3 are cumulative for each exposure scenario, summed across all COPCs and exposure routes.

The calculated ELCRs based on RME parameters for the current and future outdoor commercial/industrial worker, future adolescent trespasser, and future construction worker receptors are within the Arizona Administrative Code (R18-7-206) and USEPA target risk range of 1×10^{-6} to 1×10^{-4}, and the cumulative HIs are less than the target of 1 for all EAs. The calculated ELCRs based on site-specific parameters for the current/future outdoor commercial/industrial workers at the former CLEAR Plant EA and former Esperanza Mill EA are lower than the RME based ELCRs and are within the target cancer risk range. The calculated ELCRs based on site-specific parameters for the current/future outdoor commercial/industrial workers at the former Rhenium Ponds EA are less than the target cancer risk range. The cumulative HIs based on site-specific parameters for the current/future outdoor commercial/industrial workers are less than the target of 1 for all EAs.

The ELCRs for receptors at the former CLEAR Plant EA and former Esperanza Mill EA are attributable to arsenic and radionuclides (Ra-226, Ra-228, U-235, and U-238) in soil/sediment. The calculated cancer risk from radionuclides at the former CLEAR Plant EA and former Esperanza Mill EA accounts for between 83% (adolescent trespasser) and 99% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The ELCRs at the former Rhenium Ponds EA are due solely to radionuclides (Ra-226, Ra-228, and U-238) in soil/sediment. The noncancer hazards for receptors at the former CLEAR Plant EA are attributable to arsenic and copper and at the former Esperanza Mill EA are due to arsenic and molybdenum in soil/sediment.

It is important to note that radionuclides are naturally present in soils in this part of Arizona. Due to its size and charge, uranium is found at higher concentrations in silica-rich magmas such as rhyolites and granites (USEPA 2008). In Arizona, uranium is often found in minerals associated with porphyry copper deposits (USEPA 1990a, 1999, 2008), and it most commonly occurs in granitic rocks associated with Precambrian outcrops and Laramide intrusives (ADEQ 1989). The porphyry copper deposit at the Sierrita mine is part of the Laramide physiographic province, and in the vicinity of the Sierrita mine, the bedrock units include a variety of silica-rich igneous units (see Arcadis 2013 for a summary of the individual units). Uranium activities measured in Arizona rock formations range from 0.80 pCi/g in the Wilderness Granite near the Santa Catalina Mountains to 378.3 pCi/g in the Lawler Peak Granite (ADEQ 1989), and a map published by the Arizona Geological Survey showed that uranium activities around the Sierrita mine range from 1.7 pCi/g to 3.4 pCi/g (AZGS 2002; data converted from ppm to pCi/g). In the Sierrita area, there appears to be a band of uranium-bearing minerals that runs across the Sierrita Mountains, and uranium has been found in minerals associated with a number of mines in the region (USEPA 1999).

As part of a geochemical investigation of the Sierrita Batholith that included the Sierrita deposit, samples were collected of different lithologies and analyzed for total uranium. Total uranium in pulverized samples averaged 1.0 pCi/g in the leucoadamellite, 1.6 pCi/g in the biotite granodiorite and miscellaneous granite, and 2.9 pCi/g in the hornblende-biotite granodiorite (Conoco 1981; data converted from ppm to pCi/g). Additionally, a study to improve the geochronology of the Pima Mining District included uranium-lead dating. Uranium concentrations were measured in zircons separated from four different lithologic units; for example, activities of uranium ranged from 754 pCi/g to 2,237 pCi/g in the fractions of zircons separated from the Ruby Star Granodiorite (Herrmann 2001; data converted from ppm to pCi/g).

Previous work has shown that uranium is present in bedrock at Sierrita, specifically in minerals present in the Harris Ranch Quartz Monzonite (uranium concentrations ranged from 2.5 to 35 mg/kg, with an average of 7.42 mg/kg [2.79 pCi/g U-238]; average activity measured in 10 rock samples from one core) (Arcadis 2013b). Other bedrock units, including the Ruby Star Granodiorite and Tinaja Peak Formation, also contain naturally occurring uranium (Table 9-4). The Ruby Star Granodiorite average activity was 2.68 pCi/g (19 rock samples from two cores), and the average activity in the Tinaja Peak was 1.37 pCi/g (four rock samples from one core). Radium-226 in the granodiorite has been measured at activities up to 5.8 pCi/g, and in the monzonite at up to 11 pCi/g (Arcadis 2013).

Quaternary alluvium that was sampled for this BHHRA consists of soils and sediments generated from weathered bedrock material. Alluvial sediments in the Sierrita area are generated through erosion of the exposed bedrock of the Sierrita Mountains. Eroded material is transported downslope by gravity (rock falls and other mass movements) and by rain events, which can transport large quantities of sedimentary materials. These materials are deposited in low-lying and flat areas on the valley floor. Because alluvial sediments are derived from bedrock material, their mineralogical and chemical composition are similar to their bedrock source. Surface soil samples collected from the Former CLEAR Plant, Esperanza Mill, and the Rhenium Pond indeed contain Ra-226, Ra-228, U-235, and U-238 that is comparable to or lower than in the source bedrock (Figure 9-1). The presence of statistical outliers in the plots (Figure 9-1) is a reflection of the variability in material composition. In the Sierrita area, gullies, washes, and shallow, low-lying areas accumulate sediment from large geographic stretches of upslope, exposed bedrock from different formations and geologic units, creating sedimentological variability. Because the alluvial sediments are derived from local bedrock, it is expected that they contain comparable levels of metals

and radiological materials as is seen in the Ruby Star Granodiorite, Tinaja Peak Formation, and the Harris Ranch Quartz Monzonite. These data indicate that there is not any increase in radionuclide content of the surface soil as compared to the bedrock material from which the surface soil is sourced

11.1.2 Lead Evaluation Summary

Lead was identified as a COPC for the former CLEAR Plant and former Esperanza Mill EAs. Based on the results of the ALM, exposure to lead in soil/sediment at the former CLEAR Plant and former Esperanza Mill EAs is not likely to result in adverse health effects in current/future outdoor commercial/industrial workers, future trespassers, or future construction workers. Lead was not evaluated for the Rhenium Ponds EA, as it was not identified as a COPC.

11.2 Conclusions and Recommendations

Potential risks and hazards calculated in this BHHRA for the current scenario (i.e., outdoor commercial/industrial workers), as well as for the future trespasser and future construction worker, are within or below the target range for cancer risks (1×10^{-6} to 1×10^{-4}) and target HI for noncancer hazards established by the USEPA and the Arizona Administrative Code (R18-7-206). The ELCRs are attributable to arsenic and radionuclides (Ra-226, Ra-228, U-235, and U-238) in soil/sediment, with radionuclides contributing between 83% (adolescent trespasser) and 99% (outdoor commercial/industrial worker) of the total calculated receptor-specific ELCR. The noncancer hazards are attributable to arsenic, copper, and molybdenum in soil/sediment. It is important to note that trace metals, including arsenic, copper, and molybdenum, as well as radionuclides, are naturally present in soils in this part of Arizona.

12 REFERENCES

Arizona Department of Environmental Quality (ADEQ). 1989. Radionuclides in groundwater and their occurrences in Arizona, paper presented by Robin Jenkins at Arizona Hydrological Society annual symposium, Water Quality and Water Quantity Issues into the 1990s - Adaptation to Current Realities, Casa Grande, AZ, September 1989.

ADEQ. 2002. UST Program Release Reporting & Corrective Action Guidance. Arizona Department of Environmental Quality. August 20. Available at: http://www.azdeq.gov/environ/waste/ust/lust/tg.html

ADEQ. 2011. Significant Amendment to Aquifer Protection Permit No. P-101679, Place ID No. 1567, LTF 52973. Authorized by Michael A. Fulton, Director, Water Quality Division, Arizona Department of Environmental Quality, Signed September 20th, 2011.

Arizona Department of Health Services (ADHS). 2003. Deterministic Risk Assessment Guidance. Arizona Department of Health Services.

Arcadis. 2013a. Addendum to the Soil and Sediment Characterization Report. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. Voluntary Remediation Program – VRP Site Code: 100073-03. August 14.

Arcadis. 2013b. Groundwater Investigation Report. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. Voluntary Remediation Program – VRP Site Code: 100073-03. December.

Arcadis. 2013c. Voluntary Remediation Program Former CLEAR Plant Area Soil Excavation and Tier I Screening Risk Evaluation Report. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. January 2013.

Arcadis. 2015a. Voluntary Remediation Program (VRP) Baseline Human Health Risk Assessment Work Plan. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. April 24, 2015.

Arcadis. 2015b. Voluntary Remediation Program (VRP) Data Gaps Work Plan. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. Voluntary Remediation Program – VRP Site Code – 100073-03. September.

Arcadis. 2015c. Former CLEAR Plant Area Paving Project Soil Excavation and Tier I Screening Risk Evaluation Report. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. July.

Arizona Administrative Code. Title 18, Environmental Quality, Chapter 7. Department of Environmental Quality - Remedial Action, Appendix A, Soil Remediation Levels, March 31, 2009, Appendix A made by final rulemaking at 13 A.A.R. 971, effective May 5, 2007 (Supp. 07-1).

Arizona Geological Survey (AZGS). 2002. Arizona Uranium Levels. Data acquired by US Department of Energy (DOE) National Uranium Resource Evaluation (NURE). Distributed by USGS. Map compiled by AZGS, 2002.

Agency for Toxic Substances and Disease Registry (ATSDR). 2014. Minimum Risk Levels. Available at: http://www.atsdr.cdc.gov/mrls/mrllist.asp. January.

Bradham, K.D., K.G. Scheckel, C.M. Nelson, P.E. Seales, G.E. Lee, M.F. Hughes, B.W. Miller, A. Yeow, T. Gilmore, S. Harper, and D.J. Thomas. 2011. Relative bioavailability and bioaccessibility and speciation of arsenic in contaminated soils. Environ. Health Perspect. 119:1629-1634.

Brown and Caldwell (BC). 2009. Human Health Risk Assessment. Site-Specific Soil Remediation Levels for Arsenic, Copper, and Manganese at Ajo and Bisbee, Arizona. Phoenix, Arizona.

BC. 2013. Human Health Risk Assessment. Site-Specific Soil Remediation Levels for Arsenic, Copper, and Lead at Douglas Reduction Works. Douglas, Arizona.

CalEPA. 2015. Office of Environmental Health Hazard Assessment. Toxicity Criteria Database. Available at: http://oehha.ca.gov/tcdb/index.asp.

Casteel, S.W., L.D. Brown, M.E. Dunsmore, C.P. Weis, G.M. Henningsen, E. Hoffman, W.J. Brattin, and T.L. Hammon. 1997. Relative bioavailability of arsenic in mining wastes. United States Environmental Protection Agency, Region 8, Denver, CO.

Conoco. 1981. Rock Geochemistry in Mineral Exploration: Study Area 1. Sierrita Batholith, Pima Co., Arizona-Progress Report 2, Research Report 1240-3-2-81.

Damian Applied Toxicology, LLC. 2015. Human Health Risk Assessment to Support Site-Specific Remediation Levels for Arsenic, Copper, and Lead at the United Verde Soil Program. Prepared for Freeport Minerals Corporation, Phoenix, Arizona.

Drexler, J.W. and W.J. Brattin. 2007. An in Vitro Procedure for Estimation of Lead Relative Bioavailability: With Validation. Human and Ecological Risk Assessment, 13: 383–401.

Errol L. Montgomery and Associates (ELMA) and Dames and Moore. 1994. Aquifer Protection Permit Application, Sierrita Operation, Cyprus Sierrita Corporation, Pima County, AZ, Volume I. September.

ELMA. 2001. Additional Characterization of Hydrogeologic Conditions Aquifer Protection Permit Application No. 101679, Sierrita Mine, Phelps Dodge Sierrita, Inc. Pima County, Arizona. January.

Freeman, G.B., J.D. Johnson, J.M. Killinger, S.C. Liao, A.O. Davis, M.V. Ruby, R.L. Chaney, S.C. Lovre, and P.D. Bergstrom. 1993. Bioavailability of arsenic in soil impacted by smelter activities following oral administration in rabbits. Fundam. Appl. Toxicol. 21:83-88.

Freeport-McMoRan Copper & Gold (FCX). 2011a. Sierrita Mine Site Overview. Available online at: http://www.fcx.com/operations/USA_Arizona_Sierrita.htm. Accessed on March 22, 2011.

FCX. 2011b. Sulfate Information at Sierrita. Available at: http://www.fcx.com/envir/pdf/fast_facts/sierrita_sulfate_info_Jun09.pdf. Accessed March 22, 2011.

Griffith, G.E., Omernik, J.M., Johnson, C.B., and Turner, D.S. 2014. Ecoregions of Arizona (poster): U.S. Geological Survey Open-File Report 2014-1141, with map, scale 1:1,325,000. Available at: http://dx.doi.org/10.3133/ofr20141141.

Herrmann, M.A. 2001. Episodic magmatism and hydrothermal activity, Pima Mining District, Arizona. Masters Thesis, University of Arizona, 2001.

Hydro Geo Chem Inc. (HGC). 2008. Soil, Surface Water, and Groundwater Sampling in the CLEAR Plant and Esperanza Mill Areas. As referenced in URS Corporation. 2011. Voluntary Remediation Program (VRP) Soil and Sediment Characterization Report, Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. Final. March.

Office of Environmental Health Hazard Assessment (OEHHA). 2009. Hot Spots Unit Risk and Cancer Potency Values. Available at: http://oehha.ca.gov/air/hot_spots/pdf/CPFs042909.pdf. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment.

Spencer, J.E., C.A. Ferguson, S.M. Richard, and A. Youberg. 2003. Geologic Map of the Esperanza Mill 7½' Quadrangle, Pima County, Arizona. Arizona Geological Survey, Digital Geologic Map DGM-33. November.

URS Corporation (URS). 2008a. Voluntary Remediation Program (VRP) Investigation Work Plan, Volumes I and II, Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. April.

URS. 2008b. Addendum to Sampling and Analysis Plan & Quality Assurance Project Plan (QAPP), Voluntary Remediation Program (VRP), Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. September.

URS. 2012. Voluntary Remediation Program (VRP) Soil and Sediment Characterization Report, Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. Final. December.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA/540/1 89 002. U.S. Environmental Protection Agency.

USEPA. 1990a. Report to Congress on Special Wastes from Mineral Processing. EPA/530-SW-90-070C, July 17, 1990.

USEPA. 1990b. National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR), Part 300.400. U.S. Environmental Protection Agency. September.

USEPA. 1992. Guidelines for Exposure Assessment. EPA/600/Z 92/001. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC. May.

USEPA. 1997. Exposure Factors Handbook. EPA/600/P 95/002Ba. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment.

USEPA. 1999. Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona. EPA 402-R-99-002.

USEPA. 2000. Soil Screening Guidance for Radionuclides: Technical Background Document. Office of Emergency and Remedial Response and Office of Radiation and Indoor Air. Washington, DC. OSWER No. 9355.4-16. Available at: http://www.epa.gov/superfund/health/contaminants/radiation/radssg.htm

USEPA. 2001. Health Effects Assessment Summary Tables (HEAST) User's Guide: Radionuclide Carcinogenicity. EPA/540/R-97/036. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. April.

USEPA. 2002. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6 10. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response.

USEPA. 2003a. OSWER Directive 9285.7 53, Human Health Toxicity Values in Superfund Risk Assessments. Memo from Michael B. Cook. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. December. Available at: http://www.epa.gov/oswer/riskassessment/pdf/hhmemo.pdf

USEPA. 2003b. Adult Lead Model (ALM) Spreadsheet. Available at: http://www.epa.gov/oswer/riskassessment/tools.htm. EPA-540-R-03-001. OSWER 9285.7-54. U.S. Environmental Protection Agency, Technical Review Workgroup for Lead, Adult Lead Committee. U.S. Environmental Protection Agency. January.

USEPA. 2003c. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposure to Lead in Soil. EPA-540-R-03-001. U.S. Environmental Protection Agency. January.

USEPA. 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment. EPA/540/R/99/005. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response.

USEPA. 2005. Guidelines for Carcinogen Risk Assessment. EPA/650/P-03/001F. March.

USEPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume 1: Mining and Reclamation Background. USEPA Office of Radiation and Indoor Air Radiation Protection Division (6608J), previously published on-line and printed as Vol. 1 of EPA 402-R-05-007, January 2006, Updated June 2007 and printed April 2008 as EPA 402-R-08-005.

USEPA. 2009a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). EPA-540-R-070-002 OSWER 9285.7-82. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Toxic Integration Branch. January.

USEPA. 2009b. Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameter. OSWER 9200.2-82. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June 2009 – Update to the ALM.

USEPA. 2010. Relative bioavailability of arsenic in soils at 11 hazardous waste sites using an in vivo juvenile swine method. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Bioavailability Subcommittee of the Technical Review Workgroup. OSWER Directive 9200.0-76. June.

USEPA. 2011. Exposure Factors Handbook 2011 Edition (Final). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, 2011.

USEPA. 2013a. ProUCL Version 5.0.00 User Guide. Prepared by Lockheed Martin Environmental Services for U.S. Environmental Protection Agency, Office of Research and Development. September.

USEPA. 2013b. ProUCL Version 5.0.00 Technical Guide. EPA/600/R-07/041. U.S. Environmental Protection Agency, Office of Research and Development. September.

USEPA. 2013c. ProUCL Version 5.0.00. Available at: http://www.epa.gov/osp/hstl/tsc/software.htm. U.S. Environmental Protection Agency. September.

USEPA 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. Office of Solid Waste and Emergency Response. February 6.

USEPA 2014b. Frequently Asked Questions (FAQs) About Update of Standard Default Exposure Factors (OSWER Directive 9285.6-03, dated February 6, 2014). Office of Solid Waste and Emergency Response. May 9.

USEPA. 2014c. Preliminary Remediation Goals for Radionuclides. Available at: epa-prgs.ornl.gov/radionuclides/. U.S. Environmental Protection Agency, Office of Superfund and Oak Ridge National Laboratory. November.

USEPA 2015a Regional Screening Level (RSL) Summary Table (TR=1E-6, HQ=1) January 2015. Available at: http://www.epa.gov/region9/superfund/prg/. Last updated January.

USEPA. 2015b. Integrated Risk Information System. Available at: http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList.

USEPA 2015c. Regional Screening Levels User's Guide (November 2014). Available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm. Last updated March 25, 2015.

USEPA. 2015d. Provisional Peer Reviewed Toxicity Values. Available at: http://hhpprtv.ornl.gov/quickview/pprtv.php.

USEPA. 2015e. Health Effects Assessment Summary Tables. Available at: http://epa-heast.ornl.gov/heast.php.

USEPA. 2015f. Regional Screening Level Table, Frequently Asked Questions (November 2014). Available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/faq.htm#FAQ24. Last updated March 3.

USEPA. 2015g. Preliminary Remediation Goals for Radionuclides, User's Guide. Accessed at: http://epa-prgs.ornl.gov/radionuclides/prg_guide.html.

TABLES

Table 5-1
Summary of Available Soil and Sediment Data for Metals and Radionuclides
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Report Reference	Sampling Period	Investigation Area	No. / Type Samples [1]	No. Locations	Sample Depths	Sampling Methods	Sieved?	Laboratory	Analysis and Analytical Method	
HGC (2008)	August - October 2004	Former CLEAR Plant	12 Surficial Soil	12 locations	0-0.25 ft bgs	plastic trowel	All soil samples were sieved to <2mm by HGC prior to sample analysis.	ACZ Laboratories, Steamboat Springs, CO	Metals via or Mercury via	EPA Method 6020 ICP-MS EPA Method 6010B ICP-AES EPA Method 7471A CVAA
			17 Subsurface Soil		≤ 6 ft bgs	plastic trowel				
			7 Subsurface Soil	8 trench locations	> 6 and ≤ 15 ft bgs	backhoe bucket				
		Former Esperanza Mill	9 Surficial Soil	9 locations	0-0.25 ft bgs	plastic trowel				
			5 Subsurface Soil		≤ 6 ft bgs	plastic trowel				
			1 Subsurface Soil	2 trench locations	> 6 and ≤ 15 ft bgs	backhoe bucket				
		Former C Pond	1 Surficial Soil	1 location	0-0.25 ft bgs	plastic trowel				
			1 Subsurface Soil	1 trench location	≤ 6 ft bgs	plastic trowel				
			1 Subsurface Soil		> 6 and ≤ 15 ft bgs	backhoe bucket				
		Former Raffinate Pond	1 Surficial Soil	1 location	0-0.25 ft bgs	plastic trowel				
			3 Subsurface Soil	1 trench location	≤ 6 ft bgs	plastic trowel				
			1 Subsurface Soil		> 6 and ≤ 15 ft bgs	backhoe bucket				
		Former Laydown Yard	1 Surficial Soil	1 location	0-0.25 ft bgs	plastic trowel				
URS (2012); ARCADIS (2013a)	June - November 2008	Former CLEAR Plant	27 Gridded Soil	10 locations	up to 17 ft bgs	Soil and sediment borings installed using direct push techniques and Geoprobe tooling. Samples were collected using disposable acetate liners within a Macro-core sampler. Samples from the Former Raffinate Pond were collected using stainless steel hand auger, due to Geoprobe access issues.	No	ACZ Laboratories, Steamboat Springs, CO	Metals via or Mercury via Lead via and Chromium +6 via	EPA Method 6020 ICP-MS EPA Method 6010B ICP-AES EPA Method 7471A CVAA EPA Method 1312 SPLP EPA Method 6020 ICP-MS EPA Method 7196A (colorimetric)
			15 Biased Soil	4 locations	up to 20 ft bgs					
			20 Sediment	10 locations	0-1.5, 1.5-3.0 ft bgs					
		Former E Pond	5 Biased Soil	2 locations	up to 7 ft bgs					
		Former Evaporation Pond	6 Biased Soil	2 locations	up to 7 ft bgs					
		Old D Pond	7 Biased Soil	3 locations	up to 7 ft bgs					
			12 Sediment	6 locations	0-1.5, 1.5-3.0 ft bgs					
		Former Esperanza Mill	26 Gridded Soil	9 locations	up to 11 ft bgs			Paragon Analytics, Inc., Fort Collins, CO	Isotopic uranium Radium-226 via Radium-228 via and	ASTM Method D3972 (alpha spectroscopy) EPA Method 903.1 (radon emanation) EPA Method 9320/904.0M (gas flow proportional counting) EPA Method 901.1M (gamma spectroscopy)
			2 Biased Soil	1 location	0-1.0, 1.0-3.0 ft bgs					
		Former C Pond and C Pond Spoils	3 Gridded Soil	1 location	up to 5.5 ft bgs					
			36 Biased Soil	11 locations	up to 17 ft bgs					
		Former Raffinate Pond	12 Biased Soil	5 locations	up to 7 ft bgs					
			4 Sediment	2 locations	0-1.5, 1.5-3.0 ft bgs					
		Former Laydown Yard	15 Biased Soil	4 locations	up to 16 ft bgs					
		Former Rhenium Ponds	10 Biased Soil	2 locations	up to 17 ft bgs					
ARCADIS (2013c)	May 2012	Former CLEAR Plant Soil excavation for new training facility building	35 Initial Soil (count does not include excavated samples)	43 locations	6 inches bgs	Disposable plastic scoop; Samples from the parking lot area and building pad were collected with hand auger.	No. 12 mesh sieve was used to remove large rocks and debris from dry soil samples.	SVL Analytical, Inc., Kellogg, ID	Arsenic, copper, and lead	Field screened using portable handheld XRF analyzer; EPA Method 6010B
			38 Confirmation Soil	38 locations	6 inches bgs					
ARCADIS (2015c)	May - June 2015	Former CLEAR Plant Paving Areas	25 Gridded Samples	25 locations	6 inches bgs	Disposable plastic scoop	No	SVL Analytical, Inc., Kellogg, ID	Select metals via or Mercury via	EPA Method 6010B ICP-AES EPA Method 6020A ICP-MS EPA Method 7471 CVAA
			2 Biased Samples	2 locations	6 inches bgs	Disposable plastic scoop				
			2 Biased Samples	2 locations	3.5 ft bgs	Hand auger				

Notes
[1] Sample counts do not include field duplicates or excavated samples.

CVAA = cold-vapor atomic absorption.
EPA = United States Environmental Protection Agency.
ft bgs = feet below ground surface.
ICP-AES = inductively coupled plasma-atomic emission spectroscopy.
ICP-MS = inductively coupled plasma-mass spectroscopy.
mm = millimeters.
SPLP = synthetic precipitation leaching procedure.

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former CLEAR Plant	Former CLEAR Plant	CP-1 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-2 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-3 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-5 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-7 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-9 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-13 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-14 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-15 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-16 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-19 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-21 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-1-18IN 100404	10/4/2004	✓	--	1.5	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-1-2 100404	10/4/2004	✓	--	2	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-1-4 100404	10/4/2004	✓	--	4	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-1-8 100404	10/4/2004	✓	--	8	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-2-10 100404	10/4/2004	✓	--	10	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-2-2 100404	10/4/2004	✓	--	2	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-2-7 100404	10/4/2004	✓	--	7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-2-B-6 100404	10/4/2004	✓	--	6	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-2-7BL 100404	10/4/2004	✓	--	7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-2-C-6 100404	10/4/2004	✓	--	6	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-4-1.5C 100404	10/4/2004	✓	--	1.5	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-4-14 100404	10/4/2004	✓	--	14	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-4-18IN 100404	10/4/2004	✓	--	1.5	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-4-2.5 100404	10/4/2004	✓	--	2.5	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-5-1.5 100404	10/4/2004	✓	--	1.5	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-5-3 100404	10/4/2004	✓	--	3	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-5-6 100404	10/4/2004	✓	--	6	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-6-2 100404	10/4/2004	✓	--	2	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-6-4 100404	10/4/2004	✓	--	4	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-6-6 100404	10/4/2004	✓	--	6	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-T-3-6 100504	10/5/2004	✓	--	0.5	0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-T-3-8 100504	10/5/2004	✓	--	8	0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-T-3-8IN 100504	10/5/2004	✓	--	0.75	0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-JS-02-0-1_07112008	7/11/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-JS-02-1-3_07112008	7/11/2008	✓	✓	1-3	0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-M04-0-1_07112008	7/11/2008	✓	sample jar broken	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-M04-1-2.5_07112008	7/11/2008	✓	✓	1-2.5	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-M04-5-5.4_07112008	7/11/2008	✓	✓	5-5.4	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-M06-0-1_07112008	7/11/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-M06-1-3_07112008	7/11/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-N08-0-1_07112008	7/11/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-N08-10-11_07112008	7/11/2008	✓	sample jar broken	10-11	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-N08-1-3_07112008	7/11/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-N08-5-7_07112008	7/11/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-O03-0-1_07112008	7/11/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former CLEAR Plant	Former CLEAR Plant	CP-O03-1-3_07112008	7/11/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-O09-0-1_07112008	7/11/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-O09-10-12_07112008	7/11/2008	✓	✓	10-12	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-O09-1-3_07112008	7/11/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-O09-5-7_07112008	7/11/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-03-0-1_07142008	7/14/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-03-1-3_07142008	7/14/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-03-5-7_07142008	7/14/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-01-0-1_07152008	7/15/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-01-10-12_07152008	7/15/2008	✓	✓	10-12	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-01-1-3_07152008	7/15/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-01-5-7_07152008	7/15/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P04-0-1_07152008	7/15/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P04-1-3_07152008	7/15/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P05-0-1_07152008	7/15/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P05-1-3_07152008	7/15/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-01-0-1.5_07162008	7/16/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-01-1.5-3.0_07162008	7/16/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-02-0-1.5_07162008	7/16/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-02-1.5-3.0_07162008	7/16/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-03-0-1.5_07162008	7/16/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-03-1.5-3.0_07162008	7/16/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-05-0-1.5_07162008	7/16/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-05-1.5-3.0_07162008	7/16/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-06-0-1.5_07162008	7/16/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-06-1.5-3.0_07162008	7/16/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-04-0-1.5_07172008	7/17/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-04-1.5-3.0_07172008	7/17/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P07-0-1_07172008	7/17/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P07-1-3_07172008	7/17/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P07-5-7_07172008	7/17/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-07-0-1.5_07232008	7/23/2008	✓	sample jar broken	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-07-1.5-3.0_07232008	7/23/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P12-0-1_07232008	7/23/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-P12-1-3_07232008	7/23/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-Q09-0-1_07232008	7/23/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-Q09-1-3_07232008	7/23/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-08-0-1.5_07282008	7/28/2008	✓	sample jar broken	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-08-1.5-3.0_07282008	7/28/2008	✓	sample jar broken	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-09-0-1.5_07282008	7/28/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-09-1.5-3.0_07282008	7/28/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-10-0-1.5_07282008	7/28/2008	✓	sample jar broken	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-SD-10-1.5-3.0_07282008	7/28/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-04-0-1_08272008	8/27/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-04-10-12_08272008	8/27/2008	✓	✓	10-12	0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-04-1-3_08272008	8/27/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former CLEAR Plant	CP-JS-04-5-7_08272008	8/27/2008	✓	✓	5-7	0-15	exposed at surface

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former CLEAR Plant	Former CLEAR Plant	CPS-SWW-D2.5-01_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-D3-01_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-D4-02_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWE-D1.5-01_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWW-D2-01_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-D5-06_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D2.5-01_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D2.5-02_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D2.5-03_20120501	5/1/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-D3-01_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-D3-02_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-D3-03_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-D3-04_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-SWE-D1.5-01_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-SWE-D1.5-02_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-SWW-D1.5-02_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWE-D1.5-02_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWE-D2.5-02_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-D4-05_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AE-S-01_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AE-S-02_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AE-S-03_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AE-S-04_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AN-S-01_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AN-S-02_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AN-S-03_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AN-S-04_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AW-S-01_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AW-S-02_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AW-S-03_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AW-S-04_20120502	5/2/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWE-D2.5-01_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D4-04_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	RCP-16-D2.5-01_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	RCP-T-3-D0.5-01_20120502	5/2/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPB-S-02_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPB-S-03_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPB-S-04_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPB-S-05_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPB-S-06_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-D2-06_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-D3-05_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-SWE-D1.5-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-SWW-D1-04_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AE-SWW-D2-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-D2-05_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWE-D0.5-04_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWE-D2.5-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWW-D0.75-04_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AW-SWW-D1-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AE-S-05_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPP-AN-S-05_20120511	5/11/2012	✓	--	6 inches bgs (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWN-D2-01_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWN-D2-02_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWN-D2-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWN-D2-04_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWN-D3.5-05_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D2.5-07_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D2-05_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D4.5-06_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWS-D4.5-08_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPS-SWW-D2.5-02_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-D1-01_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWN-D0.5-05_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWN-D1.5-02_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWN-D1.5-04_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWN-D1-01_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWN-D1-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWS-D0.5-02_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWS-D0.5-03_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWS-D0.5-04_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	RCP-T-3-D0.5-02_20120511	5/11/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CPF-AN-SWS-D0.5-05_20120521	5/21/2012	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-01_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-02_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-03_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-04_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-05_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-06_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-07_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-08_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-09_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-NPA-S-10_20150528	5/28/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-1_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-2_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-3_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-4_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-5_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-6_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-7_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-8_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-9_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-10_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-11_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-12_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-13_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-14_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-15_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-16_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-S-17_20150609	6/9/2015	✓	--	surface (0)	0-0.5, 0-2, 0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-SL-E-D3.5-01	6/19/2015	✓	--	3.5	0-15	paved/developed
Former CLEAR Plant	Former CLEAR Plant	CP-SPA-SL-W-D3.5-01	6/19/2015	✓	--	3.5	0-15	paved/developed
Former CLEAR Plant	Former E Pond	E-JS-01-0-1_07142008	7/14/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former E Pond	E-JS-01-1-3_07142008	7/14/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former E Pond	E-JS-01-5-7_07142008	7/14/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former E Pond	E-JS-02-0-1_07142008	7/14/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former E Pond	E-JS-02-1-3_07142008	7/14/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former Evaporation Pond	EV-JS-01-0-1_07142008	7/14/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former Evaporation Pond	EV-JS-01-1-3_07142008	7/14/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former Evaporation Pond	EV-JS-01-5-7_07142008	7/14/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Former Evaporation Pond	EV-JS-02-0-1_07142008	7/14/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Former Evaporation Pond	EV-JS-02-1-3_07142008	7/14/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Former Evaporation Pond	EV-JS-02-5-7_07142008	7/14/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-01-0-1.5_07282008	7/28/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-01-1.5-3.0_07282008	7/28/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-02-0-1.5_07282008	7/28/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-02-1.5-3.0_07282008	7/28/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-03-0-1.5_07282008	7/28/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-03-1.5-3.0_07282008	7/28/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-04-0-1.5_07282008	7/28/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-04-1.5-3.0_07282008	7/28/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-01-0-1_07292008	7/29/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-01-1-3_07292008	7/29/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-02-0-1_07292008	7/29/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-02-1-3_07292008	7/29/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-02-5-7_07292008	7/29/2008	✓	✓	5-7	0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-05-0-1.5_07292008	7/29/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-05-1.5-3.0_07292008	7/29/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-06-0-1.5_07292008	7/29/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-SD-06-1.5-3.0_07292008	7/29/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-03-0-1_08272008	8/27/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former CLEAR Plant	Old D Pond	OD-JS-03-1-3_08272008	8/27/2008	✓	no radionuclide data	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	EM-26 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	EM-T-4-10 100504	10/5/2004	✓	--	10	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	EM-T-4-6 100504	10/5/2004	✓	--	6	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-01-0-1_08012008	8/1/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-01-1-3_08012008	8/1/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-02-0-1_08012008	8/1/2008	✓	sample jar broken	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-02-1-3_08012008	8/1/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-02-5-7_08012008	8/1/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-03-0-1_08042008	8/4/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former Esperanza Mill	Former C Pond	C-JS-03-10-12_08042008	8/4/2008	✓	✓	10-12	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-03-1-3_08042008	8/4/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-03-5-7_08042008	8/4/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-04-0-1_08052008	8/5/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-04-10-12_08052008	8/5/2008	✓	✓	10-12	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-04-1-3_08052008	8/5/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-04-5-7_08052008	8/5/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-05-0-1_08052008	8/5/2008	✓	no radionuclide data	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond	C-JS-05-1-3_08052008	8/5/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-01-0-1_08042008	8/4/2008	✓	sample jar broken	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-01-10-12_08042008	8/4/2008	✓	✓	10-12	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-01-1-3_08042008	8/4/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-01-5-7_08042008	8/4/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-02-0-1_08042008	8/4/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-02-10-11_08042008	8/4/2008	✓	✓	10-11	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-02-1-3_08042008	8/4/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-02-5-7_08042008	8/4/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-03-0-1_08052008	8/5/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-03-10-12_08052008	8/5/2008	✓	✓	10-12	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-03-1-3_08052008	8/5/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-03-5-7_08052008	8/5/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	EM-U25-0-1_08062008	8/6/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	EM-U25-1-3_08062008	8/6/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	EM-U25-5-5.5_08062008	8/6/2008	✓	✓	5-5.5	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-04-0-1_08062008	8/6/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-04-1-3_08062008	8/6/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-04-5-7_08062008	8/6/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-05-0-1_08272008	8/27/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-05-1-3_08272008	8/27/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-06-0-1_08272008	8/27/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former C Pond Spoils	CS-JS-06-1-3_08272008	8/27/2008	✓	no radionuclide data	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-3 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-4 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-5 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-10 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-13 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-14 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-17 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-18 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-21 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-T-2-2 100504	10/5/2004	✓	--	2	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-T-2-2.5 100504	10/5/2004	✓	--	2.5	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-T-2-B-18 100504	10/5/2004	✓	--	1.5	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-T-3-12 100504	10/5/2004	✓	--	12	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-T-3-4 100504	10/5/2004	✓	--	4	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-T-3-6 100504	10/5/2004	✓	--	6	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-C22-0-1_07292008	7/29/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former Esperanza Mill	Former Esperanza Mill	EM-C22-1-3_07292008	7/29/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-C22-5-7_07292008	7/29/2008	✓	sample jar broken	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-E24-0-1_07292008	7/29/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-E24-1-3_07292008	7/29/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-E24-5-7_07292008	7/29/2008	✓	sample jar broken	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-H22-0-1_07302008	7/30/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-H22-1-3_07302008	7/30/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-H22-5-7_07312008	7/31/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-K24-0-1_07312008	7/31/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-K24-1-3_07312008	7/31/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-K24-5-7_07312008	7/31/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-JS-01-0-1_08012008	8/1/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-JS-01-1-3_08012008	8/1/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-M26-0-1_08012008	8/1/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-M26-1-3_08012008	8/1/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-M26-5-7_08012008	8/1/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-N29-0-1_08062008	8/6/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-N29-1-3_08062008	8/6/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-X26-0-1_08062008	8/6/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-X26-1-3_08062008	8/6/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-X26-5-7_08062008	8/6/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-G27-0-1_08072008	8/7/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-G27-1-3_08072008	8/7/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-P24-0-1_08072008	8/7/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-P24-10-11_08072008	8/7/2008	✓	✓	10-11	0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-P24-1-3_08072008	8/7/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Esperanza Mill	EM-P24-5-7_08072008	8/7/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-20 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-02-0-1_08012008	8/1/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-02-1-3_08012008	8/1/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-08-0-1_08122008	8/12/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-08-10-12_08122008	8/12/2008	✓	✓	10-12	0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-08-1-3_08122008	8/12/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-08-5-7_08122008	8/12/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-06-0-1_08132008	8/13/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-06-10-11_08132008	8/13/2008	✓	✓	10-11	0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-06-1-3_08132008	8/13/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-06-5-7_08132008	8/13/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-07-0-1_08132008	8/13/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-07-10-12_08132008	8/13/2008	✓	✓	10-12	0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-07-1-3_08132008	8/13/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Laydown Yard	EM-JS-07-5-7_08132008	8/13/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	EM-9 081304	8/13/2004	✓	--	0-0.25	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	EM-T-1-1.5 100504	10/5/2004	✓	--	1.5	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	EM-T-1-13 100504	10/5/2004	✓	--	13	0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	EM-T-1-2 100504	10/5/2004	✓	--	2	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	EM-T-1-6 100504	10/5/2004	✓	--	6	0-15	exposed at surface

Table 5-2
Inventory of Soil and Sediment Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Exposure Area	Location SubArea	Sample ID	Sample Date	Metals Analysis	Radionuclide Analysis	Depth (ft bgs)	Applicable Data Set(s)	Sample Descriptor
Former Esperanza Mill	Former Raffinate Pond	RA-JS-01-0-1_08072008	8/7/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-01-1-3_08072008	8/7/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-01-5-7_08072008	8/7/2008	✓	✓	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-03-0-1_08072008	8/7/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-03-1-3_08072008	8/7/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-04-0-1_08072008	8/7/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-04-1-2.5_08072008	8/7/2008	✓	✓	1-2.5	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-05-0-1_08072008	8/7/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-05-1-3_08072008	8/7/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-02-0-1_08112008	8/11/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-02-1-3_08112008	8/11/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-JS-02-5-7_08112008	8/11/2008	✓	no radionuclide data	5-7	0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-SD-01-0-1.5_08112008	8/11/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-SD-01-1.5-3.0_08112008	8/11/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-SD-02-0-1.5_08112008	8/11/2008	✓	✓	0-1.5	0-0.5, 0-2, 0-15	exposed at surface
Former Esperanza Mill	Former Raffinate Pond	RA-SD-02-1.5-3.0_08112008	8/11/2008	✓	✓	1.5-3.0	0-2, 0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-01-0-1_08122008	8/12/2008	✓	✓	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-01-10-12_08122008	8/12/2008	✓	✓	10-12	0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-01-1-3_08122008	8/12/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-01-5-7_08122008	8/12/2008	✓	✓	5-7	0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-02-0-1_08122008	8/12/2008	✓	sample jar broken	0-1	0-0.5, 0-2, 0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-02-10-12_08122008	8/12/2008	✓	✓	10-12	0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-02-1-3_08122008	8/12/2008	✓	✓	1-3	0-2, 0-15	exposed at surface
Former Rhenium Ponds	Former Rhenium Ponds	RP-JS-02-5-7_08122008	8/12/2008	✓	✓	5-7	0-15	exposed at surface

Notes
Sample inventory does not include field duplicates or excavated samples.

BHHRA = Baseline Human Health Risk Assessment.
ft bgs = feet below ground surface.

Table 5-3
Soil Screening Levels Used to Select Constituents of Potential Concern
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]		CASRN	Constituent Class [b]	Selected Soil Screening Level [c,d]	
				(mg/kg) or (pCi/g)	Surrogate
Inorganics					
Antimony		7440-36-0	nc	4.10E+02	–
Arsenic		7440-38-2	ca, nc	1.00E+01	–
Barium		7440-39-3	nc	1.70E+05	–
Beryllium		7440-41-7	ca, nc	1.90E+03	–
Cadmium		7440-43-9	ca, nc	5.10E+02	–
Chromium		7440-47-3	nc	1.00E+06	Chromium III
Cobalt		7440-48-4	ca, nc	1.30E+04	–
Copper		7440-50-8	nc	4.10E+04	–
Lead		7439-92-1	ca, nc	8.00E+02	–
Manganese		7439-96-5	nc	3.20E+04	–
Mercury		7487-94-7	nc	3.10E+02	–
Molybdenum		7439-98-7	nc	5.10E+03	–
Nickel		7440-02-0	nc	2.00E+04	–
Selenium		7782-49-2	nc	5.10E+03	–
Thallium		7440-28-0	nc	6.70E+01	–
Uranium		7440-61-1	nc	2.00E+02	–
Zinc		7440-66-6	nc	3.10E+05	–
Radionuclides					
Radium-226	+D	Ra-226	–	2.10E-02	–
Radium-228	+D	Ra-228	–	1.30E-01	–
Uranium-234		U-234	–	2.80E+01	–
Uranium-235	+D	U-235	–	3.00E-01	–
Uranium-238	+D	U-238	–	1.40E+00	–

Notes:
[a] All detected constituents are presented.
[b] Constituent Class: "ca" indicates carcinogenic effects; "nc" indicates noncarcinogenic effects.
[c] The selected screening levels for inorganic constituents are the ADEQ's Non-Residential Soil Remediation Levels (nrSRLs). 2007. Available online at: http://apps.azsos.gov/public_services/Title_18/18-07.pdf.
[d] Screening levels for radiological constituents are the USEPA's Preliminary Remediation Goals (PRGs) for Radionuclides (USEPA 2014c). PRGs for the composite worker were used. Available online at: epa- prgs.ornl.gov/radionuclides/.

"+D" (plus daughters) indicates branches in the decay chain.
Ra-226: Rn-222, Po-218, Pb-214+At-218, Bi-214, Po-214+Tl-210
Ra-228: Ac-228
U-235: Th-231
U-238: Th234, Pa-234m+Pa234

–: not available or not applicable.
ADEQ: Arizona Department of Environmental Quality.
CASRN: Chemical Abstracts Service Registry Number.
mg/kg: milligram(s) per kilogram.
pCi/g: picoCurie(s) per gram.
USEPA: United States Environmental Protection Agency.

Table 5-4
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	32	46	70	1.00E+00	1.00E+00	2.00E-01	6.60E+01	CP-2 081304(8/13/2004)	3.64E+00	1.13E+01	4.10E+02	–	no	no	BSL
Arsenic	46	46	100	–	–	1.10E+00	1.66E+02	CP-2 081304(8/13/2004)	1.18E+01	3.01E+01	1.00E+01	–	YES	**YES**	ASL
Barium	36	36	100	–	–	6.71E+01	6.54E+02	CP-JS-01-0-1_07152008(7/15/2008)	1.54E+02	1.80E+02	1.70E+05	–	no	no	BSL
Beryllium	43	46	94	1.00E+00	1.00E+00	1.10E-01	1.30E+00	CP-JS-01-0-1_07152008(7/15/2008)	5.27E-01	6.31E-01	1.90E+03	–	no	no	BSL
Cadmium	16	46	35	2.00E+00	2.00E+00	4.80E-01	2.49E+01	CP-9 081304(8/13/2004)	2.59E+00	2.93E+00	5.10E+02	–	no	no	BSL
Chromium	46	46	100	–	–	3.00E+00	5.80E+01	CP-5 081304(8/13/2004)	1.20E+01	1.87E+01	1.00E+06	Chromium III	no	no	BSL
Cobalt	41	41	100	–	–	4.00E+00	7.60E+01	CP-1 081304(8/13/2004)	1.32E+01	2.15E+01	1.30E+04	–	no	no	BSL
Copper	46	46	100	–	–	2.07E+02	5.93E+04	CP-9 081304(8/13/2004)	5.04E+03	1.23E+04	4.10E+04	–	no	**YES**	ASL
Lead	46	46	100	–	–	4.00E+00	1.82E+03	CP-2 081304(8/13/2004)	8.70E+01	2.67E+02	8.00E+02	–	no	**YES**	ASL
Manganese	46	46	100	–	–	7.10E+01	5.87E+02	CP-9 081304(8/13/2004)	3.17E+02	3.42E+02	3.20E+04	–	no	no	BSL
Mercury	9	46	20	4.00E-02	2.00E-01	5.00E-02	6.20E-01	CP-2 081304(8/13/2004)	1.84E-01	1.32E-01	3.10E+02	–	no	no	BSL
Molybdenum	46	46	100	–	–	1.50E+01	3.02E+03	CP-2 081304(8/13/2004)	3.96E+02	8.55E+02	5.10E+03	–	no	no	BSL
Nickel	46	46	100	–	–	3.00E+00	6.40E+01	CP-5 081304(8/13/2004)	1.60E+01	2.40E+01	2.00E+04	–	no	no	BSL
Selenium	45	46	98	6.70E-01	6.70E-01	2.30E-01	5.00E+01	CP-2 081304(8/13/2004)	3.59E+00	9.74E+00	5.10E+03	–	no	no	BSL
Thallium	46	46	100	–	–	1.00E-01	5.20E+00	CP-2 081304(8/13/2004)	3.80E-01	8.52E-01	6.70E+01	–	no	no	BSL
Uranium	36	36	100	–	–	1.45E+00	7.57E+00	OD-SD-03-0-1.5_07282008(7/28/2008)	4.06E+00	4.40E+00	2.00E+02	–	no	no	BSL
Zinc	46	46	100	–	–	2.60E+01	6.21E+03	CP-9 081304(8/13/2004)	2.65E+02	8.50E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-5
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	Min - Max			Min - Max										
	No. of Detects	No. of Sample	(%)	(pCi/g)		(pCi/g)			(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	31 /	32	97	8.40E-01 -	8.40E-01	4.30E-01 -	3.50E+00	OD-JS-02-0-1_07292008(7/29/2008)	1.90E+00	2.15E+00	2.10E-02	YES	**YES**	ASL
Radium-228	32 /	32	100	– -	–	1.20E+00 -	7.60E+00	CP-O09-0-1_07112008(7/11/2008)	2.33E+00	2.66E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	32 /	32	100	– -	–	9.80E-01 -	3.90E+00	OD-SD-05-0-1.5_07292008(7/29/2008)	2.24E+00	2.46E+00	2.80E+01	no	no	BSL
Uranium-235	23 /	32	72	3.90E-02 -	1.90E-01	6.30E-02 -	3.10E-01	OD-SD-03-0-1.5_07282008(7/28/2008)	1.37E-01	1.46E-01	3.00E-01	no	**YES**	ASL
Uranium-238	32 /	32	100	– -	–	1.10E+00 -	4.00E+00	EV-JS-01-0-1_07142008(7/14/2008), OD-SD-03-0-1.5_07282008(7/28/2008)	2.34E+00	2.57E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-6
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 2 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	Min - Max			Min - Max		Min - Max									
	No. of Detects	No. of Samples	(%)	(mg/kg)		(mg/kg)			(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	47 /	86	55	1.00E+00 -	2.00E+00	2.00E-01 -	6.60E+01	CP-2 081304(8/13/2004)	2.32E+00	6.28E+00	4.10E+02	–	no	no	BSL
Arsenic	89 /	89	100	– -	–	7.00E-01 -	1.66E+02	CP-2 081304(8/13/2004)	7.75E+00	1.74E+01	1.00E+01	–	YES	**YES**	ASL
Barium	72 /	72	100	– -	–	4.11E+01 -	6.54E+02	CP-JS-01-0-1_07152008(7/15/2008)	1.54E+02	1.69E+02	1.70E+05	–	no	no	BSL
Beryllium	79 /	89	89	1.00E+00 -	1.00E+00	1.10E-01 -	1.30E+00	CP-JS-01-0-1_07152008(7/15/2008)	5.41E-01	5.18E-01	1.90E+03	–	no	no	BSL
Cadmium	23 /	86	27	2.00E+00 -	2.00E+00	4.80E-01 -	2.49E+01	CP-9 081304(8/13/2004)	2.53E+00	2.45E+00	5.10E+02	–	no	no	BSL
Chromium	86 /	86	100	– -	–	2.00E+00 -	4.70E+02	CP-T-4-18IN 100404(10/4/2004)	1.60E+01	3.96E+01	1.00E+06	Chromium III	no	no	BSL
Cobalt	77 /	77	100	– -	–	3.00E+00 -	7.60E+01	CP-1 081304(8/13/2004)	1.14E+01	1.32E+01	1.30E+04	–	no	no	BSL
Copper	89 /	89	100	– -	–	2.70E+01 -	5.93E+04	CP-9 081304(8/13/2004)	4.20E+03	9.19E+03	4.10E+04	–	no	**YES**	ASL
Lead	89 /	89	100	– -	–	1.20E+00 -	1.82E+03	CP-2 081304(8/13/2004)	5.39E+01	1.49E+02	8.00E+02	–	no	**YES**	ASL
Manganese	86 /	86	100	– -	–	7.10E+01 -	7.59E+02	CP-T-4-18IN 100404(10/4/2004)	3.28E+02	3.49E+02	3.20E+04	–	no	no	BSL
Mercury	13 /	86	15	4.00E-02 -	2.00E-01	4.00E-02 -	6.20E-01	CP-2 081304(8/13/2004)	1.80E-01	9.28E-02	3.10E+02	–	no	no	BSL
Molybdenum	89 /	89	100	– -	–	2.00E+00 -	3.02E+03	CP-2 081304(8/13/2004)	2.38E+02	4.19E+02	5.10E+03	–	no	no	BSL
Nickel	86 /	86	100	– -	–	2.00E+00 -	7.00E+01	CP-T-4-18IN 100404(10/4/2004)	1.59E+01	2.19E+01	2.00E+04	–	no	no	BSL
Selenium	81 /	86	94	3.00E-01 -	6.70E-01	7.00E-02 -	5.00E+01	CP-2 081304(8/13/2004)	2.20E+00	5.54E+00	5.10E+03	–	no	no	BSL
Thallium	82 /	86	95	1.00E-01 -	3.00E-01	1.00E-01 -	5.20E+00	CP-2 081304(8/13/2004)	3.35E-01	4.54E-01	6.70E+01	–	no	no	BSL
Uranium	72 /	72	100	– -	–	1.30E+00 -	1.03E+01	OD-SD-05-1.5-3.0_07292008(7/29/2008)	4.21E+00	4.58E+00	2.00E+02	–	no	no	BSL
Zinc	86 /	86	100	– -	–	2.60E+01 -	6.21E+03	CP-9 081304(8/13/2004)	2.49E+02	6.48E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-7
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 2 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Sample	(%)	Min (pCi/g)	Max (pCi/g)	Min (pCi/g)	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	65 /	66	99	8.40E-01	8.40E-01	4.30E-01	4.80E+00	CP-P07-1-3_07172008(7/17/2008), E-JS-02-1-3_07142008(7/14/2008)	2.10E+00	2.29E+00	2.10E-02	YES	**YES**	ASL
Radium-228	66 /	66	100	–	–	1.20E+00	7.60E+00	CP-O09-0-1_07112008(7/11/2008)	2.26E+00	2.44E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	66 /	66	100	–	–	8.80E-01	4.60E+00	E-JS-02-1-3_07142008(7/14/2008)	2.26E+00	2.44E+00	2.80E+01	no	no	BSL
Uranium-235	48 /	66	73	3.90E-02	2.30E-01	2.00E-02	3.10E-01	E-JS-02-1-3_07142008(7/14/2008), OD-SD-03-0-1.5_07282008(7/28/2008)	1.37E-01	1.37E-01	3.00E-01	no	**YES**	ASL
Uranium-238	66 /	66	100	–	–	8.40E-01	4.90E+00	E-JS-02-1-3_07142008(7/14/2008)	2.32E+00	2.51E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-8
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	Min - Max			Min - Max											
	No. of Detects	No. of Samples	(%)	(mg/kg)		(mg/kg)			(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	36 /	54	67	1.00E+00 -	2.00E+00	2.00E-01 -	6.60E+01	CP-2 081304(8/13/2004)	3.59E+00	1.01E+01	4.10E+02	–	no	no	BSL
Arsenic	139 /	149	93	2.50E+00 -	2.50E+00	1.10E+00 -	1.66E+02	CP-2 081304(8/13/2004)	9.24E+00	1.19E+01	1.00E+01	–	YES	**YES**	ASL
Barium	42 /	42	100	– -	–	3.68E+01 -	6.54E+02	CP-JS-01-0-1_07152008(7/15/2008)	1.49E+02	1.73E+02	1.70E+05	–	no	no	BSL
Beryllium	51 /	54	94	1.00E+00 -	1.00E+00	1.10E-01 -	1.30E+00	CP-JS-01-0-1_07152008(7/15/2008)	5.18E-01	6.10E-01	1.90E+03	–	no	no	BSL
Cadmium	21 /	54	39	2.00E-01 -	2.00E+00	4.30E-01 -	2.49E+01	CP-9 081304(8/13/2004)	2.79E+00	3.07E+00	5.10E+02	–	no	no	BSL
Chromium	54 /	54	100	– -	–	3.00E+00 -	5.80E+01	CP-5 081304(8/13/2004)	1.12E+01	1.71E+01	1.00E+06	Chromium III	no	no	BSL
Cobalt	47 /	47	100	– -	–	4.00E+00 -	7.60E+01	CP-1 081304(8/13/2004)	1.27E+01	2.00E+01	1.30E+04	–	no	no	BSL
Copper	149 /	149	100	– -	–	1.33E+02 -	1.09E+05	CP-16 081304(8/13/2004)	4.05E+03	7.96E+03	4.10E+04	–	no	**YES**	ASL
Lead	149 /	149	100	– -	–	2.70E+00 -	3.22E+03	CPS-SWN-D2-01_20120511(5/11/2012)	1.36E+02	2.58E+02	8.00E+02	–	no	**YES**	ASL
Manganese	53 /	54	98	4.00E-01 -	4.00E-01	7.10E+01 -	5.87E+02	CP-9 081304(8/13/2004)	3.07E+02	3.29E+02	3.20E+04	–	no	no	BSL
Mercury	13 /	54	24	3.30E-02 -	2.00E-01	3.70E-02 -	6.20E-01	CP-2 081304(8/13/2004)	1.70E-01	1.07E-01	3.10E+02	–	no	no	BSL
Molybdenum	54 /	54	100	– -	–	1.36E+01 -	3.02E+03	CP-2 081304(8/13/2004)	4.43E+02	8.89E+02	5.10E+03	–	no	no	BSL
Nickel	54 /	54	100	– -	–	2.00E+00 -	6.40E+01	CP-5 081304(8/13/2004)	1.52E+01	2.24E+01	2.00E+04	–	no	no	BSL
Selenium	48 /	54	89	6.70E-01 -	4.00E+00	2.30E-01 -	5.00E+01	CP-2 081304(8/13/2004)	4.24E+00	9.62E+00	5.10E+03	–	no	no	BSL
Thallium	49 /	54	91	1.50E+00 -	1.50E+00	1.00E-01 -	5.20E+00	CP-2 081304(8/13/2004)	4.76E-01	7.66E-01	6.70E+01	–	no	no	BSL
Uranium	42 /	42	100	– -	–	1.32E+00 -	7.57E+00	OD-SD-03-0-1.5_07282008(7/28/2008)	4.01E+00	4.38E+00	2.00E+02	–	no	no	BSL
Zinc	54 /	54	100	– -	–	2.60E+01 -	6.21E+03	CP-9 081304(8/13/2004)	3.33E+02	9.34E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-9
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Sample	(%)	Min (pCi/g)	Max (pCi/g)	Min (pCi/g)	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	32 /	33	97	8.40E-01	8.40E-01	4.30E-01	3.50E+00	OD-JS-02-0-1_07292008(7/29/2008)	1.93E+00	2.17E+00	2.10E-02	YES	**YES**	ASL
Radium-228	33 /	33	100	–	–	1.20E+00	7.60E+00	CP-O09-0-1_07112008(7/11/2008)	2.32E+00	2.63E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	33 /	33	100	–	–	9.80E-01	1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.53E+00	3.08E+00	2.80E+01	no	no	BSL
Uranium-235	24 /	33	73	3.90E-02	1.90E-01	6.30E-02	7.40E-01	CP-JS-02-0-1_07112008(7/11/2008)	1.56E-01	1.79E-01	3.00E-01	no	**YES**	ASL
Uranium-238	33 /	33	100	–	–	1.10E+00	1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.63E+00	3.17E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-10
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 2 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	Min - Max			Min - Max											
	No. of Detects	No. of Samples	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	53 /	96	55	1.00E+00 -	2.00E+00	2.00E-01 -	6.60E+01	CP-2 081304(8/13/2004)	2.37E+00	5.88E+00	4.10E+02	–	no	no	BSL
Arsenic	185 /	195	95	2.50E+00 -	2.50E+00	7.00E-01 -	1.66E+02	CP-2 081304(8/13/2004)	7.97E+00	1.00E+01	1.00E+01	–	YES	**YES**	ASL
Barium	79 /	79	100	– -	–	3.68E+01 -	6.54E+02	CP-JS-01-0-1_07152008(7/15/2008)	1.50E+02	1.65E+02	1.70E+05	–	no	no	BSL
Beryllium	90 /	100	90	1.00E+00 -	1.00E+00	1.10E-01 -	1.40E+00	CP-T-3-6 100504(10/5/2004)	5.45E-01	5.28E-01	1.90E+03	–	no	no	BSL
Cadmium	29 /	96	30	2.00E-01 -	2.00E+00	4.30E-01 -	2.49E+01	CP-9 081304(8/13/2004)	2.62E+00	2.55E+00	5.10E+02	–	no	no	BSL
Chromium	96 /	96	100	– -	–	2.00E+00 -	4.70E+02	CP-T-4-18IN 100404(10/4/2004)	1.50E+01	3.62E+01	1.00E+06	Chromium III	no	no	BSL
Cobalt	84 /	84	100	– -	–	3.00E+00 -	7.60E+01	CP-1 081304(8/13/2004)	1.12E+01	1.28E+01	1.30E+04	–	no	no	BSL
Copper	195 /	195	100	– -	–	2.70E+01 -	1.09E+05	CP-16 081304(8/13/2004)	3.85E+03	7.20E+03	4.10E+04	–	no	**YES**	ASL
Lead	195 /	195	100	– -	–	1.20E+00 -	3.22E+03	CPS-SWN-D2-01_20120511(5/11/2012)	1.08E+02	2.03E+02	8.00E+02	–	no	**YES**	ASL
Manganese	95 /	96	99	4.00E-01 -	4.00E-01	7.10E+01 -	7.59E+02	CP-T-4-18IN 100404(10/4/2004)	3.20E+02	3.40E+02	3.20E+04	–	no	no	BSL
Mercury	17 /	96	18	3.30E-02 -	2.00E-01	3.70E-02 -	6.20E-01	CP-2 081304(8/13/2004)	1.71E-01	8.31E-02	3.10E+02	–	no	no	BSL
Molybdenum	100 /	100	100	– -	–	2.00E+00 -	3.02E+03	CP-2 081304(8/13/2004)	2.72E+02	4.82E+02	5.10E+03	–	no	no	BSL
Nickel	96 /	96	100	– -	–	2.00E+00 -	7.00E+01	CP-T-4-18IN 100404(10/4/2004)	1.52E+01	2.08E+01	2.00E+04	–	no	no	BSL
Selenium	86 /	96	90	3.00E-01 -	4.00E+00	7.00E-02 -	5.00E+01	CP-2 081304(8/13/2004)	2.64E+00	5.73E+00	5.10E+03	–	no	no	BSL
Thallium	86 /	96	90	1.00E-01 -	1.50E+00	1.00E-01 -	5.20E+00	CP-2 081304(8/13/2004)	3.92E-01	4.43E-01	6.70E+01	–	no	no	BSL
Uranium	79 /	79	100	– -	–	9.30E-01 -	1.03E+01	OD-SD-05-1.5-3.0_07292008(7/29/2008)	4.14E+00	4.51E+00	2.00E+02	–	no	no	BSL
Zinc	96 /	96	100	– -	–	2.60E+01 -	6.21E+03	CP-9 081304(8/13/2004)	2.84E+02	6.89E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-11
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former CLEAR Plant - Shallow Soil/Sediment (0 to 2 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
				Min - Max		Min - Max								
	No. of Detects	No. of Sample	(%)	(pCi/g)		(pCi/g)			(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	67 /	68	99	8.40E-01	- 8.40E-01	4.30E-01	- 4.80E+00	CP-P07-1-3_07172008(7/17/2008), E-JS-02-1-3_07142008(7/14/2008)	2.10E+00	2.27E+00	2.10E-02	YES	**YES**	ASL
Radium-228	68 /	68	100	–	- –	1.20E+00	- 7.60E+00	CP-O09-0-1_07112008(7/11/2008)	2.24E+00	2.42E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	68 /	68	100	–	- –	8.40E-01	- 1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.38E+00	2.59E+00	2.80E+01	no	no	BSL
Uranium-235	50 /	68	74	3.90E-02	- 2.30E-01	2.00E-02	- 7.40E-01	CP-JS-02-0-1_07112008(7/11/2008)	1.45E-01	1.48E-01	3.00E-01	no	**YES**	ASL
Uranium-238	68 /	68	100	–	- –	8.40E-01	- 1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.44E+00	2.66E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-12
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	62	116	53	1.00E+00	2.00E+00	2.00E-01	6.60E+01	CP-2 081304(8/13/2004)	2.27E+00	5.11E+00	4.10E+02	–	no	no	BSL
Arsenic	216	226	96	2.50E+00	2.50E+00	7.00E-01	1.66E+02	CP-2 081304(8/13/2004)	8.35E+00	1.02E+01	1.00E+01	–	YES	**YES**	ASL
Barium	96	96	100	–	–	3.68E+01	6.54E+02	CP-JS-01-0-1_07152008(7/15/2008)	1.52E+02	1.65E+02	1.70E+05	–	no	no	BSL
Beryllium	118	131	90	1.00E+00	5.00E+00	1.10E-01	1.40E+00	CP-T-3-6 100504(10/5/2004)	5.75E-01	5.22E-01	1.90E+03	–	no	no	BSL
Cadmium	36	116	31	2.00E-01	8.00E+00	4.20E-01	2.49E+01	CP-9 081304(8/13/2004)	2.58E+00	2.34E+00	5.10E+02	–	no	no	BSL
Chromium	116	116	100	–	–	2.00E+00	4.70E+02	CP-T-4-18IN 100404(10/4/2004)	1.42E+01	3.18E+01	1.00E+06	Chromium III	no	no	BSL
Cobalt	101	101	100	–	–	3.00E+00	7.60E+01	CP-1 081304(8/13/2004)	1.10E+01	1.24E+01	1.30E+04	–	no	no	BSL
Copper	226	226	100	–	–	2.70E+01	1.09E+05	CP-16 081304(8/13/2004)	3.59E+03	6.50E+03	4.10E+04	–	no	**YES**	ASL
Lead	226	226	100	–	–	1.20E+00	3.22E+03	CPS-SWN-D2-01_20120511(5/11/2012)	1.00E+02	1.83E+02	8.00E+02	–	no	**YES**	ASL
Manganese	115	116	99	4.00E-01	4.00E-01	7.10E+01	1.24E+03	CP-JS-01-10-12_07152008(7/15/2008)	3.30E+02	3.52E+02	3.20E+04	–	no	no	BSL
Mercury	21	116	18	3.30E-02	2.00E-01	3.70E-02	6.20E-01	CP-2 081304(8/13/2004)	1.70E-01	8.03E-02	3.10E+02	–	no	no	BSL
Molybdenum	131	131	100	–	–	2.00E+00	3.02E+03	CP-2 081304(8/13/2004)	2.46E+02	3.76E+02	5.10E+03	–	no	no	BSL
Nickel	116	116	100	–	–	2.00E+00	7.00E+01	CP-T-4-18IN 100404(10/4/2004)	1.43E+01	1.90E+01	2.00E+04	–	no	no	BSL
Selenium	104	116	90	3.00E-01	4.00E+00	7.00E-02	5.00E+01	CP-2 081304(8/13/2004)	2.48E+00	5.00E+00	5.10E+03	–	no	no	BSL
Thallium	104	116	90	1.00E-01	1.50E+00	1.00E-01	5.20E+00	CP-2 081304(8/13/2004)	3.96E-01	4.18E-01	6.70E+01	–	no	no	BSL
Uranium	96	96	100	–	–	9.30E-01	1.60E+01	CP-JS-04-5-7_08272008(8/27/2008)	4.61E+00	5.02E+00	2.00E+02	–	no	no	BSL
Zinc	116	116	100	–	–	2.60E+01	6.21E+03	CP-9 081304(8/13/2004)	2.51E+02	5.87E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-13
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Sample	(%)	Min (pCi/g)	Max (pCi/g)	Min (pCi/g)	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	80 /	82	98	4.00E-01	8.40E-01	4.30E-01	5.30E+00	CP-JS-03-5-7_07142008(7/14/2008)	2.20E+00	2.41E+00	2.10E-02	YES	**YES**	ASL
Radium-228	82 /	82	100	–	–	1.20E+00	7.60E+00	CP-O09-0-1_07112008(7/11/2008)	2.26E+00	2.42E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	82 /	82	100	–	–	8.40E-01	1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.51E+00	2.72E+00	2.80E+01	no	no	BSL
Uranium-235	63 /	82	77	3.90E-02	2.30E-01	2.00E-02	7.40E-01	CP-JS-02-0-1_07112008(7/11/2008)	1.49E-01	1.53E-01	3.00E-01	no	**YES**	ASL
Uranium-238	82 /	82	100	–	–	8.40E-01	1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.59E+00	2.87E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-14
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	40	45	89	1.00E+00	1.00E+00	2.00E-01	6.90E+01	EM-17 081304(8/13/2004)	2.66E+00	9.27E+00	4.10E+02	–	no	no	BSL
Arsenic	42	45	93	1.01E+01	3.54E+01	1.40E+00	1.01E+02	EM-17 081304(8/13/2004)	1.06E+01	1.93E+01	1.00E+01	–	YES	**YES**	ASL
Barium	33	33	100	–	–	4.50E+01	2.94E+02	CS-JS-05-0-1_08272008(8/27/2008)	1.09E+02	1.26E+02	1.70E+05	–	no	no	BSL
Beryllium	40	45	89	1.00E+00	5.00E+00	1.70E-01	2.36E+00	EM-26 081304(8/13/2004)	7.97E-01	7.54E-01	1.90E+03	–	no	no	BSL
Cadmium	20	45	44	2.00E+00	2.00E+00	3.20E-01	5.65E+00	EM-3 081304(8/13/2004)	1.81E+00	1.57E+00	5.10E+02	–	no	no	BSL
Chromium	45	45	100	–	–	2.00E+00	2.30E+01	C-JS-04-0-1_08052008(8/5/2008)	8.67E+00	9.87E+00	1.00E+06	Chromium III	no	no	BSL
Cobalt	36	37	97	5.00E+00	5.00E+00	3.00E+00	1.90E+01	EM-JS-07-0-1_08132008(8/13/2008)	9.41E+00	1.05E+01	1.30E+04	–	no	no	BSL
Copper	45	45	100	–	–	1.13E+02	3.02E+04	RA-JS-02-0-1_08112008(8/11/2008)	2.90E+03	6.14E+03	4.10E+04	–	no	no	BSL
Lead	45	45	100	–	–	4.99E+00	4.77E+02	C-JS-05-0-1_08052008(8/5/2008)	6.94E+01	8.82E+01	8.00E+02	–	no	no	BSL
Manganese	45	45	100	–	–	3.00E+01	9.28E+02	EM-26 081304(8/13/2004)	3.62E+02	4.12E+02	3.20E+04	–	no	no	BSL
Mercury	17	45	38	4.00E-02	2.00E-01	4.00E-02	3.60E-01	RA-JS-02-0-1_08112008(8/11/2008)	1.50E-01	1.04E-01	3.10E+02	–	no	no	BSL
Molybdenum	45	45	100	–	–	7.00E+00	6.83E+03	EM-JS-07-0-1_08132008(8/13/2008)	8.57E+02	1.85E+03	5.10E+03	–	no	**YES**	ASL
Nickel	39	45	87	1.00E+00	5.00E+00	2.00E+00	2.50E+01	EM-4 081304(8/13/2004)	6.87E+00	7.82E+00	2.00E+04	–	no	no	BSL
Selenium	36	45	80	4.10E-01	1.11E+01	9.00E-02	9.40E+00	EM-3 081304(8/13/2004)	1.85E+00	2.83E+00	5.10E+03	–	no	no	BSL
Thallium	38	44	86	1.80E-01	3.00E-01	7.00E-02	8.90E-01	EM-14 081304(8/13/2004)	2.54E-01	2.76E-01	6.70E+01	–	no	no	BSL
Uranium	33	33	100	–	–	1.96E+00	1.10E+01	CS-JS-03-0-1_08052008(8/5/2008)	4.42E+00	4.99E+00	2.00E+02	–	no	no	BSL
Zinc	44	44	100	–	–	2.50E+01	8.24E+02	EM-3 081304(8/13/2004)	1.84E+02	2.27E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-15
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits			Detected Concentrations			Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detec	No. of Sampl	(%)	Min (pCi/g)	-	Max (pCi/g)	Min (pCi/g)	-	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides																
Radium-226	30	/ 30	100	–	-	–	5.40E-01	-	5.80E+00	RA-JS-03-0-1_08072008(8/7/2008)	2.25E+00	2.60E+00	2.10E-02	YES	**YES**	ASL
Radium-228	28	/ 30	93.3	2.40E+00	-	2.50E+00	1.40E+00	-	3.70E+00	EM-JS-02-0-1_08012008(8/1/2008)	2.07E+00	2.18E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	30	/ 30	100	–	-	–	1.00E+00	-	3.70E+00	RA-JS-05-0-1_08072008(8/7/2008)	1.93E+00	2.12E+00	2.80E+01	no	no	BSL
Uranium-235	21	/ 30	70	5.20E-02	-	1.10E-01	5.50E-02	-	2.00E-01	RA-JS-05-0-1_08072008(8/7/2008)	1.03E-01	1.12E-01	3.00E-01	no	no	BSL
Uranium-238	30	/ 30	100	–	-	–	9.20E-01	-	3.50E+00	RA-JS-05-0-1_08072008(8/7/2008)	1.93E+00	2.10E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-16
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Esperanza Mill - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects / No. of Samples	(%)	Min - Max (mg/kg)		Min - Max (mg/kg)				(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	64 / 80	80	1.00E+00	1.00E+00	2.00E-01	6.90E+01	EM-17 081304(8/13/2004)		2.16E+00	5.92E+00	4.10E+02	–	no	no	BSL
Arsenic	76 / 82	93	1.01E+01	8.97E+01	1.00E+00	1.01E+02	EM-17 081304(8/13/2004)		1.02E+01	1.05E+01	1.00E+01	–	YES	**YES**	ASL
Barium	66 / 66	100	–	–	4.02E+01	2.94E+02	CS-JS-05-0-1_08272008(8/27/2008)		1.05E+02	1.15E+02	1.70E+05	–	no	no	BSL
Beryllium	71 / 82	87	1.00E+00	5.00E+00	1.70E-01	2.36E+00	EM-26 081304(8/13/2004)		8.00E-01	7.15E-01	1.90E+03	–	no	no	BSL
Cadmium	33 / 80	41	2.00E+00	2.00E+00	3.20E-01	5.65E+00	EM-3 081304(8/13/2004)		1.74E+00	1.31E+00	5.10E+02	–	no	no	BSL
Chromium	80 / 80	100	–	–	2.00E+00	3.70E+01	CS-JS-01-1-3_08042008(8/4/2008)		8.86E+00	1.18E+01	1.00E+06	Chromium III	no	no	BSL
Cobalt	69 / 70	99	5.00E+00	5.00E+00	1.00E+00	2.20E+01	RA-JS-02-1-3_08112008(8/11/2008)		9.01E+00	9.91E+00	1.30E+04	–	no	no	BSL
Copper	82 / 82	100	–	–	6.20E+01	3.02E+04	RA-JS-02-0-1_08112008(8/11/2008)		2.61E+03	4.95E+03	4.10E+04	–	no	no	BSL
Lead	82 / 82	100	–	–	2.81E+00	3.74E+03	C-JS-05-1-3_08052008(8/5/2008)		1.16E+02	1.29E+02	8.00E+02	–	no	**YES**	ASL
Manganese	80 / 80	100	–	–	3.00E+01	9.28E+02	EM-26 081304(8/13/2004)		3.36E+02	3.73E+02	3.20E+04	–	no	no	BSL
Mercury	24 / 80	30	4.00E-02	2.00E-01	4.00E-02	3.60E-01	RA-JS-02-0-1_08112008(8/11/2008)		1.60E-01	9.22E-02	3.10E+02	–	no	no	BSL
Molybdenum	81 / 82	99	5.00E+00	5.00E+00	3.00E+00	6.83E+03	EM-JS-07-0-1_08132008(8/13/2008)		6.17E+02	1.21E+03	5.10E+03	–	no	**YES**	ASL
Nickel	71 / 80	89	1.00E+00	5.00E+00	2.00E+00	2.50E+01	EM-4 081304(8/13/2004)		6.26E+00	6.84E+00	2.00E+04	–	no	no	BSL
Selenium	66 / 80	83	2.60E-01	1.11E+01	5.00E-02	9.40E+00	EM-3 081304(8/13/2004)		1.65E+00	2.14E+00	5.10E+03	–	no	no	BSL
Thallium	67 / 78	86	1.20E-01	3.00E-01	7.00E-02	8.90E-01	EM-14 081304(8/13/2004)		2.47E-01	2.64E-01	6.70E+01	–	no	no	BSL
Uranium	66 / 66	100	–	–	1.17E+00	1.34E+01	RA-JS-01-1-3_08072008(8/7/2008)		4.68E+00	5.17E+00	2.00E+02	–	no	no	BSL
Zinc	78 / 78	100	–	–	2.50E+01	8.24E+02	EM-3 081304(8/13/2004)		1.80E+02	2.18E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-17
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Esperanza Mill - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits			Detected Concentrations			Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detec	No. of Sampl	(%)	Min (pCi/g)	-	Max (pCi/g)	Min (pCi/g)	-	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides																
Radium-226	62	/ 62	100	–	-	–	5.40E-01	-	5.80E+00	RA-JS-03-0-1_08072008(8/7/2008)	2.18E+00	2.42E+00	2.10E-02	YES	**YES**	ASL
Radium-228	59	/ 62	95.2	2.00E+00	-	2.50E+00	1.00E+00	-	8.90E+00	RA-JS-02-1-3_08112008(8/11/2008)	2.22E+00	2.79E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	62	/ 62	100	–	-	–	8.50E-01	-	6.60E+00	CS-JS-05-1-3_08272008(8/27/2008)	2.22E+00	2.44E+00	2.80E+01	no	no	BSL
Uranium-235	45	/ 62	72.6	4.20E-02	-	2.00E-01	4.20E-02	-	3.40E-01	CS-JS-05-1-3_08272008(8/27/2008)	1.14E-01	1.17E-01	3.00E-01	no	**YES**	ASL
Uranium-238	62	/ 62	100	–	-	–	9.00E-01	-	6.60E+00	CS-JS-05-1-3_08272008(8/27/2008)	2.23E+00	2.45E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-18
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	Min - Max			Min - Max											
	No. of Detects	No. of Samples	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	86 /	114	75	2.00E-01 -	1.00E+00	2.00E-01 -	6.90E+01	EM-17 081304(8/13/2004)	1.99E+00	4.64E+00	4.10E+02	–	no	no	BSL
Arsenic	112 /	119	94	1.01E+01 -	8.97E+01	1.00E+00 -	1.01E+02	EM-17 081304(8/13/2004)	9.90E+00	9.82E+00	1.00E+01	–	YES	**YES**	ASL
Barium	95 /	95	100	– -	–	3.92E+01 -	3.66E+02	CS-JS-02-5-7_08042008(8/4/2008)	1.13E+02	1.23E+02	1.70E+05	–	no	no	BSL
Beryllium	107 /	119	90	1.00E+00 -	5.00E+00	1.70E-01 -	6.20E+00	RA-JS-02-5-7_08112008(8/11/2008)	8.12E-01	8.07E-01	1.90E+03	–	no	no	BSL
Cadmium	51 /	114	45	2.00E+00 -	2.00E+00	2.60E-01 -	8.30E+00	CS-JS-02-10-11_08042008(8/4/2008)	1.86E+00	1.53E+00	5.10E+02	–	no	no	BSL
Chromium	114 /	114	100	– -	–	2.00E+00 -	1.93E+02	EM-JS-08-10-12_08122008(8/12/2008)	1.21E+01	2.03E+01	1.00E+06	Chromium III	no	no	BSL
Chromium VI	1 /	5	20	4.00E+00 -	9.00E+00	4.00E+00 -	4.00E+00	EM-JS-08-10-12_08122008(8/12/2008)	5.80E+00	–	6.50E+01	–	no	no	BSL
Cobalt	98 /	99	99	5.00E+00 -	5.00E+00	1.00E+00 -	4.20E+01	EM-JS-08-5-7_08122008(8/12/2008)	1.03E+01	1.13E+01	1.30E+04	–	no	no	BSL
Copper	119 /	119	100	– -	–	6.20E+01 -	3.02E+04	RA-JS-02-0-1_08112008(8/11/2008)	2.66E+03	4.66E+03	4.10E+04	–	no	no	BSL
Lead	119 /	119	100	– -	–	2.81E+00 -	3.74E+03	C-JS-05-1-3_08052008(8/5/2008)	1.16E+02	1.33E+02	8.00E+02	–	no	**YES**	ASL
Manganese	114 /	114	100	– -	–	3.00E+01 -	9.32E+02	EM-JS-08-5-7_08122008(8/12/2008)	3.56E+02	3.89E+02	3.20E+04	–	no	no	BSL
Mercury	35 /	114	31	4.00E-02 -	2.00E-01	4.00E-02 -	6.00E-01	EM-JS-08-5-7_08122008(8/12/2008)	1.66E-01	1.01E-01	3.10E+02	–	no	no	BSL
Molybdenum	118 /	119	99	5.00E+00 -	5.00E+00	3.00E+00 -	6.83E+03	EM-JS-07-0-1_08132008(8/13/2008)	6.12E+02	1.13E+03	5.10E+03	–	no	**YES**	ASL
Nickel	103 /	114	90	1.00E+00 -	5.00E+00	2.00E+00 -	3.30E+01	EM-JS-08-5-7_08122008(8/12/2008)	7.17E+00	7.81E+00	2.00E+04	–	no	no	BSL
Selenium	93 /	114	82	1.90E-01 -	1.11E+01	5.00E-02 -	9.40E+00	EM-3 081304(8/13/2004)	1.55E+00	1.92E+00	5.10E+03	–	no	no	BSL
Thallium	98 /	111	88	1.20E-01 -	3.00E-01	7.00E-02 -	1.10E+00	EM-T-2-2.5 100504(10/5/2004)	2.58E-01	2.76E-01	6.70E+01	–	no	no	BSL
Uranium	95 /	95	100	– -	–	1.17E+00 -	2.99E+01	RA-JS-02-5-7_08112008(8/11/2008)	5.42E+00	7.16E+00	2.00E+02	–	no	no	BSL
Zinc	111 /	111	100	– -	–	2.50E+01 -	3.63E+03	CS-JS-02-10-11_08042008(8/4/2008)	2.63E+02	2.96E+02	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-19
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detec / No. of Sampl		(%)	Min (pCi/g)	Max (pCi/g)	Min (pCi/g)	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	88 / 88		100	–	–	5.40E-01	5.80E+00	RA-JS-03-0-1_08072008(8/7/2008)	2.24E+00	2.43E+00	2.10E-02	YES	**YES**	ASL
Radium-228	85 / 88		96.6	2.00E+00	2.50E+00	1.00E+00	8.90E+00	RA-JS-02-1-3_08112008(8/11/2008)	2.30E+00	2.50E+00	1.30E-01	YES	**YES**	ASL
Uranium-234	88 / 88		100	–	–	8.50E-01	1.20E+01	EM-JS-08-10-12_08122008(8/12/2008)	2.43E+00	2.69E+00	2.80E+01	no	no	BSL
Uranium-235	68 / 88		77.3	4.20E-02	2.00E-01	4.20E-02	5.70E-01	EM-JS-08-10-12_08122008(8/12/2008)	1.25E-01	1.33E-01	3.00E-01	no	**YES**	ASL
Uranium-238	88 / 88		100	–	–	9.00E-01	1.20E+01	EM-JS-08-10-12_08122008(8/12/2008)	2.47E+00	2.74E+00	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-20
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	1	2	50	1.00E+00	1.00E+00	2.00E-01	2.00E-01	RP-JS-02-0-1_08122008(8/12/2008)	6.00E-01	–	4.10E+02	–	no	no	BSL
Arsenic	2	2	100	–	–	3.50E+00	3.50E+00	RP-JS-01-0-1_08122008(8/12/2008), RP-JS-02-0-1_08122008(8/12/2008)	3.50E+00	–	1.00E+01	–	no	no	BSL
Barium	2	2	100	–	–	1.27E+02	3.03E+02	RP-JS-02-0-1_08122008(8/12/2008)	2.15E+02	–	1.70E+05	–	no	no	BSL
Beryllium	2	2	100	–	–	6.00E-01	1.60E+00	RP-JS-02-0-1_08122008(8/12/2008)	1.10E+00	–	1.90E+03	–	no	no	BSL
Chromium	2	2	100	–	–	4.00E+00	7.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	5.50E+00	–	1.00E+06	Chromium III	no	no	BSL
Cobalt	2	2	100	–	–	5.00E+00	1.00E+01	RP-JS-02-0-1_08122008(8/12/2008)	7.50E+00	–	1.30E+04	–	no	no	BSL
Copper	2	2	100	–	–	6.30E+01	1.24E+02	RP-JS-01-0-1_08122008(8/12/2008)	9.35E+01	–	4.10E+04	–	no	no	BSL
Lead	2	2	100	–	–	1.08E+01	1.14E+01	RP-JS-01-0-1_08122008(8/12/2008)	1.11E+01	–	8.00E+02	–	no	no	BSL
Manganese	2	2	100	–	–	2.71E+02	9.75E+02	RP-JS-02-0-1_08122008(8/12/2008)	6.23E+02	–	3.20E+04	–	no	no	BSL
Mercury	2	2	100	–	–	4.00E-02	7.00E-02	RP-JS-01-0-1_08122008(8/12/2008)	5.50E-02	–	3.10E+02	–	no	no	BSL
Molybdenum	2	2	100	–	–	6.00E+00	5.10E+01	RP-JS-01-0-1_08122008(8/12/2008)	2.85E+01	–	5.10E+03	–	no	no	BSL
Nickel	2	2	100	–	–	2.00E+00	6.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	4.00E+00	–	2.00E+04	–	no	no	BSL
Selenium	2	2	100	–	–	3.40E-01	9.10E-01	RP-JS-01-0-1_08122008(8/12/2008)	6.25E-01	–	5.10E+03	–	no	no	BSL
Thallium	2	2	100	–	–	1.50E-01	2.50E-01	RP-JS-02-0-1_08122008(8/12/2008)	2.00E-01	–	6.70E+01	–	no	no	BSL
Uranium	2	2	100	–	–	2.11E+00	2.64E+00	RP-JS-01-0-1_08122008(8/12/2008)	2.38E+00	–	2.00E+02	–	no	no	BSL
Zinc	2	2	100	–	–	4.00E+01	5.10E+01	RP-JS-02-0-1_08122008(8/12/2008)	4.55E+01	–	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-21
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits			Detected Concentrations			Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detec	No. of Sampl	(%)	Min (pCi/g)	-	Max (pCi/g)	Min (pCi/g)	-	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides																
Radium-226	1	/ 1	100	–	-	–	1.90E+00	-	1.90E+00	RP-JS-01-0-1_08122008(8/12/2008)	1.90E+00	–	2.10E-02	YES	**YES**	ASL
Radium-228	1	/ 1	100	–	-	–	1.40E+00	-	1.40E+00	RP-JS-01-0-1_08122008(8/12/2008)	1.40E+00	–	1.30E-01	YES	**YES**	ASL
Uranium-234	1	/ 1	100	–	-	–	1.30E+00	-	1.30E+00	RP-JS-01-0-1_08122008(8/12/2008)	1.30E+00	–	2.80E+01	no	no	BSL
Uranium-238	1	/ 1	100	–	-	–	1.20E+00	-	1.20E+00	RP-JS-01-0-1_08122008(8/12/2008)	1.20E+00	–	1.40E+00	no	no	BSL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-22
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	1	4	25	1.00E+00	1.00E+00	2.00E-01	2.00E-01	RP-JS-02-0-1_08122008(8/12/2008)	8.00E-01	–	4.10E+02	–	no	no	BSL
Arsenic	4	4	100	–	–	3.10E+00	3.50E+00	RP-JS-01-0-1_08122008(8/12/2008), RP-JS-02-0-1_08122008(8/12/2008), RP-JS-02-1-3_08122008(8/12/2008)	3.40E+00	–	1.00E+01	–	no	no	BSL
Barium	4	4	100	–	–	4.61E+01	3.03E+02	RP-JS-02-0-1_08122008(8/12/2008)	1.31E+02	–	1.70E+05	–	no	no	BSL
Beryllium	3	4	75	1.00E+00	1.00E+00	2.00E-01	1.60E+00	RP-JS-02-0-1_08122008(8/12/2008)	8.50E-01	–	1.90E+03	–	no	no	BSL
Chromium	4	4	100	–	–	3.00E+00	7.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	4.50E+00	–	1.00E+06	Chromium III	no	no	BSL
Cobalt	4	4	100	–	–	2.00E+00	1.00E+01	RP-JS-02-0-1_08122008(8/12/2008)	5.50E+00	–	1.30E+04	–	no	no	BSL
Copper	4	4	100	–	–	6.30E+01	1.83E+02	RP-JS-01-1-3_08122008(8/12/2008)	1.11E+02	–	4.10E+04	–	no	no	BSL
Lead	4	4	100	–	–	8.50E+00	1.27E+01	RP-JS-01-1-3_08122008(8/12/2008)	1.09E+01	–	8.00E+02	–	no	no	BSL
Manganese	4	4	100	–	–	1.60E+02	9.75E+02	RP-JS-02-0-1_08122008(8/12/2008)	4.13E+02	–	3.20E+04	–	no	no	BSL
Mercury	2	4	50	2.00E-01	2.00E-01	4.00E-02	7.00E-02	RP-JS-01-0-1_08122008(8/12/2008)	1.28E-01	–	3.10E+02	–	no	no	BSL
Molybdenum	4	4	100	–	–	6.00E+00	1.21E+02	RP-JS-02-1-3_08122008(8/12/2008)	6.60E+01	–	5.10E+03	–	no	no	BSL
Nickel	3	4	75	5.00E+00	5.00E+00	2.00E+00	6.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	3.75E+00	–	2.00E+04	–	no	no	BSL
Selenium	4	4	100	–	–	3.40E-01	9.10E-01	RP-JS-01-0-1_08122008(8/12/2008)	6.98E-01	–	5.10E+03	–	no	no	BSL
Thallium	4	4	100	–	–	1.10E-01	2.50E-01	RP-JS-02-0-1_08122008(8/12/2008)	1.60E-01	–	6.70E+01	–	no	no	BSL
Uranium	4	4	100	–	–	1.07E+00	2.64E+00	RP-JS-01-0-1_08122008(8/12/2008)	2.07E+00	–	2.00E+02	–	no	no	BSL
Zinc	4	4	100	–	–	2.30E+01	5.10E+01	RP-JS-02-0-1_08122008(8/12/2008)	3.93E+01	–	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-23
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits			Detected Concentrations			Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detec	No. of Sampl	(%)	Min (pCi/g)	-	Max (pCi/g)	Min (pCi/g)	-	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides																
Radium-226	3	3	100	–	-	–	1.90E+00	-	2.60E+00	RP-JS-01-1-3_08122008(8/12/2008), RP-JS-02-1-3_08122008(8/12/2008)	2.37E+00	–	2.10E-02	YES	**YES**	ASL
Radium-228	3	3	100	–	-	–	1.40E+00	-	1.70E+00	RP-JS-02-1-3_08122008(8/12/2008)	1.57E+00	–	1.30E-01	YES	**YES**	ASL
Uranium-234	3	3	100	–	-	–	1.00E+00	-	1.40E+00	RP-JS-01-1-3_08122008(8/12/2008)	1.23E+00	–	2.80E+01	no	no	BSL
Uranium-235	1	3	33.3	8.40E-02	-	1.80E-01	4.60E-02	-	4.60E-02	RP-JS-02-1-3_08122008(8/12/2008)	1.03E-01	–	3.00E-01	no	no	BSL
Uranium-238	3	3	100	–	-	–	9.40E-01	-	1.20E+00	RP-JS-01-0-1_08122008(8/12/2008), RP-JS-01-1-3_08122008(8/12/2008)	1.11E+00	–	1.40E+00	no	no	BSL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-24
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Non-Residential Screening Level [b]		Is Maximum Concentration > 10x nrSRL?	Is Constituent a COPC? [c]	
	No. of Detects / No. of Samples		(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	2 / 8		25	1.00E+00	1.00E+00	2.00E-01	3.00E-01	RP-JS-02-10-12_08122008(8/12/2008)	8.13E-01	–	4.10E+02	–	no	no	BSL
Arsenic	8 / 8		100	–	–	1.90E+00	5.20E+00	RP-JS-02-5-7_08122008(8/12/2008)	3.33E+00	3.96E+00	1.00E+01	–	no	no	BSL
Barium	8 / 8		100	–	–	4.61E+01	3.03E+02	RP-JS-02-0-1_08122008(8/12/2008)	1.08E+02	2.53E+02	1.70E+05	–	no	no	BSL
Beryllium	6 / 8		75	1.00E+00	1.00E+00	2.00E-01	1.60E+00	RP-JS-02-0-1_08122008(8/12/2008)	7.50E-01	8.97E-01	1.90E+03	–	no	no	BSL
Chromium	8 / 8		100	–	–	2.00E+00	7.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	3.50E+00	4.63E+00	1.00E+06	Chromium III	no	no	BSL
Cobalt	8 / 8		100	–	–	2.00E+00	1.60E+01	RP-JS-02-10-12_08122008(8/12/2008)	7.25E+00	1.02E+01	1.30E+04	–	no	no	BSL
Copper	8 / 8		100	–	–	6.30E+01	4.66E+02	RP-JS-01-10-12_08122008(8/12/2008)	1.87E+02	2.80E+02	4.10E+04	–	no	no	BSL
Lead	8 / 8		100	–	–	6.43E+00	1.45E+01	RP-JS-02-10-12_08122008(8/12/2008)	1.02E+01	1.20E+01	8.00E+02	–	no	no	BSL
Manganese	8 / 8		100	–	–	1.60E+02	1.25E+03	RP-JS-02-5-7_08122008(8/12/2008)	5.06E+02	1.09E+03	3.20E+04	–	no	no	BSL
Mercury	4 / 8		50	2.00E-01	2.00E-01	4.00E-02	7.00E-02	RP-JS-01-0-1_08122008(8/12/2008), RP-JS-02-10-12_08122008(8/12/2008)	1.30E-01	–	3.10E+02	–	no	no	BSL
Molybdenum	8 / 8		100	–	–	6.00E+00	1.26E+02	RP-JS-01-10-12_08122008(8/12/2008)	6.85E+01	9.82E+01	5.10E+03	–	no	no	BSL
Nickel	7 / 8		88	5.00E+00	5.00E+00	2.00E+00	6.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	3.50E+00	5.78E+00	2.00E+04	–	no	no	BSL
Selenium	8 / 8		100	–	–	3.40E-01	1.04E+00	RP-JS-01-10-12_08122008(8/12/2008)	7.58E-01	9.05E-01	5.10E+03	–	no	no	BSL
Thallium	8 / 8		100	–	–	8.00E-02	2.50E-01	RP-JS-02-0-1_08122008(8/12/2008)	1.38E-01	1.74E-01	6.70E+01	–	no	no	BSL
Uranium	8 / 8		100	–	–	1.07E+00	9.12E+00	RP-JS-02-10-12_08122008(8/12/2008)	2.88E+00	5.34E+00	2.00E+02	–	no	no	BSL
Zinc	8 / 8		100	–	–	2.30E+01	1.39E+02	RP-JS-02-10-12_08122008(8/12/2008)	5.64E+01	8.06E+01	3.10E+05	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
nrSRL: non-residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Table 5-25
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits			Detected Concentrations			Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Composite Worker PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detec	No. of Sampl	(%)	Min (pCi/g)	-	Max (pCi/g)	Min (pCi/g)	-	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides																
Radium-226	7	/ 7	100	–	-	–	1.50E+00	-	2.80E+00	RP-JS-01-10-12_08122008(8/12/2008)	2.21E+00	–	2.10E-02	YES	**YES**	ASL
Radium-228	7	/ 7	100	–	-	–	8.20E-01	-	1.90E+00	RP-JS-01-10-12_08122008(8/12/2008)	1.50E+00	–	1.30E-01	YES	**YES**	ASL
Uranium-234	7	/ 7	100	–	-	–	7.00E-01	-	3.10E+00	RP-JS-02-10-12_08122008(8/12/2008)	1.43E+00	–	2.80E+01	no	no	BSL
Uranium-235	2	/ 7	28.6	4.20E-02	-	1.80E-01	4.60E-02	-	5.70E-02	RP-JS-01-10-12_08122008(8/12/2008)	8.49E-02	–	3.00E-01	no	no	BSL
Uranium-238	7	/ 7	100	–	-	–	8.00E-01	-	3.20E+00	RP-JS-02-10-12_08122008(8/12/2008)	1.42E+00	–	1.40E+00	no	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] Refer to Table 5-3 for screening level selection.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Table 5-26
Summary of Exposure Point Concentrations (Chemicals) for Soil/Sediment:
Former CLEAR Plant, Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

COPC	CASRN	COPC? [a]	Exposure Point Concentrations [b]
		Shallow Soil/Sediment (0 to 0.5 ft bgs)	Shallow Soil/Sediment (0 to 0.5 ft bgs) (mg/kg)
Inorganics			
Antimony	7440-36-0	no	–
Arsenic	7440-38-2	**YES**	3.01E+01
Barium	7440-39-3	no	–
Beryllium	7440-41-7	no	–
Cadmium	7440-43-9	no	–
Chromium	7440-47-3	no	–
Cobalt	7440-48-4	no	–
Copper	7440-50-8	**YES**	1.23E+04
Lead	7439-92-1	**YES**	2.67E+02
Manganese	7439-96-5	no	–
Mercury	7487-94-7	no	–
Molybdenum	7439-98-7	no	–
Nickel	7440-02-0	no	–
Selenium	7782-49-2	no	–
Thallium	7440-28-0	no	–
Uranium	7440-61-1	no	–
Zinc	7440-66-6	no	–

Notes:
[a] Constituent of potential concern (COPC), as determined in Table 5-4.
[b] The exposure point concentrations (EPCs) are presented for compounds selected as COPCs. EPCs are the upper confidence limit on the mean concentration (UCL) and were calculated using ProUCL (5.0.00).

–: not applicable.
CASRN: Chemical Abstracts Service Registry Number.
ft bgs: feet below ground surface.
mg/kg: milligram(s) per kilogram.

Table 5-27
Summary of Exposure Point Concentrations (Radionuclides) for Soil/Sediment:
Former CLEAR Plant, Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	COPC? [a]	Exposure Point Concentrations [b]
	Shallow Soil/Sediment (0-0.5 ft bgs)	Shallow Soil/Sediment (0-0.5 ft bgs) (pCi/g)
Radionuclides		
Radium-226	**YES**	2.15E+00
Radium-228	**YES**	2.66E+00
Uranium-234	no	--
Uranium-235	**YES**	1.46E-01
Uranium-238	**YES**	2.57E+00

Notes:
[a] Constituent of potential concern (COPC), as determined in Table 5-5.
[b] The exposure point concentrations (EPCs) are presented for radionuclides selected as COPCs. EPCs are the upper confidence limit on the mean concentration (UCL) or the maximum concentration where data are insufficient to calculate a UCL (i.e., less than 8 samples or less than 5 detects). The UCLs were calculated using ProUCL (5.0.00). The UCL

--: not detected or not applicable.
ft bgs: feet below ground surface.
pCi/g: picoCurie(s) per gram.

Table 5-28
Summary of Exposure Point Concentrations (Chemicals) for Soil/Sediment:
Former CLEAR Plant, All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

COPC	CASRN	COPC? [a]		Exposure Point Concentrations [b]	
		Shallow Soil/Sediment (0 to 0.5 ft bgs)	Shallow and Deep Soil/Sediment (0 to 15 ft bgs)	Shallow Soil/Sediment (0 to 0.5 ft bgs) (mg/kg)	Shallow and Deep Soil/Sediment (0 to 15 ft bgs) (mg/kg)
Inorganics					
Antimony	7440-36-0	no	no	–	–
Arsenic	7440-38-2	**YES**	**YES**	1.19E+01	1.02E+01
Barium	7440-39-3	no	no	–	–
Beryllium	7440-41-7	no	no	–	–
Cadmium	7440-43-9	no	no	–	–
Chromium	7440-47-3	no	no	–	–
Cobalt	7440-48-4	no	no	–	–
Copper	7440-50-8	**YES**	**YES**	7.96E+03	6.50E+03
Lead	7439-92-1	**YES**	**YES**	2.58E+02	1.83E+02
Manganese	7439-96-5	no	no	–	–
Mercury	7487-94-7	no	no	–	–
Molybdenum	7439-98-7	no	no	–	–
Nickel	7440-02-0	no	no	–	–
Selenium	7782-49-2	no	no	–	–
Thallium	7440-28-0	no	no	–	–
Uranium	7440-61-1	no	no	–	–
Zinc	7440-66-6	no	no	–	–

Notes:
[a] Constituent of potential concern (COPC), as determined in Tables 5-8 and 5-12.
[b] The exposure point concentrations (EPCs) are presented for compounds selected as COPCs. EPCs are the upper confidence limit on the mean concentration (UCL) and were calculated using ProUCL (5.0.00).

–: not applicable.
CASRN: Chemical Abstracts Service Registry Number.
ft bgs: feet below ground surface.
mg/kg: milligram(s) per kilogram.

Table 5-29
Summary of Exposure Point Concentrations (Chemicals) for Soil/Sediment:
Former Esperanza Mill
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

COPC	CASRN	COPC? [a]		Exposure Point Concentrations [b]	
		Shallow Soil/Sediment (0 to 0.5 ft bgs)	Shallow and Deep Soil/Sediment (0 to 15 ft bgs)	Shallow Soil/Sediment (0 to 0.5 ft bgs) (mg/kg)	Shallow and Deep Soil/Sediment (0 to 15 ft bgs) (mg/kg)
Inorganics					
Antimony	7440-36-0	no	no	–	–
Arsenic	7440-38-2	**YES**	**YES**	1.93E+01	9.82E+00
Barium	7440-39-3	no	no	–	–
Beryllium	7440-41-7	no	no	–	–
Cadmium	7440-43-9	no	no	–	–
Chromium	7440-47-3	no	no	–	–
Chromium VI	18540-29-9	no	no	–	–
Cobalt	7440-48-4	no	no	–	–
Copper	7440-50-8	no	no	–	–
Lead	7439-92-1	no	**YES**	–	1.33E+02
Manganese	7439-96-5	no	no	–	–
Mercury	7487-94-7	no	no	–	–
Molybdenum	7439-98-7	**YES**	**YES**	1.85E+03	1.13E+03
Nickel	7440-02-0	no	no	–	–
Selenium	7782-49-2	no	no	–	–
Thallium	7440-28-0	no	no	–	–
Uranium	7440-61-1	no	no	–	–
Zinc	7440-66-6	no	no	–	–

Notes:
[a] Constituent of potential concern (COPC), as determined in Tables 5-14 and 5-18.
[b] The exposure point concentrations (EPCs) are presented for compounds selected as COPCs. EPCs are the upper confidence limit on the mean concentration (UCL) and were calculated using ProUCL (5.0.00).

–: not applicable.
CASRN: Chemical Abstracts Service Registry Number.
ft bgs: feet below ground surface.
mg/kg: milligram(s) per kilogram.

Table 5-30
Summary of Exposure Point Concentrations (Radionuclides):
All Exposure Areas
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	COPC? [a]						Exposure Point Concentrations [b]					
	Former CLEAR Plant, All Samples		Former Esperanza Mill		Former Rhenium Ponds		Former CLEAR Plant, All Samples		Former Esperanza Mill		Former Rhenium Ponds	
	Shallow Soil/Sediment (0-0.5 ft bgs)	Shallow and Deep Soil/Sediment (0-15 ft bgs)	Shallow Soil/Sediment (0-0.5 ft bgs)	Shallow and Deep Soil/Sediment (0-15 ft bgs)	Shallow Soil/Sediment (0-2 ft bgs)	Shallow and Deep Soil/Sediment (0-15 ft bgs)	Shallow Soil/Sediment, Exposed and Covered Samples (0-0.5 ft bgs) (pCi/g)	Shallow and Deep Soil/Sediment (0-15 ft bgs) (pCi/g)	Shallow Soil/Sediment (0-0.5 ft bgs) (pCi/g)	Shallow and Deep Soil/Sediment (0-15 ft bgs) (pCi/g)	Shallow Soil/Sediment (0-2 ft bgs) (pCi/g)	Shallow and Deep Soil/Sediment (0-15 ft bgs) (pCi/g)
Radionuclides												
Radium-226	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	2.17E+00	2.41E+00	2.60E+00	2.43E+00	2.60E+00 m	2.80E+00 m
Radium-228	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	2.63E+00	2.42E+00	2.18E+00	2.50E+00	1.70E+00 m	1.90E+00 m
Uranium-234	no	no	no	no	no	no	--	--	--	--	--	--
Uranium-235	**YES**	**YES**	no	**YES**	no	no	1.79E-01	1.53E-01	--	1.33E-01	--	--
Uranium-238	**YES**	**YES**	**YES**	**YES**	no	**YES**	3.17E+00	2.87E+00	2.10E+00	2.74E+00	--	3.20E+00 m

Notes:
[a] Constituent of potential concern (COPC), as determined in Tables 5-9, 5-13, 5-15, 5-19, 5-23, and 5-25.
[b] The exposure point concentrations (EPCs) are presented for radionuclides selected as COPCs. EPCs are the upper confidence limit on the mean concentration (UCL) or the maximum concentration where data are insufficient to calculate a UCL (i.e., less than 8 samples or less than 5 detects). The UCLs were calculated using ProUCL (5.0.00). The UCL used is the 95UCL recommended by ProUCL (5.0.00).

--: not detected or not applicable.
ft bgs: feet below ground surface.
m: maximum concentration.
pCi/g: picoCurie(s) per gram.

Table 6-1
Human Health Exposure Parameters
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Parameter	Symbol	Units	Commercial/Industrial Outdoor Worker – Adult						Adolescent Trespasser (6 to 16 years)		Construction Worker – Adult	
			EPA and Arizona Recommended Factors		Site-Specific Factors				EPA and Arizona Recommended		EPA and Arizona Recommended	
			All Exposure Areas		CLEAR Plant	Esperanza Mill	Rhenium Ponds		All Exposure Areas		All Exposure Areas	
General Factors												
Averaging Time (cancer)	ATc	days	28,470	[1]	28,470	28,470	28,470	[1]	28,470	[1]	28,470	[1]
Averaging Time (noncancer)	ATnc	days	9,125	[2]	9,125	9,125	9,125	[2]	3,650	[2]	365	[2]
Body Weight	BW	kg	80	[3]	80	80	80	[3]	44	[4]	80	[3]
Exposure Frequency	EF	days/year	225	[5]	225	225	12	[22]	52	[6]	250	[7]
Exposure Duration	ED	years	25	[8]	25	25	25	[8]	10	[6]	1	[9]
Inhalation												
Exposure Time	ET	hours/day	8	[10]	4	4	1	[22]	1	[6]	8	[10]
Exposure Time, indoor	ET_i	hours/day	0		0	0	0		0		0	
Exposure Time, outdoor	ET_o	hours/day	8	[10]	4	4	1	[22]	1	[6]	8	[10]
Conversion Factor	CF	day/hour	0.042		0.042	0.042	0.042		0.042		0.042	
Particulate Emission Factor	PEF	m^3/kg	1.396E +09	[11]	1.396E +09	1.396E +09	1.396E +09	[11]	1.396E +09	[11]	1.396E +09	[11]
Inhalation Rate	InhR	m^3/day	60	[12]	60	60	60	[12]	13.6	[13]	60	[12]
Age-Adjusted Inhalation Rate	$InhR_{adj}$	m^3/day	–		–	–	–		–		–	
Soil - Ingestion (Oral)												
Incidental Soil Ingestion Rate	IRs	mg/day	50	[14], [15]	50	50	50	[14], [15]	50	[14]	330	[16]
Age-Adjusted Soil Ingestion Rat	IR_{adj}	mg/day	–		–	–	–		–		–	
Soil - Dermal Contact												
Exposed Skin Surface Area	SA	cm^2	6,125	[17]	6,125	6,125	6,125	[17]	4,400	[18]	6,125	[17]
Soil-to-Skin Adherence Rate	SAR	$mg/cm^2/day$	0.15	[19]	0.15	0.15	0.15	[19]	0.07	[20]	0.19	[21]

Table 6-1
Human Health Exposure Parameters
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Notes:

[1] The averaging time for assessing cancer risk is the average expected lifespan of 78 years (Table 18-1, USEPA 2011) expressed in days.

[2] The averaging time for evaluating non-cancer health effects is the exposure duration expressed in days (e.g., 25 years x 365 days/year = 9,125 days) (USEPA 1989).

[3] Mean recommended body weight for adults (Table 8-1, USEPA 2011).

[4] Mean recommended body weight for adolescents, ages 6-16 (Table 8-1, USEPA 2011).

[5] Standard default occupational exposure frequency for an outdoor worker (ADHS 2003).

[6] Professional Judgment: Assumes trespassing occurs one day per week, for one hour at a time. Also assumes trespasser age is 6 to 16 years.

[7] Standard default occupational exposure frequency for a construction worker (ADHS 2003).

[8] Standard default occupational exposure duration for an outdoor worker (ADHS 2003; ADEQ 2002).

[9] Standard default occupational exposure duration for a construction worker (ADHS 2003).

[10] Professional Judgment: Based on a typical 8-hour workday.

[11] Standard default particulate emission factor (ADHS 2003; ADEQ 2002).

[12] Recommended default exposure parameter (USEPA 2015g).

[13] Based on an age-weighted average of mean inhalation rates for combined males and females, ages 6 to <16 (Table 6-1, USEPA 2011).

[14] Recommended central tendency soil and dust ingestion rate for an adult (Table 5-1, USEPA 2011). There is no upper percentile soil and dust ingestion rate for an adult available in Table 5-1 (USEPA, 2011).

[15] Standard default occupational soil ingestion rate (ADEQ 2002).

[16] Standard default occupational soil ingestion rate for a construction worker (ADHS 2003).

[17] Based on an age-weighted average of 95th percentile total skin surface areas for combined males and females, ages 18 to 60 (2.45 m^2 or 24,500 cm^2) (Table 7-9; USEPA 2011). The exposed skin surface area was assumed to be 25% of the total skin surface area (ADEQ, 2002); 24,500 cm^2 x 0.25 = 6,125 cm^2.

[18] Assumes that a receptor 6 to 16 years old is wearing a short-sleeved shirt, shorts, and shoes; therefore, the SA is the time-weighted average of the surface area for the hands, forearms, and lower legs (USEPA 2011).

[19] Average of recommended values for mean solids adherence to skin for adult hands (0.1595 mg/cm^2) and feet (0.1393 mg/cm^2), during "activities with soil" (Table 7-4, USEPA 2011).

[20] The soil-to-skin adherence factor for the adolescent trespasser is based on the geometric mean adherence factor for gardeners (USEPA 2004).

[21] Average of recommended values for mean solids adherence to skin for adult face (0.0982 mg/cm^2), arms (0.1859 mg/cm^2), and hands (0.2763 mg/cm^2) during "construction activities" (Table 7-4, USEPA 2011).

[22] Site-specific exposure parameters are based on typical outdoor worker activities and conditions at each of the three exposure areas.

References:

Arizona Department of Environmental Quality. 2002. Appendix P, Table 1: Standard Default Factors. UST Program Release Reporting and Corrective Action Guidance. Accessed online: http://www.azdeq.gov/environ/waste/ust/lust/rbca/appp.pdf

Arizona Department of Health Services. 2003. Table 1: Standard Default Factors. Deterministic Risk Assessment Guidance. ADHS Office of Environmental Health. Accessed online: http://www.azdhs.gov/phs/oeh/pdf/guidance.pdf

U.S. Environmental Protection Agency. 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). EPA/540/1-89/002. Office of Emergency and Remedial Response, USEPA, Washington, DC. (December)

U.S. Environmental Protection Agency. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. National Center for Environmental Assessment, Office of Research and Development, USEPA, Washington, DC. (September)

U.S. Environmental Protection Agency. 2015g. Preliminary Remediation Goals for Radionuclides, User's Guide. Accessed online: http://epa-prgs.ornl.gov/radionuclides/prg_guide.html.

ADEQ: Arizona Department of Environmental Quality.
ADHS: Arizona Department of Health Services.
cm^2: square centimeter(s).
kg: kilogram(s).
m^2: square meter(s).
m^3: cubic meter(s).
mg: milligram(s).
USEPA: United States Environmental Protection Agency.

Table 6-2
Dermal Absorption Parameters
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	ABSd [b] (Unitless)
Inorganics	
Arsenic	0.03
Cobalt	0
Copper	0
Lead	0

Notes:
[a] Only constituents of potential concern are presented.
[b] Dermal absorption efficiency for uptake of constituents from a soil matrix (unitless) (USEPA 2004).

ABSd: dermal absorption efficiency.

Table 7-1
Human Health Toxicity Values for Chemical COPCs
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	ABS_{GI} [b]	Oral RfD [c]				Dermal RfD [d]		Inhalation RfC [c]				Oral CSF [c]		Dermal CSF [d]	Inhalation Unit Risk [c]	
		Subchronic		Chronic		Subchronic	Chronic	Subchronic		Chronic						
		(mg/kg/day)	[ref]	(mg/kg/day)	[ref]	(mg/kg/day)	(mg/kg/day)	(mg/m^3)	[ref]	(mg/m^3)	[ref]	$(mg/kg/day)^{-1}$	[ref]	$(mg/kg/day)^{-1}$	$(mg/m^3)^{-1}$	[ref]
Inorganics																
Arsenic	1	3.0E-04	c	3.0E-04	I	3.0E-04	3.0E-04	1.5E-05	c	1.5E-05	C	1.5E+00	I	1.5E+00	4.3E+00	I
Copper	1	4.0E-02	c	4.0E-02	H	4.0E-02	4.0E-02	NA		NA		NA		NA	NA	
Lead [e]	1	NA		NA		NA	NA	NA		NA		NA		NA	NA	
Molybdenum	1	5.0E-03	H	5.0E-03	I	5.0E-03	5.0E-03	NA		NA		NA		NA	NA	

Notes:

[a] Only constituents of potential concern are presented.

[b] ABS_{GI} - Gastrointestinal absorption fraction (USEPA 2004).

[c] Toxicity values were selected from the following hierarchy of sources:
(1) USEPA Integrated Risk Information System (I) (USEPA 2015b).
(2) USEPA Provisional Peer Reviewed Toxicity Values (P) (USEPA 2015d).
(3) Agency for Toxic Substances and Disease Registry (A) (ATSDR 2014).
(4) USEPA Health Effects Summary Tables (H). (USEPA 2015e).
(5) California Environmental Protection Agency Toxicity Criteria Database (C). (CalEPA 2015).

[d] RfD (dermal) = RfD (oral) × ABS_{GI}.
CSF (dermal) = CSF (oral) / ABS_{GI}.

[e] The potential for adverse effects from exposure to lead is evaluated using USEPA lead models.

c: The chronic value is used if no subchronic value is available.
CSF: cancer slope factor.
mg/kg/day: milligram(s) per kilogram per day.
$(mg/kg/day)^{-1}$: inverse of milligram(s) per kilogram per day.
mg/m^3: milligram(s) per cubic meter.
$(mg/m^3)^{-1}$: inverse of milligram(s) per cubic meter.
NA: not available or applicable.
RfC: reference concentration.
RfD: reference dose.
USEPA: United States Environmental Protection Agency.

Table 7-2
Radionuclide Physical Constants and Carcinogenicity Slope Factors
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	Radioactive Half-Life [a]	Decay Constant (λ) [a]	Slope Factors [a]				ACFs [c]			GSFi [d]	GSFo [e]
			Soil Ingestion [b]	Adult Only Soil Ingestion [b]	Inhalation	External Exposure	CP	EM	RP		
	yr	yr^{-1}	risk/pCi	risk/pCi	risk/pCi	risk-yr/pCi-g					
Radionuclides											
Radium-226 +D [f]	1.60E+03	4.33E-04	6.77E-10	2.95E-10	2.82E-08	8.37E-06	1.0	1.0	0.82	0.4	1.0
Radium-228 +D [f]	5.75E+00	1.21E-01	1.98E-09	6.70E-10	4.37E-08	4.04E-06	1.0	1.0	0.84	0.4	1.0
Uranium-235 +D [f]	7.04E+08	9.84E-10	1.54E-10	5.00E-11	2.50E-08	5.76E-07	1.0	1.0	0.94	0.4	1.0
Uranium-238 +D [f]	4.47E+09	1.55E-10	1.97E-10	5.62E-11	2.37E-08	1.19E-07	1.0	1.0	0.94	0.4	1.0

Notes:

[a] Radioactive half-lives, decay constants and slope factors are from the USEPA Preliminary Remediation Goal (PRG) Summary Table (USEPA 2014c).

[b] "Adult Only Soil Ingestion" slope factors are used to evaluate worker and trespasser exposures. "Soil Ingestion" slope factors are lifetime values and are appropriate for evaluating residential exposure.

[c] Isotope-specific ACFs for source area size from Appendix B of Bellamy et al. 2014 (http://epa-prgs.ornl.gov/radionuclides/ACF_FINAL_APPENDIX.pdf), based on the following calculated exposure areas:
Former CLEAR Plant Area: 226,499 m^2 (ground plane, infinite source area)
Former Esperanza Mill Area: 521,523 m^2 (ground plane, infinite source area)
Former Rhenium Ponds Area: 9,745 m^2 (ground plane, 10,000 m^2 source area)

[d] Gamma shielding factor for indoor exposure (USEPA 2000).

[e] Assumes no gamma shielding when individual is outdoors.

[f] Slope factors account for contributions to risks from ingrowth of the following short-lived radioactive decay products (radioactive half-lives less than or equal to 6 months), with a decay chain extending to, but not including, the next principal or stable radionuclide out to 100 years (+D). This method assumes secular equilibrium (equal activity concentrations) with the parent radionuclide in the environment in the absence of empirical data.
"+" indicates branches in the decay chain.
Ra-226: Rn-222, Po-218, Pb-214+At-218, Bi-214, Po-214+Tl-210
Ra-228: Ac-228
U-235: Th-231
U-238: Th234, Pa-234m+Pa234

ACF: Area correction factor.
CP: Former CLEAR Plant Area.
EM: Former Esperanza Mill Area.
risk/pCi: Risk per picoCurie.
GSFi: Gamma shielding factor, indoor.
GSFo: Gamma shielding factor, outdoor.
risk-yr/pCi-g: Risk per year per picoCurie per gram soil.
RP: Former Rhenium Ponds Area.
yr: year

Table 9-1
Summary of Calculated Excess Lifetime Cancer Risks and Noncancer Hazard Indices:
Former CLEAR Plant Exposure Area
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Human Receptors	Exposure Type (Table Reference)	TOTAL EXCESS LIFETIME CANCER RISK: Direct Contact with Shallow Soil/Sediment (0 to 0.5 ft bgs)	TOTAL EXCESS LIFETIME CANCER RISK: Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)	NONCANCER HAZARD INDEX: Direct Contact with Shallow Soil/Sediment (0 to 0.5 ft bgs)	NONCANCER HAZARD INDEX: Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Former CLEAR Plant Exposure Area					
Current/Future Scenario					
RME Outdoor Commercial/Industrial Worker - Exposed Samples Only	Chemical (Table C-1)	5E-06		0.2	
	Radiological (Table D-1)	1E-04		–	
	Receptor Total	1E-04		0.2	
Site-Specific Outdoor Commercial/Industrial Worker - Exposed Samples Only	Chemical (Table C-2)	5E-06		0.2	
	Radiological (Table D-2)	6E-05		–	
	Receptor Total	7E-05		0.2	
Hypothetical Future Scenario					
RME Outdoor Commercial/Industrial Worker - All Samples	Chemical (Tables C-4 and C-7)	2E-06	2E-06	0.09	0.08
	Radiological (Tables D-4 and D-7)	1E-04	1E-04	–	–
	Receptor Total	1E-04	1E-04	0.09	0.08
Site-Specific Outdoor Commercial/Industrial Worker - All Samples	Chemical (Tables C-5 and C-8)	2E-06	2E-06	0.09	0.08
	Radiological (Tables D-5 and D-8)	6E-05	6E-05	–	–
	Receptor Total	6E-05	6E-05	0.09	0.08
Hypothetical Construction Worker	Chemical (Table C-10)		3E-07		0.5
	Radiological (Table D-10)		7E-06		–
	Receptor Total		7E-06		0.5
Hypothetical Adolescent Trespasser	Chemical (Tables C-6 and C-9)	2E-07	2E-07	0.04	0.03
	Radiological (Tables D-6 and D-9)	2E-06	2E-06	–	–
	Receptor Total	2E-06	2E-06	0.04	0.03

Notes:
The current/future scenario evaluated for the Former CLEAR Plant Exposure Area is based on shallow soil and sediment data from the sample locations that are currently exposed at the surface.
The hypothetical future scenarios evaluated for the Former CLEAR Plant Exposure Area are based on soil and sediment data from sample locations that are currently exposed at the surface and from sample locations that are currently covered (i.e., paved or developed) at the surface. This assumes that the currently covered soils will become exposed in the future.

– : not applicable.
ft bgs: feet below ground surface.

Table 9-2
Summary of Calculated Excess Lifetime Cancer Risks and Noncancer Hazard Indices:
Former Esperanza Mill Exposure Area
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

		TOTAL EXCESS LIFETIME CANCER RISK		NONCANCER HAZARD INDEX	
		Direct Contact with Shallow Soil/Sediment	Direct Contact with Shallow and Deep Soil/Sediment	Direct Contact with Shallow Soil/Sediment	Direct Contact with Shallow and Deep Soil/Sediment
Human Receptors	**Exposure Type (Table Reference)**	**(0 to 0.5 ft bgs)**	**(0 to 15 ft bgs)**	**(0 to 0.5 ft bgs)**	**(0 to 15 ft bgs)**
Former Esperanza Mill Exposure Area					
Current Scenario					
RME Outdoor Commercial/Industrial Worker	Chemical (Table C-11)	3E-06		0.2	
	Radiological (Table D-11)	1E-04		–	
	Receptor Total	1E-04		0.2	
Site-Specific Outdoor Commercial/Industrial Worker	Chemical (Table C-12)	3E-06		0.2	
	Radiological (Table D-12)	6E-05		–	
	Receptor Total	6E-05		0.2	
Future Scenario					
RME Outdoor Commercial/Industrial Worker	Chemical (Tables C-11 and C-14)	3E-06	2E-06	0.2	0.1
	Radiological (Tables D-11 and D-14)	1E-04	1E-04	–	–
	Receptor Total	1E-04	1E-04	0.2	0.1
Site-Specific Outdoor Commercial/Industrial Worker	Chemical (Tables C-12 and C-15)	3E-06	2E-06	0.2	0.1
	Radiological (Tables D-12 and D-15)	6E-05	6E-05	–	–
	Receptor Total	6E-05	6E-05	0.2	0.1
Hypothetical Construction Worker	Chemical (Table C-17)		3E-07		0.7
	Radiological (Table D-17)		7E-06		–
	Receptor Total		7E-06		0.7
Hypothetical Adolescent Trespasser	Chemical (Tables C-13 and C-16)	4E-07	2E-07	0.07	0.04
	Radiological (Tables D-13 and D-16)	2E-06	2E-06	–	–
	Receptor Total	2E-06	2E-06	0.07	0.04

Notes:
– : not applicable.
ft bgs: feet below ground surface.

Table 9-3
Summary of Calculated Excess Lifetime Cancer Risks and Noncancer Hazard Indices:
Former Rhenium Ponds Exposure Area
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Human Receptors	Exposure Type (Table Reference)	TOTAL EXCESS LIFETIME CANCER RISK: Direct Contact with Shallow Soil/Sediment (0 to 2 ft bgs)	TOTAL EXCESS LIFETIME CANCER RISK: Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)	NONCANCER HAZARD INDEX: Direct Contact with Shallow Soil/Sediment (0 to 2 ft bgs)	NONCANCER HAZARD INDEX: Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Former Rhenium Ponds Exposure Area					
Current Scenario					
RME Outdoor Commercial/Industrial Worker	Chemical	No COPCs		No COPCs	
	Radiological (Table D-18)	1E-04		–	
	Receptor Total	1E-04		–	
Site-Specific Outdoor Commercial/Industrial Worker	Chemical	No COPCs		No COPCs	
	Radiological (Table D-19)	7E-07		–	
	Receptor Total	7E-07		–	
Future Scenario					
RME Outdoor Commercial/Industrial Worker	Chemical	No COPCs	No COPCs	No COPCs	No COPCs
	Radiological (Tables D-18 and D-21)	1E-04	1E-04	–	–
	Receptor Total	1E-04	1E-04	–	–
Site-Specific Outdoor Commercial/Industrial Worker	Chemical	No COPCs	No COPCs	No COPCs	No COPCs
	Radiological (Tables D-19 and D-22)	7E-07	8E-07	–	–
	Receptor Total	7E-07	8E-07	–	–
Hypothetical Construction Worker	Chemical		No COPCs		No COPCs
	Radiological (Table D-24)		6E-06		–
	Receptor Total		6E-06		–
Hypothetical Adolescent Trespasser	Chemical	No COPCs	No COPCs	No COPCs	No COPCs
	Radiological (Tables D-20 and D-23)	1E-06	1E-06	–	–
	Receptor Total	1E-06	1E-06	–	–

Notes:
– : not applicable.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.

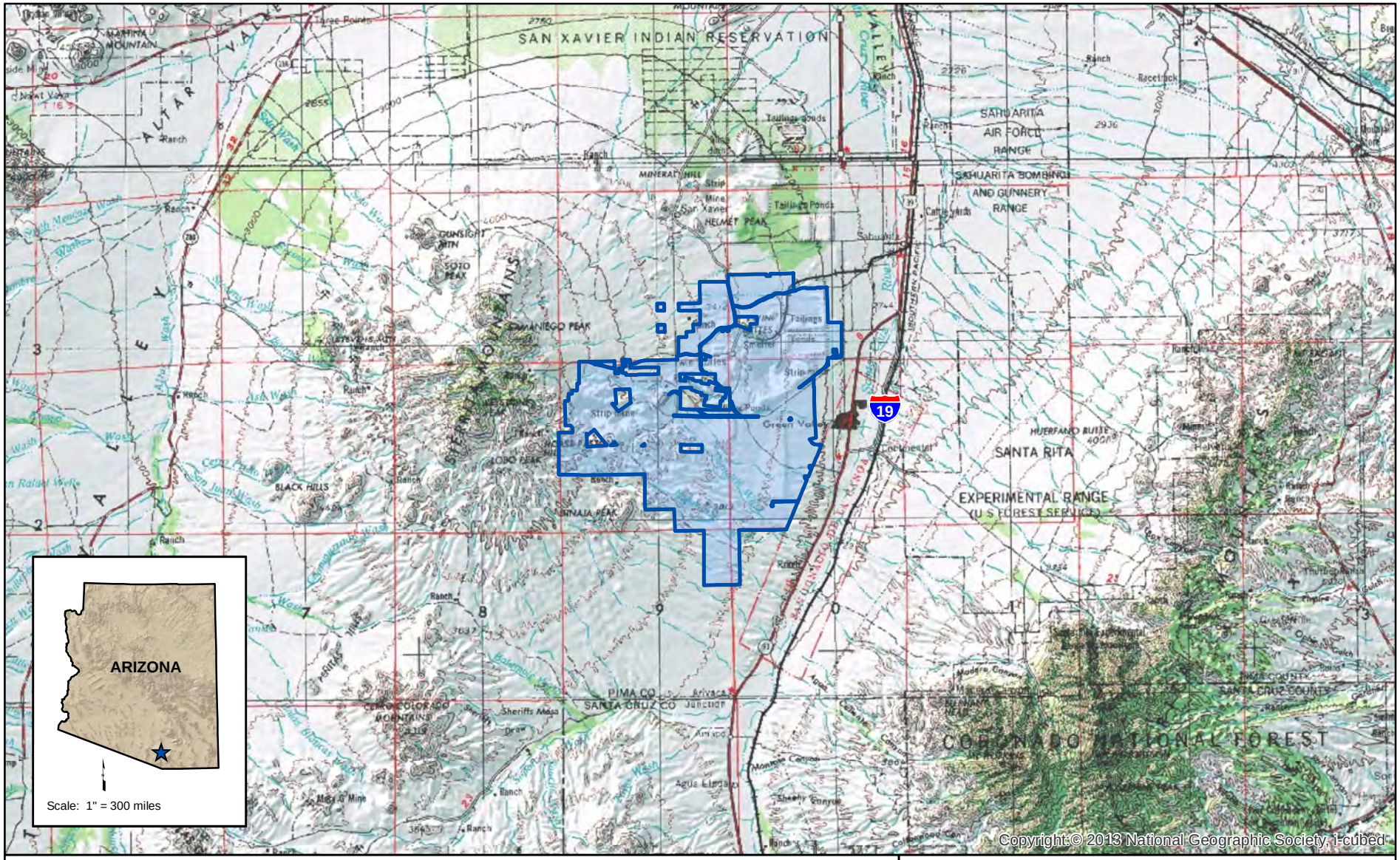
Table 9-4
Rock Core and Alluvial Sediments Radiochemistry Results
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita Inc.
Sierrita Mine, Green Valley, Arizona

Unit	Ruby Star Granodiorite			Tinaja Peak Formation			Harris Ranch Quartz Monzonite		
Analyte	Mean	Median	Range	Mean	Median	Range	Mean	Median	Range
Radium-226	2.91	2.75	1.4-5.8	1.53	1.6	1.1-1.8	3.34	2.35	1.4-11
Radium-228	2.04	2	1.2-2.9	3.00	2.85	1.8-4.5	2.27	2.25	1.5-2.8
Uranium-235	0.14	0.12	0.05-0.3	0.06	0.05	0.04-0.08	0.14	0.0925	0.05-0.6
Uranium-238	2.68	2.3	1.6-6.7	1.37	1.5	0.9-1.6	2.79	1.85	1.3-10

Unit	Former CLEAR Plant			Esperanza Mill			Rhenium Ponds		
Analyte	Mean	Median	Range	Mean	Median	Range	Mean	Median	Range
Radium-226	2.20	2.1	0.4-5.3	2.24	2.05	0.5-5.8	2.21	2.5	1.5-2.8
Radium-228	2.26	2.1	1.2-7.6	2.30	2.1	1-8.9	1.50	1.6	0.8-1.9
Uranium-235	0.15	0.12	0.02-0.7	0.13	0.11	0.04-0.6	0.08	0.075	0.04-0.2
Uranium-238	2.59	2.2	0.8-12	2.47	2.05	0.9-12	1.42	1.2	0.8-3.2

Results presented in picoCuries per gram (pCi/g).

FIGURES



LEGEND

Approximate property boundary

NOTES

· Topographic map source: ESRI USA Topo Maps.

N

0 2.5 5 Miles

Scale: 1" = 5 mi

FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

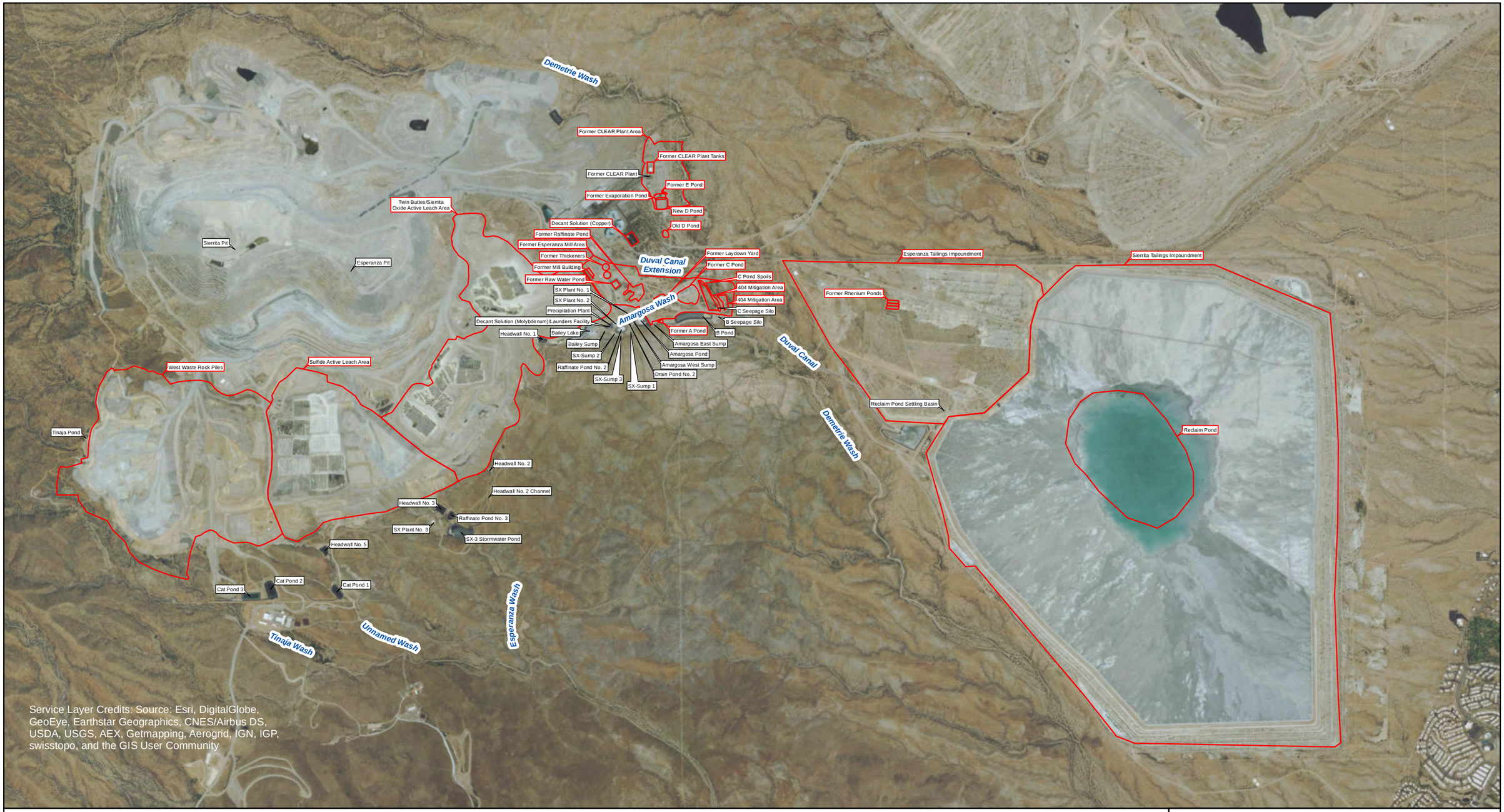
BASELINE HUMAN HEALTH RISK ASSESSMENT

SITE LOCATION MAP

ARCADIS

FIGURE
1-1

Document Path: W:\ArcGisData\GISPROJECTS_ENV\Sierrita\GIS\ArcMap_MXD\2015\BHHRA\Fig 1-1 SiteLocationMap.mxd



Document Path: W:\GISPROJECTS_ENV\Sierrita\GIS\ArcMap_MXD\2015\BHHRA\Fig 2-1 SiteFeaturesMap.mxd

LEGEND

SITE FEATURE

N

0 1,500 3,000 Feet

Scale: 1" = 3,000'

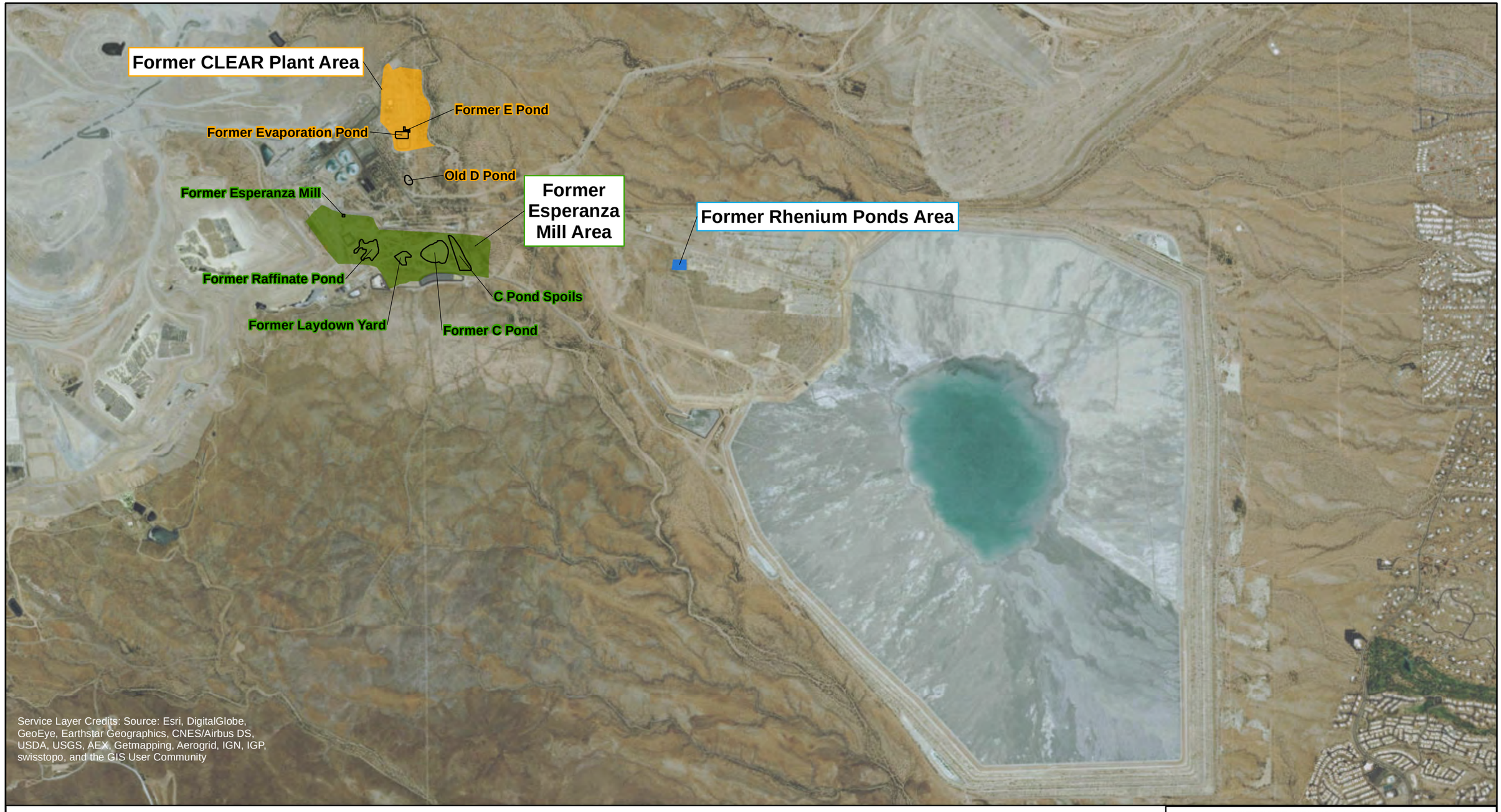
FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

BASELINE HUMAN HEALTH RISK ASSESSMENT

SITE FEATURES MAP

ARCADIS

FIGURE
2-1



Path: W:\ArcGisData\GISPROJECTS_ENVSierrita\GIS\ArcMap_MXD\2015\BHHRA\Fig 5-1 ExposureAreasEval.mxd Date Saved: 9/25/2015 8:41:00 AM Author: J.Chen @ Boulder, CO

LEGEND

- FOOTPRINT* OF FORMER CLEAR PLANT AREA
- FOOTPRINT* OF FORMER ESPERANZA MILL AREA
- FOOTPRINT* OF FORMER RHENIUM PONDS AREA

* These footprints of former site features are according to the Final Voluntary Remediation Program - Soil and Sediment Characterization Report, URS Corporation, March 2011, Freeport-McMoran Sierrita Inc.

N

0 1,250 2,500 Feet

Scale: 1 inch = 2500 feet

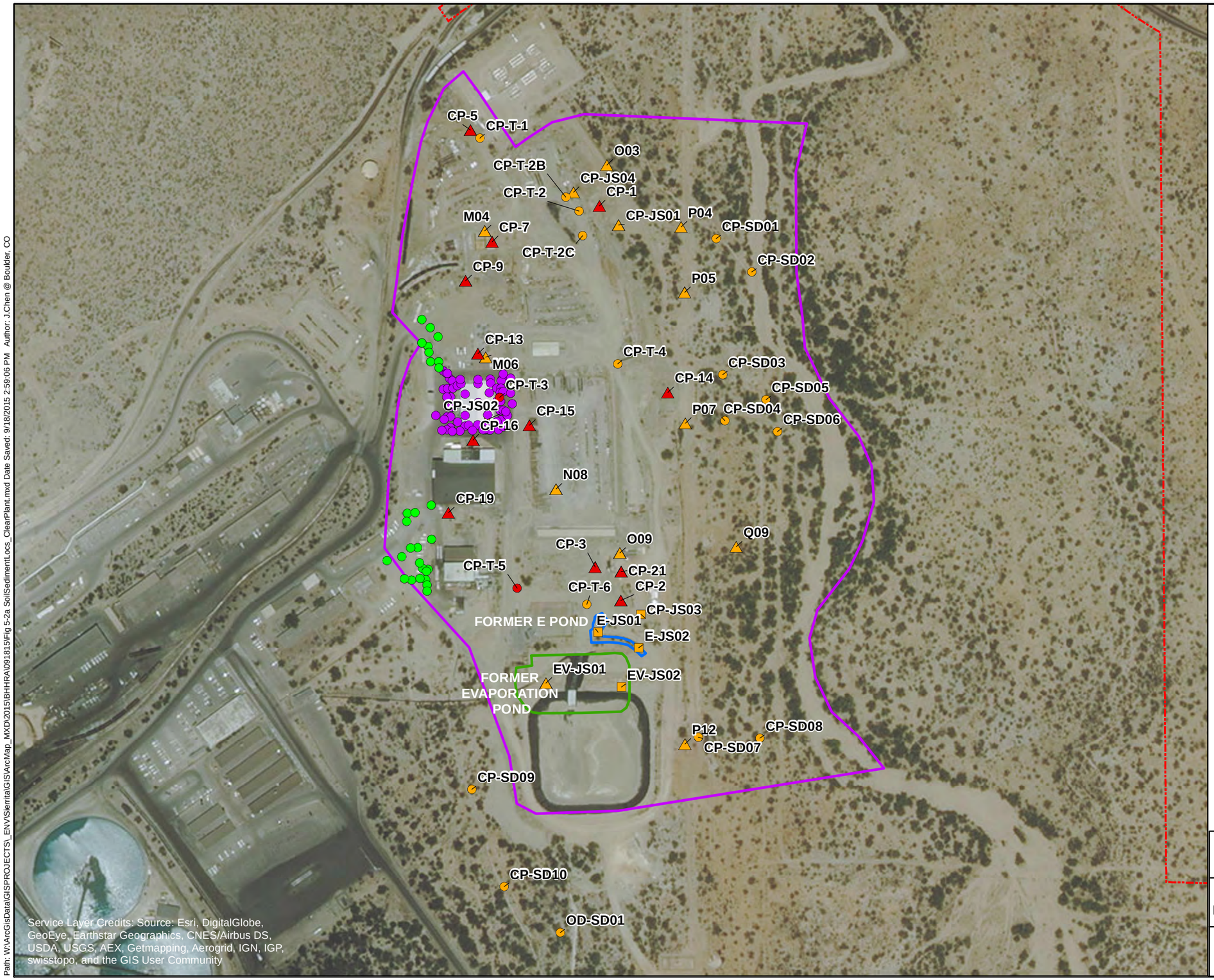
FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

BASELINE HUMAN HEALTH RISK ASSESSMENT

EXPOSURE AREAS EVALUATED IN THE BASELINE HUMAN HEALTH RISK ASSESSMENT

ARCADIS

FIGURE
5-1



LEGEND

- SURFACE SOIL SAMPLE (2004/2008)
- TRENCH LOCATION (2004/2008)
- JUDGMENTAL SAMPLING LOCATION (2004/2008)
- GRID SAMPLING LOCATION (2004/2008)
- SEDIMENT SAMPLING LOCATION (2004/2008)
- SOIL SAMPLING LOCATION (2012)
- PAVING SAMPLING LOCATION (2015)
- FORMER CLEAR PLANT AREA
- FORMER EVAPORATION POND
- FORMER E POND

N

0 150 300 600 Feet

FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

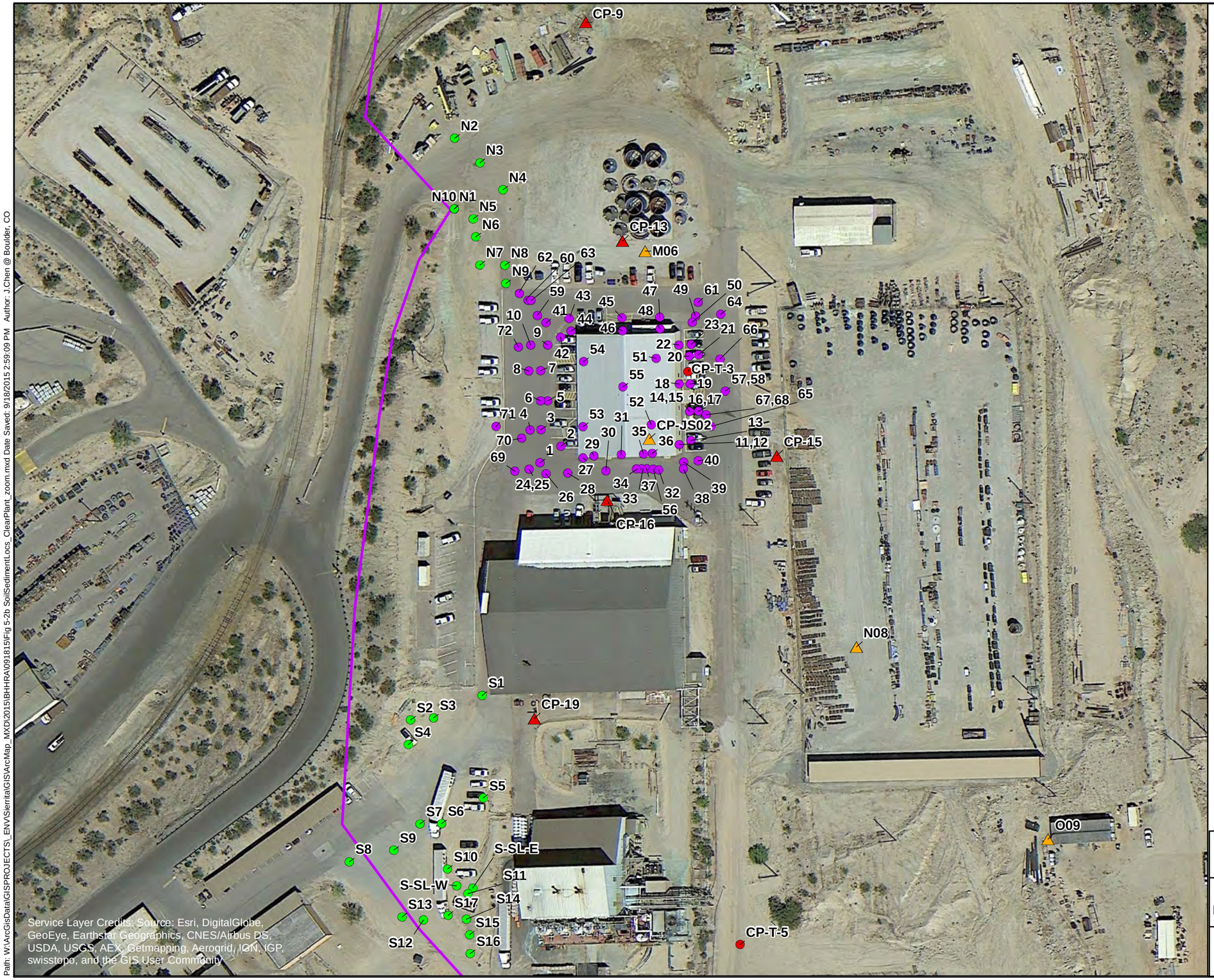
BASELINE HUMAN HEALTH RISK ASSESSMENT

SOIL AND SEDIMENT SAMPLE LOCATIONS IN THE FORMER CLEAR PLANT EXPOSURE AREA

ARCADIS

FIGURE
5-2a

Path: W:\ArcGis\Data\GIS\PROJECTS_ENV\SierritaGIS\ArcMap_MXD\2015\BHHRA\0918151\Fig 5-2a SoilSedimentLocs_ClearPlant.mxd Date Saved: 9/18/2015 2:59:06 PM Author: J.Chen @ Boulder, CO



LEGEND

- SURFACE SOIL SAMPLE (2004/2008)
- TRENCH LOCATION (2004/2008)
- GRID SAMPLING LOCATION (2004/2008)
- SOIL SAMPLING LOCATION (2012)
- PAVING SAMPLING LOCATION (2015)
- FORMER CLEAR PLANT AREA

N

0 50 100 200 Feet

FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

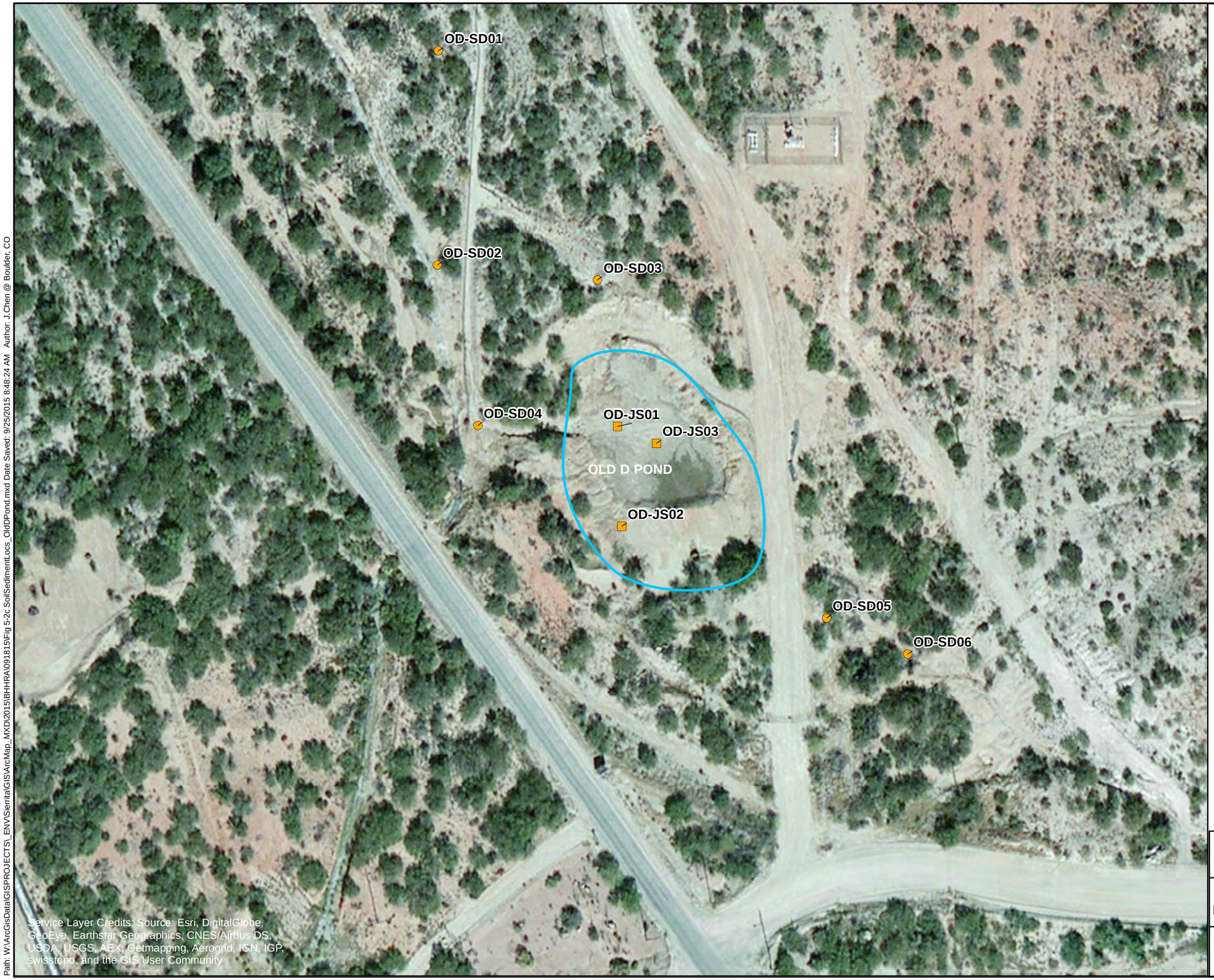
BASELINE HUMAN HEALTH RISK ASSESSMENT

SOIL AND SEDIMENT SAMPLE LOCATIONS IN THE FORMER CLEAR PLANT EXPOSURE AREA

ARCADIS

FIGURE
5-2b

Path: W:\ArcGisData\GISPROJECTS_ENV\Sierrita\GIS\ArcMap_MXD\2015\BHHRA\091815\Fig 5-2b SoilSedimentLocs_ClearPlant_zoom.mxd Date Saved: 9/18/2015 2:59:09 PM Author: J.Chen @ Boulder, CO



LEGEND

- JUDGMENTAL SAMPLING LOCATION (2004/2008)
- SEDIMENT SAMPLING LOCATION (2004/2008)
- OLD D POND

N

0 50 100 200 Feet

FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

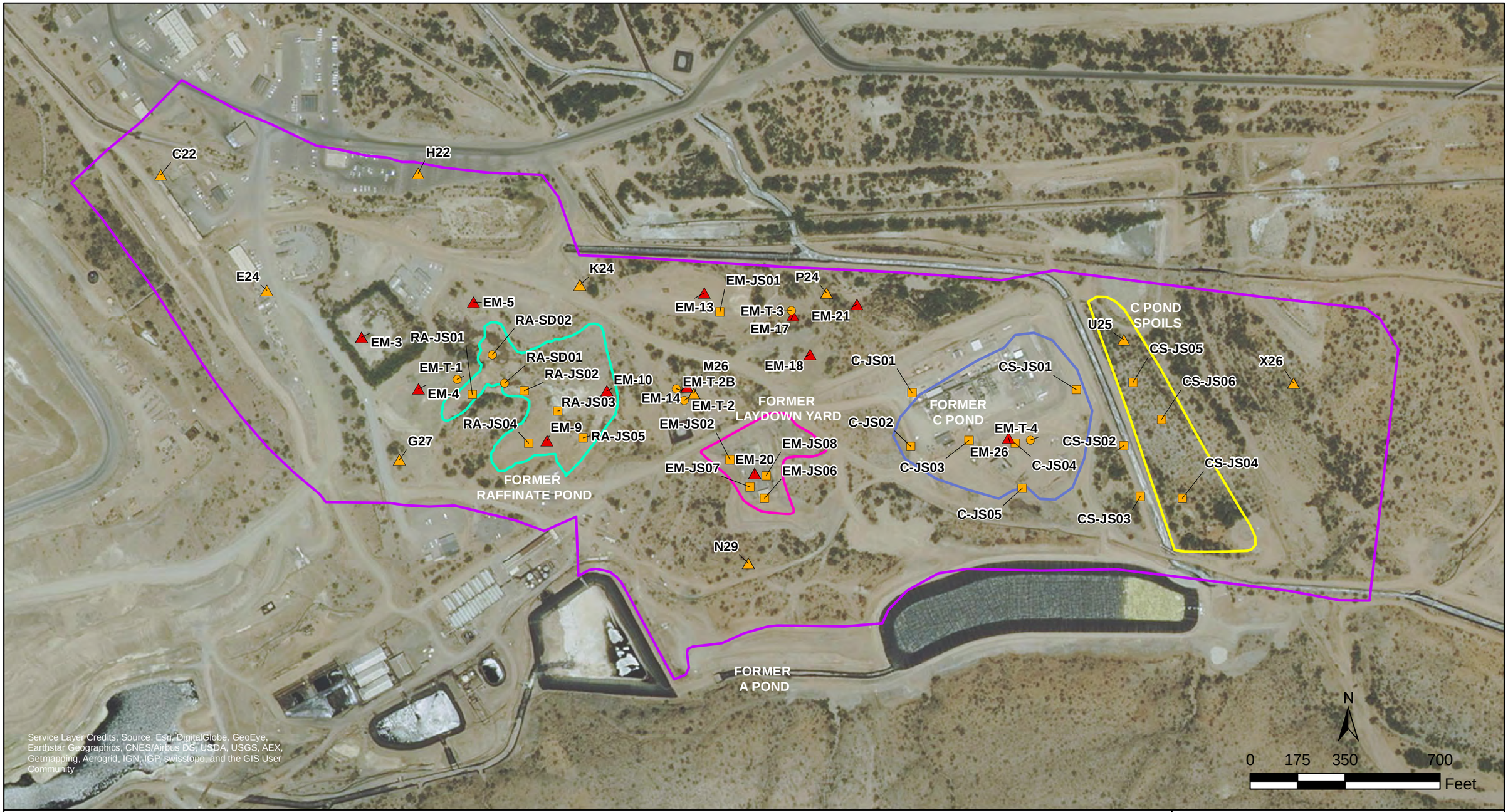
BASELINE HUMAN HEALTH RISK ASSESSMENT

SOIL AND SEDIMENT SAMPLE LOCATIONS IN THE FORMER CLEAR PLANT EXPOSURE AREA

ARCADIS

FIGURE
5-2c

Path: W:\ArcGisData\GISPROJECTS_ENV\Sierrita\GIS\ArcMap_MXD\2015\BHHRA\091815\Fig 5-2c SoilSedimentLocs_OldDPond.mxd Date Saved: 9/25/2015 8:48:24 AM Author: J.Chen @ Boulder, CO



LEGEND

- SURFACE SOIL SAMPLE (2004/2008)
- JUDGMENTAL SAMPLING LOCATION (2004/2008)
- GRID SAMPLING LOCATION (2004/2008)
- SEDIMENT SAMPLING LOCATION (2004/2008)
- C POND SPOILS
- FORMER C POND
- FORMER ESPERANZA MILL AREA
- FORMER LAYDOWN YARD
- FORMER RAFFINATE POND

FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

BASELINE HUMAN HEALTH RISK ASSESSMENT

SOIL AND SEDIMENT SAMPLE LOCATIONS IN THE FORMER ESPERANZA MILL EXPOSURE AREA

ARCADIS

FIGURE
5-3

CITY:(DEN-TECH) DIV/GROUP:(ENV/GIS) DB: BGRIFFITH LD: PIC: PM: TM:
PROJECT: PATH: W:\ArcGisData\GISPROJECTS_ENVSierritaGIS\ArcMap_MXD\2015\BHHRA\091815\Fig 5-3 SoilSedimentLocs_FormerEsperanzaMill.mxd

RP-JS01

FORMER
RHENIUM
PONDS

RP-JS02

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

LEGEND

- JUDGMENTAL SAMPLING LOCATION (2004/2008)
- FORMER RHENIUM PONDS AREA

N

0 50 100 200

Feet

FREEPORT-MCMORAN SIERRITA INC.
GREEN VALLEY, ARIZONA

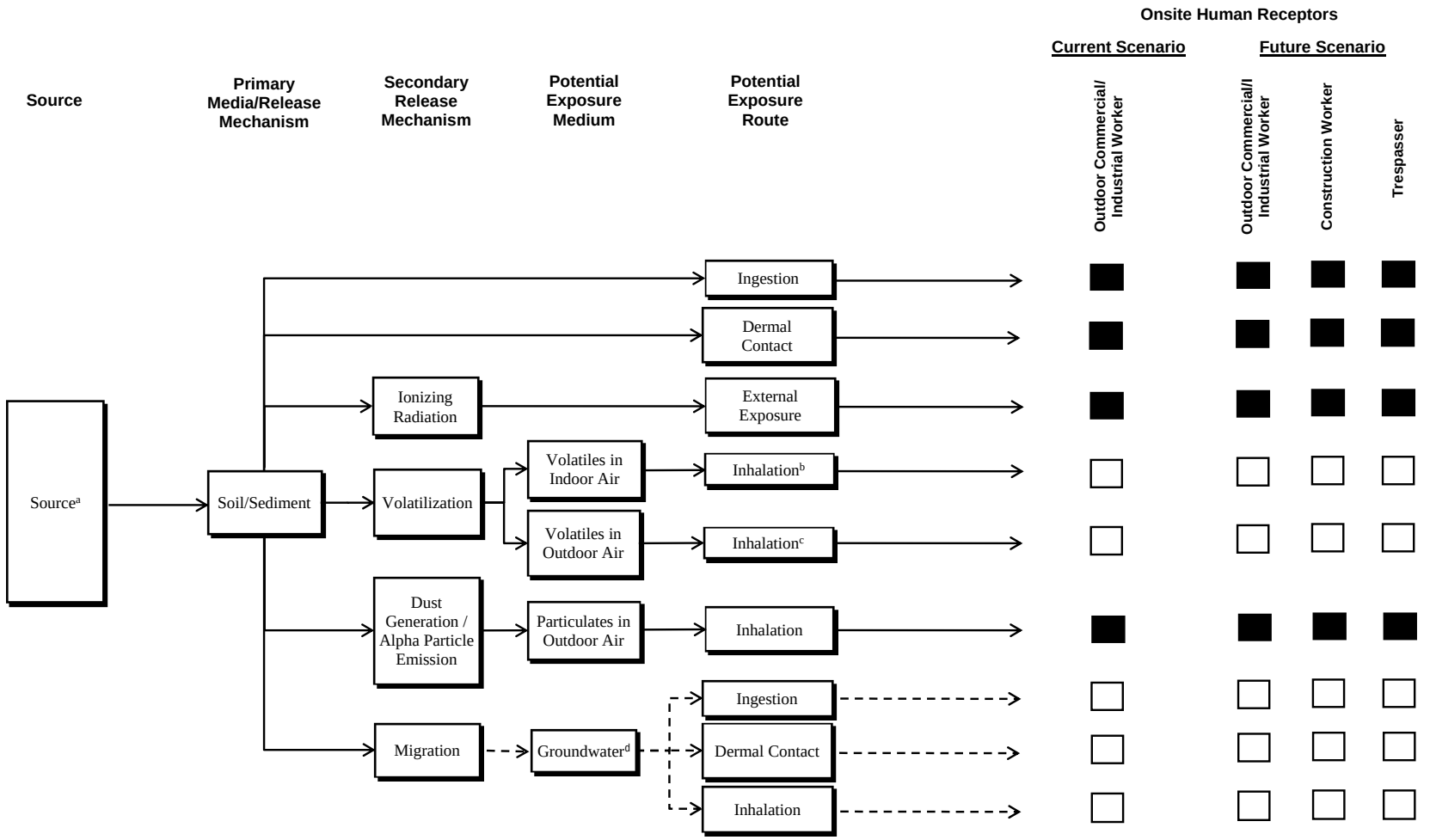
BASELINE HUMAN HEALTH RISK ASSESSMENT

SOIL AND SEDIMENT SAMPLE LOCATIONS IN THE FORMER RHENIUM PONDS EXPOSURE AREA

ARCADIS

FIGURE
5-4

CITY:(DEN-TECH) DIV/GROUP:(ENV/GIS) DB: BGRIFFITH LD: PIC: PM: TM:
PROJECT: PATH: W:\ArcGIs\Data\GISPROJECTS_ENV\Sierrita\GIS\ArcMap_MXD\2015\BHHRA\091815\Fig 5-4 SoilSedimentLocs_FormerRheniumPonds.mxd



Notes:

a. Source is related to current and historical activities including: a) excavation; b) hauling and dumping of overburden; c) historic processes to refine ore; d) storage of reagents and other solutions; d) accidental spills.

b. This exposure pathway is incomplete for metals, which are not volatile. Radionuclides were identified as constituents of potential concern, and the potential for radon gas generation was considered. However, the radium 226 (Ra-226) exposure point concentrations (EPCs) used in this risk assessment are considerably lower than the 5 pCi/g cleanup criterion established by the United States Environmental Protection Agency (USEPA) for surface soil at sites with residual radioactive contamination (40 CFR Part 192). The USEPA criterion was intended to limit gamma radiation exposure and to limit the risk from inhalation of radon decay products in houses built on land containing radioactive tailings. Based on these considerations, the indoor air pathway is considered incomplete.

c. This exposure pathway is incomplete for metals, which are not volatile. The potential for outdoor inhalation exposure to radon is negligible, considering mixing with ambient air would occur. In addition, the Ra-226 EPCs used in this risk assessment are considerably lower than the 5 pCi/g cleanup criterion established by the USEPA for surface soil at sites with residual radioactive contamination. Based on these considerations, the outdoor air pathway is considered incomplete.

d. Groundwater is not used at the facility nor does it discharge to the surface at any of the three exposure areas. For this reason, it is not an exposure medium for this risk assessment.

Explanation:

- - → Transport pathway incomplete; → Transport pathway complete

☐ Exposure pathway is incomplete.

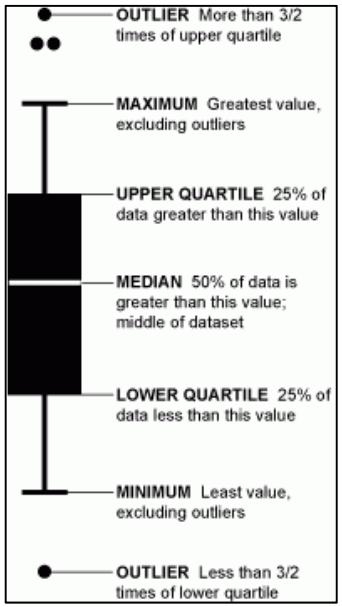
■ Exposure pathway is complete or potentially complete and is quantitatively evaluated in the risk assessment.

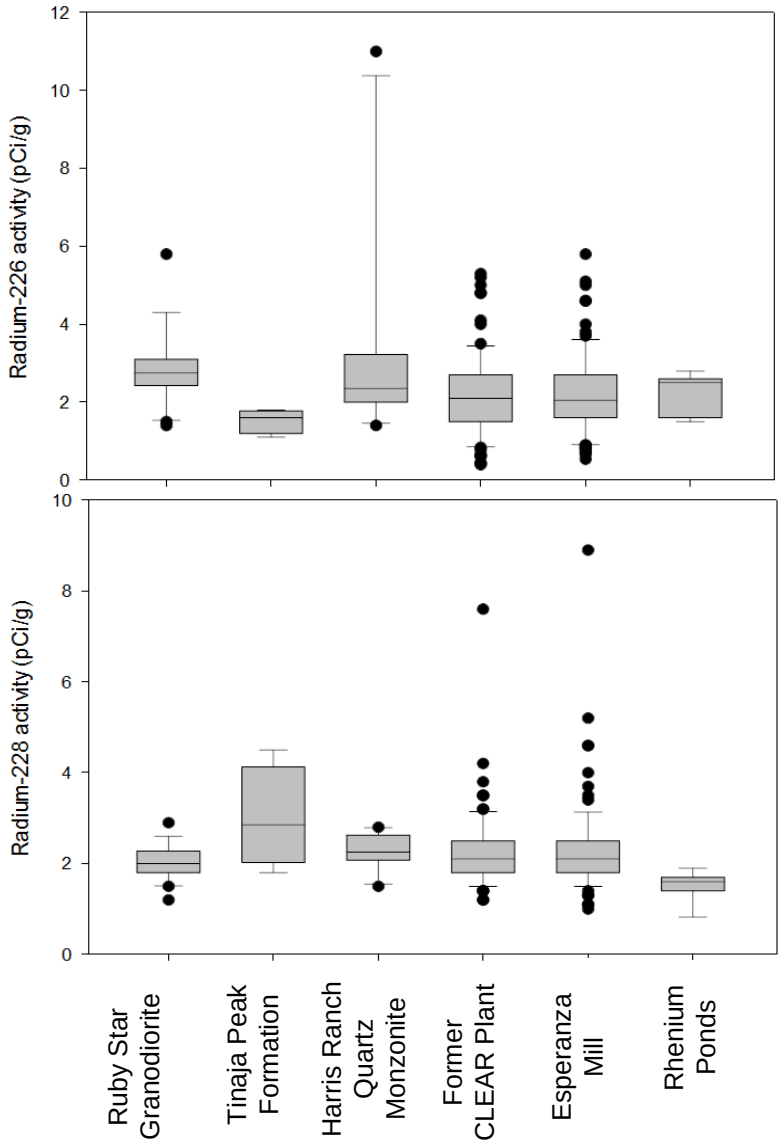
BASELINE HUMAN HEALTH RISK ASSESSMENT
FREEPORT-MCMORAN SIERRITA
SIERRITA MINE, GREEN VALLEY, ARIZONA

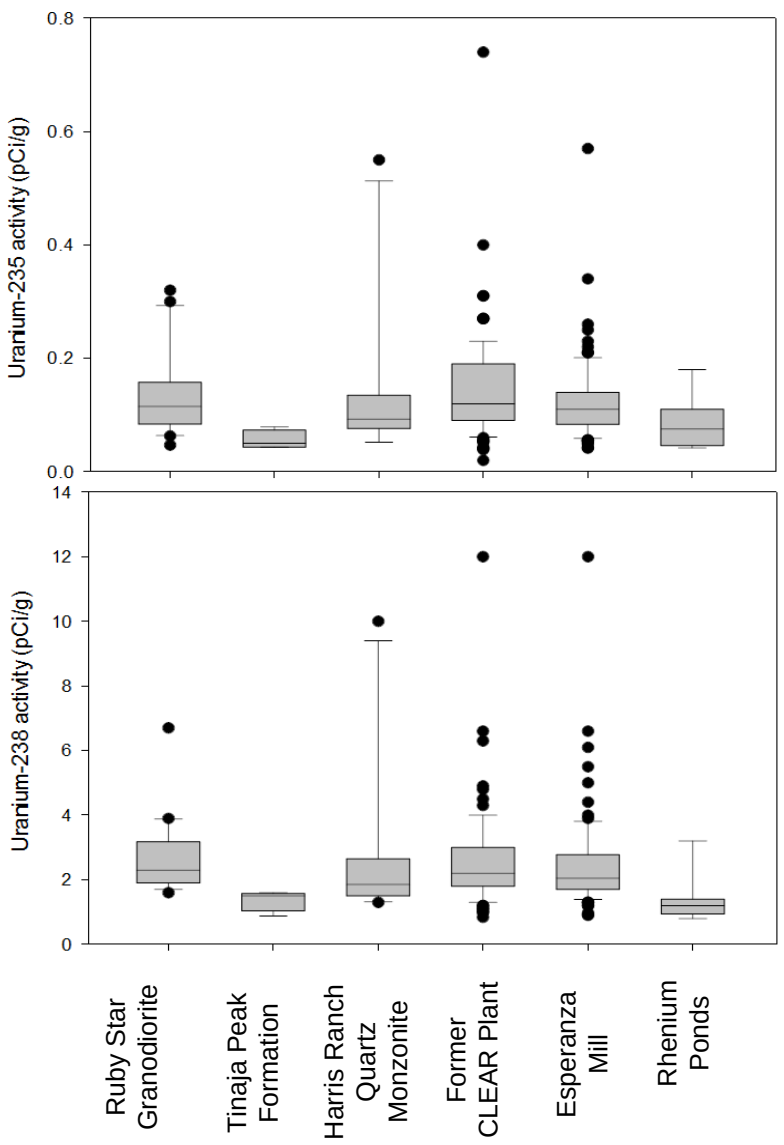
HUMAN HEALTH CONCEPTUAL SITE MODEL

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6-1







Notes:

1. pCi/g = picoCuries per gram

Freeport-McMoRan Sierrita Inc.
Green Valley, Arizona

BASELINE HUMAN HEALTH RISK ASSESSMENT

Rock Core and Alluvial Sediments Radiochemistry Results

ARCADIS Design & Consultancy for natural and built assets

FIGURE
9-1

APPENDIX A

Soil and Sediment Data Used to Conduct the Baseline Human Health Risk Assessment

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-01		CP-02		CP-03		CP-05		CP-07		CP-09		CP-13		CP-14		CP-15	
		Sample ID	CP-1 081304		CP-2 081304		CP-3 081304		CP-5 081304		CP-7 081304		CP-9 081304		CP-13 081304		CP-14 081304		CP-15 081304	
		Sample Date	8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004	
		Sample Depth (feet bgs)	0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	52		66		4.5		2.0		4.5		10.3		0.6		0.3		1.9	
Arsenic	7440-38-2	mg/kg	105		166		16.30		17.10		31.30		40.10		5.44		4.63		13.70	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	0.38		0.11		0.27		0.58		0.52		0.51		1.08		0.44		0.51	
Cadmium	7440-43-9	mg/kg	3		4		3.23		4.5		5.01		24.9		0.48		1.01		7.38	
Chromium	7440-47-3	mg/kg	42		35		21		58		9		20		12		6		22	
Cobalt	7440-48-4	mg/kg	76		40		37		20		NA		20		NA		NA		NA	
Copper	7440-50-8	mg/kg	45600		9020		21700		6220		20000		59300		1090		2080		8260	
Lead	7439-92-1	mg/kg	638		1820		51.70		141		152		200		15.4		12.70		116	
Manganese	7439-96-5	mg/kg	156		71		317		332		295		587		177		464		335	
Mercury	7439-97-6	mg/kg	< 0.04	U	0.62		0.07		0.12		0.32		0.18		< 0.05	U	< 0.04	U	0.11	
Molybdenum	7439-98-7	mg/kg	1440		3020		1900		522		2820		2290		273		369		456	
Nickel	7440-02-0	mg/kg	38		17		26		64		7		23		7		8		14	
Selenium	7782-49-2	mg/kg	40		50		13.4		4		10.3		16.1		0.7		0.9		3.2	
Thallium	7440-28-0	mg/kg	0.7		5.2		0.35		0.46		0.23		0.23		0.31		0.23		0.17	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	34		300		143		793		451		6210		76		118		730	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-16		CP-19		CP-21		CPB-S-02		CPB-S-03		CPB-S-04		CPB-S-05		CPB-S-06		CPF-AE-D2-06	
		Sample ID	CP-16 081304		CP-19 081304		CP-21 081304		CPB-S-02_20120511		CPB-S-03_20120511		CPB-S-04_20120511		CPB-S-05_20120511		CPB-S-06_20120511		CPF-AE-D2-06_20120511	
		Sample Date	8/13/2004		8/13/2004		8/13/2004		5/11/2012		5/11/2012		5/11/2012		5/11/2012		5/11/2012		5/11/2012	
		Sample Depth (feet bgs)	0-0.25		0-0.25		0-0.25		0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	11		1.6		0.4		NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	34.90		9.10		4.81		17.1		6.9		3.7		17.5		4		11.1	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	0.39		0.42		0.46		NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	21.2		5.95		1.26		NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	17		7		7		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	109000		23800		2360		2340		1700		1140		1640		2160		2360	
Lead	7439-92-1	mg/kg	950		45.00		25.10		132		17.7		13.3		174		34.2		73.3	
Manganese	7439-96-5	mg/kg	384		273		377		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	0.37		0.11		< 0.04	U	NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	1980		2430		446		NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	31		12		9		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	12		28.4		1.0		NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	0.4		0.21		0.21		NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	4400		658		134		NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
			Location ID	CPF-AE-D3-01		CPF-AE-D3-02		CPF-AE-D3-03		CPF-AE-D3-04		CPF-AE-D3-05		CPF-AE-SWE-D1.5-01		CPF-AE-SWE-D1.5-02	
			Sample ID	CPF-AE-D3-01_20120502		CPF-AE-D3-02_20120502		CPF-AE-D3-03_20120502		CPF-AE-D3-04_20120502		CPF-AE-D3-05_20120511		CPF-AE-SWE-D1.5-01_20120502		CPF-AE-SWE-D1.5-02_20120502	
			Sample Date	5/2/2012		5/2/2012		5/2/2012		5/2/2012		5/11/2012		5/2/2012		5/2/2012	
			Sample Depth (feet bgs)	0		0		0		0		0		0		0	
Analyte	CASRN	Units		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg		10.9		7.6		9.3		8.1		12.2		12.7		9.9	
Barium	7440-39-3	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg		2330		1840		1860		2860		1680		2500		1490	
Lead	7439-92-1	mg/kg		56		127		38.3		19.3		36.9		94		12.5	
Manganese	7439-96-5	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg		NA		NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPF-AE-SWE-D1.5-03		CPF-AE-SWW-D1.5-02		CPF-AE-SWW-D1-04		CPF-AE-SWW-D2-03		CPF-AN-D1-01		CPF-AN-SWN-D0.5-05	
		Sample ID	CPF-AE-SWE-D1.5-03_20120511		CPF-AE-SWW-D1.5-02_20120502		CPF-AE-SWW-D1-04_20120511		CPF-AE-SWW-D2-03_20120511		CPF-AN-D1-01_20120511		CPF-AN-SWN-D0.5-05_20120511	
		Sample Date	5/11/2012		5/2/2012		5/11/2012		5/11/2012		5/11/2012		5/11/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	9.5		8.7		12		8.1		10.1		9.9	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	3060		1800		4070		2540		4910		4090	
Lead	7439-92-1	mg/kg	35.6		45.7		279		93.7		236		105	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPF-AN-SWN-D1.5-02		CPF-AN-SWN-D1.5-04		CPF-AN-SWN-D1-01		CPF-AN-SWN-D1-03		CPF-AN-SWS-D0.5-02		CPF-AN-SWS-D0.5-03	
		Sample ID	CPF-AN-SWN-D1.5-02_20120511		CPF-AN-SWN-D1.5-04_20120511		CPF-AN-SWN-D1-01_20120511		CPF-AN-SWN-D1-03_20120511		CPF-AN-SWS-D0.5-02_20120511		CPF-AN-SWS-D0.5-03_20120511	
		Sample Date	5/11/2012		5/11/2012		5/11/2012		5/11/2012		5/11/2012		5/11/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	9.8		8.7		6.1		10.7		6.3		18	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	4570		3490		1910		3800		2470		3810	
Lead	7439-92-1	mg/kg	453		466		171		473		279		470	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPF-AN-SWS-D0.5-04		CPF-AN-SWS-D0.5-05		CPF-AW-D2-05		CPF-AW-D3-01		CPF-AW-D4-02		CPF-AW-D4-05		CPF-AW-SWE-D0.5-04	
		Sample ID	CPF-AN-SWS-D0.5-04_20120511		CPF-AN-SWS-D0.5-05_20120521		CPF-AW-D2-05_20120511		CPF-AW-D3-01_20120501		CPF-AW-D4-02_20120501		CPF-AW-D4-05_20120502		CPF-AW-SWE-D0.5-04_20120511	
		Sample Date	5/11/2012		5/21/2012		5/11/2012		5/1/2012		5/1/2012		5/2/2012		5/11/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA				NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	21.7		6.3		9.8		2.6		< 2.5	U	< 2.5	U	15	
Barium	7440-39-3	mg/kg	NA				NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA				NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA				NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA				NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA				NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	4390		3760		1040		313		248		924		8970	
Lead	7439-92-1	mg/kg	379		578		12.3		11.5		11.7		63.1		1140	
Manganese	7439-96-5	mg/kg	NA				NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA				NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA				NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA				NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA				NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA				NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA				NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA				NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPF-AW-SWE-D1.5-01		CPF-AW-SWE-D1.5-02		CPF-AW-SWE-D2.5-02		CPF-AW-SWE-D2.5-03		CPF-AW-SWW-D0.75-04		CPF-AW-SWW-D1-03	
		Sample ID	CPF-AW-SWE-D1.5-01_20120501		CPF-AW-SWE-D1.5-02_20120502		CPF-AW-SWE-D2.5-02_20120502		CPF-AW-SWE-D2.5-03_20120511		CPF-AW-SWW-D0.75-04_20120511		CPF-AW-SWW-D1-03_20120511	
		Sample Date	5/1/2012		5/2/2012		5/2/2012		5/11/2012		5/11/2012		5/11/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	3		9.9		10.3		2.6		6.9		7.6	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	360		1490		3040		423		4610		1290	
Lead	7439-92-1	mg/kg	18.7		12.5		459		37.5		622		120	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPF-AW-SWW-D2-01		CP-JS01		CP-JS01		CP-JS01		CP-JS01		CP-JS02		CP-JS02	
		Sample ID	CPF-AW-SWW-D2-01_20120501		CP-JS-01-0-1_07152008		CP-JS-01-10-12_07152008		CP-JS-01-1-3_07152008		CP-JS-01-5-7_07152008		CP-JS-02-0-1_07112008		CP-JS-02-1-3_07112008	
		Sample Date	5/1/2012		7/15/2008		7/15/2008		7/15/2008		7/15/2008		7/11/2008		7/11/2008	
		Sample Depth (feet bgs)	0		0-1		10-12		1-3		5-7		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		0.4		0.7		0.4	J	5.9		1		0.2	
Arsenic	7440-38-2	mg/kg	3.5		7.3		28.1		12.3		32.8		6.3		2.8	
Barium	7440-39-3	mg/kg	NA		654		159		336		130		36.8		77.4	
Beryllium	7440-41-7	mg/kg	NA		1.3		< 5	U	0.8		0.7		0.8		0.8	
Cadmium	7440-43-9	mg/kg	NA		< 2	U	< 8	U	< 2	U	< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	NA		8		3		7		7		3		7	
Cobalt	7440-48-4	mg/kg	NA		8		18		12		12		12		5	
Copper	7440-50-8	mg/kg	779		1390		506		781		822		2690		174	
Lead	7439-92-1	mg/kg	39.9		5.93		8.98		7.4		44.3		39.7		7.39	
Manganese	7439-96-5	mg/kg	NA		297		1240		379		482		345		122	
Mercury	7439-97-6	mg/kg	NA		0.06		< 0.2	U	< 0.2	U	< 0.2	U	0.07		< 0.2	U
Molybdenum	7439-98-7	mg/kg	NA		15		200		53		34		618		27	
Nickel	7440-02-0	mg/kg	NA		8		14		8		7		2		4	
Selenium	7782-49-2	mg/kg	NA		0.28		1.68		0.69		0.24		3.15		0.17	
Thallium	7440-28-0	mg/kg	NA		0.3		0.36		< 0.3	U	0.39		0.12		< 0.3	U
Uranium	7440-61-1	mg/kg	NA		2.36		7.77		4.29		5.11		6.34		0.93	
Zinc	7440-66-6	mg/kg	NA		45		65		39		42		114		34	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-JS03		CP-JS03		CP-JS03		CP-JS04		CP-JS04		CP-JS04		CP-JS04		CPP-AE-S-01	
		Sample ID	CP-JS-03-0-1_07142008		CP-JS-03-1-3_07142008		CP-JS-03-5-7_07142008		CP-JS-04-0-1_08272008		CP-JS-04-10-12_08272008		CP-JS-04-1-3_08272008		CP-JS-04-5-7_08272008		CPP-AE-S-01_20120502	
		Sample Date	7/14/2008		7/14/2008		7/14/2008		8/27/2008		8/27/2008		8/27/2008		8/27/2008		5/2/2012	
		Sample Depth (feet bgs)	0-1		1-3		5-7		0-1		10-12		1-3		5-7		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	< 1	UJ	< 1	U	0.4		< 1	U	0.2		0.4		NA	
Arsenic	7440-38-2	mg/kg	3.3		2		2		4.5		2.3		1.6		8.7		5.9	
Barium	7440-39-3	mg/kg	164	J	189		205		165	J	106		172		183		NA	
Beryllium	7440-41-7	mg/kg	0.3		0.2		0.4		0.5		0.4		0.4		0.4		NA	
Cadmium	7440-43-9	mg/kg	0.7		< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	NA	
Chromium	7440-47-3	mg/kg	7		9		8		5	J	5		5	J	5		NA	
Cobalt	7440-48-4	mg/kg	11		12		11		13		9		12		11		NA	
Copper	7440-50-8	mg/kg	1700		888		1680		1710		1080		684		1400		2850	
Lead	7439-92-1	mg/kg	24.5		13		5.98		14.3		5.36		4.55		10.9		21.8	
Manganese	7439-96-5	mg/kg	456		456		496		396		347		469		343		NA	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	NA	
Molybdenum	7439-98-7	mg/kg	75	J	20		26		223		34		24		202		NA	
Nickel	7440-02-0	mg/kg	15		15		13		8		7		8		7		NA	
Selenium	7782-49-2	mg/kg	< 0.67	U	< 0.31	U	0.44		1.26		0.56		0.26	J	0.76		NA	
Thallium	7440-28-0	mg/kg	0.29		0.22		0.49		0.35		0.26		0.28	J	0.36		NA	
Uranium	7440-61-1	mg/kg	4.29		3.96		5.27		4.96		8.72		5.03	J	16		NA	
Zinc	7440-66-6	mg/kg	158		129		78		82		71		77		63		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPP-AE-S-02		CPP-AE-S-03		CPP-AE-S-04		CPP-AE-S-05		CPP-AN-S-01		CPP-AN-S-02		CPP-AN-S-03		CPP-AN-S-04	
		Sample ID	CPP-AE-S-02_20120502		CPP-AE-S-03_20120502		CPP-AE-S-04_20120502		CPP-AE-S-05_20120511		CPP-AN-S-01_20120502		CPP-AN-S-02_20120502		CPP-AN-S-03_20120502		CPP-AN-S-04_20120502	
		Sample Date	5/2/2012		5/2/2012		5/2/2012		5/11/2012		5/2/2012		5/2/2012		5/2/2012		5/2/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	4.2		9.3		10.1		16.3		3.5		< 2.5	U	6.9		< 2.5	U
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	1410		1890		3310		2090		987		4550		2090		133	
Lead	7439-92-1	mg/kg	64.8		45.9		73.9		37.4		48.8		8.98		65.2		5.1	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPP-AN-S-05		CPP-AW-S-01		CPP-AW-S-02		CPP-AW-S-03		CPP-AW-S-04		CP-SD01		CP-SD01	
		Sample ID	CPP-AN-S-05_20120511		CPP-AW-S-01_20120502		CPP-AW-S-02_20120502		CPP-AW-S-03_20120502		CPP-AW-S-04_20120502		CP-SD-01-0-1.5_07162008		CP-SD-01-1.5-3.0_07162008	
		Sample Date	5/11/2012		5/2/2012		5/2/2012		5/2/2012		5/2/2012		7/16/2008		7/16/2008	
		Sample Depth (feet bgs)	0		0		0		0		0		0-1.5		1.5-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		< 1	U	< 1	U
Arsenic	7440-38-2	mg/kg	2.6		2.5		4.5		2.6		11.1		2.1		1	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		145		140	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		0.4		0.4	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		6		6	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		10		9	
Copper	7440-50-8	mg/kg	264		679		1520		217		1190		979		253	
Lead	7439-92-1	mg/kg	9.25		9.98		65.6		11.9		22.3		5.49		1.72	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		342		314	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		121		4	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		8		8	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		0.37		0.08	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		0.23		0.25	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		4.04		2.34	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		49		30	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-SD02		CP-SD02		CP-SD03		CP-SD03		CP-SD04		CP-SD04		CP-SD05	
		Sample ID	CP-SD-02-0-1.5_07162008		CP-SD-02-1.5-3.0_07162008		CP-SD-03-0-1.5_07162008		CP-SD-03-1.5-3.0_07162008		CP-SD-04-0-1.5_07172008		CP-SD-04-1.5-3.0_07172008		CP-SD-05-0-1.5_07162008	
		Sample Date	7/16/2008		7/16/2008		7/16/2008		7/16/2008		7/17/2008		7/17/2008		7/16/2008	
		Sample Depth (feet bgs)	0-1.5		1.5-3		0-1.5		1.5-3		0-1.5		1.5-3		0-1.5	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U
Arsenic	7440-38-2	mg/kg	1.1		1.5		2.9		1.9		1.8		1		5.4	
Barium	7440-39-3	mg/kg	117		41.1		95.3		112		166		170		123	
Beryllium	7440-41-7	mg/kg	< 1	U	0.3		0.7		0.5		0.6		0.4		0.6	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	3		2		5		4		7		7		6	
Cobalt	7440-48-4	mg/kg	6		3		7		7		11		11		11	
Copper	7440-50-8	mg/kg	451		780		995		335		1180		512		561	
Lead	7439-92-1	mg/kg	4		3.78		9.49		5.32		4.25		2.14		8.74	
Manganese	7439-96-5	mg/kg	207		148		257		302		403		448		343	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	32		18		114		44		40		7		126	
Nickel	7440-02-0	mg/kg	6		2		5		6		10		10		7	
Selenium	7782-49-2	mg/kg	0.31		0.21		0.36		0.2		0.36		0.12		0.51	
Thallium	7440-28-0	mg/kg	0.18		< 0.3	U	0.13		0.14		0.43		0.35		0.13	
Uranium	7440-61-1	mg/kg	2.5		2.82		4.05		3.86		4.05		4.76		3.61	
Zinc	7440-66-6	mg/kg	31		30		48		34		57		46		43	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-SD05		CP-SD06		CP-SD06		CP-SD07		CP-SD07		CP-SD08		CP-SD08	
		Sample ID	CP-SD-05-1.5-3.0_07162008		CP-SD-06-0-1.5_07162008		CP-SD-06-1.5-3.0_07162008		CP-SD-07-0-1.5_07232008		CP-SD-07-1.5-3.0_07232008		CP-SD-08-0-1.5_07282008		CP-SD-08-1.5-3.0_07282008	
		Sample Date	7/16/2008		7/16/2008		7/16/2008		7/23/2008		7/23/2008		7/28/2008		7/28/2008	
		Sample Depth (feet bgs)	1.5-3		0-1.5		1.5-3		0-1.5		1.5-3		0-1.5		1.5-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	< 1	U	< 1	U	0.2		0.2		0.2		< 1	U
Arsenic	7440-38-2	mg/kg	3.6		3.7		4		2.9		0.8		2		1.2	
Barium	7440-39-3	mg/kg	181		177		174		136		166		135		164	
Beryllium	7440-41-7	mg/kg	0.5		0.7		0.5		0.9		0.5		0.5		0.5	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	6		6		6		14		9		12		11	
Cobalt	7440-48-4	mg/kg	11		17		11		9		11		10		11	
Copper	7440-50-8	mg/kg	283		976		729		439		180		599		142	
Lead	7439-92-1	mg/kg	4.91		4.17		3.75		7.05		2.49		6.87		3.69	
Manganese	7439-96-5	mg/kg	359		447		375		298		344		283		300	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	24		43		37		42		2		86		9	
Nickel	7440-02-0	mg/kg	8		10		8		33		31		31		27	
Selenium	7782-49-2	mg/kg	0.31		0.46		0.26		0.34		< 0.3	U	0.27		0.09	
Thallium	7440-28-0	mg/kg	0.17		0.29		0.28		0.27		0.3		0.25		0.33	
Uranium	7440-61-1	mg/kg	2.86		5.54		3.81		3.45		2.19		5.96		3.99	
Zinc	7440-66-6	mg/kg	42		86		39		45		47		50		52	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-SD09		CP-SD09		CP-SD10		CP-SD10		CPS-D5-06		CPS-SWE-D2.5-01		CPS-SWN-D2-01	
		Sample ID	CP-SD-09-0-1.5_07282008		CP-SD-09-1.5-3.0_07282008		CP-SD-10-0-1.5_07282008		CP-SD-10-1.5-3.0_07282008		CPS-D5-06_20120501		CPS-SWE-D2.5-01_20120502		CPS-SWN-D2-01_20120511	
		Sample Date	7/28/2008		7/28/2008		7/28/2008		7/28/2008		5/1/2012		5/2/2012		5/11/2012	
		Sample Depth (feet bgs)	0-1.5		1.5-3		0-1.5		1.5-3		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.3		< 1	U	0.2		< 1	U	NA		NA		NA	
Arsenic	7440-38-2	mg/kg	1.9		0.7		3.6		1.2		5.5		5.6		19.3	
Barium	7440-39-3	mg/kg	139		131		161		193		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	0.4		0.2		0.5		0.4		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	NA		NA		NA	
Chromium	7440-47-3	mg/kg	11		11		11		13		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	10		9		9		12		NA		NA		NA	
Copper	7440-50-8	mg/kg	1100		380		570		269		2670		2220		4350	
Lead	7439-92-1	mg/kg	11.3		26.6		6.23		1.81		176		258		3220	
Manganese	7439-96-5	mg/kg	312		239		278		332		NA		NA		NA	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	157		25		84		3		NA		NA		NA	
Nickel	7440-02-0	mg/kg	29		28		29		31		NA		NA		NA	
Selenium	7782-49-2	mg/kg	0.3		< 0.3	U	0.34		< 0.3	U	NA		NA		NA	
Thallium	7440-28-0	mg/kg	0.21		0.25		0.25		0.32		NA		NA		NA	
Uranium	7440-61-1	mg/kg	2.44		2.46		4.13		4.41		NA		NA		NA	
Zinc	7440-66-6	mg/kg	75		52		47		53		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPS-SWN-D2-02		CPS-SWN-D2-03		CPS-SWN-D2-04		CPS-SWN-D3.5-05		CPS-SWS-D2.5-01		CPS-SWS-D2.5-02		CPS-SWS-D2.5-03	
		Sample ID	CPS-SWN-D2-02_20120511		CPS-SWN-D2-03_20120511		CPS-SWN-D2-04_20120511		CPS-SWN-D3.5-05_20120511		CPS-SWS-D2.5-01_20120501		CPS-SWS-D2.5-02_20120501		CPS-SWS-D2.5-03_20120501	
		Sample Date	5/11/2012		5/11/2012		5/11/2012		5/11/2012		5/1/2012		5/1/2012		5/1/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	3.1		11.9		3.2		13.1		12		9.7		4.1	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	261		4150		1350		4560		2210		7560		914	
Lead	7439-92-1	mg/kg	13		617		29.5		643		208		503		32.4	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CPS-SWS-D2.5-07		CPS-SWS-D2-05		CPS-SWS-D4.5-06		CPS-SWS-D4.5-08		CPS-SWS-D4-04		CPS-SWW-D2.5-01		CPS-SWW-D2.5-02	
		Sample ID	CPS-SWS-D2.5-07_20120511		CPS-SWS-D2-05_20120511		CPS-SWS-D4.5-06_20120511		CPS-SWS-D4.5-08_20120511		CPS-SWS-D4-04_20120502		CPS-SWW-D2.5-01_20120501		CPS-SWW-D2.5-02_20120511	
		Sample Date	5/11/2012		5/11/2012		5/11/2012		5/11/2012		5/2/2012		5/1/2012		5/11/2012	
		Sample Depth (feet bgs)	0		0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Arsenic	7440-38-2	mg/kg	5		6.7		14.3		3.2		< 2.5	U	12.3		< 2.5	U
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	1580		3220		2200		451		287		3250		248	
Lead	7439-92-1	mg/kg	20.6		34		97.2		20.3		6.99		126		9.3	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-T01		CP-T01		CP-T01		CP-T01		CP-T02		CP-T02		CP-T02		CP-T02B		CP-T02BL		CP-T02C	
		Sample ID	CP-T-1-18IN 100404		CP-T-1-2 100404		CP-T-1-4 100404		CP-T-1-8 100404		CP-T-2-10 100404		CP-T-2-2 100404		CP-T-2-7 100404		CP-T-2-B-6 100404		CP-T-2-7BL 100404		CP-T-2-C-6 100404	
		Sample Date	10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004	
		Sample Depth (feet bgs)	1.5		2		4		8		10		2		7		6		7		6	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.8		NA		NA		NA		NA		NA		NA		1.4		7.6		2.1	
Arsenic	7440-38-2	mg/kg	18.1		8.64		14.30		4.20		5.43		3.60		5.63		11.80		37.1		14.8	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	0.7		0.82		1.29		0.52		0.63		0.63		0.58		0.35		0.2		0.3	
Cadmium	7440-43-9	mg/kg	8.9		NA		NA		NA		NA		NA		NA		2.75		2.2		1.5	
Chromium	7440-47-3	mg/kg	25		NA		NA		NA		NA		NA		NA		10		9		9	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	40100		2520		4390		1200		2850		765		2160		2600		1470		1950	
Lead	7439-92-1	mg/kg	77.1		21.70		37.20		12.70		44.70		12.50		39.80		62.40		270		293	
Manganese	7439-96-5	mg/kg	347		NA		NA		NA		NA		NA		NA		569		157		197	
Mercury	7439-97-6	mg/kg	0.06		NA		NA		NA		NA		NA		NA		0.05		< 0.05	U	< 0.04	U
Molybdenum	7439-98-7	mg/kg	377		368		182		114		99		38		135		625		535		331	
Nickel	7440-02-0	mg/kg	37		NA		NA		NA		NA		NA		NA		9		4		6	
Selenium	7782-49-2	mg/kg	2.1		NA		NA		NA		NA		NA		NA		2.5		8.1		3.9	
Thallium	7440-28-0	mg/kg	1		NA		NA		NA		NA		NA		NA		0.32		0.2		0.3	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	1270		NA		NA		NA		NA		NA		NA		127		43		92	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-T03		CP-T03		CP-T03		CP-T04		CP-T04		CP-T04		CP-T04		CP-T05		CP-T05		CP-T05	
		Sample ID	CP-T-3-6 100504		CP-T-3-8 100504		CP-T-3-8IN 100504		CP-T-4-1.5C 100404		CP-T-4-14 100404		CP-T-4-18IN 100404		CP-T-4-2.5 100404		CP-T-5-1.5 100404		CP-T-5-3 100404		CP-T-5-6 100404	
		Sample Date	10/5/2004		10/5/2004		10/5/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004		10/4/2004	
		Sample Depth (feet bgs)	0.5		8		0.75		1.5		14		1.5		2.5		1.5		3		6	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		1.2		0.5		NA		0.4		NA		0.4		NA		NA	
Arsenic	7440-38-2	mg/kg	5.60		26.9		20.90		4.88		10.40		1.1		16.40		4.70		4.14		5.27	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	1.40		0.5		0.48		0.28		0.45		1		0.41		0.23		0.57		0.44	
Cadmium	7440-43-9	mg/kg	NA		NA		1.07		1.74		NA		18.1		NA		0.62		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		7		24		NA		470		NA		9		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	4750		14100		978		2790		1570		57300		998		839		1050		746	
Lead	7439-92-1	mg/kg	31.10		488		6.03		14.40		3.66		4.1		7.26		13.90		12.40		3.98	
Manganese	7439-96-5	mg/kg	NA		NA		379		244		NA		759		NA		235		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		< 0.04	U	< 0.04	U	NA		< 0.04	U	NA		< 0.04	U	NA		NA	
Molybdenum	7439-98-7	mg/kg	62		615		264		347		91		60		330		115		95		60	
Nickel	7440-02-0	mg/kg	NA		NA		9		11		NA		70		NA		4		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		0.6		2.6		NA		3.7		NA		0.8		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		0.37		0.34		NA		< 0.1	U	NA		0.18		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		47		153		NA		4900		NA		57		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-T06		CP-T06		CP-T06		M04		M04		M04		M06		M06	
		Sample ID	CP-T-6-2 100404		CP-T-6-4 100404		CP-T-6-6 100404		CP-M04-0-1_07112008		CP-M04-1-2.5_07112008		CP-M04-5-5.4_07112008		CP-M06-0-1_07112008		CP-M06-1-3_07112008	
		Sample Date	10/4/2004		10/4/2004		10/4/2004		7/11/2008		7/11/2008		7/11/2008		7/11/2008		7/11/2008	
		Sample Depth (feet bgs)	2		4		6		0-1		1-2.5		5-5.4		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		2.3		1.1		< 1	U	< 1	U	0.2	
Arsenic	7440-38-2	mg/kg	5.38		4.75		3.96		12.6		7.5		1.5		2.6		3	
Barium	7440-39-3	mg/kg	NA		NA		NA		130		142		197		67.1		92.4	
Beryllium	7440-41-7	mg/kg	0.60		0.60		0.51		0.5		0.4		0.5		0.5		0.7	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		0.7		0.6		< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	NA		NA		NA		9		26		6		6		7	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		9		5		11		4		4	
Copper	7440-50-8	mg/kg	1900		2150		1410		9390		3900		1720		207		200	
Lead	7439-92-1	mg/kg	29.20		45.00		28.10		48.1		48.1		6.55		7.76		8.17	
Manganese	7439-96-5	mg/kg	NA		NA		NA		333		319		374		159		157	
Mercury	7439-97-6	mg/kg	NA		NA		NA		0.15		0.16		< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	76		143		52		704		206		48		23		14	
Nickel	7440-02-0	mg/kg	NA		NA		NA		7		7		7		3		4	
Selenium	7782-49-2	mg/kg	NA		NA		NA		3.09		1.29		0.87		0.23		0.35	
Thallium	7440-28-0	mg/kg	NA		NA		NA		0.24		0.12		0.41		0.11		0.14	
Uranium	7440-61-1	mg/kg	NA		NA		NA		5.55		3.01		9.05		1.45		1.35	
Zinc	7440-66-6	mg/kg	NA		NA		NA		272		212		45		26		27	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	N08		N08		N08		N08		O03		O03		O09		O09	
		Sample ID	CP-N08-0-1_07112008		CP-N08-10-11_07112008		CP-N08-1-3_07112008		CP-N08-5-7_07112008		CP-O03-0-1_07112008		CP-O03-1-3_07112008		CP-O09-0-1_07112008		CP-O09-10-12_07112008	
		Sample Date	7/11/2008		7/11/2008		7/11/2008		7/11/2008		7/11/2008		7/11/2008		7/11/2008		7/11/2008	
		Sample Depth (feet bgs)	0-1		10-11		1-3		5-7		0-1		1-3		0-1		10-12	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	UJ	2.9		0.6		0.5		< 1	U	< 1	U	< 1	U	0.4	
Arsenic	7440-38-2	mg/kg	4.1		41.9		7.5		7.7		2.3		1.2		3.5		3.7	
Barium	7440-39-3	mg/kg	169		213		188	J	186		251		212		142		155	
Beryllium	7440-41-7	mg/kg	0.4		0.6		0.4	J	0.4		0.5		< 1	U	0.5		0.4	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	UJ	< 2	U	< 2	U	< 2	U	< 2	U	1.1	
Chromium	7440-47-3	mg/kg	5		14		7	J	11		8		5		5		25	
Cobalt	7440-48-4	mg/kg	11		9		12	J	11		14		13		11		11	
Copper	7440-50-8	mg/kg	1070		1190		2420		1100		1700		298		913		1670	
Lead	7439-92-1	mg/kg	10.1		9.66		16.3		9.56		5.35		1.72		11.2		46.1	
Manganese	7439-96-5	mg/kg	504		271		294		365		386		440		469		343	
Mercury	7439-97-6	mg/kg	< 0.2	U	0.1		0.04		< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	27		106		149	J	77		102		2		69		73	
Nickel	7440-02-0	mg/kg	8		9		9	J	9		11		11		8		11	
Selenium	7782-49-2	mg/kg	0.42		1.58		0.85		0.54		0.45		0.81		0.39		0.84	
Thallium	7440-28-0	mg/kg	0.27		0.34		0.53		0.41		0.4		0.31		0.32		0.31	
Uranium	7440-61-1	mg/kg	4.77		9.05		8.99		9.35		4.91		7.25		4.91		3.45	
Zinc	7440-66-6	mg/kg	94		73		161	J	66		119		77		106		123	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	O09		O09		P04		P04		P05		P05		P07		P07	
		Sample ID	CP-O09-1-3_07112008		CP-O09-5-7_07112008		CP-P04-0-1_07152008		CP-P04-1-3_07152008		CP-P05-0-1_07152008		CP-P05-1-3_07152008		CP-P07-0-1_07172008		CP-P07-1-3_07172008	
		Sample Date	7/11/2008		7/11/2008		7/15/2008		7/15/2008		7/15/2008		7/15/2008		7/17/2008		7/17/2008	
		Sample Depth (feet bgs)	1-3		5-7		0-1		1-3		0-1		1-3		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U
Arsenic	7440-38-2	mg/kg	3.4		2.6		1.6		1		1.6		1.1		1.5		1.1	
Barium	7440-39-3	mg/kg	187		158		206		154		115		197		99.5		80.4	
Beryllium	7440-41-7	mg/kg	0.5		0.4		0.4		< 1	U	0.4		0.4		0.4		0.3	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	7		12		8		3		5		4		6		5	
Cobalt	7440-48-4	mg/kg	13		9		7		8		9		7		8		7	
Copper	7440-50-8	mg/kg	1500		2480		626		518		973		289		538		210	
Lead	7439-92-1	mg/kg	26.7		18.6		4.87		1.2		7.41		2.05		9.36		3.38	
Manganese	7439-96-5	mg/kg	442		317		275		295		330		307		293		276	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	43		36		33		4		72		3		26		31	
Nickel	7440-02-0	mg/kg	10		9		7		6		7		6		7		6	
Selenium	7782-49-2	mg/kg	0.45		0.39		0.48		0.07		0.34		0.07		0.36		0.24	
Thallium	7440-28-0	mg/kg	0.35		0.29		0.37		0.29		0.22		0.22		0.15		0.14	
Uranium	7440-61-1	mg/kg	5.66		3.4		3.77		2.41		4.75		3.16		3.24		3.79	
Zinc	7440-66-6	mg/kg	146		78		34		39		55		29		44		39	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	P07		P12		P12		Q09		Q09		RCP-16-D2.5-01		RCP-T-3-D0.5-01		RCP-T-3-D0.5-02	
		Sample ID	CP-P07-5-7_07172008		CP-P12-0-1_07232008		CP-P12-1-3_07232008		CP-Q09-0-1_07232008		CP-Q09-1-3_07232008		RCP-16-D2.5-01_20120502		RCP-T-3-D0.5-01_20120502		RCP-T-3-D0.5-02_20120511	
		Sample Date	7/17/2008		7/23/2008		7/23/2008		7/23/2008		7/23/2008		5/2/2012		5/2/2012		5/11/2012	
		Sample Depth (feet bgs)	5-7		0-1		1-3		0-1		1-3		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	0.9		0.3		0.3	J	< 1	U	NA		NA		NA	
Arsenic	7440-38-2	mg/kg	1.4		5.5		3.4		2.3		1.5		< 2.5	U	18.1		7.3	
Barium	7440-39-3	mg/kg	101		81.4		49.9		120		247		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	< 1	U	0.7		0.8		0.6		0.3		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	NA		NA		NA	
Chromium	7440-47-3	mg/kg	13		13		10		12		7		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	8		6		3		8		5		NA		NA		NA	
Copper	7440-50-8	mg/kg	333		1680		337		724		499		1250		3610		2910	
Lead	7439-92-1	mg/kg	3.79		39		7.98		4.61		3.19		139		65.1		39.3	
Manganese	7439-96-5	mg/kg	283		167		85		202		170		NA		NA		NA	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	53		239		9		123		8		NA		NA		NA	
Nickel	7440-02-0	mg/kg	8		31		31		29		22		NA		NA		NA	
Selenium	7782-49-2	mg/kg	0.5		1.48		0.19		0.35		0.14		NA		NA		NA	
Thallium	7440-28-0	mg/kg	0.16		0.26		0.18		0.26		0.49		NA		NA		NA	
Uranium	7440-61-1	mg/kg	4.03		3.15		1.3		2.21		2.67		NA		NA		NA	
Zinc	7440-66-6	mg/kg	88		96		27		44		30		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-NPA-S-01		CP-NPA-S-02		CP-NPA-S-03		CP-NPA-S-04		CP-NPA-S-05		CP-NPA-S-06		CP-NPA-S-07		CP-NPA-S-08	
		Sample ID	CP-NPA-S-01_20150528		CP-NPA-S-02_20150528		CP-NPA-S-03_20150528		CP-NPA-S-04_20150528		CP-NPA-S-05_20150528		CP-NPA-S-06_20150528		CP-NPA-S-07_20150528		CP-NPA-S-08_20150528	
		Sample Date	5/28/2015		5/28/2015		5/28/2015		5/28/2015		5/28/2015		5/28/2015		5/28/2015		5/28/2015	
		Sample Depth (feet bgs)	0		0		0		0		0		0		0		0	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 2	U	NA		NA		NA		< 2	U	NA		NA		NA	
Arsenic	7440-38-2	mg/kg	< 2.5	U	5.1		7.9		7.3		< 2.5	U	18.9		23.6		2.9	
Barium	7440-39-3	mg/kg	115		NA		NA		NA		68.9		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	0.42		NA		NA		NA		0.44		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	0.43		NA		NA		NA		< 0.2	U	NA		NA		NA	
Chromium	7440-47-3	mg/kg	4.52		NA		NA		NA		3.45		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	7.46		NA		NA		NA		5.64		NA		NA		NA	
Copper	7440-50-8	mg/kg	1580		2550		12800		4730		764		4810		3200		618	
Lead	7439-92-1	mg/kg	3.9		19.8		69		41.6		5.8		97		57		20.6	
Manganese	7439-96-5	mg/kg	< 0.4	U	NA		NA		NA		231		NA		NA		NA	
Mercury	7439-97-6	mg/kg	< 0.033	U	NA		NA		NA		< 0.033	U	NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	13.6		NA		NA		NA		26.6		NA		NA		NA	
Nickel	7440-02-0	mg/kg	8.53		NA		NA		NA		4.88		NA		NA		NA	
Selenium	7782-49-2	mg/kg	< 4	U	NA		NA		NA		< 4	U	NA		NA		NA	
Thallium	7440-28-0	mg/kg	< 1.5	U	NA		NA		NA		< 1.5	U	NA		NA		NA	
Uranium	7440-61-1	mg/kg	2.64		NA		NA		NA		1.32		NA		NA		NA	
Zinc	7440-66-6	mg/kg	187		NA		NA		NA		67.3		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-NPA-S-09		CP-NPA-S-10		CP-SPA-SL-E		CP-SPA-SL-W		CP-SPA-S-01		CP-SPA-S-02		CP-SPA-S-03		CP-SPA-S-04	
		Sample ID	CP-NPA-S-09_20150528		CP-NPA-S-10_20150528		CP-SPA-SL-E-D3.5-01		CP-SPA-SL-W-D3.5-01		CP-SPA-S-01_20150609		CP-SPA-S-02_20150609		CP-SPA-S-03_20150609		CP-SPA-S-04_20150609	
		Sample Date	5/28/2015		5/28/2015		5/19/2015		5/19/2015		6/9/2015		6/9/2015		6/9/2015		6/9/2015	
		Sample Depth (feet bgs)	0		0		3.5		3.5		0-0.25		0-0.25		0-0.25		0-0.25	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		5.1		< 2	U	< 2	U	NA		NA		< 2.0	U	NA	
Arsenic	7440-38-2	mg/kg	3.8		10.3		4.1		18.7		10.3		3.8		6.2		12	
Barium	7440-39-3	mg/kg	NA		51.8		136		167		NA		NA		134		NA	
Beryllium	7440-41-7	mg/kg	NA		0.38		0.42		0.48		NA		NA		0.45		NA	
Cadmium	7440-43-9	mg/kg	NA		0.98		0.42		1.04		NA		NA		0.43		NA	
Chromium	7440-47-3	mg/kg	NA		3.12		8.35		21.5		NA		NA		6.63		NA	
Cobalt	7440-48-4	mg/kg	NA		8.4		5.72		5.38		NA		NA		7.67		NA	
Copper	7440-50-8	mg/kg	1290		5090		2100		1310		1050		2310		823		2340	
Lead	7439-92-1	mg/kg	23.9		80.7		17.3		22.6		6.2		311		4.2		33.1	
Manganese	7439-96-5	mg/kg	NA		168		220		235		NA		NA		292		NA	
Mercury	7439-97-6	mg/kg	NA		0.037		0.052		0.137		NA		NA		< 0.033	U	NA	
Molybdenum	7439-98-7	mg/kg	NA		366		157		263		NA		NA		216		NA	
Nickel	7440-02-0	mg/kg	NA		6.53		8.73		14.3		NA		NA		7.44		NA	
Selenium	7782-49-2	mg/kg	NA		< 4	U	< 4	U	< 4	U	NA		NA		< 4.0	U	NA	
Thallium	7440-28-0	mg/kg	NA		< 1.5	U	< 1.5	U	< 1.5	U	NA		NA		< 1.5	U	NA	
Uranium	7440-61-1	mg/kg	NA		2.33		4.16		6.28		NA		NA		7.25		NA	
Zinc	7440-66-6	mg/kg	NA		249		57.8		78.9		NA		NA		35.2		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant	
		Location ID	CP-SPA-S-05		CP-SPA-S-06		CP-SPA-S-07		CP-SPA-S-08		CP-SPA-S-09		CP-SPA-S-10		CP-SPA-S-11		CP-SPA-S-12	
		Sample ID	CP-SPA-S-05_20150609		CP-SPA-S-06_20150609		CP-SPA-S-07_20150609		CP-SPA-S-08_20150609		CP-SPA-S-09_20150609		CP-SPA-S-10_20150609		CP-SPA-S-11_20150609		CP-SPA-S-12_20150609	
		Sample Date	6/9/2015		6/9/2015		6/9/2015		6/9/2015		6/9/2015		6/9/2015		6/9/2015		6/9/2015	
		Sample Depth (feet bgs)	0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		< 2.0	U	NA		NA		NA	
Arsenic	7440-38-2	mg/kg	6.1		4.5		6.4		2.5		3.1		5.6		3.7		3.1	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		318		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		0.41		NA		NA		NA	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		< 0.20	U	NA		NA		NA	
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		7.53		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		13.1		NA		NA		NA	
Copper	7440-50-8	mg/kg	2490		1420		1770		943		922		1770		1920		1500	
Lead	7439-92-1	mg/kg	35.1		14.2		20.5		4.6		2.7		16		15.5		12.2	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		306		NA		NA		NA	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		< 0.033	U	NA		NA		NA	
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		47.7		NA		NA		NA	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		10.4		NA		NA		NA	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		< 4.0	U	NA		NA		NA	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		< 1.5	U	NA		NA		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		2.72		NA		NA		NA	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		39.1		NA		NA		NA	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former CLEAR Plant		Former E Pond		Former E Pond		Former E Pond	
		Location ID	CP-SPA-S-13		CP-SPA-S-14		CP-SPA-S-15		CP-SPA-S-16		CP-SPA-S-17		E-JS01		E-JS01		E-JS01	
		Sample ID	CP-SPA-S-13_20150609		CP-SPA-S-14_20150609		CP-SPA-S-15_20150609		CP-SPA-S-16_20150609		CP-SPA-S-17_20150609		E-JS-01-0-1_07142008		E-JS-01-1-3_07142008		E-JS-01-5-7_07142008	
		Sample Date	6/9/2015		6/9/2015		6/9/2015		6/9/2015		6/9/2015		7/14/2008		7/14/2008		7/14/2008	
		Sample Depth (feet bgs)	0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-1		1-3		5-7	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	NA		NA		NA		NA		NA		0.3		0.2		< 1	U
Arsenic	7440-38-2	mg/kg	11.1		5.6		8.9		< 2.5	U	4.8		2.9		2.5		2	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		146		122		203	
Beryllium	7440-41-7	mg/kg	NA		NA		NA		NA		NA		< 1	U	< 1	U	0.3	
Cadmium	7440-43-9	mg/kg	NA		NA		NA		NA		NA		0.8		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	NA		NA		NA		NA		NA		5		3		4	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		NA		10		8		6	
Copper	7440-50-8	mg/kg	767		2970		2820		515		1710		2650		1810		1510	
Lead	7439-92-1	mg/kg	4.2		17.4		40.1		4.9		17.7		22.9		19.1		6.62	
Manganese	7439-96-5	mg/kg	NA		NA		NA		NA		NA		369		327		182	
Mercury	7439-97-6	mg/kg	NA		NA		NA		NA		NA		< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	NA		NA		NA		NA		NA		104		79		246	
Nickel	7440-02-0	mg/kg	NA		NA		NA		NA		NA		11		10		9	
Selenium	7782-49-2	mg/kg	NA		NA		NA		NA		NA		0.78		0.59		0.42	
Thallium	7440-28-0	mg/kg	NA		NA		NA		NA		NA		0.17		0.13		0.12	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		3.11		3.04		2.9	
Zinc	7440-66-6	mg/kg	NA		NA		NA		NA		NA		197		165		134	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former E Pond		Former E Pond		Former Evaporation Pond		Former Evaporation Pond		Former Evaporation Pond		Former Evaporation Pond		Former Evaporation Pond		Former Evaporation Pond	
		Location ID	E-JS02		E-JS02		EV-JS01		EV-JS01		EV-JS01		EV-JS02		EV-JS02		EV-JS02	
		Sample ID	E-JS-02-0-1_07142008		E-JS-02-1-3_07142008		EV-JS-01-0-1_07142008		EV-JS-01-1-3_07142008		EV-JS-01-5-7_07142008		EV-JS-02-0-1_07142008		EV-JS-02-1-3_07142008		EV-JS-02-5-7_07142008	
		Sample Date	7/14/2008		7/14/2008		7/14/2008		7/14/2008		7/14/2008		7/14/2008		7/14/2008		7/14/2008	
		Sample Depth (feet bgs)	0-1		1-3		0-1		1-3		5-7		0-1		1-3		5-7	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.3		< 1	U	1.1		0.4		< 1	U	0.3		< 1	U	< 1	U
Arsenic	7440-38-2	mg/kg	3		4		9.9		5.7		5.5		2.8		1.1		3.5	
Barium	7440-39-3	mg/kg	183		75.1		122		213		169		105		96.2		142	
Beryllium	7440-41-7	mg/kg	0.3		0.5		0.2		0.4		0.6		0.2		< 1	U	< 1	U
Cadmium	7440-43-9	mg/kg	0.5		< 2	U	0.6		1.6		6		< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	7		6		6		9		7		4		7		20	
Cobalt	7440-48-4	mg/kg	10		8		7		15		12		9		10		9	
Copper	7440-50-8	mg/kg	1160		1290		3380		5440		1550		2020		583		890	
Lead	7439-92-1	mg/kg	83.5		10.2		196		73.8		12		19.1		1.59		11.3	
Manganese	7439-96-5	mg/kg	408		719		208		402		342		330		357		394	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	138		98		547		258		77		67		11		37	
Nickel	7440-02-0	mg/kg	15		12		11		18		14		14		13		17	
Selenium	7782-49-2	mg/kg	0.57		0.67		3.43		1.85		1.69		0.47		1.02		0.46	
Thallium	7440-28-0	mg/kg	0.21		< 0.3	U	0.4		0.44		0.1		0.1		0.12		0.14	
Uranium	7440-61-1	mg/kg	3.62		9.68		4.26		7.05		8.51		2.87		4.14		5.53	
Zinc	7440-66-6	mg/kg	98		87		100		224		407		124		54		77	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond	
		Location ID	OD-JS01		OD-JS01		OD-JS02		OD-JS02		OD-JS02		OD-JS03		OD-JS03		OD-SD01	
		Sample ID	OD-JS-01-0-1_07292008		OD-JS-01-1-3_07292008		OD-JS-02-0-1_07292008		OD-JS-02-1-3_07292008		OD-JS-02-5-7_07292008		OD-JS-03-0-1_08272008		OD-JS-03-1-3_08272008		OD-SD-01-0-1.5_07282008	
		Sample Date	7/29/2008		7/29/2008		7/29/2008		7/29/2008		7/29/2008		8/27/2008		8/27/2008		7/28/2008	
		Sample Depth (feet bgs)	0-1		1-3		0-1		1-3		5-7		0-1		1-3		0-1.5	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.3		< 1	U	0.4		< 1	U	< 1	U	0.6		0.4		0.3	
Arsenic	7440-38-2	mg/kg	3.6		1.8		3.4		1.4		0.8		10.6		6.4		2	
Barium	7440-39-3	mg/kg	121		149		96.8		170		139		118		114		184	
Beryllium	7440-41-7	mg/kg	0.3		< 1	U	< 1	U	0.5		0.5		0.3		< 1	U	0.4	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	15		9		8		9		9		8		5		13	
Cobalt	7440-48-4	mg/kg	9		10		7		13		11		8		6		11	
Copper	7440-50-8	mg/kg	1770		121		1840		1310		110		1470		1510		361	
Lead	7439-92-1	mg/kg	17.7		2.1		13.8		4.43		2.12		19.3		10.6		5.32	
Manganese	7439-96-5	mg/kg	231		328		250		391		378		236		203		332	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	95		8		304		9		8		97		74		87	
Nickel	7440-02-0	mg/kg	6		7		6		9		9		7		6		30	
Selenium	7782-49-2	mg/kg	1.1		0.11		1.44		0.11		0.71		0.85		0.72		0.23	
Thallium	7440-28-0	mg/kg	0.25		0.28		0.28		0.32		0.35		0.23		0.23		0.29	
Uranium	7440-61-1	mg/kg	5.3		2.54		2.92		3.68		7.34		4.32		3.31		3.11	
Zinc	7440-66-6	mg/kg	99		42		83		89		45		111		71		51	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond		Old D Pond	
		Location ID	OD-SD01		OD-SD02		OD-SD02		OD-SD03		OD-SD03		OD-SD04		OD-SD04	
		Sample ID	OD-SD-01-1.5-3.0_07282008		OD-SD-02-0-1.5_07282008		OD-SD-02-1.5-3.0_07282008		OD-SD-03-0-1.5_07282008		OD-SD-03-1.5-3.0_07282008		OD-SD-04-0-1.5_07282008		OD-SD-04-1.5-3.0_07282008	
		Sample Date	7/28/2008		7/28/2008		7/28/2008		7/28/2008		7/28/2008		7/28/2008		7/28/2008	
		Sample Depth (feet bgs)	1.5-3		0-1.5		1.5-3		0-1.5		1.5-3		0-1.5		1.5-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	0.2		< 1	U	0.3		< 2	U	0.3		< 1	U
Arsenic	7440-38-2	mg/kg	1.2		2.2		0.9		2.7		2.8		3.1		2.1	
Barium	7440-39-3	mg/kg	185		173		173		158		87.9	J	118		133	
Beryllium	7440-41-7	mg/kg	< 1	U	0.5		0.2		0.4		0.3		0.4		0.3	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	0.5		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	14		13		9		18		13		11		9	
Cobalt	7440-48-4	mg/kg	10		12		9		11		8		11		9	
Copper	7440-50-8	mg/kg	125		376		27		2350		4390		1640		671	
Lead	7439-92-1	mg/kg	2.59		7.63		1.89		46.7		253		8.86		2.2	
Manganese	7439-96-5	mg/kg	346		390		320		316		173		262		258	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	0.05		< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	6		107		3		100		145		128		25	
Nickel	7440-02-0	mg/kg	29		32		26		31		30		29		27	
Selenium	7782-49-2	mg/kg	0.08		0.42		0.07		0.41		0.4		0.53		0.19	
Thallium	7440-28-0	mg/kg	0.28		0.3		0.32		0.28		0.2		0.3		0.26	
Uranium	7440-61-1	mg/kg	7.42		4.66		3.37		7.57		7.8		4.25		2.18	
Zinc	7440-66-6	mg/kg	43		60		41		147		201		68		48	

Appendix A, Table A-1
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Old D Pond		Old D Pond		Old D Pond		Old D Pond	
		Location ID	OD-SD05		OD-SD05		OD-SD06		OD-SD06	
		Sample ID	OD-SD-05-0-1.5_07292008		OD-SD-05-1.5-3.0_07292008		OD-SD-06-0-1.5_07292008		OD-SD-06-1.5-3.0_07292008	
		Sample Date	7/29/2008		7/29/2008		7/29/2008		7/29/2008	
		Sample Depth (feet bgs)	0-1.5		1.5-3		0-1.5		1.5-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.8		0.3		0.5		< 1	U
Arsenic	7440-38-2	mg/kg	6.2		4.6		5.3		3.2	
Barium	7440-39-3	mg/kg	141	J	169		109		122	
Beryllium	7440-41-7	mg/kg	0.6		0.5		0.5		0.5	
Cadmium	7440-43-9	mg/kg	1.1		< 2	U	< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	22		13		13		12	
Cobalt	7440-48-4	mg/kg	13		12		11		14	
Copper	7440-50-8	mg/kg	3960		916		2590		1130	
Lead	7439-92-1	mg/kg	102		35.3		29.3		7.26	
Manganese	7439-96-5	mg/kg	365		402		334		552	
Mercury	7439-97-6	mg/kg	0.05		< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	230		63		115		9	
Nickel	7440-02-0	mg/kg	8		7		7		11	
Selenium	7782-49-2	mg/kg	1.04		0.47		1.04		0.23	
Thallium	7440-28-0	mg/kg	0.39		0.28		0.3		0.23	
Uranium	7440-61-1	mg/kg	5.57		10.3		4.33		6.42	
Zinc	7440-66-6	mg/kg	179		105		198		218	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

	Location Subarea		Esperanza Mill		Esperanza Mill		Esperanza Mill		Raffinate Pond		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Laydown Yard	
	Location ID		EM-03		EM-04		EM-05		EM-09		EM-10		EM-13		EM-14		EM-17		EM-18		EM-20	
	Sample ID		EM-3 081304		EM-4 081304		EM-5 081304		EM-9 081304		EM-10 081304		EM-13 081304		EM-14 081304		EM-17 081304		EM-18 081304		EM-20 081304	
	Sample Date		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004		8/13/2004	
	Sample Depth (feet bgs)		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25		0-0.25	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	4.7		0.9		0.3		0.6		0.6		0.3		0.4		69		0.7		2.0	
Arsenic	7440-38-2	mg/kg	34.80		10.80		3.62		5.01		9.52		4.23		11.80		101		10.40		13.70	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	1		0.55		0.37		0.44		0.93		0.72		0.26		0.33		0.48		0.55	
Cadmium	7440-43-9	mg/kg	5.65		2.55		0.59		0.57		1.78		0.83		0.85		2.8		2.31		2.39	
Chromium	7440-47-3	mg/kg	6		10		7		8		10		8		14		3		8		17	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		12		NA		< 5	U	3		NA		NA	
Copper	7440-50-8	mg/kg	11600		8360		1880		522		814		668		409		2330		3560		4710	
Lead	7439-92-1	mg/kg	133		61.9		12.00		38.10		54.50		12.7		8.87		80.7		54.80		87.8	
Manganese	7439-96-5	mg/kg	715		657		323		340		538		172		30		75.5		173		405	
Mercury	7439-97-6	mg/kg	0.14		0.08		< 0.04	U	< 0.04	U	< 0.04	U	< 0.05	U	< 0.05	U	0.3		0.04		0.07	
Molybdenum	7439-98-7	mg/kg	1570		630		122		230		239		2640		471		1690		1470		6500	
Nickel	7440-02-0	mg/kg	11		25		8		5		8		8		< 5	U	< 1	U	4		14	
Selenium	7782-49-2	mg/kg	9.4		1.5		< 0.5	U	< 0.5	U	0.7		< 0.5	U	1.0		< 5	U	2.9		5.5	
Thallium	7440-28-0	mg/kg	0.17		0.15		0.27		NA		0.22		0.27		0.89		< 0.3	U	0.19		0.2	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	824		443		195		NA		256		64		29		77		67		234	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Esperanza Mill		C Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill	
		Location ID	EM-21		EM-26		EM-T01		EM-T01		EM-T01		EM-T01		EM-T02		EM-T02		EM-T02B		EM-T03	
		Sample ID	EM-21 081304		EM-26 081304		EM-T-1-1.5 100504		EM-T-1-13 100504		EM-T-1-2 100504		EM-T-1-6 100504		EM-T-2-2 100504		EM-T-2-2.5 100504		EM-T-2-B-18 100504		EM-T-3-12 100504	
		Sample Date	8/13/2004		8/13/2004		10/5/2004		10/5/2004		10/5/2004		10/5/2004		10/5/2004		10/5/2004		10/5/2004		10/5/2004	
		Sample Depth (feet bgs)	0-0.25		0-0.25		1.5		13		2		6		2		2.5		1.5		12	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.5		2.5		1.4		NA		NA		0.5		NA		< 0.2	U	0.3		NA	
Arsenic	7440-38-2	mg/kg	4.09		23.00		28.30		1.35		23.00		5.49		3.58		5.3		6.4		3.52	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Beryllium	7440-41-7	mg/kg	0.17		2.36		0.41		0.69		0.82		0.85		0.51		0.7		0.9		1.43	
Cadmium	7440-43-9	mg/kg	0.32		1.99		1.3		NA		NA		0.26		NA		3.6		0.5		NA	
Chromium	7440-47-3	mg/kg	2		15		9		NA		NA		12		NA		36		33		NA	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	4		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Copper	7440-50-8	mg/kg	514		5220		2200		159		9850		1700		533		1170		1400		733	
Lead	7439-92-1	mg/kg	8.79		127		60.90		65.90		63.60		36.50		17.20		19.0		17.5		12.40	
Manganese	7439-96-5	mg/kg	110		928		151		NA		NA		146		NA		31		198		NA	
Mercury	7439-97-6	mg/kg	< 0.04	U	0.18		< 0.05	U	NA		NA		0.06		NA		< 0.05	U	< 0.04	U	NA	
Molybdenum	7439-98-7	mg/kg	151		936		305		3		229		24		16		1050		103		20	
Nickel	7440-02-0	mg/kg	< 1	U	20		6		NA		NA		9		NA		< 5	U	< 5	U	NA	
Selenium	7782-49-2	mg/kg	1.5		2.2		3.76		NA		NA		0.41		NA		0.9		2.2		NA	
Thallium	7440-28-0	mg/kg	0.07		0.4		NA		NA		NA		NA		NA		1.1		0.2		NA	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Zinc	7440-66-6	mg/kg	25		429		NA		NA		NA		NA		NA		40		169		NA	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Esperanza Mill		Esperanza Mill		C Pond		C Pond		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill	
		Location ID	EM-T03		EM-T03		EM-T04		EM-T04		EM-JS01		EM-JS01		C22		C22		C22	
		Sample ID	EM-T-3-4 100504		EM-T-3-6 100504		EM-T-4-10 100504		EM-T-4-6 100504		EM-JS-01-0-1_08012008		EM-JS-01-1-3_08012008		EM-C22-0-1_07292008		EM-C22-1-3_07292008		EM-C22-5-7_07292008	
		Sample Date	10/5/2004		10/5/2004		10/5/2004		10/5/2004		8/1/2008		8/1/2008		7/29/2008		7/29/2008		7/29/2008	
		Sample Depth (feet bgs)	4		6		10		6		0-1		1-3		0-1		1-3		5-7	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	3.1		2.0		NA		0.7		0.5		< 1	U	2		0.5		< 1	U
Arsenic	7440-38-2	mg/kg	38.8		4.70		2.66		6.77		4.3		3.1		13.9		5.1		2.2	
Barium	7440-39-3	mg/kg	NA		NA		NA		NA		103		228		82.7		161		234	
Beryllium	7440-41-7	mg/kg	0.9		1.03		0.76		0.76		0.6		0.8		0.5		0.5		0.5	
Cadmium	7440-43-9	mg/kg	1.6		1.37		NA		2.83		< 2	U	0.8		0.8		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	90		8		NA		7		7		11		19		13		10	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	NA		NA		NA		NA		8		10		16		13		14	
Copper	7440-50-8	mg/kg	1850		1270		643		2020		840		543		5480		1120		739	
Lead	7439-92-1	mg/kg	43.8		10.80		21.60		64.30		24		9.8		85.2		12.1		5.13	
Manganese	7439-96-5	mg/kg	212		593		NA		250		238		388		323		378		370	
Mercury	7439-97-6	mg/kg	< 0.05	U	< 0.04	U	NA		0.05		< 0.2	U	< 0.2	U	0.2		< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	260		21		88		550		143		8		4800		270		5	
Nickel	7440-02-0	mg/kg	< 5	U	8		NA		6		7		13		5		9		8	
Selenium	7782-49-2	mg/kg	0.9		0.31		NA		2.27		0.46		0.12		7.25		0.28		0.15	
Thallium	7440-28-0	mg/kg	0.2		0.16		NA		0.21		< 0.28	U	< 0.26	U	0.21		0.25		0.26	
Uranium	7440-61-1	mg/kg	NA		NA		NA		NA		2.9		3.64		4.74		3.37		2.45	
Zinc	7440-66-6	mg/kg	111		209		NA		104		88		187		332		122		85	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill	
		Location ID	E24		E24		E24		G27		G27		H22		H22		H22	
		Sample ID	EM-E24-0-1_07292008		EM-E24-1-3_07292008		EM-E24-5-7_07292008		EM-G27-0-1_08072008		EM-G27-1-3_08072008		EM-H22-0-1_07302008		EM-H22-1-3_07302008		EM-H22-5-7_07312008	
		Sample Date	7/29/2008		7/29/2008		7/29/2008		8/7/2008		8/7/2008		7/30/2008		7/30/2008		7/31/2008	
		Sample Depth (feet bgs)	0-1		1-3		5-7		0-1		1-3		0-1		1-3		5-7	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.6		1		0.2		0.3		< 1	UJ	3.7		0.4		< 1	U
Arsenic	7440-38-2	mg/kg	5		7.6		2.2		3.5		1.2		11.7		3.7		1.1	
Barium	7440-39-3	mg/kg	149		116		198		81.2		126		115	J	70.4		199	
Beryllium	7440-41-7	mg/kg	0.8		0.9		0.6		0.5		0.4		0.5		0.3		0.5	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	1.6		1		1.7	
Chromium	7440-47-3	mg/kg	10		11		12		6		4		8		5		6	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	9		10		14		7		11		10		5		14	
Copper	7440-50-8	mg/kg	2270		2470		364		2750		933		10000		2330		1740	
Lead	7439-92-1	mg/kg	26.5		47.9		13.1		30.9		3.92		91.3		15		3.75	
Manganese	7439-96-5	mg/kg	364		369		434		233		399		294		188		594	
Mercury	7439-97-6	mg/kg	0.04		< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	0.05		< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	234		362		57		403		3		821		118		10	
Nickel	7440-02-0	mg/kg	2		3		10		5		7		7		7		14	
Selenium	7782-49-2	mg/kg	1.65		2.42		0.32		0.8		0.07		4.53		1.07		0.06	
Thallium	7440-28-0	mg/kg	0.18		0.22		0.38		0.2		0.29		0.42		0.24		0.51	
Uranium	7440-61-1	mg/kg	4.05		5.32		4.07		2.8		3.7		3.34		2.3		3.75	
Zinc	7440-66-6	mg/kg	132		159		68		90		57		293		181		464	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill	
		Location ID	K24		K24		K24		M26		M26		M26		N29		N29	
		Sample ID	EM-K24-0-1_07312008		EM-K24-1-3_07312008		EM-K24-5-7_07312008		EM-M26-0-1_08012008		EM-M26-1-3_08012008		EM-M26-5-7_08012008		EM-N29-0-1_08062008		EM-N29-1-3_08062008	
		Sample Date	7/31/2008		7/31/2008		7/31/2008		8/1/2008		8/1/2008		8/1/2008		8/6/2008		8/6/2008	
		Sample Depth (feet bgs)	0-1		1-3		5-7		0-1		1-3		5-7		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	0.2		< 1	U	< 1	U	0.3		0.2		0.4		0.6	
Arsenic	7440-38-2	mg/kg	3		2.5		2.4		2.6		3.7		4.6		5.2		7.5	
Barium	7440-39-3	mg/kg	78.7		79.4		152		126		48.4		67.5		56		65.9	
Beryllium	7440-41-7	mg/kg	0.8		0.6		0.6		< 1	U	0.4		0.7		0.9		1.1	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	0.5		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	7		8		6		7		8		10		9		6	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	8		5		8		5		4		6		6		17	
Copper	7440-50-8	mg/kg	629		530		486		358		469		536		495		805	
Lead	7439-92-1	mg/kg	15.9		13.1		12.3		21.9		20.3		19.5		25.8		41.8	
Manganese	7439-96-5	mg/kg	175		124		241		146		109		144		194		429	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	66		19		24		66		23		44		124		94	
Nickel	7440-02-0	mg/kg	6		6		7		5		5		7		3		3	
Selenium	7782-49-2	mg/kg	0.52		0.21		0.27		0.35		0.28		0.16		0.5		0.79	
Thallium	7440-28-0	mg/kg	0.28		0.26		0.25		< 0.18	U	< 0.16	U	< 0.19	U	0.13		0.13	
Uranium	7440-61-1	mg/kg	2.5		3.16		2.89		3.13		5.3		5.57		1.96		2.7	
Zinc	7440-66-6	mg/kg	46		47		45		57		97		142		78		59	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		Esperanza Mill		C Pond	
			Location ID		P24		P24		P24		P24		X26		X26		X26		C-JS01	
			Sample ID		EM-P24-0-1_08072008		EM-P24-10-11_08072008		EM-P24-1-3_08072008		EM-P24-5-7_08072008		EM-X26-0-1_08062008		EM-X26-1-3_08062008		EM-X26-5-7_08062008		C-JS-01-0-1_08012008	
			Sample Date		8/7/2008		8/7/2008		8/7/2008		8/7/2008		8/6/2008		8/6/2008		8/6/2008		8/1/2008	
			Sample Depth (feet bgs)		0-1		10-11		1-3		5-7		0-1		1-3		5-7		0-1	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	< 1	U	< 1	U	< 1	U	0.4		< 1	U	0.5		0.4			
Arsenic	7440-38-2	mg/kg	2.3		2.1		2.6		2.3		3.2		1.7		4.5		5.3			
Barium	7440-39-3	mg/kg	104		132		79.9		86.5		94.8		52.8		101		79.2			
Beryllium	7440-41-7	mg/kg	0.7		0.9		0.5		0.4		0.6		0.2		0.5		0.6			
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U		
Chromium	7440-47-3	mg/kg	5		3		6		8		6		5		5		9			
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA			
Cobalt	7440-48-4	mg/kg	10		8		5		6		10		7		7		7			
Copper	7440-50-8	mg/kg	719		348		483		540		1390		424		1030		677			
Lead	7439-92-1	mg/kg	15		104		14.6		24.6		12.8		6.02		75.2		56.6			
Manganese	7439-96-5	mg/kg	379		293		146		230		356		199		232		338			
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	0.06		< 0.2	U		
Molybdenum	7439-98-7	mg/kg	60		9		260		106		154		51		307		135			
Nickel	7440-02-0	mg/kg	7		8		4		5		5		3		5		7			
Selenium	7782-49-2	mg/kg	0.36		0.14		0.48		0.27		0.52		0.27		0.63		0.33			
Thallium	7440-28-0	mg/kg	0.24		0.28		0.17		0.16		0.3		0.14		0.24		< 0.19	U		
Uranium	7440-61-1	mg/kg	4.54		6.46		5.44		3.97		3.78		2.38		5.86		3.39			
Zinc	7440-66-6	mg/kg	82		550		64		89		67		37		77		149			

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	C Pond		C Pond		C Pond		C Pond		C Pond		C Pond		C Pond		C Pond	
		Location ID	C-JS01		C-JS02		C-JS02		C-JS02		C-JS03		C-JS03		C-JS03		C-JS03	
		Sample ID	C-JS-01-1-3_08012008		C-JS-02-0-1_08012008		C-JS-02-1-3_08012008		C-JS-02-5-7_08012008		C-JS-03-0-1_08042008		C-JS-03-10-12_08042008		C-JS-03-1-3_08042008		C-JS-03-5-7_08042008	
		Sample Date	8/1/2008		8/1/2008		8/1/2008		8/1/2008		8/4/2008		8/4/2008		8/4/2008		8/4/2008	
		Sample Depth (feet bgs)	1-3		0-1		1-3		5-7		0-1		10-12		1-3		5-7	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.5		0.2		< 1	U	< 1	UJ	0.5		< 1	U	< 1	U	< 1	U
Arsenic	7440-38-2	mg/kg	4.5		3.4		1.8		1.6		6.6		2.2		3.3		2.7	
Barium	7440-39-3	mg/kg	136		116		64.9		143		82.5		85.8		136		88.1	
Beryllium	7440-41-7	mg/kg	0.7		1.3		0.5		0.7		1.4		0.7		0.7		0.6	
Cadmium	7440-43-9	mg/kg	0.6		1.7		< 2	U	1		< 2	U	< 2	U	0.7		< 2	U
Chromium	7440-47-3	mg/kg	8		8		6		4		11		8		8		12	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	8		14		5		9		12		4		8		6	
Copper	7440-50-8	mg/kg	763		794		399		442		1020		365		485		371	
Lead	7439-92-1	mg/kg	46.3		30.5		10		37.3	J	74.8		89.3		53.2		45.9	
Manganese	7439-96-5	mg/kg	329		551		170		373		573		211		351		256	
Mercury	7439-97-6	mg/kg	0.04		< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	194		99		18		5		199		7		37		18	
Nickel	7440-02-0	mg/kg	6		9		6		7		10		4		6		6	
Selenium	7782-49-2	mg/kg	0.4		0.39		0.18		0.07		< 0.69	U	< 0.41	U	< 0.29	U	< 0.23	U
Thallium	7440-28-0	mg/kg	< 0.18	U	< 0.19	U	< 0.12	U	< 0.19	U	0.2		0.18		0.22		0.15	
Uranium	7440-61-1	mg/kg	4.1		4.64		4.34		9.38		6.11		13		3.7		3.15	
Zinc	7440-66-6	mg/kg	188		362		180		1070		256		178		442		255	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	C Pond		C Pond		C Pond		C Pond		C Pond		C Pond		C Pond Spoils		C Pond Spoils	
		Location ID	C-JS04		C-JS04		C-JS04		C-JS04		C-JS05		C-JS05		CS-JS01		CS-JS01	
		Sample ID	C-JS-04-0-1_08052008		C-JS-04-10-12_08052008		C-JS-04-1-3_08052008		C-JS-04-5-7_08052008		C-JS-05-0-1_08052008		C-JS-05-1-3_08052008		CS-JS-01-0-1_08042008		CS-JS-01-10-12_08042008	
		Sample Date	8/5/2008		8/5/2008		8/5/2008		8/5/2008		8/5/2008		8/5/2008		8/4/2008		8/4/2008	
		Sample Depth (feet bgs)	0-1		10-12		1-3		5-7		0-1		1-3		0-1		10-12	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.4		0.7		< 1	U	< 1	U	0.2	J	0.3		0.5		1	
Arsenic	7440-38-2	mg/kg	8.9		4.7		1.4		2.3		4.2		11.2		8.7		5.8	
Barium	7440-39-3	mg/kg	73		88.1		137		152		120		104	J	82.3		123	
Beryllium	7440-41-7	mg/kg	1.2		0.4		0.5		0.6		0.9		< 1	U	0.6		0.7	
Cadmium	7440-43-9	mg/kg	< 2	U	2.1		< 2	U	< 2	U	1.2		0.6		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	23		9		6		11		16		3		14		9	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		< 4	U	NA	
Cobalt	7440-48-4	mg/kg	12		11		7		11		10		1		7		12	
Copper	7440-50-8	mg/kg	671		2780		491		420		481		185		423		4580	
Lead	7439-92-1	mg/kg	44.4		41.4		15.1		56.1		477		3740		65.1		47.9	
Manganese	7439-96-5	mg/kg	664		187		333		388		838		78.1	J	386		392	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	98		537		16		38		74		18		142		735	
Nickel	7440-02-0	mg/kg	11		6		6		8		7		< 5	U	6		5	
Selenium	7782-49-2	mg/kg	0.3		2.39		0.15		0.26		< 1	U	< 5	U	< 0.62	U	< 3.37	U
Thallium	7440-28-0	mg/kg	0.18		0.22		0.28		0.27		0.18		0.62		0.22		0.27	
Uranium	7440-61-1	mg/kg	4.05		7.23		3.28		3.23		5.66		4.19		3.67		6.9	
Zinc	7440-66-6	mg/kg	245		135		45		106		315		156	J	124		150	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils	
			Location ID		CS-JS01		CS-JS01		CS-JS02		CS-JS02		CS-JS02		CS-JS02		CS-JS03	
			Sample ID		CS-JS-01-1-3_08042008		CS-JS-01-5-7_08042008		CS-JS-02-0-1_08042008		CS-JS-02-10-11_08042008		CS-JS-02-1-3_08042008		CS-JS-02-5-7_08042008		CS-JS-03-0-1_08052008	
			Sample Date		8/4/2008		8/4/2008		8/4/2008		8/4/2008		8/4/2008		8/4/2008		8/5/2008	
			Sample Depth (feet bgs)		1-3		5-7		0-1		10-11		1-3		5-7		0-1	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	0.3		0.3		0.7	J	0.2		< 1	U	0.3			
Arsenic	7440-38-2	mg/kg	2.2		3.6		4		5.3		3.3		1.6		3.8			
Barium	7440-39-3	mg/kg	121		146		157		138		85.6		366		95.4			
Beryllium	7440-41-7	mg/kg	0.6		0.7		0.6		0.6		0.7		0.5		0.4			
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	8.3		< 2	U	< 2	U	< 2	U		
Chromium	7440-47-3	mg/kg	37		5		8		5		7		5		8			
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA			
Cobalt	7440-48-4	mg/kg	8		10		9		12		7		11		17			
Copper	7440-50-8	mg/kg	432		602		640		448		448		131		562			
Lead	7439-92-1	mg/kg	90.5		343		126		376		25.7		20.3		57.2			
Manganese	7439-96-5	mg/kg	546		486		348		717		269		430		279			
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U		
Molybdenum	7439-98-7	mg/kg	54		134		81		15		28		5		51			
Nickel	7440-02-0	mg/kg	6		5		6		8		5		9		5			
Selenium	7782-49-2	mg/kg	< 0.26	U	< 0.48	U	< 0.41	U	< 0.24	U	< 0.32	U	< 0.19	U	0.28			
Thallium	7440-28-0	mg/kg	0.2		0.23		0.32		0.4		0.26		0.38		0.17			
Uranium	7440-61-1	mg/kg	4.66		6.09		3.77		7.77		3.28		3		11			
Zinc	7440-66-6	mg/kg	172		302		218		3630		269		1140		129			

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils	
		Location ID	CS-JS03		CS-JS03		CS-JS03		CS-JS04		CS-JS04		CS-JS04		CS-JS05		CS-JS05	
		Sample ID	CS-JS-03-10-12_08052008		CS-JS-03-1-3_08052008		CS-JS-03-5-7_08052008		CS-JS-04-0-1_08062008		CS-JS-04-1-3_08062008		CS-JS-04-5-7_08062008		CS-JS-05-0-1_08272008		CS-JS-05-1-3_08272008	
		Sample Date	8/5/2008		8/5/2008		8/5/2008		8/6/2008		8/6/2008		8/6/2008		8/27/2008		8/27/2008	
		Sample Depth (feet bgs)	10-12		1-3		5-7		0-1		1-3		5-7		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.3		0.3		0.2		0.4		0.6	J	< 1	U	0.2		0.5	
Arsenic	7440-38-2	mg/kg	3.3		3.5		2.9		3.2		4.3		1.6		3.9		14.6	
Barium	7440-39-3	mg/kg	201		123		142		111		101		216		294		103	
Beryllium	7440-41-7	mg/kg	0.4		0.6		0.6		0.4		0.4		0.6		0.5		0.6	
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	1.4		< 2	U	1.7	
Chromium	7440-47-3	mg/kg	8		8		13		7		17		6		5		4	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	11		8		10		8		8		14		12		6	
Copper	7440-50-8	mg/kg	641		802		770		557		658		425		116		148	
Lead	7439-92-1	mg/kg	71.4		48.8		88.7		131		18.2		16.3		38.1		280	
Manganese	7439-96-5	mg/kg	371		273		478		375		209		495		515		538	
Mercury	7439-97-6	mg/kg	0.04		< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U
Molybdenum	7439-98-7	mg/kg	98		66		46		281		822		8		19		17	
Nickel	7440-02-0	mg/kg	9		6		10		6		5		9		11		6	
Selenium	7782-49-2	mg/kg	0.34		0.37		0.3		0.49		0.88		0.1		0.16		0.39	
Thallium	7440-28-0	mg/kg	0.35		0.23		0.31		0.31		0.19		0.4		0.36		0.17	
Uranium	7440-61-1	mg/kg	3		3.24		3.01		2.94		3.42		3.29		5.08		8.01	
Zinc	7440-66-6	mg/kg	456		154		217		207		76		451		134		502	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		C Pond Spoils		C Pond Spoils		C Pond Spoils		C Pond Spoils		Laydown Yard		Laydown Yard	
			Location ID		CS-JS06		CS-JS06		U25		U25		EM-JS02		EM-JS02	
			Sample ID		CS-JS-06-0-1_08272008		CS-JS-06-1-3_08272008		EM-U25-0-1_08062008		EM-U25-1-3_08062008		EM-U25-5-5.5_08062008		EM-JS-02-0-1_08012008		EM-JS-02-1-3_08012008	
			Sample Date		8/27/2008		8/27/2008		8/6/2008		8/6/2008		8/6/2008		8/1/2008		8/1/2008	
			Sample Depth (feet bgs)		0-1		1-3		0-1		1-3		5-5.5		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.2		0.2	J	0.4		0.4		0.3		0.4		< 1	U
Arsenic	7440-38-2	mg/kg	1.6		1.2		3.2		4.6		8.6		5.1		3.4	
Barium	7440-39-3	mg/kg	213		168		265		156		88.7		115		89.6	
Beryllium	7440-41-7	mg/kg	0.4		0.5		0.6		0.7		0.6		0.7		0.5	
Cadmium	7440-43-9	mg/kg	< 2	U	1		0.6		< 2	U	0.6		0.9		1.5	
Chromium	7440-47-3	mg/kg	5		5		7		8		7		7		5	
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA	
Cobalt	7440-48-4	mg/kg	16		11		10		11		9		9		6	
Copper	7440-50-8	mg/kg	175		149		728		1210		204		2160		722	
Lead	7439-92-1	mg/kg	30.5		3.5		100		136		433		187		576	
Manganese	7439-96-5	mg/kg	501		373		398		366		693		566		684	
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	< 0.2	U	0.05		0.11		< 0.2	U
Molybdenum	7439-98-7	mg/kg	7		3		113		292		57		382		8	
Nickel	7440-02-0	mg/kg	12		9		7		7		6		9		5	
Selenium	7782-49-2	mg/kg	0.14		0.13		0.32		0.72		0.26		0.55		0.23	
Thallium	7440-28-0	mg/kg	0.49		0.5		0.25		0.23		0.15		< 0.22	U	< 0.17	U
Uranium	7440-61-1	mg/kg	3.15		2.88		3.65		3.89		14.1		6.85		10.2	
Zinc	7440-66-6	mg/kg	168		257		234		233		971		531		640	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea	Laydown Yard		Laydown Yard		Laydown Yard		Laydown Yard		Laydown Yard		Laydown Yard		Laydown Yard	
			Location ID	EM-JS06		EM-JS06		EM-JS06		EM-JS06		EM-JS07		EM-JS07		EM-JS07	
			Sample ID	EM-JS-06-0-1_08132008		EM-JS-06-10-11_08132008		EM-JS-06-1-3_08132008		EM-JS-06-5-7_08132008		EM-JS-07-0-1_08132008		EM-JS-07-10-12_08132008		EM-JS-07-1-3_08132008	
			Sample Date	8/13/2008		8/13/2008		8/13/2008		8/13/2008		8/13/2008		8/13/2008		8/13/2008	
			Sample Depth (feet bgs)	0-1		10-11		1-3		5-7		0-1		10-12		1-3	
Analyte	CASRN	Units		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg		1.5		2.1		1		0.9		1.4		2.6		2.3	
Arsenic	7440-38-2	mg/kg		10.3		15.8		6.5		8.1		11.7		16.1		10.7	
Barium	7440-39-3	mg/kg		45		142		40.2		39.2		96.2		62.6		77.8	
Beryllium	7440-41-7	mg/kg		0.7		0.9		0.4		0.5		0.2		0.5		0.7	
Cadmium	7440-43-9	mg/kg		< 2	U	1		< 2	U	< 2	U	0.6		2		0.7	
Chromium	7440-47-3	mg/kg		9		22		6		14		12		36		13	
Chromium VI	18540-29-9	mg/kg		NA		NA		NA		NA		NA		< 4	U	NA	
Cobalt	7440-48-4	mg/kg		18		16		14		17		19		25		17	
Copper	7440-50-8	mg/kg		4090		5870		1900		2650		3770		5150		4840	
Lead	7439-92-1	mg/kg		86.1		93.3		33.5		157		96.4		147		151	
Manganese	7439-96-5	mg/kg		448		579		288		371		382		645		556	
Mercury	7439-97-6	mg/kg		0.06		0.05		< 0.2	U	< 0.2	U	0.09		0.23		0.05	
Molybdenum	7439-98-7	mg/kg		1180		481		472		309		6830		5610		1000	
Nickel	7440-02-0	mg/kg		4		19		2		4		< 5	U	16		10	
Selenium	7782-49-2	mg/kg		3.01		1.85		2.58		2.53		3.68		3.96		2.77	
Thallium	7440-28-0	mg/kg		0.21		0.25		0.19		0.21		0.27		0.26		0.21	
Uranium	7440-61-1	mg/kg		6.63		18.1		4.13		5.12		6.01		9.21		8.97	
Zinc	7440-66-6	mg/kg		161		283		53		110		122		393		238	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		Laydown Yard		Laydown Yard		Laydown Yard		Laydown Yard		Laydown Yard		Raffinate Pond		Raffinate Pond	
			Location ID		EM-JS07		EM-JS08		EM-JS08		EM-JS08		EM-JS08		RA-JS01		RA-JS01	
			Sample ID		EM-JS-07-5-7_08132008		EM-JS-08-0-1_08122008		EM-JS-08-10-12_08122008		EM-JS-08-1-3_08122008		EM-JS-08-5-7_08122008		RA-JS-01-0-1_08072008		RA-JS-01-1-3_08072008	
			Sample Date		8/13/2008		8/12/2008		8/12/2008		8/12/2008		8/12/2008		8/7/2008		8/7/2008	
			Sample Depth (feet bgs)		5-7		0-1		10-12		1-3		5-7		0-1		1-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	1.2		1.1		2	J	0.4		13.6		0.6		0.8	
Arsenic	7440-38-2	mg/kg	9.1		11.9	J	16		7.7	J	64.8	J	9.7		16.8	
Barium	7440-39-3	mg/kg	75.8		55.7		77.6		47.3		150		67.3		99.1	
Beryllium	7440-41-7	mg/kg	0.7		< 1	U	0.9		< 1	U	< 1	U	0.9		2.1	
Cadmium	7440-43-9	mg/kg	0.9		< 2	U	5.3		< 2	U	5		< 2	U	< 2	U
Chromium	7440-47-3	mg/kg	10		5		193		2		36	J	5		8	
Chromium VI	18540-29-9	mg/kg	NA		NA		4	R	NA		< 9	U	NA		NA	
Cobalt	7440-48-4	mg/kg	17		4		23		5		42		7		13	
Copper	7440-50-8	mg/kg	3840		2040		4120		1800		26800		3550		4020	
Lead	7439-92-1	mg/kg	144		57		303		152		999		64.7		120	
Manganese	7439-96-5	mg/kg	590		166		683		190		932		401		566	
Mercury	7439-97-6	mg/kg	0.07		0.08		0.4		0.09		0.6		0.07		0.08	
Molybdenum	7439-98-7	mg/kg	343		1240		2220		315		6470		955		767	
Nickel	7440-02-0	mg/kg	11		< 5	U	29		< 5	U	33		4		7	
Selenium	7782-49-2	mg/kg	2.13		3.24		2.86		3.38		7.85		1.9		2.17	
Thallium	7440-28-0	mg/kg	0.26		0.12		0.17		0.2		0.22		0.22		0.28	
Uranium	7440-61-1	mg/kg	6.49		2.41		7.78		1.17		5.2		4.42		13.4	
Zinc	7440-66-6	mg/kg	274		39		741		39		1550		133		173	

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond	
			Location ID		RA-JS01		RA-JS02		RA-JS02		RA-JS02		RA-JS03		RA-JS03		RA-JS04	
			Sample ID		RA-JS-01-5-7_08072008		RA-JS-02-0-1_08112008		RA-JS-02-1-3_08112008		RA-JS-02-5-7_08112008		RA-JS-03-0-1_08072008		RA-JS-03-1-3_08072008		RA-JS-04-0-1_08072008	
			Sample Date		8/7/2008		8/11/2008		8/11/2008		8/11/2008		8/7/2008		8/7/2008		8/7/2008	
			Sample Depth (feet bgs)		5-7		0-1		1-3		5-7		0-1		1-3		0-1	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	0.9		8		17.4		9.6		< 1	U	< 1	U	< 1	U		
Arsenic	7440-38-2	mg/kg	13.5		< 35.4	U	< 89.7	U	< 60	U	1.7		1.1		1.4			
Barium	7440-39-3	mg/kg	83.7		74.1		68.9		78.1		163		127		121			
Beryllium	7440-41-7	mg/kg	0.8		< 5	U	< 5	U	6.2		0.3		< 1	U	< 1	U		
Cadmium	7440-43-9	mg/kg	< 2	U	1.5		2.5		1.8		< 2	U	< 2	U	< 2	U		
Chromium	7440-47-3	mg/kg	6		10		18		35		5		4		4			
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		< 8	UJ	NA		NA		NA			
Cobalt	7440-48-4	mg/kg	16		17		22		26		7		6		6			
Copper	7440-50-8	mg/kg	7520		30200		27800		19600		113		62		201			
Lead	7439-92-1	mg/kg	78.6		137		349		199		4.99		2.81		10.8			
Manganese	7439-96-5	mg/kg	276		384		327		382		239		228		232			
Mercury	7439-97-6	mg/kg	< 0.2	U	0.36		0.28		0.32		< 0.2	U	< 0.2	U	< 0.2	U		
Molybdenum	7439-98-7	mg/kg	525		1430		3430		1950		26		12		13			
Nickel	7440-02-0	mg/kg	7		2		2		8		6		6		5			
Selenium	7782-49-2	mg/kg	2.43		< 11.1	U	< 9.76	U	< 6.25	U	0.13		0.05		0.09			
Thallium	7440-28-0	mg/kg	0.19		0.35		0.36		0.39		0.32		0.26		0.34			
Uranium	7440-61-1	mg/kg	6.59		5.63		8.62		29.9		3.7		3.33		2.75			
Zinc	7440-66-6	mg/kg	125		281		466		629		75		63		60			

Appendix A, Table A-2
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond		Raffinate Pond	
			Location ID		RA-JS04		RA-JS05		RA-JS05		RA-SD01		RA-SD01		RA-SD02		RA-SD02	
			Sample ID		RA-JS-04-1-2.5_08072008		RA-JS-05-0-1_08072008		RA-JS-05-1-3_08072008		RA-SD-01-0-1.5_08112008		RA-SD-01-1.5-3.0_08112008		RA-SD-02-0-1.5_08112008		RA-SD-02-1.5-3.0_08112008	
			Sample Date		8/7/2008		8/7/2008		8/7/2008		8/11/2008		8/11/2008		8/11/2008		8/11/2008	
			Sample Depth (feet bgs)		1-2.5		0-1		1-3		0-1.5		1.5-3		0-1.5		1.5-3	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	0.4		0.6		1.3		4		5.8		7.4			
Arsenic	7440-38-2	mg/kg	1		5.2		3.1		< 10.1	U	< 24.7	U	< 32.4	U	< 39.1	U		
Barium	7440-39-3	mg/kg	98.9		52.2		53.5		73.1		81.7		52.4		57.4			
Beryllium	7440-41-7	mg/kg	< 1	U	0.4		< 1	U	0.7		0.7		< 1	U	0.5			
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	0.8		< 2	U	< 2	U		
Chromium	7440-47-3	mg/kg	3		2		2		11		14		7		8			
Chromium VI	18540-29-9	mg/kg	NA		NA		NA		NA		NA		NA		NA			
Cobalt	7440-48-4	mg/kg	5		4		5		6		10		4		5			
Copper	7440-50-8	mg/kg	136		380		284		7630		6960		4210		4180			
Lead	7439-92-1	mg/kg	3		24.5		8.63		86.9		114		106		91.3			
Manganese	7439-96-5	mg/kg	220		169		210		277		226		108		181			
Mercury	7439-97-6	mg/kg	< 0.2	U	< 0.2	U	< 0.2	U	0.09		0.11		0.13		0.13			
Molybdenum	7439-98-7	mg/kg	< 5	U	157		25		998		1590		530		1000			
Nickel	7440-02-0	mg/kg	4		3		3		2		2		< 5	U	2			
Selenium	7782-49-2	mg/kg	0.06		0.33		0.15		2.61		3.46		3.13		3.02			
Thallium	7440-28-0	mg/kg	0.22		0.14		0.15		0.2		0.31		0.18		0.25			
Uranium	7440-61-1	mg/kg	3.4		6.88		8.31		7.72		10.9		2.12		3.98			
Zinc	7440-66-6	mg/kg	51		82		87		91		186		51		77			

Appendix A, Table A-3
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Rhenium Ponds - Metals
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

			Location Subarea		Rhenium Ponds		Rhenium Ponds		Rhenium Ponds		Rhenium Ponds		Rhenium Ponds		Rhenium Ponds		Rhenium Ponds		Rhenium Ponds	
			Location ID		RP-JS01		RP-JS01		RP-JS01		RP-JS01		RP-JS02		RP-JS02		RP-JS02		RP-JS02	
			Sample ID		RP-JS-01-0-1_08122008		RP-JS-01-10-12_08122008		RP-JS-01-1-3_08122008		RP-JS-01-5-7_08122008		RP-JS-02-0-1_08122008		RP-JS-02-10-12_08122008		RP-JS-02-1-3_08122008		RP-JS-02-5-7_08122008	
			Sample Date		8/12/2008		8/12/2008		8/12/2008		8/12/2008		8/12/2008		8/12/2008		8/12/2008		8/12/2008	
			Sample Depth (feet bgs)		0-1		10-12		1-3		5-7		0-1		10-12		1-3		5-7	
Analyte	CASRN	Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
Antimony	7440-36-0	mg/kg	< 1	U	< 1	U	< 1	U	< 1	U	0.2		0.3		< 1	U	< 1	U		
Arsenic	7440-38-2	mg/kg	3.5	J	2.6	J	3.1	J	1.9	J	3.5	J	3.3	J	3.5	J	5.2	J		
Barium	7440-39-3	mg/kg	127		50.8		46.1		49		303		50.9		47.3		188			
Beryllium	7440-41-7	mg/kg	0.6		0.3		0.2		< 1	U	1.6		0.5		< 1	U	0.8			
Cadmium	7440-43-9	mg/kg	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U		
Chromium	7440-47-3	mg/kg	4		2		4		2		7		2		3		4			
Cobalt	7440-48-4	mg/kg	5		5		5		5		10		16		2		10			
Copper	7440-50-8	mg/kg	124		466		183		137		63		323		74		123			
Lead	7439-92-1	mg/kg	11.4		9.69		12.7		6.43		10.8		14.5		8.5		7.69			
Manganese	7439-96-5	mg/kg	271		207		244		231		975		713		160		1250			
Mercury	7439-97-6	mg/kg	0.07		0.06		< 0.2	U	< 0.2	U	0.04		0.07		< 0.2	U	< 0.2	U		
Molybdenum	7439-98-7	mg/kg	51		126		86		33		6		93		121		32			
Nickel	7440-02-0	mg/kg	2		2		2		2		6		5		< 5	U	4			
Selenium	7782-49-2	mg/kg	0.91		1.04		0.8		0.6		0.34		0.93		0.74		0.7			
Thallium	7440-28-0	mg/kg	0.15		0.09		0.13		0.08		0.25		0.12		0.11		0.17			
Uranium	7440-61-1	mg/kg	2.64		2.25		2.44		1.26		2.11		9.12		1.07		2.12			
Zinc	7440-66-6	mg/kg	40		48		43		36		51		139		23		71			

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	CP-JS01				CP-JS01				CP-JS01				CP-JS01				CP-JS02				CP-JS02			
		Sample ID	CP-JS-01-0-1_07152008				CP-JS-01-10-12_07152008				CP-JS-01-1-3_07152008				CP-JS-01-5-7_07152008				CP-JS-02-0-1_07112008				CP-JS-02-1-3_07112008			
		Sample Date	7/15/2008				7/15/2008				7/15/2008				7/15/2008				7/11/2008				7/11/2008			
		Sample Depth (feet bgs)	0-1				10-12				1-3				5-7				0-1				1-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	0.64		0.59	0.44	2.4		0.33	0.71	2		0.37	0.54	2.8		0.6	0.49	2.9		0.46	0.8	1.1	J	0.42	0.28
Radium-228	15262-20-1	pCi/g	4.2		2.7	1.9	2.5		0.96	0.68	2.1	J	0.98	0.64	1.7	J	0.77	0.57	1.9	J	1.6	0.85	1.5	J	1.1	0.63
Uranium-234	13966-29-5	pCi/g	1.3		0.034	0.27	2.8		0.047	0.52	2.4		0.073	0.47	2		0.043	0.39	12		0.017	2	0.84		0.034	0.19
Uranium-235	15117-96-1	pCi/g	< 0.039	U	0.039	0.039	0.11		0.047	0.059	0.19		0.053	0.084	0.2		0.034	0.079	0.74		0.046	0.19	0.081		0.033	0.048
Uranium-238	ARC-U238	pCi/g	1.3		0.034	0.28	3		0.058	0.55	2.7		0.06	0.52	2.1		0.029	0.4	12		0.017	2	1		0.028	0.22

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	CP-JS03				CP-JS03				CP-JS03				CP-JS04				CP-JS04				CP-JS04			
		Sample ID	CP-JS-03-0-1_07142008				CP-JS-03-1-3_07142008				CP-JS-03-5-7_07142008				CP-JS-04-0-1_08272008				CP-JS-04-10-12_08272008				CP-JS-04-1-3_08272008			
		Sample Date	7/14/2008				7/14/2008				7/14/2008				8/27/2008				8/27/2008				8/27/2008			
		Sample Depth (feet bgs)	0-1				1-3				5-7				0-1				10-12				1-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.5		0.38	0.66	2.1		0.35	0.6	5.3		0.35	1.2	2.6		0.38	0.69	0.88	J	0.52	0.43	2.4		0.51	0.41
Radium-228	15262-20-1	pCi/g	2.3		0.87	0.61	2.3	J	0.89	0.64	2	J	0.74	0.52	2.3		0.99	0.62	1.8	J	0.66	0.57	1.7		1.1	0.53
Uranium-234	13966-29-5	pCi/g	2.6		0.036	0.49	2.3		0.027	0.42	3.6		0.03	0.65	3		0.051	0.55	2.9		0.11	0.52	2.3		0.073	0.45
Uranium-235	15117-96-1	pCi/g	0.11		0.048	0.059	0.072		0.032	0.044	0.2		0.042	0.081	0.081		0.076	0.059	0.19		0.052	0.078	0.14		0.086	0.083
Uranium-238	ARC-U238	pCi/g	2.7		0.036	0.5	2.2		0.033	0.42	3.6		0.036	0.64	2.6		0.058	0.48	3.1		0.077	0.55	2.2		0.052	0.45

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	CP-JS04				CP-SD01				CP-SD01				CP-SD02				CP-SD02				CP-SD03			
		Sample ID	CP-JS-04-5-7_08272008				CP-SD-01-0-1.5_07162008				CP-SD-01-1.5-3.0_07162008				CP-SD-02-0-1.5_07162008				CP-SD-02-1.5-3.0_07162008				CP-SD-03-0-1.5_07162008			
		Sample Date	8/27/2008				7/16/2008				7/16/2008				7/16/2008				7/16/2008				7/16/2008			
		Sample Depth (feet bgs)	5-7				0-1.5				1.5-3				0-1.5				1.5-3				0-1.5			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	5	J	0.62	0.75	2.1		0.41	0.61	2.2		0.42	0.39	1.5		0.54	0.34	1.5		0.35	0.47	2.8		0.094	0.79
Radium-228	15262-20-1	pCi/g	2.4	J	1.1	0.67	1.5		0.96	0.5	2.4		0.78	0.57	1.4	J	1	0.58	1.5		0.95	0.66	1.5	J	1	0.61
Uranium-234	13966-29-5	pCi/g	6.4		0.087	1.1	1.5		0.031	0.32	2.2		0.03	0.42	1.9		0.014	0.37	1.2		0.046	0.27	0.98		0.049	0.23
Uranium-235	15117-96-1	pCi/g	0.27		0.085	0.11	0.11		0.036	0.058	0.14		0.042	0.067	0.092		0.033	0.051	0.043		0.023	0.039	0.075		0.053	0.051
Uranium-238	ARC-U238	pCi/g	6.3		0.11	1.1	1.5		0.016	0.31	2.2		0.03	0.42	1.8		0.028	0.36	1.2		0.046	0.27	1.1		0.04	0.25

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	CP-SD03				CP-SD04				CP-SD04				CP-SD05				CP-SD05				CP-SD06			
		Sample ID	CP-SD-03-1.5-3.0_07162008				CP-SD-04-0-1.5_07172008				CP-SD-04-1.5-3.0_07172008				CP-SD-05-0-1.5_07162008				CP-SD-05-1.5-3.0_07162008				CP-SD-06-0-1.5_07162008			
		Sample Date	7/16/2008				7/17/2008				7/17/2008				7/16/2008				7/16/2008				7/16/2008			
		Sample Depth (feet bgs)	1.5-3				0-1.5				1.5-3				0-1.5				1.5-3				0-1.5			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.3		0.45	0.42	0.77		0.065	0.31	1.4		0.46	0.49	2.7		0.54	0.46	2.3		0.06	0.61	2.7		0.49	0.44
Radium-228	15262-20-1	pCi/g	1.8	J	0.78	0.59	2.7		1.6	0.81	2.3	J	1.5	0.84	2		1	0.56	2.1		0.96	0.62	2.1		0.91	0.59
Uranium-234	13966-29-5	pCi/g	1.8		0.13	0.42	1.9		0.059	0.42	1.4		0.031	0.29	2.1		0.05	0.4	2.3		0.1	0.49	1.7		0.037	0.34
Uranium-235	15117-96-1	pCi/g	< 0.097	U	0.097	0.08	0.097		0.069	0.075	0.11		0.036	0.058	0.15		0.035	0.068	0.098		0.038	0.076	0.095		0.039	0.052
Uranium-238	ARC-U238	pCi/g	1.9		0.031	0.42	2.1		0.041	0.46	1.3		0.031	0.27	2		0.04	0.39	1.9		0.11	0.44	1.9		0.028	0.37

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	CP-SD06				CP-SD07				CP-SD09				CP-SD09				CP-SD10				M04			
		Sample ID	CP-SD-06-1.5-3.0_07162008				CP-SD-07-1.5-3.0_07232008				CP-SD-09-0-1.5_07282008				CP-SD-09-1.5-3.0_07282008				CP-SD-10-1.5-3.0_07282008				CP-M04-1-2.5_07112008			
		Sample Date	7/16/2008				7/23/2008				7/28/2008				7/28/2008				7/28/2008				7/11/2008			
		Sample Depth (feet bgs)	1.5-3				1.5-3				0-1.5				1.5-3				1.5-3				1-2.5			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	3		0.51	0.49	2.1		0.45	0.38	3		0.26	0.76	1.6		0.42	0.55	0.61		0.58	0.4	2.3		0.56	0.42
Radium-228	15262-20-1	pCi/g	2.6		0.92	0.65	2.5		0.83	0.6	2		1	0.59	1.4		0.79	0.45	2.2	J	0.93	0.66	1.5	J	1.1	0.6
Uranium-234	13966-29-5	pCi/g	1.7		0.034	0.34	2		0.034	0.39	2.1		0.041	0.4	1.7		0.051	0.34	1.2		0.079	0.27	1.9		0.067	0.37
Uranium-235	15117-96-1	pCi/g	0.11		0.034	0.056	< 0.12	U	0.12	0.067	0.098		0.043	0.055	0.072		0.035	0.046	< 0.054	U	0.054	0.045	0.069		0.049	0.047
Uranium-238	ARC-U238	pCi/g	1.9		0.029	0.36	2.2		0.051	0.44	2.4		0.03	0.46	1.7		0.041	0.34	1.4		0.063	0.3	1.8		0.055	0.35

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	M04				M06				M06				N08				N08				N08			
		Sample ID	CP-M04-5-5.4_07112008				CP-M06-0-1_07112008				CP-M06-1-3_07112008				CP-N08-0-1_07112008				CP-N08-1-3_07112008				CP-N08-5-7_07112008			
		Sample Date	7/11/2008				7/11/2008				7/11/2008				7/11/2008				7/11/2008				7/11/2008			
		Sample Depth (feet bgs)	5-5.4				0-1				1-3				0-1				1-3				5-7			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	4		0.57	0.61	1.3	J	0.47	0.29	1		0.52	0.28	1.5		0.42	0.31	4.1		0.47	0.94	2.3		0.35	0.59
Radium-228	15262-20-1	pCi/g	2.5	J	1.1	0.72	1.2	J	0.9	0.45	1.6	J	1.2	0.64	1.6		0.72	0.47	3	J	0.96	0.8	2.4	J	1.2	0.78
Uranium-234	13966-29-5	pCi/g	3.8		0.034	0.68	1.1		0.065	0.24	0.88		0.034	0.2	1.5		0.043	0.32	3.9		0.05	0.7	4		0.058	0.72
Uranium-235	15117-96-1	pCi/g	0.2		0.017	0.079	0.063		0.056	0.046	0.056		0.034	0.04	0.089		0.037	0.053	0.2		0.036	0.082	0.18		0.038	0.079
Uranium-238	ARC-U238	pCi/g	3.8		0.034	0.68	1.1		0.047	0.23	1		0.034	0.22	1.8		0.047	0.36	4		0.042	0.71	4.3		0.044	0.78

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	O03				O03				O09				O09				O09				O09			
		Sample ID	CP-O03-0-1_07112008				CP-O03-1-3_07112008				CP-O09-0-1_07112008				CP-O09-10-12_07112008				CP-O09-1-3_07112008				CP-O09-5-7_07112008			
		Sample Date	7/11/2008				7/11/2008				7/11/2008				7/11/2008				7/11/2008				7/11/2008			
		Sample Depth (feet bgs)	0-1				1-3				0-1				10-12				1-3				5-7			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.1		0.44	0.38	3.3		0.5	0.52	1.4		0.29	0.42	< 0.4	U	0.4	0.3	1.2		0.44	0.44	1.7		0.42	0.54
Radium-228	15262-20-1	pCi/g	2		0.9	0.52	2.4		0.83	0.61	7.6	J	3.4	2.9	1.9	J	1.1	0.67	2.1		1	0.64	2.2	J	1.4	0.77
Uranium-234	13966-29-5	pCi/g	2.5		0.072	0.49	3.1		0.072	0.56	2.7		0.054	0.51	1.8		0.05	0.37	2		0.051	0.4	1.9		0.066	0.38
Uranium-235	15117-96-1	pCi/g	0.14		0.043	0.069	0.23		0.044	0.085	0.21		0.038	0.086	0.1		0.019	0.057	0.17	J	0.019	0.075	0.16		0.044	0.074
Uranium-238	ARC-U238	pCi/g	2.7		0.075	0.52	3.1		0.053	0.56	2.8		0.043	0.53	1.9		0.042	0.38	2		0.057	0.4	1.9		0.016	0.37

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant			
		Location ID	P04				P04				P05				P05				P07				P07			
		Sample ID	CP-P04-0-1_07152008				CP-P04-1-3_07152008				CP-P05-0-1_07152008				CP-P05-1-3_07152008				CP-P07-0-1_07172008				CP-P07-1-3_07172008			
		Sample Date	7/15/2008				7/15/2008				7/15/2008				7/15/2008				7/17/2008				7/17/2008			
		Sample Depth (feet bgs)	0-1				1-3				0-1				1-3				0-1				1-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.9		0.47	0.58	1.8		0.44	0.35	1.2		0.28	0.38	2.2		0.41	0.39	2.8		0.3	0.69	4.8		0.71	1.2
Radium-228	15262-20-1	pCi/g	2.5	J	0.88	0.7	2.1		0.91	0.57	2.5		0.94	0.63	1.9		0.72	0.52	2.8	J	0.9	0.69	2.8	J	1.3	0.78
Uranium-234	13966-29-5	pCi/g	2.5		0.016	0.48	2.3		0.055	0.45	2.9		0.038	0.54	2.5		0.045	0.47	2.2		0.11	0.49	2.4		0.1	0.52
Uranium-235	15117-96-1	pCi/g	0.17		0.019	0.075	0.19		0.049	0.084	0.27		0.045	0.1	0.22		0.036	0.085	0.21		0.04	0.12	0.19		0.04	0.11
Uranium-238	ARC-U238	pCi/g	2.5		0.047	0.47	1.9		0.062	0.39	3		0.032	0.57	2.6		0.041	0.48	2.9		0.079	0.62	2.6		0.089	0.56

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former CLEAR Plant				Former E Pond			
		Location ID	P07				P12				P12				Q09				Q09				E-JS01			
		Sample ID	CP-P07-5-7_07172008				CP-P12-0-1_07232008				CP-P12-1-3_07232008				CP-Q09-0-1_07232008				CP-Q09-1-3_07232008				E-JS-01-0-1_07142008			
		Sample Date	7/17/2008				7/23/2008				7/23/2008				7/23/2008				7/23/2008				7/14/2008			
		Sample Depth (feet bgs)	5-7				0-1				1-3				0-1				1-3				0-1			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.3		0.33	0.44	1.5		0.055	0.43	1.9		0.58	0.65	< 0.84	U	0.84	0.54	1.9		0.44	0.35	1.3	J	0.24	0.44
Radium-228	15262-20-1	pCi/g	3.5		2.8	1.8	1.6	J	1.1	0.62	1.9	J	1	0.67	2	J	1.2	0.66	1.8	J	0.69	0.54	1.4		0.88	0.5
Uranium-234	13966-29-5	pCi/g	1.9		0.1	0.36	1.6		0.083	0.39	0.91		0.049	0.21	1.7		0.095	0.4	1.2		0.036	0.26	1.8		0.06	0.35
Uranium-235	15117-96-1	pCi/g	< 0.074	U	0.074	0.068	< 0.19	U	0.19	0.11	0.041		0.019	0.034	0.14		0.099	0.09	0.02		0.018	0.025	0.097		0.051	0.055
Uranium-238	ARC-U238	pCi/g	1.8		0.11	0.35	1.7		0.061	0.39	0.84		0.055	0.2	1.5		0.12	0.37	1.2		0.036	0.25	1.6		0.058	0.33

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former E Pond				Former E Pond				Former E Pond				Former E Pond				Former Evaporation Pond				Former Evaporation Pond			
		Location ID	E-JS01				E-JS01				E-JS02				E-JS02				EV-JS01				EV-JS01			
		Sample ID	E-JS-01-1-3_07142008				E-JS-01-5-7_07142008				E-JS-02-0-1_07142008				E-JS-02-1-3_07142008				EV-JS-01-0-1_07142008				EV-JS-01-1-3_07142008			
		Sample Date	7/14/2008				7/14/2008				7/14/2008				7/14/2008				7/14/2008				7/14/2008			
		Sample Depth (feet bgs)	1-3				5-7				0-1				1-3				0-1				1-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.6		0.5	0.54	2		0.41	0.61	1.8		0.063	0.52	4.8		0.42	1.1	0.44		0.17	0.23	3		0.33	0.85
Radium-228	15262-20-1	pCi/g	3.5		2.5	1.7	2.2	J	1.2	0.66	2.7		1	0.71	2		1	0.63	1.9	J	0.88	0.59	3.8		2.5	1.7
Uranium-234	13966-29-5	pCi/g	2.1		0.088	0.43	2.3		0.09	0.47	2.2		0.029	0.41	4.6		0.046	0.83	3.8		0.051	0.68	2.4		0.048	0.46
Uranium-235	15117-96-1	pCi/g	0.092		0.074	0.062	0.072		0.063	0.055	0.12		0.018	0.061	0.31		0.019	0.1	0.27		0.019	0.098	0.13		0.035	0.063
Uranium-238	ARC-U238	pCi/g	2.5		0.044	0.48	2.5		0.048	0.51	2.3		0.015	0.44	4.9		0.037	0.87	4		0.051	0.72	2.6		0.04	0.48

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Former Evaporation Pond				Former Evaporation Pond				Former Evaporation Pond				Former Evaporation Pond				Old D Pond				Old D Pond			
		Location ID	EV-JS01				EV-JS02				EV-JS02				EV-JS02				OD-JS01				OD-JS01			
		Sample ID	EV-JS-01-5-7_07142008				EV-JS-02-0-1_07142008				EV-JS-02-1-3_07142008				EV-JS-02-5-7_07142008				OD-JS-01-0-1_07292008				OD-JS-01-1-3_07292008			
		Sample Date	7/14/2008				7/14/2008				7/14/2008				7/14/2008				7/29/2008				7/29/2008			
		Sample Depth (feet bgs)	5-7				0-1				1-3				5-7				0-1				1-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	5.2		0.64	0.76	0.43		0.35	0.3	2.5		0.47	0.43	2.6	J	0.59	0.48	3.1		0.41	0.91	1.5		0.37	0.46
Radium-228	15262-20-1	pCi/g	2.5		1	0.69	1.5	J	0.84	0.56	1.6		0.77	0.51	1.9	J	0.95	0.58	1.8	J	0.99	0.66	2.1	J	1.1	0.71
Uranium-234	13966-29-5	pCi/g	6.1		0.031	1.1	2		0.037	0.39	2.7		0.047	0.51	2		0.016	0.39	2.8		0.033	0.52	2.3		0.05	0.47
Uranium-235	15117-96-1	pCi/g	0.4		0.036	0.16	0.15		0.044	0.07	0.21		0.041	0.087	0.069		0.038	0.047	< 0.11	U	0.11	0.057	0.17		0.049	0.084
Uranium-238	ARC-U238	pCi/g	6.6		0.071	1.2	2		0.046	0.4	2.6		0.042	0.5	2.3		0.032	0.45	2.9		0.014	0.52	2		0.062	0.42

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Old D Pond				Old D Pond				Old D Pond				Old D Pond				Old D Pond				Old D Pond			
		Location ID	OD-JS02				OD-JS02				OD-JS02				OD-JS03				OD-SD01				OD-SD01			
		Sample ID	OD-JS-02-0-1_07292008				OD-JS-02-1-3_07292008				OD-JS-02-5-7_07292008				OD-JS-03-0-1_08272008				OD-SD-01-0-1.5_07282008				OD-SD-01-1.5-3.0_07282008			
		Sample Date	7/29/2008				7/29/2008				7/29/2008				8/27/2008				7/28/2008				7/28/2008			
		Sample Depth (feet bgs)	0-1				1-3				5-7				0-1				0-1.5				1.5-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	3.5		0.79	1.1	3.3		0.22	0.79	2.2		0.42	0.6	2.3		0.52	0.42	2		0.4	0.59	1.6		0.31	0.5
Radium-228	15262-20-1	pCi/g	1.2	J	0.67	0.46	2.6		1	0.69	3.5	J	1.3	0.84	1.7		1.1	0.54	2.6		1.1	0.68	1.8		1	0.57
Uranium-234	13966-29-5	pCi/g	1.8		0.015	0.36	2.5		0.036	0.47	2.7	J	0.026	0.57	3		0.037	0.53	1.9		0.029	0.37	1.8		0.039	0.35
Uranium-235	15117-96-1	pCi/g	< 0.052	U	0.052	0.038	< 0.079	U	0.079	0.049	0.12	J	0.083	0.084	0.16		0.044	0.072	< 0.099	U	0.099	0.055	< 0.091	U	0.091	0.051
Uranium-238	ARC-U238	pCi/g	2.1		0.015	0.4	2.4		0.016	0.46	3	J	0.1	0.63	3		0.053	0.54	2.2		0.035	0.42	1.9		0.029	0.38

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Old D Pond				Old D Pond				Old D Pond				Old D Pond				Old D Pond				Old D Pond			
		Location ID	OD-SD02				OD-SD02				OD-SD03				OD-SD03				OD-SD04				OD-SD04			
		Sample ID	OD-SD-02-0-1.5_07282008				OD-SD-02-1.5-3.0_07282008				OD-SD-03-0-1.5_07282008				OD-SD-03-1.5-3.0_07282008				OD-SD-04-0-1.5_07282008				OD-SD-04-1.5-3.0_07282008			
		Sample Date	7/28/2008				7/28/2008				7/28/2008				7/28/2008				7/28/2008				7/28/2008			
		Sample Depth (feet bgs)	0-1.5				1.5-3				0-1.5				1.5-3				0-1.5				1.5-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.9		0.58	0.61	2.5		0.69	0.83	2.9		0.25	0.7	2.2		0.49	0.42	2.6		0.39	0.66	2.6		0.22	0.63
Radium-228	15262-20-1	pCi/g	2.7		0.85	0.62	2.3		0.79	0.56	3		0.88	0.65	2		1.1	0.59	2.1		1.1	0.63	1.6	J	0.81	0.56
Uranium-234	13966-29-5	pCi/g	1.7		0.16	0.35	1.7		0.05	0.34	3.7		0.11	0.72	4.5		0.038	0.8	2.5		0.05	0.49	1.6		0.054	0.34
Uranium-235	15117-96-1	pCi/g	< 0.06	U	0.06	0.058	< 0.11	U	0.11	0.059	0.31		0.097	0.14	< 0.23	U	0.23	0.089	< 0.18	U	0.18	0.079	< 0.1	U	0.1	0.059
Uranium-238	ARC-U238	pCi/g	1.9		0.1	0.38	1.8		0.042	0.36	4		0.12	0.77	4.8		0.042	0.85	2.6		0.05	0.49	1.6		0.066	0.34

Appendix A, Table A-4
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former CLEAR Plant - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Old D Pond				Old D Pond				Old D Pond				Old D Pond			
		Location ID	OD-SD05				OD-SD05				OD-SD06				OD-SD06			
		Sample ID	OD-SD-05-0-1.5_07292008				OD-SD-05-1.5-3.0_07292008				OD-SD-06-0-1.5_07292008				OD-SD-06-1.5-3.0_07292008			
		Sample Date	7/29/2008				7/29/2008				7/29/2008				7/29/2008			
		Sample Depth (feet bgs)	0-1.5				1.5-3				0-1.5				1.5-3			
Analyte	CAS	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.1		0.39	0.68	1.5		0.77	0.68	0.64		0.18	0.29	2.6		0.54	0.45
Radium-228	15262-20-1	pCi/g	2.9		1	0.72	3.2	J	1.2	0.77	3.2	J	0.96	0.77	2		0.88	0.57
Uranium-234	13966-29-5	pCi/g	3.9		0.054	0.7	3.1		0.049	0.6	2.7		0.039	0.5	4.4		0.016	0.79
Uranium-235	15117-96-1	pCi/g	< 0.18	U	0.18	0.079	0.23		0.043	0.096	< 0.18	U	0.18	0.075	< 0.23	U	0.23	0.088
Uranium-238	ARC-U238	pCi/g	3.7		0.061	0.67	3		0.019	0.59	3.1		0.015	0.56	4.5		0.037	0.8

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill			
Location ID			EM-JS01				EM-JS01				C22				C22				E24				E24			
Sample ID			EM-JS-01-0-1_08012008				EM-JS-01-1-3_08012008				EM-C22-0-1_07292008				EM-C22-1-3_07292008				EM-E24-0-1_07292008				EM-E24-1-3_07292008			
Sample Date			8/1/2008				8/1/2008				7/29/2008				7/29/2008				7/29/2008				7/29/2008			
Sample Depth (feet bgs)			0-1				1-3				0-1				1-3				0-1				1-3			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.7	J	0.55	0.48	1.6	J	0.32	0.5	2.4		0.2	0.61	1.6		0.76	0.73	0.54		0.2	0.25	2.1		0.47	0.68
Radium-228	15262-20-1	pCi/g	1.8	J	1.2	0.6	2.8	J	1.2	0.84	1.4		1.1	0.52	2.4	J	1	0.66	1.7		1.2	0.6	1.3	J	1	0.56
Uranium-234	13966-29-5	pCi/g	1.6		0.079	0.32	2.9		0.053	0.55	2.2		0.045	0.42	2.3		0.052	0.48	1.8		0.053	0.35	1.9		0.057	0.41
Uranium-235	15117-96-1	pCi/g	0.079		0.047	0.05	0.11		0.042	0.058	< 0.11	U	0.11	0.059	0.12		0.061	0.073	< 0.086	U	0.086	0.052	< 0.11	U	0.11	0.074
Uranium-238	ARC-U238	pCi/g	1.7		0.058	0.35	2.9		0.044	0.54	1.9		0.052	0.37	2.4		0.064	0.5	1.7		0.037	0.35	1.8		0.065	0.41

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill			
Location ID			G27				G27				H22				H22				H22				K24			
Sample ID			EM-G27-0-1_08072008				EM-G27-1-3_08072008				EM-H22-0-1_07302008				EM-H22-1-3_07302008				EM-H22-5-7_07312008				EM-K24-0-1_07312008			
Sample Date			8/7/2008				8/7/2008				7/30/2008				7/30/2008				7/31/2008				7/31/2008			
Sample Depth (feet bgs)			0-1				1-3				0-1				1-3				5-7				0-1			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.1		0.87	0.83	2		0.56	0.69	1.8	J	0.53	0.38	1.6		0.42	0.55	2.4		0.43	0.41	1.8		0.47	0.35
Radium-228	15262-20-1	pCi/g	2.3	J	0.95	0.77	2.2	J	1.6	0.9	2	J	0.9	0.6	1	J	0.82	0.63	1.3	J	0.89	0.54	1.7	J	0.84	0.57
Uranium-234	13966-29-5	pCi/g	2.8		0.052	0.54	1.6		0.043	0.32	1.9		0.045	0.37	1.5		0.062	0.31	2.7		0.051	0.51	1.7		0.052	0.34
Uranium-235	15117-96-1	pCi/g	0.18		0.052	0.078	0.074		0.045	0.049	0.096		0.049	0.056	< 0.055	U	0.055	0.044	0.13		0.018	0.064	0.12		0.052	0.063
Uranium-238	ARC-U238	pCi/g	2.7		0.052	0.51	1.7		0.016	0.34	1.9		0.037	0.39	1.3		0.05	0.28	2.6		0.036	0.49	1.7		0.039	0.34

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill			
Location ID			K24				K24				M26				M26				M26				N29			
Sample ID			EM-K24-1-3_07312008				EM-K24-5-7_07312008				EM-M26-0-1_08012008				EM-M26-1-3_08012008				EM-M26-5-7_08012008				EM-N29-0-1_08062008			
Sample Date			7/31/2008				7/31/2008				8/1/2008				8/1/2008				8/1/2008				8/6/2008			
Sample Depth (feet bgs)			1-3				5-7				0-1				1-3				5-7				0-1			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2		0.45	0.37	2.2		0.41	0.39	2.5		0.43	0.68	1.6		0.35	0.5	2.7	J	0.58	0.49	0.79		0.32	0.34
Radium-228	15262-20-1	pCi/g	2	J	0.74	0.57	2.3		0.7	0.59	2.2	J	1.1	0.83	1.7	J	0.96	0.56	2.9	J	1	0.79	1.5		1	0.48
Uranium-234	13966-29-5	pCi/g	1.4		0.041	0.29	1.7		0.046	0.35	1.7		0.054	0.35	2.4		0.045	0.46	2.7		0.029	0.51	1.4		0.084	0.29
Uranium-235	15117-96-1	pCi/g	0.081		0.018	0.049	< 0.049	U	0.049	0.041	0.11		0.058	0.064	0.13		0.036	0.063	0.25		0.034	0.09	0.056		0.05	0.043
Uranium-238	ARC-U238	pCi/g	1.3		0.052	0.28	1.6		0.037	0.32	1.7		0.054	0.36	2.5		0.045	0.48	2.9		0.035	0.54	1.4		0.061	0.29

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill				Esperanza Mill			
Location ID			N29				P24				P24				P24				P24				X26			
Sample ID			EM-N29-1-3_08062008				EM-P24-0-1_08072008				EM-P24-10-11_08072008				EM-P24-1-3_08072008				EM-P24-5-7_08072008				EM-X26-0-1_08062008			
Sample Date			8/6/2008				8/7/2008				8/7/2008				8/7/2008				8/7/2008				8/6/2008			
Sample Depth (feet bgs)			1-3				0-1				10-11				1-3				5-7				0-1			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2		0.29	0.58	2.4		0.53	0.42	2.8		0.41	0.75	1.8		0.2	0.55	2.6		0.23	0.73	3.5		0.37	0.91
Radium-228	15262-20-1	pCi/g	1.7	J	1.4	0.75	1.9		0.97	0.56	3	J	1	0.78	2.1		0.87	0.6	2		0.87	0.58	1.8	J	0.94	0.67
Uranium-234	13966-29-5	pCi/g	1.2		0.048	0.27	2.2		0.03	0.43	2		0.048	0.38	3.3		0.043	0.57	2.1		0.042	0.41	1.7		0.046	0.33
Uranium-235	15117-96-1	pCi/g	0.078		0.038	0.05	< 0.078	U	0.078	0.048	0.12		0.062	0.064	0.14		0.04	0.066	< 0.12	U	0.12	0.059	0.063		0.05	0.044
Uranium-238	ARC-U238	pCi/g	1.3		0.039	0.28	2.1		0.036	0.41	2.2		0.053	0.41	3.4		0.036	0.6	2.2		0.015	0.42	1.8		0.049	0.35

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Esperanza Mill				Esperanza Mill				C Pond				C Pond				C Pond				C Pond			
Location ID			X26				X26				C-JS01				C-JS01				C-JS02				C-JS02			
Sample ID			EM-X26-1-3_08062008				EM-X26-5-7_08062008				C-JS-01-0-1_08012008				C-JS-01-1-3_08012008				C-JS-02-1-3_08012008				C-JS-02-5-7_08012008			
Sample Date			8/6/2008				8/6/2008				8/1/2008				8/1/2008				8/1/2008				8/1/2008			
Sample Depth (feet bgs)			1-3				5-7				0-1				1-3				1-3				5-7			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	0.72		0.63	0.47	1.1		0.072	0.38	1.5		0.48	0.53	2.1		0.29	0.62	2.3	J	0.42	0.41	4		0.46	0.98
Radium-228	15262-20-1	pCi/g	< 2	U	2	1.4	2.2		1.1	0.69	2.1	J	1.1	0.77	2.2	J	1.1	0.69	1.8	J	0.94	0.56	5.2	J	1.3	1.2
Uranium-234	13966-29-5	pCi/g	0.85		0.061	0.2	2.1		0.11	0.49	1.6		0.032	0.32	1.8		0.03	0.36	2.6		0.036	0.49	3.3		0.029	0.62
Uranium-235	15117-96-1	pCi/g	0.059		0.052	0.044	0.084		0.083	0.072	0.092		0.019	0.053	0.11		0.018	0.058	0.088		0.018	0.051	0.2		0.047	0.082
Uranium-238	ARC-U238	pCi/g	0.9		0.041	0.21	2.2		0.087	0.5	1.5		0.016	0.31	1.7		0.03	0.34	2.6		0.03	0.5	4		0.035	0.72

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			C Pond				C Pond				C Pond				C Pond				C Pond				C Pond			
Location ID			C-JS03				C-JS03				C-JS03				C-JS03				C-JS04				C-JS04			
Sample ID			C-JS-03-0-1_08042008				C-JS-03-10-12_08042008				C-JS-03-1-3_08042008				C-JS-03-5-7_08042008				C-JS-04-0-1_08052008				C-JS-04-10-12_08052008			
Sample Date			8/4/2008				8/4/2008				8/4/2008				8/4/2008				8/5/2008				8/5/2008			
Sample Depth (feet bgs)			0-1				10-12				1-3				5-7				0-1				10-12			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.9		0.39	0.61	2.2	J	0.7	0.45	0.91		0.073	0.35	2.6		0.29	0.65	0.82		0.18	0.33	3.1		0.86	1
Radium-228	15262-20-1	pCi/g	1.8	J	1.2	0.8	2.7	J	0.99	0.74	1.9	J	1.1	0.69	2.1	J	1.1	0.66	< 2.4	U	2.4	1.5	2.3	J	1.2	0.77
Uranium-234	13966-29-5	pCi/g	1.9		0.045	0.38	3.6		0.032	0.67	1.9		0.046	0.37	1.9		0.029	0.38	1.6		0.045	0.33	3		0.034	0.55
Uranium-235	15117-96-1	pCi/g	0.12		0.018	0.059	0.21		0.019	0.084	0.14		0.041	0.066	0.1		0.018	0.055	0.071		0.043	0.047	0.15		0.033	0.067
Uranium-238	ARC-U238	pCi/g	1.9		0.036	0.38	3.5		0.032	0.66	2		0.034	0.39	2.1		0.015	0.41	1.5		0.041	0.31	3.1		0.038	0.56

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			C Pond				C Pond				C Pond				C Pond Spoils				C Pond Spoils				C Pond Spoils			
Location ID			C-JS04				C-JS04				C-JS05				CS-JS01				CS-JS01				CS-JS01			
Sample ID			C-JS-04-1-3_08052008				C-JS-04-5-7_08052008				C-JS-05-1-3_08052008				CS-JS-01-10-12_08042008				CS-JS-01-1-3_08042008				CS-JS-01-5-7_08042008			
Sample Date			8/5/2008				8/5/2008				8/5/2008				8/4/2008				8/4/2008				8/4/2008			
Sample Depth (feet bgs)			1-3				5-7				1-3				10-12				1-3				5-7			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.6		0.53	0.85	1.4		0.55	0.62	5	J	0.34	1.1	1.9		0.61	0.64	1.8	J	0.28	0.53	3.6		0.45	0.92
Radium-228	15262-20-1	pCi/g	2.6		1	0.73	2.4		0.73	0.64	4.6		2.7	2	2.7	J	0.98	0.77	2	J	1.5	0.79	3.4	J	1.1	0.91
Uranium-234	13966-29-5	pCi/g	1.9		0.056	0.38	1.5		0.038	0.3	2.2		0.055	0.44	2.2		0.042	0.42	2.2		0.031	0.43	2.1		0.049	0.43
Uranium-235	15117-96-1	pCi/g	0.19		0.061	0.084	0.092		0.033	0.051	0.085	J	0.038	0.052	0.087		0.034	0.05	< 0.042	U	0.042	0.038	0.14		0.053	0.071
Uranium-238	ARC-U238	pCi/g	2.1		0.064	0.42	1.6		0.028	0.32	2.1		0.048	0.42	2.4		0.039	0.46	2		0.037	0.39	2.1		0.04	0.41

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils			
Location ID			CS-JS02				CS-JS02				CS-JS02				CS-JS02				CS-JS03				CS-JS03			
Sample ID			CS-JS-02-0-1_08042008				CS-JS-02-10-11_08042008				CS-JS-02-1-3_08042008				CS-JS-02-5-7_08042008				CS-JS-03-0-1_08052008				CS-JS-03-10-12_08052008			
Sample Date			8/4/2008				8/4/2008				8/4/2008				8/4/2008				8/5/2008				8/5/2008			
Sample Depth (feet bgs)			0-1				10-11				1-3				5-7				0-1				10-12			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	2.2		0.33	0.62	3.7		0.33	0.93	1.9		0.39	0.6	1.7		0.61	0.38	2.3		0.45	0.65	2.7	J	0.51	0.46
Radium-228	15262-20-1	pCi/g	2.2	J	0.94	0.74	2.2		0.94	0.64	1.9		0.73	0.53	2.1	J	0.77	0.63	2		1	0.64	2.6		0.99	0.66
Uranium-234	13966-29-5	pCi/g	1.6		0.042	0.32	2.5		0.015	0.48	2.4		0.066	0.45	1.6		0.039	0.34	1.5		0.042	0.31	1.7		0.037	0.35
Uranium-235	15117-96-1	pCi/g	< 0.056	U	0.056	0.046	0.093		0.018	0.052	0.11		0.054	0.059	0.098		0.046	0.058	0.077		0.049	0.05	0.11		0.043	0.058
Uranium-238	ARC-U238	pCi/g	1.8		0.037	0.37	2.7		0.03	0.51	2.5		0.056	0.47	1.9		0.049	0.38	1.8		0.031	0.37	1.8		0.046	0.36

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils			
Location ID			CS-JS03				CS-JS03				CS-JS04				CS-JS04				CS-JS04				CS-JS05			
Sample ID			CS-JS-03-1-3_08052008				CS-JS-03-5-7_08052008				CS-JS-04-0-1_08062008				CS-JS-04-1-3_08062008				CS-JS-04-5-7_08062008				CS-JS-05-0-1_08272008			
Sample Date			8/5/2008				8/5/2008				8/6/2008				8/6/2008				8/6/2008				8/27/2008			
Sample Depth (feet bgs)			1-3				5-7				0-1				1-3				5-7				0-1			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	0.92		0.76	0.54	1.9		0.67	0.69	0.89		0.75	0.55	1.7		0.5	0.56	1.5		0.31	0.51	2.1		0.44	0.37
Radium-228	15262-20-1	pCi/g	1.7	J	1	0.62	1.9		1.4	0.67	2.6		0.82	0.65	2.4	J	0.81	0.71	2		1.2	0.62	2.4	J	0.69	0.64
Uranium-234	13966-29-5	pCi/g	1.5		0.098	0.35	1.3		0.016	0.27	1.8		0.027	0.35	1.7		0.027	0.34	1.4		0.091	0.35	3.3		0.042	0.62
Uranium-235	15117-96-1	pCi/g	0.12		0.083	0.081	0.071		0.043	0.047	0.14		0.016	0.063	0.096		0.032	0.051	0.088		0.087	0.075	0.19		0.044	0.08
Uranium-238	ARC-U238	pCi/g	1.5		0.063	0.36	1.4		0.037	0.29	1.8		0.027	0.35	1.8		0.033	0.35	1.8		0.032	0.41	3.3		0.016	0.62

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils				C Pond Spoils				Laydown Yard			
Location ID			CS-JS05				CS-JS06				U25				U25				U25				EM-JS02			
Sample ID			CS-JS-05-1-3_08272008				CS-JS-06-0-1_08272008				EM-U25-0-1_08062008				EM-U25-1-3_08062008				EM-U25-5-5.5_08062008				EM-JS-02-0-1_08012008			
Sample Date			8/27/2008				8/27/2008				8/6/2008				8/6/2008				8/6/2008				8/1/2008			
Sample Depth (feet bgs)			1-3				0-1				0-1				1-3				5-5.5				0-1			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	4.6		0.5	1.2	1.7		0.39	0.33	0.67	J	0.3	0.31	1.6		0.38	0.52	5.1		0.63	0.74	3		0.31	0.74
Radium-228	15262-20-1	pCi/g	2.6	J	0.91	0.61	1.5	J	0.65	0.44	2	J	0.92	0.7	2.1	J	1.1	0.69	3.5		1.3	0.78	3.7	J	1.5	0.96
Uranium-234	13966-29-5	pCi/g	6.6		0.032	1.2	1.5		0.046	0.31	2.1		0.046	0.4	1.7		0.072	0.35	5.4		0.07	1	2.1		0.043	0.41
Uranium-235	15117-96-1	pCi/g	0.34		0.02	0.11	0.096		0.019	0.054	0.13		0.019	0.062	0.11		0.045	0.065	0.26		0.051	0.11	0.13		0.034	0.062
Uranium-238	ARC-U238	pCi/g	6.6		0.044	1.2	1.6		0.046	0.33	2.2		0.037	0.42	1.8		0.052	0.37	6.1		0.052	1.1	2.5		0.043	0.47

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Laydown Yard				Laydown Yard				Laydown Yard				Laydown Yard				Laydown Yard				Laydown Yard			
Location ID			EM-JS02				EM-JS06				EM-JS06				EM-JS06				EM-JS06				EM-JS07			
Sample ID			EM-JS-02-1-3_08012008				EM-JS-06-0-1_08132008				EM-JS-06-10-11_08132008				EM-JS-06-1-3_08132008				EM-JS-06-5-7_08132008				EM-JS-07-0-1_08132008			
Sample Date			8/1/2008				8/13/2008				8/13/2008				8/13/2008				8/13/2008				8/13/2008			
Sample Depth (feet bgs)			1-3				0-1				10-11				1-3				5-7				0-1			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	3		0.44	0.81	2.9		0.53	0.49	1.4	J	0.21	0.38	1.3	J	0.28	0.4	1.8	J	0.44	0.54	4.6		0.29	1.1
Radium-228	15262-20-1	pCi/g	4		2.3	1.7	2.1	J	0.86	0.63	4.6	J	1.4	1.2	1.5		0.8	0.49	1.9	J	0.93	0.67	1.9		0.92	0.58
Uranium-234	13966-29-5	pCi/g	4.5		0.046	0.82	1.9		0.031	0.39	4.4		0.016	0.79	5.5		0.015	0.96	2.4		0.039	0.47	2.8		0.065	0.51
Uranium-235	15117-96-1	pCi/g	0.2		0.021	0.085	0.094		0.036	0.054	0.19		0.049	0.079	0.23		0.018	0.086	0.086		0.019	0.052	0.19		0.064	0.084
Uranium-238	ARC-U238	pCi/g	4.4		0.058	0.81	1.9		0.037	0.38	5		0.037	0.89	5.5		0.035	0.96	2		0.017	0.41	2.5		0.054	0.47

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Laydown Yard				Laydown Yard				Laydown Yard				Laydown Yard				Laydown Yard				Laydown Yard			
Location ID			EM-JS07				EM-JS07				EM-JS07				EM-JS08				EM-JS08				EM-JS08			
Sample ID			EM-JS-07-10-12_08132008				EM-JS-07-1-3_08132008				EM-JS-07-5-7_08132008				EM-JS-08-0-1_08122008				EM-JS-08-10-12_08122008				EM-JS-08-1-3_08122008			
Sample Date			8/13/2008				8/13/2008				8/13/2008				8/12/2008				8/12/2008				8/12/2008			
Sample Depth (feet bgs)			10-12				1-3				5-7				0-1				10-12				1-3			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.4	J	0.4	0.49	2	J	0.25	0.59	2.3	J	0.36	0.6	1.9		0.43	0.61	3.4	J	0.27	0.86	2.9	J	0.52	0.49
Radium-228	15262-20-1	pCi/g	1.8	J	0.99	0.66	1.6	J	0.99	0.62	2.1	J	1.2	0.78	1.6	J	0.87	0.63	1.8	J	0.96	0.75	1.1	J	0.71	0.6
Uranium-234	13966-29-5	pCi/g	3.6		0.045	0.68	3.2		0.016	0.59	2.8		0.038	0.52	1.2		0.034	0.25	12		0.095	2.1	0.93		0.026	0.18
Uranium-235	15117-96-1	pCi/g	0.12		0.052	0.068	0.16		0.037	0.073	0.14		0.037	0.068	0.055		0.049	0.042	0.57		0.068	0.17	0.042		0.031	0.029
Uranium-238	ARC-U238	pCi/g	3.3		0.037	0.64	3.7		0.031	0.67	2.7		0.032	0.51	1.2		0.072	0.25	12		0.044	2.1	0.97		0.021	0.19

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Laydown Yard				Raffinate Pond				Raffinate Pond				Raffinate Pond				Raffinate Pond				Raffinate Pond			
Location ID			EM-JS08				RA-JS01				RA-JS01				RA-JS01				RA-JS02				RA-JS02			
Sample ID			EM-JS-08-5-7_08122008				RA-JS-01-0-1_08072008				RA-JS-01-1-3_08072008				RA-JS-01-5-7_08072008				RA-JS-02-0-1_08112008				RA-JS-02-1-3_08112008			
Sample Date			8/12/2008				8/7/2008				8/7/2008				8/7/2008				8/11/2008				8/11/2008			
Sample Depth (feet bgs)			5-7				0-1				1-3				5-7				0-1				1-3			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1	J	0.34	0.41	1.4		0.66	0.61	2.1		0.2	0.61	0.9		0.24	0.39	3.4	J	0.85	0.62	1.5		0.35	0.55
Radium-228	15262-20-1	pCi/g	2.5	J	1.1	0.76	< 2.5	U	2.5	1.5	1.9	J	1.4	0.84	1.7	J	1.2	0.64	2	J	1.5	0.75	8.9		2.7	3.1
Uranium-234	13966-29-5	pCi/g	2.8		0.069	0.54	1.6		0.044	0.32	2.9		0.025	0.56	3.3		0.059	0.59	2		0.051	0.4	3.8		0.048	0.7
Uranium-235	15117-96-1	pCi/g	0.22		0.051	0.094	< 0.087	U	0.087	0.052	0.21		0.086	0.11	< 0.16	U	0.16	0.071	< 0.082	U	0.082	0.053	0.19		0.051	0.081
Uranium-238	ARC-U238	pCi/g	2.8		0.058	0.54	1.6		0.053	0.32	3.2		0.073	0.62	3.4		0.039	0.61	2.1		0.034	0.43	3.8		0.063	0.7

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Raffinate Pond				Raffinate Pond				Raffinate Pond				Raffinate Pond				Raffinate Pond				Raffinate Pond			
Location ID			RA-JS03				RA-JS03				RA-JS04				RA-JS04				RA-JS05				RA-JS05			
Sample ID			RA-JS-03-0-1_08072008				RA-JS-03-1-3_08072008				RA-JS-04-0-1_08072008				RA-JS-04-1-2.5_08072008				RA-JS-05-0-1_08072008				RA-JS-05-1-3_08072008			
Sample Date			8/7/2008				8/7/2008				8/7/2008				8/7/2008				8/7/2008				8/7/2008			
Sample Depth (feet bgs)			0-1				1-3				0-1				1-2.5				0-1				1-3			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	5.8		0.82	1.5	0.84		0.43	0.36	2.7		0.56	0.47	2.7		0.46	0.8	1.8		0.49	0.65	3.8		0.44	0.95
Radium-228	15262-20-1	pCi/g	2.9	J	1.4	0.88	2.2	J	1.1	0.73	2.4		0.97	0.64	2.6		0.87	0.67	2.6	J	1.5	0.83	3.1		1.5	0.84
Uranium-234	13966-29-5	pCi/g	1.8		0.029	0.32	1.8		0.035	0.35	1.5		0.041	0.3	2		0.039	0.39	3.7		0.015	0.63	3.7		0.027	0.66
Uranium-235	15117-96-1	pCi/g	0.092		0.0092	0.038	< 0.1	U	0.1	0.056	< 0.079	U	0.079	0.049	< 0.083	U	0.083	0.049	0.2		0.052	0.082	< 0.12	U	0.12	0.056
Uranium-238	ARC-U238	pCi/g	1.8		0.0078	0.31	1.9		0.03	0.38	1.6		0.03	0.32	2		0.039	0.39	3.5		0.036	0.6	3.5		0.027	0.62

Appendix A, Table A-5
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Esperanza Mill - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Location Subarea			Raffinate Pond				Raffinate Pond				Raffinate Pond				Raffinate Pond			
Location ID			RA-SD01				RA-SD01				RA-SD02				RA-SD02			
Sample ID			RA-SD-01-0-1.5_08112008				RA-SD-01-1.5-3.0_08112008				RA-SD-02-0-1.5_08112008				RA-SD-02-1.5-3.0_08112008			
Sample Date			8/11/2008				8/11/2008				8/11/2008				8/11/2008			
Sample Depth (feet bgs)			0-1.5				1.5-3				0-1.5				1.5-3			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	3	J	0.47	0.49	3.1	J	0.54	0.52	2.5	J	0.59	0.47	2	J	0.65	0.44
Radium-228	15262-20-1	pCi/g	1.6	J	0.91	0.6	2.4	J	1.2	0.65	1.6	J	1	0.65	1.1	J	1.1	0.6
Uranium-234	13966-29-5	pCi/g	2.3		0.047	0.44	4.2		0.05	0.75	1		0.043	0.22	1.3		0.058	0.28
Uranium-235	15117-96-1	pCi/g	< 0.091	U	0.091	0.052	< 0.2	U	0.2	0.083	< 0.052	U	0.052	0.038	< 0.06	U	0.06	0.043
Uranium-238	ARC-U238	pCi/g	2.3		0.036	0.44	3.9		0.047	0.71	0.92		0.035	0.21	1.2		0.042	0.25

Appendix A, Table A-6
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Former Rhenium Ponds - Radionuclides
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

		Location Subarea	Rhenium Ponds				Rhenium Ponds				Rhenium Ponds				Rhenium Ponds				Rhenium Ponds				Rhenium Ponds				Rhenium Ponds			
		Location ID	RP-JS01				RP-JS01				RP-JS01				RP-JS01				RP-JS02				RP-JS02				RP-JS02			
		Sample ID	RP-JS-01-0-1_08122008				RP-JS-01-10-12_08122008				RP-JS-01-1-3_08122008				RP-JS-01-5-7_08122008				RP-JS-02-10-12_08122008				RP-JS-02-1-3_08122008				RP-JS-02-5-7_08122008			
		Sample Date	8/12/2008				8/12/2008				8/12/2008				8/12/2008				8/12/2008				8/12/2008				8/12/2008			
		Sample Depth (feet bgs)	0-1				10-12				1-3				5-7				10-12				1-3				5-7			
Analyte	CASRN	Units	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU	Result	Qual	MDC	TPU
Radium-226	13982-63-3	pCi/g	1.9		0.49	0.65	2.8	J	0.69	0.53	2.6	J	0.55	0.47	1.6		0.32	0.54	2.5	J	0.49	0.45	2.6		0.43	0.79	1.5		0.65	0.69
Radium-228	15262-20-1	pCi/g	1.4	J	1.1	0.53	1.9	J	1.3	0.77	1.6	J	1.2	0.64	0.82	J	0.77	0.4	1.6	J	1.2	0.66	1.7	J	1	0.74	1.5	J	1.2	0.71
Uranium-234	13966-29-5	pCi/g	1.3		0.043	0.28	1.2		0.016	0.21	1.4		0.041	0.29	0.7		0.063	0.19	3.1		0.054	0.56	1		0.033	0.19	1.3		0.084	0.27
Uranium-235	15117-96-1	pCi/g	< 0.18	U	0.18	0.077	0.057		0.0081	0.027	< 0.084	U	0.084	0.051	< 0.042	U	0.042	0.044	< 0.11	U	0.11	0.058	0.046		0.0096	0.027	< 0.075	U	0.075	0.049
Uranium-238	ARC-U238	pCi/g	1.2		0.032	0.26	1.2		0.0069	0.21	1.2		0.016	0.26	0.8		0.057	0.21	3.2		0.044	0.59	0.94		0.03	0.18	1.4		0.06	0.28

Appendix A, Table A-7
Soil and Sediment Data used to Conduct the Baseline Human Health Risk Assessment
Notes for All Appendix A Tables
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Notes

Sources of data presented in this appendix include:

ARCADIS. 2013a. Addendum to the Soil and Sediment Characterization Report. Prepared for Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. August 2013.
ARCADIS. 2013c. Voluntary Remediation Program Former CLEAR Plant Area Soil Excavation and Tier I Screening Risk Evaluation Report. Prepared for Sierrita Mine, Green Valley, Arizona.
ARCADIS. 2015c. Former CLEAR Plant Area Paving Project Soil Excavation and Tier I Screening Risk Evaluation Report. Prepared for Sierrita Mine, Green Valley, Arizona. July 2015.
HGC. 2008. Soil, Surface Water, and Groundwater Sampling in the CLEAR Plant and Esperanza Mill Areas, Prepared for Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. April 2008.
URS. 2012. Voluntary Remediation Program Soil and Sediment Characterization Report, Freeport-McMoRan Sierrita Inc., Green Valley, Arizona. Final. December 2012.

For samples collected in 2004, please see Appendix C of HGC 2008 for additional data qualifiers and associated definitions.

Acronyms and Abbreviations

bgs = below ground surface.
CASRN = Chemical Abstracts Service Registry Number.
MDL = method detection limit.
mg/kg = milligram(s) per kilogram.
NA = not available.
pCi/g = picoCurie(s) per gram.
PQL = practical quantitation limit.
Qual = qualifier.
TPU = total propagated uncertainty.

Qualifier Definitions

J = Analyte concentration detected at a value between MDL and PQL.
U = Analyte was analyzed for but was not detected at the indicated MDL.

APPENDIX B

ProUCL 5.0.00 Input and Output Files (ProUCL input files are provided electronically on CD)

Result (antimony)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	16
Number of Detects	32	Number of Non-Detects	14
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	66	Maximum Non-Detect	1
Variance Detects	209.3	Percent Non-Detects	30.43%
Mean Detects	4.794	SD Detects	14.47
Median Detects	0.4	CV Detects	3.018
Skewness Detects	3.778	Kurtosis Detects	13.67
Mean of Logged Detects	-0.264	SD of Logged Detects	1.522

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.352	**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	0.157	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

Mean	3.451	Standard Error of Mean	1.805
SD	12.05	95% KM (BCA) UCL	7.148
95% KM (t) UCL	6.483	95% KM (Percentile Bootstrap) UCL	6.587
95% KM (z) UCL	6.421	95% KM Bootstrap t UCL	22.93
90% KM Chebyshev UCL	8.867	95% KM Chebyshev UCL	11.32
97.5% KM Chebyshev UCL	14.72	99% KM Chebyshev UCL	21.41

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.348	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.84	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.167	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)	0.365	k star (bias corrected MLE)	0.351
Theta hat (MLE)	13.14	Theta star (bias corrected MLE)	13.64
nu hat (MLE)	23.35	nu star (bias corrected)	22.49
MLE Mean (bias corrected)	4.794	MLE Sd (bias corrected)	8.087

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.082	nu hat (KM)	7.547
Approximate Chi Square Value (7.55, α)	2.475	Adjusted Chi Square Value (7.55, β)	2.382
95% Gamma Approximate KM-UCL (use when n>=50)	10.52	95% Gamma Adjusted KM-UCL (use when n<50)	10.93

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3.545
Maximum	66	Median	0.3
SD	12.19	CV	3.438
k hat (MLE)	0.285	k star (bias corrected MLE)	0.281
Theta hat (MLE)	12.44	Theta star (bias corrected MLE)	12.62
nu hat (MLE)	26.21	nu star (bias corrected)	25.84
MLE Mean (bias corrected)	3.545	MLE Sd (bias corrected)	6.689
		Adjusted Level of Significance (β)	0.0448
Approximate Chi Square Value (25.84, α)	15.25	Adjusted Chi Square Value (25.84, β)	14.99
95% Gamma Approximate UCL (use when n>=50)	6.004	95% Gamma Adjusted UCL (use when n<50)	6.11

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.772	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.228	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	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	3.51	Mean in Log Scale	-0.453
SD in Original Scale	12.17	SD in Log Scale	1.385
95% t UCL (assumes normality of ROS data)	6.523	95% Percentile Bootstrap UCL	6.679
95% BCA Bootstrap UCL	8.144	95% Bootstrap t UCL	23.12
95% H-UCL (Log ROS)	2.936		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.487	Mean in Log Scale	-0.394
SD in Original Scale	12.17	SD in Log Scale	1.279
95% t UCL (Assumes normality)	6.501	95% H-Stat UCL	2.525

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

97.5% KM (Chebyshev) UCL	14.72

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.

Result (arsenic)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	1.1	Mean	11.79
Maximum	166	Median	3.55
SD	28.43	Std. Error of Mean	4.191
Coefficient of Variation	2.412	Skewness	4.534

Normal GOF Test

Shapiro Wilk Test Statistic	0.383	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	18.83	95% Adjusted-CLT UCL (Chen-1995)	21.68
		95% Modified-t UCL (Johnson-1978)	19.29

Gamma GOF Test

A-D Test Statistic	5.401	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.797	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.291	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.136	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.675	k star (bias corrected MLE)	0.646
Theta hat (MLE)	17.45	Theta star (bias corrected MLE)	18.25
nu hat (MLE)	62.14	nu star (bias corrected)	59.42
MLE Mean (bias corrected)	11.79	MLE Sd (bias corrected)	14.67
		Approximate Chi Square Value (0.05)	42.7
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	42.24

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	16.4	95% Adjusted Gamma UCL (use when n<50)	16.58

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.188	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.0953	Mean of logged Data	1.568
Maximum of Logged Data	5.112	SD of logged Data	1.066

Assuming Lognormal Distribution

95% H-UCL	12.39	90% Chebyshev (MVUE) UCL	12.98
95% Chebyshev (MVUE) UCL	15.09	97.5% Chebyshev (MVUE) UCL	18.03
99% Chebyshev (MVUE) UCL	23.79		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	18.68	95% Jackknife UCL	18.83
95% Standard Bootstrap UCL	18.75	95% Bootstrap-t UCL	35.54
95% Hall's Bootstrap UCL	45.88	95% Percentile Bootstrap UCL	19.25
95% BCA Bootstrap UCL	23.08		
90% Chebyshev(Mean, Sd) UCL	24.36	95% Chebyshev(Mean, Sd) UCL	30.06
97.5% Chebyshev(Mean, Sd) UCL	37.96	99% Chebyshev(Mean, Sd) UCL	53.49

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	30.06

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (barium)

General Statistics

Total Number of Observations	36	Number of Distinct Observations	35
		Number of Missing Observations	0
Minimum	67.1	Mean	153.7
Maximum	654	Median	137.5
SD	93.2	Std. Error of Mean	15.53
Coefficient of Variation	0.606	Skewness	4.643

Normal GOF Test

Shapiro Wilk Test Statistic	0.524	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.148	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	179.9	95% Adjusted-CLT UCL (Chen-1995)	192.1
		95% Modified-t UCL (Johnson-1978)	181.9

Gamma GOF Test

A-D Test Statistic	1.982	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.147	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.851	k star (bias corrected MLE)	5.382
Theta hat (MLE)	26.27	Theta star (bias corrected MLE)	28.56
nu hat (MLE)	421.3	nu star (bias corrected)	387.5
MLE Mean (bias corrected)	153.7	MLE Sd (bias corrected)	66.25
		Approximate Chi Square Value (0.05)	342.9
Adjusted Level of Significance	0.0428	Adjusted Chi Square Value	341

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	173.7	95% Adjusted Gamma UCL (use when n<50)	174.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.935	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.148	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.206	Mean of logged Data	4.947
Maximum of Logged Data	6.483	SD of logged Data	0.373

Assuming Lognormal Distribution

95% H-UCL	169.3	90% Chebyshev (MVUE) UCL	179.4
95% Chebyshev (MVUE) UCL	192.5	97.5% Chebyshev (MVUE) UCL	210.6
99% Chebyshev (MVUE) UCL	246.1		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	179.2	95% Jackknife UCL	179.9
95% Standard Bootstrap UCL	178.9	95% Bootstrap-t UCL	213.3
95% Hall's Bootstrap UCL	288.9	95% Percentile Bootstrap UCL	181.2
95% BCA Bootstrap UCL	198.9		
90% Chebyshev(Mean, Sd) UCL	200.3	95% Chebyshev(Mean, Sd) UCL	221.4
97.5% Chebyshev(Mean, Sd) UCL	250.7	99% Chebyshev(Mean, Sd) UCL	308.2

Suggested UCL to Use

95% Student's-t UCL	179.9	or 95% Modified-t UCL	181.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	18
Number of Detects	43	Number of Non-Detects	3
Number of Distinct Detects	17	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	1.3	Maximum Non-Detect	1
Variance Detects	0.0466	Percent Non-Detects	6.522%
Mean Detects	0.494	SD Detects	0.216
Median Detects	0.5	CV Detects	0.437
Skewness Detects	1.649	Kurtosis Detects	4.591
Mean of Logged Detects	-0.791	SD of Logged Detects	0.433

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.197	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	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

Mean	0.492	Standard Error of Mean	0.0319
SD	0.21	95% KM (BCA) UCL	0.547
95% KM (t) UCL	0.546	95% KM (Percentile Bootstrap) UCL	0.547
95% KM (z) UCL	0.545	95% KM Bootstrap t UCL	0.557
90% KM Chebyshev UCL	0.588	95% KM Chebyshev UCL	0.631
97.5% KM Chebyshev UCL	0.691	99% KM Chebyshev UCL	0.809

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.048	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.752	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.135	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)	5.913	k star (bias corrected MLE)	5.516
Theta hat (MLE)	0.0836	Theta star (bias corrected MLE)	0.0896
nu hat (MLE)	508.5	nu star (bias corrected)	474.4
MLE Mean (bias corrected)	0.494	MLE Sd (bias corrected)	0.211

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.498	nu hat (KM)	505.8
Approximate Chi Square Value (505.80, α)	454.6	Adjusted Chi Square Value (505.80, β)	453.1
95% Gamma Approximate KM-UCL (use when n>=50)	0.548	95% Gamma Adjusted KM-UCL (use when n<50)	0.549

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.11	Mean	0.492
Maximum	1.3	Median	0.5
SD	0.211	CV	0.428
k hat (MLE)	6.17	k star (bias corrected MLE)	5.782
Theta hat (MLE)	0.0798	Theta star (bias corrected MLE)	0.0851
nu hat (MLE)	567.6	nu star (bias corrected)	531.9
MLE Mean (bias corrected)	0.492	MLE Sd (bias corrected)	0.205
		Adjusted Level of Significance (β)	0.0448
Approximate Chi Square Value (531.92, α)	479.4	Adjusted Chi Square Value (531.92, β)	477.8
95% Gamma Approximate UCL (use when n>=50)	0.546	95% Gamma Adjusted UCL (use when n<50)	0.548

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.177	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	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	0.492	Mean in Log Scale	-0.793
SD in Original Scale	0.21	SD in Log Scale	0.423
95% t UCL (assumes normality of ROS data)	0.544	95% Percentile Bootstrap UCL	0.546
95% BCA Bootstrap UCL	0.552	95% Bootstrap t UCL	0.553
95% H-UCL (Log ROS)	0.555		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.495	Mean in Log Scale	-0.785
SD in Original Scale	0.209	SD in Log Scale	0.419
95% t UCL (Assumes normality)	0.546	95% H-Stat UCL	0.558

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	0.631

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

Result (cadmium)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	16
Number of Detects	16	Number of Non-Detects	30
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	0.48	Minimum Non-Detect	2
Maximum Detect	24.9	Maximum Non-Detect	2
Variance Detects	36.18	Percent Non-Detects	65.22%
Mean Detects	3.698	SD Detects	6.015
Median Detects	1.18	CV Detects	1.627
Skewness Detects	3.276	Kurtosis Detects	11.74
Mean of Logged Detects	0.591	SD of Logged Detects	1.148

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.552	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.222	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

Mean	1.804	Standard Error of Mean	0.569
SD	3.709	95% KM (BCA) UCL	2.929
95% KM (t) UCL	2.759	95% KM (Percentile Bootstrap) UCL	2.809
95% KM (z) UCL	2.74	95% KM Bootstrap t UCL	4.385
90% KM Chebyshev UCL	3.51	95% KM Chebyshev UCL	4.283
97.5% KM Chebyshev UCL	5.355	99% KM Chebyshev UCL	7.462

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.963	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.771	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.232	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.223	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)	0.824	k star (bias corrected MLE)	0.711
Theta hat (MLE)	4.487	Theta star (bias corrected MLE)	5.199
nu hat (MLE)	26.37	nu star (bias corrected)	22.76
MLE Mean (bias corrected)	3.698	MLE Sd (bias corrected)	4.385

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.237	nu hat (KM)	21.78
Approximate Chi Square Value (21.78, α)	12.17	Adjusted Chi Square Value (21.78, β)	11.94
95% Gamma Approximate KM-UCL (use when n>=50)	3.228	95% Gamma Adjusted KM-UCL (use when n<50)	3.292

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.816
Maximum	24.9	Median	0.66
SD	3.871	CV	2.131
k hat (MLE)	0.338	k star (bias corrected MLE)	0.33
Theta hat (MLE)	5.378	Theta star (bias corrected MLE)	5.501
nu hat (MLE)	31.07	nu star (bias corrected)	30.38
MLE Mean (bias corrected)	1.816	MLE Sd (bias corrected)	3.161
		Adjusted Level of Significance (β)	0.0448
Approximate Chi Square Value (30.38, α)	18.79	Adjusted Chi Square Value (30.38, β)	18.49
95% Gamma Approximate UCL (use when n>=50)	2.936	95% Gamma Adjusted UCL (use when n<50)	2.983

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.185	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.222	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	1.964	Mean in Log Scale	0.0633
SD in Original Scale	3.745	SD in Log Scale	0.988
95% t UCL (assumes normality of ROS data)	2.891	95% Percentile Bootstrap UCL	2.959
95% BCA Bootstrap UCL	3.639	95% Bootstrap t UCL	4.361
95% H-UCL (Log ROS)	2.441		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.0215	95% H-UCL (KM -Log)	1.855
KM SD (logged)	0.818	95% Critical H Value (KM-Log)	2.145
KM Standard Error of Mean (logged)	0.149		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.938	Mean in Log Scale	0.205
SD in Original Scale	3.708	SD in Log Scale	0.721
95% t UCL (Assumes normality)	2.857	95% H-Stat UCL	1.985

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

95% KM (BCA) UCL	2.929

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

Result (chromium)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	3	Mean	12.02
Maximum	58	Median	8
SD	10.37	Std. Error of Mean	1.528
Coefficient of Variation	0.862	Skewness	2.795

Normal GOF Test

Shapiro Wilk Test Statistic	0.687	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	14.59	95% Adjusted-CLT UCL (Chen-1995)	15.21
		95% Modified-t UCL (Johnson-1978)	14.69

Gamma GOF Test

A-D Test Statistic	1.738	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.163	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.363	k star (bias corrected MLE)	2.223
Theta hat (MLE)	5.087	Theta star (bias corrected MLE)	5.407
nu hat (MLE)	217.4	nu star (bias corrected)	204.6
MLE Mean (bias corrected)	12.02	MLE Sd (bias corrected)	8.062
		Approximate Chi Square Value (0.05)	172.5
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	171.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.26	95% Adjusted Gamma UCL (use when n<50)	14.34

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	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	2.26
Maximum of Logged Data	4.06	SD of logged Data	0.627

Assuming Lognormal Distribution

95% H-UCL	14.04	90% Chebyshev (MVUE) UCL	15.08
95% Chebyshev (MVUE) UCL	16.65	97.5% Chebyshev (MVUE) UCL	18.83
99% Chebyshev (MVUE) UCL	23.11		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	14.54	95% Jackknife UCL	14.59
95% Standard Bootstrap UCL	14.55	95% Bootstrap-t UCL	15.84
95% Hall's Bootstrap UCL	17.17	95% Percentile Bootstrap UCL	14.7
95% BCA Bootstrap UCL	14.98		
90% Chebyshev(Mean, Sd) UCL	16.61	95% Chebyshev(Mean, Sd) UCL	18.68
97.5% Chebyshev(Mean, Sd) UCL	21.57	99% Chebyshev(Mean, Sd) UCL	27.23

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	18.68

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	41	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	4	Mean	13.2
Maximum	76	Median	10
SD	12.24	Std. Error of Mean	1.911
Coefficient of Variation	0.927	Skewness	3.98

Normal GOF Test

Shapiro Wilk Test Statistic	0.518	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.138	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	16.41	95% Adjusted-CLT UCL (Chen-1995)	17.61
		95% Modified-t UCL (Johnson-1978)	16.61

Gamma GOF Test

A-D Test Statistic	3.869	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.293	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.812	k star (bias corrected MLE)	2.623
Theta hat (MLE)	4.692	Theta star (bias corrected MLE)	5.031
nu hat (MLE)	230.6	nu star (bias corrected)	215.1
MLE Mean (bias corrected)	13.2	MLE Sd (bias corrected)	8.148
		Approximate Chi Square Value (0.05)	182.1
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	181

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15.58	95% Adjusted Gamma UCL (use when n<50)	15.68

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.941	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.251	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.138	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.386	Mean of logged Data	2.392
Maximum of Logged Data	4.331	SD of logged Data	0.528

Assuming Lognormal Distribution

95% H-UCL	14.75	90% Chebyshev (MVUE) UCL	15.79
95% Chebyshev (MVUE) UCL	17.26	97.5% Chebyshev (MVUE) UCL	19.32
99% Chebyshev (MVUE) UCL	23.35		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	16.34	95% Jackknife UCL	16.41
95% Standard Bootstrap UCL	16.25	95% Bootstrap-t UCL	19.82
95% Hall's Bootstrap UCL	26.24	95% Percentile Bootstrap UCL	16.56
95% BCA Bootstrap UCL	18.29		
90% Chebyshev(Mean, Sd) UCL	18.93	95% Chebyshev(Mean, Sd) UCL	21.52
97.5% Chebyshev(Mean, Sd) UCL	25.13	99% Chebyshev(Mean, Sd) UCL	32.21

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	21.52

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (copper)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	207	Mean	5036
Maximum	59300	Median	1555
SD	11230	Std. Error of Mean	1656
Coefficient of Variation	2.23	Skewness	3.814

Normal GOF Test

Shapiro Wilk Test Statistic	0.444	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.367	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	7817	95% Adjusted-CLT UCL (Chen-1995)	8755
		95% Modified-t UCL (Johnson-1978)	7972

Gamma GOF Test

A-D Test Statistic	4.364	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.805	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.137	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.596	k star (bias corrected MLE)	0.572
Theta hat (MLE)	8444	Theta star (bias corrected MLE)	8805
nu hat (MLE)	54.87	nu star (bias corrected)	52.62
MLE Mean (bias corrected)	5036	MLE Sd (bias corrected)	6659
		Approximate Chi Square Value (0.05)	36.96
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	36.53

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7171	95% Adjusted Gamma UCL (use when n<50)	7254

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.333	Mean of logged Data	7.487
Maximum of Logged Data	10.99	SD of logged Data	1.242

Assuming Lognormal Distribution

95% H-UCL	6248	90% Chebyshev (MVUE) UCL	6318
95% Chebyshev (MVUE) UCL	7480	97.5% Chebyshev (MVUE) UCL	9092
99% Chebyshev (MVUE) UCL	12258		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	7760	95% Jackknife UCL	7817
95% Standard Bootstrap UCL	7780	95% Bootstrap-t UCL	11552
95% Hall's Bootstrap UCL	16985	95% Percentile Bootstrap UCL	7856
95% BCA Bootstrap UCL	9190		
90% Chebyshev(Mean, Sd) UCL	10004	95% Chebyshev(Mean, Sd) UCL	12254
97.5% Chebyshev(Mean, Sd) UCL	15377	99% Chebyshev(Mean, Sd) UCL	21512

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	12254

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	4	Mean	87.05
Maximum	1820	Median	13.25
SD	280.4	Std. Error of Mean	41.34
Coefficient of Variation	3.221	Skewness	5.649

Normal GOF Test

Shapiro Wilk Test Statistic	0.318	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.384	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	156.5	95% Adjusted-CLT UCL (Chen-1995)	191.8
		95% Modified-t UCL (Johnson-1978)	162.2

Gamma GOF Test

A-D Test Statistic	4.937	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.828	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.258	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.441	k star (bias corrected MLE)	0.427
Theta hat (MLE)	197.3	Theta star (bias corrected MLE)	203.9
nu hat (MLE)	40.58	nu star (bias corrected)	39.27
MLE Mean (bias corrected)	87.05	MLE Sd (bias corrected)	133.2
		Approximate Chi Square Value (0.05)	25.92
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	25.56

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	131.9	95% Adjusted Gamma UCL (use when n<50)	133.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.386	Mean of logged Data	2.998
Maximum of Logged Data	7.507	SD of logged Data	1.418

Assuming Lognormal Distribution

95% H-UCL	99.18	90% Chebyshev (MVUE) UCL	95.19
95% Chebyshev (MVUE) UCL	114.5	97.5% Chebyshev (MVUE) UCL	141.3
99% Chebyshev (MVUE) UCL	194		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	155	95% Jackknife UCL	156.5
95% Standard Bootstrap UCL	153.6	95% Bootstrap-t UCL	397.2
95% Hall's Bootstrap UCL	415	95% Percentile Bootstrap UCL	164.6
95% BCA Bootstrap UCL	213.6		
90% Chebyshev(Mean, Sd) UCL	211.1	95% Chebyshev(Mean, Sd) UCL	267.2
97.5% Chebyshev(Mean, Sd) UCL	345.2	99% Chebyshev(Mean, Sd) UCL	498.4

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	267.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	71	Mean	316.9
Maximum	587	Median	323.5
SD	100.5	Std. Error of Mean	14.82
Coefficient of Variation	0.317	Skewness	0.13

Normal GOF Test

Shapiro Wilk Test Statistic	0.991	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0933	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	341.8	95% Adjusted-CLT UCL (Chen-1995)	341.6
		95% Modified-t UCL (Johnson-1978)	341.9

Gamma GOF Test

A-D Test Statistic	0.56	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.107	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.131	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.647	k star (bias corrected MLE)	8.097
Theta hat (MLE)	36.65	Theta star (bias corrected MLE)	39.14
nu hat (MLE)	795.5	nu star (bias corrected)	744.9
MLE Mean (bias corrected)	316.9	MLE Sd (bias corrected)	111.4
		Approximate Chi Square Value (0.05)	682.6
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	680.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	345.9	95% Adjusted Gamma UCL (use when n<50)	346.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.92	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.263	Mean of logged Data	5.7
Maximum of Logged Data	6.375	SD of logged Data	0.373

Assuming Lognormal Distribution

95% H-UCL	354	90% Chebyshev (MVUE) UCL	374
95% Chebyshev (MVUE) UCL	398.6	97.5% Chebyshev (MVUE) UCL	432.7
99% Chebyshev (MVUE) UCL	499.7		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	341.3	95% Jackknife UCL	341.8
95% Standard Bootstrap UCL	341.4	95% Bootstrap-t UCL	341.7
95% Hall's Bootstrap UCL	342.2	95% Percentile Bootstrap UCL	341.6
95% BCA Bootstrap UCL	340.3		
90% Chebyshev(Mean, Sd) UCL	361.4	95% Chebyshev(Mean, Sd) UCL	381.5
97.5% Chebyshev(Mean, Sd) UCL	409.5	99% Chebyshev(Mean, Sd) UCL	464.4

Suggested UCL to Use

95% Student's-t UCL	341.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (mercury)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	37
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.05	Minimum Non-Detect	0.04
Maximum Detect	0.62	Maximum Non-Detect	0.2
Variance Detects	0.0332	Percent Non-Detects	80.43%
Mean Detects	0.187	SD Detects	0.182
Median Detects	0.12	CV Detects	0.976
Skewness Detects	2.04	Kurtosis Detects	4.28
Mean of Logged Detects	-2.003	SD of Logged Detects	0.813

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.747	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.292	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	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

Mean	0.0987	Standard Error of Mean	0.0198
SD	0.0971	95% KM (BCA) UCL	0.132
95% KM (t) UCL	0.132	95% KM (Percentile Bootstrap) UCL	0.132
95% KM (z) UCL	0.131	95% KM Bootstrap t UCL	0.143
90% KM Chebyshev UCL	0.158	95% KM Chebyshev UCL	0.185
97.5% KM Chebyshev UCL	0.222	99% KM Chebyshev UCL	0.296

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.427	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.283	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)	1.689	k star (bias corrected MLE)	1.2
Theta hat (MLE)	0.111	Theta star (bias corrected MLE)	0.156
nu hat (MLE)	30.4	nu star (bias corrected)	21.6
MLE Mean (bias corrected)	0.187	MLE Sd (bias corrected)	0.17

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.033	nu hat (KM)	95
Approximate Chi Square Value (95.00, α)	73.52	Adjusted Chi Square Value (95.00, β)	72.91
95% Gamma Approximate KM-UCL (use when n>=50)	0.128	95% Gamma Adjusted KM-UCL (use when n<50)	0.129

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0906
Maximum	0.62	Median	0.05
SD	0.117	CV	1.287
k hat (MLE)	0.766	k star (bias corrected MLE)	0.73
Theta hat (MLE)	0.118	Theta star (bias corrected MLE)	0.124
nu hat (MLE)	70.44	nu star (bias corrected)	67.18
MLE Mean (bias corrected)	0.0906	MLE Sd (bias corrected)	0.106
		Adjusted Level of Significance (β)	0.0448
Approximate Chi Square Value (67.18, α)	49.32	Adjusted Chi Square Value (67.18, β)	48.82
95% Gamma Approximate UCL (use when n>=50)	0.123	95% Gamma Adjusted UCL (use when n<50)	0.125

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.139	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	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	0.095	Mean in Log Scale	-2.763
SD in Original Scale	0.105	SD in Log Scale	0.904
95% t UCL (assumes normality of ROS data)	0.121	95% Percentile Bootstrap UCL	0.123
95% BCA Bootstrap UCL	0.127	95% Bootstrap t UCL	0.134
95% H-UCL (Log ROS)	0.128		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.582	95% H-UCL (KM -Log)	0.115
KM SD (logged)	0.663	95% Critical H Value (KM-Log)	2.004
KM Standard Error of Mean (logged)	0.179		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.11	Mean in Log Scale	-2.379
SD in Original Scale	0.0886	SD in Log Scale	0.587
95% t UCL (Assumes normality)	0.132	95% H-Stat UCL	0.131

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	0.132	95% KM (Percentile Bootstrap) UCL	0.132

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

Result (molybdenum)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	15	Mean	396.3
Maximum	3020	Median	114.5
SD	714.2	Std. Error of Mean	105.3
Coefficient of Variation	1.802	Skewness	2.72

Normal GOF Test

Shapiro Wilk Test Statistic	0.541	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.312	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	573.2	95% Adjusted-CLT UCL (Chen-1995)	614.7
		95% Modified-t UCL (Johnson-1978)	580.2

Gamma GOF Test

A-D Test Statistic	3.201	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.801	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.238	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.137	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.635	k star (bias corrected MLE)	0.608
Theta hat (MLE)	624.2	Theta star (bias corrected MLE)	651.9
nu hat (MLE)	58.41	nu star (bias corrected)	55.93
MLE Mean (bias corrected)	396.3	MLE Sd (bias corrected)	508.3
		Approximate Chi Square Value (0.05)	39.75
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	39.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	557.7	95% Adjusted Gamma UCL (use when n<50)	564

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	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	5.017
Maximum of Logged Data	8.013	SD of logged Data	1.298

Assuming Lognormal Distribution

95% H-UCL	586.7	90% Chebyshev (MVUE) UCL	584.7
95% Chebyshev (MVUE) UCL	695.8	97.5% Chebyshev (MVUE) UCL	850.1
99% Chebyshev (MVUE) UCL	1153		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	569.5	95% Jackknife UCL	573.2
95% Standard Bootstrap UCL	567.1	95% Bootstrap-t UCL	671.1
95% Hall's Bootstrap UCL	587.9	95% Percentile Bootstrap UCL	580.4
95% BCA Bootstrap UCL	609.8		
90% Chebyshev(Mean, Sd) UCL	712.3	95% Chebyshev(Mean, Sd) UCL	855.4
97.5% Chebyshev(Mean, Sd) UCL	1054	99% Chebyshev(Mean, Sd) UCL	1444

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	855.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (nickel)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	3	Mean	16.02
Maximum	64	Median	10
SD	12.47	Std. Error of Mean	1.839
Coefficient of Variation	0.779	Skewness	1.615

Normal GOF Test

Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	19.11	95% Adjusted-CLT UCL (Chen-1995)	19.52
		95% Modified-t UCL (Johnson-1978)	19.18

Gamma GOF Test

A-D Test Statistic	2.513	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.205	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.134	k star (bias corrected MLE)	2.01
Theta hat (MLE)	7.507	Theta star (bias corrected MLE)	7.972
nu hat (MLE)	196.4	nu star (bias corrected)	184.9
MLE Mean (bias corrected)	16.02	MLE Sd (bias corrected)	11.3
		Approximate Chi Square Value (0.05)	154.4
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	153.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	19.18	95% Adjusted Gamma UCL (use when n<50)	19.29

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	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	2.522
Maximum of Logged Data	4.159	SD of logged Data	0.7

Assuming Lognormal Distribution

95% H-UCL	19.67	90% Chebyshev (MVUE) UCL	21.16
95% Chebyshev (MVUE) UCL	23.58	97.5% Chebyshev (MVUE) UCL	26.94
99% Chebyshev (MVUE) UCL	33.55		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	19.05	95% Jackknife UCL	19.11
95% Standard Bootstrap UCL	18.95	95% Bootstrap-t UCL	19.74
95% Hall's Bootstrap UCL	19.77	95% Percentile Bootstrap UCL	19.22
95% BCA Bootstrap UCL	19.59		
90% Chebyshev(Mean, Sd) UCL	21.54	95% Chebyshev(Mean, Sd) UCL	24.04
97.5% Chebyshev(Mean, Sd) UCL	27.51	99% Chebyshev(Mean, Sd) UCL	34.32

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	24.04

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (selenium)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	39
Number of Detects	45	Number of Non-Detects	1
Number of Distinct Detects	38	Number of Distinct Non-Detects	1
Minimum Detect	0.23	Minimum Non-Detect	0.67
Maximum Detect	50	Maximum Non-Detect	0.67
Variance Detects	93.33	Percent Non-Detects	2.174%
Mean Detects	3.659	SD Detects	9.661
Median Detects	0.51	CV Detects	2.64
Skewness Detects	3.945	Kurtosis Detects	15.91
Mean of Logged Detects	-0.0942	SD of Logged Detects	1.356

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.397	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.389	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	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

Mean	3.588	Standard Error of Mean	1.411
SD	9.461	95% KM (BCA) UCL	6.171
95% KM (t) UCL	5.957	95% KM (Percentile Bootstrap) UCL	6.062
95% KM (z) UCL	5.908	95% KM Bootstrap t UCL	10.33
90% KM Chebyshev UCL	7.82	95% KM Chebyshev UCL	9.737
97.5% KM Chebyshev UCL	12.4	99% KM Chebyshev UCL	17.62

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.375	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.823	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.309	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.14	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)	0.462	k star (bias corrected MLE)	0.446
Theta hat (MLE)	7.918	Theta star (bias corrected MLE)	8.201
nu hat (MLE)	41.59	nu star (bias corrected)	40.15
MLE Mean (bias corrected)	3.659	MLE Sd (bias corrected)	5.478

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.144	nu hat (KM)	13.23
Approximate Chi Square Value (13.23, α)	6.049	Adjusted Chi Square Value (13.23, β)	5.891
95% Gamma Approximate KM-UCL (use when n>=50)	7.848	95% Gamma Adjusted KM-UCL (use when n<50)	8.058

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3.58
Maximum	50	Median	0.495
SD	9.568	CV	2.673
k hat (MLE)	0.441	k star (bias corrected MLE)	0.427
Theta hat (MLE)	8.11	Theta star (bias corrected MLE)	8.382
nu hat (MLE)	40.61	nu star (bias corrected)	39.29
MLE Mean (bias corrected)	3.58	MLE Sd (bias corrected)	5.478
		Adjusted Level of Significance (β)	0.0448
Approximate Chi Square Value (39.29, α)	25.93	Adjusted Chi Square Value (39.29, β)	25.58
95% Gamma Approximate UCL (use when n>=50)	5.424	95% Gamma Adjusted UCL (use when n<50)	5.499

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.803	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	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	3.589	Mean in Log Scale	-0.111
SD in Original Scale	9.565	SD in Log Scale	1.346
95% t UCL (assumes normality of ROS data)	5.957	95% Percentile Bootstrap UCL	5.96
95% BCA Bootstrap UCL	7.308	95% Bootstrap t UCL	10.05
95% H-UCL (Log ROS)	3.823		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.587	Mean in Log Scale	-0.116
SD in Original Scale	9.565	SD in Log Scale	1.349
95% t UCL (Assumes normality)	5.955	95% H-Stat UCL	3.829

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	9.737

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

Result (thallium)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	0.1	Mean	0.38
Maximum	5.2	Median	0.265
SD	0.734	Std. Error of Mean	0.108
Coefficient of Variation	1.929	Skewness	6.574

Normal GOF Test

Shapiro Wilk Test Statistic	0.253	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.413	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.562	95% Adjusted-CLT UCL (Chen-1995)	0.67
		95% Modified-t UCL (Johnson-1978)	0.58

Gamma GOF Test

A-D Test Statistic	6.119	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.285	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.133	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.649	k star (bias corrected MLE)	1.556
Theta hat (MLE)	0.231	Theta star (bias corrected MLE)	0.245
nu hat (MLE)	151.7	nu star (bias corrected)	143.1
MLE Mean (bias corrected)	0.38	MLE Sd (bias corrected)	0.305
		Approximate Chi Square Value (0.05)	116.5
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	115.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.467	95% Adjusted Gamma UCL (use when n<50)	0.471

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.769	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.303	Mean of logged Data	-1.299
Maximum of Logged Data	1.649	SD of logged Data	0.58

Assuming Lognormal Distribution

95% H-UCL	0.382	90% Chebyshev (MVUE) UCL	0.409
95% Chebyshev (MVUE) UCL	0.449	97.5% Chebyshev (MVUE) UCL	0.504
99% Chebyshev (MVUE) UCL	0.613		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.558	95% Jackknife UCL	0.562
95% Standard Bootstrap UCL	0.561	95% Bootstrap-t UCL	1.486
95% Hall's Bootstrap UCL	1.375	95% Percentile Bootstrap UCL	0.594
95% BCA Bootstrap UCL	0.705		
90% Chebyshev(Mean, Sd) UCL	0.705	95% Chebyshev(Mean, Sd) UCL	0.852
97.5% Chebyshev(Mean, Sd) UCL	1.056	99% Chebyshev(Mean, Sd) UCL	1.457

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.852

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium)

General Statistics

Total Number of Observations	36	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	1.45	Mean	4.055
Maximum	7.57	Median	4.09
SD	1.232	Std. Error of Mean	0.205
Coefficient of Variation	0.304	Skewness	0.357

Normal GOF Test

Shapiro Wilk Test Statistic	0.984	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0785	**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	4.402	95% Adjusted-CLT UCL (Chen-1995)	4.406
		95% Modified-t UCL (Johnson-1978)	4.404

Gamma GOF Test

A-D Test Statistic	0.29	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.147	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	10.41	k star (bias corrected MLE)	9.565
Theta hat (MLE)	0.389	Theta star (bias corrected MLE)	0.424
nu hat (MLE)	749.8	nu star (bias corrected)	688.6
MLE Mean (bias corrected)	4.055	MLE Sd (bias corrected)	1.311
		Approximate Chi Square Value (0.05)	628.8
Adjusted Level of Significance	0.0428	Adjusted Chi Square Value	626.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.441	95% Adjusted Gamma UCL (use when n<50)	4.46

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.935	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.138	**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	0.372	Mean of logged Data	1.351
Maximum of Logged Data	2.024	SD of logged Data	0.328

Assuming Lognormal Distribution

95% H-UCL	4.504	90% Chebyshev (MVUE) UCL	4.751
95% Chebyshev (MVUE) UCL	5.06	97.5% Chebyshev (MVUE) UCL	5.489
99% Chebyshev (MVUE) UCL	6.331		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.393	95% Jackknife UCL	4.402
95% Standard Bootstrap UCL	4.388	95% Bootstrap-t UCL	4.404
95% Hall's Bootstrap UCL	4.426	95% Percentile Bootstrap UCL	4.403
95% BCA Bootstrap UCL	4.396		
90% Chebyshev(Mean, Sd) UCL	4.671	95% Chebyshev(Mean, Sd) UCL	4.95
97.5% Chebyshev(Mean, Sd) UCL	5.337	99% Chebyshev(Mean, Sd) UCL	6.097

Suggested UCL to Use

95% Student's-t UCL	4.402

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	46	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	26	Mean	265.4
Maximum	6210	Median	90
SD	909.6	Std. Error of Mean	134.1
Coefficient of Variation	3.427	Skewness	6.484

Normal GOF Test

Shapiro Wilk Test Statistic	0.246	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.399	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	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	490.7	95% Adjusted-CLT UCL (Chen-1995)	623
		95% Modified-t UCL (Johnson-1978)	512

Gamma GOF Test

A-D Test Statistic	6.044	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.801	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.287	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.137	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.633	k star (bias corrected MLE)	0.606
Theta hat (MLE)	419.5	Theta star (bias corrected MLE)	438.1
nu hat (MLE)	58.21	nu star (bias corrected)	55.75
MLE Mean (bias corrected)	265.4	MLE Sd (bias corrected)	341
		Approximate Chi Square Value (0.05)	39.59
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	39.15

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	373.8	95% Adjusted Gamma UCL (use when n<50)	378

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.858	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.131	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.258	Mean of logged Data	4.612
Maximum of Logged Data	8.734	SD of logged Data	0.994

Assuming Lognormal Distribution

95% H-UCL	232.8	90% Chebyshev (MVUE) UCL	246.2
95% Chebyshev (MVUE) UCL	284.1	97.5% Chebyshev (MVUE) UCL	336.7
99% Chebyshev (MVUE) UCL	440		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	486	95% Jackknife UCL	490.7
95% Standard Bootstrap UCL	485.1	95% Bootstrap-t UCL	1495
95% Hall's Bootstrap UCL	1231	95% Percentile Bootstrap UCL	523.5
95% BCA Bootstrap UCL	690.6		
90% Chebyshev(Mean, Sd) UCL	667.8	95% Chebyshev(Mean, Sd) UCL	850
97.5% Chebyshev(Mean, Sd) UCL	1103	99% Chebyshev(Mean, Sd) UCL	1600

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	850

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (antimony)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	19
Number of Detects	36	Number of Non-Detects	18
Number of Distinct Detects	19	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	66	Maximum Non-Detect	2
Variance Detects	187.2	Percent Non-Detects	33.33%
Mean Detects	4.781	SD Detects	13.68
Median Detects	0.45	CV Detects	2.862
Skewness Detects	3.932	Kurtosis Detects	15.14
Mean of Logged Detects	-0.11	SD of Logged Detects	1.532

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.37	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.38	**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

Mean	3.322	Standard Error of Mean	1.547
SD	11.21	95% KM (BCA) UCL	6.399
95% KM (t) UCL	5.912	95% KM (Percentile Bootstrap) UCL	6.193
95% KM (z) UCL	5.867	95% KM Bootstrap t UCL	16.69
90% KM Chebyshev UCL	7.963	95% KM Chebyshev UCL	10.07
97.5% KM Chebyshev UCL	12.98	99% KM Chebyshev UCL	18.71

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.741	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.836	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.268	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.157	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)	0.394	k star (bias corrected MLE)	0.38
Theta hat (MLE)	12.13	Theta star (bias corrected MLE)	12.59
nu hat (MLE)	28.37	nu star (bias corrected)	27.34
MLE Mean (bias corrected)	4.781	MLE Sd (bias corrected)	7.758

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0878	nu hat (KM)	9.487
Approximate Chi Square Value (9.49, α)	3.624	Adjusted Chi Square Value (9.49, β)	3.525
95% Gamma Approximate KM-UCL (use when n>=50)	8.697	95% Gamma Adjusted KM-UCL (use when n<50)	8.941

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3.313
Maximum	66	Median	0.3
SD	11.32	CV	3.418
k hat (MLE)	0.284	k star (bias corrected MLE)	0.281
Theta hat (MLE)	11.66	Theta star (bias corrected MLE)	11.8
nu hat (MLE)	30.69	nu star (bias corrected)	30.32
MLE Mean (bias corrected)	3.313	MLE Sd (bias corrected)	6.252
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (30.32, α)	18.75	Adjusted Chi Square Value (30.32, β)	18.5
95% Gamma Approximate UCL (use when n>=50)	5.359	95% Gamma Adjusted UCL (use when n<50)	5.431

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.826	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.201	**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	3.374	Mean in Log Scale	-0.366
SD in Original Scale	11.3	SD in Log Scale	1.387
95% t UCL (assumes normality of ROS data)	5.949	95% Percentile Bootstrap UCL	5.944
95% BCA Bootstrap UCL	7.393	95% Bootstrap t UCL	15.74
95% H-UCL (Log ROS)	3.119		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.391	Mean in Log Scale	-0.253
SD in Original Scale	11.3	SD in Log Scale	1.273
95% t UCL (Assumes normality)	5.964	95% H-Stat UCL	2.802

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

97.5% KM (Chebyshev) UCL	12.98

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

Result (arsenic)

General Statistics

Total Number of Observations	149	Number of Distinct Observations	86
Number of Detects	139	Number of Non-Detects	10
Number of Distinct Detects	86	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	2.5
Maximum Detect	166	Maximum Non-Detect	2.5
Variance Detects	285.5	Percent Non-Detects	6.711%
Mean Detects	9.726	SD Detects	16.9
Median Detects	6.2	CV Detects	1.737
Skewness Detects	7.202	Kurtosis Detects	60.1
Mean of Logged Detects	1.85	SD of Logged Detects	0.806

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.387	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0751	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

Mean	9.199	Standard Error of Mean	1.347
SD	16.38	95% KM (BCA) UCL	11.87
95% KM (t) UCL	11.43	95% KM (Percentile Bootstrap) UCL	11.67
95% KM (z) UCL	11.41	95% KM Bootstrap t UCL	14.34
90% KM Chebyshev UCL	13.24	95% KM Chebyshev UCL	15.07
97.5% KM Chebyshev UCL	17.61	99% KM Chebyshev UCL	22.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.481	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.775	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.128	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0812	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)	1.317	k star (bias corrected MLE)	1.294
Theta hat (MLE)	7.384	Theta star (bias corrected MLE)	7.519
nu hat (MLE)	366.2	nu star (bias corrected)	359.6
MLE Mean (bias corrected)	9.726	MLE Sd (bias corrected)	8.552

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.315	nu hat (KM)	93.98
Approximate Chi Square Value (93.98, α)	72.62	Adjusted Chi Square Value (93.98, β)	72.44
95% Gamma Approximate KM-UCL (use when n>=50)	11.9	95% Gamma Adjusted KM-UCL (use when n<50)	11.93

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	9.074
Maximum	166	Median	5.6
SD	16.5	CV	1.818
k hat (MLE)	0.758	k star (bias corrected MLE)	0.747
Theta hat (MLE)	11.98	Theta star (bias corrected MLE)	12.15
nu hat (MLE)	225.8	nu star (bias corrected)	222.5
MLE Mean (bias corrected)	9.074	MLE Sd (bias corrected)	10.5
		Adjusted Level of Significance (β)	0.0484
Approximate Chi Square Value (222.54, α)	189	Adjusted Chi Square Value (222.54, β)	188.7
95% Gamma Approximate UCL (use when n>=50)	10.68	95% Gamma Adjusted UCL (use when n<50)	10.7

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.062	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0751	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.181	Mean in Log Scale	1.754
SD in Original Scale	16.44	SD in Log Scale	0.86
95% t UCL (assumes normality of ROS data)	11.41	95% Percentile Bootstrap UCL	11.46
95% BCA Bootstrap UCL	12.59	95% Bootstrap t UCL	14.57
95% H-UCL (Log ROS)	9.688		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.766	95% H-UCL (KM -Log)	9.575
KM SD (logged)	0.838	95% Critical H Value (KM-Log)	2.064
KM Standard Error of Mean (logged)	0.0692		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	9.158	Mean in Log Scale	1.74
SD in Original Scale	16.46	SD in Log Scale	0.879
95% t UCL (Assumes normality)	11.39	95% H-Stat UCL	9.762

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

95% KM (BCA) UCL	11.87

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

Result (barium)

General Statistics

Total Number of Observations	42	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	36.8	Mean	149
Maximum	654	Median	134.5
SD	94.12	Std. Error of Mean	14.52
Coefficient of Variation	0.632	Skewness	4.008

Normal GOF Test

Shapiro Wilk Test Statistic	0.613	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.26	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.137	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	173.4	95% Adjusted-CLT UCL (Chen-1995)	182.5
		95% Modified-t UCL (Johnson-1978)	174.9

Gamma GOF Test

A-D Test Statistic	1.619	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.137	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.466	k star (bias corrected MLE)	4.163
Theta hat (MLE)	33.36	Theta star (bias corrected MLE)	35.79
nu hat (MLE)	375.1	nu star (bias corrected)	349.7
MLE Mean (bias corrected)	149	MLE Sd (bias corrected)	73.03
		Approximate Chi Square Value (0.05)	307.3
Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	305.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	169.5	95% Adjusted Gamma UCL (use when n<50)	170.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.137	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.605	Mean of logged Data	4.888
Maximum of Logged Data	6.483	SD of logged Data	0.462

Assuming Lognormal Distribution

95% H-UCL	168.9	90% Chebyshev (MVUE) UCL	179.9
95% Chebyshev (MVUE) UCL	194.7	97.5% Chebyshev (MVUE) UCL	215.3
99% Chebyshev (MVUE) UCL	255.8		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	172.9	95% Jackknife UCL	173.4
95% Standard Bootstrap UCL	172.5	95% Bootstrap-t UCL	193.3
95% Hall's Bootstrap UCL	286.5	95% Percentile Bootstrap UCL	173.7
95% BCA Bootstrap UCL	188.7		
90% Chebyshev(Mean, Sd) UCL	192.6	95% Chebyshev(Mean, Sd) UCL	212.3
97.5% Chebyshev(Mean, Sd) UCL	239.7	99% Chebyshev(Mean, Sd) UCL	293.5

Suggested UCL to Use

95% Student's-t UCL	173.4	or 95% Modified-t UCL	174.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	23
Number of Detects	51	Number of Non-Detects	3
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	1.3	Maximum Non-Detect	1
Variance Detects	0.0419	Percent Non-Detects	5.556%
Mean Detects	0.49	SD Detects	0.205
Median Detects	0.45	CV Detects	0.418
Skewness Detects	1.742	Kurtosis Detects	5.029
Mean of Logged Detects	-0.792	SD of Logged Detects	0.407

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.861	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	3.2515E-6	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	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

Mean	0.488	Standard Error of Mean	0.0279
SD	0.2	95% KM (BCA) UCL	0.535
95% KM (t) UCL	0.535	95% KM (Percentile Bootstrap) UCL	0.536
95% KM (z) UCL	0.534	95% KM Bootstrap t UCL	0.544
90% KM Chebyshev UCL	0.572	95% KM Chebyshev UCL	0.61
97.5% KM Chebyshev UCL	0.662	99% KM Chebyshev UCL	0.766

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.323	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.752	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.155	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.124	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)	6.565	k star (bias corrected MLE)	6.192
Theta hat (MLE)	0.0746	Theta star (bias corrected MLE)	0.0791
nu hat (MLE)	669.6	nu star (bias corrected)	631.5
MLE Mean (bias corrected)	0.49	MLE Sd (bias corrected)	0.197

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.947	nu hat (KM)	642.3
Approximate Chi Square Value (642.26, α)	584.5	Adjusted Chi Square Value (642.26, β)	583
95% Gamma Approximate KM-UCL (use when n>=50)	0.536	95% Gamma Adjusted KM-UCL (use when n<50)	0.538

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.11	Mean	0.488
Maximum	1.3	Median	0.452
SD	0.2	CV	0.411
k hat (MLE)	6.806	k star (bias corrected MLE)	6.44
Theta hat (MLE)	0.0717	Theta star (bias corrected MLE)	0.0758
nu hat (MLE)	735	nu star (bias corrected)	695.5
MLE Mean (bias corrected)	0.488	MLE Sd (bias corrected)	0.192
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (695.52, α)	635.3	Adjusted Chi Square Value (695.52, β)	633.8
95% Gamma Approximate UCL (use when n>=50)	0.534	95% Gamma Adjusted UCL (use when n<50)	0.536

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.176	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	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	0.487	Mean in Log Scale	-0.794
SD in Original Scale	0.2	SD in Log Scale	0.398
95% t UCL (assumes normality of ROS data)	0.533	95% Percentile Bootstrap UCL	0.532
95% BCA Bootstrap UCL	0.537	95% Bootstrap t UCL	0.545
95% H-UCL (Log ROS)	0.541		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.49	Mean in Log Scale	-0.787
SD in Original Scale	0.199	SD in Log Scale	0.396
95% t UCL (Assumes normality)	0.535	95% H-Stat UCL	0.543

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	0.61

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

Result (cadmium)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	21
Number of Detects	21	Number of Non-Detects	33
Number of Distinct Detects	19	Number of Distinct Non-Detects	2
Minimum Detect	0.43	Minimum Non-Detect	0.2
Maximum Detect	24.9	Maximum Non-Detect	2
Variance Detects	43.88	Percent Non-Detects	61.11%
Mean Detects	4.198	SD Detects	6.624
Median Detects	1.1	CV Detects	1.578
Skewness Detects	2.533	Kurtosis Detects	5.931
Mean of Logged Detects	0.599	SD of Logged Detects	1.26

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.596	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.285	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.193	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

Mean	2.025	Standard Error of Mean	0.616
SD	4.396	95% KM (BCA) UCL	3.068
95% KM (t) UCL	3.056	95% KM (Percentile Bootstrap) UCL	3.047
95% KM (z) UCL	3.038	95% KM Bootstrap t UCL	4.771
90% KM Chebyshev UCL	3.873	95% KM Chebyshev UCL	4.709
97.5% KM Chebyshev UCL	5.871	99% KM Chebyshev UCL	8.153

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.299	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.785	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.239	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.197	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)	0.72	k star (bias corrected MLE)	0.649
Theta hat (MLE)	5.828	Theta star (bias corrected MLE)	6.467
nu hat (MLE)	30.25	nu star (bias corrected)	27.26
MLE Mean (bias corrected)	4.198	MLE Sd (bias corrected)	5.211

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.212	nu hat (KM)	22.92
Approximate Chi Square Value (22.92, α)	13.03	Adjusted Chi Square Value (22.92, β)	12.83
95% Gamma Approximate KM-UCL (use when n>=50)	3.562	95% Gamma Adjusted KM-UCL (use when n<50)	3.619

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.049
Maximum	24.9	Median	0.507
SD	4.524	CV	2.207
k hat (MLE)	0.303	k star (bias corrected MLE)	0.298
Theta hat (MLE)	6.774	Theta star (bias corrected MLE)	6.875
nu hat (MLE)	32.68	nu star (bias corrected)	32.19
MLE Mean (bias corrected)	2.049	MLE Sd (bias corrected)	3.754
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (32.19, α)	20.23	Adjusted Chi Square Value (32.19, β)	19.97
95% Gamma Approximate UCL (use when n>=50)	3.262	95% Gamma Adjusted UCL (use when n<50)	3.305

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.186	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.193	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	2.122	Mean in Log Scale	-0.179
SD in Original Scale	4.434	SD in Log Scale	1.288
95% t UCL (assumes normality of ROS data)	3.132	95% Percentile Bootstrap UCL	3.223
95% BCA Bootstrap UCL	3.608	95% Bootstrap t UCL	4.915
95% H-UCL (Log ROS)	3.101		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.133	95% H-UCL (KM -Log)	2.21
KM SD (logged)	1.07	95% Critical H Value (KM-Log)	2.408
KM Standard Error of Mean (logged)	0.182		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.21	Mean in Log Scale	0.148
SD in Original Scale	4.376	SD in Log Scale	0.959
95% t UCL (Assumes normality)	3.207	95% H-Stat UCL	2.476

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

95% KM (BCA) UCL	3.068

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

Result (chromium)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	3	Mean	11.21
Maximum	58	Median	8
SD	9.895	Std. Error of Mean	1.346
Coefficient of Variation	0.883	Skewness	2.911

Normal GOF Test

Shapiro Wilk Test Statistic	0.688	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	2.909E-14	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.121	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	13.46	95% Adjusted-CLT UCL (Chen-1995)	13.99
		95% Modified-t UCL (Johnson-1978)	13.55

Gamma GOF Test

A-D Test Statistic	1.686	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogrov-Smirnoff 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)	2.254	k star (bias corrected MLE)	2.142
Theta hat (MLE)	4.972	Theta star (bias corrected MLE)	5.234
nu hat (MLE)	243.5	nu star (bias corrected)	231.3
MLE Mean (bias corrected)	11.21	MLE Sd (bias corrected)	7.659
		Approximate Chi Square Value (0.05)	197.1
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	196.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	13.15	95% Adjusted Gamma UCL (use when n<50)	13.21

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0533	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.099	Mean of logged Data	2.179
Maximum of Logged Data	4.06	SD of logged Data	0.647

Assuming Lognormal Distribution

95% H-UCL	13	90% Chebyshev (MVUE) UCL	13.95
95% Chebyshev (MVUE) UCL	15.35	97.5% Chebyshev (MVUE) UCL	17.3
99% Chebyshev (MVUE) UCL	21.13		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	13.42	95% Jackknife UCL	13.46
95% Standard Bootstrap UCL	13.43	95% Bootstrap-t UCL	14.57
95% Hall's Bootstrap UCL	15.18	95% Percentile Bootstrap UCL	13.6
95% BCA Bootstrap UCL	14.03		
90% Chebyshev(Mean, Sd) UCL	15.25	95% Chebyshev(Mean, Sd) UCL	17.08
97.5% Chebyshev(Mean, Sd) UCL	19.62	99% Chebyshev(Mean, Sd) UCL	24.61

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	17.08

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	47	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	4	Mean	12.67
Maximum	76	Median	10
SD	11.53	Std. Error of Mean	1.682
Coefficient of Variation	0.911	Skewness	4.235

Normal GOF Test

Shapiro Wilk Test Statistic	0.51	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	**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	15.49	95% Adjusted-CLT UCL (Chen-1995)	16.54
		95% Modified-t UCL (Johnson-1978)	15.66

Gamma GOF Test

A-D Test Statistic	4.076	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.261	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.13	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.985	k star (bias corrected MLE)	2.809
Theta hat (MLE)	4.243	Theta star (bias corrected MLE)	4.509
nu hat (MLE)	280.6	nu star (bias corrected)	264
MLE Mean (bias corrected)	12.67	MLE Sd (bias corrected)	7.557
		Approximate Chi Square Value (0.05)	227.4
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	226.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.71	95% Adjusted Gamma UCL (use when n<50)	14.77

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.217	**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	1.386	Mean of logged Data	2.362
Maximum of Logged Data	4.331	SD of logged Data	0.51

Assuming Lognormal Distribution

95% H-UCL	13.93	90% Chebyshev (MVUE) UCL	14.87
95% Chebyshev (MVUE) UCL	16.15	97.5% Chebyshev (MVUE) UCL	17.93
99% Chebyshev (MVUE) UCL	21.42		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	15.43	95% Jackknife UCL	15.49
95% Standard Bootstrap UCL	15.43	95% Bootstrap-t UCL	19.64
95% Hall's Bootstrap UCL	25.05	95% Percentile Bootstrap UCL	15.71
95% BCA Bootstrap UCL	16.85		
90% Chebyshev(Mean, Sd) UCL	17.71	95% Chebyshev(Mean, Sd) UCL	20
97.5% Chebyshev(Mean, Sd) UCL	23.17	99% Chebyshev(Mean, Sd) UCL	29.41

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	20

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (copper)

General Statistics

Total Number of Observations	149	Number of Distinct Observations	133
		Number of Missing Observations	0
Minimum	133	Mean	4048
Maximum	109000	Median	1800
SD	10957	Std. Error of Mean	897.6
Coefficient of Variation	2.707	Skewness	7.355

Normal GOF Test

Shapiro Wilk Test Statistic	0.312	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.375	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0726	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	5533	95% Adjusted-CLT UCL (Chen-1995)	6102
		95% Modified-t UCL (Johnson-1978)	5624

Gamma GOF Test

A-D Test Statistic	9.627	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.795	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0798	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.752	k star (bias corrected MLE)	0.742
Theta hat (MLE)	5381	Theta star (bias corrected MLE)	5458
nu hat (MLE)	224.2	nu star (bias corrected)	221
MLE Mean (bias corrected)	4048	MLE Sd (bias corrected)	4700
		Approximate Chi Square Value (0.05)	187.6
Adjusted Level of Significance	0.0484	Adjusted Chi Square Value	187.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4769	95% Adjusted Gamma UCL (use when n<50)	4776

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00284	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0838	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0726	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.89	Mean of logged Data	7.51
Maximum of Logged Data	11.6	SD of logged Data	1.07

Assuming Lognormal Distribution

95% H-UCL	3953	90% Chebyshev (MVUE) UCL	4262
95% Chebyshev (MVUE) UCL	4735	97.5% Chebyshev (MVUE) UCL	5391
99% Chebyshev (MVUE) UCL	6680		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5524	95% Jackknife UCL	5533
95% Standard Bootstrap UCL	5461	95% Bootstrap-t UCL	7363
95% Hall's Bootstrap UCL	10620	95% Percentile Bootstrap UCL	5726
95% BCA Bootstrap UCL	6527		
90% Chebyshev(Mean, Sd) UCL	6741	95% Chebyshev(Mean, Sd) UCL	7960
97.5% Chebyshev(Mean, Sd) UCL	9653	99% Chebyshev(Mean, Sd) UCL	12979

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	7960

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	149	Number of Distinct Observations	142
		Number of Missing Observations	0
Minimum	2.7	Mean	135.6
Maximum	3220	Median	33.1
SD	343.2	Std. Error of Mean	28.12
Coefficient of Variation	2.531	Skewness	6.157

Normal GOF Test

Shapiro Wilk Test Statistic	0.416	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.349	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0726	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	182.2	95% Adjusted-CLT UCL (Chen-1995)	197
		95% Modified-t UCL (Johnson-1978)	184.5

Gamma GOF Test

A-D Test Statistic	8.091	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.822	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.182	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0814	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.489	k star (bias corrected MLE)	0.484
Theta hat (MLE)	277.1	Theta star (bias corrected MLE)	280.2
nu hat (MLE)	145.8	nu star (bias corrected)	144.2
MLE Mean (bias corrected)	135.6	MLE Sd (bias corrected)	194.9
		Approximate Chi Square Value (0.05)	117.5
Adjusted Level of Significance	0.0484	Adjusted Chi Square Value	117.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	166.5	95% Adjusted Gamma UCL (use when n<50)	166.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	3.3820E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0855	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0726	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	3.608
Maximum of Logged Data	8.077	SD of logged Data	1.519

Assuming Lognormal Distribution

95% H-UCL	164.5	90% Chebyshev (MVUE) UCL	175.9
95% Chebyshev (MVUE) UCL	203.4	97.5% Chebyshev (MVUE) UCL	241.7
99% Chebyshev (MVUE) UCL	316.8		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	181.9	95% Jackknife UCL	182.2
95% Standard Bootstrap UCL	183.4	95% Bootstrap-t UCL	215.6
95% Hall's Bootstrap UCL	371.6	95% Percentile Bootstrap UCL	186.3
95% BCA Bootstrap UCL	203.7		
90% Chebyshev(Mean, Sd) UCL	220	95% Chebyshev(Mean, Sd) UCL	258.2
97.5% Chebyshev(Mean, Sd) UCL	311.2	99% Chebyshev(Mean, Sd) UCL	415.4

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	258.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	51
Number of Detects	53	Number of Non-Detects	1
Number of Distinct Detects	50	Number of Distinct Non-Detects	1
Minimum Detect	71	Minimum Non-Detect	0.4
Maximum Detect	587	Maximum Non-Detect	0.4
Variance Detects	9443	Percent Non-Detects	1.852%
Mean Detects	312.8	SD Detects	97.18
Median Detects	316	CV Detects	0.311
Skewness Detects	0.176	Kurtosis Detects	0.583
Mean of Logged Detects	5.69	SD of Logged Detects	0.36

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.99	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0.977	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0871	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.122	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

Mean	307	Standard Error of Mean	14.32
SD	104.2	95% KM (BCA) UCL	328
95% KM (t) UCL	331	95% KM (Percentile Bootstrap) UCL	329.1
95% KM (z) UCL	330.6	95% KM Bootstrap t UCL	331.3
90% KM Chebyshev UCL	350	95% KM Chebyshev UCL	369.4
97.5% KM Chebyshev UCL	396.4	99% KM Chebyshev UCL	449.5

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.591	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.104	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.122	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	9.133	k star (bias corrected MLE)	8.629
Theta hat (MLE)	34.25	Theta star (bias corrected MLE)	36.25
nu hat (MLE)	968.1	nu star (bias corrected)	914.6
MLE Mean (bias corrected)	312.8	MLE Sd (bias corrected)	106.5

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	8.673	nu hat (KM)	936.7
Approximate Chi Square Value (936.69, α)	866.7	Adjusted Chi Square Value (936.69, β)	864.8
95% Gamma Approximate KM-UCL (use when n>=50)	331.8	95% Gamma Adjusted KM-UCL (use when n<50)	332.5

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	71	Mean	309.2
Maximum	587	Median	314
SD	99.83	CV	0.323
k hat (MLE)	8.341	k star (bias corrected MLE)	7.89
Theta hat (MLE)	37.07	Theta star (bias corrected MLE)	39.19
nu hat (MLE)	900.8	nu star (bias corrected)	852.1
MLE Mean (bias corrected)	309.2	MLE Sd (bias corrected)	110.1
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (852.10, α)	785.4	Adjusted Chi Square Value (852.10, β)	783.6
95% Gamma Approximate UCL (use when n>=50)	335.5	95% Gamma Adjusted UCL (use when n<50)	336.2

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.122	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	309.2	Mean in Log Scale	5.673
SD in Original Scale	99.72	SD in Log Scale	0.377
95% t UCL (assumes normality of ROS data)	332	95% Percentile Bootstrap UCL	331.3
95% BCA Bootstrap UCL	331.3	95% Bootstrap t UCL	332.2
95% H-UCL (Log ROS)	342.5		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	307	Mean in Log Scale	5.555
SD in Original Scale	105.2	SD in Log Scale	1.055
95% t UCL (Assumes normality)	331	95% H-Stat UCL	637.8

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	331	95% KM (Percentile Bootstrap) UCL	329.1

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

Result (mercury)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	14
Number of Detects	13	Number of Non-Detects	41
Number of Distinct Detects	11	Number of Distinct Non-Detects	4
Minimum Detect	0.037	Minimum Non-Detect	0.033
Maximum Detect	0.62	Maximum Non-Detect	0.2
Variance Detects	0.0283	Percent Non-Detects	75.93%
Mean Detects	0.174	SD Detects	0.168
Median Detects	0.11	CV Detects	0.964
Skewness Detects	1.867	Kurtosis Detects	3.391
Mean of Logged Detects	-2.091	SD of Logged Detects	0.835

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.766	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.256	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.246	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

Mean	0.0885	Standard Error of Mean	0.0165
SD	0.1	95% KM (BCA) UCL	0.117
95% KM (t) UCL	0.116	95% KM (Percentile Bootstrap) UCL	0.116
95% KM (z) UCL	0.116	95% KM Bootstrap t UCL	0.126
90% KM Chebyshev UCL	0.138	95% KM Chebyshev UCL	0.16
97.5% KM Chebyshev UCL	0.191	99% KM Chebyshev UCL	0.252

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.516	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.183	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.241	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)	1.598	k star (bias corrected MLE)	1.28
Theta hat (MLE)	0.109	Theta star (bias corrected MLE)	0.136
nu hat (MLE)	41.54	nu star (bias corrected)	33.29
MLE Mean (bias corrected)	0.174	MLE Sd (bias corrected)	0.154

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.783	nu hat (KM)	84.57
Approximate Chi Square Value (84.57, α)	64.38	Adjusted Chi Square Value (84.57, β)	63.89
95% Gamma Approximate KM-UCL (use when n>=50)	0.116	95% Gamma Adjusted KM-UCL (use when n<50)	0.117

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.08
Maximum	0.62	Median	0.0297
SD	0.114	CV	1.419
k hat (MLE)	0.72	k star (bias corrected MLE)	0.692
Theta hat (MLE)	0.111	Theta star (bias corrected MLE)	0.116
nu hat (MLE)	77.73	nu star (bias corrected)	74.75
MLE Mean (bias corrected)	0.08	MLE Sd (bias corrected)	0.0962
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (74.75, α)	55.83	Adjusted Chi Square Value (74.75, β)	55.39
95% Gamma Approximate UCL (use when n>=50)	0.107	95% Gamma Adjusted UCL (use when n<50)	0.108

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.246	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	0.0835	Mean in Log Scale	-3.01
SD in Original Scale	0.105	SD in Log Scale	1.026
95% t UCL (assumes normality of ROS data)	0.107	95% Percentile Bootstrap UCL	0.109
95% BCA Bootstrap UCL	0.114	95% Bootstrap t UCL	0.121
95% H-UCL (Log ROS)	0.116		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.765	95% H-UCL (KM -Log)	0.102
KM SD (logged)	0.738	95% Critical H Value (KM-Log)	2.063
KM Standard Error of Mean (logged)	0.152		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.106	Mean in Log Scale	-2.5
SD in Original Scale	0.0934	SD in Log Scale	0.746
95% t UCL (Assumes normality)	0.127	95% H-Stat UCL	0.134

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 (t) UCL	0.116	95% GROS Approximate Gamma UCL	0.107
95% Approximate Gamma KM-UCL	0.116		

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

Result (molybdenum)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	54
		Number of Missing Observations	0
Minimum	13.6	Mean	443.1
Maximum	3020	Median	118
SD	752	Std. Error of Mean	102.3
Coefficient of Variation	1.697	Skewness	2.336

Normal GOF Test

Shapiro Wilk Test Statistic	0.582	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.121	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	614.4	95% Adjusted-CLT UCL (Chen-1995)	646.2
		95% Modified-t UCL (Johnson-1978)	619.9

Gamma GOF Test

A-D Test Statistic	3.121	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.806	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.211	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.127	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.602	k star (bias corrected MLE)	0.581
Theta hat (MLE)	736.6	Theta star (bias corrected MLE)	763.3
nu hat (MLE)	64.98	nu star (bias corrected)	62.7
MLE Mean (bias corrected)	443.1	MLE Sd (bias corrected)	581.6
		Approximate Chi Square Value (0.05)	45.48
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	45.08

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	610.8	95% Adjusted Gamma UCL (use when n<50)	616.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0195	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.61	Mean of logged Data	5.067
Maximum of Logged Data	8.013	SD of logged Data	1.394

Assuming Lognormal Distribution

95% H-UCL	725.1	90% Chebyshev (MVUE) UCL	706.3
95% Chebyshev (MVUE) UCL	842.5	97.5% Chebyshev (MVUE) UCL	1032
99% Chebyshev (MVUE) UCL	1403		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	611.4	95% Jackknife UCL	614.4
95% Standard Bootstrap UCL	611	95% Bootstrap-t UCL	672.2
95% Hall's Bootstrap UCL	620.9	95% Percentile Bootstrap UCL	617.4
95% BCA Bootstrap UCL	657.7		
90% Chebyshev(Mean, Sd) UCL	750.1	95% Chebyshev(Mean, Sd) UCL	889.2
97.5% Chebyshev(Mean, Sd) UCL	1082	99% Chebyshev(Mean, Sd) UCL	1461

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	889.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (nickel)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	2	Mean	15.18
Maximum	64	Median	9.5
SD	12.11	Std. Error of Mean	1.648
Coefficient of Variation	0.798	Skewness	1.672

Normal GOF Test

Shapiro Wilk Test Statistic	0.784	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	3.352E-10	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.121	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	17.94	95% Adjusted-CLT UCL (Chen-1995)	18.29
		95% Modified-t UCL (Johnson-1978)	18

Gamma GOF Test

A-D Test Statistic	2.688	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.189	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.123	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.037	k star (bias corrected MLE)	1.936
Theta hat (MLE)	7.453	Theta star (bias corrected MLE)	7.841
nu hat (MLE)	220	nu star (bias corrected)	209.1
MLE Mean (bias corrected)	15.18	MLE Sd (bias corrected)	10.91
		Approximate Chi Square Value (0.05)	176.6
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	175.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	17.97	95% Adjusted Gamma UCL (use when n<50)	18.05

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00304	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.161	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.455
Maximum of Logged Data	4.159	SD of logged Data	0.723

Assuming Lognormal Distribution

95% H-UCL	18.55	90% Chebyshev (MVUE) UCL	19.93
95% Chebyshev (MVUE) UCL	22.15	97.5% Chebyshev (MVUE) UCL	25.22
99% Chebyshev (MVUE) UCL	31.27		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	17.89	95% Jackknife UCL	17.94
95% Standard Bootstrap UCL	17.87	95% Bootstrap-t UCL	18.51
95% Hall's Bootstrap UCL	18.51	95% Percentile Bootstrap UCL	17.84
95% BCA Bootstrap UCL	18.28		
90% Chebyshev(Mean, Sd) UCL	20.13	95% Chebyshev(Mean, Sd) UCL	22.37
97.5% Chebyshev(Mean, Sd) UCL	25.48	99% Chebyshev(Mean, Sd) UCL	31.58

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	22.37

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (selenium)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	42
Number of Detects	48	Number of Non-Detects	6
Number of Distinct Detects	41	Number of Distinct Non-Detects	2
Minimum Detect	0.23	Minimum Non-Detect	0.67
Maximum Detect	50	Maximum Non-Detect	4
Variance Detects	101.4	Percent Non-Detects	11.11%
Mean Detects	4.338	SD Detects	10.07
Median Detects	0.55	CV Detects	2.322
Skewness Detects	3.382	Kurtosis Detects	11.7
Mean of Logged Detects	0.0571	SD of Logged Detects	1.458

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.465	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.369	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.128	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

Mean	3.94	Standard Error of Mean	1.302
SD	9.466	95% KM (BCA) UCL	6.6
95% KM (t) UCL	6.121	95% KM (Percentile Bootstrap) UCL	6.218
95% KM (z) UCL	6.083	95% KM Bootstrap t UCL	7.811
90% KM Chebyshev UCL	7.847	95% KM Chebyshev UCL	9.617
97.5% KM Chebyshev UCL	12.07	99% KM Chebyshev UCL	16.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.855	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.824	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.136	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)	0.457	k star (bias corrected MLE)	0.442
Theta hat (MLE)	9.496	Theta star (bias corrected MLE)	9.81
nu hat (MLE)	43.85	nu star (bias corrected)	42.45
MLE Mean (bias corrected)	4.338	MLE Sd (bias corrected)	6.523

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.173	nu hat (KM)	18.72
Approximate Chi Square Value (18.72, α)	9.91	Adjusted Chi Square Value (18.72, β)	9.734
95% Gamma Approximate KM-UCL (use when n>=50)	7.442	95% Gamma Adjusted KM-UCL (use when n<50)	7.577

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3.97
Maximum	50	Median	0.52
SD	9.559	CV	2.408
k hat (MLE)	0.402	k star (bias corrected MLE)	0.392
Theta hat (MLE)	9.872	Theta star (bias corrected MLE)	10.12
nu hat (MLE)	43.43	nu star (bias corrected)	42.35
MLE Mean (bias corrected)	3.97	MLE Sd (bias corrected)	6.34
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (42.35, α)	28.44	Adjusted Chi Square Value (42.35, β)	28.12
95% Gamma Approximate UCL (use when n>=50)	5.914	95% Gamma Adjusted UCL (use when n<50)	5.979

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.185	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.128	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	3.953	Mean in Log Scale	0.00617
SD in Original Scale	9.549	SD in Log Scale	1.403
95% t UCL (assumes normality of ROS data)	6.128	95% Percentile Bootstrap UCL	6.209
95% BCA Bootstrap UCL	7.17	95% Bootstrap t UCL	7.629
95% H-UCL (Log ROS)	4.674		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.047	Mean in Log Scale	0.0947
SD in Original Scale	9.522	SD in Log Scale	1.395
95% t UCL (Assumes normality)	6.216	95% H-Stat UCL	5.03

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	9.617

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

Result (thallium)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	28
Number of Detects	49	Number of Non-Detects	5
Number of Distinct Detects	27	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	1.5
Maximum Detect	5.2	Maximum Non-Detect	1.5
Variance Detects	0.507	Percent Non-Detects	9.259%
Mean Detects	0.372	SD Detects	0.712
Median Detects	0.26	CV Detects	1.913
Skewness Detects	6.768	Kurtosis Detects	46.76
Mean of Logged Detects	-1.314	SD of Logged Detects	0.578

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.253	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.41	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.127	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

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

Mean	0.363	Standard Error of Mean	0.0926
SD	0.673	95% KM (BCA) UCL	0.557
95% KM (t) UCL	0.518	95% KM (Percentile Bootstrap) UCL	0.544
95% KM (z) UCL	0.515	95% KM Bootstrap t UCL	1.187
90% KM Chebyshev UCL	0.64	95% KM Chebyshev UCL	0.766
97.5% KM Chebyshev UCL	0.941	99% KM Chebyshev UCL	1.284

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.019	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.766	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.28	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.129	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)	1.686	k star (bias corrected MLE)	1.597
Theta hat (MLE)	0.221	Theta star (bias corrected MLE)	0.233
nu hat (MLE)	165.3	nu star (bias corrected)	156.5
MLE Mean (bias corrected)	0.372	MLE Sd (bias corrected)	0.294

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.291	nu hat (KM)	31.42
Approximate Chi Square Value (31.42, α)	19.61	Adjusted Chi Square Value (31.42, β)	19.35
95% Gamma Approximate KM-UCL (use when n>=50)	0.581	95% Gamma Adjusted KM-UCL (use when n<50)	0.589

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.366
Maximum	5.2	Median	0.26
SD	0.682	CV	1.863
k hat (MLE)	1.527	k star (bias corrected MLE)	1.454
Theta hat (MLE)	0.24	Theta star (bias corrected MLE)	0.252
nu hat (MLE)	164.9	nu star (bias corrected)	157.1
MLE Mean (bias corrected)	0.366	MLE Sd (bias corrected)	0.304
		Adjusted Level of Significance (β)	0.0456
Approximate Chi Square Value (157.07, α)	129.1	Adjusted Chi Square Value (157.07, β)	128.4
95% Gamma Approximate UCL (use when n>=50)	0.446	95% Gamma Adjusted UCL (use when n<50)	0.448

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.164	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.127	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.363	Mean in Log Scale	-1.316
SD in Original Scale	0.679	SD in Log Scale	0.56
95% t UCL (assumes normality of ROS data)	0.518	95% Percentile Bootstrap UCL	0.542
95% BCA Bootstrap UCL	0.65	95% Bootstrap t UCL	1.178
95% H-UCL (Log ROS)	0.364		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.407	Mean in Log Scale	-1.219
SD in Original Scale	0.686	SD in Log Scale	0.626
95% t UCL (Assumes normality)	0.563	95% H-Stat UCL	0.426

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	0.766

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

Result (uranium)

General Statistics

Total Number of Observations	42	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	1.32	Mean	4.014
Maximum	7.57	Median	4.05
SD	1.42	Std. Error of Mean	0.219
Coefficient of Variation	0.354	Skewness	0.411

Normal GOF Test

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0786	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.137	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	4.383	95% Adjusted-CLT UCL (Chen-1995)	4.389
		95% Modified-t UCL (Johnson-1978)	4.385

Gamma GOF Test

A-D Test Statistic	0.225	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.103	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.137	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.652	k star (bias corrected MLE)	7.121
Theta hat (MLE)	0.525	Theta star (bias corrected MLE)	0.564
nu hat (MLE)	642.7	nu star (bias corrected)	598.2
MLE Mean (bias corrected)	4.014	MLE Sd (bias corrected)	1.504
		Approximate Chi Square Value (0.05)	542.4
Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	540.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.426	95% Adjusted Gamma UCL (use when n<50)	4.442

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.942	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.278	Mean of logged Data	1.323
Maximum of Logged Data	2.024	SD of logged Data	0.384

Assuming Lognormal Distribution

95% H-UCL	4.51	90% Chebyshev (MVUE) UCL	4.774
95% Chebyshev (MVUE) UCL	5.108	97.5% Chebyshev (MVUE) UCL	5.573
99% Chebyshev (MVUE) UCL	6.485		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.374	95% Jackknife UCL	4.383
95% Standard Bootstrap UCL	4.374	95% Bootstrap-t UCL	4.397
95% Hall's Bootstrap UCL	4.41	95% Percentile Bootstrap UCL	4.373
95% BCA Bootstrap UCL	4.397		
90% Chebyshev(Mean, Sd) UCL	4.671	95% Chebyshev(Mean, Sd) UCL	4.969
97.5% Chebyshev(Mean, Sd) UCL	5.382	99% Chebyshev(Mean, Sd) UCL	6.194

Suggested UCL to Use

95% Student's-t UCL	4.383

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	54	Number of Distinct Observations	51
		Number of Missing Observations	0
Minimum	26	Mean	332.6
Maximum	6210	Median	95
SD	1013	Std. Error of Mean	137.9
Coefficient of Variation	3.047	Skewness	5.081

Normal GOF Test

Shapiro Wilk Test Statistic	0.305	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.402	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.121	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	563.4	95% Adjusted-CLT UCL (Chen-1995)	661.3
		95% Modified-t UCL (Johnson-1978)	579.3

Gamma GOF Test

A-D Test Statistic	7.211	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.809	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.293	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.127	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.565	k star (bias corrected MLE)	0.546
Theta hat (MLE)	588.8	Theta star (bias corrected MLE)	609.3
nu hat (MLE)	61	nu star (bias corrected)	58.95
MLE Mean (bias corrected)	332.6	MLE Sd (bias corrected)	450.2
		Approximate Chi Square Value (0.05)	42.29
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	41.91

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	463.5	95% Adjusted Gamma UCL (use when n<50)	467.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	3.4742E-7	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.143	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.258	Mean of logged Data	4.703
Maximum of Logged Data	8.734	SD of logged Data	1.109

Assuming Lognormal Distribution

95% H-UCL	296.8	90% Chebyshev (MVUE) UCL	310.4
95% Chebyshev (MVUE) UCL	360.3	97.5% Chebyshev (MVUE) UCL	429.4
99% Chebyshev (MVUE) UCL	565.3		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	559.4	95% Jackknife UCL	563.4
95% Standard Bootstrap UCL	557.6	95% Bootstrap-t UCL	1592
95% Hall's Bootstrap UCL	1557	95% Percentile Bootstrap UCL	574.4
95% BCA Bootstrap UCL	682		
90% Chebyshev(Mean, Sd) UCL	746.2	95% Chebyshev(Mean, Sd) UCL	933.6
97.5% Chebyshev(Mean, Sd) UCL	1194	99% Chebyshev(Mean, Sd) UCL	1705

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	933.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (antimony)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	16
Number of Detects	47	Number of Non-Detects	39
Number of Distinct Detects	15	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	66	Maximum Non-Detect	2
Variance Detects	145.3	Percent Non-Detects	45.35%
Mean Detects	3.4	SD Detects	12.06
Median Detects	0.4	CV Detects	3.546
Skewness Detects	4.657	Kurtosis Detects	21.35
Mean of Logged Detects	-0.494	SD of Logged Detects	1.325

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.289	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.43	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.129	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

Mean	2.031	Standard Error of Mean	0.975
SD	8.945	95% KM (BCA) UCL	3.996
95% KM (t) UCL	3.653	95% KM (Percentile Bootstrap) UCL	3.775
95% KM (z) UCL	3.635	95% KM Bootstrap t UCL	12.83
90% KM Chebyshev UCL	4.957	95% KM Chebyshev UCL	6.282
97.5% KM Chebyshev UCL	8.121	99% KM Chebyshev UCL	11.73

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	9.022	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.841	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.342	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.139	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)	0.385	k star (bias corrected MLE)	0.375
Theta hat (MLE)	8.821	Theta star (bias corrected MLE)	9.066
nu hat (MLE)	36.23	nu star (bias corrected)	35.25
MLE Mean (bias corrected)	3.4	MLE Sd (bias corrected)	5.552

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0516	nu hat (KM)	8.872
Approximate Chi Square Value (8.87, α)	3.25	Adjusted Chi Square Value (8.87, β)	3.192
95% Gamma Approximate KM-UCL (use when n>=50)	5.546	95% Gamma Adjusted KM-UCL (use when n<50)	5.646

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.294
Maximum	66	Median	0.3
SD	9.049	CV	3.944
k hat (MLE)	0.282	k star (bias corrected MLE)	0.28
Theta hat (MLE)	8.145	Theta star (bias corrected MLE)	8.206
nu hat (MLE)	48.44	nu star (bias corrected)	48.09
MLE Mean (bias corrected)	2.294	MLE Sd (bias corrected)	4.339
		Adjusted Level of Significance (β)	0.0472
Approximate Chi Square Value (48.09, α)	33.17	Adjusted Chi Square Value (48.09, β)	32.96
95% Gamma Approximate UCL (use when n>=50)	3.326	95% Gamma Adjusted UCL (use when n<50)	3.347

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.738	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.946	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.242	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.129	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	2.102	Mean in Log Scale	-0.685
SD in Original Scale	8.987	SD in Log Scale	1.143
95% t UCL (assumes normality of ROS data)	3.714	95% Percentile Bootstrap UCL	3.928
95% BCA Bootstrap UCL	4.861	95% Bootstrap t UCL	13.33
95% H-UCL (Log ROS)	1.3		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.091	Mean in Log Scale	-0.576
SD in Original Scale	8.986	SD in Log Scale	0.982
95% t UCL (Assumes normality)	3.702	95% H-Stat UCL	1.154

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	6.282

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

Result (arsenic)

General Statistics

Total Number of Observations	89	Number of Distinct Observations	59
		Number of Missing Observations	0
Minimum	0.7	Mean	7.75
Maximum	166	Median	3.1
SD	20.89	Std. Error of Mean	2.214
Coefficient of Variation	2.695	Skewness	6.276

Normal GOF Test

Shapiro Wilk Test Statistic	0.318	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	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	11.43	95% Adjusted-CLT UCL (Chen-1995)	12.97
		95% Modified-t UCL (Johnson-1978)	11.68

Gamma GOF Test

A-D Test Statistic	7.778	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.794	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.239	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0986	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.742	k star (bias corrected MLE)	0.724
Theta hat (MLE)	10.44	Theta star (bias corrected MLE)	10.7
nu hat (MLE)	132.1	nu star (bias corrected)	129
MLE Mean (bias corrected)	7.75	MLE Sd (bias corrected)	9.105
		Approximate Chi Square Value (0.05)	103.7
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	103.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.636	95% Adjusted Gamma UCL (use when n<50)	9.67

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.8861E-6	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0939	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.357	Mean of logged Data	1.24
Maximum of Logged Data	5.112	SD of logged Data	1.004

Assuming Lognormal Distribution

95% H-UCL	7.278	90% Chebyshev (MVUE) UCL	7.845
95% Chebyshev (MVUE) UCL	8.828	97.5% Chebyshev (MVUE) UCL	10.19
99% Chebyshev (MVUE) UCL	12.87		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	11.39	95% Jackknife UCL	11.43
95% Standard Bootstrap UCL	11.32	95% Bootstrap-t UCL	19.48
95% Hall's Bootstrap UCL	26.41	95% Percentile Bootstrap UCL	11.84
95% BCA Bootstrap UCL	13.58		
90% Chebyshev(Mean, Sd) UCL	14.39	95% Chebyshev(Mean, Sd) UCL	17.4
97.5% Chebyshev(Mean, Sd) UCL	21.58	99% Chebyshev(Mean, Sd) UCL	29.78

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	17.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (barium)

General Statistics

Total Number of Observations	72	Number of Distinct Observations	63
		Number of Missing Observations	0
Minimum	41.1	Mean	153.6
Maximum	654	Median	143.5
SD	76.61	Std. Error of Mean	9.028
Coefficient of Variation	0.499	Skewness	4.112

Normal GOF Test

Shapiro Wilk Test Statistic	0.696	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.197	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	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	168.7	95% Adjusted-CLT UCL (Chen-1995)	173.2
		95% Modified-t UCL (Johnson-1978)	169.4

Gamma GOF Test

A-D Test Statistic	1.403	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.127	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.105	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.231	k star (bias corrected MLE)	5.981
Theta hat (MLE)	24.65	Theta star (bias corrected MLE)	25.69
nu hat (MLE)	897.3	nu star (bias corrected)	861.3
MLE Mean (bias corrected)	153.6	MLE Sd (bias corrected)	62.82
		Approximate Chi Square Value (0.05)	794.2
Adjusted Level of Significance	0.0467	Adjusted Chi Square Value	792.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	166.6	95% Adjusted Gamma UCL (use when n<50)	166.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0202	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.104	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.716	Mean of logged Data	4.952
Maximum of Logged Data	6.483	SD of logged Data	0.396

Assuming Lognormal Distribution

95% H-UCL	166.5	90% Chebyshev (MVUE) UCL	175
95% Chebyshev (MVUE) UCL	185.1	97.5% Chebyshev (MVUE) UCL	199
99% Chebyshev (MVUE) UCL	226.4		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	168.5	95% Jackknife UCL	168.7
95% Standard Bootstrap UCL	168.4	95% Bootstrap-t UCL	178
95% Hall's Bootstrap UCL	243.4	95% Percentile Bootstrap UCL	170
95% BCA Bootstrap UCL	174.1		
90% Chebyshev(Mean, Sd) UCL	180.7	95% Chebyshev(Mean, Sd) UCL	193
97.5% Chebyshev(Mean, Sd) UCL	210	99% Chebyshev(Mean, Sd) UCL	243.5

Suggested UCL to Use

95% Student's-t UCL	168.7	or 95% Modified-t UCL	169.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	89	Number of Distinct Observations	23
Number of Detects	79	Number of Non-Detects	10
Number of Distinct Detects	23	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	1.3	Maximum Non-Detect	1
Variance Detects	0.0416	Percent Non-Detects	11.24%
Mean Detects	0.483	SD Detects	0.204
Median Detects	0.5	CV Detects	0.423
Skewness Detects	1.354	Kurtosis Detects	3.218
Mean of Logged Detects	-0.813	SD of Logged Detects	0.421

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.903	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	1.5237E-6	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0997	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

Mean	0.48	Standard Error of Mean	0.022
SD	0.198	95% KM (BCA) UCL	0.518
95% KM (t) UCL	0.516	95% KM (Percentile Bootstrap) UCL	0.519
95% KM (z) UCL	0.516	95% KM Bootstrap t UCL	0.518
90% KM Chebyshev UCL	0.546	95% KM Chebyshev UCL	0.576
97.5% KM Chebyshev UCL	0.617	99% KM Chebyshev UCL	0.699

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.331	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.139	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.101	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)	6.109	k star (bias corrected MLE)	5.886
Theta hat (MLE)	0.079	Theta star (bias corrected MLE)	0.082
nu hat (MLE)	965.2	nu star (bias corrected)	929.9
MLE Mean (bias corrected)	0.483	MLE Sd (bias corrected)	0.199

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.85	nu hat (KM)	1041
Approximate Chi Square Value (N/A, α)	967.4	Adjusted Chi Square Value (N/A, β)	966.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.516	95% Gamma Adjusted KM-UCL (use when n<50)	0.517

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.11	Mean	0.48
Maximum	1.3	Median	0.5
SD	0.198	CV	0.413
k hat (MLE)	6.357	k star (bias corrected MLE)	6.15
Theta hat (MLE)	0.0755	Theta star (bias corrected MLE)	0.078
nu hat (MLE)	1132	nu star (bias corrected)	1095
MLE Mean (bias corrected)	0.48	MLE Sd (bias corrected)	0.193
		Adjusted Level of Significance (β)	0.0473
Approximate Chi Square Value (N/A, α)	1019	Adjusted Chi Square Value (N/A, β)	1018
95% Gamma Approximate UCL (use when n>=50)	0.515	95% Gamma Adjusted UCL (use when n<50)	0.516

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0997	Detected Data Not 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	0.479	Mean in Log Scale	-0.816
SD in Original Scale	0.198	SD in Log Scale	0.41
95% t UCL (assumes normality of ROS data)	0.514	95% Percentile Bootstrap UCL	0.514
95% BCA Bootstrap UCL	0.516	95% Bootstrap t UCL	0.516
95% H-UCL (Log ROS)	0.52		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.817	95% H-UCL (KM -Log)	0.521
KM SD (logged)	0.414	95% Critical H Value (KM-Log)	1.798
KM Standard Error of Mean (logged)	0.0465		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.484	Mean in Log Scale	-0.799
SD in Original Scale	0.192	SD in Log Scale	0.398
95% t UCL (Assumes normality)	0.518	95% H-Stat UCL	0.525

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

95% KM (BCA) UCL	0.518

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

Result (cadmium)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	21
Number of Detects	23	Number of Non-Detects	63
Number of Distinct Detects	20	Number of Distinct Non-Detects	1
Minimum Detect	0.48	Minimum Non-Detect	2
Maximum Detect	24.9	Maximum Non-Detect	2
Variance Detects	36.96	Percent Non-Detects	73.26%
Mean Detects	3.967	SD Detects	6.079
Median Detects	1.26	CV Detects	1.533
Skewness Detects	2.597	Kurtosis Detects	6.78
Mean of Logged Detects	0.603	SD of Logged Detects	1.199

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.617	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.185	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

Mean	1.7	Standard Error of Mean	0.383
SD	3.383	95% KM (BCA) UCL	2.446
95% KM (t) UCL	2.337	95% KM (Percentile Bootstrap) UCL	2.379
95% KM (z) UCL	2.33	95% KM Bootstrap t UCL	2.982
90% KM Chebyshev UCL	2.849	95% KM Chebyshev UCL	3.37
97.5% KM Chebyshev UCL	4.093	99% KM Chebyshev UCL	5.513

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.368	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.781	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.188	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)	0.77	k star (bias corrected MLE)	0.699
Theta hat (MLE)	5.152	Theta star (bias corrected MLE)	5.679
nu hat (MLE)	35.42	nu star (bias corrected)	32.13
MLE Mean (bias corrected)	3.967	MLE Sd (bias corrected)	4.746

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.252	nu hat (KM)	43.41
Approximate Chi Square Value (43.41, α)	29.3	Adjusted Chi Square Value (43.41, β)	29.11
95% Gamma Approximate KM-UCL (use when n>=50)	2.518	95% Gamma Adjusted KM-UCL (use when n<50)	2.535

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.8
Maximum	24.9	Median	0.6
SD	3.606	CV	2.003
k hat (MLE)	0.324	k star (bias corrected MLE)	0.32
Theta hat (MLE)	5.558	Theta star (bias corrected MLE)	5.619
nu hat (MLE)	55.7	nu star (bias corrected)	55.09
MLE Mean (bias corrected)	1.8	MLE Sd (bias corrected)	3.18
		Adjusted Level of Significance (β)	0.0472
Approximate Chi Square Value (55.09, α)	39.04	Adjusted Chi Square Value (55.09, β)	38.81
95% Gamma Approximate UCL (use when n>=50)	2.54	95% Gamma Adjusted UCL (use when n<50)	2.555

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.185	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	1.901	Mean in Log Scale	0.0468
SD in Original Scale	3.414	SD in Log Scale	0.989
95% t UCL (assumes normality of ROS data)	2.513	95% Percentile Bootstrap UCL	2.557
95% BCA Bootstrap UCL	2.774	95% Bootstrap t UCL	3.291
95% H-UCL (Log ROS)	2.17		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.00594	95% H-UCL (KM -Log)	1.626
KM SD (logged)	0.794	95% Critical H Value (KM-Log)	2.059
KM Standard Error of Mean (logged)	0.127		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.793	Mean in Log Scale	0.161
SD in Original Scale	3.363	SD in Log Scale	0.667
95% t UCL (Assumes normality)	2.396	95% H-Stat UCL	1.692

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

95% KM (BCA) UCL	2.446

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

Result (chromium)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	2	Mean	16
Maximum	470	Median	8
SD	50.26	Std. Error of Mean	5.42
Coefficient of Variation	3.141	Skewness	8.882

Normal GOF Test

Shapiro Wilk Test Statistic	0.204	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.39	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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	25.01	95% Adjusted-CLT UCL (Chen-1995)	30.46
		95% Modified-t UCL (Johnson-1978)	25.88

Gamma GOF Test

A-D Test Statistic	9.385	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.272	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0992	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.025	k star (bias corrected MLE)	0.997
Theta hat (MLE)	15.6	Theta star (bias corrected MLE)	16.04
nu hat (MLE)	176.4	nu star (bias corrected)	171.5
MLE Mean (bias corrected)	16	MLE Sd (bias corrected)	16.02
		Approximate Chi Square Value (0.05)	142.3
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	141.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	19.29	95% Adjusted Gamma UCL (use when n<50)	19.36

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.88	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.1251E-9	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0955	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.211
Maximum of Logged Data	6.153	SD of logged Data	0.735

Assuming Lognormal Distribution

95% H-UCL	14.06	90% Chebyshev (MVUE) UCL	15.06
95% Chebyshev (MVUE) UCL	16.49	97.5% Chebyshev (MVUE) UCL	18.47
99% Chebyshev (MVUE) UCL	22.36		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	24.91	95% Jackknife UCL	25.01
95% Standard Bootstrap UCL	24.82	95% Bootstrap-t UCL	63.97
95% Hall's Bootstrap UCL	57.43	95% Percentile Bootstrap UCL	26.55
95% BCA Bootstrap UCL	33.16		
90% Chebyshev(Mean, Sd) UCL	32.26	95% Chebyshev(Mean, Sd) UCL	39.62
97.5% Chebyshev(Mean, Sd) UCL	49.85	99% Chebyshev(Mean, Sd) UCL	69.93

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	39.62

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	77	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	3	Mean	11.44
Maximum	76	Median	10
SD	9.313	Std. Error of Mean	1.061
Coefficient of Variation	0.814	Skewness	5.125

Normal GOF Test

Shapiro Wilk Test Statistic	0.511	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.101	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	13.21	95% Adjusted-CLT UCL (Chen-1995)	13.85
		95% Modified-t UCL (Johnson-1978)	13.31

Gamma GOF Test

A-D Test Statistic	4.496	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.22	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.102	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.588	k star (bias corrected MLE)	3.457
Theta hat (MLE)	3.188	Theta star (bias corrected MLE)	3.309
nu hat (MLE)	552.6	nu star (bias corrected)	532.4
MLE Mean (bias corrected)	11.44	MLE Sd (bias corrected)	6.153
		Approximate Chi Square Value (0.05)	479.9
Adjusted Level of Significance	0.0469	Adjusted Chi Square Value	479

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.69	95% Adjusted Gamma UCL (use when n<50)	12.72

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	4.4379E-7	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.169	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.101	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	2.291
Maximum of Logged Data	4.331	SD of logged Data	0.484

Assuming Lognormal Distribution

95% H-UCL	12.32	90% Chebyshev (MVUE) UCL	13.03
95% Chebyshev (MVUE) UCL	13.9	97.5% Chebyshev (MVUE) UCL	15.11
99% Chebyshev (MVUE) UCL	17.5		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	13.19	95% Jackknife UCL	13.21
95% Standard Bootstrap UCL	13.18	95% Bootstrap-t UCL	14.91
95% Hall's Bootstrap UCL	20.53	95% Percentile Bootstrap UCL	13.31
95% BCA Bootstrap UCL	13.86		
90% Chebyshev(Mean, Sd) UCL	14.63	95% Chebyshev(Mean, Sd) UCL	16.07
97.5% Chebyshev(Mean, Sd) UCL	18.07	99% Chebyshev(Mean, Sd) UCL	22

Suggested UCL to Use

95% Student's-t UCL	13.21	or 95% Modified-t UCL	13.31

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (copper)

General Statistics

Total Number of Observations	89	Number of Distinct Observations	88
		Number of Missing Observations	0
Minimum	27	Mean	4198
Maximum	59300	Median	1070
SD	10805	Std. Error of Mean	1145
Coefficient of Variation	2.574	Skewness	4.066

Normal GOF Test

Shapiro Wilk Test Statistic	0.388	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.383	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	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	6102	95% Adjusted-CLT UCL (Chen-1995)	6609
		95% Modified-t UCL (Johnson-1978)	6184

Gamma GOF Test

A-D Test Statistic	7.845	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.818	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.248	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.1	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.503	k star (bias corrected MLE)	0.494
Theta hat (MLE)	8339	Theta star (bias corrected MLE)	8499
nu hat (MLE)	89.6	nu star (bias corrected)	87.91
MLE Mean (bias corrected)	4198	MLE Sd (bias corrected)	5973
		Approximate Chi Square Value (0.05)	67.3
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	67

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5484	95% Adjusted Gamma UCL (use when n<50)	5508

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00829	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.103	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0939	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.296	Mean of logged Data	7.082
Maximum of Logged Data	10.99	SD of logged Data	1.392

Assuming Lognormal Distribution

95% H-UCL	4648	90% Chebyshev (MVUE) UCL	4889
95% Chebyshev (MVUE) UCL	5713	97.5% Chebyshev (MVUE) UCL	6856
99% Chebyshev (MVUE) UCL	9102		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6081	95% Jackknife UCL	6102
95% Standard Bootstrap UCL	6044	95% Bootstrap-t UCL	7175
95% Hall's Bootstrap UCL	6315	95% Percentile Bootstrap UCL	6199
95% BCA Bootstrap UCL	6943		
90% Chebyshev(Mean, Sd) UCL	7634	95% Chebyshev(Mean, Sd) UCL	9190
97.5% Chebyshev(Mean, Sd) UCL	11350	99% Chebyshev(Mean, Sd) UCL	15593

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	9190

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	89	Number of Distinct Observations	85
		Number of Missing Observations	0
Minimum	1.2	Mean	53.94
Maximum	1820	Median	9.49
SD	205.3	Std. Error of Mean	21.77
Coefficient of Variation	3.807	Skewness	7.675

Normal GOF Test

Shapiro Wilk Test Statistic	0.264	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.399	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	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	90.13	95% Adjusted-CLT UCL (Chen-1995)	108.7
		95% Modified-t UCL (Johnson-1978)	93.08

Gamma GOF Test

A-D Test Statistic	8.175	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.834	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.237	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.101	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.439	k star (bias corrected MLE)	0.431
Theta hat (MLE)	123	Theta star (bias corrected MLE)	125.1
nu hat (MLE)	78.07	nu star (bias corrected)	76.78
MLE Mean (bias corrected)	53.94	MLE Sd (bias corrected)	82.14
		Approximate Chi Square Value (0.05)	57.59
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	57.32

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	71.91	95% Adjusted Gamma UCL (use when n<50)	72.25

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.3981E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0963	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0939	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	2.51
Maximum of Logged Data	7.507	SD of logged Data	1.422

Assuming Lognormal Distribution

95% H-UCL	50.83	90% Chebyshev (MVUE) UCL	53.27
95% Chebyshev (MVUE) UCL	62.42	97.5% Chebyshev (MVUE) UCL	75.11
99% Chebyshev (MVUE) UCL	100		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	89.75	95% Jackknife UCL	90.13
95% Standard Bootstrap UCL	88.77	95% Bootstrap-t UCL	186.3
95% Hall's Bootstrap UCL	225	95% Percentile Bootstrap UCL	90.87
95% BCA Bootstrap UCL	115.4		
90% Chebyshev(Mean, Sd) UCL	119.2	95% Chebyshev(Mean, Sd) UCL	148.8
97.5% Chebyshev(Mean, Sd) UCL	189.9	99% Chebyshev(Mean, Sd) UCL	270.5

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	148.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	79
		Number of Missing Observations	0
Minimum	71	Mean	327.8
Maximum	759	Median	327.5
SD	117.3	Std. Error of Mean	12.64
Coefficient of Variation	0.358	Skewness	0.864

Normal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.00546	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0978	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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	348.8	95% Adjusted-CLT UCL (Chen-1995)	349.9
		95% Modified-t UCL (Johnson-1978)	349

Gamma GOF Test

A-D Test Statistic	1.039	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0965	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.487	k star (bias corrected MLE)	7.233
Theta hat (MLE)	43.79	Theta star (bias corrected MLE)	45.32
nu hat (MLE)	1288	nu star (bias corrected)	1244
MLE Mean (bias corrected)	327.8	MLE Sd (bias corrected)	121.9
		Approximate Chi Square Value (0.05)	1163
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	1162

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	350.6	95% Adjusted Gamma UCL (use when n<50)	351

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	8.0649E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0955	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.263	Mean of logged Data	5.724
Maximum of Logged Data	6.632	SD of logged Data	0.392

Assuming Lognormal Distribution

95% H-UCL	356.6	90% Chebyshev (MVUE) UCL	373.5
95% Chebyshev (MVUE) UCL	393.1	97.5% Chebyshev (MVUE) UCL	420.3
99% Chebyshev (MVUE) UCL	473.7		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	348.6	95% Jackknife UCL	348.8
95% Standard Bootstrap UCL	348.1	95% Bootstrap-t UCL	350.6
95% Hall's Bootstrap UCL	351.8	95% Percentile Bootstrap UCL	348.7
95% BCA Bootstrap UCL	349.5		
90% Chebyshev(Mean, Sd) UCL	365.7	95% Chebyshev(Mean, Sd) UCL	382.9
97.5% Chebyshev(Mean, Sd) UCL	406.8	99% Chebyshev(Mean, Sd) UCL	453.6

Suggested UCL to Use

95% Student's-t UCL	348.8	or 95% Modified-t UCL	349

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (mercury)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	12
Number of Detects	13	Number of Non-Detects	73
Number of Distinct Detects	11	Number of Distinct Non-Detects	3
Minimum Detect	0.04	Minimum Non-Detect	0.04
Maximum Detect	0.62	Maximum Non-Detect	0.2
Variance Detects	0.0257	Percent Non-Detects	84.88%
Mean Detects	0.153	SD Detects	0.16
Median Detects	0.11	CV Detects	1.046
Skewness Detects	2.409	Kurtosis Detects	6.315
Mean of Logged Detects	-2.222	SD of Logged Detects	0.807

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.692	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.246	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

Mean	0.0831	Standard Error of Mean	0.0132
SD	0.0786	95% KM (BCA) UCL	0.107
95% KM (t) UCL	0.105	95% KM (Percentile Bootstrap) UCL	0.106
95% KM (z) UCL	0.105	95% KM Bootstrap t UCL	0.113
90% KM Chebyshev UCL	0.123	95% KM Chebyshev UCL	0.141
97.5% KM Chebyshev UCL	0.166	99% KM Chebyshev UCL	0.215

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.651	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.186	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.241	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)	1.595	k star (bias corrected MLE)	1.278
Theta hat (MLE)	0.096	Theta star (bias corrected MLE)	0.12
nu hat (MLE)	41.46	nu star (bias corrected)	33.23
MLE Mean (bias corrected)	0.153	MLE Sd (bias corrected)	0.135

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.117	nu hat (KM)	192.1
Approximate Chi Square Value (192.09, α)	161	Adjusted Chi Square Value (192.09, β)	160.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.0991	95% Gamma Adjusted KM-UCL (use when n<50)	0.0994

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0748
Maximum	0.62	Median	0.0351
SD	0.0986	CV	1.318
k hat (MLE)	0.786	k star (bias corrected MLE)	0.767
Theta hat (MLE)	0.0951	Theta star (bias corrected MLE)	0.0976
nu hat (MLE)	135.3	nu star (bias corrected)	131.9
MLE Mean (bias corrected)	0.0748	MLE Sd (bias corrected)	0.0854
		Adjusted Level of Significance (β)	0.0472
Approximate Chi Square Value (131.87, α)	106.3	Adjusted Chi Square Value (131.87, β)	106
95% Gamma Approximate UCL (use when n>=50)	0.0928	95% Gamma Adjusted UCL (use when n<50)	0.0931

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.246	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	0.0771	Mean in Log Scale	-2.987
SD in Original Scale	0.0866	SD in Log Scale	0.923
95% t UCL (assumes normality of ROS data)	0.0926	95% Percentile Bootstrap UCL	0.0935
95% BCA Bootstrap UCL	0.0987	95% Bootstrap t UCL	0.0988
95% H-UCL (Log ROS)	0.0959		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.721	95% H-UCL (KM -Log)	0.09
KM SD (logged)	0.611	95% Critical H Value (KM-Log)	1.919
KM Standard Error of Mean (logged)	0.133		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.102	Mean in Log Scale	-2.419
SD in Original Scale	0.0676	SD in Log Scale	0.534
95% t UCL (Assumes normality)	0.114	95% H-Stat UCL	0.114

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 (t) UCL	0.105	95% GROS Approximate Gamma UCL	0.0928
95% Approximate Gamma KM-UCL	0.0991		

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

Result (molybdenum)

General Statistics

Total Number of Observations	89	Number of Distinct Observations	77
		Number of Missing Observations	0
Minimum	2	Mean	237.5
Maximum	3020	Median	75
SD	541.2	Std. Error of Mean	57.37
Coefficient of Variation	2.279	Skewness	3.92

Normal GOF Test

Shapiro Wilk Test Statistic	0.444	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.332	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	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	332.9	95% Adjusted-CLT UCL (Chen-1995)	357.3
		95% Modified-t UCL (Johnson-1978)	336.9

Gamma GOF Test

A-D Test Statistic	3.41	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.822	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.177	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.1	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.486	k star (bias corrected MLE)	0.477
Theta hat (MLE)	488.9	Theta star (bias corrected MLE)	498
nu hat (MLE)	86.47	nu star (bias corrected)	84.89
MLE Mean (bias corrected)	237.5	MLE Sd (bias corrected)	343.9
		Approximate Chi Square Value (0.05)	64.66
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	64.37

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	311.9	95% Adjusted Gamma UCL (use when n<50)	313.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.2	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0621	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0939	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	4.157
Maximum of Logged Data	8.013	SD of logged Data	1.65

Assuming Lognormal Distribution

95% H-UCL	418.8	90% Chebyshev (MVUE) UCL	421.8
95% Chebyshev (MVUE) UCL	503.9	97.5% Chebyshev (MVUE) UCL	617.8
99% Chebyshev (MVUE) UCL	841.5		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	331.9	95% Jackknife UCL	332.9
95% Standard Bootstrap UCL	335.3	95% Bootstrap-t UCL	382
95% Hall's Bootstrap UCL	344.2	95% Percentile Bootstrap UCL	338.2
95% BCA Bootstrap UCL	367.2		
90% Chebyshev(Mean, Sd) UCL	409.6	95% Chebyshev(Mean, Sd) UCL	487.6
97.5% Chebyshev(Mean, Sd) UCL	595.8	99% Chebyshev(Mean, Sd) UCL	808.3

Suggested UCL to Use

95% H-UCL	418.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (nickel)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	2	Mean	15.88
Maximum	70	Median	10
SD	12.73	Std. Error of Mean	1.373
Coefficient of Variation	0.802	Skewness	1.808

Normal GOF Test

Shapiro Wilk Test Statistic	0.78	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.242	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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	18.17	95% Adjusted-CLT UCL (Chen-1995)	18.43
		95% Modified-t UCL (Johnson-1978)	18.21

Gamma GOF Test

A-D Test Statistic	3.726	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0977	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.036	k star (bias corrected MLE)	1.973
Theta hat (MLE)	7.801	Theta star (bias corrected MLE)	8.051
nu hat (MLE)	350.2	nu star (bias corrected)	339.3
MLE Mean (bias corrected)	15.88	MLE Sd (bias corrected)	11.31
		Approximate Chi Square Value (0.05)	297.7
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	297

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	18.11	95% Adjusted Gamma UCL (use when n<50)	18.15

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.2332E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0955	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.5
Maximum of Logged Data	4.248	SD of logged Data	0.72

Assuming Lognormal Distribution

95% H-UCL	18.48	90% Chebyshev (MVUE) UCL	19.79
95% Chebyshev (MVUE) UCL	21.62	97.5% Chebyshev (MVUE) UCL	24.18
99% Chebyshev (MVUE) UCL	29.19		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	18.14	95% Jackknife UCL	18.17
95% Standard Bootstrap UCL	18.15	95% Bootstrap-t UCL	18.42
95% Hall's Bootstrap UCL	18.58	95% Percentile Bootstrap UCL	18.21
95% BCA Bootstrap UCL	18.27		
90% Chebyshev(Mean, Sd) UCL	20	95% Chebyshev(Mean, Sd) UCL	21.87
97.5% Chebyshev(Mean, Sd) UCL	24.46	99% Chebyshev(Mean, Sd) UCL	29.54

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	21.87

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (selenium)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	62
Number of Detects	81	Number of Non-Detects	5
Number of Distinct Detects	62	Number of Distinct Non-Detects	3
Minimum Detect	0.07	Minimum Non-Detect	0.3
Maximum Detect	50	Maximum Non-Detect	0.67
Variance Detects	53.92	Percent Non-Detects	5.814%
Mean Detects	2.309	SD Detects	7.343
Median Detects	0.45	CV Detects	3.18
Skewness Detects	5.376	Kurtosis Detects	30.48
Mean of Logged Detects	-0.534	SD of Logged Detects	1.339

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.318	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.384	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	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

Mean	2.186	Standard Error of Mean	0.77
SD	7.099	95% KM (BCA) UCL	3.637
95% KM (t) UCL	3.467	95% KM (Percentile Bootstrap) UCL	3.586
95% KM (z) UCL	3.453	95% KM Bootstrap t UCL	5.74
90% KM Chebyshev UCL	4.497	95% KM Chebyshev UCL	5.544
97.5% KM Chebyshev UCL	6.997	99% KM Chebyshev UCL	9.851

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.97	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.826	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.268	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.105	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)	0.468	k star (bias corrected MLE)	0.459
Theta hat (MLE)	4.934	Theta star (bias corrected MLE)	5.032
nu hat (MLE)	75.82	nu star (bias corrected)	74.35
MLE Mean (bias corrected)	2.309	MLE Sd (bias corrected)	3.409

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0948	nu hat (KM)	16.31
Approximate Chi Square Value (16.31, α)	8.184	Adjusted Chi Square Value (16.31, β)	8.085
95% Gamma Approximate KM-UCL (use when n>=50)	4.358	95% Gamma Adjusted KM-UCL (use when n<50)	4.411

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.176
Maximum	50	Median	0.42
SD	7.144	CV	3.284
k hat (MLE)	0.421	k star (bias corrected MLE)	0.415
Theta hat (MLE)	5.162	Theta star (bias corrected MLE)	5.249
nu hat (MLE)	72.49	nu star (bias corrected)	71.3
MLE Mean (bias corrected)	2.176	MLE Sd (bias corrected)	3.379
		Adjusted Level of Significance (β)	0.0472
Approximate Chi Square Value (71.30, α)	52.85	Adjusted Chi Square Value (71.30, β)	52.59
95% Gamma Approximate UCL (use when n>=50)	2.935	95% Gamma Adjusted UCL (use when n<50)	2.95

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	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	2.185	Mean in Log Scale	-0.612
SD in Original Scale	7.141	SD in Log Scale	1.34
95% t UCL (assumes normality of ROS data)	3.465	95% Percentile Bootstrap UCL	3.623
95% BCA Bootstrap UCL	4.176	95% Bootstrap t UCL	5.491
95% H-UCL (Log ROS)	1.94		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.186	Mean in Log Scale	-0.604
SD in Original Scale	7.141	SD in Log Scale	1.331
95% t UCL (Assumes normality)	3.466	95% H-Stat UCL	1.925

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	5.544

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.

Result (thallium)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	35
Number of Detects	82	Number of Non-Detects	4
Number of Distinct Detects	35	Number of Distinct Non-Detects	2
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	5.2	Maximum Non-Detect	0.3
Variance Detects	0.312	Percent Non-Detects	4.651%
Mean Detects	0.339	SD Detects	0.559
Median Detects	0.27	CV Detects	1.649
Skewness Detects	8.357	Kurtosis Detects	73.21
Mean of Logged Detects	-1.326	SD of Logged Detects	0.523

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.262	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.359	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0978	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

Mean	0.332	Standard Error of Mean	0.059
SD	0.543	95% KM (BCA) UCL	0.454
95% KM (t) UCL	0.43	95% KM (Percentile Bootstrap) UCL	0.447
95% KM (z) UCL	0.429	95% KM Bootstrap t UCL	0.72
90% KM Chebyshev UCL	0.508	95% KM Chebyshev UCL	0.589
97.5% KM Chebyshev UCL	0.7	99% KM Chebyshev UCL	0.918

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	7.136	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.763	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.245	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0998	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)	2.211	k star (bias corrected MLE)	2.138
Theta hat (MLE)	0.153	Theta star (bias corrected MLE)	0.158
nu hat (MLE)	362.6	nu star (bias corrected)	350.7
MLE Mean (bias corrected)	0.339	MLE Sd (bias corrected)	0.232

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.373	nu hat (KM)	64.07
Approximate Chi Square Value (64.07, α)	46.66	Adjusted Chi Square Value (64.07, β)	46.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.455	95% Gamma Adjusted KM-UCL (use when n<50)	0.458

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.328
Maximum	5.2	Median	0.26
SD	0.548	CV	1.669
k hat (MLE)	1.937	k star (bias corrected MLE)	1.877
Theta hat (MLE)	0.169	Theta star (bias corrected MLE)	0.175
nu hat (MLE)	333.1	nu star (bias corrected)	322.8
MLE Mean (bias corrected)	0.328	MLE Sd (bias corrected)	0.24
		Adjusted Level of Significance (β)	0.0472
Approximate Chi Square Value (322.84, α)	282.2	Adjusted Chi Square Value (322.84, β)	281.6
95% Gamma Approximate UCL (use when n>=50)	0.375	95% Gamma Adjusted UCL (use when n<50)	0.376

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0978	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	0.331	Mean in Log Scale	-1.349
SD in Original Scale	0.547	SD in Log Scale	0.532
95% t UCL (assumes normality of ROS data)	0.429	95% Percentile Bootstrap UCL	0.439
95% BCA Bootstrap UCL	0.519	95% Bootstrap t UCL	0.704
95% H-UCL (Log ROS)	0.333		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.329	Mean in Log Scale	-1.365
SD in Original Scale	0.547	SD in Log Scale	0.551
95% t UCL (Assumes normality)	0.427	95% H-Stat UCL	0.333

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 (BCA) UCL	0.454

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

Result (uranium)

General Statistics

Total Number of Observations	72	Number of Distinct Observations	68
		Number of Missing Observations	0
Minimum	1.3	Mean	4.212
Maximum	10.3	Median	3.975
SD	1.847	Std. Error of Mean	0.218
Coefficient of Variation	0.438	Skewness	1.236

Normal GOF Test

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	9.6530E-6	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.141	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.575	95% Adjusted-CLT UCL (Chen-1995)	4.604
		95% Modified-t UCL (Johnson-1978)	4.58

Gamma GOF Test

A-D Test Statistic	0.496	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0854	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.105	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.826	k star (bias corrected MLE)	5.592
Theta hat (MLE)	0.723	Theta star (bias corrected MLE)	0.753
nu hat (MLE)	838.9	nu star (bias corrected)	805.3
MLE Mean (bias corrected)	4.212	MLE Sd (bias corrected)	1.781
		Approximate Chi Square Value (0.05)	740.4
Adjusted Level of Significance	0.0467	Adjusted Chi Square Value	739.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	4.581	95% Adjusted Gamma UCL (use when n<50)	4.589

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.517	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0593	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.104	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.262	Mean of logged Data	1.35
Maximum of Logged Data	2.332	SD of logged Data	0.425

Assuming Lognormal Distribution

95% H-UCL	4.625	90% Chebyshev (MVUE) UCL	4.875
95% Chebyshev (MVUE) UCL	5.173	97.5% Chebyshev (MVUE) UCL	5.587
99% Chebyshev (MVUE) UCL	6.401		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.57	95% Jackknife UCL	4.575
95% Standard Bootstrap UCL	4.573	95% Bootstrap-t UCL	4.598
95% Hall's Bootstrap UCL	4.601	95% Percentile Bootstrap UCL	4.578
95% BCA Bootstrap UCL	4.615		
90% Chebyshev(Mean, Sd) UCL	4.865	95% Chebyshev(Mean, Sd) UCL	5.161
97.5% Chebyshev(Mean, Sd) UCL	5.571	99% Chebyshev(Mean, Sd) UCL	6.378

Suggested UCL to Use

95% Approximate Gamma UCL	4.581

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	86	Number of Distinct Observations	69
		Number of Missing Observations	0
Minimum	26	Mean	249.2
Maximum	6210	Median	75.5
SD	848.1	Std. Error of Mean	91.45
Coefficient of Variation	3.403	Skewness	6.186

Normal GOF Test

Shapiro Wilk Test Statistic	0.259	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.419	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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	401.3	95% Adjusted-CLT UCL (Chen-1995)	464.9
		95% Modified-t UCL (Johnson-1978)	411.5

Gamma GOF Test

A-D Test Statistic	11.7	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.809	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.101	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.598	k star (bias corrected MLE)	0.585
Theta hat (MLE)	417	Theta star (bias corrected MLE)	426.3
nu hat (MLE)	102.8	nu star (bias corrected)	100.6
MLE Mean (bias corrected)	249.2	MLE Sd (bias corrected)	326
		Approximate Chi Square Value (0.05)	78.42
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	78.09

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	319.6	95% Adjusted Gamma UCL (use when n<50)	321

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.310E-13	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0955	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.258	Mean of logged Data	4.484
Maximum of Logged Data	8.734	SD of logged Data	1.023

Assuming Lognormal Distribution

95% H-UCL	192.2	90% Chebyshev (MVUE) UCL	207.2
95% Chebyshev (MVUE) UCL	233.9	97.5% Chebyshev (MVUE) UCL	271
99% Chebyshev (MVUE) UCL	343.9		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	399.7	95% Jackknife UCL	401.3
95% Standard Bootstrap UCL	391.4	95% Bootstrap-t UCL	1015
95% Hall's Bootstrap UCL	1030	95% Percentile Bootstrap UCL	408
95% BCA Bootstrap UCL	483.8		
90% Chebyshev(Mean, Sd) UCL	523.6	95% Chebyshev(Mean, Sd) UCL	647.9
97.5% Chebyshev(Mean, Sd) UCL	820.4	99% Chebyshev(Mean, Sd) UCL	1159

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	647.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (antimony)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	20
Number of Detects	53	Number of Non-Detects	43
Number of Distinct Detects	20	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	66	Maximum Non-Detect	2
Variance Detects	130.2	Percent Non-Detects	44.79%
Mean Detects	3.394	SD Detects	11.41
Median Detects	0.4	CV Detects	3.361
Skewness Detects	4.842	Kurtosis Detects	23.5
Mean of Logged Detects	-0.38	SD of Logged Detects	1.358

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.306	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.406	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.122	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

Mean	2.046	Standard Error of Mean	0.879
SD	8.531	95% KM (BCA) UCL	3.903
95% KM (t) UCL	3.507	95% KM (Percentile Bootstrap) UCL	3.623
95% KM (z) UCL	3.492	95% KM Bootstrap t UCL	9.065
90% KM Chebyshev UCL	4.684	95% KM Chebyshev UCL	5.879
97.5% KM Chebyshev UCL	7.537	99% KM Chebyshev UCL	10.79

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.366	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.837	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.302	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.131	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)	0.409	k star (bias corrected MLE)	0.399
Theta hat (MLE)	8.294	Theta star (bias corrected MLE)	8.514
nu hat (MLE)	43.38	nu star (bias corrected)	42.26
MLE Mean (bias corrected)	3.394	MLE Sd (bias corrected)	5.376

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0575	nu hat (KM)	11.04
Approximate Chi Square Value (11.04, α)	4.605	Adjusted Chi Square Value (11.04, β)	4.541
95% Gamma Approximate KM-UCL (use when n>=50)	4.908	95% Gamma Adjusted KM-UCL (use when n<50)	4.976

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.156
Maximum	66	Median	0.3
SD	8.6	CV	3.989
k hat (MLE)	0.284	k star (bias corrected MLE)	0.282
Theta hat (MLE)	7.59	Theta star (bias corrected MLE)	7.642
nu hat (MLE)	54.54	nu star (bias corrected)	54.17
MLE Mean (bias corrected)	2.156	MLE Sd (bias corrected)	4.059
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (54.17, α)	38.26	Adjusted Chi Square Value (54.17, β)	38.06
95% Gamma Approximate UCL (use when n>=50)	3.053	95% Gamma Adjusted UCL (use when n<50)	3.069

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.22	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.122	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	2.11	Mean in Log Scale	-0.629
SD in Original Scale	8.566	SD in Log Scale	1.181
95% t UCL (assumes normality of ROS data)	3.562	95% Percentile Bootstrap UCL	3.595
95% BCA Bootstrap UCL	4.476	95% Bootstrap t UCL	9.299
95% H-UCL (Log ROS)	1.439		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.124	Mean in Log Scale	-0.484
SD in Original Scale	8.561	SD in Log Scale	1.022
95% t UCL (Assumes normality)	3.575	95% H-Stat UCL	1.319

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	5.879

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

Result (arsenic)

General Statistics

Total Number of Observations	195	Number of Distinct Observations	100
Number of Detects	185	Number of Non-Detects	10
Number of Distinct Detects	100	Number of Distinct Non-Detects	1
Minimum Detect	0.7	Minimum Non-Detect	2.5
Maximum Detect	166	Maximum Non-Detect	2.5
Variance Detects	224.9	Percent Non-Detects	5.128%
Mean Detects	8.264	SD Detects	15
Median Detects	5.1	CV Detects	1.815
Skewness Detects	7.971	Kurtosis Detects	75.61
Mean of Logged Detects	1.628	SD of Logged Detects	0.902

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.389	**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	0.0651	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

Mean	7.917	Standard Error of Mean	1.052
SD	14.64	95% KM (BCA) UCL	10
95% KM (t) UCL	9.655	95% KM (Percentile Bootstrap) UCL	9.765
95% KM (z) UCL	9.647	95% KM Bootstrap t UCL	11.58
90% KM Chebyshev UCL	11.07	95% KM Chebyshev UCL	12.5
97.5% KM Chebyshev UCL	14.48	99% KM Chebyshev UCL	18.38

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.937	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.779	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0955	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0692	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)	1.171	k star (bias corrected MLE)	1.155
Theta hat (MLE)	7.058	Theta star (bias corrected MLE)	7.152
nu hat (MLE)	433.2	nu star (bias corrected)	427.5
MLE Mean (bias corrected)	8.264	MLE Sd (bias corrected)	7.688

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.292	nu hat (KM)	114
Approximate Chi Square Value (113.98, α)	90.33	Adjusted Chi Square Value (113.98, β)	90.17
95% Gamma Approximate KM-UCL (use when n>=50)	9.99	95% Gamma Adjusted KM-UCL (use when n<50)	10.01

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.841
Maximum	166	Median	4.7
SD	14.72	CV	1.877
k hat (MLE)	0.791	k star (bias corrected MLE)	0.782
Theta hat (MLE)	9.912	Theta star (bias corrected MLE)	10.02
nu hat (MLE)	308.5	nu star (bias corrected)	305.1
MLE Mean (bias corrected)	7.841	MLE Sd (bias corrected)	8.865
		Adjusted Level of Significance (β)	0.0488
Approximate Chi Square Value (305.08, α)	265.6	Adjusted Chi Square Value (305.08, β)	265.4
95% Gamma Approximate UCL (use when n>=50)	9.006	95% Gamma Adjusted UCL (use when n<50)	9.015

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0383	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0651	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	7.917	Mean in Log Scale	1.562
SD in Original Scale	14.68	SD in Log Scale	0.926
95% t UCL (assumes normality of ROS data)	9.655	95% Percentile Bootstrap UCL	9.746
95% BCA Bootstrap UCL	10.67	95% Bootstrap t UCL	11.61
95% H-UCL (Log ROS)	8.429		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.562	95% H-UCL (KM -Log)	8.401
KM SD (logged)	0.923	95% Critical H Value (KM-Log)	2.109
KM Standard Error of Mean (logged)	0.0666		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	7.905	Mean in Log Scale	1.556
SD in Original Scale	14.69	SD in Log Scale	0.932
95% t UCL (Assumes normality)	9.643	95% H-Stat UCL	8.427

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

95% KM (BCA) UCL	10

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

Result (barium)

General Statistics

Total Number of Observations	79	Number of Distinct Observations	69
		Number of Missing Observations	0
Minimum	36.8	Mean	150.2
Maximum	654	Median	141
SD	78.58	Std. Error of Mean	8.841
Coefficient of Variation	0.523	Skewness	3.613

Normal GOF Test

Shapiro Wilk Test Statistic	0.744	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0997	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	164.9	95% Adjusted-CLT UCL (Chen-1995)	168.5
		95% Modified-t UCL (Johnson-1978)	165.5

Gamma GOF Test

A-D Test Statistic	1.287	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.119	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.101	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.204	k star (bias corrected MLE)	5.015
Theta hat (MLE)	28.86	Theta star (bias corrected MLE)	29.95
nu hat (MLE)	822.2	nu star (bias corrected)	792.3
MLE Mean (bias corrected)	150.2	MLE Sd (bias corrected)	67.06
		Approximate Chi Square Value (0.05)	728
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	726.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	163.4	95% Adjusted Gamma UCL (use when n<50)	163.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.028	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.105	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0997	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.605	Mean of logged Data	4.913
Maximum of Logged Data	6.483	SD of logged Data	0.445

Assuming Lognormal Distribution

95% H-UCL	164.6	90% Chebyshev (MVUE) UCL	173.4
95% Chebyshev (MVUE) UCL	184.1	97.5% Chebyshev (MVUE) UCL	198.8
99% Chebyshev (MVUE) UCL	227.8		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	164.7	95% Jackknife UCL	164.9
95% Standard Bootstrap UCL	164.4	95% Bootstrap-t UCL	171.1
95% Hall's Bootstrap UCL	193.8	95% Percentile Bootstrap UCL	165.1
95% BCA Bootstrap UCL	168.6		
90% Chebyshev(Mean, Sd) UCL	176.7	95% Chebyshev(Mean, Sd) UCL	188.7
97.5% Chebyshev(Mean, Sd) UCL	205.4	99% Chebyshev(Mean, Sd) UCL	238.1

Suggested UCL to Use

95% Student's-t UCL	164.9	or 95% Modified-t UCL	165.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	100	Number of Distinct Observations	29
Number of Detects	90	Number of Non-Detects	10
Number of Distinct Detects	29	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	1.4	Maximum Non-Detect	1
Variance Detects	0.0484	Percent Non-Detects	10%
Mean Detects	0.495	SD Detects	0.22
Median Detects	0.47	CV Detects	0.445
Skewness Detects	1.673	Kurtosis Detects	4.291
Mean of Logged Detects	-0.791	SD of Logged Detects	0.422

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.866	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	2.757E-11	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.216	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0934	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

Mean	0.491	Standard Error of Mean	0.0221
SD	0.214	95% KM (BCA) UCL	0.528
95% KM (t) UCL	0.528	95% KM (Percentile Bootstrap) UCL	0.528
95% KM (z) UCL	0.528	95% KM Bootstrap t UCL	0.532
90% KM Chebyshev UCL	0.558	95% KM Chebyshev UCL	0.588
97.5% KM Chebyshev UCL	0.63	99% KM Chebyshev UCL	0.712

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.728	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.16	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0944	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)	5.901	k star (bias corrected MLE)	5.712
Theta hat (MLE)	0.0838	Theta star (bias corrected MLE)	0.0866
nu hat (MLE)	1062	nu star (bias corrected)	1028
MLE Mean (bias corrected)	0.495	MLE Sd (bias corrected)	0.207

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.282	nu hat (KM)	1056
Approximate Chi Square Value (N/A, α)	982	Adjusted Chi Square Value (N/A, β)	980.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.529	95% Gamma Adjusted KM-UCL (use when n<50)	0.529

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.11	Mean	0.492
Maximum	1.4	Median	0.468
SD	0.214	CV	0.436
k hat (MLE)	6.095	k star (bias corrected MLE)	5.918
Theta hat (MLE)	0.0807	Theta star (bias corrected MLE)	0.0831
nu hat (MLE)	1219	nu star (bias corrected)	1184
MLE Mean (bias corrected)	0.492	MLE Sd (bias corrected)	0.202
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (N/A, α)	1105	Adjusted Chi Square Value (N/A, β)	1104
95% Gamma Approximate UCL (use when n>=50)	0.527	95% Gamma Adjusted UCL (use when n<50)	0.527

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0934	Detected Data Not 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	0.491	Mean in Log Scale	-0.795
SD in Original Scale	0.214	SD in Log Scale	0.412
95% t UCL (assumes normality of ROS data)	0.527	95% Percentile Bootstrap UCL	0.527
95% BCA Bootstrap UCL	0.533	95% Bootstrap t UCL	0.531
95% H-UCL (Log ROS)	0.53		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.796	95% H-UCL (KM -Log)	0.53
KM SD (logged)	0.415	95% Critical H Value (KM-Log)	1.805
KM Standard Error of Mean (logged)	0.0436		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.495	Mean in Log Scale	-0.781
SD in Original Scale	0.209	SD in Log Scale	0.401
95% t UCL (Assumes normality)	0.53	95% H-Stat UCL	0.533

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

95% KM (BCA) UCL	0.528

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

Result (cadmium)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	27
Number of Detects	29	Number of Non-Detects	67
Number of Distinct Detects	25	Number of Distinct Non-Detects	2
Minimum Detect	0.43	Minimum Non-Detect	0.2
Maximum Detect	24.9	Maximum Non-Detect	2
Variance Detects	41.25	Percent Non-Detects	69.79%
Mean Detects	4.182	SD Detects	6.423
Median Detects	1.1	CV Detects	1.536
Skewness Detects	2.311	Kurtosis Detects	4.678
Mean of Logged Detects	0.589	SD of Logged Detects	1.252

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.624	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.28	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.165	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

Mean	1.793	Standard Error of Mean	0.404
SD	3.824	95% KM (BCA) UCL	2.554
95% KM (t) UCL	2.464	95% KM (Percentile Bootstrap) UCL	2.463
95% KM (z) UCL	2.457	95% KM Bootstrap t UCL	2.924
90% KM Chebyshev UCL	3.004	95% KM Chebyshev UCL	3.553
97.5% KM Chebyshev UCL	4.314	99% KM Chebyshev UCL	5.81

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.845	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.788	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.217	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.169	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)	0.715	k star (bias corrected MLE)	0.664
Theta hat (MLE)	5.847	Theta star (bias corrected MLE)	6.296
nu hat (MLE)	41.49	nu star (bias corrected)	38.53
MLE Mean (bias corrected)	4.182	MLE Sd (bias corrected)	5.131

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.22	nu hat (KM)	42.21
Approximate Chi Square Value (42.21, α)	28.32	Adjusted Chi Square Value (42.21, β)	28.14
95% Gamma Approximate KM-UCL (use when n>=50)	2.673	95% Gamma Adjusted KM-UCL (use when n<50)	2.689

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.912
Maximum	24.9	Median	0.5
SD	4.007	CV	2.096
k hat (MLE)	0.304	k star (bias corrected MLE)	0.301
Theta hat (MLE)	6.289	Theta star (bias corrected MLE)	6.342
nu hat (MLE)	58.37	nu star (bias corrected)	57.88
MLE Mean (bias corrected)	1.912	MLE Sd (bias corrected)	3.482
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (57.88, α)	41.39	Adjusted Chi Square Value (57.88, β)	41.18
95% Gamma Approximate UCL (use when n>=50)	2.674	95% Gamma Adjusted UCL (use when n<50)	2.688

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.17	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.165	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	1.944	Mean in Log Scale	-0.136
SD in Original Scale	3.853	SD in Log Scale	1.181
95% t UCL (assumes normality of ROS data)	2.597	95% Percentile Bootstrap UCL	2.683
95% BCA Bootstrap UCL	2.825	95% Bootstrap t UCL	3.042
95% H-UCL (Log ROS)	2.355		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.943	Mean in Log Scale	0.13
SD in Original Scale	3.791	SD in Log Scale	0.814
95% t UCL (Assumes normality)	2.585	95% H-Stat UCL	1.887

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 (BCA) UCL	2.554

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

Result (chromium)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	2	Mean	15.02
Maximum	470	Median	7.765
SD	47.65	Std. Error of Mean	4.863
Coefficient of Variation	3.171	Skewness	9.367

Normal GOF Test

Shapiro Wilk Test Statistic	0.199	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.392	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	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	23.1	95% Adjusted-CLT UCL (Chen-1995)	27.99
		95% Modified-t UCL (Johnson-1978)	23.88

Gamma GOF Test

A-D Test Statistic	9.951	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.259	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.094	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.052	k star (bias corrected MLE)	1.026
Theta hat (MLE)	14.29	Theta star (bias corrected MLE)	14.65
nu hat (MLE)	201.9	nu star (bias corrected)	196.9
MLE Mean (bias corrected)	15.02	MLE Sd (bias corrected)	14.83
		Approximate Chi Square Value (0.05)	165.5
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	165

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	17.88	95% Adjusted Gamma UCL (use when n<50)	17.93

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	9.458E-10	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.138	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0904	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.164
Maximum of Logged Data	6.153	SD of logged Data	0.727

Assuming Lognormal Distribution

95% H-UCL	13.21	90% Chebyshev (MVUE) UCL	14.1
95% Chebyshev (MVUE) UCL	15.37	97.5% Chebyshev (MVUE) UCL	17.13
99% Chebyshev (MVUE) UCL	20.58		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	23.02	95% Jackknife UCL	23.1
95% Standard Bootstrap UCL	23.26	95% Bootstrap-t UCL	58.8
95% Hall's Bootstrap UCL	52.59	95% Percentile Bootstrap UCL	24.75
95% BCA Bootstrap UCL	30.23		
90% Chebyshev(Mean, Sd) UCL	29.61	95% Chebyshev(Mean, Sd) UCL	36.22
97.5% Chebyshev(Mean, Sd) UCL	45.39	99% Chebyshev(Mean, Sd) UCL	63.41

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	36.22

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	84	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	3	Mean	11.19
Maximum	76	Median	10
SD	8.987	Std. Error of Mean	0.981
Coefficient of Variation	0.803	Skewness	5.285

Normal GOF Test

Shapiro Wilk Test Statistic	0.512	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0967	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	12.82	95% Adjusted-CLT UCL (Chen-1995)	13.41
		95% Modified-t UCL (Johnson-1978)	12.92

Gamma GOF Test

A-D Test Statistic	4.371	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.098	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.696	k star (bias corrected MLE)	3.572
Theta hat (MLE)	3.029	Theta star (bias corrected MLE)	3.134
nu hat (MLE)	620.9	nu star (bias corrected)	600.1
MLE Mean (bias corrected)	11.19	MLE Sd (bias corrected)	5.923
		Approximate Chi Square Value (0.05)	544.3
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	543.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.34	95% Adjusted Gamma UCL (use when n<50)	12.36

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.3741E-7	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0967	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	2.274
Maximum of Logged Data	4.331	SD of logged Data	0.476

Assuming Lognormal Distribution

95% H-UCL	11.98	90% Chebyshev (MVUE) UCL	12.65
95% Chebyshev (MVUE) UCL	13.45	97.5% Chebyshev (MVUE) UCL	14.57
99% Chebyshev (MVUE) UCL	16.77		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	12.81	95% Jackknife UCL	12.82
95% Standard Bootstrap UCL	12.81	95% Bootstrap-t UCL	14.49
95% Hall's Bootstrap UCL	19.42	95% Percentile Bootstrap UCL	13.03
95% BCA Bootstrap UCL	13.5		
90% Chebyshev(Mean, Sd) UCL	14.14	95% Chebyshev(Mean, Sd) UCL	15.47
97.5% Chebyshev(Mean, Sd) UCL	17.32	99% Chebyshev(Mean, Sd) UCL	20.95

Suggested UCL to Use

95% Student's-t UCL	12.82	or 95% Modified-t UCL	12.92

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (copper)

General Statistics

Total Number of Observations	195	Number of Distinct Observations	176
		Number of Missing Observations	0
Minimum	27	Mean	3851
Maximum	109000	Median	1640
SD	10731	Std. Error of Mean	768.4
Coefficient of Variation	2.786	Skewness	6.837

Normal GOF Test

Shapiro Wilk Test Statistic	0.323	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.374	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0634	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	5121	95% Adjusted-CLT UCL (Chen-1995)	5517
		95% Modified-t UCL (Johnson-1978)	5184

Gamma GOF Test

A-D Test Statistic	11.63	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.806	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.182	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.068	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.646	k star (bias corrected MLE)	0.639
Theta hat (MLE)	5961	Theta star (bias corrected MLE)	6022
nu hat (MLE)	251.9	nu star (bias corrected)	249.4
MLE Mean (bias corrected)	3851	MLE Sd (bias corrected)	4816
		Approximate Chi Square Value (0.05)	213.8
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	213.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4491	95% Adjusted Gamma UCL (use when n<50)	4497

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0531	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0764	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0634	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.296	Mean of logged Data	7.31
Maximum of Logged Data	11.6	SD of logged Data	1.214

Assuming Lognormal Distribution

95% H-UCL	3839	90% Chebyshev (MVUE) UCL	4150
95% Chebyshev (MVUE) UCL	4625	97.5% Chebyshev (MVUE) UCL	5284
99% Chebyshev (MVUE) UCL	6579		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5115	95% Jackknife UCL	5121
95% Standard Bootstrap UCL	5113	95% Bootstrap-t UCL	6020
95% Hall's Bootstrap UCL	5857	95% Percentile Bootstrap UCL	5222
95% BCA Bootstrap UCL	5815		
90% Chebyshev(Mean, Sd) UCL	6156	95% Chebyshev(Mean, Sd) UCL	7201
97.5% Chebyshev(Mean, Sd) UCL	8650	99% Chebyshev(Mean, Sd) UCL	11497

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	7201

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	195	Number of Distinct Observations	182
		Number of Missing Observations	0
Minimum	1.2	Mean	107.9
Maximum	3220	Median	20.3
SD	304.5	Std. Error of Mean	21.8
Coefficient of Variation	2.821	Skewness	6.965

Normal GOF Test

Shapiro Wilk Test Statistic	0.378	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0634	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	144	95% Adjusted-CLT UCL (Chen-1995)	155.4
		95% Modified-t UCL (Johnson-1978)	145.8

Gamma GOF Test

A-D Test Statistic	11.18	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.834	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.187	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0692	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.446	k star (bias corrected MLE)	0.443
Theta hat (MLE)	242	Theta star (bias corrected MLE)	243.9
nu hat (MLE)	174	nu star (bias corrected)	172.6
MLE Mean (bias corrected)	107.9	MLE Sd (bias corrected)	162.2
		Approximate Chi Square Value (0.05)	143.2
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	143

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	130.1	95% Adjusted Gamma UCL (use when n<50)	130.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.7069E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0693	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0634	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	3.232
Maximum of Logged Data	8.077	SD of logged Data	1.602

Assuming Lognormal Distribution

95% H-UCL	125.6	90% Chebyshev (MVUE) UCL	135.4
95% Chebyshev (MVUE) UCL	155.9	97.5% Chebyshev (MVUE) UCL	184.4
99% Chebyshev (MVUE) UCL	240.5		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	143.8	95% Jackknife UCL	144
95% Standard Bootstrap UCL	142.6	95% Bootstrap-t UCL	165.1
95% Hall's Bootstrap UCL	288.6	95% Percentile Bootstrap UCL	147.9
95% BCA Bootstrap UCL	158.9		
90% Chebyshev(Mean, Sd) UCL	173.4	95% Chebyshev(Mean, Sd) UCL	203
97.5% Chebyshev(Mean, Sd) UCL	244.1	99% Chebyshev(Mean, Sd) UCL	324.9

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	203

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	87
Number of Detects	95	Number of Non-Detects	1
Number of Distinct Detects	86	Number of Distinct Non-Detects	1
Minimum Detect	71	Minimum Non-Detect	0.4
Maximum Detect	759	Maximum Non-Detect	0.4
Variance Detects	13347	Percent Non-Detects	1.042%
Mean Detects	323.1	SD Detects	115.5
Median Detects	320	CV Detects	0.358
Skewness Detects	0.845	Kurtosis Detects	2.534
Mean of Logged Detects	5.709	SD of Logged Detects	0.392

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.95	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0.00387	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0916	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0909	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

Mean	319.7	Standard Error of Mean	12.2
SD	118.9	95% KM (BCA) UCL	339.5
95% KM (t) UCL	340	95% KM (Percentile Bootstrap) UCL	339.4
95% KM (z) UCL	339.8	95% KM Bootstrap t UCL	341.5
90% KM Chebyshev UCL	356.3	95% KM Chebyshev UCL	372.9
97.5% KM Chebyshev UCL	395.9	99% KM Chebyshev UCL	441.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.168	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0919	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)	7.462	k star (bias corrected MLE)	7.234
Theta hat (MLE)	43.3	Theta star (bias corrected MLE)	44.66
nu hat (MLE)	1418	nu star (bias corrected)	1374
MLE Mean (bias corrected)	323.1	MLE Sd (bias corrected)	120.1

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	7.228	nu hat (KM)	1388
Approximate Chi Square Value (N/A, α)	1302	Adjusted Chi Square Value (N/A, β)	1301
95% Gamma Approximate KM-UCL (use when n>=50)	340.7	95% Gamma Adjusted KM-UCL (use when n<50)	341

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	71	Mean	320.7
Maximum	759	Median	319.5
SD	117.2	CV	0.365
k hat (MLE)	7.008	k star (bias corrected MLE)	6.796
Theta hat (MLE)	45.76	Theta star (bias corrected MLE)	47.19
nu hat (MLE)	1346	nu star (bias corrected)	1305
MLE Mean (bias corrected)	320.7	MLE Sd (bias corrected)	123
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (N/A, α)	1222	Adjusted Chi Square Value (N/A, β)	1221
95% Gamma Approximate UCL (use when n>=50)	342.5	95% Gamma Adjusted UCL (use when n<50)	342.8

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0909	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	320.8	Mean in Log Scale	5.699
SD in Original Scale	117	SD in Log Scale	0.404
95% t UCL (assumes normality of ROS data)	340.7	95% Percentile Bootstrap UCL	341
95% BCA Bootstrap UCL	341.2	95% Bootstrap t UCL	341.6
95% H-UCL (Log ROS)	348.8		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	319.7	Mean in Log Scale	5.633
SD in Original Scale	119.5	SD in Log Scale	0.842
95% t UCL (Assumes normality)	340	95% H-Stat UCL	478.1

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 (BCA) UCL	339.5

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

Result (mercury)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	15
Number of Detects	17	Number of Non-Detects	79
Number of Distinct Detects	13	Number of Distinct Non-Detects	4
Minimum Detect	0.037	Minimum Non-Detect	0.033
Maximum Detect	0.62	Maximum Non-Detect	0.2
Variance Detects	0.0236	Percent Non-Detects	82.29%
Mean Detects	0.152	SD Detects	0.154
Median Detects	0.11	CV Detects	1.013
Skewness Detects	2.157	Kurtosis Detects	4.867
Mean of Logged Detects	-2.238	SD of Logged Detects	0.817

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.215	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

Mean	0.0759	Standard Error of Mean	0.0113
SD	0.0813	95% KM (BCA) UCL	0.0952
95% KM (t) UCL	0.0946	95% KM (Percentile Bootstrap) UCL	0.0953
95% KM (z) UCL	0.0944	95% KM Bootstrap t UCL	0.1
90% KM Chebyshev UCL	0.11	95% KM Chebyshev UCL	0.125
97.5% KM Chebyshev UCL	0.146	99% KM Chebyshev UCL	0.188

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.743	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.188	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.213	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)	1.569	k star (bias corrected MLE)	1.332
Theta hat (MLE)	0.0966	Theta star (bias corrected MLE)	0.114
nu hat (MLE)	53.36	nu star (bias corrected)	45.27
MLE Mean (bias corrected)	0.152	MLE Sd (bias corrected)	0.131

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.87	nu hat (KM)	167.1
Approximate Chi Square Value (167.07, α)	138.2	Adjusted Chi Square Value (167.07, β)	137.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.0917	95% Gamma Adjusted KM-UCL (use when n<50)	0.092

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0675
Maximum	0.62	Median	0.0149
SD	0.0965	CV	1.428
k hat (MLE)	0.752	k star (bias corrected MLE)	0.735
Theta hat (MLE)	0.0898	Theta star (bias corrected MLE)	0.0919
nu hat (MLE)	144.3	nu star (bias corrected)	141.1
MLE Mean (bias corrected)	0.0675	MLE Sd (bias corrected)	0.0788
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (141.12, α)	114.7	Adjusted Chi Square Value (141.12, β)	114.3
95% Gamma Approximate UCL (use when n>=50)	0.0831	95% Gamma Adjusted UCL (use when n<50)	0.0834

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.215	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	0.0701	Mean in Log Scale	-3.16
SD in Original Scale	0.0871	SD in Log Scale	1.003
95% t UCL (assumes normality of ROS data)	0.0849	95% Percentile Bootstrap UCL	0.0853
95% BCA Bootstrap UCL	0.0892	95% Bootstrap t UCL	0.0906
95% H-UCL (Log ROS)	0.0884		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.865	95% H-UCL (KM -Log)	0.0816
KM SD (logged)	0.668	95% Critical H Value (KM-Log)	1.986
KM Standard Error of Mean (logged)	0.118		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.099	Mean in Log Scale	-2.498
SD in Original Scale	0.0726	SD in Log Scale	0.65
95% t UCL (Assumes normality)	0.111	95% H-Stat UCL	0.116

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 (t) UCL	0.0946	95% GROS Approximate Gamma UCL	0.0831
95% Approximate Gamma KM-UCL	0.0917		

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

Result (molybdenum)

General Statistics

Total Number of Observations	100	Number of Distinct Observations	87
		Number of Missing Observations	0
Minimum	2	Mean	271.9
Maximum	3020	Median	75.5
SD	584.9	Std. Error of Mean	58.49
Coefficient of Variation	2.151	Skewness	3.389

Normal GOF Test

Shapiro Wilk Test Statistic	0.477	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.322	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0886	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	369	95% Adjusted-CLT UCL (Chen-1995)	389.3
		95% Modified-t UCL (Johnson-1978)	372.3

Gamma GOF Test

A-D Test Statistic	3.971	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.825	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0949	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.475	k star (bias corrected MLE)	0.468
Theta hat (MLE)	572.2	Theta star (bias corrected MLE)	581.5
nu hat (MLE)	95.04	nu star (bias corrected)	93.52
MLE Mean (bias corrected)	271.9	MLE Sd (bias corrected)	397.6
		Approximate Chi Square Value (0.05)	72.22
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	71.95

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	352.1	95% Adjusted Gamma UCL (use when n<50)	353.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.152	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0518	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0886	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	4.258
Maximum of Logged Data	8.013	SD of logged Data	1.68

Assuming Lognormal Distribution

95% H-UCL	481.9	90% Chebyshev (MVUE) UCL	485.9
95% Chebyshev (MVUE) UCL	579	97.5% Chebyshev (MVUE) UCL	708.3
99% Chebyshev (MVUE) UCL	962.2		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	368.1	95% Jackknife UCL	369
95% Standard Bootstrap UCL	366.6	95% Bootstrap-t UCL	400.4
95% Hall's Bootstrap UCL	384	95% Percentile Bootstrap UCL	374.2
95% BCA Bootstrap UCL	397.8		
90% Chebyshev(Mean, Sd) UCL	447.4	95% Chebyshev(Mean, Sd) UCL	526.8
97.5% Chebyshev(Mean, Sd) UCL	637.2	99% Chebyshev(Mean, Sd) UCL	853.9

Suggested UCL to Use

95% H-UCL	481.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (nickel)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	35
		Number of Missing Observations	0
Minimum	2	Mean	15.23
Maximum	70	Median	10
SD	12.45	Std. Error of Mean	1.271
Coefficient of Variation	0.818	Skewness	1.862

Normal GOF Test

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.247	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	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	17.34	95% Adjusted-CLT UCL (Chen-1995)	17.58
		95% Modified-t UCL (Johnson-1978)	17.38

Gamma GOF Test

A-D Test Statistic	4.001	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0926	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.979	k star (bias corrected MLE)	1.924
Theta hat (MLE)	7.696	Theta star (bias corrected MLE)	7.916
nu hat (MLE)	379.9	nu star (bias corrected)	369.3
MLE Mean (bias corrected)	15.23	MLE Sd (bias corrected)	10.98
		Approximate Chi Square Value (0.05)	325.8
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	325.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	17.26	95% Adjusted Gamma UCL (use when n<50)	17.29

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	8.9225E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.143	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0904	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.45
Maximum of Logged Data	4.248	SD of logged Data	0.732

Assuming Lognormal Distribution

95% H-UCL	17.65	90% Chebyshev (MVUE) UCL	18.85
95% Chebyshev (MVUE) UCL	20.55	97.5% Chebyshev (MVUE) UCL	22.92
99% Chebyshev (MVUE) UCL	27.57		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	17.32	95% Jackknife UCL	17.34
95% Standard Bootstrap UCL	17.36	95% Bootstrap-t UCL	17.79
95% Hall's Bootstrap UCL	17.6	95% Percentile Bootstrap UCL	17.39
95% BCA Bootstrap UCL	17.79		
90% Chebyshev(Mean, Sd) UCL	19.04	95% Chebyshev(Mean, Sd) UCL	20.77
97.5% Chebyshev(Mean, Sd) UCL	23.16	99% Chebyshev(Mean, Sd) UCL	27.87

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	20.77

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (selenium)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	67
Number of Detects	86	Number of Non-Detects	10
Number of Distinct Detects	67	Number of Distinct Non-Detects	4
Minimum Detect	0.07	Minimum Non-Detect	0.3
Maximum Detect	50	Maximum Non-Detect	4
Variance Detects	59.81	Percent Non-Detects	10.42%
Mean Detects	2.69	SD Detects	7.734
Median Detects	0.465	CV Detects	2.875
Skewness Detects	4.659	Kurtosis Detects	23.16
Mean of Logged Detects	-0.449	SD of Logged Detects	1.42

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.367	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.376	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0955	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

Mean	2.457	Standard Error of Mean	0.751
SD	7.312	95% KM (BCA) UCL	3.817
95% KM (t) UCL	3.704	95% KM (Percentile Bootstrap) UCL	3.728
95% KM (z) UCL	3.692	95% KM Bootstrap t UCL	4.724
90% KM Chebyshev UCL	4.71	95% KM Chebyshev UCL	5.73
97.5% KM Chebyshev UCL	7.146	99% KM Chebyshev UCL	9.928

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	9.273	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.831	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.268	**Kolmogrov-Smirnoff 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)	0.449	k star (bias corrected MLE)	0.441
Theta hat (MLE)	5.99	Theta star (bias corrected MLE)	6.098
nu hat (MLE)	77.25	nu star (bias corrected)	75.89
MLE Mean (bias corrected)	2.69	MLE Sd (bias corrected)	4.05

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.113	nu hat (KM)	21.68
Approximate Chi Square Value (21.68, α)	12.1	Adjusted Chi Square Value (21.68, β)	11.99
95% Gamma Approximate KM-UCL (use when n>=50)	4.403	95% Gamma Adjusted KM-UCL (use when n<50)	4.443

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.466
Maximum	50	Median	0.435
SD	7.357	CV	2.983
k hat (MLE)	0.394	k star (bias corrected MLE)	0.389
Theta hat (MLE)	6.255	Theta star (bias corrected MLE)	6.341
nu hat (MLE)	75.71	nu star (bias corrected)	74.67
MLE Mean (bias corrected)	2.466	MLE Sd (bias corrected)	3.955
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (74.67, α)	55.77	Adjusted Chi Square Value (74.67, β)	55.52
95% Gamma Approximate UCL (use when n>=50)	3.302	95% Gamma Adjusted UCL (use when n<50)	3.317

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.121	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0955	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	2.454	Mean in Log Scale	-0.538
SD in Original Scale	7.35	SD in Log Scale	1.398
95% t UCL (assumes normality of ROS data)	3.7	95% Percentile Bootstrap UCL	3.789
95% BCA Bootstrap UCL	4.105	95% Bootstrap t UCL	4.742
95% H-UCL (Log ROS)	2.279		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.524	Mean in Log Scale	-0.456
SD in Original Scale	7.337	SD in Log Scale	1.401
95% t UCL (Assumes normality)	3.768	95% H-Stat UCL	2.487

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	5.73

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

Result (thallium)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	36
Number of Detects	86	Number of Non-Detects	10
Number of Distinct Detects	35	Number of Distinct Non-Detects	3
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	5.2	Maximum Non-Detect	1.5
Variance Detects	0.298	Percent Non-Detects	10.42%
Mean Detects	0.336	SD Detects	0.546
Median Detects	0.27	CV Detects	1.626
Skewness Detects	8.532	Kurtosis Detects	76.47
Mean of Logged Detects	-1.329	SD of Logged Detects	0.522

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.263	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.36	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0955	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

Mean	0.325	Standard Error of Mean	0.0531
SD	0.516	95% KM (BCA) UCL	0.443
95% KM (t) UCL	0.413	95% KM (Percentile Bootstrap) UCL	0.426
95% KM (z) UCL	0.412	95% KM Bootstrap t UCL	0.648
90% KM Chebyshev UCL	0.484	95% KM Chebyshev UCL	0.556
97.5% KM Chebyshev UCL	0.656	99% KM Chebyshev UCL	0.853

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.93	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.763	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0975	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)	2.258	k star (bias corrected MLE)	2.187
Theta hat (MLE)	0.149	Theta star (bias corrected MLE)	0.153
nu hat (MLE)	388.4	nu star (bias corrected)	376.2
MLE Mean (bias corrected)	0.336	MLE Sd (bias corrected)	0.227

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.396	nu hat (KM)	76.12
Approximate Chi Square Value (76.12, α)	57.03	Adjusted Chi Square Value (76.12, β)	56.78
95% Gamma Approximate KM-UCL (use when n>=50)	0.434	95% Gamma Adjusted KM-UCL (use when n<50)	0.436

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.321
Maximum	5.2	Median	0.26
SD	0.522	CV	1.625
k hat (MLE)	1.824	k star (bias corrected MLE)	1.774
Theta hat (MLE)	0.176	Theta star (bias corrected MLE)	0.181
nu hat (MLE)	350.3	nu star (bias corrected)	340.7
MLE Mean (bias corrected)	0.321	MLE Sd (bias corrected)	0.241
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (340.68, α)	298.9	Adjusted Chi Square Value (340.68, β)	298.3
95% Gamma Approximate UCL (use when n>=50)	0.366	95% Gamma Adjusted UCL (use when n<50)	0.367

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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	0.324	Mean in Log Scale	-1.356
SD in Original Scale	0.518	SD in Log Scale	0.521
95% t UCL (assumes normality of ROS data)	0.412	95% Percentile Bootstrap UCL	0.424
95% BCA Bootstrap UCL	0.496	95% Bootstrap t UCL	0.653
95% H-UCL (Log ROS)	0.326		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.347	Mean in Log Scale	-1.316
SD in Original Scale	0.527	SD in Log Scale	0.586
95% t UCL (Assumes normality)	0.436	95% H-Stat UCL	0.357

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 (BCA) UCL	0.443

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

Result (uranium)

General Statistics

Total Number of Observations	79	Number of Distinct Observations	74
		Number of Missing Observations	0
Minimum	0.93	Mean	4.137
Maximum	10.3	Median	3.86
SD	1.904	Std. Error of Mean	0.214
Coefficient of Variation	0.46	Skewness	1.077

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	7.1260E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.13	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0997	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.493	95% Adjusted-CLT UCL (Chen-1995)	4.517
		95% Modified-t UCL (Johnson-1978)	4.498

Gamma GOF Test

A-D Test Statistic	0.388	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0714	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.101	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.01	k star (bias corrected MLE)	4.829
Theta hat (MLE)	0.826	Theta star (bias corrected MLE)	0.857
nu hat (MLE)	791.6	nu star (bias corrected)	762.9
MLE Mean (bias corrected)	4.137	MLE Sd (bias corrected)	1.883
		Approximate Chi Square Value (0.05)	699.8
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	698.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	4.51	95% Adjusted Gamma UCL (use when n<50)	4.517

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.409	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0622	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0997	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.0726	Mean of logged Data	1.317
Maximum of Logged Data	2.332	SD of logged Data	0.468

Assuming Lognormal Distribution

95% H-UCL	4.59	90% Chebyshev (MVUE) UCL	4.846
95% Chebyshev (MVUE) UCL	5.158	97.5% Chebyshev (MVUE) UCL	5.59
99% Chebyshev (MVUE) UCL	6.44		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.489	95% Jackknife UCL	4.493
95% Standard Bootstrap UCL	4.493	95% Bootstrap-t UCL	4.523
95% Hall's Bootstrap UCL	4.529	95% Percentile Bootstrap UCL	4.484
95% BCA Bootstrap UCL	4.528		
90% Chebyshev(Mean, Sd) UCL	4.78	95% Chebyshev(Mean, Sd) UCL	5.071
97.5% Chebyshev(Mean, Sd) UCL	5.475	99% Chebyshev(Mean, Sd) UCL	6.269

Suggested UCL to Use

95% Approximate Gamma UCL	4.51

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	77
		Number of Missing Observations	0
Minimum	26	Mean	284
Maximum	6210	Median	75.5
SD	909.9	Std. Error of Mean	92.86
Coefficient of Variation	3.204	Skewness	5.375

Normal GOF Test

Shapiro Wilk Test Statistic	0.289	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.412	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	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	438.3	95% Adjusted-CLT UCL (Chen-1995)	491.2
		95% Modified-t UCL (Johnson-1978)	446.8

Gamma GOF Test

A-D Test Statistic	13.36	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.813	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.273	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0962	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.558	k star (bias corrected MLE)	0.547
Theta hat (MLE)	509.1	Theta star (bias corrected MLE)	518.9
nu hat (MLE)	107.1	nu star (bias corrected)	105.1
MLE Mean (bias corrected)	284	MLE Sd (bias corrected)	383.9
		Approximate Chi Square Value (0.05)	82.44
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	82.13

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	362.1	95% Adjusted Gamma UCL (use when n<50)	363.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.827	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.110E-16	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0904	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.258	Mean of logged Data	4.529
Maximum of Logged Data	8.734	SD of logged Data	1.089

Assuming Lognormal Distribution

95% H-UCL	217.8	90% Chebyshev (MVUE) UCL	234.2
95% Chebyshev (MVUE) UCL	265	97.5% Chebyshev (MVUE) UCL	307.8
99% Chebyshev (MVUE) UCL	391.9		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	436.8	95% Jackknife UCL	438.3
95% Standard Bootstrap UCL	434.9	95% Bootstrap-t UCL	707
95% Hall's Bootstrap UCL	1090	95% Percentile Bootstrap UCL	458.1
95% BCA Bootstrap UCL	516.8		
90% Chebyshev(Mean, Sd) UCL	562.6	95% Chebyshev(Mean, Sd) UCL	688.8
97.5% Chebyshev(Mean, Sd) UCL	864	99% Chebyshev(Mean, Sd) UCL	1208

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	688.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (antimony)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	26
Number of Detects	62	Number of Non-Detects	54
Number of Distinct Detects	26	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	66	Maximum Non-Detect	2
Variance Detects	112	Percent Non-Detects	46.55%
Mean Detects	3.255	SD Detects	10.58
Median Detects	0.4	CV Detects	3.251
Skewness Detects	5.184	Kurtosis Detects	27.35
Mean of Logged Detects	-0.275	SD of Logged Detects	1.344

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.311	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.386	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.113	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

Mean	1.924	Standard Error of Mean	0.731
SD	7.807	95% KM (BCA) UCL	3.355
95% KM (t) UCL	3.137	95% KM (Percentile Bootstrap) UCL	3.192
95% KM (z) UCL	3.127	95% KM Bootstrap t UCL	7.046
90% KM Chebyshev UCL	4.117	95% KM Chebyshev UCL	5.111
97.5% KM Chebyshev UCL	6.489	99% KM Chebyshev UCL	9.198

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.091	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.829	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.261	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.12	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)	0.445	k star (bias corrected MLE)	0.434
Theta hat (MLE)	7.322	Theta star (bias corrected MLE)	7.503
nu hat (MLE)	55.12	nu star (bias corrected)	53.79
MLE Mean (bias corrected)	3.255	MLE Sd (bias corrected)	4.942

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0608	nu hat (KM)	14.1
Approximate Chi Square Value (14.10, α)	6.638	Adjusted Chi Square Value (14.10, β)	6.574
95% Gamma Approximate KM-UCL (use when n>=50)	4.087	95% Gamma Adjusted KM-UCL (use when n<50)	4.127

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.983
Maximum	66	Median	0.3
SD	7.865	CV	3.967
k hat (MLE)	0.291	k star (bias corrected MLE)	0.289
Theta hat (MLE)	6.814	Theta star (bias corrected MLE)	6.856
nu hat (MLE)	67.51	nu star (bias corrected)	67.09
MLE Mean (bias corrected)	1.983	MLE Sd (bias corrected)	3.687
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (67.09, α)	49.24	Adjusted Chi Square Value (67.09, β)	49.05
95% Gamma Approximate UCL (use when n>=50)	2.702	95% Gamma Adjusted UCL (use when n<50)	2.712

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.113	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	1.992	Mean in Log Scale	-0.57
SD in Original Scale	7.831	SD in Log Scale	1.176
95% t UCL (assumes normality of ROS data)	3.198	95% Percentile Bootstrap UCL	3.272
95% BCA Bootstrap UCL	4.049	95% Bootstrap t UCL	7.169
95% H-UCL (Log ROS)	1.467		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.003	Mean in Log Scale	-0.428
SD in Original Scale	7.826	SD in Log Scale	1.005
95% t UCL (Assumes normality)	3.207	95% H-Stat UCL	1.331

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	5.111

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

Result (arsenic)

General Statistics

Total Number of Observations	226	Number of Distinct Observations	117
Number of Detects	216	Number of Non-Detects	10
Number of Distinct Detects	117	Number of Distinct Non-Detects	1
Minimum Detect	0.7	Minimum Non-Detect	2.5
Maximum Detect	166	Maximum Non-Detect	2.5
Variance Detects	211.1	Percent Non-Detects	4.425%
Mean Detects	8.617	SD Detects	14.53
Median Detects	5.285	CV Detects	1.686
Skewness Detects	7.555	Kurtosis Detects	72.55
Mean of Logged Detects	1.662	SD of Logged Detects	0.925

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.439	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.293	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0603	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

Mean	8.303	Standard Error of Mean	0.95
SD	14.25	95% KM (BCA) UCL	10.2
95% KM (t) UCL	9.872	95% KM (Percentile Bootstrap) UCL	10.01
95% KM (z) UCL	9.865	95% KM Bootstrap t UCL	11.14
90% KM Chebyshev UCL	11.15	95% KM Chebyshev UCL	12.44
97.5% KM Chebyshev UCL	14.24	99% KM Chebyshev UCL	17.75

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.37	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.78	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.105	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0634	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)	1.154	k star (bias corrected MLE)	1.141
Theta hat (MLE)	7.466	Theta star (bias corrected MLE)	7.551
nu hat (MLE)	498.6	nu star (bias corrected)	493
MLE Mean (bias corrected)	8.617	MLE Sd (bias corrected)	8.066

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.34	nu hat (KM)	153.5
Approximate Chi Square Value (153.52, α)	125.9	Adjusted Chi Square Value (153.52, β)	125.7
95% Gamma Approximate KM-UCL (use when n>=50)	10.13	95% Gamma Adjusted KM-UCL (use when n<50)	10.14

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	8.236
Maximum	166	Median	4.805
SD	14.31	CV	1.738
k hat (MLE)	0.817	k star (bias corrected MLE)	0.809
Theta hat (MLE)	10.08	Theta star (bias corrected MLE)	10.18
nu hat (MLE)	369.4	nu star (bias corrected)	365.8
MLE Mean (bias corrected)	8.236	MLE Sd (bias corrected)	9.155
		Adjusted Level of Significance (β)	0.0489
Approximate Chi Square Value (365.81, α)	322.5	Adjusted Chi Square Value (365.81, β)	322.2
95% Gamma Approximate UCL (use when n>=50)	9.343	95% Gamma Adjusted UCL (use when n<50)	9.35

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0366	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0603	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	8.302	Mean in Log Scale	1.604
SD in Original Scale	14.28	SD in Log Scale	0.946
95% t UCL (assumes normality of ROS data)	9.871	95% Percentile Bootstrap UCL	10.02
95% BCA Bootstrap UCL	10.76	95% Bootstrap t UCL	10.98
95% H-UCL (Log ROS)	8.885		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.604	95% H-UCL (KM -Log)	8.857
KM SD (logged)	0.943	95% Critical H Value (KM-Log)	2.103
KM Standard Error of Mean (logged)	0.0631		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.291	Mean in Log Scale	1.598
SD in Original Scale	14.28	SD in Log Scale	0.951
95% t UCL (Assumes normality)	9.86	95% H-Stat UCL	8.886

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

95% KM (BCA) UCL	10.2

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.

Result (barium)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	77
		Number of Missing Observations	0
Minimum	36.8	Mean	152.2
Maximum	654	Median	143.5
SD	72.66	Std. Error of Mean	7.415
Coefficient of Variation	0.477	Skewness	3.664

Normal GOF Test

Shapiro Wilk Test Statistic	0.758	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.16	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	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	164.5	95% Adjusted-CLT UCL (Chen-1995)	167.4
		95% Modified-t UCL (Johnson-1978)	165

Gamma GOF Test

A-D Test Statistic	1.515	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.106	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0915	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.985	k star (bias corrected MLE)	5.805
Theta hat (MLE)	25.43	Theta star (bias corrected MLE)	26.22
nu hat (MLE)	1149	nu star (bias corrected)	1115
MLE Mean (bias corrected)	152.2	MLE Sd (bias corrected)	63.17
		Approximate Chi Square Value (0.05)	1038
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	1037

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	163.4	95% Adjusted Gamma UCL (use when n<50)	163.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00335	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.104	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0904	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.605	Mean of logged Data	4.939
Maximum of Logged Data	6.483	SD of logged Data	0.417

Assuming Lognormal Distribution

95% H-UCL	164.6	90% Chebyshev (MVUE) UCL	172.4
95% Chebyshev (MVUE) UCL	181.6	97.5% Chebyshev (MVUE) UCL	194.3
99% Chebyshev (MVUE) UCL	219.2		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	164.4	95% Jackknife UCL	164.5
95% Standard Bootstrap UCL	164.5	95% Bootstrap-t UCL	168.1
95% Hall's Bootstrap UCL	175.2	95% Percentile Bootstrap UCL	165.2
95% BCA Bootstrap UCL	167.7		
90% Chebyshev(Mean, Sd) UCL	174.5	95% Chebyshev(Mean, Sd) UCL	184.5
97.5% Chebyshev(Mean, Sd) UCL	198.5	99% Chebyshev(Mean, Sd) UCL	226

Suggested UCL to Use

95% Student's-t UCL	164.5	or 95% Modified-t UCL	165

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	131	Number of Distinct Observations	33
Number of Detects	118	Number of Non-Detects	13
Number of Distinct Detects	32	Number of Distinct Non-Detects	2
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	1.4	Maximum Non-Detect	5
Variance Detects	0.0453	Percent Non-Detects	9.924%
Mean Detects	0.495	SD Detects	0.213
Median Detects	0.47	CV Detects	0.431
Skewness Detects	1.819	Kurtosis Detects	5.046
Mean of Logged Detects	-0.784	SD of Logged Detects	0.401

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.849	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0816	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

Mean	0.492	Standard Error of Mean	0.0187
SD	0.207	95% KM (BCA) UCL	0.522
95% KM (t) UCL	0.523	95% KM (Percentile Bootstrap) UCL	0.522
95% KM (z) UCL	0.522	95% KM Bootstrap t UCL	0.526
90% KM Chebyshev UCL	0.548	95% KM Chebyshev UCL	0.573
97.5% KM Chebyshev UCL	0.609	99% KM Chebyshev UCL	0.678

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.398	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.146	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0849	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)	6.427	k star (bias corrected MLE)	6.269
Theta hat (MLE)	0.077	Theta star (bias corrected MLE)	0.0789
nu hat (MLE)	1517	nu star (bias corrected)	1479
MLE Mean (bias corrected)	0.495	MLE Sd (bias corrected)	0.198

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.63	nu hat (KM)	1475
Approximate Chi Square Value (N/A, α)	1387	Adjusted Chi Square Value (N/A, β)	1386
95% Gamma Approximate KM-UCL (use when n>=50)	0.523	95% Gamma Adjusted KM-UCL (use when n<50)	0.523

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.11	Mean	0.492
Maximum	1.4	Median	0.466
SD	0.207	CV	0.421
k hat (MLE)	6.649	k star (bias corrected MLE)	6.502
Theta hat (MLE)	0.074	Theta star (bias corrected MLE)	0.0757
nu hat (MLE)	1742	nu star (bias corrected)	1703
MLE Mean (bias corrected)	0.492	MLE Sd (bias corrected)	0.193
		Adjusted Level of Significance (β)	0.0482
Approximate Chi Square Value (N/A, α)	1609	Adjusted Chi Square Value (N/A, β)	1608
95% Gamma Approximate UCL (use when n>=50)	0.521	95% Gamma Adjusted UCL (use when n<50)	0.521

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0816	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	0.491	Mean in Log Scale	-0.787
SD in Original Scale	0.207	SD in Log Scale	0.392
95% t UCL (assumes normality of ROS data)	0.521	95% Percentile Bootstrap UCL	0.522
95% BCA Bootstrap UCL	0.524	95% Bootstrap t UCL	0.527
95% H-UCL (Log ROS)	0.522		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.51	Mean in Log Scale	-0.763
SD in Original Scale	0.267	SD in Log Scale	0.409
95% t UCL (Assumes normality)	0.549	95% H-Stat UCL	0.541

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 (BCA) UCL	0.522

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.

Result (cadmium)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	34
Number of Detects	36	Number of Non-Detects	80
Number of Distinct Detects	31	Number of Distinct Non-Detects	3
Minimum Detect	0.42	Minimum Non-Detect	0.2
Maximum Detect	24.9	Maximum Non-Detect	8
Variance Detects	34.27	Percent Non-Detects	68.97%
Mean Detects	3.786	SD Detects	5.854
Median Detects	1.18	CV Detects	1.546
Skewness Detects	2.602	Kurtosis Detects	6.411
Mean of Logged Detects	0.565	SD of Logged Detects	1.174

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.603	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.283	**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

Mean	1.73	Standard Error of Mean	0.338
SD	3.518	95% KM (BCA) UCL	2.337
95% KM (t) UCL	2.29	95% KM (Percentile Bootstrap) UCL	2.289
95% KM (z) UCL	2.286	95% KM Bootstrap t UCL	2.613
90% KM Chebyshev UCL	2.744	95% KM Chebyshev UCL	3.203
97.5% KM Chebyshev UCL	3.84	99% KM Chebyshev UCL	5.093

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.028	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.787	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.194	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.152	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)	0.777	k star (bias corrected MLE)	0.731
Theta hat (MLE)	4.871	Theta star (bias corrected MLE)	5.179
nu hat (MLE)	55.96	nu star (bias corrected)	52.63
MLE Mean (bias corrected)	3.786	MLE Sd (bias corrected)	4.428

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.242	nu hat (KM)	56.09
Approximate Chi Square Value (56.09, α)	39.88	Adjusted Chi Square Value (56.09, β)	39.71
95% Gamma Approximate KM-UCL (use when n>=50)	2.433	95% Gamma Adjusted KM-UCL (use when n<50)	2.444

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.748
Maximum	24.9	Median	0.5
SD	3.685	CV	2.108
k hat (MLE)	0.315	k star (bias corrected MLE)	0.313
Theta hat (MLE)	5.544	Theta star (bias corrected MLE)	5.586
nu hat (MLE)	73.16	nu star (bias corrected)	72.6
MLE Mean (bias corrected)	1.748	MLE Sd (bias corrected)	3.125
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (72.60, α)	53.98	Adjusted Chi Square Value (72.60, β)	53.78
95% Gamma Approximate UCL (use when n>=50)	2.351	95% Gamma Adjusted UCL (use when n<50)	2.36

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.155	**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	1.844	Mean in Log Scale	-0.0904
SD in Original Scale	3.542	SD in Log Scale	1.092
95% t UCL (assumes normality of ROS data)	2.39	95% Percentile Bootstrap UCL	2.405
95% BCA Bootstrap UCL	2.569	95% Bootstrap t UCL	2.825
95% H-UCL (Log ROS)	2.098		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.875	Mean in Log Scale	0.148
SD in Original Scale	3.49	SD in Log Scale	0.779
95% t UCL (Assumes normality)	2.412	95% H-Stat UCL	1.819

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 (BCA) UCL	2.337

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

Result (chromium)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	2	Mean	14.22
Maximum	470	Median	8
SD	43.41	Std. Error of Mean	4.03
Coefficient of Variation	3.053	Skewness	10.25

Normal GOF Test

Shapiro Wilk Test Statistic	0.194	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.389	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0823	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	20.9	95% Adjusted-CLT UCL (Chen-1995)	24.94
		95% Modified-t UCL (Johnson-1978)	21.54

Gamma GOF Test

A-D Test Statistic	8.621E+28	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.779	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.241	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0876	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.168	k star (bias corrected MLE)	1.144
Theta hat (MLE)	12.17	Theta star (bias corrected MLE)	12.43
nu hat (MLE)	271.1	nu star (bias corrected)	265.4
MLE Mean (bias corrected)	14.22	MLE Sd (bias corrected)	13.29
		Approximate Chi Square Value (0.05)	228.7
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	228.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	16.5	95% Adjusted Gamma UCL (use when n<50)	16.53

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	5.025E-10	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.13	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0823	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.169
Maximum of Logged Data	6.153	SD of logged Data	0.698

Assuming Lognormal Distribution

95% H-UCL	12.69	90% Chebyshev (MVUE) UCL	13.53
95% Chebyshev (MVUE) UCL	14.61	97.5% Chebyshev (MVUE) UCL	16.12
99% Chebyshev (MVUE) UCL	19.07		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	20.85	95% Jackknife UCL	20.9
95% Standard Bootstrap UCL	20.75	95% Bootstrap-t UCL	47.1
95% Hall's Bootstrap UCL	46.28	95% Percentile Bootstrap UCL	22.19
95% BCA Bootstrap UCL	26.59		
90% Chebyshev(Mean, Sd) UCL	26.31	95% Chebyshev(Mean, Sd) UCL	31.78
97.5% Chebyshev(Mean, Sd) UCL	39.39	99% Chebyshev(Mean, Sd) UCL	54.32

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	31.78

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	101	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	3	Mean	10.98
Maximum	76	Median	10
SD	8.287	Std. Error of Mean	0.825
Coefficient of Variation	0.754	Skewness	5.645

Normal GOF Test

Shapiro Wilk Test Statistic	0.512	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0882	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	12.35	95% Adjusted-CLT UCL (Chen-1995)	12.84
		95% Modified-t UCL (Johnson-1978)	12.43

Gamma GOF Test

A-D Test Statistic	4.908	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.206	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0895	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.139	k star (bias corrected MLE)	4.023
Theta hat (MLE)	2.653	Theta star (bias corrected MLE)	2.73
nu hat (MLE)	836.2	nu star (bias corrected)	812.7
MLE Mean (bias corrected)	10.98	MLE Sd (bias corrected)	5.476
		Approximate Chi Square Value (0.05)	747.5
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	746.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.94	95% Adjusted Gamma UCL (use when n<50)	11.96

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.6166E-8	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0882	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	2.271
Maximum of Logged Data	4.331	SD of logged Data	0.451

Assuming Lognormal Distribution

95% H-UCL	11.63	90% Chebyshev (MVUE) UCL	12.22
95% Chebyshev (MVUE) UCL	12.9	97.5% Chebyshev (MVUE) UCL	13.85
99% Chebyshev (MVUE) UCL	15.71		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	12.34	95% Jackknife UCL	12.35
95% Standard Bootstrap UCL	12.34	95% Bootstrap-t UCL	13.53
95% Hall's Bootstrap UCL	18.33	95% Percentile Bootstrap UCL	12.42
95% BCA Bootstrap UCL	13.02		
90% Chebyshev(Mean, Sd) UCL	13.46	95% Chebyshev(Mean, Sd) UCL	14.58
97.5% Chebyshev(Mean, Sd) UCL	16.13	99% Chebyshev(Mean, Sd) UCL	19.19

Suggested UCL to Use

95% Student's-t UCL	12.35	or 95% Modified-t UCL	12.43

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (copper)

General Statistics

Total Number of Observations	226	Number of Distinct Observations	196
		Number of Missing Observations	0
Minimum	27	Mean	3589
Maximum	109000	Median	1560
SD	10024	Std. Error of Mean	666.8
Coefficient of Variation	2.793	Skewness	7.302

Normal GOF Test

Shapiro Wilk Test Statistic	0.313	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0589	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	4690	95% Adjusted-CLT UCL (Chen-1995)	5032
		95% Modified-t UCL (Johnson-1978)	4744

Gamma GOF Test

A-D Test Statistic	13.69	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.803	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.191	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0634	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.684	k star (bias corrected MLE)	0.678
Theta hat (MLE)	5244	Theta star (bias corrected MLE)	5291
nu hat (MLE)	309.3	nu star (bias corrected)	306.6
MLE Mean (bias corrected)	3589	MLE Sd (bias corrected)	4357
		Approximate Chi Square Value (0.05)	267
Adjusted Level of Significance	0.0489	Adjusted Chi Square Value	266.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4120	95% Adjusted Gamma UCL (use when n<50)	4124

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0106	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.072	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0589	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.296	Mean of logged Data	7.3
Maximum of Logged Data	11.6	SD of logged Data	1.165

Assuming Lognormal Distribution

95% H-UCL	3486	90% Chebyshev (MVUE) UCL	3765
95% Chebyshev (MVUE) UCL	4156	97.5% Chebyshev (MVUE) UCL	4699
99% Chebyshev (MVUE) UCL	5764		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4685	95% Jackknife UCL	4690
95% Standard Bootstrap UCL	4671	95% Bootstrap-t UCL	5512
95% Hall's Bootstrap UCL	5401	95% Percentile Bootstrap UCL	4772
95% BCA Bootstrap UCL	5130		
90% Chebyshev(Mean, Sd) UCL	5589	95% Chebyshev(Mean, Sd) UCL	6495
97.5% Chebyshev(Mean, Sd) UCL	7753	99% Chebyshev(Mean, Sd) UCL	10223

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	6495

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	226	Number of Distinct Observations	208
		Number of Missing Observations	0
Minimum	1.2	Mean	100.2
Maximum	3220	Median	19.2
SD	286	Std. Error of Mean	19.02
Coefficient of Variation	2.855	Skewness	7.327

Normal GOF Test

Shapiro Wilk Test Statistic	0.371	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.365	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0589	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	131.6	95% Adjusted-CLT UCL (Chen-1995)	141.4
		95% Modified-t UCL (Johnson-1978)	133.1

Gamma GOF Test

A-D Test Statistic	13.72	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.832	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.198	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0645	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.453	k star (bias corrected MLE)	0.45
Theta hat (MLE)	220.9	Theta star (bias corrected MLE)	222.4
nu hat (MLE)	204.9	nu star (bias corrected)	203.6
MLE Mean (bias corrected)	100.2	MLE Sd (bias corrected)	149.3
		Approximate Chi Square Value (0.05)	171.5
Adjusted Level of Significance	0.0489	Adjusted Chi Square Value	171.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	118.9	95% Adjusted Gamma UCL (use when n<50)	119

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.1565E-6	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0717	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0589	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	3.184
Maximum of Logged Data	8.077	SD of logged Data	1.567

Assuming Lognormal Distribution

95% H-UCL	109.3	90% Chebyshev (MVUE) UCL	118.6
95% Chebyshev (MVUE) UCL	135.4	97.5% Chebyshev (MVUE) UCL	158.7
99% Chebyshev (MVUE) UCL	204.5		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	131.5	95% Jackknife UCL	131.6
95% Standard Bootstrap UCL	132	95% Bootstrap-t UCL	148.2
95% Hall's Bootstrap UCL	177.2	95% Percentile Bootstrap UCL	133
95% BCA Bootstrap UCL	141.9		
90% Chebyshev(Mean, Sd) UCL	157.2	95% Chebyshev(Mean, Sd) UCL	183.1
97.5% Chebyshev(Mean, Sd) UCL	219	99% Chebyshev(Mean, Sd) UCL	289.5

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	183.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	98
Number of Detects	115	Number of Non-Detects	1
Number of Distinct Detects	97	Number of Distinct Non-Detects	1
Minimum Detect	71	Minimum Non-Detect	0.4
Maximum Detect	1240	Maximum Non-Detect	0.4
Variance Detects	20186	Percent Non-Detects	0.862%
Mean Detects	332.4	SD Detects	142.1
Median Detects	328	CV Detects	0.427
Skewness Detects	2.614	Kurtosis Detects	14.38
Mean of Logged Detects	5.728	SD of Logged Detects	0.404

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.843	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0826	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

Mean	329.5	Standard Error of Mean	13.44
SD	144.2	95% KM (BCA) UCL	351.6
95% KM (t) UCL	351.8	95% KM (Percentile Bootstrap) UCL	352.9
95% KM (z) UCL	351.7	95% KM Bootstrap t UCL	354
90% KM Chebyshev UCL	369.9	95% KM Chebyshev UCL	388.1
97.5% KM Chebyshev UCL	413.5	99% KM Chebyshev UCL	463.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.508	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0965	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0857	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)	6.557	k star (bias corrected MLE)	6.392
Theta hat (MLE)	50.69	Theta star (bias corrected MLE)	52
nu hat (MLE)	1508	nu star (bias corrected)	1470
MLE Mean (bias corrected)	332.4	MLE Sd (bias corrected)	131.5

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.226	nu hat (KM)	1212
Approximate Chi Square Value (N/A, α)	1133	Adjusted Chi Square Value (N/A, β)	1132
95% Gamma Approximate KM-UCL (use when n>=50)	352.8	95% Gamma Adjusted KM-UCL (use when n<50)	353.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	71	Mean	330.2
Maximum	1240	Median	327.5
SD	143.5	CV	0.435
k hat (MLE)	6.13	k star (bias corrected MLE)	5.978
Theta hat (MLE)	53.86	Theta star (bias corrected MLE)	55.24
nu hat (MLE)	1422	nu star (bias corrected)	1387
MLE Mean (bias corrected)	330.2	MLE Sd (bias corrected)	135
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (N/A, α)	1301	Adjusted Chi Square Value (N/A, β)	1300
95% Gamma Approximate UCL (use when n>=50)	351.9	95% Gamma Adjusted UCL (use when n<50)	352.1

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.119	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0826	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	330.4	Mean in Log Scale	5.719
SD in Original Scale	143	SD in Log Scale	0.414
95% t UCL (assumes normality of ROS data)	352.5	95% Percentile Bootstrap UCL	352.8
95% BCA Bootstrap UCL	353.9	95% Bootstrap t UCL	356.3
95% H-UCL (Log ROS)	355.6		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	329.5	Mean in Log Scale	5.665
SD in Original Scale	144.8	SD in Log Scale	0.791
95% t UCL (Assumes normality)	351.8	95% H-Stat UCL	458.6

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 (BCA) UCL	351.6

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.

Result (mercury)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	18
Number of Detects	21	Number of Non-Detects	95
Number of Distinct Detects	16	Number of Distinct Non-Detects	4
Minimum Detect	0.037	Minimum Non-Detect	0.033
Maximum Detect	0.62	Maximum Non-Detect	0.2
Variance Detects	0.0198	Percent Non-Detects	81.9%
Mean Detects	0.139	SD Detects	0.141
Median Detects	0.1	CV Detects	1.014
Skewness Detects	2.437	Kurtosis Detects	6.459
Mean of Logged Detects	-2.299	SD of Logged Detects	0.766

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.687	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.193	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

Mean	0.0745	Standard Error of Mean	0.00965
SD	0.0757	95% KM (BCA) UCL	0.0916
95% KM (t) UCL	0.0905	95% KM (Percentile Bootstrap) UCL	0.0906
95% KM (z) UCL	0.0904	95% KM Bootstrap t UCL	0.0934
90% KM Chebyshev UCL	0.103	95% KM Chebyshev UCL	0.117
97.5% KM Chebyshev UCL	0.135	99% KM Chebyshev UCL	0.171

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.989	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.757	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.177	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.192	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)	1.686	k star (bias corrected MLE)	1.477
Theta hat (MLE)	0.0824	Theta star (bias corrected MLE)	0.094
nu hat (MLE)	70.8	nu star (bias corrected)	62.02
MLE Mean (bias corrected)	0.139	MLE Sd (bias corrected)	0.114

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.97	nu hat (KM)	224.9
Approximate Chi Square Value (224.95, α)	191.2	Adjusted Chi Square Value (224.95, β)	190.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.0877	95% Gamma Adjusted KM-UCL (use when n<50)	0.0878

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0669
Maximum	0.62	Median	0.0239
SD	0.0914	CV	1.366
k hat (MLE)	0.791	k star (bias corrected MLE)	0.776
Theta hat (MLE)	0.0846	Theta star (bias corrected MLE)	0.0862
nu hat (MLE)	183.4	nu star (bias corrected)	180
MLE Mean (bias corrected)	0.0669	MLE Sd (bias corrected)	0.0759
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (180.02, α)	150	Adjusted Chi Square Value (180.02, β)	149.6
95% Gamma Approximate UCL (use when n>=50)	0.0803	95% Gamma Adjusted UCL (use when n<50)	0.0805

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.908	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.193	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	0.0699	Mean in Log Scale	-3.108
SD in Original Scale	0.0817	SD in Log Scale	0.943
95% t UCL (assumes normality of ROS data)	0.0825	95% Percentile Bootstrap UCL	0.083
95% BCA Bootstrap UCL	0.0857	95% Bootstrap t UCL	0.087
95% H-UCL (Log ROS)	0.0843		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.859	95% H-UCL (KM -Log)	0.0793
KM SD (logged)	0.645	95% Critical H Value (KM-Log)	1.93
KM Standard Error of Mean (logged)	0.104		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0973	Mean in Log Scale	-2.499
SD in Original Scale	0.0671	SD in Log Scale	0.624
95% t UCL (Assumes normality)	0.108	95% H-Stat UCL	0.112

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 (t) UCL	0.0905	95% GROS Approximate Gamma UCL	0.0803
95% Approximate Gamma KM-UCL	0.0877		

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

Result (molybdenum)

General Statistics

Total Number of Observations	131	Number of Distinct Observations	108
		Number of Missing Observations	0
Minimum	2	Mean	246.4
Maximum	3020	Median	84
SD	518.7	Std. Error of Mean	45.32
Coefficient of Variation	2.105	Skewness	3.829

Normal GOF Test

Shapiro Wilk Test Statistic	0.468	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.319	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0774	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	321.4	95% Adjusted-CLT UCL (Chen-1995)	337.1
		95% Modified-t UCL (Johnson-1978)	324

Gamma GOF Test

A-D Test Statistic	4.367	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.815	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0859	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.542	k star (bias corrected MLE)	0.535
Theta hat (MLE)	454.3	Theta star (bias corrected MLE)	460.5
nu hat (MLE)	142.1	nu star (bias corrected)	140.2
MLE Mean (bias corrected)	246.4	MLE Sd (bias corrected)	336.8
		Approximate Chi Square Value (0.05)	113.8
Adjusted Level of Significance	0.0482	Adjusted Chi Square Value	113.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	303.4	95% Adjusted Gamma UCL (use when n<50)	304.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.145	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0495	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0774	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	4.35
Maximum of Logged Data	8.013	SD of logged Data	1.552

Assuming Lognormal Distribution

95% H-UCL	375.6	90% Chebyshev (MVUE) UCL	400
95% Chebyshev (MVUE) UCL	466.4	97.5% Chebyshev (MVUE) UCL	558.6
99% Chebyshev (MVUE) UCL	739.7		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	320.9	95% Jackknife UCL	321.4
95% Standard Bootstrap UCL	321.8	95% Bootstrap-t UCL	348.5
95% Hall's Bootstrap UCL	334.8	95% Percentile Bootstrap UCL	319.2
95% BCA Bootstrap UCL	340.8		
90% Chebyshev(Mean, Sd) UCL	382.3	95% Chebyshev(Mean, Sd) UCL	443.9
97.5% Chebyshev(Mean, Sd) UCL	529.4	99% Chebyshev(Mean, Sd) UCL	697.3

Suggested UCL to Use

95% H-UCL	375.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (nickel)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	2	Mean	14.26
Maximum	70	Median	9
SD	11.59	Std. Error of Mean	1.076
Coefficient of Variation	0.813	Skewness	2.117

Normal GOF Test

Shapiro Wilk Test Statistic	0.752	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.249	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0823	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	16.04	95% Adjusted-CLT UCL (Chen-1995)	16.25
		95% Modified-t UCL (Johnson-1978)	16.08

Gamma GOF Test

A-D Test Statistic	5.097	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0864	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.155	k star (bias corrected MLE)	2.105
Theta hat (MLE)	6.617	Theta star (bias corrected MLE)	6.774
nu hat (MLE)	499.9	nu star (bias corrected)	488.3
MLE Mean (bias corrected)	14.26	MLE Sd (bias corrected)	9.827
		Approximate Chi Square Value (0.05)	438.1
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	437.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15.89	95% Adjusted Gamma UCL (use when n<50)	15.91

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	1.1076E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0823	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.408
Maximum of Logged Data	4.248	SD of logged Data	0.686

Assuming Lognormal Distribution

95% H-UCL	15.93	90% Chebyshev (MVUE) UCL	16.97
95% Chebyshev (MVUE) UCL	18.31	97.5% Chebyshev (MVUE) UCL	20.17
99% Chebyshev (MVUE) UCL	23.81		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	16.03	95% Jackknife UCL	16.04
95% Standard Bootstrap UCL	16.03	95% Bootstrap-t UCL	16.35
95% Hall's Bootstrap UCL	16.3	95% Percentile Bootstrap UCL	16.06
95% BCA Bootstrap UCL	16.29		
90% Chebyshev(Mean, Sd) UCL	17.49	95% Chebyshev(Mean, Sd) UCL	18.95
97.5% Chebyshev(Mean, Sd) UCL	20.98	99% Chebyshev(Mean, Sd) UCL	24.97

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	18.95

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (selenium)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	81
Number of Detects	104	Number of Non-Detects	12
Number of Distinct Detects	81	Number of Distinct Non-Detects	4
Minimum Detect	0.07	Minimum Non-Detect	0.3
Maximum Detect	50	Maximum Non-Detect	4
Variance Detects	50.17	Percent Non-Detects	10.34%
Mean Detects	2.476	SD Detects	7.083
Median Detects	0.505	CV Detects	2.86
Skewness Detects	5.077	Kurtosis Detects	27.97
Mean of Logged Detects	-0.388	SD of Logged Detects	1.348

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.358	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.367	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0869	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

Mean	2.275	Standard Error of Mean	0.626
SD	6.705	95% KM (BCA) UCL	3.456
95% KM (t) UCL	3.313	95% KM (Percentile Bootstrap) UCL	3.358
95% KM (z) UCL	3.304	95% KM Bootstrap t UCL	4.027
90% KM Chebyshev UCL	4.153	95% KM Chebyshev UCL	5.003
97.5% KM Chebyshev UCL	6.183	99% KM Chebyshev UCL	8.502

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	10.24	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.821	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.254	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0936	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)	0.492	k star (bias corrected MLE)	0.484
Theta hat (MLE)	5.036	Theta star (bias corrected MLE)	5.117
nu hat (MLE)	102.3	nu star (bias corrected)	100.7
MLE Mean (bias corrected)	2.476	MLE Sd (bias corrected)	3.56

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.115	nu hat (KM)	26.71
Approximate Chi Square Value (26.71, α)	15.93	Adjusted Chi Square Value (26.71, β)	15.82
95% Gamma Approximate KM-UCL (use when n>=50)	3.815	95% Gamma Adjusted KM-UCL (use when n<50)	3.84

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.294
Maximum	50	Median	0.47
SD	6.744	CV	2.94
k hat (MLE)	0.429	k star (bias corrected MLE)	0.424
Theta hat (MLE)	5.346	Theta star (bias corrected MLE)	5.414
nu hat (MLE)	99.54	nu star (bias corrected)	98.3
MLE Mean (bias corrected)	2.294	MLE Sd (bias corrected)	3.524
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (98.30, α)	76.43	Adjusted Chi Square Value (98.30, β)	76.18
95% Gamma Approximate UCL (use when n>=50)	2.95	95% Gamma Adjusted UCL (use when n<50)	2.96

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.119	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0869	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	2.273	Mean in Log Scale	-0.467
SD in Original Scale	6.733	SD in Log Scale	1.332
95% t UCL (assumes normality of ROS data)	3.31	95% Percentile Bootstrap UCL	3.407
95% BCA Bootstrap UCL	3.642	95% Bootstrap t UCL	4.181
95% H-UCL (Log ROS)	2.092		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.349	Mean in Log Scale	-0.381
SD in Original Scale	6.72	SD in Log Scale	1.335
95% t UCL (Assumes normality)	3.384	95% H-Stat UCL	2.289

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	5.003

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

Result (thallium)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	39
Number of Detects	104	Number of Non-Detects	12
Number of Distinct Detects	38	Number of Distinct Non-Detects	3
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	5.2	Maximum Non-Detect	1.5
Variance Detects	0.248	Percent Non-Detects	10.34%
Mean Detects	0.329	SD Detects	0.498
Median Detects	0.28	CV Detects	1.516
Skewness Detects	9.266	Kurtosis Detects	90.97
Mean of Logged Detects	-1.325	SD of Logged Detects	0.51

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.267	**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	0.0869	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

Mean	0.319	Standard Error of Mean	0.0441
SD	0.472	95% KM (BCA) UCL	0.418
95% KM (t) UCL	0.393	95% KM (Percentile Bootstrap) UCL	0.4
95% KM (z) UCL	0.392	95% KM Bootstrap t UCL	0.559
90% KM Chebyshev UCL	0.452	95% KM Chebyshev UCL	0.512
97.5% KM Chebyshev UCL	0.595	99% KM Chebyshev UCL	0.758

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.554	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.197	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0893	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)	2.506	k star (bias corrected MLE)	2.44
Theta hat (MLE)	0.131	Theta star (bias corrected MLE)	0.135
nu hat (MLE)	521.3	nu star (bias corrected)	507.6
MLE Mean (bias corrected)	0.329	MLE Sd (bias corrected)	0.21

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.459	nu hat (KM)	106.4
Approximate Chi Square Value (106.39, α)	83.59	Adjusted Chi Square Value (106.39, β)	83.34
95% Gamma Approximate KM-UCL (use when n>=50)	0.407	95% Gamma Adjusted KM-UCL (use when n<50)	0.408

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.317
Maximum	5.2	Median	0.27
SD	0.477	CV	1.506
k hat (MLE)	2.056	k star (bias corrected MLE)	2.008
Theta hat (MLE)	0.154	Theta star (bias corrected MLE)	0.158
nu hat (MLE)	476.9	nu star (bias corrected)	465.9
MLE Mean (bias corrected)	0.317	MLE Sd (bias corrected)	0.223
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (465.91, α)	416.9	Adjusted Chi Square Value (465.91, β)	416.3
95% Gamma Approximate UCL (use when n>=50)	0.354	95% Gamma Adjusted UCL (use when n<50)	0.354

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.111	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0869	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	-1.349
SD in Original Scale	0.474	SD in Log Scale	0.509
95% t UCL (assumes normality of ROS data)	0.392	95% Percentile Bootstrap UCL	0.392
95% BCA Bootstrap UCL	0.48	95% Bootstrap t UCL	0.561
95% H-UCL (Log ROS)	0.322		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.346	Mean in Log Scale	-1.297
SD in Original Scale	0.484	SD in Log Scale	0.577
95% t UCL (Assumes normality)	0.42	95% H-Stat UCL	0.357

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 (BCA) UCL	0.418

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

Result (uranium)

General Statistics

Total Number of Observations	96	Number of Distinct Observations	89
		Number of Missing Observations	0
Minimum	0.93	Mean	4.612
Maximum	16	Median	4.05
SD	2.411	Std. Error of Mean	0.246
Coefficient of Variation	0.523	Skewness	1.603

Normal GOF Test

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.5969E-9	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0904	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	5.021	95% Adjusted-CLT UCL (Chen-1995)	5.06
		95% Modified-t UCL (Johnson-1978)	5.027

Gamma GOF Test

A-D Test Statistic	0.663	**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	0.0902	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0916	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.239	k star (bias corrected MLE)	4.113
Theta hat (MLE)	1.088	Theta star (bias corrected MLE)	1.121
nu hat (MLE)	813.9	nu star (bias corrected)	789.8
MLE Mean (bias corrected)	4.612	MLE Sd (bias corrected)	2.274
		Approximate Chi Square Value (0.05)	725.6
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	724.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	5.02	95% Adjusted Gamma UCL (use when n<50)	5.026

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.787	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.057	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0904	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.0726	Mean of logged Data	1.406
Maximum of Logged Data	2.773	SD of logged Data	0.503

Assuming Lognormal Distribution

95% H-UCL	5.093	90% Chebyshev (MVUE) UCL	5.373
95% Chebyshev (MVUE) UCL	5.714	97.5% Chebyshev (MVUE) UCL	6.186
99% Chebyshev (MVUE) UCL	7.113		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5.017	95% Jackknife UCL	5.021
95% Standard Bootstrap UCL	5.011	95% Bootstrap-t UCL	5.061
95% Hall's Bootstrap UCL	5.086	95% Percentile Bootstrap UCL	5.034
95% BCA Bootstrap UCL	5.078		
90% Chebyshev(Mean, Sd) UCL	5.35	95% Chebyshev(Mean, Sd) UCL	5.684
97.5% Chebyshev(Mean, Sd) UCL	6.149	99% Chebyshev(Mean, Sd) UCL	7.06

Suggested UCL to Use

95% Approximate Gamma UCL	5.02

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	116	Number of Distinct Observations	89
		Number of Missing Observations	0
Minimum	26	Mean	251
Maximum	6210	Median	75.5
SD	830.8	Std. Error of Mean	77.14
Coefficient of Variation	3.31	Skewness	5.93

Normal GOF Test

Shapiro Wilk Test Statistic	0.267	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.41	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0823	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	378.9	95% Adjusted-CLT UCL (Chen-1995)	423.3
		95% Modified-t UCL (Johnson-1978)	386

Gamma GOF Test

A-D Test Statistic	16.34	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.809	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.272	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0896	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.602	k star (bias corrected MLE)	0.592
Theta hat (MLE)	416.8	Theta star (bias corrected MLE)	423.7
nu hat (MLE)	139.7	nu star (bias corrected)	137.5
MLE Mean (bias corrected)	251	MLE Sd (bias corrected)	326.1
		Approximate Chi Square Value (0.05)	111.4
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	111.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	309.8	95% Adjusted Gamma UCL (use when n<50)	310.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0823	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.258	Mean of logged Data	4.5
Maximum of Logged Data	8.734	SD of logged Data	1.014

Assuming Lognormal Distribution

95% H-UCL	185.9	90% Chebyshev (MVUE) UCL	200.5
95% Chebyshev (MVUE) UCL	223.6	97.5% Chebyshev (MVUE) UCL	255.7
99% Chebyshev (MVUE) UCL	318.6		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	377.9	95% Jackknife UCL	378.9
95% Standard Bootstrap UCL	378.5	95% Bootstrap-t UCL	474.8
95% Hall's Bootstrap UCL	955.1	95% Percentile Bootstrap UCL	387.1
95% BCA Bootstrap UCL	455.8		
90% Chebyshev(Mean, Sd) UCL	482.4	95% Chebyshev(Mean, Sd) UCL	587.3
97.5% Chebyshev(Mean, Sd) UCL	732.7	99% Chebyshev(Mean, Sd) UCL	1019

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	587.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (antimony)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	19
Number of Detects	40	Number of Non-Detects	5
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	69	Maximum Non-Detect	1
Variance Detects	117.7	Percent Non-Detects	11.11%
Mean Detects	2.873	SD Detects	10.85
Median Detects	0.5	CV Detects	3.777
Skewness Detects	6.104	Kurtosis Detects	38.02
Mean of Logged Detects	-0.291	SD of Logged Detects	1.203

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.247	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.403	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	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

Mean	2.601	Standard Error of Mean	1.529
SD	10.13	95% KM (BCA) UCL	5.721
95% KM (t) UCL	5.17	95% KM (Percentile Bootstrap) UCL	5.592
95% KM (z) UCL	5.116	95% KM Bootstrap t UCL	18.3
90% KM Chebyshev UCL	7.189	95% KM Chebyshev UCL	9.267
97.5% KM Chebyshev UCL	12.15	99% KM Chebyshev UCL	17.82

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.73	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.285	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.148	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)	0.475	k star (bias corrected MLE)	0.456
Theta hat (MLE)	6.042	Theta star (bias corrected MLE)	6.293
nu hat (MLE)	38.04	nu star (bias corrected)	36.52
MLE Mean (bias corrected)	2.873	MLE Sd (bias corrected)	4.252

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0659	nu hat (KM)	5.931
Approximate Chi Square Value (5.93, α)	1.605	Adjusted Chi Square Value (5.93, β)	1.532
95% Gamma Approximate KM-UCL (use when n>=50)	9.612	95% Gamma Adjusted KM-UCL (use when n<50)	10.07

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.581
Maximum	69	Median	0.5
SD	10.25	CV	3.972
k hat (MLE)	0.407	k star (bias corrected MLE)	0.395
Theta hat (MLE)	6.341	Theta star (bias corrected MLE)	6.539
nu hat (MLE)	36.63	nu star (bias corrected)	35.52
MLE Mean (bias corrected)	2.581	MLE Sd (bias corrected)	4.108
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (35.52, α)	22.88	Adjusted Chi Square Value (35.52, β)	22.54
95% Gamma Approximate UCL (use when n>=50)	4.006	95% Gamma Adjusted UCL (use when n<50)	4.066

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	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	2.612	Mean in Log Scale	-0.347
SD in Original Scale	10.24	SD in Log Scale	1.16
95% t UCL (assumes normality of ROS data)	5.177	95% Percentile Bootstrap UCL	5.62
95% BCA Bootstrap UCL	7.465	95% Bootstrap t UCL	19.05
95% H-UCL (Log ROS)	2.167		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.609	Mean in Log Scale	-0.336
SD in Original Scale	10.24	SD in Log Scale	1.14
95% t UCL (Assumes normality)	5.175	95% H-Stat UCL	2.116

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 (Chebyshev) UCL	9.267

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

Result (arsenic)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	41
Number of Detects	42	Number of Non-Detects	3
Number of Distinct Detects	38	Number of Distinct Non-Detects	3
Minimum Detect	1.4	Minimum Non-Detect	10.1
Maximum Detect	101	Maximum Non-Detect	35.4
Variance Detects	247.4	Percent Non-Detects	6.667%
Mean Detects	9.535	SD Detects	15.73
Median Detects	5.055	CV Detects	1.65
Skewness Detects	5.123	Kurtosis Detects	29.28
Mean of Logged Detects	1.794	SD of Logged Detects	0.835

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.424	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.942	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.137	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

Mean	9.306	Standard Error of Mean	2.283
SD	15.09	95% KM (BCA) UCL	13.73
95% KM (t) UCL	13.14	95% KM (Percentile Bootstrap) UCL	13.36
95% KM (z) UCL	13.06	95% KM Bootstrap t UCL	19.96
90% KM Chebyshev UCL	16.16	95% KM Chebyshev UCL	19.26
97.5% KM Chebyshev UCL	23.57	99% KM Chebyshev UCL	32.03

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.307	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.773	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.14	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)	1.224	k star (bias corrected MLE)	1.153
Theta hat (MLE)	7.787	Theta star (bias corrected MLE)	8.271
nu hat (MLE)	102.9	nu star (bias corrected)	96.84
MLE Mean (bias corrected)	9.535	MLE Sd (bias corrected)	8.88

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.381	nu hat (KM)	34.25
Approximate Chi Square Value (34.25, α)	21.86	Adjusted Chi Square Value (34.25, β)	21.53
95% Gamma Approximate KM-UCL (use when n>=50)	14.58	95% Gamma Adjusted KM-UCL (use when n<50)	14.8

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.4	Mean	9.19
Maximum	101	Median	5.1
SD	15.24	CV	1.659
k hat (MLE)	1.251	k star (bias corrected MLE)	1.183
Theta hat (MLE)	7.343	Theta star (bias corrected MLE)	7.769
nu hat (MLE)	112.6	nu star (bias corrected)	106.5
MLE Mean (bias corrected)	9.19	MLE Sd (bias corrected)	8.45
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (106.45, α)	83.64	Adjusted Chi Square Value (106.45, β)	82.97
95% Gamma Approximate UCL (use when n>=50)	11.7	95% Gamma Adjusted UCL (use when n<50)	11.79

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.897	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.942	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.137	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	9.25	Mean in Log Scale	1.784
SD in Original Scale	15.22	SD in Log Scale	0.807
95% t UCL (assumes normality of ROS data)	13.06	95% Percentile Bootstrap UCL	13.32
95% BCA Bootstrap UCL	15.56	95% Bootstrap t UCL	20.02
95% H-UCL (Log ROS)	10.74		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	9.765	Mean in Log Scale	1.836
SD in Original Scale	15.28	SD in Log Scale	0.835
95% t UCL (Assumes normality)	13.59	95% H-Stat UCL	11.72

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	19.26

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

Result (barium)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	32
		Number of Missing Observations	0
Minimum	45	Mean	108.9
Maximum	294	Median	95.4
SD	56.98	Std. Error of Mean	9.919
Coefficient of Variation	0.523	Skewness	1.861

Normal GOF Test

Shapiro Wilk Test Statistic	0.811	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.204	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	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	125.7	95% Adjusted-CLT UCL (Chen-1995)	128.7
		95% Modified-t UCL (Johnson-1978)	126.2

Gamma GOF Test

A-D Test Statistic	0.755	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.137	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.154	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	4.953	k star (bias corrected MLE)	4.523
Theta hat (MLE)	21.99	Theta star (bias corrected MLE)	24.08
nu hat (MLE)	326.9	nu star (bias corrected)	298.5
MLE Mean (bias corrected)	108.9	MLE Sd (bias corrected)	51.21
		Approximate Chi Square Value (0.05)	259.5
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	257.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	125.3	95% Adjusted Gamma UCL (use when n<50)	126.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.107	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.807	Mean of logged Data	4.586
Maximum of Logged Data	5.684	SD of logged Data	0.445

Assuming Lognormal Distribution

95% H-UCL	125.8	90% Chebyshev (MVUE) UCL	134
95% Chebyshev (MVUE) UCL	145.8	97.5% Chebyshev (MVUE) UCL	162.2
99% Chebyshev (MVUE) UCL	194.3		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	125.2	95% Jackknife UCL	125.7
95% Standard Bootstrap UCL	124.9	95% Bootstrap-t UCL	132
95% Hall's Bootstrap UCL	131.2	95% Percentile Bootstrap UCL	126.2
95% BCA Bootstrap UCL	129.3		
90% Chebyshev(Mean, Sd) UCL	138.7	95% Chebyshev(Mean, Sd) UCL	152.1
97.5% Chebyshev(Mean, Sd) UCL	170.8	99% Chebyshev(Mean, Sd) UCL	207.6

Suggested UCL to Use

95% Adjusted Gamma UCL	126.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	23
Number of Detects	40	Number of Non-Detects	5
Number of Distinct Detects	22	Number of Distinct Non-Detects	2
Minimum Detect	0.17	Minimum Non-Detect	1
Maximum Detect	2.36	Maximum Non-Detect	5
Variance Detects	0.153	Percent Non-Detects	11.11%
Mean Detects	0.672	SD Detects	0.392
Median Detects	0.6	CV Detects	0.583
Skewness Detects	2.314	Kurtosis Detects	8.061
Mean of Logged Detects	-0.531	SD of Logged Detects	0.517

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.818	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.176	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	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

Mean	0.661	Standard Error of Mean	0.058
SD	0.375	95% KM (BCA) UCL	0.761
95% KM (t) UCL	0.759	95% KM (Percentile Bootstrap) UCL	0.758
95% KM (z) UCL	0.757	95% KM Bootstrap t UCL	0.796
90% KM Chebyshev UCL	0.835	95% KM Chebyshev UCL	0.914
97.5% KM Chebyshev UCL	1.024	99% KM Chebyshev UCL	1.239

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.452	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.119	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.14	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)	3.926	k star (bias corrected MLE)	3.648
Theta hat (MLE)	0.171	Theta star (bias corrected MLE)	0.184
nu hat (MLE)	314.1	nu star (bias corrected)	291.8
MLE Mean (bias corrected)	0.672	MLE Sd (bias corrected)	0.352

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.114	nu hat (KM)	280.3
Approximate Chi Square Value (280.26, α)	242.5	Adjusted Chi Square Value (280.26, β)	241.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.764	95% Gamma Adjusted KM-UCL (use when n<50)	0.768

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.17	Mean	0.66
Maximum	2.36	Median	0.6
SD	0.374	CV	0.567
k hat (MLE)	4.177	k star (bias corrected MLE)	3.914
Theta hat (MLE)	0.158	Theta star (bias corrected MLE)	0.169
nu hat (MLE)	376	nu star (bias corrected)	352.2
MLE Mean (bias corrected)	0.66	MLE Sd (bias corrected)	0.334
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (352.24, α)	309.7	Adjusted Chi Square Value (352.24, β)	308.4
95% Gamma Approximate UCL (use when n>=50)	0.751	95% Gamma Adjusted UCL (use when n<50)	0.754

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.986	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0844	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.14	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	0.659	Mean in Log Scale	-0.54
SD in Original Scale	0.373	SD in Log Scale	0.495
95% t UCL (assumes normality of ROS data)	0.752	95% Percentile Bootstrap UCL	0.756
95% BCA Bootstrap UCL	0.783	95% Bootstrap t UCL	0.793
95% H-UCL (Log ROS)	0.759		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.542	95% H-UCL (KM -Log)	0.763
KM SD (logged)	0.503	95% Critical H Value (KM-Log)	1.908
KM Standard Error of Mean (logged)	0.0793		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.697	Mean in Log Scale	-0.513
SD in Original Scale	0.462	SD in Log Scale	0.535
95% t UCL (Assumes normality)	0.813	95% H-Stat UCL	0.807

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 (BCA) UCL	0.761	95% GROS Adjusted Gamma UCL	0.754
95% Adjusted Gamma KM-UCL	0.768		

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

Result (cadmium)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	20
Number of Detects	20	Number of Non-Detects	25
Number of Distinct Detects	19	Number of Distinct Non-Detects	1
Minimum Detect	0.32	Minimum Non-Detect	2
Maximum Detect	5.65	Maximum Non-Detect	2
Variance Detects	1.486	Percent Non-Detects	55.56%
Mean Detects	1.577	SD Detects	1.219
Median Detects	1.35	CV Detects	0.773
Skewness Detects	2.063	Kurtosis Detects	5.842
Mean of Logged Detects	0.217	SD of Logged Detects	0.707

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.8	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	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

Mean	1.287	Standard Error of Mean	0.169
SD	0.916	95% KM (BCA) UCL	1.553
95% KM (t) UCL	1.572	95% KM (Percentile Bootstrap) UCL	1.576
95% KM (z) UCL	1.566	95% KM Bootstrap t UCL	1.624
90% KM Chebyshev UCL	1.795	95% KM Chebyshev UCL	2.025
97.5% KM Chebyshev UCL	2.345	99% KM Chebyshev UCL	2.972

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.39	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.196	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)	2.248	k star (bias corrected MLE)	1.944
Theta hat (MLE)	0.701	Theta star (bias corrected MLE)	0.811
nu hat (MLE)	89.9	nu star (bias corrected)	77.75
MLE Mean (bias corrected)	1.577	MLE Sd (bias corrected)	1.131

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.973	nu hat (KM)	177.5
Approximate Chi Square Value (177.54, α)	147.7	Adjusted Chi Square Value (177.54, β)	146.8
95% Gamma Approximate KM-UCL (use when n>=50)	1.547	95% Gamma Adjusted KM-UCL (use when n<50)	1.556

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0714	Mean	1.275
Maximum	5.65	Median	1.037
SD	0.962	CV	0.755
k hat (MLE)	2.023	k star (bias corrected MLE)	1.903
Theta hat (MLE)	0.631	Theta star (bias corrected MLE)	0.67
nu hat (MLE)	182	nu star (bias corrected)	171.2
MLE Mean (bias corrected)	1.275	MLE Sd (bias corrected)	0.925
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (171.24, α)	142	Adjusted Chi Square Value (171.24, β)	141.1
95% Gamma Approximate UCL (use when n>=50)	1.538	95% Gamma Adjusted UCL (use when n<50)	1.548

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	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	1.271	Mean in Log Scale	0.0451
SD in Original Scale	0.922	SD in Log Scale	0.619
95% t UCL (assumes normality of ROS data)	1.502	95% Percentile Bootstrap UCL	1.505
95% BCA Bootstrap UCL	1.575	95% Bootstrap t UCL	1.6
95% H-UCL (Log ROS)	1.527		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.0564	95% H-UCL (KM -Log)	1.538
KM SD (logged)	0.615	95% Critical H Value (KM-Log)	1.995
KM Standard Error of Mean (logged)	0.134		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.256	Mean in Log Scale	0.0962
SD in Original Scale	0.852	SD in Log Scale	0.477
95% t UCL (Assumes normality)	1.47	95% H-Stat UCL	1.413

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	1.572	95% KM (Percentile Bootstrap) UCL	1.576

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

Result (chromium)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	2	Mean	8.667
Maximum	23	Median	8
SD	4.348	Std. Error of Mean	0.648
Coefficient of Variation	0.502	Skewness	1.268

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.183	**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	9.756	95% Adjusted-CLT UCL (Chen-1995)	9.864
		95% Modified-t UCL (Johnson-1978)	9.776

Gamma GOF Test

A-D Test Statistic	0.607	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.123	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.33	k star (bias corrected MLE)	4.056
Theta hat (MLE)	2.002	Theta star (bias corrected MLE)	2.137
nu hat (MLE)	389.7	nu star (bias corrected)	365
MLE Mean (bias corrected)	8.667	MLE Sd (bias corrected)	4.303
		Approximate Chi Square Value (0.05)	321.7
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	320.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	9.832	95% Adjusted Gamma UCL (use when n<50)	9.874

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.138	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.132	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.04
Maximum of Logged Data	3.135	SD of logged Data	0.511

Assuming Lognormal Distribution

95% H-UCL	10.15	90% Chebyshev (MVUE) UCL	10.83
95% Chebyshev (MVUE) UCL	11.77	97.5% Chebyshev (MVUE) UCL	13.09
99% Chebyshev (MVUE) UCL	15.68		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	9.733	95% Jackknife UCL	9.756
95% Standard Bootstrap UCL	9.723	95% Bootstrap-t UCL	9.934
95% Hall's Bootstrap UCL	10.01	95% Percentile Bootstrap UCL	9.733
95% BCA Bootstrap UCL	9.8		
90% Chebyshev(Mean, Sd) UCL	10.61	95% Chebyshev(Mean, Sd) UCL	11.49
97.5% Chebyshev(Mean, Sd) UCL	12.71	99% Chebyshev(Mean, Sd) UCL	15.12

Suggested UCL to Use

95% Adjusted Gamma UCL	9.874

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	37	Number of Distinct Observations	14
Number of Detects	36	Number of Non-Detects	1
Number of Distinct Detects	14	Number of Distinct Non-Detects	1
Minimum Detect	3	Minimum Non-Detect	5
Maximum Detect	19	Maximum Non-Detect	5
Variance Detects	19	Percent Non-Detects	2.703%
Mean Detects	9.528	SD Detects	4.359
Median Detects	9	CV Detects	0.457
Skewness Detects	0.626	Kurtosis Detects	-0.442
Mean of Logged Detects	2.148	SD of Logged Detects	0.479

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**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

Mean	9.373	Standard Error of Mean	0.724
SD	4.34	95% KM (BCA) UCL	10.51
95% KM (t) UCL	10.59	95% KM (Percentile Bootstrap) UCL	10.54
95% KM (z) UCL	10.56	95% KM Bootstrap t UCL	10.67
90% KM Chebyshev UCL	11.54	95% KM Chebyshev UCL	12.53
97.5% KM Chebyshev UCL	13.89	99% KM Chebyshev UCL	16.57

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.36	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0924	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.147	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)	4.866	k star (bias corrected MLE)	4.479
Theta hat (MLE)	1.958	Theta star (bias corrected MLE)	2.127
nu hat (MLE)	350.3	nu star (bias corrected)	322.5
MLE Mean (bias corrected)	9.528	MLE Sd (bias corrected)	4.502

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.663	nu hat (KM)	345.1
Approximate Chi Square Value (345.08, α)	303	Adjusted Chi Square Value (345.08, β)	301.3
95% Gamma Approximate KM-UCL (use when n>=50)	10.67	95% Gamma Adjusted KM-UCL (use when n<50)	10.73

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3	Mean	9.372
Maximum	19	Median	9
SD	4.402	CV	0.47
k hat (MLE)	4.622	k star (bias corrected MLE)	4.265
Theta hat (MLE)	2.028	Theta star (bias corrected MLE)	2.197
nu hat (MLE)	342	nu star (bias corrected)	315.6
MLE Mean (bias corrected)	9.372	MLE Sd (bias corrected)	4.538
		Adjusted Level of Significance (β)	0.0431
Approximate Chi Square Value (315.63, α)	275.5	Adjusted Chi Square Value (315.63, β)	273.8
95% Gamma Approximate UCL (use when n>=50)	10.74	95% Gamma Adjusted UCL (use when n<50)	10.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0867	**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	9.381	Mean in Log Scale	2.128
SD in Original Scale	4.389	SD in Log Scale	0.488
95% t UCL (assumes normality of ROS data)	10.6	95% Percentile Bootstrap UCL	10.46
95% BCA Bootstrap UCL	10.62	95% Bootstrap t UCL	10.7
95% H-UCL (Log ROS)	11.04		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.126	95% H-UCL (KM -Log)	10.99
KM SD (logged)	0.485	95% Critical H Value (KM-Log)	1.902
KM Standard Error of Mean (logged)	0.0809		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	9.338	Mean in Log Scale	2.115
SD in Original Scale	4.45	SD in Log Scale	0.514
95% t UCL (Assumes normality)	10.57	95% H-Stat UCL	11.15

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 (BCA) UCL	10.51	95% GROS Adjusted Gamma UCL	10.8
95% Adjusted Gamma KM-UCL	10.73		

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

Result (copper)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	113	Mean	2905
Maximum	30200	Median	814
SD	4976	Std. Error of Mean	741.8
Coefficient of Variation	1.713	Skewness	4.114

Normal GOF Test

Shapiro Wilk Test Statistic	0.552	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.287	**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	4151	95% Adjusted-CLT UCL (Chen-1995)	4611
		95% Modified-t UCL (Johnson-1978)	4227

Gamma GOF Test

A-D Test Statistic	1.648	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.793	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.137	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.72	k star (bias corrected MLE)	0.687
Theta hat (MLE)	4033	Theta star (bias corrected MLE)	4228
nu hat (MLE)	64.81	nu star (bias corrected)	61.82
MLE Mean (bias corrected)	2905	MLE Sd (bias corrected)	3504
		Approximate Chi Square Value (0.05)	44.74
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	44.26

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4014	95% Adjusted Gamma UCL (use when n<50)	4057

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.157	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.132	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.727	Mean of logged Data	7.138
Maximum of Logged Data	10.32	SD of logged Data	1.284

Assuming Lognormal Distribution

95% H-UCL	4855	90% Chebyshev (MVUE) UCL	4786
95% Chebyshev (MVUE) UCL	5694	97.5% Chebyshev (MVUE) UCL	6953
99% Chebyshev (MVUE) UCL	9428		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4125	95% Jackknife UCL	4151
95% Standard Bootstrap UCL	4117	95% Bootstrap-t UCL	5293
95% Hall's Bootstrap UCL	9030	95% Percentile Bootstrap UCL	4306
95% BCA Bootstrap UCL	4788		
90% Chebyshev(Mean, Sd) UCL	5130	95% Chebyshev(Mean, Sd) UCL	6138
97.5% Chebyshev(Mean, Sd) UCL	7537	99% Chebyshev(Mean, Sd) UCL	10285

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	6138

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	4.99	Mean	69.38
Maximum	477	Median	56.6
SD	75.73	Std. Error of Mean	11.29
Coefficient of Variation	1.092	Skewness	3.733

Normal GOF Test

Shapiro Wilk Test Statistic	0.665	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.198	**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	88.35	95% Adjusted-CLT UCL (Chen-1995)	94.66
		95% Modified-t UCL (Johnson-1978)	89.39

Gamma GOF Test

A-D Test Statistic	0.405	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.771	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0781	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.135	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.339	k star (bias corrected MLE)	1.265
Theta hat (MLE)	51.81	Theta star (bias corrected MLE)	54.86
nu hat (MLE)	120.5	nu star (bias corrected)	113.8
MLE Mean (bias corrected)	69.38	MLE Sd (bias corrected)	61.69
		Approximate Chi Square Value (0.05)	90.2
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	89.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	87.56	95% Adjusted Gamma UCL (use when n<50)	88.24

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.945	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.129	**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	1.607	Mean of logged Data	3.822
Maximum of Logged Data	6.168	SD of logged Data	0.958

Assuming Lognormal Distribution

95% H-UCL	101.2	90% Chebyshev (MVUE) UCL	106.7
95% Chebyshev (MVUE) UCL	122.8	97.5% Chebyshev (MVUE) UCL	145.1
99% Chebyshev (MVUE) UCL	188.8		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	87.95	95% Jackknife UCL	88.35
95% Standard Bootstrap UCL	87.81	95% Bootstrap-t UCL	98.89
95% Hall's Bootstrap UCL	174.5	95% Percentile Bootstrap UCL	88.98
95% BCA Bootstrap UCL	97.4		
90% Chebyshev(Mean, Sd) UCL	103.2	95% Chebyshev(Mean, Sd) UCL	118.6
97.5% Chebyshev(Mean, Sd) UCL	139.9	99% Chebyshev(Mean, Sd) UCL	181.7

Suggested UCL to Use

95% Adjusted Gamma UCL	88.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	30	Mean	362.4
Maximum	928	Median	348
SD	197.9	Std. Error of Mean	29.51
Coefficient of Variation	0.546	Skewness	0.827

Normal GOF Test

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.148	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	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	411.9	95% Adjusted-CLT UCL (Chen-1995)	414.8
		95% Modified-t UCL (Johnson-1978)	412.6

Gamma GOF Test

A-D Test Statistic	0.301	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.099	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.133	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.038	k star (bias corrected MLE)	2.85
Theta hat (MLE)	119.3	Theta star (bias corrected MLE)	127.1
nu hat (MLE)	273.4	nu star (bias corrected)	256.5
MLE Mean (bias corrected)	362.4	MLE Sd (bias corrected)	214.6
		Approximate Chi Square Value (0.05)	220.4
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	219.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	421.7	95% Adjusted Gamma UCL (use when n<50)	423.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.132	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.401	Mean of logged Data	5.719
Maximum of Logged Data	6.833	SD of logged Data	0.658

Assuming Lognormal Distribution

95% H-UCL	462.7	90% Chebyshev (MVUE) UCL	495.7
95% Chebyshev (MVUE) UCL	549.9	97.5% Chebyshev (MVUE) UCL	625.2
99% Chebyshev (MVUE) UCL	773		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	410.9	95% Jackknife UCL	411.9
95% Standard Bootstrap UCL	411.2	95% Bootstrap-t UCL	413.9
95% Hall's Bootstrap UCL	416.8	95% Percentile Bootstrap UCL	414.1
95% BCA Bootstrap UCL	420.4		
90% Chebyshev(Mean, Sd) UCL	450.9	95% Chebyshev(Mean, Sd) UCL	491
97.5% Chebyshev(Mean, Sd) UCL	546.6	99% Chebyshev(Mean, Sd) UCL	656

Suggested UCL to Use

95% Student's-t UCL	411.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (mercury)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	13
Number of Detects	17	Number of Non-Detects	28
Number of Distinct Detects	13	Number of Distinct Non-Detects	3
Minimum Detect	0.04	Minimum Non-Detect	0.04
Maximum Detect	0.36	Maximum Non-Detect	0.2
Variance Detects	0.00823	Percent Non-Detects	62.22%
Mean Detects	0.123	SD Detects	0.0907
Median Detects	0.09	CV Detects	0.738
Skewness Detects	1.632	Kurtosis Detects	2.186
Mean of Logged Detects	-2.306	SD of Logged Detects	0.645

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.806	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.215	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

Mean	0.0877	Standard Error of Mean	0.012
SD	0.0674	95% KM (BCA) UCL	0.108
95% KM (t) UCL	0.108	95% KM (Percentile Bootstrap) UCL	0.108
95% KM (z) UCL	0.107	95% KM Bootstrap t UCL	0.114
90% KM Chebyshev UCL	0.124	95% KM Chebyshev UCL	0.14
97.5% KM Chebyshev UCL	0.163	99% KM Chebyshev UCL	0.207

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.515	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.211	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)	2.54	k star (bias corrected MLE)	2.131
Theta hat (MLE)	0.0484	Theta star (bias corrected MLE)	0.0577
nu hat (MLE)	86.35	nu star (bias corrected)	72.44
MLE Mean (bias corrected)	0.123	MLE Sd (bias corrected)	0.0842

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.691	nu hat (KM)	152.2
Approximate Chi Square Value (152.23, α)	124.7	Adjusted Chi Square Value (152.23, β)	123.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.107	95% Gamma Adjusted KM-UCL (use when n<50)	0.108

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0796
Maximum	0.36	Median	0.0639
SD	0.0771	CV	0.968
k hat (MLE)	1.121	k star (bias corrected MLE)	1.062
Theta hat (MLE)	0.071	Theta star (bias corrected MLE)	0.075
nu hat (MLE)	100.9	nu star (bias corrected)	95.54
MLE Mean (bias corrected)	0.0796	MLE Sd (bias corrected)	0.0773
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (95.54, α)	73.99	Adjusted Chi Square Value (95.54, β)	73.37
95% Gamma Approximate UCL (use when n>=50)	0.103	95% Gamma Adjusted UCL (use when n<50)	0.104

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.215	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	0.0834	Mean in Log Scale	-2.767
SD in Original Scale	0.0709	SD in Log Scale	0.753
95% t UCL (assumes normality of ROS data)	0.101	95% Percentile Bootstrap UCL	0.101
95% BCA Bootstrap UCL	0.106	95% Bootstrap t UCL	0.107
95% H-UCL (Log ROS)	0.106		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.637	95% H-UCL (KM -Log)	0.102
KM SD (logged)	0.594	95% Critical H Value (KM-Log)	1.977
KM Standard Error of Mean (logged)	0.118		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0982	Mean in Log Scale	-2.508
SD in Original Scale	0.0635	SD in Log Scale	0.656
95% t UCL (Assumes normality)	0.114	95% H-Stat UCL	0.123

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 (t) UCL	0.108	95% GROS Adjusted Gamma UCL	0.104
95% Adjusted Gamma KM-UCL	0.108		

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

Result (molybdenum)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	7	Mean	856.9
Maximum	6830	Median	230
SD	1534	Std. Error of Mean	228.6
Coefficient of Variation	1.79	Skewness	2.968

Normal GOF Test

Shapiro Wilk Test Statistic	0.564	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.29	**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	1241	95% Adjusted-CLT UCL (Chen-1995)	1341
		95% Modified-t UCL (Johnson-1978)	1258

Gamma GOF Test

A-D Test Statistic	1.494	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.809	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.546	k star (bias corrected MLE)	0.524
Theta hat (MLE)	1570	Theta star (bias corrected MLE)	1634
nu hat (MLE)	49.12	nu star (bias corrected)	47.18
MLE Mean (bias corrected)	856.9	MLE Sd (bias corrected)	1183
		Approximate Chi Square Value (0.05)	32.42
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	32.01

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1247	95% Adjusted Gamma UCL (use when n<50)	1263

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.101	**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	1.946	Mean of logged Data	5.605
Maximum of Logged Data	8.829	SD of logged Data	1.596

Assuming Lognormal Distribution

95% H-UCL	2059	90% Chebyshev (MVUE) UCL	1792
95% Chebyshev (MVUE) UCL	2190	97.5% Chebyshev (MVUE) UCL	2741
99% Chebyshev (MVUE) UCL	3824		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	1233	95% Jackknife UCL	1241
95% Standard Bootstrap UCL	1226	95% Bootstrap-t UCL	1502
95% Hall's Bootstrap UCL	1378	95% Percentile Bootstrap UCL	1245
95% BCA Bootstrap UCL	1396		
90% Chebyshev(Mean, Sd) UCL	1543	95% Chebyshev(Mean, Sd) UCL	1853
97.5% Chebyshev(Mean, Sd) UCL	2285	99% Chebyshev(Mean, Sd) UCL	3132

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	1853

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (nickel)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	15
Number of Detects	39	Number of Non-Detects	6
Number of Distinct Detects	14	Number of Distinct Non-Detects	2
Minimum Detect	2	Minimum Non-Detect	1
Maximum Detect	25	Maximum Non-Detect	5
Variance Detects	20.97	Percent Non-Detects	13.33%
Mean Detects	7.359	SD Detects	4.58
Median Detects	6	CV Detects	0.622
Skewness Detects	2.088	Kurtosis Detects	5.8
Mean of Logged Detects	1.841	SD of Logged Detects	0.561

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.814	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.939	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.198	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.142	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

Mean	6.653	Standard Error of Mean	0.697
SD	4.597	95% KM (BCA) UCL	7.822
95% KM (t) UCL	7.824	95% KM (Percentile Bootstrap) UCL	7.867
95% KM (z) UCL	7.799	95% KM Bootstrap t UCL	8.145
90% KM Chebyshev UCL	8.744	95% KM Chebyshev UCL	9.691
97.5% KM Chebyshev UCL	11	99% KM Chebyshev UCL	13.59

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.6	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.142	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)	3.387	k star (bias corrected MLE)	3.144
Theta hat (MLE)	2.172	Theta star (bias corrected MLE)	2.341
nu hat (MLE)	264.2	nu star (bias corrected)	245.2
MLE Mean (bias corrected)	7.359	MLE Sd (bias corrected)	4.15

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.095	nu hat (KM)	188.5
Approximate Chi Square Value (188.52, α)	157.8	Adjusted Chi Square Value (188.52, β)	156.8
95% Gamma Approximate KM-UCL (use when n>=50)	7.951	95% Gamma Adjusted KM-UCL (use when n<50)	7.998

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.542
Maximum	25	Median	6
SD	4.767	CV	0.729
k hat (MLE)	1.389	k star (bias corrected MLE)	1.311
Theta hat (MLE)	4.71	Theta star (bias corrected MLE)	4.989
nu hat (MLE)	125	nu star (bias corrected)	118
MLE Mean (bias corrected)	6.542	MLE Sd (bias corrected)	5.713
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (118.01, α)	93.93	Adjusted Chi Square Value (118.01, β)	93.22
95% Gamma Approximate UCL (use when n>=50)	8.219	95% Gamma Adjusted UCL (use when n<50)	8.282

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.939	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.135	**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	6.693	Mean in Log Scale	1.704
SD in Original Scale	4.598	SD in Log Scale	0.642
95% t UCL (assumes normality of ROS data)	7.844	95% Percentile Bootstrap UCL	7.918
95% BCA Bootstrap UCL	8.101	95% Bootstrap t UCL	8.207
95% H-UCL (Log ROS)	8.205		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.671	95% H-UCL (KM -Log)	8.509
KM SD (logged)	0.706	95% Critical H Value (KM-Log)	2.079
KM Standard Error of Mean (logged)	0.11		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	6.622	Mean in Log Scale	1.646
SD in Original Scale	4.674	SD in Log Scale	0.777
95% t UCL (Assumes normality)	7.793	95% H-Stat UCL	9.012

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 (BCA) UCL	7.822	95% GROS Adjusted Gamma UCL	8.282
95% Adjusted Gamma KM-UCL	7.998		

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

Result (selenium)

General Statistics

Total Number of Observations	45	Number of Distinct Observations	38
Number of Detects	36	Number of Non-Detects	9
Number of Distinct Detects	33	Number of Distinct Non-Detects	7
Minimum Detect	0.09	Minimum Non-Detect	0.41
Maximum Detect	9.4	Maximum Non-Detect	11.1
Variance Detects	4.596	Percent Non-Detects	20%
Mean Detects	1.742	SD Detects	2.144
Median Detects	0.625	CV Detects	1.23
Skewness Detects	2.013	Kurtosis Detects	4.308
Mean of Logged Detects	-0.134	SD of Logged Detects	1.228

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.743	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.225	**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

Mean	1.499	Standard Error of Mean	0.306
SD	1.992	95% KM (BCA) UCL	2.068
95% KM (t) UCL	2.013	95% KM (Percentile Bootstrap) UCL	2.011
95% KM (z) UCL	2.002	95% KM Bootstrap t UCL	2.19
90% KM Chebyshev UCL	2.417	95% KM Chebyshev UCL	2.832
97.5% KM Chebyshev UCL	3.409	99% KM Chebyshev UCL	4.542

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.052	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.783	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.152	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)	0.854	k star (bias corrected MLE)	0.801
Theta hat (MLE)	2.041	Theta star (bias corrected MLE)	2.175
nu hat (MLE)	61.45	nu star (bias corrected)	57.67
MLE Mean (bias corrected)	1.742	MLE Sd (bias corrected)	1.947

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.567	nu hat (KM)	51.01
Approximate Chi Square Value (51.01, α)	35.61	Adjusted Chi Square Value (51.01, β)	35.18
95% Gamma Approximate KM-UCL (use when n>=50)	2.148	95% Gamma Adjusted KM-UCL (use when n<50)	2.174

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.441
Maximum	9.4	Median	0.52
SD	2.011	CV	1.396
k hat (MLE)	0.633	k star (bias corrected MLE)	0.605
Theta hat (MLE)	2.277	Theta star (bias corrected MLE)	2.38
nu hat (MLE)	56.95	nu star (bias corrected)	54.49
MLE Mean (bias corrected)	1.441	MLE Sd (bias corrected)	1.852
		Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (54.49, α)	38.52	Adjusted Chi Square Value (54.49, β)	38.08
95% Gamma Approximate UCL (use when n>=50)	2.038	95% Gamma Adjusted UCL (use when n<50)	2.062

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.147	**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	1.474	Mean in Log Scale	-0.308
SD in Original Scale	1.989	SD in Log Scale	1.167
95% t UCL (assumes normality of ROS data)	1.972	95% Percentile Bootstrap UCL	1.99
95% BCA Bootstrap UCL	2.101	95% Bootstrap t UCL	2.173
95% H-UCL (Log ROS)	2.279		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.325	95% H-UCL (KM -Log)	2.386
KM SD (logged)	1.202	95% Critical H Value (KM-Log)	2.608
KM Standard Error of Mean (logged)	0.189		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.62	Mean in Log Scale	-0.242
SD in Original Scale	2.077	SD in Log Scale	1.223
95% t UCL (Assumes normality)	2.14	95% H-Stat UCL	2.697

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

95% KM (Chebyshev) UCL	2.832

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

Result (thallium)

General Statistics

Total Number of Observations	44	Number of Distinct Observations	25
Number of Detects	38	Number of Non-Detects	6
Number of Distinct Detects	25	Number of Distinct Non-Detects	5
Minimum Detect	0.07	Minimum Non-Detect	0.18
Maximum Detect	0.89	Maximum Non-Detect	0.3
Variance Detects	0.019	Percent Non-Detects	13.64%
Mean Detects	0.258	SD Detects	0.138
Median Detects	0.22	CV Detects	0.533
Skewness Detects	2.787	Kurtosis Detects	11.4
Mean of Logged Detects	-1.455	SD of Logged Detects	0.443

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.771	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.938	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.162	**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

Mean	0.246	Standard Error of Mean	0.0202
SD	0.131	95% KM (BCA) UCL	0.286
95% KM (t) UCL	0.28	95% KM (Percentile Bootstrap) UCL	0.281
95% KM (z) UCL	0.279	95% KM Bootstrap t UCL	0.293
90% KM Chebyshev UCL	0.306	95% KM Chebyshev UCL	0.334
97.5% KM Chebyshev UCL	0.372	99% KM Chebyshev UCL	0.447

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.693	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	**Kolmogrov-Smirnoff GOF**	
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 on Detected Data Only

k hat (MLE)	5.083	k star (bias corrected MLE)	4.699
Theta hat (MLE)	0.0508	Theta star (bias corrected MLE)	0.055
nu hat (MLE)	386.3	nu star (bias corrected)	357.1
MLE Mean (bias corrected)	0.258	MLE Sd (bias corrected)	0.119

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.49	nu hat (KM)	307.1
Approximate Chi Square Value (307.11, α)	267.5	Adjusted Chi Square Value (307.11, β)	266.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.282	95% Gamma Adjusted KM-UCL (use when n<50)	0.283

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.07	Mean	0.243
Maximum	0.89	Median	0.205
SD	0.134	CV	0.552
k hat (MLE)	4.774	k star (bias corrected MLE)	4.463
Theta hat (MLE)	0.0509	Theta star (bias corrected MLE)	0.0545
nu hat (MLE)	420.1	nu star (bias corrected)	392.8
MLE Mean (bias corrected)	0.243	MLE Sd (bias corrected)	0.115
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (392.77, α)	347.8	Adjusted Chi Square Value (392.77, β)	346.4
95% Gamma Approximate UCL (use when n>=50)	0.275	95% Gamma Adjusted UCL (use when n<50)	0.276

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.938	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.106	**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	0.245	Mean in Log Scale	-1.508
SD in Original Scale	0.133	SD in Log Scale	0.437
95% t UCL (assumes normality of ROS data)	0.279	95% Percentile Bootstrap UCL	0.281
95% BCA Bootstrap UCL	0.29	95% Bootstrap t UCL	0.294
95% H-UCL (Log ROS)	0.276		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.509	95% H-UCL (KM -Log)	0.277
KM SD (logged)	0.443	95% Critical H Value (KM-Log)	1.863
KM Standard Error of Mean (logged)	0.0702		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.239	Mean in Log Scale	-1.556
SD in Original Scale	0.138	SD in Log Scale	0.491
95% t UCL (Assumes normality)	0.274	95% H-Stat UCL	0.274

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 (BCA) UCL	0.286	95% GROS Adjusted Gamma UCL	0.276
95% Adjusted Gamma KM-UCL	0.283		

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

Result (uranium)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	32
		Number of Missing Observations	0
Minimum	1.96	Mean	4.423
Maximum	11	Median	3.78
SD	1.914	Std. Error of Mean	0.333
Coefficient of Variation	0.433	Skewness	1.452

Normal GOF Test

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	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	4.988	95% Adjusted-CLT UCL (Chen-1995)	5.061
		95% Modified-t UCL (Johnson-1978)	5.002

Gamma GOF Test

A-D Test Statistic	0.346	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.116	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.153	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.45	k star (bias corrected MLE)	5.884
Theta hat (MLE)	0.686	Theta star (bias corrected MLE)	0.752
nu hat (MLE)	425.7	nu star (bias corrected)	388.4
MLE Mean (bias corrected)	4.423	MLE Sd (bias corrected)	1.824
		Approximate Chi Square Value (0.05)	343.7
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	341.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.998	95% Adjusted Gamma UCL (use when n<50)	5.03

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.983	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0926	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.673	Mean of logged Data	1.407
Maximum of Logged Data	2.398	SD of logged Data	0.398

Assuming Lognormal Distribution

95% H-UCL	5.039	90% Chebyshev (MVUE) UCL	5.352
95% Chebyshev (MVUE) UCL	5.779	97.5% Chebyshev (MVUE) UCL	6.372
99% Chebyshev (MVUE) UCL	7.535		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.971	95% Jackknife UCL	4.988
95% Standard Bootstrap UCL	4.985	95% Bootstrap-t UCL	5.081
95% Hall's Bootstrap UCL	5.21	95% Percentile Bootstrap UCL	4.966
95% BCA Bootstrap UCL	5.05		
90% Chebyshev(Mean, Sd) UCL	5.423	95% Chebyshev(Mean, Sd) UCL	5.876
97.5% Chebyshev(Mean, Sd) UCL	6.505	99% Chebyshev(Mean, Sd) UCL	7.739

Suggested UCL to Use

95% Student's-t UCL	4.988

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	44	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	25	Mean	183.5
Maximum	824	Median	132.5
SD	156.5	Std. Error of Mean	23.59
Coefficient of Variation	0.853	Skewness	2.023

Normal GOF Test

Shapiro Wilk Test Statistic	0.815	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.17	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	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	223.2	95% Adjusted-CLT UCL (Chen-1995)	230
		95% Modified-t UCL (Johnson-1978)	224.4

Gamma GOF Test

A-D Test Statistic	0.458	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.126	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.135	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.773	k star (bias corrected MLE)	1.668
Theta hat (MLE)	103.5	Theta star (bias corrected MLE)	110.1
nu hat (MLE)	156.1	nu star (bias corrected)	146.8
MLE Mean (bias corrected)	183.5	MLE Sd (bias corrected)	142.1
		Approximate Chi Square Value (0.05)	119.8
Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	118.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	224.9	95% Adjusted Gamma UCL (use when n<50)	226.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.983	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0971	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.134	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.219	Mean of logged Data	4.905
Maximum of Logged Data	6.714	SD of logged Data	0.803

Assuming Lognormal Distribution

95% H-UCL	242.7	90% Chebyshev (MVUE) UCL	259.3
95% Chebyshev (MVUE) UCL	293.2	97.5% Chebyshev (MVUE) UCL	340.3
99% Chebyshev (MVUE) UCL	432.7		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	222.3	95% Jackknife UCL	223.2
95% Standard Bootstrap UCL	220.1	95% Bootstrap-t UCL	232.4
95% Hall's Bootstrap UCL	243.4	95% Percentile Bootstrap UCL	224.5
95% BCA Bootstrap UCL	230.3		
90% Chebyshev(Mean, Sd) UCL	254.3	95% Chebyshev(Mean, Sd) UCL	286.3
97.5% Chebyshev(Mean, Sd) UCL	330.8	99% Chebyshev(Mean, Sd) UCL	418.2

Suggested UCL to Use

95% Adjusted Gamma UCL	226.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (antimony)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	24
Number of Detects	64	Number of Non-Detects	16
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	69	Maximum Non-Detect	1
Variance Detects	78.18	Percent Non-Detects	20%
Mean Detects	2.445	SD Detects	8.842
Median Detects	0.5	CV Detects	3.616
Skewness Detects	7.067	Kurtosis Detects	53.05
Mean of Logged Detects	-0.32	SD of Logged Detects	1.172

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.262	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.4	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.111	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

Mean	2.041	Standard Error of Mean	0.889
SD	7.888	95% KM (BCA) UCL	3.95
95% KM (t) UCL	3.52	95% KM (Percentile Bootstrap) UCL	3.596
95% KM (z) UCL	3.503	95% KM Bootstrap t UCL	8.367
90% KM Chebyshev UCL	4.708	95% KM Chebyshev UCL	5.916
97.5% KM Chebyshev UCL	7.592	99% KM Chebyshev UCL	10.89

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.303	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.286	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.118	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)	0.52	k star (bias corrected MLE)	0.506
Theta hat (MLE)	4.702	Theta star (bias corrected MLE)	4.832
nu hat (MLE)	66.57	nu star (bias corrected)	64.78
MLE Mean (bias corrected)	2.445	MLE Sd (bias corrected)	3.437

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0669	nu hat (KM)	10.71
Approximate Chi Square Value (10.71, α)	4.389	Adjusted Chi Square Value (10.71, β)	4.315
95% Gamma Approximate KM-UCL (use when n>=50)	4.979	95% Gamma Adjusted KM-UCL (use when n<50)	5.064

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.035
Maximum	69	Median	0.45
SD	7.947	CV	3.904
k hat (MLE)	0.4	k star (bias corrected MLE)	0.394
Theta hat (MLE)	5.085	Theta star (bias corrected MLE)	5.171
nu hat (MLE)	64.05	nu star (bias corrected)	62.98
MLE Mean (bias corrected)	2.035	MLE Sd (bias corrected)	3.244
		Adjusted Level of Significance (β)	0.047
Approximate Chi Square Value (62.98, α)	45.72	Adjusted Chi Square Value (62.98, β)	45.45
95% Gamma Approximate UCL (use when n>=50)	2.803	95% Gamma Adjusted UCL (use when n<50)	2.82

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.221	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.111	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	2.063	Mean in Log Scale	-0.423
SD in Original Scale	7.934	SD in Log Scale	1.111
95% t UCL (assumes normality of ROS data)	3.54	95% Percentile Bootstrap UCL	3.73
95% BCA Bootstrap UCL	4.857	95% Bootstrap t UCL	8.572
95% H-UCL (Log ROS)	1.636		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.056	Mean in Log Scale	-0.394
SD in Original Scale	7.934	SD in Log Scale	1.058
95% t UCL (Assumes normality)	3.533	95% H-Stat UCL	1.555

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	5.916

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

Result (arsenic)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	66
Number of Detects	76	Number of Non-Detects	6
Number of Distinct Detects	60	Number of Distinct Non-Detects	6
Minimum Detect	1	Minimum Non-Detect	10.1
Maximum Detect	101	Maximum Non-Detect	89.7
Variance Detects	155.5	Percent Non-Detects	7.317%
Mean Detects	7.982	SD Detects	12.47
Median Detects	4.3	CV Detects	1.562
Skewness Detects	5.896	Kurtosis Detects	42.09
Mean of Logged Detects	1.627	SD of Logged Detects	0.861

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.468	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.288	**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

Mean	7.844	Standard Error of Mean	1.347
SD	12.02	95% KM (BCA) UCL	10.48
95% KM (t) UCL	10.08	95% KM (Percentile Bootstrap) UCL	10.3
95% KM (z) UCL	10.06	95% KM Bootstrap t UCL	12.31
90% KM Chebyshev UCL	11.88	95% KM Chebyshev UCL	13.71
97.5% KM Chebyshev UCL	16.25	99% KM Chebyshev UCL	21.24

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.625	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.776	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.179	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.105	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)	1.251	k star (bias corrected MLE)	1.21
Theta hat (MLE)	6.383	Theta star (bias corrected MLE)	6.597
nu hat (MLE)	190.1	nu star (bias corrected)	183.9
MLE Mean (bias corrected)	7.982	MLE Sd (bias corrected)	7.257

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.426	nu hat (KM)	69.79
Approximate Chi Square Value (69.79, α)	51.55	Adjusted Chi Square Value (69.79, β)	51.27
95% Gamma Approximate KM-UCL (use when n>=50)	10.62	95% Gamma Adjusted KM-UCL (use when n<50)	10.68

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1	Mean	7.725
Maximum	101	Median	4.55
SD	12.04	CV	1.558
k hat (MLE)	1.308	k star (bias corrected MLE)	1.268
Theta hat (MLE)	5.907	Theta star (bias corrected MLE)	6.092
nu hat (MLE)	214.5	nu star (bias corrected)	208
MLE Mean (bias corrected)	7.725	MLE Sd (bias corrected)	6.86
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (207.97, α)	175.6	Adjusted Chi Square Value (207.97, β)	175.1
95% Gamma Approximate UCL (use when n>=50)	9.149	95% Gamma Adjusted UCL (use when n<50)	9.176

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.113	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.102	Detected Data Not 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	7.745	Mean in Log Scale	1.621
SD in Original Scale	12.03	SD in Log Scale	0.829
95% t UCL (assumes normality of ROS data)	9.956	95% Percentile Bootstrap UCL	10.08
95% BCA Bootstrap UCL	11.23	95% Bootstrap t UCL	12.2
95% H-UCL (Log ROS)	8.643		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.619	95% H-UCL (KM -Log)	8.812
KM SD (logged)	0.848	95% Critical H Value (KM-Log)	2.095
KM Standard Error of Mean (logged)	0.0971		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.809	Mean in Log Scale	1.71
SD in Original Scale	12.81	SD in Log Scale	0.898
95% t UCL (Assumes normality)	11.16	95% H-Stat UCL	10.24

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

95% KM (BCA) UCL	10.48

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.

Result (barium)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	59
		Number of Missing Observations	0
Minimum	40.2	Mean	104.5
Maximum	294	Median	95.8
SD	49.78	Std. Error of Mean	6.127
Coefficient of Variation	0.476	Skewness	1.675

Normal GOF Test

Shapiro Wilk Test Statistic	0.863	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	4.8177E-8	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.109	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	114.7	95% Adjusted-CLT UCL (Chen-1995)	116
		95% Modified-t UCL (Johnson-1978)	115

Gamma GOF Test

A-D Test Statistic	0.552	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0877	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.11	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.458	k star (bias corrected MLE)	5.22
Theta hat (MLE)	19.15	Theta star (bias corrected MLE)	20.02
nu hat (MLE)	720.4	nu star (bias corrected)	689
MLE Mean (bias corrected)	104.5	MLE Sd (bias corrected)	45.75
		Approximate Chi Square Value (0.05)	629.1
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	627.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	114.5	95% Adjusted Gamma UCL (use when n<50)	114.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.505	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0671	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.109	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.694	Mean of logged Data	4.555
Maximum of Logged Data	5.684	SD of logged Data	0.429

Assuming Lognormal Distribution

95% H-UCL	114.9	90% Chebyshev (MVUE) UCL	121.2
95% Chebyshev (MVUE) UCL	129	97.5% Chebyshev (MVUE) UCL	139.8
99% Chebyshev (MVUE) UCL	160.9		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	114.6	95% Jackknife UCL	114.7
95% Standard Bootstrap UCL	114.6	95% Bootstrap-t UCL	116.9
95% Hall's Bootstrap UCL	116.5	95% Percentile Bootstrap UCL	114.9
95% BCA Bootstrap UCL	115.5		
90% Chebyshev(Mean, Sd) UCL	122.9	95% Chebyshev(Mean, Sd) UCL	131.2
97.5% Chebyshev(Mean, Sd) UCL	142.8	99% Chebyshev(Mean, Sd) UCL	165.5

Suggested UCL to Use

95% Approximate Gamma UCL	114.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	28
Number of Detects	71	Number of Non-Detects	11
Number of Distinct Detects	27	Number of Distinct Non-Detects	2
Minimum Detect	0.17	Minimum Non-Detect	1
Maximum Detect	2.36	Maximum Non-Detect	5
Variance Detects	0.133	Percent Non-Detects	13.41%
Mean Detects	0.656	SD Detects	0.365
Median Detects	0.6	CV Detects	0.556
Skewness Detects	2.515	Kurtosis Detects	8.903
Mean of Logged Detects	-0.537	SD of Logged Detects	0.474

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.785	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	3.364E-14	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.105	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

Mean	0.646	Standard Error of Mean	0.0399
SD	0.348	95% KM (BCA) UCL	0.715
95% KM (t) UCL	0.712	95% KM (Percentile Bootstrap) UCL	0.713
95% KM (z) UCL	0.712	95% KM Bootstrap t UCL	0.721
90% KM Chebyshev UCL	0.766	95% KM Chebyshev UCL	0.82
97.5% KM Chebyshev UCL	0.895	99% KM Chebyshev UCL	1.043

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.211	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.106	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)	4.481	k star (bias corrected MLE)	4.301
Theta hat (MLE)	0.146	Theta star (bias corrected MLE)	0.153
nu hat (MLE)	636.2	nu star (bias corrected)	610.7
MLE Mean (bias corrected)	0.656	MLE Sd (bias corrected)	0.316

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.447	nu hat (KM)	565.3
Approximate Chi Square Value (565.26, α)	511.1	Adjusted Chi Square Value (565.26, β)	510.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.714	95% Gamma Adjusted KM-UCL (use when n<50)	0.716

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.17	Mean	0.646
Maximum	2.36	Median	0.6
SD	0.348	CV	0.539
k hat (MLE)	4.697	k star (bias corrected MLE)	4.533
Theta hat (MLE)	0.138	Theta star (bias corrected MLE)	0.143
nu hat (MLE)	770.3	nu star (bias corrected)	743.5
MLE Mean (bias corrected)	0.646	MLE Sd (bias corrected)	0.304
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (743.48, α)	681.2	Adjusted Chi Square Value (743.48, β)	680.2
95% Gamma Approximate UCL (use when n>=50)	0.705	95% Gamma Adjusted UCL (use when n<50)	0.706

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.103	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.105	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	0.645	Mean in Log Scale	-0.546
SD in Original Scale	0.346	SD in Log Scale	0.456
95% t UCL (assumes normality of ROS data)	0.709	95% Percentile Bootstrap UCL	0.706
95% BCA Bootstrap UCL	0.722	95% Bootstrap t UCL	0.725
95% H-UCL (Log ROS)	0.705		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.548	95% H-UCL (KM -Log)	0.706
KM SD (logged)	0.462	95% Critical H Value (KM-Log)	1.821
KM Standard Error of Mean (logged)	0.0541		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.684	Mean in Log Scale	-0.519
SD in Original Scale	0.448	SD in Log Scale	0.499
95% t UCL (Assumes normality)	0.766	95% H-Stat UCL	0.747

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

95% KM (BCA) UCL	0.715

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

Result (cadmium)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	25
Number of Detects	33	Number of Non-Detects	47
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	0.32	Minimum Non-Detect	2
Maximum Detect	5.65	Maximum Non-Detect	2
Variance Detects	1.07	Percent Non-Detects	58.75%
Mean Detects	1.371	SD Detects	1.035
Median Detects	1	CV Detects	0.755
Skewness Detects	2.413	Kurtosis Detects	8.216
Mean of Logged Detects	0.108	SD of Logged Detects	0.632

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.769	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.931	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.185	**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

Mean	1.154	Standard Error of Mean	0.109
SD	0.764	95% KM (BCA) UCL	1.33
95% KM (t) UCL	1.335	95% KM (Percentile Bootstrap) UCL	1.333
95% KM (z) UCL	1.333	95% KM Bootstrap t UCL	1.356
90% KM Chebyshev UCL	1.48	95% KM Chebyshev UCL	1.628
97.5% KM Chebyshev UCL	1.833	99% KM Chebyshev UCL	2.237

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.788	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.756	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.15	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.155	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)	2.569	k star (bias corrected MLE)	2.356
Theta hat (MLE)	0.533	Theta star (bias corrected MLE)	0.582
nu hat (MLE)	169.6	nu star (bias corrected)	155.5
MLE Mean (bias corrected)	1.371	MLE Sd (bias corrected)	0.893

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.28	nu hat (KM)	364.8
Approximate Chi Square Value (364.75, α)	321.5	Adjusted Chi Square Value (364.75, β)	320.8
95% Gamma Approximate KM-UCL (use when n>=50)	1.309	95% Gamma Adjusted KM-UCL (use when n<50)	1.312

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0636	Mean	1.158
Maximum	5.65	Median	0.952
SD	0.814	CV	0.703
k hat (MLE)	2.352	k star (bias corrected MLE)	2.272
Theta hat (MLE)	0.492	Theta star (bias corrected MLE)	0.51
nu hat (MLE)	376.3	nu star (bias corrected)	363.5
MLE Mean (bias corrected)	1.158	MLE Sd (bias corrected)	0.768
		Adjusted Level of Significance (β)	0.047
Approximate Chi Square Value (363.49, α)	320.3	Adjusted Chi Square Value (363.49, β)	319.6
95% Gamma Approximate UCL (use when n>=50)	1.314	95% Gamma Adjusted UCL (use when n<50)	1.317

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.931	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.12	**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	1.156	Mean in Log Scale	-0.0157
SD in Original Scale	0.767	SD in Log Scale	0.554
95% t UCL (assumes normality of ROS data)	1.298	95% Percentile Bootstrap UCL	1.31
95% BCA Bootstrap UCL	1.336	95% Bootstrap t UCL	1.341
95% H-UCL (Log ROS)	1.292		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.0152	95% H-UCL (KM -Log)	1.279
KM SD (logged)	0.541	95% Critical H Value (KM-Log)	1.885
KM Standard Error of Mean (logged)	0.09		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.153	Mean in Log Scale	0.0446
SD in Original Scale	0.684	SD in Log Scale	0.405
95% t UCL (Assumes normality)	1.28	95% H-Stat UCL	1.233

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 (t) UCL	1.335	95% GROS Approximate Gamma UCL	1.314
95% Approximate Gamma KM-UCL	1.309		

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

Result (chromium)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	2	Mean	8.863
Maximum	37	Median	8
SD	5.923	Std. Error of Mean	0.662
Coefficient of Variation	0.668	Skewness	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.777	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.22	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.965	95% Adjusted-CLT UCL (Chen-1995)	10.15
		95% Modified-t UCL (Johnson-1978)	9.996

Gamma GOF Test

A-D Test Statistic	1.308	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.1	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.13	k star (bias corrected MLE)	3.021
Theta hat (MLE)	2.831	Theta star (bias corrected MLE)	2.933
nu hat (MLE)	500.9	nu star (bias corrected)	483.4
MLE Mean (bias corrected)	8.863	MLE Sd (bias corrected)	5.099
		Approximate Chi Square Value (0.05)	433.4
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	432.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9.885	95% Adjusted Gamma UCL (use when n<50)	9.904

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0944	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.014
Maximum of Logged Data	3.611	SD of logged Data	0.577

Assuming Lognormal Distribution

95% H-UCL	10.02	90% Chebyshev (MVUE) UCL	10.66
95% Chebyshev (MVUE) UCL	11.48	97.5% Chebyshev (MVUE) UCL	12.63
99% Chebyshev (MVUE) UCL	14.89		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	9.952	95% Jackknife UCL	9.965
95% Standard Bootstrap UCL	9.954	95% Bootstrap-t UCL	10.25
95% Hall's Bootstrap UCL	10.3	95% Percentile Bootstrap UCL	10.04
95% BCA Bootstrap UCL	10.13		
90% Chebyshev(Mean, Sd) UCL	10.85	95% Chebyshev(Mean, Sd) UCL	11.75
97.5% Chebyshev(Mean, Sd) UCL	13	99% Chebyshev(Mean, Sd) UCL	15.45

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	11.75

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	70	Number of Distinct Observations	18
Number of Detects	69	Number of Non-Detects	1
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	1	Minimum Non-Detect	5
Maximum Detect	22	Maximum Non-Detect	5
Variance Detects	19.19	Percent Non-Detects	1.429%
Mean Detects	9.072	SD Detects	4.38
Median Detects	8	CV Detects	0.483
Skewness Detects	0.853	Kurtosis Detects	0.288
Mean of Logged Detects	2.084	SD of Logged Detects	0.521

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.93	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	8.5752E-4	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	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

Mean	8.992	Standard Error of Mean	0.526
SD	4.371	95% KM (BCA) UCL	9.914
95% KM (t) UCL	9.87	95% KM (Percentile Bootstrap) UCL	9.843
95% KM (z) UCL	9.858	95% KM Bootstrap t UCL	9.935
90% KM Chebyshev UCL	10.57	95% KM Chebyshev UCL	11.29
97.5% KM Chebyshev UCL	12.28	99% KM Chebyshev UCL	14.23

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.509	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0875	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.108	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)	4.298	k star (bias corrected MLE)	4.121
Theta hat (MLE)	2.111	Theta star (bias corrected MLE)	2.201
nu hat (MLE)	593.2	nu star (bias corrected)	568.7
MLE Mean (bias corrected)	9.072	MLE Sd (bias corrected)	4.469

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.233	nu hat (KM)	592.6
Approximate Chi Square Value (592.58, α)	537.1	Adjusted Chi Square Value (592.58, β)	536
95% Gamma Approximate KM-UCL (use when n>=50)	9.92	95% Gamma Adjusted KM-UCL (use when n<50)	9.941

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1	Mean	8.987
Maximum	22	Median	8
SD	4.407	CV	0.49
k hat (MLE)	4.158	k star (bias corrected MLE)	3.989
Theta hat (MLE)	2.162	Theta star (bias corrected MLE)	2.253
nu hat (MLE)	582.1	nu star (bias corrected)	558.5
MLE Mean (bias corrected)	8.987	MLE Sd (bias corrected)	4.5
		Adjusted Level of Significance (β)	0.0466
Approximate Chi Square Value (558.45, α)	504.6	Adjusted Chi Square Value (558.45, β)	503.6
95% Gamma Approximate UCL (use when n>=50)	9.945	95% Gamma Adjusted UCL (use when n<50)	9.966

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0796	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	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	8.992	Mean in Log Scale	2.072
SD in Original Scale	4.4	SD in Log Scale	0.527
95% t UCL (assumes normality of ROS data)	9.869	95% Percentile Bootstrap UCL	9.869
95% BCA Bootstrap UCL	9.878	95% Bootstrap t UCL	9.86
95% H-UCL (Log ROS)	10.29		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.071	95% H-UCL (KM -Log)	10.29
KM SD (logged)	0.529	95% Critical H Value (KM-Log)	1.889
KM Standard Error of Mean (logged)	0.0641		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.979	Mean in Log Scale	2.068
SD in Original Scale	4.419	SD in Log Scale	0.536
95% t UCL (Assumes normality)	9.859	95% H-Stat UCL	10.32

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 (BCA) UCL	9.914	95% GROS Approximate Gamma UCL	9.945
95% Approximate Gamma KM-UCL	9.92		

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

Result (copper)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	81
		Number of Missing Observations	0
Minimum	62	Mean	2606
Maximum	30200	Median	778.5
SD	4871	Std. Error of Mean	537.9
Coefficient of Variation	1.869	Skewness	4.218

Normal GOF Test

Shapiro Wilk Test Statistic	0.507	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0978	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	3501	95% Adjusted-CLT UCL (Chen-1995)	3758
		95% Modified-t UCL (Johnson-1978)	3543

Gamma GOF Test

A-D Test Statistic	3.504	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.8	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.2	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.103	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.681	k star (bias corrected MLE)	0.664
Theta hat (MLE)	3828	Theta star (bias corrected MLE)	3924
nu hat (MLE)	111.6	nu star (bias corrected)	108.9
MLE Mean (bias corrected)	2606	MLE Sd (bias corrected)	3198
		Approximate Chi Square Value (0.05)	85.81
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	85.45

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3307	95% Adjusted Gamma UCL (use when n<50)	3321

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0862	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0978	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.127	Mean of logged Data	6.974
Maximum of Logged Data	10.32	SD of logged Data	1.288

Assuming Lognormal Distribution

95% H-UCL	3514	90% Chebyshev (MVUE) UCL	3734
95% Chebyshev (MVUE) UCL	4335	97.5% Chebyshev (MVUE) UCL	5171
99% Chebyshev (MVUE) UCL	6812		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3491	95% Jackknife UCL	3501
95% Standard Bootstrap UCL	3485	95% Bootstrap-t UCL	4118
95% Hall's Bootstrap UCL	7497	95% Percentile Bootstrap UCL	3605
95% BCA Bootstrap UCL	3978		
90% Chebyshev(Mean, Sd) UCL	4220	95% Chebyshev(Mean, Sd) UCL	4951
97.5% Chebyshev(Mean, Sd) UCL	5965	99% Chebyshev(Mean, Sd) UCL	7958

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4951

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	78
		Number of Missing Observations	0
Minimum	2.81	Mean	116.3
Maximum	3740	Median	47.1
SD	415.9	Std. Error of Mean	45.93
Coefficient of Variation	3.577	Skewness	8.39

Normal GOF Test

Shapiro Wilk Test Statistic	0.236	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.393	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0978	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	192.7	95% Adjusted-CLT UCL (Chen-1995)	237.3
		95% Modified-t UCL (Johnson-1978)	199.8

Gamma GOF Test

A-D Test Statistic	4.344	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.81	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.189	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.104	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.59	k star (bias corrected MLE)	0.577
Theta hat (MLE)	197	Theta star (bias corrected MLE)	201.6
nu hat (MLE)	96.81	nu star (bias corrected)	94.6
MLE Mean (bias corrected)	116.3	MLE Sd (bias corrected)	153.1
		Approximate Chi Square Value (0.05)	73.17
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	72.83

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	150.3	95% Adjusted Gamma UCL (use when n<50)	151

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.416	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.076	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0978	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.033	Mean of logged Data	3.707
Maximum of Logged Data	8.227	SD of logged Data	1.266

Assuming Lognormal Distribution

95% H-UCL	129.1	90% Chebyshev (MVUE) UCL	137.4
95% Chebyshev (MVUE) UCL	159.2	97.5% Chebyshev (MVUE) UCL	189.5
99% Chebyshev (MVUE) UCL	249		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	191.8	95% Jackknife UCL	192.7
95% Standard Bootstrap UCL	190.8	95% Bootstrap-t UCL	449.5
95% Hall's Bootstrap UCL	448.5	95% Percentile Bootstrap UCL	207.3
95% BCA Bootstrap UCL	252.1		
90% Chebyshev(Mean, Sd) UCL	254.1	95% Chebyshev(Mean, Sd) UCL	316.5
97.5% Chebyshev(Mean, Sd) UCL	403.1	99% Chebyshev(Mean, Sd) UCL	573.3

Suggested UCL to Use

95% H-UCL	129.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (manganese)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	76
		Number of Missing Observations	0
Minimum	30	Mean	336.2
Maximum	928	Median	328
SD	178.9	Std. Error of Mean	20.01
Coefficient of Variation	0.532	Skewness	0.927

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	9.7061E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.125	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0991	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	369.5	95% Adjusted-CLT UCL (Chen-1995)	371.3
		95% Modified-t UCL (Johnson-1978)	369.8

Gamma GOF Test

A-D Test Statistic	0.35	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0807	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.1	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.418	k star (bias corrected MLE)	3.298
Theta hat (MLE)	98.37	Theta star (bias corrected MLE)	101.9
nu hat (MLE)	546.8	nu star (bias corrected)	527.7
MLE Mean (bias corrected)	336.2	MLE Sd (bias corrected)	185.1
		Approximate Chi Square Value (0.05)	475.4
Adjusted Level of Significance	0.047	Adjusted Chi Square Value	474.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	373.2	95% Adjusted Gamma UCL (use when n<50)	373.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0712	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.113	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0991	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.401	Mean of logged Data	5.664
Maximum of Logged Data	6.833	SD of logged Data	0.596

Assuming Lognormal Distribution

95% H-UCL	391.9	90% Chebyshev (MVUE) UCL	417.5
95% Chebyshev (MVUE) UCL	450.9	97.5% Chebyshev (MVUE) UCL	497.4
99% Chebyshev (MVUE) UCL	588.7		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	369.1	95% Jackknife UCL	369.5
95% Standard Bootstrap UCL	369.2	95% Bootstrap-t UCL	372
95% Hall's Bootstrap UCL	373.1	95% Percentile Bootstrap UCL	368.9
95% BCA Bootstrap UCL	370.4		
90% Chebyshev(Mean, Sd) UCL	396.2	95% Chebyshev(Mean, Sd) UCL	423.4
97.5% Chebyshev(Mean, Sd) UCL	461.1	99% Chebyshev(Mean, Sd) UCL	535.2

Suggested UCL to Use

95% Approximate Gamma UCL	373.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (mercury)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	14
Number of Detects	24	Number of Non-Detects	56
Number of Distinct Detects	14	Number of Distinct Non-Detects	3
Minimum Detect	0.04	Minimum Non-Detect	0.04
Maximum Detect	0.36	Maximum Non-Detect	0.2
Variance Detects	0.00746	Percent Non-Detects	70%
Mean Detects	0.12	SD Detects	0.0864
Median Detects	0.09	CV Detects	0.722
Skewness Detects	1.602	Kurtosis Detects	1.968
Mean of Logged Detects	-2.328	SD of Logged Detects	0.631

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.803	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	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

Mean	0.0838	Standard Error of Mean	0.00879
SD	0.0603	95% KM (BCA) UCL	0.0988
95% KM (t) UCL	0.0984	95% KM (Percentile Bootstrap) UCL	0.0981
95% KM (z) UCL	0.0983	95% KM Bootstrap t UCL	0.101
90% KM Chebyshev UCL	0.11	95% KM Chebyshev UCL	0.122
97.5% KM Chebyshev UCL	0.139	99% KM Chebyshev UCL	0.171

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.688	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.18	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)	2.606	k star (bias corrected MLE)	2.308
Theta hat (MLE)	0.0459	Theta star (bias corrected MLE)	0.0518
nu hat (MLE)	125.1	nu star (bias corrected)	110.8
MLE Mean (bias corrected)	0.12	MLE Sd (bias corrected)	0.0787

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.934	nu hat (KM)	309.4
Approximate Chi Square Value (309.43, α)	269.7	Adjusted Chi Square Value (309.43, β)	269
95% Gamma Approximate KM-UCL (use when n>=50)	0.0962	95% Gamma Adjusted KM-UCL (use when n<50)	0.0964

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0771
Maximum	0.36	Median	0.0615
SD	0.0707	CV	0.916
k hat (MLE)	1.217	k star (bias corrected MLE)	1.18
Theta hat (MLE)	0.0634	Theta star (bias corrected MLE)	0.0654
nu hat (MLE)	194.7	nu star (bias corrected)	188.8
MLE Mean (bias corrected)	0.0771	MLE Sd (bias corrected)	0.071
		Adjusted Level of Significance (β)	0.047
Approximate Chi Square Value (188.76, α)	158	Adjusted Chi Square Value (188.76, β)	157.5
95% Gamma Approximate UCL (use when n>=50)	0.0922	95% Gamma Adjusted UCL (use when n<50)	0.0925

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.134	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	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	0.0805	Mean in Log Scale	-2.774
SD in Original Scale	0.064	SD in Log Scale	0.715
95% t UCL (assumes normality of ROS data)	0.0924	95% Percentile Bootstrap UCL	0.0929
95% BCA Bootstrap UCL	0.0952	95% Bootstrap t UCL	0.0949
95% H-UCL (Log ROS)	0.0946		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.66	95% H-UCL (KM -Log)	0.0925
KM SD (logged)	0.564	95% Critical H Value (KM-Log)	1.9
KM Standard Error of Mean (logged)	0.0946		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0981	Mean in Log Scale	-2.463
SD in Original Scale	0.0539	SD in Log Scale	0.572
95% t UCL (Assumes normality)	0.108	95% H-Stat UCL	0.113

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 (t) UCL	0.0984	95% GROS Approximate Gamma UCL	0.0922
95% Approximate Gamma KM-UCL	0.0962		

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

Result (molybdenum)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	73
Number of Detects	81	Number of Non-Detects	1
Number of Distinct Detects	72	Number of Distinct Non-Detects	1
Minimum Detect	3	Minimum Non-Detect	5
Maximum Detect	6830	Maximum Non-Detect	5
Variance Detects	1542342	Percent Non-Detects	1.22%
Mean Detects	624.8	SD Detects	1242
Median Detects	154	CV Detects	1.988
Skewness Detects	3.621	Kurtosis Detects	14.25
Mean of Logged Detects	5.077	SD of Logged Detects	1.793

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.523	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.308	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	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

Mean	617.2	Standard Error of Mean	136.5
SD	1229	95% KM (BCA) UCL	847
95% KM (t) UCL	844.3	95% KM (Percentile Bootstrap) UCL	852
95% KM (z) UCL	841.7	95% KM Bootstrap t UCL	934.3
90% KM Chebyshev UCL	1027	95% KM Chebyshev UCL	1212
97.5% KM Chebyshev UCL	1470	99% KM Chebyshev UCL	1976

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.862	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.826	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.134	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.105	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)	0.471	k star (bias corrected MLE)	0.462
Theta hat (MLE)	1325	Theta star (bias corrected MLE)	1352
nu hat (MLE)	76.37	nu star (bias corrected)	74.87
MLE Mean (bias corrected)	624.8	MLE Sd (bias corrected)	919

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.252	nu hat (KM)	41.39
Approximate Chi Square Value (41.39, α)	27.64	Adjusted Chi Square Value (41.39, β)	27.44
95% Gamma Approximate KM-UCL (use when n>=50)	924.1	95% Gamma Adjusted KM-UCL (use when n<50)	930.8

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	617.1
Maximum	6830	Median	152.5
SD	1236	CV	2.003
k hat (MLE)	0.442	k star (bias corrected MLE)	0.434
Theta hat (MLE)	1397	Theta star (bias corrected MLE)	1423
nu hat (MLE)	72.46	nu star (bias corrected)	71.15
MLE Mean (bias corrected)	617.1	MLE Sd (bias corrected)	937
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (71.15, α)	52.73	Adjusted Chi Square Value (71.15, β)	52.44
95% Gamma Approximate UCL (use when n>=50)	832.7	95% Gamma Adjusted UCL (use when n<50)	837.2

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.057	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	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	617.2	Mean in Log Scale	5.029
SD in Original Scale	1236	SD in Log Scale	1.836
95% t UCL (assumes normality of ROS data)	844.3	95% Percentile Bootstrap UCL	848
95% BCA Bootstrap UCL	924.9	95% Bootstrap t UCL	945.6
95% H-UCL (Log ROS)	1570		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	5.029	95% H-UCL (KM -Log)	1526
KM SD (logged)	1.824	95% Critical H Value (KM-Log)	3.145
KM Standard Error of Mean (logged)	0.203		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	617.2	Mean in Log Scale	5.027
SD in Original Scale	1236	SD in Log Scale	1.84
95% t UCL (Assumes normality)	844.3	95% H-Stat UCL	1584

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

97.5% KM (Chebyshev) UCL	1470

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

Result (nickel)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	16
Number of Detects	71	Number of Non-Detects	9
Number of Distinct Detects	15	Number of Distinct Non-Detects	2
Minimum Detect	2	Minimum Non-Detect	1
Maximum Detect	25	Maximum Non-Detect	5
Variance Detects	14.97	Percent Non-Detects	11.25%
Mean Detects	6.535	SD Detects	3.869
Median Detects	6	CV Detects	0.592
Skewness Detects	2.276	Kurtosis Detects	8.031
Mean of Logged Detects	1.734	SD of Logged Detects	0.539

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.814	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	3.212E-12	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.213	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.105	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

Mean	6.061	Standard Error of Mean	0.438
SD	3.873	95% KM (BCA) UCL	6.844
95% KM (t) UCL	6.79	95% KM (Percentile Bootstrap) UCL	6.801
95% KM (z) UCL	6.781	95% KM Bootstrap t UCL	6.914
90% KM Chebyshev UCL	7.374	95% KM Chebyshev UCL	7.969
97.5% KM Chebyshev UCL	8.795	99% KM Chebyshev UCL	10.42

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.156	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.756	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.14	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.106	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)	3.66	k star (bias corrected MLE)	3.515
Theta hat (MLE)	1.785	Theta star (bias corrected MLE)	1.859
nu hat (MLE)	519.7	nu star (bias corrected)	499.1
MLE Mean (bias corrected)	6.535	MLE Sd (bias corrected)	3.486

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.449	nu hat (KM)	391.8
Approximate Chi Square Value (391.78, α)	346.9	Adjusted Chi Square Value (391.78, β)	346.1
95% Gamma Approximate KM-UCL (use when n>=50)	6.845	95% Gamma Adjusted KM-UCL (use when n<50)	6.861

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.003
Maximum	25	Median	6
SD	3.961	CV	0.66
k hat (MLE)	2.05	k star (bias corrected MLE)	1.981
Theta hat (MLE)	2.928	Theta star (bias corrected MLE)	3.03
nu hat (MLE)	328	nu star (bias corrected)	317
MLE Mean (bias corrected)	6.003	MLE Sd (bias corrected)	4.265
		Adjusted Level of Significance (β)	0.047
Approximate Chi Square Value (317.01, α)	276.8	Adjusted Chi Square Value (317.01, β)	276.1
95% Gamma Approximate UCL (use when n>=50)	6.876	95% Gamma Adjusted UCL (use when n<50)	6.893

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.105	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	6.084	Mean in Log Scale	1.637
SD in Original Scale	3.868	SD in Log Scale	0.589
95% t UCL (assumes normality of ROS data)	6.803	95% Percentile Bootstrap UCL	6.859
95% BCA Bootstrap UCL	6.938	95% Bootstrap t UCL	6.978
95% H-UCL (Log ROS)	6.942		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	6.031	Mean in Log Scale	1.602
SD in Original Scale	3.92	SD in Log Scale	0.669
95% t UCL (Assumes normality)	6.761	95% H-Stat UCL	7.201

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 (BCA) UCL	6.844

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

Result (selenium)

General Statistics

Total Number of Observations	80	Number of Distinct Observations	65
Number of Detects	66	Number of Non-Detects	14
Number of Distinct Detects	57	Number of Distinct Non-Detects	11
Minimum Detect	0.05	Minimum Non-Detect	0.26
Maximum Detect	9.4	Maximum Non-Detect	11.1
Variance Detects	3.258	Percent Non-Detects	17.5%
Mean Detects	1.451	SD Detects	1.805
Median Detects	0.52	CV Detects	1.244
Skewness Detects	2.16	Kurtosis Detects	5.886
Mean of Logged Detects	-0.375	SD of Logged Detects	1.3

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.742	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	1.776E-15	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.232	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.109	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

Mean	1.284	Standard Error of Mean	0.196
SD	1.709	95% KM (BCA) UCL	1.662
95% KM (t) UCL	1.611	95% KM (Percentile Bootstrap) UCL	1.636
95% KM (z) UCL	1.607	95% KM Bootstrap t UCL	1.696
90% KM Chebyshev UCL	1.873	95% KM Chebyshev UCL	2.139
97.5% KM Chebyshev UCL	2.51	99% KM Chebyshev UCL	3.237

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.656	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.79	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.166	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.114	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)	0.795	k star (bias corrected MLE)	0.769
Theta hat (MLE)	1.826	Theta star (bias corrected MLE)	1.888
nu hat (MLE)	104.9	nu star (bias corrected)	101.5
MLE Mean (bias corrected)	1.451	MLE Sd (bias corrected)	1.655

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.564	nu hat (KM)	90.32
Approximate Chi Square Value (90.32, α)	69.4	Adjusted Chi Square Value (90.32, β)	69.07
95% Gamma Approximate KM-UCL (use when n>=50)	1.671	95% Gamma Adjusted KM-UCL (use when n<50)	1.679

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.245
Maximum	9.4	Median	0.47
SD	1.705	CV	1.37
k hat (MLE)	0.645	k star (bias corrected MLE)	0.629
Theta hat (MLE)	1.93	Theta star (bias corrected MLE)	1.978
nu hat (MLE)	103.2	nu star (bias corrected)	100.7
MLE Mean (bias corrected)	1.245	MLE Sd (bias corrected)	1.569
		Adjusted Level of Significance (β)	0.047
Approximate Chi Square Value (100.65, α)	78.5	Adjusted Chi Square Value (100.65, β)	78.15
95% Gamma Approximate UCL (use when n>=50)	1.596	95% Gamma Adjusted UCL (use when n<50)	1.603

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.109	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	1.257	Mean in Log Scale	-0.528
SD in Original Scale	1.694	SD in Log Scale	1.248
95% t UCL (assumes normality of ROS data)	1.572	95% Percentile Bootstrap UCL	1.572
95% BCA Bootstrap UCL	1.648	95% Bootstrap t UCL	1.649
95% H-UCL (Log ROS)	1.833		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.422	Mean in Log Scale	-0.426
SD in Original Scale	1.803	SD in Log Scale	1.303
95% t UCL (Assumes normality)	1.757	95% H-Stat UCL	2.231

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	2.139

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

Result (thallium)

General Statistics

Total Number of Observations	78	Number of Distinct Observations	31
Number of Detects	67	Number of Non-Detects	11
Number of Distinct Detects	30	Number of Distinct Non-Detects	9
Minimum Detect	0.07	Minimum Non-Detect	0.12
Maximum Detect	0.89	Maximum Non-Detect	0.3
Variance Detects	0.015	Percent Non-Detects	14.1%
Mean Detects	0.254	SD Detects	0.123
Median Detects	0.22	CV Detects	0.482
Skewness Detects	2.728	Kurtosis Detects	11.01
Mean of Logged Detects	-1.452	SD of Logged Detects	0.397

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.784	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	3.137E-13	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	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

Mean	0.239	Standard Error of Mean	0.0139
SD	0.12	95% KM (BCA) UCL	0.264
95% KM (t) UCL	0.262	95% KM (Percentile Bootstrap) UCL	0.264
95% KM (z) UCL	0.262	95% KM Bootstrap t UCL	0.267
90% KM Chebyshev UCL	0.281	95% KM Chebyshev UCL	0.3
97.5% KM Chebyshev UCL	0.326	99% KM Chebyshev UCL	0.377

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.339	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.109	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)	6.126	k star (bias corrected MLE)	5.862
Theta hat (MLE)	0.0415	Theta star (bias corrected MLE)	0.0434
nu hat (MLE)	820.9	nu star (bias corrected)	785.5
MLE Mean (bias corrected)	0.254	MLE Sd (bias corrected)	0.105

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.943	nu hat (KM)	615.2
Approximate Chi Square Value (615.15, α)	558.6	Adjusted Chi Square Value (615.15, β)	557.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.263	95% Gamma Adjusted KM-UCL (use when n<50)	0.264

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0465	Mean	0.237
Maximum	0.89	Median	0.21
SD	0.123	CV	0.52
k hat (MLE)	4.843	k star (bias corrected MLE)	4.665
Theta hat (MLE)	0.0488	Theta star (bias corrected MLE)	0.0507
nu hat (MLE)	755.5	nu star (bias corrected)	727.8
MLE Mean (bias corrected)	0.237	MLE Sd (bias corrected)	0.11
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (727.80, α)	666.2	Adjusted Chi Square Value (727.80, β)	665.1
95% Gamma Approximate UCL (use when n>=50)	0.258	95% Gamma Adjusted UCL (use when n<50)	0.259

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0909	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	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	0.239	Mean in Log Scale	-1.521
SD in Original Scale	0.12	SD in Log Scale	0.414
95% t UCL (assumes normality of ROS data)	0.262	95% Percentile Bootstrap UCL	0.261
95% BCA Bootstrap UCL	0.268	95% Bootstrap t UCL	0.268
95% H-UCL (Log ROS)	0.259		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.529	95% H-UCL (KM -Log)	0.261
KM SD (logged)	0.436	95% Critical H Value (KM-Log)	1.819
KM Standard Error of Mean (logged)	0.0518		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.233	Mean in Log Scale	-1.574
SD in Original Scale	0.126	SD in Log Scale	0.485
95% t UCL (Assumes normality)	0.257	95% H-Stat UCL	0.258

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

95% KM (BCA) UCL	0.264

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.

Result (uranium)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	62
		Number of Missing Observations	0
Minimum	1.17	Mean	4.677
Maximum	13.4	Median	3.835
SD	2.401	Std. Error of Mean	0.296
Coefficient of Variation	0.513	Skewness	1.614

Normal GOF Test

Shapiro Wilk Test Statistic	0.843	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	2.5521E-9	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.109	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	5.17	95% Adjusted-CLT UCL (Chen-1995)	5.226
		95% Modified-t UCL (Johnson-1978)	5.18

Gamma GOF Test

A-D Test Statistic	1.55	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.139	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.11	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.817	k star (bias corrected MLE)	4.608
Theta hat (MLE)	0.971	Theta star (bias corrected MLE)	1.015
nu hat (MLE)	635.8	nu star (bias corrected)	608.2
MLE Mean (bias corrected)	4.677	MLE Sd (bias corrected)	2.179
		Approximate Chi Square Value (0.05)	552
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	550.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.153	95% Adjusted Gamma UCL (use when n<50)	5.164

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.291	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.109	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.157	Mean of logged Data	1.435
Maximum of Logged Data	2.595	SD of logged Data	0.455

Assuming Lognormal Distribution

95% H-UCL	5.169	90% Chebyshev (MVUE) UCL	5.468
95% Chebyshev (MVUE) UCL	5.837	97.5% Chebyshev (MVUE) UCL	6.35
99% Chebyshev (MVUE) UCL	7.359		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5.163	95% Jackknife UCL	5.17
95% Standard Bootstrap UCL	5.171	95% Bootstrap-t UCL	5.219
95% Hall's Bootstrap UCL	5.231	95% Percentile Bootstrap UCL	5.153
95% BCA Bootstrap UCL	5.243		
90% Chebyshev(Mean, Sd) UCL	5.564	95% Chebyshev(Mean, Sd) UCL	5.965
97.5% Chebyshev(Mean, Sd) UCL	6.523	99% Chebyshev(Mean, Sd) UCL	7.618

Suggested UCL to Use

95% Student's-t UCL	5.17	or 95% Modified-t UCL	5.18
or 95% H-UCL	5.169		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (zinc)

General Statistics

Total Number of Observations	78	Number of Distinct Observations	68
		Number of Missing Observations	0
Minimum	25	Mean	179.5
Maximum	824	Median	141.5
SD	150.6	Std. Error of Mean	17.06
Coefficient of Variation	0.839	Skewness	1.872

Normal GOF Test

Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	2.163E-13	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.1	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	207.9	95% Adjusted-CLT UCL (Chen-1995)	211.4
		95% Modified-t UCL (Johnson-1978)	208.5

Gamma GOF Test

A-D Test Statistic	0.814	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.109	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.103	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.801	k star (bias corrected MLE)	1.74
Theta hat (MLE)	99.65	Theta star (bias corrected MLE)	103.1
nu hat (MLE)	281	nu star (bias corrected)	271.5
MLE Mean (bias corrected)	179.5	MLE Sd (bias corrected)	136.1
		Approximate Chi Square Value (0.05)	234.4
Adjusted Level of Significance	0.0469	Adjusted Chi Square Value	233.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	208	95% Adjusted Gamma UCL (use when n<50)	208.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.312	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.081	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.1	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.219	Mean of logged Data	4.888
Maximum of Logged Data	6.714	SD of logged Data	0.789

Assuming Lognormal Distribution

95% H-UCL	218	90% Chebyshev (MVUE) UCL	234.5
95% Chebyshev (MVUE) UCL	259.1	97.5% Chebyshev (MVUE) UCL	293.3
99% Chebyshev (MVUE) UCL	360.4		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	207.6	95% Jackknife UCL	207.9
95% Standard Bootstrap UCL	206.9	95% Bootstrap-t UCL	211.7
95% Hall's Bootstrap UCL	214.3	95% Percentile Bootstrap UCL	208.4
95% BCA Bootstrap UCL	209.9		
90% Chebyshev(Mean, Sd) UCL	230.7	95% Chebyshev(Mean, Sd) UCL	253.8
97.5% Chebyshev(Mean, Sd) UCL	286	99% Chebyshev(Mean, Sd) UCL	349.2

Suggested UCL to Use

95% H-UCL	218

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (antimony)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	30
Number of Detects	86	Number of Non-Detects	28
Number of Distinct Detects	30	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	0.2
Maximum Detect	69	Maximum Non-Detect	1
Variance Detects	60.64	Percent Non-Detects	24.56%
Mean Detects	2.327	SD Detects	7.787
Median Detects	0.55	CV Detects	3.347
Skewness Detects	7.692	Kurtosis Detects	64.99
Mean of Logged Detects	-0.259	SD of Logged Detects	1.171

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.281	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.392	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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

Mean	1.86	Standard Error of Mean	0.638
SD	6.774	95% KM (BCA) UCL	3.124
95% KM (t) UCL	2.918	95% KM (Percentile Bootstrap) UCL	3.02
95% KM (z) UCL	2.91	95% KM Bootstrap t UCL	5.081
90% KM Chebyshev UCL	3.775	95% KM Chebyshev UCL	4.642
97.5% KM Chebyshev UCL	5.846	99% KM Chebyshev UCL	8.211

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.997	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.812	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.245	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.102	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)	0.565	k star (bias corrected MLE)	0.553
Theta hat (MLE)	4.119	Theta star (bias corrected MLE)	4.209
nu hat (MLE)	97.15	nu star (bias corrected)	95.09
MLE Mean (bias corrected)	2.327	MLE Sd (bias corrected)	3.129

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0754	nu hat (KM)	17.18
Approximate Chi Square Value (17.18, α)	8.803	Adjusted Chi Square Value (17.18, β)	8.726
95% Gamma Approximate KM-UCL (use when n>=50)	3.63	95% Gamma Adjusted KM-UCL (use when n<50)	3.662

Gamma (KM) may not be used when k hat (KM) is < 0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.841
Maximum	69	Median	0.5
SD	6.817	CV	3.702
k hat (MLE)	0.403	k star (bias corrected MLE)	0.398
Theta hat (MLE)	4.574	Theta star (bias corrected MLE)	4.629
nu hat (MLE)	91.79	nu star (bias corrected)	90.71
MLE Mean (bias corrected)	1.841	MLE Sd (bias corrected)	2.919
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (90.71, α)	69.75	Adjusted Chi Square Value (90.71, β)	69.51
95% Gamma Approximate UCL (use when n>=50)	2.395	95% Gamma Adjusted UCL (use when n<50)	2.403

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.166	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0955	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	1.881	Mean in Log Scale	-0.433
SD in Original Scale	6.802	SD in Log Scale	1.142
95% t UCL (assumes normality of ROS data)	2.937	95% Percentile Bootstrap UCL	3.089
95% BCA Bootstrap UCL	3.639	95% Bootstrap t UCL	5.161
95% H-UCL (Log ROS)	1.604		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.875	Mean in Log Scale	-0.38
SD in Original Scale	6.801	SD in Log Scale	1.048
95% t UCL (Assumes normality)	2.931	95% H-Stat UCL	1.48

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	4.642

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

Result (arsenic)

General Statistics

Total Number of Observations	119	Number of Distinct Observations	88
Number of Detects	112	Number of Non-Detects	7
Number of Distinct Detects	81	Number of Distinct Non-Detects	7
Minimum Detect	1	Minimum Non-Detect	10.1
Maximum Detect	101	Maximum Non-Detect	89.7
Variance Detects	150.7	Percent Non-Detects	5.882%
Mean Detects	7.913	SD Detects	12.27
Median Detects	4.3	CV Detects	1.551
Skewness Detects	5.204	Kurtosis Detects	33.51
Mean of Logged Detects	1.588	SD of Logged Detects	0.882

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.498	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.287	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0837	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

Mean	7.8	Standard Error of Mean	1.108
SD	11.95	95% KM (BCA) UCL	9.822
95% KM (t) UCL	9.637	95% KM (Percentile Bootstrap) UCL	9.734
95% KM (z) UCL	9.623	95% KM Bootstrap t UCL	10.96
90% KM Chebyshev UCL	11.12	95% KM Chebyshev UCL	12.63
97.5% KM Chebyshev UCL	14.72	99% KM Chebyshev UCL	18.83

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.217	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.778	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.178	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0886	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)	1.18	k star (bias corrected MLE)	1.154
Theta hat (MLE)	6.705	Theta star (bias corrected MLE)	6.854
nu hat (MLE)	264.3	nu star (bias corrected)	258.6
MLE Mean (bias corrected)	7.913	MLE Sd (bias corrected)	7.365

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.426	nu hat (KM)	101.4
Approximate Chi Square Value (101.44, α)	79.2	Adjusted Chi Square Value (101.44, β)	78.96
95% Gamma Approximate KM-UCL (use when n>=50)	9.99	95% Gamma Adjusted KM-UCL (use when n<50)	10.02

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1	Mean	7.698
Maximum	101	Median	4.426
SD	11.94	CV	1.551
k hat (MLE)	1.223	k star (bias corrected MLE)	1.197
Theta hat (MLE)	6.297	Theta star (bias corrected MLE)	6.429
nu hat (MLE)	291	nu star (bias corrected)	285
MLE Mean (bias corrected)	7.698	MLE Sd (bias corrected)	7.035
		Adjusted Level of Significance (β)	0.048
Approximate Chi Square Value (284.98, α)	246.9	Adjusted Chi Square Value (284.98, β)	246.4
95% Gamma Approximate UCL (use when n>=50)	8.886	95% Gamma Adjusted UCL (use when n<50)	8.902

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.107	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0837	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	7.718	Mean in Log Scale	1.584
SD in Original Scale	11.93	SD in Log Scale	0.856
95% t UCL (assumes normality of ROS data)	9.531	95% Percentile Bootstrap UCL	9.711
95% BCA Bootstrap UCL	10.42	95% Bootstrap t UCL	10.94
95% H-UCL (Log ROS)	8.293		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.672	Mean in Log Scale	1.663
SD in Original Scale	12.63	SD in Log Scale	0.919
95% t UCL (Assumes normality)	10.59	95% H-Stat UCL	9.651

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 (BCA) UCL	9.822

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

Result (barium)

General Statistics

Total Number of Observations	95	Number of Distinct Observations	83
		Number of Missing Observations	0
Minimum	39.2	Mean	113.2
Maximum	366	Median	99.1
SD	56.94	Std. Error of Mean	5.842
Coefficient of Variation	0.503	Skewness	1.713

Normal GOF Test

Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	7.086E-12	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0909	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	122.9	95% Adjusted-CLT UCL (Chen-1995)	123.9
		95% Modified-t UCL (Johnson-1978)	123.1

Gamma GOF Test

A-D Test Statistic	0.756	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0871	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.092	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	4.891	k star (bias corrected MLE)	4.743
Theta hat (MLE)	23.15	Theta star (bias corrected MLE)	23.87
nu hat (MLE)	929.3	nu star (bias corrected)	901.3
MLE Mean (bias corrected)	113.2	MLE Sd (bias corrected)	51.98
		Approximate Chi Square Value (0.05)	832.6
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	831.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	122.6	95% Adjusted Gamma UCL (use when n<50)	122.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.593	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0639	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0909	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.669	Mean of logged Data	4.624
Maximum of Logged Data	5.903	SD of logged Data	0.454

Assuming Lognormal Distribution

95% H-UCL	123	90% Chebyshev (MVUE) UCL	129.2
95% Chebyshev (MVUE) UCL	136.7	97.5% Chebyshev (MVUE) UCL	147
99% Chebyshev (MVUE) UCL	167.4		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	122.8	95% Jackknife UCL	122.9
95% Standard Bootstrap UCL	123.1	95% Bootstrap-t UCL	125
95% Hall's Bootstrap UCL	124.6	95% Percentile Bootstrap UCL	122.7
95% BCA Bootstrap UCL	124.5		
90% Chebyshev(Mean, Sd) UCL	130.7	95% Chebyshev(Mean, Sd) UCL	138.7
97.5% Chebyshev(Mean, Sd) UCL	149.7	99% Chebyshev(Mean, Sd) UCL	171.3

Suggested UCL to Use

95% Approximate Gamma UCL	122.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	119	Number of Distinct Observations	34
Number of Detects	107	Number of Non-Detects	12
Number of Distinct Detects	33	Number of Distinct Non-Detects	2
Minimum Detect	0.17	Minimum Non-Detect	1
Maximum Detect	6.2	Maximum Non-Detect	5
Variance Detects	0.388	Percent Non-Detects	10.08%
Mean Detects	0.716	SD Detects	0.623
Median Detects	0.6	CV Detects	0.87
Skewness Detects	6.841	Kurtosis Detects	57.79
Mean of Logged Detects	-0.478	SD of Logged Detects	0.476

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	0.281	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0857	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

Mean	0.705	Standard Error of Mean	0.0549
SD	0.592	95% KM (BCA) UCL	0.807
95% KM (t) UCL	0.796	95% KM (Percentile Bootstrap) UCL	0.799
95% KM (z) UCL	0.795	95% KM Bootstrap t UCL	0.886
90% KM Chebyshev UCL	0.869	95% KM Chebyshev UCL	0.944
97.5% KM Chebyshev UCL	1.048	99% KM Chebyshev UCL	1.251

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.467	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.757	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.176	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0881	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)	3.636	k star (bias corrected MLE)	3.54
Theta hat (MLE)	0.197	Theta star (bias corrected MLE)	0.202
nu hat (MLE)	778.1	nu star (bias corrected)	757.6
MLE Mean (bias corrected)	0.716	MLE Sd (bias corrected)	0.381

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.416	nu hat (KM)	336.9
Approximate Chi Square Value (336.93, α)	295.4	Adjusted Chi Square Value (336.93, β)	294.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.804	95% Gamma Adjusted KM-UCL (use when n<50)	0.805

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.165	Mean	0.706
Maximum	6.2	Median	0.6
SD	0.598	CV	0.847
k hat (MLE)	3.657	k star (bias corrected MLE)	3.57
Theta hat (MLE)	0.193	Theta star (bias corrected MLE)	0.198
nu hat (MLE)	870.4	nu star (bias corrected)	849.8
MLE Mean (bias corrected)	0.706	MLE Sd (bias corrected)	0.373
		Adjusted Level of Significance (β)	0.048
Approximate Chi Square Value (849.77, α)	783.1	Adjusted Chi Square Value (849.77, β)	782.3
95% Gamma Approximate UCL (use when n>=50)	0.766	95% Gamma Adjusted UCL (use when n<50)	0.766

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0857	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	0.705	Mean in Log Scale	-0.484
SD in Original Scale	0.594	SD in Log Scale	0.462
95% t UCL (assumes normality of ROS data)	0.795	95% Percentile Bootstrap UCL	0.803
95% BCA Bootstrap UCL	0.848	95% Bootstrap t UCL	0.884
95% H-UCL (Log ROS)	0.741		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.728	Mean in Log Scale	-0.472
SD in Original Scale	0.637	SD in Log Scale	0.49
95% t UCL (Assumes normality)	0.825	95% H-Stat UCL	0.764

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 (BCA) UCL	0.807

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

Result (cadmium)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	35
Number of Detects	51	Number of Non-Detects	63
Number of Distinct Detects	35	Number of Distinct Non-Detects	1
Minimum Detect	0.26	Minimum Non-Detect	2
Maximum Detect	8.3	Maximum Non-Detect	2
Variance Detects	2.339	Percent Non-Detects	55.26%
Mean Detects	1.696	SD Detects	1.529
Median Detects	1.3	CV Detects	0.902
Skewness Detects	2.432	Kurtosis Detects	7.04
Mean of Logged Detects	0.241	SD of Logged Detects	0.74

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.741	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	2.869E-11	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.198	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	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

Mean	1.328	Standard Error of Mean	0.119
SD	1.121	95% KM (BCA) UCL	1.531
95% KM (t) UCL	1.525	95% KM (Percentile Bootstrap) UCL	1.545
95% KM (z) UCL	1.524	95% KM Bootstrap t UCL	1.554
90% KM Chebyshev UCL	1.685	95% KM Chebyshev UCL	1.846
97.5% KM Chebyshev UCL	2.071	99% KM Chebyshev UCL	2.511

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.034	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.764	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.131	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.126	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)	1.892	k star (bias corrected MLE)	1.794
Theta hat (MLE)	0.896	Theta star (bias corrected MLE)	0.945
nu hat (MLE)	193	nu star (bias corrected)	183
MLE Mean (bias corrected)	1.696	MLE Sd (bias corrected)	1.266

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.404	nu hat (KM)	320.1
Approximate Chi Square Value (320.07, α)	279.6	Adjusted Chi Square Value (320.07, β)	279.1
95% Gamma Approximate KM-UCL (use when n>=50)	1.52	95% Gamma Adjusted KM-UCL (use when n<50)	1.523

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.319
Maximum	8.3	Median	1
SD	1.203	CV	0.912
k hat (MLE)	1.234	k star (bias corrected MLE)	1.208
Theta hat (MLE)	1.069	Theta star (bias corrected MLE)	1.092
nu hat (MLE)	281.4	nu star (bias corrected)	275.4
MLE Mean (bias corrected)	1.319	MLE Sd (bias corrected)	1.2
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (275.38, α)	237.9	Adjusted Chi Square Value (275.38, β)	237.5
95% Gamma Approximate UCL (use when n>=50)	1.527	95% Gamma Adjusted UCL (use when n<50)	1.53

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0983	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.124	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	1.34	Mean in Log Scale	0.0621
SD in Original Scale	1.135	SD in Log Scale	0.655
95% t UCL (assumes normality of ROS data)	1.516	95% Percentile Bootstrap UCL	1.536
95% BCA Bootstrap UCL	1.564	95% Bootstrap t UCL	1.578
95% H-UCL (Log ROS)	1.486		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.0619	95% H-UCL (KM -Log)	1.458
KM SD (logged)	0.634	95% Critical H Value (KM-Log)	1.92
KM Standard Error of Mean (logged)	0.0825		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.311	Mean in Log Scale	0.108
SD in Original Scale	1.075	SD in Log Scale	0.507
95% t UCL (Assumes normality)	1.478	95% H-Stat UCL	1.383

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

95% KM (t) UCL	1.525	95% KM (% Bootstrap) UCL	1.545

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

Result (chromium)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	2	Mean	12.07
Maximum	193	Median	8
SD	20.04	Std. Error of Mean	1.877
Coefficient of Variation	1.661	Skewness	7.223

Normal GOF Test

Shapiro Wilk Test Statistic	0.375	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.083	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	15.18	95% Adjusted-CLT UCL (Chen-1995)	16.51
		95% Modified-t UCL (Johnson-1978)	15.4

Gamma GOF Test

A-D Test Statistic	7.361	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.77	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.2	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0874	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.535	k star (bias corrected MLE)	1.5
Theta hat (MLE)	7.866	Theta star (bias corrected MLE)	8.047
nu hat (MLE)	349.9	nu star (bias corrected)	342
MLE Mean (bias corrected)	12.07	MLE Sd (bias corrected)	9.855
		Approximate Chi Square Value (0.05)	300.2
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	299.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	13.75	95% Adjusted Gamma UCL (use when n<50)	13.78

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	2.0819E-7	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.134	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.083	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	2.131
Maximum of Logged Data	5.263	SD of logged Data	0.706

Assuming Lognormal Distribution

95% H-UCL	12.32	90% Chebyshev (MVUE) UCL	13.15
95% Chebyshev (MVUE) UCL	14.22	97.5% Chebyshev (MVUE) UCL	15.71
99% Chebyshev (MVUE) UCL	18.63		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	15.16	95% Jackknife UCL	15.18
95% Standard Bootstrap UCL	15.21	95% Bootstrap-t UCL	19.38
95% Hall's Bootstrap UCL	28.6	95% Percentile Bootstrap UCL	15.6
95% BCA Bootstrap UCL	17.02		
90% Chebyshev(Mean, Sd) UCL	17.7	95% Chebyshev(Mean, Sd) UCL	20.25
97.5% Chebyshev(Mean, Sd) UCL	23.79	99% Chebyshev(Mean, Sd) UCL	30.75

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	20.25

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	99	Number of Distinct Observations	22
Number of Detects	98	Number of Non-Detects	1
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	1	Minimum Non-Detect	5
Maximum Detect	42	Maximum Non-Detect	5
Variance Detects	34.79	Percent Non-Detects	1.01%
Mean Detects	10.36	SD Detects	5.898
Median Detects	9	CV Detects	0.569
Skewness Detects	2.093	Kurtosis Detects	7.877
Mean of Logged Detects	2.198	SD of Logged Detects	0.543

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.861	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	3.02E-13	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0895	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

Mean	10.29	Standard Error of Mean	0.594
SD	5.879	95% KM (BCA) UCL	11.41
95% KM (t) UCL	11.27	95% KM (Percentile Bootstrap) UCL	11.28
95% KM (z) UCL	11.26	95% KM Bootstrap t UCL	11.43
90% KM Chebyshev UCL	12.07	95% KM Chebyshev UCL	12.88
97.5% KM Chebyshev UCL	14	99% KM Chebyshev UCL	16.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.63	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0775	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0908	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)	3.73	k star (bias corrected MLE)	3.622
Theta hat (MLE)	2.777	Theta star (bias corrected MLE)	2.859
nu hat (MLE)	731	nu star (bias corrected)	710
MLE Mean (bias corrected)	10.36	MLE Sd (bias corrected)	5.442

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.062	nu hat (KM)	606.3
Approximate Chi Square Value (606.27, α)	550.2	Adjusted Chi Square Value (606.27, β)	549.4
95% Gamma Approximate KM-UCL (use when n>=50)	11.34	95% Gamma Adjusted KM-UCL (use when n<50)	11.35

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1	Mean	10.28
Maximum	42	Median	9
SD	5.922	CV	0.576
k hat (MLE)	3.597	k star (bias corrected MLE)	3.494
Theta hat (MLE)	2.857	Theta star (bias corrected MLE)	2.941
nu hat (MLE)	712.2	nu star (bias corrected)	691.9
MLE Mean (bias corrected)	10.28	MLE Sd (bias corrected)	5.498
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (691.91, α)	631.9	Adjusted Chi Square Value (691.91, β)	631
95% Gamma Approximate UCL (use when n>=50)	11.25	95% Gamma Adjusted UCL (use when n<50)	11.27

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0664	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0895	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	10.29	Mean in Log Scale	2.188
SD in Original Scale	5.908	SD in Log Scale	0.549
95% t UCL (assumes normality of ROS data)	11.27	95% Percentile Bootstrap UCL	11.28
95% BCA Bootstrap UCL	11.35	95% Bootstrap t UCL	11.38
95% H-UCL (Log ROS)	11.51		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.187	95% H-UCL (KM -Log)	11.5
KM SD (logged)	0.549	95% Critical H Value (KM-Log)	1.884
KM Standard Error of Mean (logged)	0.0557		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	10.28	Mean in Log Scale	2.185
SD in Original Scale	5.921	SD in Log Scale	0.556
95% t UCL (Assumes normality)	11.27	95% H-Stat UCL	11.53

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 (BCA) UCL	11.41	95% GROS Approximate Gamma UCL	11.25
95% Approximate Gamma KM-UCL	11.34		

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

Result (copper)

General Statistics

Total Number of Observations	119	Number of Distinct Observations	117
		Number of Missing Observations	0
Minimum	62	Mean	2662
Maximum	30200	Median	763
SD	4996	Std. Error of Mean	458
Coefficient of Variation	1.877	Skewness	3.944

Normal GOF Test

Shapiro Wilk Test Statistic	0.506	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0812	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	3421	95% Adjusted-CLT UCL (Chen-1995)	3592
		95% Modified-t UCL (Johnson-1978)	3448

Gamma GOF Test

A-D Test Statistic	5.502	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.802	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0883	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.674	k star (bias corrected MLE)	0.662
Theta hat (MLE)	3951	Theta star (bias corrected MLE)	4019
nu hat (MLE)	160.3	nu star (bias corrected)	157.6
MLE Mean (bias corrected)	2662	MLE Sd (bias corrected)	3271
		Approximate Chi Square Value (0.05)	129.6
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	129.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3237	95% Adjusted Gamma UCL (use when n<50)	3245

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.00477	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.134	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0812	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.127	Mean of logged Data	6.985
Maximum of Logged Data	10.32	SD of logged Data	1.277

Assuming Lognormal Distribution

95% H-UCL	3273	90% Chebyshev (MVUE) UCL	3517
95% Chebyshev (MVUE) UCL	4018	97.5% Chebyshev (MVUE) UCL	4714
99% Chebyshev (MVUE) UCL	6080		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3415	95% Jackknife UCL	3421
95% Standard Bootstrap UCL	3426	95% Bootstrap-t UCL	3759
95% Hall's Bootstrap UCL	3632	95% Percentile Bootstrap UCL	3460
95% BCA Bootstrap UCL	3620		
90% Chebyshev(Mean, Sd) UCL	4036	95% Chebyshev(Mean, Sd) UCL	4658
97.5% Chebyshev(Mean, Sd) UCL	5522	99% Chebyshev(Mean, Sd) UCL	7219

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4658

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	119	Number of Distinct Observations	111
		Number of Missing Observations	0
Minimum	2.81	Mean	116.4
Maximum	3740	Median	47.9
SD	359.2	Std. Error of Mean	32.93
Coefficient of Variation	3.086	Skewness	9.005

Normal GOF Test

Shapiro Wilk Test Statistic	0.28	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.376	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0812	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	171	95% Adjusted-CLT UCL (Chen-1995)	199.6
		95% Modified-t UCL (Johnson-1978)	175.5

Gamma GOF Test

A-D Test Statistic	4.764	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.806	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.155	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0886	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.636	k star (bias corrected MLE)	0.626
Theta hat (MLE)	182.9	Theta star (bias corrected MLE)	186
nu hat (MLE)	151.5	nu star (bias corrected)	149
MLE Mean (bias corrected)	116.4	MLE Sd (bias corrected)	147.2
		Approximate Chi Square Value (0.05)	121.8
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	121.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	142.4	95% Adjusted Gamma UCL (use when n<50)	142.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.982	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.58	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0588	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0812	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.033	Mean of logged Data	3.795
Maximum of Logged Data	8.227	SD of logged Data	1.267

Assuming Lognormal Distribution

95% H-UCL	132.6	90% Chebyshev (MVUE) UCL	142.5
95% Chebyshev (MVUE) UCL	162.7	97.5% Chebyshev (MVUE) UCL	190.7
99% Chebyshev (MVUE) UCL	245.6		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	170.6	95% Jackknife UCL	171
95% Standard Bootstrap UCL	171.3	95% Bootstrap-t UCL	277.4
95% Hall's Bootstrap UCL	376.5	95% Percentile Bootstrap UCL	175.3
95% BCA Bootstrap UCL	214.7		
90% Chebyshev(Mean, Sd) UCL	215.2	95% Chebyshev(Mean, Sd) UCL	260
97.5% Chebyshev(Mean, Sd) UCL	322.1	99% Chebyshev(Mean, Sd) UCL	444.1

Suggested UCL to Use

95% H-UCL	132.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (manganese)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	104
		Number of Missing Observations	0
Minimum	30	Mean	356.1
Maximum	932	Median	344
SD	187	Std. Error of Mean	17.51
Coefficient of Variation	0.525	Skewness	0.796

Normal GOF Test

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	7.9598E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.116	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.083	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	385.2	95% Adjusted-CLT UCL (Chen-1995)	386.4
		95% Modified-t UCL (Johnson-1978)	385.4

Gamma GOF Test

A-D Test Statistic	0.419	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.065	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0863	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.346	k star (bias corrected MLE)	3.264
Theta hat (MLE)	106.4	Theta star (bias corrected MLE)	109.1
nu hat (MLE)	763	nu star (bias corrected)	744.2
MLE Mean (bias corrected)	356.1	MLE Sd (bias corrected)	197.1
		Approximate Chi Square Value (0.05)	681.9
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	681.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	388.7	95% Adjusted Gamma UCL (use when n<50)	389.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	6.4159E-5	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0999	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.083	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.401	Mean of logged Data	5.719
Maximum of Logged Data	6.837	SD of logged Data	0.612

Assuming Lognormal Distribution

95% H-UCL	409.6	90% Chebyshev (MVUE) UCL	434.5
95% Chebyshev (MVUE) UCL	465.4	97.5% Chebyshev (MVUE) UCL	508.2
99% Chebyshev (MVUE) UCL	592.4		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	385	95% Jackknife UCL	385.2
95% Standard Bootstrap UCL	384.6	95% Bootstrap-t UCL	388.3
95% Hall's Bootstrap UCL	386.2	95% Percentile Bootstrap UCL	384.8
95% BCA Bootstrap UCL	384.9		
90% Chebyshev(Mean, Sd) UCL	408.7	95% Chebyshev(Mean, Sd) UCL	432.5
97.5% Chebyshev(Mean, Sd) UCL	465.5	99% Chebyshev(Mean, Sd) UCL	530.4

Suggested UCL to Use

95% Approximate Gamma UCL	388.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (mercury)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	18
Number of Detects	35	Number of Non-Detects	79
Number of Distinct Detects	18	Number of Distinct Non-Detects	3
Minimum Detect	0.04	Minimum Non-Detect	0.04
Maximum Detect	0.6	Maximum Non-Detect	0.2
Variance Detects	0.0163	Percent Non-Detects	69.3%
Mean Detects	0.137	SD Detects	0.128
Median Detects	0.08	CV Detects	0.93
Skewness Detects	1.996	Kurtosis Detects	4.191
Mean of Logged Detects	-2.297	SD of Logged Detects	0.753

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.742	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.244	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.15	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

Mean	0.086	Standard Error of Mean	0.00887
SD	0.0823	95% KM (BCA) UCL	0.101
95% KM (t) UCL	0.101	95% KM (Percentile Bootstrap) UCL	0.101
95% KM (z) UCL	0.101	95% KM Bootstrap t UCL	0.104
90% KM Chebyshev UCL	0.113	95% KM Chebyshev UCL	0.125
97.5% KM Chebyshev UCL	0.141	99% KM Chebyshev UCL	0.174

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.628	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.763	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.203	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.151	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)	1.76	k star (bias corrected MLE)	1.628
Theta hat (MLE)	0.0779	Theta star (bias corrected MLE)	0.0842
nu hat (MLE)	123.2	nu star (bias corrected)	114
MLE Mean (bias corrected)	0.137	MLE Sd (bias corrected)	0.107

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.093	nu hat (KM)	249.2
Approximate Chi Square Value (249.15, α)	213.6	Adjusted Chi Square Value (249.15, β)	213.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.1	95% Gamma Adjusted KM-UCL (use when n<50)	0.1

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0798
Maximum	0.6	Median	0.05
SD	0.094	CV	1.179
k hat (MLE)	0.926	k star (bias corrected MLE)	0.908
Theta hat (MLE)	0.0861	Theta star (bias corrected MLE)	0.0879
nu hat (MLE)	211.2	nu star (bias corrected)	207
MLE Mean (bias corrected)	0.0798	MLE Sd (bias corrected)	0.0837
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (207.00, α)	174.7	Adjusted Chi Square Value (207.00, β)	174.3
95% Gamma Approximate UCL (use when n>=50)	0.0945	95% Gamma Adjusted UCL (use when n<50)	0.0947

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.15	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	0.0829	Mean in Log Scale	-2.86
SD in Original Scale	0.0869	SD in Log Scale	0.847
95% t UCL (assumes normality of ROS data)	0.0964	95% Percentile Bootstrap UCL	0.0969
95% BCA Bootstrap UCL	0.0986	95% Bootstrap t UCL	0.0998
95% H-UCL (Log ROS)	0.0968		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.104	Mean in Log Scale	-2.446
SD in Original Scale	0.0768	SD in Log Scale	0.61
95% t UCL (Assumes normality)	0.116	95% H-Stat UCL	0.116

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	0.101	95% KM (% Bootstrap) UCL	0.101

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

Result (molybdenum)

General Statistics

Total Number of Observations	119	Number of Distinct Observations	99
Number of Detects	118	Number of Non-Detects	1
Number of Distinct Detects	99	Number of Distinct Non-Detects	1
Minimum Detect	3	Minimum Non-Detect	5
Maximum Detect	6830	Maximum Non-Detect	5
Variance Detects	1669550	Percent Non-Detects	0.84%
Mean Detects	616.9	SD Detects	1292
Median Detects	134.5	CV Detects	2.095
Skewness Detects	3.51	Kurtosis Detects	12.71
Mean of Logged Detects	4.88	SD of Logged Detects	1.909

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.503	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0816	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

Mean	611.7	Standard Error of Mean	118.1
SD	1282	95% KM (BCA) UCL	822.9
95% KM (t) UCL	807.5	95% KM (Percentile Bootstrap) UCL	812.3
95% KM (z) UCL	805.9	95% KM Bootstrap t UCL	855.7
90% KM Chebyshev UCL	965.9	95% KM Chebyshev UCL	1126
97.5% KM Chebyshev UCL	1349	99% KM Chebyshev UCL	1786

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.09	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.838	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.125	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0906	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)	0.422	k star (bias corrected MLE)	0.417
Theta hat (MLE)	1461	Theta star (bias corrected MLE)	1479
nu hat (MLE)	99.65	nu star (bias corrected)	98.45
MLE Mean (bias corrected)	616.9	MLE Sd (bias corrected)	955.1

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.228	nu hat (KM)	54.16
Approximate Chi Square Value (54.16, α)	38.25	Adjusted Chi Square Value (54.16, β)	38.08
95% Gamma Approximate KM-UCL (use when n>=50)	866.2	95% Gamma Adjusted KM-UCL (use when n<50)	869.9

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	611.7
Maximum	6830	Median	134
SD	1288	CV	2.105
k hat (MLE)	0.406	k star (bias corrected MLE)	0.402
Theta hat (MLE)	1506	Theta star (bias corrected MLE)	1523
nu hat (MLE)	96.67	nu star (bias corrected)	95.56
MLE Mean (bias corrected)	611.7	MLE Sd (bias corrected)	965.4
		Adjusted Level of Significance (β)	0.048
Approximate Chi Square Value (95.56, α)	74.02	Adjusted Chi Square Value (95.56, β)	73.78
95% Gamma Approximate UCL (use when n>=50)	789.8	95% Gamma Adjusted UCL (use when n<50)	792.3

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.065	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0816	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	611.7	Mean in Log Scale	4.844
SD in Original Scale	1288	SD in Log Scale	1.94
95% t UCL (assumes normality of ROS data)	807.5	95% Percentile Bootstrap UCL	820.9
95% BCA Bootstrap UCL	871.8	95% Bootstrap t UCL	877.1
95% H-UCL (Log ROS)	1493		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.848	95% H-UCL (KM -Log)	1440
KM SD (logged)	1.924	95% Critical H Value (KM-Log)	3.242
KM Standard Error of Mean (logged)	0.177		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	611.7	Mean in Log Scale	4.847
SD in Original Scale	1288	SD in Log Scale	1.935
95% t UCL (Assumes normality)	807.5	95% H-Stat UCL	1478

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

97.5% KM (Chebyshev) UCL	1349

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

Result (nickel)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	20
Number of Detects	103	Number of Non-Detects	11
Number of Distinct Detects	19	Number of Distinct Non-Detects	2
Minimum Detect	2	Minimum Non-Detect	1
Maximum Detect	33	Maximum Non-Detect	5
Variance Detects	25.17	Percent Non-Detects	9.649%
Mean Detects	7.476	SD Detects	5.017
Median Detects	6	CV Detects	0.671
Skewness Detects	2.764	Kurtosis Detects	9.989
Mean of Logged Detects	1.852	SD of Logged Detects	0.553

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.74	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0873	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

Mean	6.994	Standard Error of Mean	0.47
SD	4.982	95% KM (BCA) UCL	7.812
95% KM (t) UCL	7.774	95% KM (Percentile Bootstrap) UCL	7.813
95% KM (z) UCL	7.767	95% KM Bootstrap t UCL	7.946
90% KM Chebyshev UCL	8.404	95% KM Chebyshev UCL	9.043
97.5% KM Chebyshev UCL	9.929	99% KM Chebyshev UCL	11.67

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.214	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.758	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0892	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)	3.296	k star (bias corrected MLE)	3.207
Theta hat (MLE)	2.268	Theta star (bias corrected MLE)	2.331
nu hat (MLE)	679	nu star (bias corrected)	660.6
MLE Mean (bias corrected)	7.476	MLE Sd (bias corrected)	4.175

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.971	nu hat (KM)	449.5
Approximate Chi Square Value (449.47, α)	401.3	Adjusted Chi Square Value (449.47, β)	400.7
95% Gamma Approximate KM-UCL (use when n>=50)	7.834	95% Gamma Adjusted KM-UCL (use when n<50)	7.845

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.898
Maximum	33	Median	6
SD	5.099	CV	0.739
k hat (MLE)	1.666	k star (bias corrected MLE)	1.628
Theta hat (MLE)	4.142	Theta star (bias corrected MLE)	4.238
nu hat (MLE)	379.7	nu star (bias corrected)	371.1
MLE Mean (bias corrected)	6.898	MLE Sd (bias corrected)	5.407
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (371.08, α)	327.4	Adjusted Chi Square Value (371.08, β)	326.9
95% Gamma Approximate UCL (use when n>=50)	7.817	95% Gamma Adjusted UCL (use when n<50)	7.83

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.136	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0873	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	7.011	Mean in Log Scale	1.763
SD in Original Scale	4.983	SD in Log Scale	0.602
95% t UCL (assumes normality of ROS data)	7.785	95% Percentile Bootstrap UCL	7.802
95% BCA Bootstrap UCL	8.062	95% Bootstrap t UCL	8.016
95% H-UCL (Log ROS)	7.781		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	6.961	Mean in Log Scale	1.734
SD in Original Scale	5.029	SD in Log Scale	0.668
95% t UCL (Assumes normality)	7.742	95% H-Stat UCL	7.998

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 (BCA) UCL	7.812

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

Result (selenium)

General Statistics

Total Number of Observations	114	Number of Distinct Observations	83
Number of Detects	93	Number of Non-Detects	21
Number of Distinct Detects	73	Number of Distinct Non-Detects	17
Minimum Detect	0.05	Minimum Non-Detect	0.19
Maximum Detect	9.4	Maximum Non-Detect	11.1
Variance Detects	3.14	Percent Non-Detects	18.42%
Mean Detects	1.397	SD Detects	1.772
Median Detects	0.5	CV Detects	1.269
Skewness Detects	2.203	Kurtosis Detects	5.93
Mean of Logged Detects	-0.434	SD of Logged Detects	1.308

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.729	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0919	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

Mean	1.221	Standard Error of Mean	0.16
SD	1.671	95% KM (BCA) UCL	1.489
95% KM (t) UCL	1.486	95% KM (Percentile Bootstrap) UCL	1.499
95% KM (z) UCL	1.484	95% KM Bootstrap t UCL	1.538
90% KM Chebyshev UCL	1.701	95% KM Chebyshev UCL	1.919
97.5% KM Chebyshev UCL	2.221	99% KM Chebyshev UCL	2.814

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.537	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.793	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.162	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0963	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)	0.776	k star (bias corrected MLE)	0.758
Theta hat (MLE)	1.8	Theta star (bias corrected MLE)	1.842
nu hat (MLE)	144.3	nu star (bias corrected)	141
MLE Mean (bias corrected)	1.397	MLE Sd (bias corrected)	1.604

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.533	nu hat (KM)	121.6
Approximate Chi Square Value (121.61, α)	97.14	Adjusted Chi Square Value (121.61, β)	96.86
95% Gamma Approximate KM-UCL (use when n>=50)	1.528	95% Gamma Adjusted KM-UCL (use when n<50)	1.532

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.182
Maximum	9.4	Median	0.399
SD	1.667	CV	1.41
k hat (MLE)	0.614	k star (bias corrected MLE)	0.604
Theta hat (MLE)	1.924	Theta star (bias corrected MLE)	1.957
nu hat (MLE)	140.1	nu star (bias corrected)	137.7
MLE Mean (bias corrected)	1.182	MLE Sd (bias corrected)	1.521
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (137.72, α)	111.6	Adjusted Chi Square Value (137.72, β)	111.3
95% Gamma Approximate UCL (use when n>=50)	1.459	95% Gamma Adjusted UCL (use when n<50)	1.463

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.12	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0919	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	1.195	Mean in Log Scale	-0.607
SD in Original Scale	1.657	SD in Log Scale	1.261
95% t UCL (assumes normality of ROS data)	1.452	95% Percentile Bootstrap UCL	1.454
95% BCA Bootstrap UCL	1.511	95% Bootstrap t UCL	1.506
95% H-UCL (Log ROS)	1.618		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.346	Mean in Log Scale	-0.506
SD in Original Scale	1.746	SD in Log Scale	1.318
95% t UCL (Assumes normality)	1.617	95% H-Stat UCL	1.966

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	1.919

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

Result (thallium)

General Statistics

Total Number of Observations	111	Number of Distinct Observations	35
Number of Detects	98	Number of Non-Detects	13
Number of Distinct Detects	35	Number of Distinct Non-Detects	9
Minimum Detect	0.07	Minimum Non-Detect	0.12
Maximum Detect	1.1	Maximum Non-Detect	0.3
Variance Detects	0.0199	Percent Non-Detects	11.71%
Mean Detects	0.266	SD Detects	0.141
Median Detects	0.23	CV Detects	0.531
Skewness Detects	3.313	Kurtosis Detects	15.39
Mean of Logged Detects	-1.416	SD of Logged Detects	0.405

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.723	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0895	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

Mean	0.252	Standard Error of Mean	0.0132
SD	0.138	95% KM (BCA) UCL	0.276
95% KM (t) UCL	0.274	95% KM (Percentile Bootstrap) UCL	0.275
95% KM (z) UCL	0.274	95% KM Bootstrap t UCL	0.279
90% KM Chebyshev UCL	0.292	95% KM Chebyshev UCL	0.31
97.5% KM Chebyshev UCL	0.335	99% KM Chebyshev UCL	0.384

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.304	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0905	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)	5.619	k star (bias corrected MLE)	5.454
Theta hat (MLE)	0.0473	Theta star (bias corrected MLE)	0.0488
nu hat (MLE)	1101	nu star (bias corrected)	1069
MLE Mean (bias corrected)	0.266	MLE Sd (bias corrected)	0.114

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.347	nu hat (KM)	743
Approximate Chi Square Value (743.00, α)	680.8	Adjusted Chi Square Value (743.00, β)	680
95% Gamma Approximate KM-UCL (use when n>=50)	0.275	95% Gamma Adjusted KM-UCL (use when n<50)	0.276

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0313	Mean	0.249
Maximum	1.1	Median	0.22
SD	0.141	CV	0.568
k hat (MLE)	4.387	k star (bias corrected MLE)	4.275
Theta hat (MLE)	0.0568	Theta star (bias corrected MLE)	0.0582
nu hat (MLE)	974	nu star (bias corrected)	949
MLE Mean (bias corrected)	0.249	MLE Sd (bias corrected)	0.12
		Adjusted Level of Significance (β)	0.0478
Approximate Chi Square Value (949.01, α)	878.5	Adjusted Chi Square Value (949.01, β)	877.6
95% Gamma Approximate UCL (use when n>=50)	0.269	95% Gamma Adjusted UCL (use when n<50)	0.269

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.107	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0895	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	0.252	Mean in Log Scale	-1.476
SD in Original Scale	0.138	SD in Log Scale	0.421
95% t UCL (assumes normality of ROS data)	0.274	95% Percentile Bootstrap UCL	0.275
95% BCA Bootstrap UCL	0.279	95% Bootstrap t UCL	0.28
95% H-UCL (Log ROS)	0.268		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.247	Mean in Log Scale	-1.522
SD in Original Scale	0.143	SD in Log Scale	0.486
95% t UCL (Assumes normality)	0.269	95% H-Stat UCL	0.267

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 (BCA) UCL	0.276

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

Result (uranium)

General Statistics

Total Number of Observations	95	Number of Distinct Observations	89
		Number of Missing Observations	0
Minimum	1.17	Mean	5.424
Maximum	29.9	Median	4.07
SD	3.872	Std. Error of Mean	0.397
Coefficient of Variation	0.714	Skewness	3.438

Normal GOF Test

Shapiro Wilk Test Statistic	0.707	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0909	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	6.083	95% Adjusted-CLT UCL (Chen-1995)	6.227
		95% Modified-t UCL (Johnson-1978)	6.107

Gamma GOF Test

A-D Test Statistic	2.629	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0924	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.356	k star (bias corrected MLE)	3.257
Theta hat (MLE)	1.616	Theta star (bias corrected MLE)	1.665
nu hat (MLE)	637.6	nu star (bias corrected)	618.8
MLE Mean (bias corrected)	5.424	MLE Sd (bias corrected)	3.005
		Approximate Chi Square Value (0.05)	562.1
Adjusted Level of Significance	0.0475	Adjusted Chi Square Value	561.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.971	95% Adjusted Gamma UCL (use when n<50)	5.98

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0575	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0909	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.157	Mean of logged Data	1.534
Maximum of Logged Data	3.398	SD of logged Data	0.524

Assuming Lognormal Distribution

95% H-UCL	5.886	90% Chebyshev (MVUE) UCL	6.221
95% Chebyshev (MVUE) UCL	6.632	97.5% Chebyshev (MVUE) UCL	7.204
99% Chebyshev (MVUE) UCL	8.326		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6.077	95% Jackknife UCL	6.083
95% Standard Bootstrap UCL	6.068	95% Bootstrap-t UCL	6.375
95% Hall's Bootstrap UCL	6.493	95% Percentile Bootstrap UCL	6.092
95% BCA Bootstrap UCL	6.261		
90% Chebyshev(Mean, Sd) UCL	6.615	95% Chebyshev(Mean, Sd) UCL	7.155
97.5% Chebyshev(Mean, Sd) UCL	7.904	99% Chebyshev(Mean, Sd) UCL	9.376

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	7.155

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (zinc)

General Statistics

Total Number of Observations	111	Number of Distinct Observations	99
		Number of Missing Observations	0
Minimum	25	Mean	262.6
Maximum	3630	Median	156
SD	406.6	Std. Error of Mean	38.59
Coefficient of Variation	1.548	Skewness	5.786

Normal GOF Test

Shapiro Wilk Test Statistic	0.507	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0841	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	326.6	95% Adjusted-CLT UCL (Chen-1995)	348.7
		95% Modified-t UCL (Johnson-1978)	330.2

Gamma GOF Test

A-D Test Statistic	2.971	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.779	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0889	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.144	k star (bias corrected MLE)	1.119
Theta hat (MLE)	229.5	Theta star (bias corrected MLE)	234.6
nu hat (MLE)	254	nu star (bias corrected)	248.5
MLE Mean (bias corrected)	262.6	MLE Sd (bias corrected)	248.2
		Approximate Chi Square Value (0.05)	213
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	212.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	306.4	95% Adjusted Gamma UCL (use when n<50)	307

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.274	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0623	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0841	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.219	Mean of logged Data	5.074
Maximum of Logged Data	8.197	SD of logged Data	0.924

Assuming Lognormal Distribution

95% H-UCL	295.7	90% Chebyshev (MVUE) UCL	318.7
95% Chebyshev (MVUE) UCL	352.8	97.5% Chebyshev (MVUE) UCL	400.1
99% Chebyshev (MVUE) UCL	493		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	326.1	95% Jackknife UCL	326.6
95% Standard Bootstrap UCL	326.9	95% Bootstrap-t UCL	364.6
95% Hall's Bootstrap UCL	600.5	95% Percentile Bootstrap UCL	330.7
95% BCA Bootstrap UCL	348.2		
90% Chebyshev(Mean, Sd) UCL	378.4	95% Chebyshev(Mean, Sd) UCL	430.8
97.5% Chebyshev(Mean, Sd) UCL	503.6	99% Chebyshev(Mean, Sd) UCL	646.6

Suggested UCL to Use

95% H-UCL	295.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (arsenic)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1.9	Mean	3.325
Maximum	5.2	Median	3.4
SD	0.942	Std. Error of Mean	0.333
Coefficient of Variation	0.283	Skewness	0.756

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	3.956	95% Adjusted-CLT UCL (Chen-1995)	3.968
		95% Modified-t UCL (Johnson-1978)	3.971

Gamma GOF Test

A-D Test Statistic	0.463	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.263	**Kolmogrov-Smirnoff 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)	14.34	k star (bias corrected MLE)	9.048
Theta hat (MLE)	0.232	Theta star (bias corrected MLE)	0.367
nu hat (MLE)	229.5	nu star (bias corrected)	144.8
MLE Mean (bias corrected)	3.325	MLE Sd (bias corrected)	1.105
		Approximate Chi Square Value (0.05)	118
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	111.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.081	95% Adjusted Gamma UCL (use when n<50)	4.304

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.919	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.256	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.642	Mean of logged Data	1.166
Maximum of Logged Data	1.649	SD of logged Data	0.287

Assuming Lognormal Distribution

95% H-UCL	4.174	90% Chebyshev (MVUE) UCL	4.344
95% Chebyshev (MVUE) UCL	4.804	97.5% Chebyshev (MVUE) UCL	5.443
99% Chebyshev (MVUE) UCL	6.699		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3.873	95% Jackknife UCL	3.956
95% Standard Bootstrap UCL	3.841	95% Bootstrap-t UCL	4.016
95% Hall's Bootstrap UCL	4.431	95% Percentile Bootstrap UCL	3.825
95% BCA Bootstrap UCL	3.938		
90% Chebyshev(Mean, Sd) UCL	4.324	95% Chebyshev(Mean, Sd) UCL	4.777
97.5% Chebyshev(Mean, Sd) UCL	5.405	99% Chebyshev(Mean, Sd) UCL	6.64

Suggested UCL to Use

95% Student's-t UCL	3.956

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (barium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	46.1	Mean	107.8
Maximum	303	Median	50.85
SD	94.35	Std. Error of Mean	33.36
Coefficient of Variation	0.876	Skewness	1.574

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.732	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.352	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	171	95% Adjusted-CLT UCL (Chen-1995)	182.5
		95% Modified-t UCL (Johnson-1978)	174.1

Gamma GOF Test

A-D Test Statistic	0.99	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.377	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.298	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.962	k star (bias corrected MLE)	1.309
Theta hat (MLE)	54.93	Theta star (bias corrected MLE)	82.3
nu hat (MLE)	31.39	nu star (bias corrected)	20.95
MLE Mean (bias corrected)	107.8	MLE Sd (bias corrected)	94.17
		Approximate Chi Square Value (0.05)	11.56
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	9.838

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	195.4	95% Adjusted Gamma UCL (use when n<50)	229.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.77	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.361	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.831	Mean of logged Data	4.404
Maximum of Logged Data	5.714	SD of logged Data	0.751

Assuming Lognormal Distribution

95% H-UCL	242.8	90% Chebyshev (MVUE) UCL	188.2
95% Chebyshev (MVUE) UCL	226.3	97.5% Chebyshev (MVUE) UCL	279.3
99% Chebyshev (MVUE) UCL	383.3		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	162.6	95% Jackknife UCL	171
95% Standard Bootstrap UCL	157.4	95% Bootstrap-t UCL	275
95% Hall's Bootstrap UCL	238.8	95% Percentile Bootstrap UCL	163.6
95% BCA Bootstrap UCL	171.9		
90% Chebyshev(Mean, Sd) UCL	207.8	95% Chebyshev(Mean, Sd) UCL	253.2
97.5% Chebyshev(Mean, Sd) UCL	316.1	99% Chebyshev(Mean, Sd) UCL	439.7

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	253.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (beryllium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	2
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	1.6	Maximum Non-Detect	1
Variance Detects	0.255	Percent Non-Detects	25%
Mean Detects	0.667	SD Detects	0.505
Median Detects	0.55	CV Detects	0.757
Skewness Detects	1.54	Kurtosis Detects	2.659
Mean of Logged Detects	-0.628	SD of Logged Detects	0.732

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 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	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

Mean	0.62	Standard Error of Mean	0.17
SD	0.421	95% KM (BCA) UCL	0.871
95% KM (t) UCL	0.942	95% KM (Percentile Bootstrap) UCL	0.897
95% KM (z) UCL	0.9	95% KM Bootstrap t UCL	1.112
90% KM Chebyshev UCL	1.131	95% KM Chebyshev UCL	1.362
97.5% KM Chebyshev UCL	1.683	99% KM Chebyshev UCL	2.313

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.208	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.703	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.143	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.335	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)	2.396	k star (bias corrected MLE)	1.309
Theta hat (MLE)	0.278	Theta star (bias corrected MLE)	0.509
nu hat (MLE)	28.75	nu star (bias corrected)	15.71
MLE Mean (bias corrected)	0.667	MLE Sd (bias corrected)	0.583

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.171	nu hat (KM)	34.73
Approximate Chi Square Value (34.73, α)	22.25	Adjusted Chi Square Value (34.73, β)	19.76
95% Gamma Approximate KM-UCL (use when n>=50)	0.968	95% Gamma Adjusted KM-UCL (use when n<50)	1.09

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.2	Mean	0.619
Maximum	1.6	Median	0.55
SD	0.444	CV	0.718
k hat (MLE)	2.74	k star (bias corrected MLE)	1.796
Theta hat (MLE)	0.226	Theta star (bias corrected MLE)	0.345
nu hat (MLE)	43.85	nu star (bias corrected)	28.74
MLE Mean (bias corrected)	0.619	MLE Sd (bias corrected)	0.462
		Adjusted Level of Significance (β)	0.0195
Approximate Chi Square Value (28.74, α)	17.5	Adjusted Chi Square Value (28.74, β)	15.33
95% Gamma Approximate UCL (use when n>=50)	1.017	95% Gamma Adjusted UCL (use when n<50)	1.161

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.989	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.131	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	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	0.613	Mean in Log Scale	-0.682
SD in Original Scale	0.444	SD in Log Scale	0.648
95% t UCL (assumes normality of ROS data)	0.91	95% Percentile Bootstrap UCL	0.863
95% BCA Bootstrap UCL	0.971	95% Bootstrap t UCL	1.181
95% H-UCL (Log ROS)	1.186		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.683	95% H-UCL (KM -Log)	1.159
KM SD (logged)	0.637	95% Critical H Value (KM-Log)	2.606
KM Standard Error of Mean (logged)	0.272		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.625	Mean in Log Scale	-0.645
SD in Original Scale	0.433	SD in Log Scale	0.62
95% t UCL (Assumes normality)	0.915	95% H-Stat UCL	1.162

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	0.942	95% KM (Percentile Bootstrap) UCL	0.897

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

Result (chromium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2	Mean	3.5
Maximum	7	Median	3.5
SD	1.69	Std. Error of Mean	0.598
Coefficient of Variation	0.483	Skewness	1.302

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.826	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	4.632	95% Adjusted-CLT UCL (Chen-1995)	4.777
		95% Modified-t UCL (Johnson-1978)	4.678

Gamma GOF Test

A-D Test Statistic	0.55	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.231	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.572	k star (bias corrected MLE)	3.566
Theta hat (MLE)	0.628	Theta star (bias corrected MLE)	0.982
nu hat (MLE)	89.15	nu star (bias corrected)	57.06
MLE Mean (bias corrected)	3.5	MLE Sd (bias corrected)	1.853
		Approximate Chi Square Value (0.05)	40.69
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	37.22

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.907	95% Adjusted Gamma UCL (use when n<50)	5.365

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.224	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	1.16
Maximum of Logged Data	1.946	SD of logged Data	0.452

Assuming Lognormal Distribution

95% H-UCL	5.211	90% Chebyshev (MVUE) UCL	5.171
95% Chebyshev (MVUE) UCL	5.934	97.5% Chebyshev (MVUE) UCL	6.993
99% Chebyshev (MVUE) UCL	9.074		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.483	95% Jackknife UCL	4.632
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	5.293	95% Chebyshev(Mean, Sd) UCL	6.105
97.5% Chebyshev(Mean, Sd) UCL	7.232	99% Chebyshev(Mean, Sd) UCL	9.446

Suggested UCL to Use

95% Student's-t UCL	4.632

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (cobalt)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2	Mean	7.25
Maximum	16	Median	5
SD	4.464	Std. Error of Mean	1.578
Coefficient of Variation	0.616	Skewness	1.116

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.318	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	10.24	95% Adjusted-CLT UCL (Chen-1995)	10.51
		95% Modified-t UCL (Johnson-1978)	10.34

Gamma GOF Test

A-D Test Statistic	0.539	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.29	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.296	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.143	k star (bias corrected MLE)	2.048
Theta hat (MLE)	2.306	Theta star (bias corrected MLE)	3.54
nu hat (MLE)	50.29	nu star (bias corrected)	32.77
MLE Mean (bias corrected)	7.25	MLE Sd (bias corrected)	5.066
		Approximate Chi Square Value (0.05)	20.68
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	18.29

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	11.49	95% Adjusted Gamma UCL (use when n<50)	12.99

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.251	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	1.814
Maximum of Logged Data	2.773	SD of logged Data	0.635

Assuming Lognormal Distribution

95% H-UCL	14	90% Chebyshev (MVUE) UCL	12.27
95% Chebyshev (MVUE) UCL	14.52	97.5% Chebyshev (MVUE) UCL	17.65
99% Chebyshev (MVUE) UCL	23.8		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	9.846	95% Jackknife UCL	10.24
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	11.98	95% Chebyshev(Mean, Sd) UCL	14.13
97.5% Chebyshev(Mean, Sd) UCL	17.11	99% Chebyshev(Mean, Sd) UCL	22.95

Suggested UCL to Use

95% Student's-t UCL	10.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (copper)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	63	Mean	186.6
Maximum	466	Median	130.5
SD	138.9	Std. Error of Mean	49.11
Coefficient of Variation	0.744	Skewness	1.45

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.825	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.265	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	279.7	95% Adjusted-CLT UCL (Chen-1995)	294.3
		95% Modified-t UCL (Johnson-1978)	283.9

Gamma GOF Test

A-D Test Statistic	0.392	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.223	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.504	k star (bias corrected MLE)	1.649
Theta hat (MLE)	74.52	Theta star (bias corrected MLE)	113.2
nu hat (MLE)	40.07	nu star (bias corrected)	26.38
MLE Mean (bias corrected)	186.6	MLE Sd (bias corrected)	145.3
		Approximate Chi Square Value (0.05)	15.67
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	13.63

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	314.1	95% Adjusted Gamma UCL (use when n<50)	361.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.181	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.143	Mean of logged Data	5.016
Maximum of Logged Data	6.144	SD of logged Data	0.681

Assuming Lognormal Distribution

95% H-UCL	380.9	90% Chebyshev (MVUE) UCL	319
95% Chebyshev (MVUE) UCL	380.2	97.5% Chebyshev (MVUE) UCL	465.1
99% Chebyshev (MVUE) UCL	631.9		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	267.4	95% Jackknife UCL	279.7
95% Standard Bootstrap UCL	261	95% Bootstrap-t UCL	432.2
95% Hall's Bootstrap UCL	764.9	95% Percentile Bootstrap UCL	269.1
95% BCA Bootstrap UCL	288		
90% Chebyshev(Mean, Sd) UCL	334	95% Chebyshev(Mean, Sd) UCL	400.7
97.5% Chebyshev(Mean, Sd) UCL	493.3	99% Chebyshev(Mean, Sd) UCL	675.3

Suggested UCL to Use

95% Student's-t UCL	279.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (lead)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	6.43	Mean	10.21
Maximum	14.5	Median	10.25
SD	2.678	Std. Error of Mean	0.947
Coefficient of Variation	0.262	Skewness	0.204

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.986	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	12.01	95% Adjusted-CLT UCL (Chen-1995)	11.84
		95% Modified-t UCL (Johnson-1978)	12.02

Gamma GOF Test

A-D Test Statistic	0.135	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	**Kolmogrov-Smirnoff 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)	16.23	k star (bias corrected MLE)	10.23
Theta hat (MLE)	0.629	Theta star (bias corrected MLE)	0.998
nu hat (MLE)	259.8	nu star (bias corrected)	163.7
MLE Mean (bias corrected)	10.21	MLE Sd (bias corrected)	3.193
		Approximate Chi Square Value (0.05)	135.1
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	128.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.37	95% Adjusted Gamma UCL (use when n<50)	13.01

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.126	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.861	Mean of logged Data	2.293
Maximum of Logged Data	2.674	SD of logged Data	0.27

Assuming Lognormal Distribution

95% H-UCL	12.62	90% Chebyshev (MVUE) UCL	13.15
95% Chebyshev (MVUE) UCL	14.48	97.5% Chebyshev (MVUE) UCL	16.32
99% Chebyshev (MVUE) UCL	19.95		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	11.77	95% Jackknife UCL	12.01
95% Standard Bootstrap UCL	11.66	95% Bootstrap-t UCL	12.18
95% Hall's Bootstrap UCL	12.05	95% Percentile Bootstrap UCL	11.61
95% BCA Bootstrap UCL	11.84		
90% Chebyshev(Mean, Sd) UCL	13.05	95% Chebyshev(Mean, Sd) UCL	14.34
97.5% Chebyshev(Mean, Sd) UCL	16.13	99% Chebyshev(Mean, Sd) UCL	19.63

Suggested UCL to Use

95% Student's-t UCL	12.01

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	160	Mean	506.4
Maximum	1250	Median	257.5
SD	418.3	Std. Error of Mean	147.9
Coefficient of Variation	0.826	Skewness	1.047

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.338	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	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	786.6	95% Adjusted-CLT UCL (Chen-1995)	808.2
		95% Modified-t UCL (Johnson-1978)	795.7

Gamma GOF Test

A-D Test Statistic	0.724	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.326	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.298	Data Not Gamma Distributed at 5% Significance Level	

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

Gamma Statistics

k hat (MLE)	1.9	k star (bias corrected MLE)	1.271
Theta hat (MLE)	266.6	Theta star (bias corrected MLE)	398.5
nu hat (MLE)	30.39	nu star (bias corrected)	20.33
MLE Mean (bias corrected)	506.4	MLE Sd (bias corrected)	449.2
		Approximate Chi Square Value (0.05)	11.09
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	9.418

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	927.9	95% Adjusted Gamma UCL (use when n<50)	1093

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.857	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.291	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.075	Mean of logged Data	5.942
Maximum of Logged Data	7.131	SD of logged Data	0.791

Assuming Lognormal Distribution

95% H-UCL	1249	90% Chebyshev (MVUE) UCL	920.4
95% Chebyshev (MVUE) UCL	1112	97.5% Chebyshev (MVUE) UCL	1379
99% Chebyshev (MVUE) UCL	1903		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	749.6	95% Jackknife UCL	786.6
95% Standard Bootstrap UCL	735	95% Bootstrap-t UCL	1023
95% Hall's Bootstrap UCL	697.3	95% Percentile Bootstrap UCL	739
95% BCA Bootstrap UCL	789.3		
90% Chebyshev(Mean, Sd) UCL	950.1	95% Chebyshev(Mean, Sd) UCL	1151
97.5% Chebyshev(Mean, Sd) UCL	1430	99% Chebyshev(Mean, Sd) UCL	1978

Suggested UCL to Use

95% Adjusted Gamma UCL	1093

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (molybdenum)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	6	Mean	68.5
Maximum	126	Median	68.5
SD	44.36	Std. Error of Mean	15.68
Coefficient of Variation	0.648	Skewness	0.0262

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.163	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	98.21	95% Adjusted-CLT UCL (Chen-1995)	94.45
		95% Modified-t UCL (Johnson-1978)	98.24

Gamma GOF Test

A-D Test Statistic	0.37	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.726	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.213	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.298	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.742	k star (bias corrected MLE)	1.172
Theta hat (MLE)	39.33	Theta star (bias corrected MLE)	58.45
nu hat (MLE)	27.87	nu star (bias corrected)	18.75
MLE Mean (bias corrected)	68.5	MLE Sd (bias corrected)	63.28
		Approximate Chi Square Value (0.05)	9.936
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	8.363

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	129.3	95% Adjusted Gamma UCL (use when n<50)	153.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	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	3.913
Maximum of Logged Data	4.836	SD of logged Data	1.013

Assuming Lognormal Distribution

95% H-UCL	314.2	90% Chebyshev (MVUE) UCL	161.1
95% Chebyshev (MVUE) UCL	199.3	97.5% Chebyshev (MVUE) UCL	252.3
99% Chebyshev (MVUE) UCL	356.5		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	94.3	95% Jackknife UCL	98.21
95% Standard Bootstrap UCL	92.72	95% Bootstrap-t UCL	99.6
95% Hall's Bootstrap UCL	91.53	95% Percentile Bootstrap UCL	91.5
95% BCA Bootstrap UCL	90.5		
90% Chebyshev(Mean, Sd) UCL	115.5	95% Chebyshev(Mean, Sd) UCL	136.9
97.5% Chebyshev(Mean, Sd) UCL	166.4	99% Chebyshev(Mean, Sd) UCL	224.5

Suggested UCL to Use

95% Student's-t UCL	98.21

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (nickel)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	4
Number of Detects	7	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	2	Minimum Non-Detect	5
Maximum Detect	6	Maximum Non-Detect	5
Variance Detects	2.905	Percent Non-Detects	12.5%
Mean Detects	3.286	SD Detects	1.704
Median Detects	2	CV Detects	0.519
Skewness Detects	0.796	Kurtosis Detects	-1.301
Mean of Logged Detects	1.08	SD of Logged Detects	0.497

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.778	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.346	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	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

Mean	3.175	Standard Error of Mean	0.597
SD	1.531	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.305	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.156	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.965	95% KM Chebyshev UCL	5.775
97.5% KM Chebyshev UCL	6.901	99% KM Chebyshev UCL	9.111

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.896	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.71	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.37	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.313	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)	4.723	k star (bias corrected MLE)	2.794
Theta hat (MLE)	0.696	Theta star (bias corrected MLE)	1.176
nu hat (MLE)	66.13	nu star (bias corrected)	39.12
MLE Mean (bias corrected)	3.286	MLE Sd (bias corrected)	1.966

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.3	nu hat (KM)	68.8
Approximate Chi Square Value (68.80, α)	50.71	Adjusted Chi Square Value (68.80, β)	46.8
95% Gamma Approximate KM-UCL (use when n>=50)	4.308	95% Gamma Adjusted KM-UCL (use when n<50)	4.667

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	2	Mean	3.182
Maximum	6	Median	2.227
SD	1.605	CV	0.504
k hat (MLE)	5.15	k star (bias corrected MLE)	3.302
Theta hat (MLE)	0.618	Theta star (bias corrected MLE)	0.963
nu hat (MLE)	82.41	nu star (bias corrected)	52.84
MLE Mean (bias corrected)	3.182	MLE Sd (bias corrected)	1.751
		Adjusted Level of Significance (β)	0.0195
Approximate Chi Square Value (52.84, α)	37.14	Adjusted Chi Square Value (52.84, β)	33.84
95% Gamma Approximate UCL (use when n>=50)	4.527	95% Gamma Adjusted UCL (use when n<50)	4.968

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.759	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	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	3.177	Mean in Log Scale	1.055
SD in Original Scale	1.608	SD in Log Scale	0.465
95% t UCL (assumes normality of ROS data)	4.254	95% Percentile Bootstrap UCL	4.125
95% BCA Bootstrap UCL	4.177	95% Bootstrap t UCL	5.092
95% H-UCL (Log ROS)	4.792		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.188	Mean in Log Scale	1.06
SD in Original Scale	1.602	SD in Log Scale	0.463
95% t UCL (Assumes normality)	4.261	95% H-Stat UCL	4.799

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	5.775

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.

Result (selenium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.34	Mean	0.758
Maximum	1.04	Median	0.77
SD	0.22	Std. Error of Mean	0.0776
Coefficient of Variation	0.29	Skewness	-0.821

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.905	95% Adjusted-CLT UCL (Chen-1995)	0.861
		95% Modified-t UCL (Johnson-1978)	0.901

Gamma GOF Test

A-D Test Statistic	0.385	**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	0.189	**Kolmogrov-Smirnoff 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)	10.79	k star (bias corrected MLE)	6.828
Theta hat (MLE)	0.0702	Theta star (bias corrected MLE)	0.111
nu hat (MLE)	172.7	nu star (bias corrected)	109.3
MLE Mean (bias corrected)	0.758	MLE Sd (bias corrected)	0.29
		Approximate Chi Square Value (0.05)	86.13
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	80.94

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.961	95% Adjusted Gamma UCL (use when n<50)	1.022

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.866	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.214	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.079	Mean of logged Data	-0.325
Maximum of Logged Data	0.0392	SD of logged Data	0.351

Assuming Lognormal Distribution

95% H-UCL	1.019	90% Chebyshev (MVUE) UCL	1.048
95% Chebyshev (MVUE) UCL	1.178	97.5% Chebyshev (MVUE) UCL	1.357
99% Chebyshev (MVUE) UCL	1.71		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.885	95% Jackknife UCL	0.905
95% Standard Bootstrap UCL	0.876	95% Bootstrap-t UCL	0.888
95% Hall's Bootstrap UCL	0.871	95% Percentile Bootstrap UCL	0.868
95% BCA Bootstrap UCL	0.864		
90% Chebyshev(Mean, Sd) UCL	0.99	95% Chebyshev(Mean, Sd) UCL	1.096
97.5% Chebyshev(Mean, Sd) UCL	1.242	99% Chebyshev(Mean, Sd) UCL	1.53

Suggested UCL to Use

95% Student's-t UCL	0.905

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (thallium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.08	Mean	0.138
Maximum	0.25	Median	0.125
SD	0.0542	Std. Error of Mean	0.0192
Coefficient of Variation	0.394	Skewness	1.361

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.174	95% Adjusted-CLT UCL (Chen-1995)	0.179
		95% Modified-t UCL (Johnson-1978)	0.175

Gamma GOF Test

A-D Test Statistic	0.22	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.143	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.432	k star (bias corrected MLE)	5.353
Theta hat (MLE)	0.0163	Theta star (bias corrected MLE)	0.0257
nu hat (MLE)	134.9	nu star (bias corrected)	85.65
MLE Mean (bias corrected)	0.138	MLE Sd (bias corrected)	0.0594
		Approximate Chi Square Value (0.05)	65.32
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	60.84

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.18	95% Adjusted Gamma UCL (use when n<50)	0.194

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.526	Mean of logged Data	-2.045
Maximum of Logged Data	-1.386	SD of logged Data	0.364

Assuming Lognormal Distribution

95% H-UCL	0.186	90% Chebyshev (MVUE) UCL	0.19
95% Chebyshev (MVUE) UCL	0.214	97.5% Chebyshev (MVUE) UCL	0.248
99% Chebyshev (MVUE) UCL	0.313		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.169	95% Jackknife UCL	0.174
95% Standard Bootstrap UCL	0.167	95% Bootstrap-t UCL	0.192
95% Hall's Bootstrap UCL	0.333	95% Percentile Bootstrap UCL	0.168
95% BCA Bootstrap UCL	0.176		
90% Chebyshev(Mean, Sd) UCL	0.195	95% Chebyshev(Mean, Sd) UCL	0.221
97.5% Chebyshev(Mean, Sd) UCL	0.257	99% Chebyshev(Mean, Sd) UCL	0.328

Suggested UCL to Use

95% Student's-t UCL	0.174

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	1.07	Mean	2.876
Maximum	9.12	Median	2.185
SD	2.582	Std. Error of Mean	0.913
Coefficient of Variation	0.898	Skewness	2.569

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.619	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.411	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.606	95% Adjusted-CLT UCL (Chen-1995)	5.263
		95% Modified-t UCL (Johnson-1978)	4.744

Gamma GOF Test

A-D Test Statistic	0.902	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.723	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.341	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.297	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.412	k star (bias corrected MLE)	1.591
Theta hat (MLE)	1.192	Theta star (bias corrected MLE)	1.808
nu hat (MLE)	38.6	nu star (bias corrected)	25.46
MLE Mean (bias corrected)	2.876	MLE Sd (bias corrected)	2.28
		Approximate Chi Square Value (0.05)	14.96
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	12.97

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.894	95% Adjusted Gamma UCL (use when n<50)	5.645

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.291	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.0677	Mean of logged Data	0.835
Maximum of Logged Data	2.21	SD of logged Data	0.642

Assuming Lognormal Distribution

95% H-UCL	5.341	90% Chebyshev (MVUE) UCL	4.65
95% Chebyshev (MVUE) UCL	5.51	97.5% Chebyshev (MVUE) UCL	6.704
99% Chebyshev (MVUE) UCL	9.05		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.378	95% Jackknife UCL	4.606
95% Standard Bootstrap UCL	4.308	95% Bootstrap-t UCL	8.115
95% Hall's Bootstrap UCL	12.15	95% Percentile Bootstrap UCL	4.645
95% BCA Bootstrap UCL	4.931		
90% Chebyshev(Mean, Sd) UCL	5.615	95% Chebyshev(Mean, Sd) UCL	6.855
97.5% Chebyshev(Mean, Sd) UCL	8.577	99% Chebyshev(Mean, Sd) UCL	11.96

Suggested UCL to Use

95% H-UCL	5.341

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (zinc)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	23	Mean	56.38
Maximum	139	Median	45.5
SD	36.09	Std. Error of Mean	12.76
Coefficient of Variation	0.64	Skewness	2.083

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 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.764	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	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	80.55	95% Adjusted-CLT UCL (Chen-1995)	87.4
		95% Modified-t UCL (Johnson-1978)	82.11

Gamma GOF Test

A-D Test Statistic	0.494	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.258	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.839	k star (bias corrected MLE)	2.483
Theta hat (MLE)	14.69	Theta star (bias corrected MLE)	22.71
nu hat (MLE)	61.42	nu star (bias corrected)	39.72
MLE Mean (bias corrected)	56.38	MLE Sd (bias corrected)	35.78
		Approximate Chi Square Value (0.05)	26.28
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	23.55

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	85.2	95% Adjusted Gamma UCL (use when n<50)	95.08

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.223	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.135	Mean of logged Data	3.896
Maximum of Logged Data	4.934	SD of logged Data	0.528

Assuming Lognormal Distribution

95% H-UCL	91.38	90% Chebyshev (MVUE) UCL	86.94
95% Chebyshev (MVUE) UCL	101.2	97.5% Chebyshev (MVUE) UCL	120.9
99% Chebyshev (MVUE) UCL	159.7		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	77.36	95% Jackknife UCL	80.55
95% Standard Bootstrap UCL	75.83	95% Bootstrap-t UCL	120.1
95% Hall's Bootstrap UCL	192.3	95% Percentile Bootstrap UCL	79.13
95% BCA Bootstrap UCL	86.38		
90% Chebyshev(Mean, Sd) UCL	94.65	95% Chebyshev(Mean, Sd) UCL	112
97.5% Chebyshev(Mean, Sd) UCL	136.1	99% Chebyshev(Mean, Sd) UCL	183.3

Suggested UCL to Use

95% Student's-t UCL	80.55

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-226)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	22
Number of Detects	31	Number of Non-Detects	1
Number of Distinct Detects	21	Number of Distinct Non-Detects	1
Minimum Detect	0.43	Minimum Non-Detect	0.84
Maximum Detect	3.5	Maximum Non-Detect	0.84
Variance Detects	0.713	Percent Non-Detects	3.125%
Mean Detects	1.936	SD Detects	0.844
Median Detects	2	CV Detects	0.436
Skewness Detects	-0.208	Kurtosis Detects	-0.865
Mean of Logged Detects	0.532	SD of Logged Detects	0.572

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.929	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.107	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.159	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

Mean	1.894	Standard Error of Mean	0.153
SD	0.851	95% KM (BCA) UCL	2.152
95% KM (t) UCL	2.153	95% KM (Percentile Bootstrap) UCL	2.15
95% KM (z) UCL	2.146	95% KM Bootstrap t UCL	2.148
90% KM Chebyshev UCL	2.353	95% KM Chebyshev UCL	2.561
97.5% KM Chebyshev UCL	2.849	99% KM Chebyshev UCL	3.416

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.878	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.132	**Kolmogrov-Smirnoff GOF**	
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 on Detected Data Only

k hat (MLE)	4.038	k star (bias corrected MLE)	3.668
Theta hat (MLE)	0.48	Theta star (bias corrected MLE)	0.528
nu hat (MLE)	250.3	nu star (bias corrected)	227.4
MLE Mean (bias corrected)	1.936	MLE Sd (bias corrected)	1.011

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.951	nu hat (KM)	316.9
Approximate Chi Square Value (316.87, α)	276.6	Adjusted Chi Square Value (316.87, β)	274.6
95% Gamma Approximate KM-UCL (use when n>=50)	2.169	95% Gamma Adjusted KM-UCL (use when n<50)	2.185

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.43	Mean	1.903
Maximum	3.5	Median	1.95
SD	0.851	CV	0.447
k hat (MLE)	3.943	k star (bias corrected MLE)	3.594
Theta hat (MLE)	0.483	Theta star (bias corrected MLE)	0.53
nu hat (MLE)	252.4	nu star (bias corrected)	230
MLE Mean (bias corrected)	1.903	MLE Sd (bias corrected)	1.004
		Adjusted Level of Significance (β)	0.0416
Approximate Chi Square Value (230.04, α)	195.9	Adjusted Chi Square Value (230.04, β)	194.3
95% Gamma Approximate UCL (use when n>=50)	2.235	95% Gamma Adjusted UCL (use when n<50)	2.254

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.874	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.929	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.159	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	1.899	Mean in Log Scale	0.507
SD in Original Scale	0.856	SD in Log Scale	0.58
95% t UCL (assumes normality of ROS data)	2.156	95% Percentile Bootstrap UCL	2.141
95% BCA Bootstrap UCL	2.14	95% Bootstrap t UCL	2.148
95% H-UCL (Log ROS)	2.418		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.498	95% H-UCL (KM -Log)	2.413
KM SD (logged)	0.587	95% Critical H Value (KM-Log)	2.003
KM Standard Error of Mean (logged)	0.106		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.889	Mean in Log Scale	0.488
SD in Original Scale	0.873	SD in Log Scale	0.614
95% t UCL (Assumes normality)	2.15	95% H-Stat UCL	2.461

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	2.153	95% KM (Percentile Bootstrap) UCL	2.15

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.

Result (radium-228)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1.2	Mean	2.328
Maximum	7.6	Median	2.05
SD	1.169	Std. Error of Mean	0.207
Coefficient of Variation	0.502	Skewness	3.162

Normal GOF Test

Shapiro Wilk Test Statistic	0.701	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.679	95% Adjusted-CLT UCL (Chen-1995)	2.792
		95% Modified-t UCL (Johnson-1978)	2.698

Gamma GOF Test

A-D Test Statistic	0.849	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.119	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.156	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	6.368	k star (bias corrected MLE)	5.792
Theta hat (MLE)	0.366	Theta star (bias corrected MLE)	0.402
nu hat (MLE)	407.5	nu star (bias corrected)	370.7
MLE Mean (bias corrected)	2.328	MLE Sd (bias corrected)	0.967
		Approximate Chi Square Value (0.05)	327
Adjusted Level of Significance	0.0416	Adjusted Chi Square Value	324.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.639	95% Adjusted Gamma UCL (use when n<50)	2.656

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0953	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.157	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	0.764
Maximum of Logged Data	2.028	SD of logged Data	0.379

Assuming Lognormal Distribution

95% H-UCL	2.617	90% Chebyshev (MVUE) UCL	2.777
95% Chebyshev (MVUE) UCL	2.993	97.5% Chebyshev (MVUE) UCL	3.291
99% Chebyshev (MVUE) UCL	3.878		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.668	95% Jackknife UCL	2.679
95% Standard Bootstrap UCL	2.659	95% Bootstrap-t UCL	2.918
95% Hall's Bootstrap UCL	4.291	95% Percentile Bootstrap UCL	2.691
95% BCA Bootstrap UCL	2.825		
90% Chebyshev(Mean, Sd) UCL	2.948	95% Chebyshev(Mean, Sd) UCL	3.229
97.5% Chebyshev(Mean, Sd) UCL	3.619	99% Chebyshev(Mean, Sd) UCL	4.385

Suggested UCL to Use

95% Adjusted Gamma UCL	2.656

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-234)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.98	Mean	2.237
Maximum	3.9	Median	2.1
SD	0.74	Std. Error of Mean	0.131
Coefficient of Variation	0.331	Skewness	0.604

Normal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	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	2.459	95% Adjusted-CLT UCL (Chen-1995)	2.467
		95% Modified-t UCL (Johnson-1978)	2.461

Gamma GOF Test

A-D Test Statistic	0.223	**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	0.0857	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.155	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.518	k star (bias corrected MLE)	8.646
Theta hat (MLE)	0.235	Theta star (bias corrected MLE)	0.259
nu hat (MLE)	609.1	nu star (bias corrected)	553.4
MLE Mean (bias corrected)	2.237	MLE Sd (bias corrected)	0.761
		Approximate Chi Square Value (0.05)	499.8
Adjusted Level of Significance	0.0416	Adjusted Chi Square Value	497.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.477	95% Adjusted Gamma UCL (use when n<50)	2.49

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0941	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.157	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.0202	Mean of logged Data	0.752
Maximum of Logged Data	1.361	SD of logged Data	0.336

Assuming Lognormal Distribution

95% H-UCL	2.504	90% Chebyshev (MVUE) UCL	2.647
95% Chebyshev (MVUE) UCL	2.832	97.5% Chebyshev (MVUE) UCL	3.088
99% Chebyshev (MVUE) UCL	3.592		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.452	95% Jackknife UCL	2.459
95% Standard Bootstrap UCL	2.454	95% Bootstrap-t UCL	2.48
95% Hall's Bootstrap UCL	2.478	95% Percentile Bootstrap UCL	2.459
95% BCA Bootstrap UCL	2.449		
90% Chebyshev(Mean, Sd) UCL	2.629	95% Chebyshev(Mean, Sd) UCL	2.807
97.5% Chebyshev(Mean, Sd) UCL	3.054	99% Chebyshev(Mean, Sd) UCL	3.538

Suggested UCL to Use

95% Student's-t UCL	2.459

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-235)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	23
Number of Detects	23	Number of Non-Detects	9
Number of Distinct Detects	17	Number of Distinct Non-Detects	7
Minimum Detect	0.063	Minimum Non-Detect	0.039
Maximum Detect	0.31	Maximum Non-Detect	0.19
Variance Detects	0.00463	Percent Non-Detects	28.13%
Mean Detects	0.144	SD Detects	0.0681
Median Detects	0.12	CV Detects	0.473
Skewness Detects	1.154	Kurtosis Detects	0.523
Mean of Logged Detects	-2.034	SD of Logged Detects	0.436

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.871	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.185	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

Mean	0.124	Standard Error of Mean	0.0126
SD	0.0676	95% KM (BCA) UCL	0.148
95% KM (t) UCL	0.146	95% KM (Percentile Bootstrap) UCL	0.146
95% KM (z) UCL	0.145	95% KM Bootstrap t UCL	0.15
90% KM Chebyshev UCL	0.162	95% KM Chebyshev UCL	0.179
97.5% KM Chebyshev UCL	0.203	99% KM Chebyshev UCL	0.249

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.613	**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	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.182	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)	5.423	k star (bias corrected MLE)	4.745
Theta hat (MLE)	0.0265	Theta star (bias corrected MLE)	0.0303
nu hat (MLE)	249.5	nu star (bias corrected)	218.3
MLE Mean (bias corrected)	0.144	MLE Sd (bias corrected)	0.066

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.372	nu hat (KM)	215.8
Approximate Chi Square Value (215.84, α)	182.8	Adjusted Chi Square Value (215.84, β)	181.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.147	95% Gamma Adjusted KM-UCL (use when n<50)	0.148

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0261	Mean	0.123
Maximum	0.31	Median	0.099
SD	0.0697	CV	0.569
k hat (MLE)	3.188	k star (bias corrected MLE)	2.91
Theta hat (MLE)	0.0385	Theta star (bias corrected MLE)	0.0421
nu hat (MLE)	204	nu star (bias corrected)	186.3
MLE Mean (bias corrected)	0.123	MLE Sd (bias corrected)	0.0719
		Adjusted Level of Significance (β)	0.0416
Approximate Chi Square Value (186.25, α)	155.7	Adjusted Chi Square Value (186.25, β)	154.2
95% Gamma Approximate UCL (use when n>=50)	0.147	95% Gamma Adjusted UCL (use when n<50)	0.148

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.185	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	0.125	Mean in Log Scale	-2.194
SD in Original Scale	0.0662	SD in Log Scale	0.485
95% t UCL (assumes normality of ROS data)	0.145	95% Percentile Bootstrap UCL	0.145
95% BCA Bootstrap UCL	0.148	95% Bootstrap t UCL	0.15
95% H-UCL (Log ROS)	0.148		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.23	95% H-UCL (KM -Log)	0.152
KM SD (logged)	0.549	95% Critical H Value (KM-Log)	1.971
KM Standard Error of Mean (logged)	0.106		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.12	Mean in Log Scale	-2.293
SD in Original Scale	0.0706	SD in Log Scale	0.639
95% t UCL (Assumes normality)	0.142	95% H-Stat UCL	0.157

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	0.146	95% KM (Percentile Bootstrap) UCL	0.146

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

Result (uranium-238)

General Statistics

Total Number of Observations	32	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	1.1	Mean	2.338
Maximum	4	Median	2.25
SD	0.761	Std. Error of Mean	0.134
Coefficient of Variation	0.325	Skewness	0.47

Normal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0913	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	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	2.565	95% Adjusted-CLT UCL (Chen-1995)	2.571
		95% Modified-t UCL (Johnson-1978)	2.567

Gamma GOF Test

A-D Test Statistic	0.186	**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	0.0772	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.155	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.59	k star (bias corrected MLE)	8.712
Theta hat (MLE)	0.244	Theta star (bias corrected MLE)	0.268
nu hat (MLE)	613.8	nu star (bias corrected)	557.5
MLE Mean (bias corrected)	2.338	MLE Sd (bias corrected)	0.792
		Approximate Chi Square Value (0.05)	503.8
Adjusted Level of Significance	0.0416	Adjusted Chi Square Value	501.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.587	95% Adjusted Gamma UCL (use when n<50)	2.601

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.93	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0884	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.157	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.0953	Mean of logged Data	0.796
Maximum of Logged Data	1.386	SD of logged Data	0.337

Assuming Lognormal Distribution

95% H-UCL	2.619	90% Chebyshev (MVUE) UCL	2.769
95% Chebyshev (MVUE) UCL	2.962	97.5% Chebyshev (MVUE) UCL	3.23
99% Chebyshev (MVUE) UCL	3.758		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.559	95% Jackknife UCL	2.565
95% Standard Bootstrap UCL	2.557	95% Bootstrap-t UCL	2.569
95% Hall's Bootstrap UCL	2.575	95% Percentile Bootstrap UCL	2.563
95% BCA Bootstrap UCL	2.556		
90% Chebyshev(Mean, Sd) UCL	2.741	95% Chebyshev(Mean, Sd) UCL	2.924
97.5% Chebyshev(Mean, Sd) UCL	3.177	99% Chebyshev(Mean, Sd) UCL	3.675

Suggested UCL to Use

95% Student's-t UCL	2.565

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Appendix B
ProUCL 5.0.00 Output Files
Former CLEAR Plant - Radionuclides (0-0.5 feet bgs), Future Scenario
Baseline Human Health Risk Assessment
Sierrita Mine, Green Valley, Arizona

Result (radium-226)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	22
Number of Detects	32	Number of Non-Detects	1
Number of Distinct Detects	21	Number of Distinct Non-Detects	1
Minimum Detect	0.43	Minimum Non-Detect	0.84
Maximum Detect	3.5	Maximum Non-Detect	0.84
Variance Detects	0.719	Percent Non-Detects	3.03%
Mean Detects	1.966	SD Detects	0.848
Median Detects	2.05	CV Detects	0.431
Skewness Detects	-0.262	Kurtosis Detects	-0.889
Mean of Logged Detects	0.548	SD of Logged Detects	0.57

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.93	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.116	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.157	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

Mean	1.924	Standard Error of Mean	0.151
SD	0.856	95% KM (BCA) UCL	2.176
95% KM (t) UCL	2.181	95% KM (Percentile Bootstrap) UCL	2.174
95% KM (z) UCL	2.173	95% KM Bootstrap t UCL	2.164
90% KM Chebyshev UCL	2.379	95% KM Chebyshev UCL	2.584
97.5% KM Chebyshev UCL	2.87	99% KM Chebyshev UCL	3.431

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.978	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.751	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.156	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)	4.075	k star (bias corrected MLE)	3.713
Theta hat (MLE)	0.483	Theta star (bias corrected MLE)	0.529
nu hat (MLE)	260.8	nu star (bias corrected)	237.7
MLE Mean (bias corrected)	1.966	MLE Sd (bias corrected)	1.02

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.057	nu hat (KM)	333.8
Approximate Chi Square Value (333.78, α)	292.5	Adjusted Chi Square Value (333.78, β)	290.5
95% Gamma Approximate KM-UCL (use when n>=50)	2.196	95% Gamma Adjusted KM-UCL (use when n<50)	2.211

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.43	Mean	1.934
Maximum	3.5	Median	2
SD	0.854	CV	0.442
k hat (MLE)	3.986	k star (bias corrected MLE)	3.644
Theta hat (MLE)	0.485	Theta star (bias corrected MLE)	0.531
nu hat (MLE)	263.1	nu star (bias corrected)	240.5
MLE Mean (bias corrected)	1.934	MLE Sd (bias corrected)	1.013
		Adjusted Level of Significance (β)	0.0419
Approximate Chi Square Value (240.48, α)	205.6	Adjusted Chi Square Value (240.48, β)	203.9
95% Gamma Approximate UCL (use when n>=50)	2.263	95% Gamma Adjusted UCL (use when n<50)	2.281

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.157	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	1.93	Mean in Log Scale	0.524
SD in Original Scale	0.86	SD in Log Scale	0.579
95% t UCL (assumes normality of ROS data)	2.184	95% Percentile Bootstrap UCL	2.157
95% BCA Bootstrap UCL	2.16	95% Bootstrap t UCL	2.18
95% H-UCL (Log ROS)	2.45		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.919	Mean in Log Scale	0.506
SD in Original Scale	0.877	SD in Log Scale	0.613
95% t UCL (Assumes normality)	2.178	95% H-Stat UCL	2.493

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	2.181	95% KM (Percentile Bootstrap) UCL	2.174

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.

Result (radium-228)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1.2	Mean	2.315
Maximum	7.6	Median	2
SD	1.153	Std. Error of Mean	0.201
Coefficient of Variation	0.498	Skewness	3.221

Normal GOF Test

Shapiro Wilk Test Statistic	0.697	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.655	95% Adjusted-CLT UCL (Chen-1995)	2.766
		95% Modified-t UCL (Johnson-1978)	2.674

Gamma GOF Test

A-D Test Statistic	0.891	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.121	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.153	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	6.515	k star (bias corrected MLE)	5.943
Theta hat (MLE)	0.355	Theta star (bias corrected MLE)	0.39
nu hat (MLE)	430	nu star (bias corrected)	392.3
MLE Mean (bias corrected)	2.315	MLE Sd (bias corrected)	0.95
		Approximate Chi Square Value (0.05)	347.3
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	345.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.614	95% Adjusted Gamma UCL (use when n<50)	2.631

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0959	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	0.761
Maximum of Logged Data	2.028	SD of logged Data	0.374

Assuming Lognormal Distribution

95% H-UCL	2.592	90% Chebyshev (MVUE) UCL	2.748
95% Chebyshev (MVUE) UCL	2.956	97.5% Chebyshev (MVUE) UCL	3.244
99% Chebyshev (MVUE) UCL	3.81		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.645	95% Jackknife UCL	2.655
95% Standard Bootstrap UCL	2.641	95% Bootstrap-t UCL	2.912
95% Hall's Bootstrap UCL	4.223	95% Percentile Bootstrap UCL	2.679
95% BCA Bootstrap UCL	2.788		
90% Chebyshev(Mean, Sd) UCL	2.917	95% Chebyshev(Mean, Sd) UCL	3.19
97.5% Chebyshev(Mean, Sd) UCL	3.569	99% Chebyshev(Mean, Sd) UCL	4.313

Suggested UCL to Use

95% Adjusted Gamma UCL	2.631

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-234)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	0.98	Mean	2.533
Maximum	12	Median	2.1
SD	1.849	Std. Error of Mean	0.322
Coefficient of Variation	0.73	Skewness	4.42

Normal GOF Test

Shapiro Wilk Test Statistic	0.537	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	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	3.078	95% Adjusted-CLT UCL (Chen-1995)	3.327
		95% Modified-t UCL (Johnson-1978)	3.119

Gamma GOF Test

A-D Test Statistic	1.501	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.154	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.155	k star (bias corrected MLE)	3.797
Theta hat (MLE)	0.61	Theta star (bias corrected MLE)	0.667
nu hat (MLE)	274.2	nu star (bias corrected)	250.6
MLE Mean (bias corrected)	2.533	MLE Sd (bias corrected)	1.3
		Approximate Chi Square Value (0.05)	215
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	213.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.953	95% Adjusted Gamma UCL (use when n<50)	2.976

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.134	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.0202	Mean of logged Data	0.804
Maximum of Logged Data	2.485	SD of logged Data	0.448

Assuming Lognormal Distribution

95% H-UCL	2.871	90% Chebyshev (MVUE) UCL	3.059
95% Chebyshev (MVUE) UCL	3.33	97.5% Chebyshev (MVUE) UCL	3.705
99% Chebyshev (MVUE) UCL	4.443		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3.062	95% Jackknife UCL	3.078
95% Standard Bootstrap UCL	3.042	95% Bootstrap-t UCL	3.775
95% Hall's Bootstrap UCL	5.27	95% Percentile Bootstrap UCL	3.105
95% BCA Bootstrap UCL	3.505		
90% Chebyshev(Mean, Sd) UCL	3.498	95% Chebyshev(Mean, Sd) UCL	3.936
97.5% Chebyshev(Mean, Sd) UCL	4.543	99% Chebyshev(Mean, Sd) UCL	5.735

Suggested UCL to Use

95% Student's-t UCL	3.078	or 95% Modified-t UCL	3.119

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-235)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	24
Number of Detects	24	Number of Non-Detects	9
Number of Distinct Detects	18	Number of Distinct Non-Detects	7
Minimum Detect	0.063	Minimum Non-Detect	0.039
Maximum Detect	0.74	Maximum Non-Detect	0.19
Variance Detects	0.0192	Percent Non-Detects	27.27%
Mean Detects	0.169	SD Detects	0.139
Median Detects	0.13	CV Detects	0.823
Skewness Detects	3.303	Kurtosis Detects	12.99
Mean of Logged Detects	-1.962	SD of Logged Detects	0.554

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.624	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	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

Mean	0.143	Standard Error of Mean	0.0224
SD	0.125	95% KM (BCA) UCL	0.185
95% KM (t) UCL	0.181	95% KM (Percentile Bootstrap) UCL	0.183
95% KM (z) UCL	0.18	95% KM Bootstrap t UCL	0.211
90% KM Chebyshev UCL	0.21	95% KM Chebyshev UCL	0.24
97.5% KM Chebyshev UCL	0.283	99% KM Chebyshev UCL	0.366

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.135	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.752	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.167	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.179	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)	2.901	k star (bias corrected MLE)	2.566
Theta hat (MLE)	0.0581	Theta star (bias corrected MLE)	0.0657
nu hat (MLE)	139.2	nu star (bias corrected)	123.2
MLE Mean (bias corrected)	0.169	MLE Sd (bias corrected)	0.105

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.311	nu hat (KM)	86.5
Approximate Chi Square Value (86.50, α)	66.06	Adjusted Chi Square Value (86.50, β)	65.14
95% Gamma Approximate KM-UCL (use when n>=50)	0.187	95% Gamma Adjusted KM-UCL (use when n<50)	0.19

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.136
Maximum	0.74	Median	0.098
SD	0.131	CV	0.961
k hat (MLE)	1.517	k star (bias corrected MLE)	1.4
Theta hat (MLE)	0.0899	Theta star (bias corrected MLE)	0.0975
nu hat (MLE)	100.2	nu star (bias corrected)	92.38
MLE Mean (bias corrected)	0.136	MLE Sd (bias corrected)	0.115
		Adjusted Level of Significance (β)	0.0419
Approximate Chi Square Value (92.38, α)	71.21	Adjusted Chi Square Value (92.38, β)	70.26
95% Gamma Approximate UCL (use when n>=50)	0.177	95% Gamma Adjusted UCL (use when n<50)	0.179

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	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	0.143	Mean in Log Scale	-2.157
SD in Original Scale	0.126	SD in Log Scale	0.61
95% t UCL (assumes normality of ROS data)	0.18	95% Percentile Bootstrap UCL	0.185
95% BCA Bootstrap UCL	0.195	95% Bootstrap t UCL	0.21
95% H-UCL (Log ROS)	0.173		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.172	95% H-UCL (KM -Log)	0.175
KM SD (logged)	0.633	95% Critical H Value (KM-Log)	2.049
KM Standard Error of Mean (logged)	0.118		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.139	Mean in Log Scale	-2.232
SD in Original Scale	0.128	SD in Log Scale	0.718
95% t UCL (Assumes normality)	0.177	95% H-Stat UCL	0.182

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 (Percentile Bootstrap) UCL	0.183	95% GROS Adjusted Gamma UCL	0.179
95% Adjusted Gamma KM-UCL	0.19		

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

Result (uranium-238)

General Statistics

Total Number of Observations	33	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	1.1	Mean	2.63
Maximum	12	Median	2.3
SD	1.841	Std. Error of Mean	0.32
Coefficient of Variation	0.7	Skewness	4.328

Normal GOF Test

Shapiro Wilk Test Statistic	0.553	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	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	3.173	95% Adjusted-CLT UCL (Chen-1995)	3.416
		95% Modified-t UCL (Johnson-1978)	3.213

Gamma GOF Test

A-D Test Statistic	1.319	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.184	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.154	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.33	k star (bias corrected MLE)	3.957
Theta hat (MLE)	0.607	Theta star (bias corrected MLE)	0.665
nu hat (MLE)	285.8	nu star (bias corrected)	261.2
MLE Mean (bias corrected)	2.63	MLE Sd (bias corrected)	1.322
		Approximate Chi Square Value (0.05)	224.7
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	223

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.057	95% Adjusted Gamma UCL (use when n<50)	3.08

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.139	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.154	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.0953	Mean of logged Data	0.847
Maximum of Logged Data	2.485	SD of logged Data	0.443

Assuming Lognormal Distribution

95% H-UCL	2.985	90% Chebyshev (MVUE) UCL	3.18
95% Chebyshev (MVUE) UCL	3.459	97.5% Chebyshev (MVUE) UCL	3.845
99% Chebyshev (MVUE) UCL	4.605		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3.157	95% Jackknife UCL	3.173
95% Standard Bootstrap UCL	3.147	95% Bootstrap-t UCL	3.823
95% Hall's Bootstrap UCL	5.362	95% Percentile Bootstrap UCL	3.233
95% BCA Bootstrap UCL	3.418		
90% Chebyshev(Mean, Sd) UCL	3.592	95% Chebyshev(Mean, Sd) UCL	4.027
97.5% Chebyshev(Mean, Sd) UCL	4.632	99% Chebyshev(Mean, Sd) UCL	5.819

Suggested UCL to Use

95% Student's-t UCL	3.173	or 95% Modified-t UCL	3.213

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-226)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	30
Number of Detects	65	Number of Non-Detects	1
Number of Distinct Detects	29	Number of Distinct Non-Detects	1
Minimum Detect	0.43	Minimum Non-Detect	0.84
Maximum Detect	4.8	Maximum Non-Detect	0.84
Variance Detects	0.829	Percent Non-Detects	1.515%
Mean Detects	2.119	SD Detects	0.911
Median Detects	2.1	CV Detects	0.43
Skewness Detects	0.614	Kurtosis Detects	1.095
Mean of Logged Detects	0.643	SD of Logged Detects	0.506

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.957	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0.0623	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0679	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.11	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

Mean	2.096	Standard Error of Mean	0.114
SD	0.916	95% KM (BCA) UCL	2.278
95% KM (t) UCL	2.285	95% KM (Percentile Bootstrap) UCL	2.285
95% KM (z) UCL	2.283	95% KM Bootstrap t UCL	2.288
90% KM Chebyshev UCL	2.437	95% KM Chebyshev UCL	2.591
97.5% KM Chebyshev UCL	2.806	99% KM Chebyshev UCL	3.227

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.801	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0987	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.111	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)	4.798	k star (bias corrected MLE)	4.587
Theta hat (MLE)	0.442	Theta star (bias corrected MLE)	0.462
nu hat (MLE)	623.7	nu star (bias corrected)	596.3
MLE Mean (bias corrected)	2.119	MLE Sd (bias corrected)	0.989

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.232	nu hat (KM)	690.6
Approximate Chi Square Value (690.62, α)	630.6	Adjusted Chi Square Value (690.62, β)	629.4
95% Gamma Approximate KM-UCL (use when n>=50)	2.295	95% Gamma Adjusted KM-UCL (use when n<50)	2.3

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.43	Mean	2.1
Maximum	4.8	Median	2.1
SD	0.917	CV	0.437
k hat (MLE)	4.664	k star (bias corrected MLE)	4.462
Theta hat (MLE)	0.45	Theta star (bias corrected MLE)	0.471
nu hat (MLE)	615.6	nu star (bias corrected)	588.9
MLE Mean (bias corrected)	2.1	MLE Sd (bias corrected)	0.994
		Adjusted Level of Significance (β)	0.0464
Approximate Chi Square Value (588.95, α)	533.7	Adjusted Chi Square Value (588.95, β)	532.5
95% Gamma Approximate UCL (use when n>=50)	2.317	95% Gamma Adjusted UCL (use when n<50)	2.322

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.13	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.11	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	2.099	Mean in Log Scale	0.63
SD in Original Scale	0.918	SD in Log Scale	0.513
95% t UCL (assumes normality of ROS data)	2.288	95% Percentile Bootstrap UCL	2.295
95% BCA Bootstrap UCL	2.284	95% Bootstrap t UCL	2.3
95% H-UCL (Log ROS)	2.413		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.093	Mean in Log Scale	0.62
SD in Original Scale	0.928	SD in Log Scale	0.535
95% t UCL (Assumes normality)	2.284	95% H-Stat UCL	2.433

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	2.285	95% KM (Percentile Bootstrap) UCL	2.285

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

Result (radium-228)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	1.2	Mean	2.258
Maximum	7.6	Median	2.1
SD	0.905	Std. Error of Mean	0.111
Coefficient of Variation	0.401	Skewness	3.425

Normal GOF Test

Shapiro Wilk Test Statistic	0.744	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	2.109E-15	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.148	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.109	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.443	95% Adjusted-CLT UCL (Chen-1995)	2.491
		95% Modified-t UCL (Johnson-1978)	2.451

Gamma GOF Test

A-D Test Statistic	1.072	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.119	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.11	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.303	k star (bias corrected MLE)	8.89
Theta hat (MLE)	0.243	Theta star (bias corrected MLE)	0.254
nu hat (MLE)	1228	nu star (bias corrected)	1174
MLE Mean (bias corrected)	2.258	MLE Sd (bias corrected)	0.757
		Approximate Chi Square Value (0.05)	1095
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	1093

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.419	95% Adjusted Gamma UCL (use when n<50)	2.423

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0218	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0982	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.109	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	0.76
Maximum of Logged Data	2.028	SD of logged Data	0.314

Assuming Lognormal Distribution

95% H-UCL	2.404	90% Chebyshev (MVUE) UCL	2.509
95% Chebyshev (MVUE) UCL	2.629	97.5% Chebyshev (MVUE) UCL	2.795
99% Chebyshev (MVUE) UCL	3.123		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.441	95% Jackknife UCL	2.443
95% Standard Bootstrap UCL	2.437	95% Bootstrap-t UCL	2.532
95% Hall's Bootstrap UCL	2.75	95% Percentile Bootstrap UCL	2.461
95% BCA Bootstrap UCL	2.524		
90% Chebyshev(Mean, Sd) UCL	2.592	95% Chebyshev(Mean, Sd) UCL	2.743
97.5% Chebyshev(Mean, Sd) UCL	2.953	99% Chebyshev(Mean, Sd) UCL	3.366

Suggested UCL to Use

95% Student's-t UCL	2.443	or 95% Modified-t UCL	2.451

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-234)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	0.88	Mean	2.256
Maximum	4.6	Median	2.15
SD	0.845	Std. Error of Mean	0.104
Coefficient of Variation	0.375	Skewness	0.938

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	5.3821E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.109	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.429	95% Adjusted-CLT UCL (Chen-1995)	2.44
		95% Modified-t UCL (Johnson-1978)	2.431

Gamma GOF Test

A-D Test Statistic	0.414	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0837	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.11	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.622	k star (bias corrected MLE)	7.286
Theta hat (MLE)	0.296	Theta star (bias corrected MLE)	0.31
nu hat (MLE)	1006	nu star (bias corrected)	961.7
MLE Mean (bias corrected)	2.256	MLE Sd (bias corrected)	0.836
		Approximate Chi Square Value (0.05)	890.8
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	889.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.435	95% Adjusted Gamma UCL (use when n<50)	2.439

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.357	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0839	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.109	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.128	Mean of logged Data	0.746
Maximum of Logged Data	1.526	SD of logged Data	0.372

Assuming Lognormal Distribution

95% H-UCL	2.455	90% Chebyshev (MVUE) UCL	2.577
95% Chebyshev (MVUE) UCL	2.722	97.5% Chebyshev (MVUE) UCL	2.922
99% Chebyshev (MVUE) UCL	3.317		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.427	95% Jackknife UCL	2.429
95% Standard Bootstrap UCL	2.426	95% Bootstrap-t UCL	2.439
95% Hall's Bootstrap UCL	2.449	95% Percentile Bootstrap UCL	2.428
95% BCA Bootstrap UCL	2.445		
90% Chebyshev(Mean, Sd) UCL	2.568	95% Chebyshev(Mean, Sd) UCL	2.709
97.5% Chebyshev(Mean, Sd) UCL	2.906	99% Chebyshev(Mean, Sd) UCL	3.291

Suggested UCL to Use

95% Approximate Gamma UCL	2.435

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-235)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	37
Number of Detects	48	Number of Non-Detects	18
Number of Distinct Detects	28	Number of Distinct Non-Detects	14
Minimum Detect	0.02	Minimum Non-Detect	0.039
Maximum Detect	0.31	Maximum Non-Detect	0.23
Variance Detects	0.00494	Percent Non-Detects	27.27%
Mean Detects	0.142	SD Detects	0.0703
Median Detects	0.135	CV Detects	0.496
Skewness Detects	0.613	Kurtosis Detects	-0.176
Mean of Logged Detects	-2.089	SD of Logged Detects	0.562

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.128	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

Mean	0.121	Standard Error of Mean	0.00926
SD	0.0717	95% KM (BCA) UCL	0.138
95% KM (t) UCL	0.137	95% KM (Percentile Bootstrap) UCL	0.137
95% KM (z) UCL	0.136	95% KM Bootstrap t UCL	0.136
90% KM Chebyshev UCL	0.149	95% KM Chebyshev UCL	0.161
97.5% KM Chebyshev UCL	0.179	99% KM Chebyshev UCL	0.213

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.22	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0773	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.128	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)	3.825	k star (bias corrected MLE)	3.6
Theta hat (MLE)	0.0371	Theta star (bias corrected MLE)	0.0394
nu hat (MLE)	367.2	nu star (bias corrected)	345.6
MLE Mean (bias corrected)	0.142	MLE Sd (bias corrected)	0.0748

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.851	nu hat (KM)	376.3
Approximate Chi Square Value (376.31, α)	332.4	Adjusted Chi Square Value (376.31, β)	331.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.137	95% Gamma Adjusted KM-UCL (use when n<50)	0.138

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.02	Mean	0.122
Maximum	0.31	Median	0.098
SD	0.07	CV	0.576
k hat (MLE)	3.054	k star (bias corrected MLE)	2.925
Theta hat (MLE)	0.0398	Theta star (bias corrected MLE)	0.0416
nu hat (MLE)	403.1	nu star (bias corrected)	386.1
MLE Mean (bias corrected)	0.122	MLE Sd (bias corrected)	0.0711
		Adjusted Level of Significance (β)	0.0464
Approximate Chi Square Value (386.13, α)	341.6	Adjusted Chi Square Value (386.13, β)	340.7
95% Gamma Approximate UCL (use when n>=50)	0.137	95% Gamma Adjusted UCL (use when n<50)	0.138

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0866	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.128	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	0.122	Mean in Log Scale	-2.269
SD in Original Scale	0.0695	SD in Log Scale	0.589
95% t UCL (assumes normality of ROS data)	0.136	95% Percentile Bootstrap UCL	0.136
95% BCA Bootstrap UCL	0.137	95% Bootstrap t UCL	0.137
95% H-UCL (Log ROS)	0.142		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.32	95% H-UCL (KM -Log)	0.15
KM SD (logged)	0.702	95% Critical H Value (KM-Log)	2.015
KM Standard Error of Mean (logged)	0.0982		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.12	Mean in Log Scale	-2.316
SD in Original Scale	0.0716	SD in Log Scale	0.665
95% t UCL (Assumes normality)	0.135	95% H-Stat UCL	0.145

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	0.137	95% KM (Percentile Bootstrap) UCL	0.137

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

Result (uranium-238)

General Statistics

Total Number of Observations	66	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	0.84	Mean	2.322
Maximum	4.9	Median	2.2
SD	0.884	Std. Error of Mean	0.109
Coefficient of Variation	0.381	Skewness	1.001

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	4.2812E-4	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.109	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.503	95% Adjusted-CLT UCL (Chen-1995)	2.515
		95% Modified-t UCL (Johnson-1978)	2.506

Gamma GOF Test

A-D Test Statistic	0.434	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0698	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.11	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.461	k star (bias corrected MLE)	7.132
Theta hat (MLE)	0.311	Theta star (bias corrected MLE)	0.326
nu hat (MLE)	984.8	nu star (bias corrected)	941.4
MLE Mean (bias corrected)	2.322	MLE Sd (bias corrected)	0.869
		Approximate Chi Square Value (0.05)	871.2
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	869.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.509	95% Adjusted Gamma UCL (use when n<50)	2.513

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.579	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0827	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.109	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.174	Mean of logged Data	0.774
Maximum of Logged Data	1.589	SD of logged Data	0.375

Assuming Lognormal Distribution

95% H-UCL	2.529	90% Chebyshev (MVUE) UCL	2.655
95% Chebyshev (MVUE) UCL	2.805	97.5% Chebyshev (MVUE) UCL	3.014
99% Chebyshev (MVUE) UCL	3.424		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.501	95% Jackknife UCL	2.503
95% Standard Bootstrap UCL	2.501	95% Bootstrap-t UCL	2.518
95% Hall's Bootstrap UCL	2.512	95% Percentile Bootstrap UCL	2.507
95% BCA Bootstrap UCL	2.499		
90% Chebyshev(Mean, Sd) UCL	2.648	95% Chebyshev(Mean, Sd) UCL	2.796
97.5% Chebyshev(Mean, Sd) UCL	3.001	99% Chebyshev(Mean, Sd) UCL	3.405

Suggested UCL to Use

95% Approximate Gamma UCL	2.509

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-226)

General Statistics

Total Number of Observations	68	Number of Distinct Observations	31
Number of Detects	67	Number of Non-Detects	1
Number of Distinct Detects	30	Number of Distinct Non-Detects	1
Minimum Detect	0.43	Minimum Non-Detect	0.84
Maximum Detect	4.8	Maximum Non-Detect	0.84
Variance Detects	0.829	Percent Non-Detects	1.471%
Mean Detects	2.115	SD Detects	0.911
Median Detects	2.1	CV Detects	0.43
Skewness Detects	0.595	Kurtosis Detects	1.006
Mean of Logged Detects	0.641	SD of Logged Detects	0.505

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.96	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0.075	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0615	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	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

Mean	2.093	Standard Error of Mean	0.112
SD	0.916	95% KM (BCA) UCL	2.271
95% KM (t) UCL	2.28	95% KM (Percentile Bootstrap) UCL	2.273
95% KM (z) UCL	2.277	95% KM Bootstrap t UCL	2.294
90% KM Chebyshev UCL	2.429	95% KM Chebyshev UCL	2.581
97.5% KM Chebyshev UCL	2.792	99% KM Chebyshev UCL	3.207

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.74	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0964	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.109	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)	4.789	k star (bias corrected MLE)	4.584
Theta hat (MLE)	0.442	Theta star (bias corrected MLE)	0.461
nu hat (MLE)	641.7	nu star (bias corrected)	614.3
MLE Mean (bias corrected)	2.115	MLE Sd (bias corrected)	0.988

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.222	nu hat (KM)	710.2
Approximate Chi Square Value (710.15, α)	649.3	Adjusted Chi Square Value (710.15, β)	648.1
95% Gamma Approximate KM-UCL (use when n>=50)	2.289	95% Gamma Adjusted KM-UCL (use when n<50)	2.293

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.43	Mean	2.096
Maximum	4.8	Median	2.1
SD	0.917	CV	0.437
k hat (MLE)	4.656	k star (bias corrected MLE)	4.46
Theta hat (MLE)	0.45	Theta star (bias corrected MLE)	0.47
nu hat (MLE)	633.2	nu star (bias corrected)	606.6
MLE Mean (bias corrected)	2.096	MLE Sd (bias corrected)	0.993
		Adjusted Level of Significance (β)	0.0465
Approximate Chi Square Value (606.57, α)	550.4	Adjusted Chi Square Value (606.57, β)	549.3
95% Gamma Approximate UCL (use when n>=50)	2.31	95% Gamma Adjusted UCL (use when n<50)	2.315

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.127	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	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	2.096	Mean in Log Scale	0.629
SD in Original Scale	0.918	SD in Log Scale	0.512
95% t UCL (assumes normality of ROS data)	2.282	95% Percentile Bootstrap UCL	2.273
95% BCA Bootstrap UCL	2.269	95% Bootstrap t UCL	2.295
95% H-UCL (Log ROS)	2.404		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.09	Mean in Log Scale	0.619
SD in Original Scale	0.927	SD in Log Scale	0.534
95% t UCL (Assumes normality)	2.278	95% H-Stat UCL	2.423

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	2.28	95% KM (Percentile Bootstrap) UCL	2.273

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

Result (radium-228)

General Statistics

Total Number of Observations	68	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	1.2	Mean	2.241
Maximum	7.6	Median	2.1
SD	0.897	Std. Error of Mean	0.109
Coefficient of Variation	0.4	Skewness	3.455

Normal GOF Test

Shapiro Wilk Test Statistic	0.742	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	4.44E-16	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.423	95% Adjusted-CLT UCL (Chen-1995)	2.469
		95% Modified-t UCL (Johnson-1978)	2.43

Gamma GOF Test

A-D Test Statistic	1.138	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.123	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.108	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.362	k star (bias corrected MLE)	8.959
Theta hat (MLE)	0.239	Theta star (bias corrected MLE)	0.25
nu hat (MLE)	1273	nu star (bias corrected)	1218
MLE Mean (bias corrected)	2.241	MLE Sd (bias corrected)	0.749
		Approximate Chi Square Value (0.05)	1138
Adjusted Level of Significance	0.0465	Adjusted Chi Square Value	1137

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.399	95% Adjusted Gamma UCL (use when n<50)	2.402

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0147	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.102	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.107	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	0.753
Maximum of Logged Data	2.028	SD of logged Data	0.312

Assuming Lognormal Distribution

95% H-UCL	2.383	90% Chebyshev (MVUE) UCL	2.485
95% Chebyshev (MVUE) UCL	2.602	97.5% Chebyshev (MVUE) UCL	2.764
99% Chebyshev (MVUE) UCL	3.083		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.42	95% Jackknife UCL	2.423
95% Standard Bootstrap UCL	2.418	95% Bootstrap-t UCL	2.502
95% Hall's Bootstrap UCL	2.722	95% Percentile Bootstrap UCL	2.431
95% BCA Bootstrap UCL	2.476		
90% Chebyshev(Mean, Sd) UCL	2.568	95% Chebyshev(Mean, Sd) UCL	2.715
97.5% Chebyshev(Mean, Sd) UCL	2.921	99% Chebyshev(Mean, Sd) UCL	3.324

Suggested UCL to Use

95% Student's-t UCL	2.423	or 95% Modified-t UCL	2.43

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-234)

General Statistics

Total Number of Observations	68	Number of Distinct Observations	32
		Number of Missing Observations	0
Minimum	0.84	Mean	2.378
Maximum	12	Median	2.15
SD	1.458	Std. Error of Mean	0.177
Coefficient of Variation	0.613	Skewness	4.495

Normal GOF Test

Shapiro Wilk Test Statistic	0.648	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.673	95% Adjusted-CLT UCL (Chen-1995)	2.772
		95% Modified-t UCL (Johnson-1978)	2.689

Gamma GOF Test

A-D Test Statistic	1.314	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.132	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.108	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.795	k star (bias corrected MLE)	4.593
Theta hat (MLE)	0.496	Theta star (bias corrected MLE)	0.518
nu hat (MLE)	652.1	nu star (bias corrected)	624.7
MLE Mean (bias corrected)	2.378	MLE Sd (bias corrected)	1.11
		Approximate Chi Square Value (0.05)	567.7
Adjusted Level of Significance	0.0465	Adjusted Chi Square Value	566.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.617	95% Adjusted Gamma UCL (use when n<50)	2.622

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0725	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0956	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.107	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.174	Mean of logged Data	0.758
Maximum of Logged Data	2.485	SD of logged Data	0.438

Assuming Lognormal Distribution

95% H-UCL	2.591	90% Chebyshev (MVUE) UCL	2.735
95% Chebyshev (MVUE) UCL	2.911	97.5% Chebyshev (MVUE) UCL	3.156
99% Chebyshev (MVUE) UCL	3.637		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.669	95% Jackknife UCL	2.673
95% Standard Bootstrap UCL	2.664	95% Bootstrap-t UCL	2.844
95% Hall's Bootstrap UCL	4.048	95% Percentile Bootstrap UCL	2.712
95% BCA Bootstrap UCL	2.778		
90% Chebyshev(Mean, Sd) UCL	2.908	95% Chebyshev(Mean, Sd) UCL	3.149
97.5% Chebyshev(Mean, Sd) UCL	3.482	99% Chebyshev(Mean, Sd) UCL	4.137

Suggested UCL to Use

95% Student's-t UCL	2.673	or 95% Modified-t UCL	2.689
or 95% H-UCL	2.591		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (uranium-235)

General Statistics

Total Number of Observations	68	Number of Distinct Observations	38
Number of Detects	50	Number of Non-Detects	18
Number of Distinct Detects	29	Number of Distinct Non-Detects	14
Minimum Detect	0.02	Minimum Non-Detect	0.039
Maximum Detect	0.74	Maximum Non-Detect	0.23
Variance Detects	0.012	Percent Non-Detects	26.47%
Mean Detects	0.153	SD Detects	0.11
Median Detects	0.135	CV Detects	0.718
Skewness Detects	3.305	Kurtosis Detects	16.33
Mean of Logged Detects	-2.062	SD of Logged Detects	0.61

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.738	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.125	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

Mean	0.13	Standard Error of Mean	0.0128
SD	0.103	95% KM (BCA) UCL	0.152
95% KM (t) UCL	0.151	95% KM (Percentile Bootstrap) UCL	0.151
95% KM (z) UCL	0.151	95% KM Bootstrap t UCL	0.158
90% KM Chebyshev UCL	0.168	95% KM Chebyshev UCL	0.186
97.5% KM Chebyshev UCL	0.21	99% KM Chebyshev UCL	0.257

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.456	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0882	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.126	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)	2.902	k star (bias corrected MLE)	2.741
Theta hat (MLE)	0.0526	Theta star (bias corrected MLE)	0.0557
nu hat (MLE)	290.2	nu star (bias corrected)	274.1
MLE Mean (bias corrected)	0.153	MLE Sd (bias corrected)	0.0922

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.593	nu hat (KM)	216.6
Approximate Chi Square Value (216.63, α)	183.6	Adjusted Chi Square Value (216.63, β)	182.9
95% Gamma Approximate KM-UCL (use when n>=50)	0.153	95% Gamma Adjusted KM-UCL (use when n<50)	0.154

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.126
Maximum	0.74	Median	0.098
SD	0.105	CV	0.836
k hat (MLE)	1.816	k star (bias corrected MLE)	1.745
Theta hat (MLE)	0.0694	Theta star (bias corrected MLE)	0.0722
nu hat (MLE)	246.9	nu star (bias corrected)	237.4
MLE Mean (bias corrected)	0.126	MLE Sd (bias corrected)	0.0954
		Adjusted Level of Significance (β)	0.0465
Approximate Chi Square Value (237.36, α)	202.7	Adjusted Chi Square Value (237.36, β)	202
95% Gamma Approximate UCL (use when n>=50)	0.148	95% Gamma Adjusted UCL (use when n<50)	0.148

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.984	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0657	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.125	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	0.13	Mean in Log Scale	-2.252
SD in Original Scale	0.102	SD in Log Scale	0.639
95% t UCL (assumes normality of ROS data)	0.15	95% Percentile Bootstrap UCL	0.152
95% BCA Bootstrap UCL	0.156	95% Bootstrap t UCL	0.16
95% H-UCL (Log ROS)	0.15		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.291	95% H-UCL (KM -Log)	0.159
KM SD (logged)	0.731	95% Critical H Value (KM-Log)	2.042
KM Standard Error of Mean (logged)	0.0992		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.128	Mean in Log Scale	-2.289
SD in Original Scale	0.103	SD in Log Scale	0.699
95% t UCL (Assumes normality)	0.149	95% H-Stat UCL	0.154

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 (Percentile Bootstrap) UCL	0.151	95% GROS Approximate Gamma UCL	0.148
95% Approximate Gamma KM-UCL	0.153		

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

Result (uranium-238)

General Statistics

Total Number of Observations	68	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	0.84	Mean	2.445
Maximum	12	Median	2.2
SD	1.472	Std. Error of Mean	0.179
Coefficient of Variation	0.602	Skewness	4.31

Normal GOF Test

Shapiro Wilk Test Statistic	0.663	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.742	95% Adjusted-CLT UCL (Chen-1995)	2.838
		95% Modified-t UCL (Johnson-1978)	2.758

Gamma GOF Test

A-D Test Statistic	1.273	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.126	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.108	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.864	k star (bias corrected MLE)	4.659
Theta hat (MLE)	0.503	Theta star (bias corrected MLE)	0.525
nu hat (MLE)	661.5	nu star (bias corrected)	633.6
MLE Mean (bias corrected)	2.445	MLE Sd (bias corrected)	1.133
		Approximate Chi Square Value (0.05)	576.3
Adjusted Level of Significance	0.0465	Adjusted Chi Square Value	575.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.688	95% Adjusted Gamma UCL (use when n<50)	2.694

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.129	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0969	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.107	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.174	Mean of logged Data	0.788
Maximum of Logged Data	2.485	SD of logged Data	0.435

Assuming Lognormal Distribution

95% H-UCL	2.662	90% Chebyshev (MVUE) UCL	2.809
95% Chebyshev (MVUE) UCL	2.989	97.5% Chebyshev (MVUE) UCL	3.239
99% Chebyshev (MVUE) UCL	3.729		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.738	95% Jackknife UCL	2.742
95% Standard Bootstrap UCL	2.733	95% Bootstrap-t UCL	2.902
95% Hall's Bootstrap UCL	4.104	95% Percentile Bootstrap UCL	2.756
95% BCA Bootstrap UCL	2.869		
90% Chebyshev(Mean, Sd) UCL	2.98	95% Chebyshev(Mean, Sd) UCL	3.223
97.5% Chebyshev(Mean, Sd) UCL	3.56	99% Chebyshev(Mean, Sd) UCL	4.221

Suggested UCL to Use

95% Student's-t UCL	2.742	or 95% Modified-t UCL	2.758
or 95% H-UCL	2.662		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (radium-226)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	38
Number of Detects	80	Number of Non-Detects	2
Number of Distinct Detects	36	Number of Distinct Non-Detects	2
Minimum Detect	0.43	Minimum Non-Detect	0.4
Maximum Detect	5.3	Maximum Non-Detect	0.84
Variance Detects	1.116	Percent Non-Detects	2.439%
Mean Detects	2.243	SD Detects	1.056
Median Detects	2.15	CV Detects	0.471
Skewness Detects	0.939	Kurtosis Detects	1.249
Mean of Logged Detects	0.689	SD of Logged Detects	0.52

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.925	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	9.3872E-5	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.105	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0991	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

Mean	2.2	Standard Error of Mean	0.119
SD	1.072	95% KM (BCA) UCL	2.417
95% KM (t) UCL	2.398	95% KM (Percentile Bootstrap) UCL	2.407
95% KM (z) UCL	2.396	95% KM Bootstrap t UCL	2.411
90% KM Chebyshev UCL	2.557	95% KM Chebyshev UCL	2.719
97.5% KM Chebyshev UCL	2.944	99% KM Chebyshev UCL	3.385

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.678	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0805	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.1	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)	4.371	k star (bias corrected MLE)	4.215
Theta hat (MLE)	0.513	Theta star (bias corrected MLE)	0.532
nu hat (MLE)	699.3	nu star (bias corrected)	674.5
MLE Mean (bias corrected)	2.243	MLE Sd (bias corrected)	1.092

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.209	nu hat (KM)	690.3
Approximate Chi Square Value (690.34, α)	630.4	Adjusted Chi Square Value (690.34, β)	629.4
95% Gamma Approximate KM-UCL (use when n>=50)	2.409	95% Gamma Adjusted KM-UCL (use when n<50)	2.413

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.364	Mean	2.201
Maximum	5.3	Median	2.1
SD	1.076	CV	0.489
k hat (MLE)	3.915	k star (bias corrected MLE)	3.78
Theta hat (MLE)	0.562	Theta star (bias corrected MLE)	0.582
nu hat (MLE)	642	nu star (bias corrected)	619.9
MLE Mean (bias corrected)	2.201	MLE Sd (bias corrected)	1.132
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (619.89, α)	563.1	Adjusted Chi Square Value (619.89, β)	562.2
95% Gamma Approximate UCL (use when n>=50)	2.423	95% Gamma Adjusted UCL (use when n<50)	2.427

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0991	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	2.204	Mean in Log Scale	0.661
SD in Original Scale	1.073	SD in Log Scale	0.545
95% t UCL (assumes normality of ROS data)	2.401	95% Percentile Bootstrap UCL	2.39
95% BCA Bootstrap UCL	2.401	95% Bootstrap t UCL	2.42
95% H-UCL (Log ROS)	2.515		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.195	Mean in Log Scale	0.642
SD in Original Scale	1.086	SD in Log Scale	0.597
95% t UCL (Assumes normality)	2.395	95% H-Stat UCL	2.577

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 (BCA) UCL	2.417	95% GROS Approximate Gamma UCL	2.423
95% Approximate Gamma KM-UCL	2.409		

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

Result (radium-228)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	1.2	Mean	2.261
Maximum	7.6	Median	2.1
SD	0.847	Std. Error of Mean	0.0935
Coefficient of Variation	0.375	Skewness	3.385

Normal GOF Test

Shapiro Wilk Test Statistic	0.764	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0978	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.417	95% Adjusted-CLT UCL (Chen-1995)	2.452
		95% Modified-t UCL (Johnson-1978)	2.422

Gamma GOF Test

A-D Test Statistic	1.163	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.101	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0986	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	10.32	k star (bias corrected MLE)	9.948
Theta hat (MLE)	0.219	Theta star (bias corrected MLE)	0.227
nu hat (MLE)	1692	nu star (bias corrected)	1632
MLE Mean (bias corrected)	2.261	MLE Sd (bias corrected)	0.717
		Approximate Chi Square Value (0.05)	1539
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	1537

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.397	95% Adjusted Gamma UCL (use when n<50)	2.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0264	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0816	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0978	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	0.767
Maximum of Logged Data	2.028	SD of logged Data	0.299

Assuming Lognormal Distribution

95% H-UCL	2.384	90% Chebyshev (MVUE) UCL	2.476
95% Chebyshev (MVUE) UCL	2.579	97.5% Chebyshev (MVUE) UCL	2.722
99% Chebyshev (MVUE) UCL	3.002		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.415	95% Jackknife UCL	2.417
95% Standard Bootstrap UCL	2.416	95% Bootstrap-t UCL	2.469
95% Hall's Bootstrap UCL	2.585	95% Percentile Bootstrap UCL	2.429
95% BCA Bootstrap UCL	2.454		
90% Chebyshev(Mean, Sd) UCL	2.542	95% Chebyshev(Mean, Sd) UCL	2.669
97.5% Chebyshev(Mean, Sd) UCL	2.845	99% Chebyshev(Mean, Sd) UCL	3.192

Suggested UCL to Use

95% Student's-t UCL	2.417	or 95% Modified-t UCL	2.422

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-234)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.84	Mean	2.511
Maximum	12	Median	2.2
SD	1.486	Std. Error of Mean	0.164
Coefficient of Variation	0.592	Skewness	3.703

Normal GOF Test

Shapiro Wilk Test Statistic	0.712	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0978	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.784	95% Adjusted-CLT UCL (Chen-1995)	2.853
		95% Modified-t UCL (Johnson-1978)	2.795

Gamma GOF Test

A-D Test Statistic	1.62	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.125	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0989	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.675	k star (bias corrected MLE)	4.512
Theta hat (MLE)	0.537	Theta star (bias corrected MLE)	0.557
nu hat (MLE)	766.7	nu star (bias corrected)	740
MLE Mean (bias corrected)	2.511	MLE Sd (bias corrected)	1.182
		Approximate Chi Square Value (0.05)	677.8
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	676.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.741	95% Adjusted Gamma UCL (use when n<50)	2.745

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.133	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0956	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0978	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.174	Mean of logged Data	0.81
Maximum of Logged Data	2.485	SD of logged Data	0.448

Assuming Lognormal Distribution

95% H-UCL	2.719	90% Chebyshev (MVUE) UCL	2.865
95% Chebyshev (MVUE) UCL	3.039	97.5% Chebyshev (MVUE) UCL	3.281
99% Chebyshev (MVUE) UCL	3.755		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.781	95% Jackknife UCL	2.784
95% Standard Bootstrap UCL	2.782	95% Bootstrap-t UCL	2.922
95% Hall's Bootstrap UCL	3.152	95% Percentile Bootstrap UCL	2.801
95% BCA Bootstrap UCL	2.834		
90% Chebyshev(Mean, Sd) UCL	3.003	95% Chebyshev(Mean, Sd) UCL	3.226
97.5% Chebyshev(Mean, Sd) UCL	3.536	99% Chebyshev(Mean, Sd) UCL	4.143

Suggested UCL to Use

95% Student's-t UCL	2.784	or 95% Modified-t UCL	2.795
or 95% H-UCL	2.719		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). 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.

Result (uranium-235)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	40
Number of Detects	63	Number of Non-Detects	19
Number of Distinct Detects	32	Number of Distinct Non-Detects	15
Minimum Detect	0.02	Minimum Non-Detect	0.039
Maximum Detect	0.74	Maximum Non-Detect	0.23
Variance Detects	0.0111	Percent Non-Detects	23.17%
Mean Detects	0.157	SD Detects	0.105
Median Detects	0.14	CV Detects	0.671
Skewness Detects	2.991	Kurtosis Detects	14.37
Mean of Logged Detects	-2.021	SD of Logged Detects	0.592

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.779	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	1.426E-12	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.112	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

Mean	0.136	Standard Error of Mean	0.0114
SD	0.101	95% KM (BCA) UCL	0.158
95% KM (t) UCL	0.155	95% KM (Percentile Bootstrap) UCL	0.156
95% KM (z) UCL	0.155	95% KM Bootstrap t UCL	0.159
90% KM Chebyshev UCL	0.17	95% KM Chebyshev UCL	0.186
97.5% KM Chebyshev UCL	0.208	99% KM Chebyshev UCL	0.25

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.484	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0829	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.113	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)	3.096	k star (bias corrected MLE)	2.959
Theta hat (MLE)	0.0508	Theta star (bias corrected MLE)	0.0531
nu hat (MLE)	390.1	nu star (bias corrected)	372.8
MLE Mean (bias corrected)	0.157	MLE Sd (bias corrected)	0.0914

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.805	nu hat (KM)	296
Approximate Chi Square Value (296.02, α)	257.2	Adjusted Chi Square Value (296.02, β)	256.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.157	95% Gamma Adjusted KM-UCL (use when n<50)	0.157

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.133
Maximum	0.74	Median	0.11
SD	0.104	CV	0.778
k hat (MLE)	1.98	k star (bias corrected MLE)	1.916
Theta hat (MLE)	0.0673	Theta star (bias corrected MLE)	0.0695
nu hat (MLE)	324.7	nu star (bias corrected)	314.2
MLE Mean (bias corrected)	0.133	MLE Sd (bias corrected)	0.0963
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (314.15, α)	274.1	Adjusted Chi Square Value (314.15, β)	273.4
95% Gamma Approximate UCL (use when n>=50)	0.153	95% Gamma Adjusted UCL (use when n<50)	0.153

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0649	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.112	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	0.136	Mean in Log Scale	-2.19
SD in Original Scale	0.1	SD in Log Scale	0.627
95% t UCL (assumes normality of ROS data)	0.155	95% Percentile Bootstrap UCL	0.156
95% BCA Bootstrap UCL	0.16	95% Bootstrap t UCL	0.16
95% H-UCL (Log ROS)	0.156		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.228	95% H-UCL (KM -Log)	0.163
KM SD (logged)	0.714	95% Critical H Value (KM-Log)	2.009
KM Standard Error of Mean (logged)	0.0869		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.135	Mean in Log Scale	-2.234
SD in Original Scale	0.102	SD in Log Scale	0.694
95% t UCL (Assumes normality)	0.153	95% H-Stat UCL	0.159

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 (Percentile Bootstrap) UCL	0.156	95% GROS Approximate Gamma UCL	0.153
95% Approximate Gamma KM-UCL	0.157		

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

Result (uranium-238)

General Statistics

Total Number of Observations	82	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	0.84	Mean	2.591
Maximum	12	Median	2.2
SD	1.509	Std. Error of Mean	0.167
Coefficient of Variation	0.582	Skewness	3.51

Normal GOF Test

Shapiro Wilk Test Statistic	0.727	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0978	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.868	95% Adjusted-CLT UCL (Chen-1995)	2.934
		95% Modified-t UCL (Johnson-1978)	2.879

Gamma GOF Test

A-D Test Statistic	1.487	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.131	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0989	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.712	k star (bias corrected MLE)	4.548
Theta hat (MLE)	0.55	Theta star (bias corrected MLE)	0.57
nu hat (MLE)	772.8	nu star (bias corrected)	745.8
MLE Mean (bias corrected)	2.591	MLE Sd (bias corrected)	1.215
		Approximate Chi Square Value (0.05)	683.5
Adjusted Level of Significance	0.0471	Adjusted Chi Square Value	682.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.827	95% Adjusted Gamma UCL (use when n<50)	2.832

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.256	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.1	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0978	Data Not Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.174	Mean of logged Data	0.842
Maximum of Logged Data	2.485	SD of logged Data	0.446

Assuming Lognormal Distribution

95% H-UCL	2.806	90% Chebyshev (MVUE) UCL	2.956
95% Chebyshev (MVUE) UCL	3.136	97.5% Chebyshev (MVUE) UCL	3.384
99% Chebyshev (MVUE) UCL	3.872		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.865	95% Jackknife UCL	2.868
95% Standard Bootstrap UCL	2.864	95% Bootstrap-t UCL	2.977
95% Hall's Bootstrap UCL	3.107	95% Percentile Bootstrap UCL	2.869
95% BCA Bootstrap UCL	2.967		
90% Chebyshev(Mean, Sd) UCL	3.091	95% Chebyshev(Mean, Sd) UCL	3.317
97.5% Chebyshev(Mean, Sd) UCL	3.631	99% Chebyshev(Mean, Sd) UCL	4.249

Suggested UCL to Use

95% Student's-t UCL	2.868	or 95% Modified-t UCL	2.879

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-226)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	0.54	Mean	2.254
Maximum	5.8	Median	2.15
SD	1.131	Std. Error of Mean	0.206
Coefficient of Variation	0.502	Skewness	1.101

Normal GOF Test

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.121	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.162	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	2.604	95% Adjusted-CLT UCL (Chen-1995)	2.638
		95% Modified-t UCL (Johnson-1978)	2.611

Gamma GOF Test

A-D Test Statistic	0.494	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.161	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.979	k star (bias corrected MLE)	3.603
Theta hat (MLE)	0.566	Theta star (bias corrected MLE)	0.625
nu hat (MLE)	238.7	nu star (bias corrected)	216.2
MLE Mean (bias corrected)	2.254	MLE Sd (bias corrected)	1.187
		Approximate Chi Square Value (0.05)	183.2
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	181.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.66	95% Adjusted Gamma UCL (use when n<50)	2.686

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.166	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.162	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.616	Mean of logged Data	0.682
Maximum of Logged Data	1.758	SD of logged Data	0.55

Assuming Lognormal Distribution

95% H-UCL	2.819	90% Chebyshev (MVUE) UCL	3.011
95% Chebyshev (MVUE) UCL	3.339	97.5% Chebyshev (MVUE) UCL	3.795
99% Chebyshev (MVUE) UCL	4.69		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.593	95% Jackknife UCL	2.604
95% Standard Bootstrap UCL	2.591	95% Bootstrap-t UCL	2.651
95% Hall's Bootstrap UCL	2.729	95% Percentile Bootstrap UCL	2.587
95% BCA Bootstrap UCL	2.651		
90% Chebyshev(Mean, Sd) UCL	2.873	95% Chebyshev(Mean, Sd) UCL	3.153
97.5% Chebyshev(Mean, Sd) UCL	3.543	99% Chebyshev(Mean, Sd) UCL	4.307

Suggested UCL to Use

95% Student's-t UCL	2.604

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-228)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	15
Number of Detects	28	Number of Non-Detects	2
Number of Distinct Detects	14	Number of Distinct Non-Detects	2
Minimum Detect	1.4	Minimum Non-Detect	2.4
Maximum Detect	3.7	Maximum Non-Detect	2.5
Variance Detects	0.242	Percent Non-Detects	6.667%
Mean Detects	2.046	SD Detects	0.492
Median Detects	2	CV Detects	0.24
Skewness Detects	1.542	Kurtosis Detects	3.553
Mean of Logged Detects	0.692	SD of Logged Detects	0.219

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.889	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.145	**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

Mean	2.035	Standard Error of Mean	0.089
SD	0.474	95% KM (BCA) UCL	2.186
95% KM (t) UCL	2.186	95% KM (Percentile Bootstrap) UCL	2.182
95% KM (z) UCL	2.181	95% KM Bootstrap t UCL	2.217
90% KM Chebyshev UCL	2.302	95% KM Chebyshev UCL	2.423
97.5% KM Chebyshev UCL	2.591	99% KM Chebyshev UCL	2.921

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.407	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.119	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.165	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)	20.64	k star (bias corrected MLE)	18.46
Theta hat (MLE)	0.0991	Theta star (bias corrected MLE)	0.111
nu hat (MLE)	1156	nu star (bias corrected)	1033
MLE Mean (bias corrected)	2.046	MLE Sd (bias corrected)	0.476

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	18.46	nu hat (KM)	1108
Approximate Chi Square Value (N/A, α)	1031	Adjusted Chi Square Value (N/A, β)	1027
95% Gamma Approximate KM-UCL (use when n>=50)	2.185	95% Gamma Adjusted KM-UCL (use when n<50)	2.194

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.4	Mean	2.037
Maximum	3.7	Median	1.96
SD	0.476	CV	0.234
k hat (MLE)	21.94	k star (bias corrected MLE)	19.77
Theta hat (MLE)	0.0928	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	1316	nu star (bias corrected)	1186
MLE Mean (bias corrected)	2.037	MLE Sd (bias corrected)	0.458
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (N/A, α)	1107	Adjusted Chi Square Value (N/A, β)	1103
95% Gamma Approximate UCL (use when n>=50)	2.182	95% Gamma Adjusted UCL (use when n<50)	2.19

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.104	**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	2.036	Mean in Log Scale	0.688
SD in Original Scale	0.476	SD in Log Scale	0.212
95% t UCL (assumes normality of ROS data)	2.184	95% Percentile Bootstrap UCL	2.186
95% BCA Bootstrap UCL	2.195	95% Bootstrap t UCL	2.227
95% H-UCL (Log ROS)	2.181		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.687	95% H-UCL (KM -Log)	2.178
KM SD (logged)	0.212	95% Critical H Value (KM-Log)	1.76
KM Standard Error of Mean (logged)	0.0401		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.992	Mean in Log Scale	0.659
SD in Original Scale	0.518	SD in Log Scale	0.245
95% t UCL (Assumes normality)	2.152	95% H-Stat UCL	2.16

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	2.186	95% KM (Percentile Bootstrap) UCL	2.182

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

Result (uranium-234)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	1	Mean	1.927
Maximum	3.7	Median	1.8
SD	0.583	Std. Error of Mean	0.106
Coefficient of Variation	0.303	Skewness	1.459

Normal GOF Test

Shapiro Wilk Test Statistic	0.872	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.185	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.162	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.108	95% Adjusted-CLT UCL (Chen-1995)	2.132
		95% Modified-t UCL (Johnson-1978)	2.112

Gamma GOF Test

A-D Test Statistic	0.845	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.15	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	13.1	k star (bias corrected MLE)	11.81
Theta hat (MLE)	0.147	Theta star (bias corrected MLE)	0.163
nu hat (MLE)	786.1	nu star (bias corrected)	708.9
MLE Mean (bias corrected)	1.927	MLE Sd (bias corrected)	0.561
		Approximate Chi Square Value (0.05)	648.1
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	644.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.107	95% Adjusted Gamma UCL (use when n<50)	2.118

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.162	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0	Mean of logged Data	0.617
Maximum of Logged Data	1.308	SD of logged Data	0.276

Assuming Lognormal Distribution

95% H-UCL	2.111	90% Chebyshev (MVUE) UCL	2.218
95% Chebyshev (MVUE) UCL	2.352	97.5% Chebyshev (MVUE) UCL	2.537
99% Chebyshev (MVUE) UCL	2.901		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.102	95% Jackknife UCL	2.108
95% Standard Bootstrap UCL	2.099	95% Bootstrap-t UCL	2.165
95% Hall's Bootstrap UCL	2.177	95% Percentile Bootstrap UCL	2.1
95% BCA Bootstrap UCL	2.133		
90% Chebyshev(Mean, Sd) UCL	2.246	95% Chebyshev(Mean, Sd) UCL	2.391
97.5% Chebyshev(Mean, Sd) UCL	2.591	99% Chebyshev(Mean, Sd) UCL	2.986

Suggested UCL to Use

95% Adjusted Gamma UCL	2.118

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-235)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	22
Number of Detects	21	Number of Non-Detects	9
Number of Distinct Detects	16	Number of Distinct Non-Detects	9
Minimum Detect	0.055	Minimum Non-Detect	0.052
Maximum Detect	0.2	Maximum Non-Detect	0.11
Variance Detects	0.00202	Percent Non-Detects	30%
Mean Detects	0.113	SD Detects	0.045
Median Detects	0.096	CV Detects	0.397
Skewness Detects	0.701	Kurtosis Detects	-0.514
Mean of Logged Detects	-2.25	SD of Logged Detects	0.393

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.193	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

Mean	0.0977	Standard Error of Mean	0.00838
SD	0.0443	95% KM (BCA) UCL	0.112
95% KM (t) UCL	0.112	95% KM (Percentile Bootstrap) UCL	0.112
95% KM (z) UCL	0.111	95% KM Bootstrap t UCL	0.113
90% KM Chebyshev UCL	0.123	95% KM Chebyshev UCL	0.134
97.5% KM Chebyshev UCL	0.15	99% KM Chebyshev UCL	0.181

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.371	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	**Kolmogrov-Smirnoff 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)	6.976	k star (bias corrected MLE)	6.011
Theta hat (MLE)	0.0163	Theta star (bias corrected MLE)	0.0189
nu hat (MLE)	293	nu star (bias corrected)	252.5
MLE Mean (bias corrected)	0.113	MLE Sd (bias corrected)	0.0462

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.874	nu hat (KM)	292.4
Approximate Chi Square Value (292.44, α)	253.8	Adjusted Chi Square Value (292.44, β)	251.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.113	95% Gamma Adjusted KM-UCL (use when n<50)	0.113

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0198	Mean	0.0943
Maximum	0.2	Median	0.0855
SD	0.0483	CV	0.513
k hat (MLE)	3.987	k star (bias corrected MLE)	3.611
Theta hat (MLE)	0.0236	Theta star (bias corrected MLE)	0.0261
nu hat (MLE)	239.2	nu star (bias corrected)	216.7
MLE Mean (bias corrected)	0.0943	MLE Sd (bias corrected)	0.0496
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (216.66, α)	183.6	Adjusted Chi Square Value (216.66, β)	181.8
95% Gamma Approximate UCL (use when n>=50)	0.111	95% Gamma Adjusted UCL (use when n<50)	0.112

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.193	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	0.0964	Mean in Log Scale	-2.441
SD in Original Scale	0.046	SD in Log Scale	0.452
95% t UCL (assumes normality of ROS data)	0.111	95% Percentile Bootstrap UCL	0.11
95% BCA Bootstrap UCL	0.111	95% Bootstrap t UCL	0.114
95% H-UCL (Log ROS)	0.113		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.418	95% H-UCL (KM -Log)	0.113
KM SD (logged)	0.421	95% Critical H Value (KM-Log)	1.889
KM Standard Error of Mean (logged)	0.081		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0914	Mean in Log Scale	-2.548
SD in Original Scale	0.0508	SD in Log Scale	0.579
95% t UCL (Assumes normality)	0.107	95% H-Stat UCL	0.115

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	0.112	95% KM (Percentile Bootstrap) UCL	0.112

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

Result (uranium-238)

General Statistics

Total Number of Observations	30	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	0.92	Mean	1.931
Maximum	3.5	Median	1.8
SD	0.547	Std. Error of Mean	0.0999
Coefficient of Variation	0.283	Skewness	1.226

Normal GOF Test

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.162	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.1	95% Adjusted-CLT UCL (Chen-1995)	2.119
		95% Modified-t UCL (Johnson-1978)	2.104

Gamma GOF Test

A-D Test Statistic	0.796	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.188	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.16	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.14	k star (bias corrected MLE)	12.75
Theta hat (MLE)	0.136	Theta star (bias corrected MLE)	0.151
nu hat (MLE)	848.7	nu star (bias corrected)	765.1
MLE Mean (bias corrected)	1.931	MLE Sd (bias corrected)	0.541
		Approximate Chi Square Value (0.05)	701.9
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	698.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.104	95% Adjusted Gamma UCL (use when n<50)	2.115

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.927	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.171	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.162	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.0834	Mean of logged Data	0.622
Maximum of Logged Data	1.253	SD of logged Data	0.27

Assuming Lognormal Distribution

95% H-UCL	2.113	90% Chebyshev (MVUE) UCL	2.219
95% Chebyshev (MVUE) UCL	2.35	97.5% Chebyshev (MVUE) UCL	2.531
99% Chebyshev (MVUE) UCL	2.888		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.095	95% Jackknife UCL	2.1
95% Standard Bootstrap UCL	2.093	95% Bootstrap-t UCL	2.149
95% Hall's Bootstrap UCL	2.147	95% Percentile Bootstrap UCL	2.1
95% BCA Bootstrap UCL	2.113		
90% Chebyshev(Mean, Sd) UCL	2.23	95% Chebyshev(Mean, Sd) UCL	2.366
97.5% Chebyshev(Mean, Sd) UCL	2.555	99% Chebyshev(Mean, Sd) UCL	2.925

Suggested UCL to Use

95% Student's-t UCL	2.1	or 95% Modified-t UCL	2.104

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-226)

General Statistics

Total Number of Observations	62	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	0.54	Mean	2.182
Maximum	5.8	Median	2
SD	1.048	Std. Error of Mean	0.133
Coefficient of Variation	0.48	Skewness	1.204

Normal GOF Test

Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	1.3494E-4	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.405	95% Adjusted-CLT UCL (Chen-1995)	2.423
		95% Modified-t UCL (Johnson-1978)	2.408

Gamma GOF Test

A-D Test Statistic	0.718	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.109	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.113	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.583	k star (bias corrected MLE)	4.372
Theta hat (MLE)	0.476	Theta star (bias corrected MLE)	0.499
nu hat (MLE)	568.3	nu star (bias corrected)	542.2
MLE Mean (bias corrected)	2.182	MLE Sd (bias corrected)	1.044
		Approximate Chi Square Value (0.05)	489.2
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	488

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.419	95% Adjusted Gamma UCL (use when n<50)	2.425

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0691	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.616	Mean of logged Data	0.667
Maximum of Logged Data	1.758	SD of logged Data	0.495

Assuming Lognormal Distribution

95% H-UCL	2.478	90% Chebyshev (MVUE) UCL	2.634
95% Chebyshev (MVUE) UCL	2.831	97.5% Chebyshev (MVUE) UCL	3.105
99% Chebyshev (MVUE) UCL	3.643		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.401	95% Jackknife UCL	2.405
95% Standard Bootstrap UCL	2.402	95% Bootstrap-t UCL	2.433
95% Hall's Bootstrap UCL	2.435	95% Percentile Bootstrap UCL	2.41
95% BCA Bootstrap UCL	2.414		
90% Chebyshev(Mean, Sd) UCL	2.582	95% Chebyshev(Mean, Sd) UCL	2.762
97.5% Chebyshev(Mean, Sd) UCL	3.013	99% Chebyshev(Mean, Sd) UCL	3.506

Suggested UCL to Use

95% Approximate Gamma UCL	2.419

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-228)

General Statistics

Total Number of Observations	62	Number of Distinct Observations	23
Number of Detects	59	Number of Non-Detects	3
Number of Distinct Detects	22	Number of Distinct Non-Detects	3
Minimum Detect	1	Minimum Non-Detect	2
Maximum Detect	8.9	Maximum Non-Detect	2.5
Variance Detects	1.201	Percent Non-Detects	4.839%
Mean Detects	2.215	SD Detects	1.096
Median Detects	2	CV Detects	0.495
Skewness Detects	4.255	Kurtosis Detects	24.08
Mean of Logged Detects	0.725	SD of Logged Detects	0.345

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.634	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.244	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.115	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

Mean	2.193	Standard Error of Mean	0.137
SD	1.067	95% KM (BCA) UCL	2.429
95% KM (t) UCL	2.422	95% KM (Percentile Bootstrap) UCL	2.426
95% KM (z) UCL	2.418	95% KM Bootstrap t UCL	2.571
90% KM Chebyshev UCL	2.604	95% KM Chebyshev UCL	2.79
97.5% KM Chebyshev UCL	3.048	99% KM Chebyshev UCL	3.556

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.236	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.752	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.167	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.116	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)	7.292	k star (bias corrected MLE)	6.932
Theta hat (MLE)	0.304	Theta star (bias corrected MLE)	0.32
nu hat (MLE)	860.4	nu star (bias corrected)	818
MLE Mean (bias corrected)	2.215	MLE Sd (bias corrected)	0.841

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.227	nu hat (KM)	524.1
Approximate Chi Square Value (524.10, α)	472	Adjusted Chi Square Value (524.10, β)	470.8
95% Gamma Approximate KM-UCL (use when n>=50)	2.435	95% Gamma Adjusted KM-UCL (use when n<50)	2.441

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1	Mean	2.191
Maximum	8.9	Median	2
SD	1.075	CV	0.49
k hat (MLE)	7.472	k star (bias corrected MLE)	7.121
Theta hat (MLE)	0.293	Theta star (bias corrected MLE)	0.308
nu hat (MLE)	926.6	nu star (bias corrected)	883.1
MLE Mean (bias corrected)	2.191	MLE Sd (bias corrected)	0.821
		Adjusted Level of Significance (β)	0.0461
Approximate Chi Square Value (883.06, α)	815.1	Adjusted Chi Square Value (883.06, β)	813.5
95% Gamma Approximate UCL (use when n>=50)	2.374	95% Gamma Adjusted UCL (use when n<50)	2.378

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.115	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	2.193	Mean in Log Scale	0.718
SD in Original Scale	1.073	SD in Log Scale	0.338
95% t UCL (assumes normality of ROS data)	2.421	95% Percentile Bootstrap UCL	2.424
95% BCA Bootstrap UCL	2.502	95% Bootstrap t UCL	2.596
95% H-UCL (Log ROS)	2.343		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.164	Mean in Log Scale	0.697
SD in Original Scale	1.093	SD in Log Scale	0.36
95% t UCL (Assumes normality)	2.396	95% H-Stat UCL	2.325

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	2.79

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

Result (uranium-234)

General Statistics

Total Number of Observations	62	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	0.85	Mean	2.217
Maximum	6.6	Median	1.9
SD	1.058	Std. Error of Mean	0.134
Coefficient of Variation	0.477	Skewness	1.995

Normal GOF Test

Shapiro Wilk Test Statistic	0.818	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	3.633E-10	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.442	95% Adjusted-CLT UCL (Chen-1995)	2.475
		95% Modified-t UCL (Johnson-1978)	2.447

Gamma GOF Test

A-D Test Statistic	1.675	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.903	k star (bias corrected MLE)	5.628
Theta hat (MLE)	0.376	Theta star (bias corrected MLE)	0.394
nu hat (MLE)	732	nu star (bias corrected)	697.9
MLE Mean (bias corrected)	2.217	MLE Sd (bias corrected)	0.935
		Approximate Chi Square Value (0.05)	637.6
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	636.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.427	95% Adjusted Gamma UCL (use when n<50)	2.432

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0841	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.163	Mean of logged Data	0.709
Maximum of Logged Data	1.887	SD of logged Data	0.403

Assuming Lognormal Distribution

95% H-UCL	2.42	90% Chebyshev (MVUE) UCL	2.552
95% Chebyshev (MVUE) UCL	2.71	97.5% Chebyshev (MVUE) UCL	2.93
99% Chebyshev (MVUE) UCL	3.363		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.438	95% Jackknife UCL	2.442
95% Standard Bootstrap UCL	2.436	95% Bootstrap-t UCL	2.51
95% Hall's Bootstrap UCL	2.502	95% Percentile Bootstrap UCL	2.438
95% BCA Bootstrap UCL	2.452		
90% Chebyshev(Mean, Sd) UCL	2.62	95% Chebyshev(Mean, Sd) UCL	2.803
97.5% Chebyshev(Mean, Sd) UCL	3.056	99% Chebyshev(Mean, Sd) UCL	3.554

Suggested UCL to Use

95% Student's-t UCL	2.442	or 95% Modified-t UCL	2.447

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-235)

General Statistics

Total Number of Observations	62	Number of Distinct Observations	35
Number of Detects	45	Number of Non-Detects	17
Number of Distinct Detects	27	Number of Distinct Non-Detects	16
Minimum Detect	0.042	Minimum Non-Detect	0.042
Maximum Detect	0.34	Maximum Non-Detect	0.2
Variance Detects	0.00332	Percent Non-Detects	27.42%
Mean Detects	0.124	SD Detects	0.0577
Median Detects	0.11	CV Detects	0.464
Skewness Detects	1.416	Kurtosis Detects	3.049
Mean of Logged Detects	-2.18	SD of Logged Detects	0.437

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.152	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	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

Mean	0.106	Standard Error of Mean	0.00754
SD	0.0578	95% KM (BCA) UCL	0.119
95% KM (t) UCL	0.119	95% KM (Percentile Bootstrap) UCL	0.119
95% KM (z) UCL	0.119	95% KM Bootstrap t UCL	0.121
90% KM Chebyshev UCL	0.129	95% KM Chebyshev UCL	0.139
97.5% KM Chebyshev UCL	0.153	99% KM Chebyshev UCL	0.181

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.456	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0975	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.132	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)	5.447	k star (bias corrected MLE)	5.099
Theta hat (MLE)	0.0228	Theta star (bias corrected MLE)	0.0244
nu hat (MLE)	490.3	nu star (bias corrected)	458.9
MLE Mean (bias corrected)	0.124	MLE Sd (bias corrected)	0.0551

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.392	nu hat (KM)	420.6
Approximate Chi Square Value (420.55, α)	374	Adjusted Chi Square Value (420.55, β)	373
95% Gamma Approximate KM-UCL (use when n>=50)	0.12	95% Gamma Adjusted KM-UCL (use when n<50)	0.12

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0118	Mean	0.103
Maximum	0.34	Median	0.092
SD	0.0606	CV	0.586
k hat (MLE)	3.061	k star (bias corrected MLE)	2.924
Theta hat (MLE)	0.0338	Theta star (bias corrected MLE)	0.0354
nu hat (MLE)	379.6	nu star (bias corrected)	362.5
MLE Mean (bias corrected)	0.103	MLE Sd (bias corrected)	0.0605
		Adjusted Level of Significance (β)	0.0461
Approximate Chi Square Value (362.54, α)	319.4	Adjusted Chi Square Value (362.54, β)	318.5
95% Gamma Approximate UCL (use when n>=50)	0.117	95% Gamma Adjusted UCL (use when n<50)	0.118

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.986	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0824	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	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	0.106	Mean in Log Scale	-2.368
SD in Original Scale	0.0577	SD in Log Scale	0.499
95% t UCL (assumes normality of ROS data)	0.118	95% Percentile Bootstrap UCL	0.118
95% BCA Bootstrap UCL	0.121	95% Bootstrap t UCL	0.12
95% H-UCL (Log ROS)	0.119		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.373	95% H-UCL (KM -Log)	0.12
KM SD (logged)	0.512	95% Critical H Value (KM-Log)	1.87
KM Standard Error of Mean (logged)	0.0689		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.102	Mean in Log Scale	-2.458
SD in Original Scale	0.0616	SD in Log Scale	0.619
95% t UCL (Assumes normality)	0.115	95% H-Stat UCL	0.121

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 (Percentile Bootstrap) UCL	0.119	95% GROS Approximate Gamma UCL	0.117
95% Approximate Gamma KM-UCL	0.12		

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

Result (uranium-238)

General Statistics

Total Number of Observations	62	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	0.9	Mean	2.229
Maximum	6.6	Median	1.9
SD	1.047	Std. Error of Mean	0.133
Coefficient of Variation	0.47	Skewness	1.968

Normal GOF Test

Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	8.442E-10	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.451	95% Adjusted-CLT UCL (Chen-1995)	2.483
		95% Modified-t UCL (Johnson-1978)	2.457

Gamma GOF Test

A-D Test Statistic	1.573	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.994	k star (bias corrected MLE)	5.715
Theta hat (MLE)	0.372	Theta star (bias corrected MLE)	0.39
nu hat (MLE)	743.3	nu star (bias corrected)	708.6
MLE Mean (bias corrected)	2.229	MLE Sd (bias corrected)	0.932
		Approximate Chi Square Value (0.05)	647.9
Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	646.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.438	95% Adjusted Gamma UCL (use when n<50)	2.443

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.113	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.105	Mean of logged Data	0.716
Maximum of Logged Data	1.887	SD of logged Data	0.402

Assuming Lognormal Distribution

95% H-UCL	2.433	90% Chebyshev (MVUE) UCL	2.565
95% Chebyshev (MVUE) UCL	2.724	97.5% Chebyshev (MVUE) UCL	2.945
99% Chebyshev (MVUE) UCL	3.378		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.448	95% Jackknife UCL	2.451
95% Standard Bootstrap UCL	2.446	95% Bootstrap-t UCL	2.523
95% Hall's Bootstrap UCL	2.517	95% Percentile Bootstrap UCL	2.456
95% BCA Bootstrap UCL	2.505		
90% Chebyshev(Mean, Sd) UCL	2.628	95% Chebyshev(Mean, Sd) UCL	2.809
97.5% Chebyshev(Mean, Sd) UCL	3.06	99% Chebyshev(Mean, Sd) UCL	3.552

Suggested UCL to Use

95% Student's-t UCL	2.451	or 95% Modified-t UCL	2.457

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-226)

General Statistics

Total Number of Observations	88	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	0.54	Mean	2.235
Maximum	5.8	Median	2.05
SD	1.037	Std. Error of Mean	0.111
Coefficient of Variation	0.464	Skewness	1.058

Normal GOF Test

Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	6.1534E-5	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.109	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0944	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.419	95% Adjusted-CLT UCL (Chen-1995)	2.43
		95% Modified-t UCL (Johnson-1978)	2.421

Gamma GOF Test

A-D Test Statistic	0.463	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0675	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0956	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.827	k star (bias corrected MLE)	4.67
Theta hat (MLE)	0.463	Theta star (bias corrected MLE)	0.479
nu hat (MLE)	849.5	nu star (bias corrected)	821.9
MLE Mean (bias corrected)	2.235	MLE Sd (bias corrected)	1.034
		Approximate Chi Square Value (0.05)	756.4
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	755.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	2.429	95% Adjusted Gamma UCL (use when n<50)	2.432

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.158	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0916	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0944	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.616	Mean of logged Data	0.697
Maximum of Logged Data	1.758	SD of logged Data	0.48

Assuming Lognormal Distribution

95% H-UCL	2.476	90% Chebyshev (MVUE) UCL	2.612
95% Chebyshev (MVUE) UCL	2.776	97.5% Chebyshev (MVUE) UCL	3.004
99% Chebyshev (MVUE) UCL	3.452		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.417	95% Jackknife UCL	2.419
95% Standard Bootstrap UCL	2.413	95% Bootstrap-t UCL	2.441
95% Hall's Bootstrap UCL	2.444	95% Percentile Bootstrap UCL	2.422
95% BCA Bootstrap UCL	2.423		
90% Chebyshev(Mean, Sd) UCL	2.567	95% Chebyshev(Mean, Sd) UCL	2.717
97.5% Chebyshev(Mean, Sd) UCL	2.926	99% Chebyshev(Mean, Sd) UCL	3.335

Suggested UCL to Use

95% Approximate Gamma UCL	2.429

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (radium-228)

General Statistics

Total Number of Observations	88	Number of Distinct Observations	28
Number of Detects	85	Number of Non-Detects	3
Number of Distinct Detects	28	Number of Distinct Non-Detects	3
Minimum Detect	1	Minimum Non-Detect	2
Maximum Detect	8.9	Maximum Non-Detect	2.5
Variance Detects	1.074	Percent Non-Detects	3.409%
Mean Detects	2.305	SD Detects	1.036
Median Detects	2.1	CV Detects	0.45
Skewness Detects	3.651	Kurtosis Detects	19.59
Mean of Logged Detects	0.77	SD of Logged Detects	0.338

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.709	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0961	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

Mean	2.287	Standard Error of Mean	0.109
SD	1.019	95% KM (BCA) UCL	2.498
95% KM (t) UCL	2.469	95% KM (Percentile Bootstrap) UCL	2.468
95% KM (z) UCL	2.467	95% KM Bootstrap t UCL	2.525
90% KM Chebyshev UCL	2.615	95% KM Chebyshev UCL	2.764
97.5% KM Chebyshev UCL	2.97	99% KM Chebyshev UCL	3.376

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.631	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.097	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)	7.853	k star (bias corrected MLE)	7.583
Theta hat (MLE)	0.293	Theta star (bias corrected MLE)	0.304
nu hat (MLE)	1335	nu star (bias corrected)	1289
MLE Mean (bias corrected)	2.305	MLE Sd (bias corrected)	0.837

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.043	nu hat (KM)	887.6
Approximate Chi Square Value (887.61, α)	819.5	Adjusted Chi Square Value (887.61, β)	818.4
95% Gamma Approximate KM-UCL (use when n>=50)	2.477	95% Gamma Adjusted KM-UCL (use when n<50)	2.481

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1	Mean	2.286
Maximum	8.9	Median	2.1
SD	1.024	CV	0.448
k hat (MLE)	7.952	k star (bias corrected MLE)	7.689
Theta hat (MLE)	0.287	Theta star (bias corrected MLE)	0.297
nu hat (MLE)	1400	nu star (bias corrected)	1353
MLE Mean (bias corrected)	2.286	MLE Sd (bias corrected)	0.824
		Adjusted Level of Significance (β)	0.0473
Approximate Chi Square Value (N/A, α)	1269	Adjusted Chi Square Value (N/A, β)	1267
95% Gamma Approximate UCL (use when n>=50)	2.438	95% Gamma Adjusted UCL (use when n<50)	2.44

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.119	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0961	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	2.288	Mean in Log Scale	0.764
SD in Original Scale	1.023	SD in Log Scale	0.334
95% t UCL (assumes normality of ROS data)	2.469	95% Percentile Bootstrap UCL	2.482
95% BCA Bootstrap UCL	2.525	95% Bootstrap t UCL	2.535
95% H-UCL (Log ROS)	2.417		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.265	Mean in Log Scale	0.748
SD in Original Scale	1.04	SD in Log Scale	0.352
95% t UCL (Assumes normality)	2.45	95% H-Stat UCL	2.404

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 (BCA) UCL	2.498

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

Result (uranium-234)

General Statistics

Total Number of Observations	88	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	0.85	Mean	2.427
Maximum	12	Median	2
SD	1.463	Std. Error of Mean	0.156
Coefficient of Variation	0.603	Skewness	3.785

Normal GOF Test

Shapiro Wilk Test Statistic	0.695	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0944	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.686	95% Adjusted-CLT UCL (Chen-1995)	2.751
		95% Modified-t UCL (Johnson-1978)	2.697

Gamma GOF Test

A-D Test Statistic	2.376	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.147	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0956	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.729	k star (bias corrected MLE)	4.576
Theta hat (MLE)	0.513	Theta star (bias corrected MLE)	0.53
nu hat (MLE)	832.4	nu star (bias corrected)	805.3
MLE Mean (bias corrected)	2.427	MLE Sd (bias corrected)	1.135
		Approximate Chi Square Value (0.05)	740.5
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	739.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.64	95% Adjusted Gamma UCL (use when n<50)	2.643

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk P Value	0.0144	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.115	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.0944	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.163	Mean of logged Data	0.777
Maximum of Logged Data	2.485	SD of logged Data	0.436

Assuming Lognormal Distribution

95% H-UCL	2.603	90% Chebyshev (MVUE) UCL	2.736
95% Chebyshev (MVUE) UCL	2.893	97.5% Chebyshev (MVUE) UCL	3.111
99% Chebyshev (MVUE) UCL	3.539		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.684	95% Jackknife UCL	2.686
95% Standard Bootstrap UCL	2.675	95% Bootstrap-t UCL	2.832
95% Hall's Bootstrap UCL	2.96	95% Percentile Bootstrap UCL	2.694
95% BCA Bootstrap UCL	2.767		
90% Chebyshev(Mean, Sd) UCL	2.895	95% Chebyshev(Mean, Sd) UCL	3.107
97.5% Chebyshev(Mean, Sd) UCL	3.401	99% Chebyshev(Mean, Sd) UCL	3.978

Suggested UCL to Use

95% Student's-t UCL	2.686	or 95% Modified-t UCL	2.697

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Result (uranium-235)

General Statistics

Total Number of Observations	88	Number of Distinct Observations	44
Number of Detects	68	Number of Non-Detects	20
Number of Distinct Detects	38	Number of Distinct Non-Detects	18
Minimum Detect	0.042	Minimum Non-Detect	0.042
Maximum Detect	0.57	Maximum Non-Detect	0.2
Variance Detects	0.00613	Percent Non-Detects	22.73%
Mean Detects	0.135	SD Detects	0.0783
Median Detects	0.115	CV Detects	0.579
Skewness Detects	2.963	Kurtosis Detects	13.59
Mean of Logged Detects	-2.116	SD of Logged Detects	0.462

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.765	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	1.099E-14	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.197	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	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

Mean	0.119	Standard Error of Mean	0.00821
SD	0.0759	95% KM (BCA) UCL	0.133
95% KM (t) UCL	0.132	95% KM (Percentile Bootstrap) UCL	0.133
95% KM (z) UCL	0.132	95% KM Bootstrap t UCL	0.135
90% KM Chebyshev UCL	0.143	95% KM Chebyshev UCL	0.154
97.5% KM Chebyshev UCL	0.17	99% KM Chebyshev UCL	0.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.19	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.108	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)	4.478	k star (bias corrected MLE)	4.29
Theta hat (MLE)	0.0302	Theta star (bias corrected MLE)	0.0315
nu hat (MLE)	609	nu star (bias corrected)	583.5
MLE Mean (bias corrected)	0.135	MLE Sd (bias corrected)	0.0653

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.444	nu hat (KM)	430.1
Approximate Chi Square Value (430.09, α)	383	Adjusted Chi Square Value (430.09, β)	382.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.133	95% Gamma Adjusted KM-UCL (use when n<50)	0.133

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 detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.114
Maximum	0.57	Median	0.096
SD	0.0802	CV	0.703
k hat (MLE)	2.273	k star (bias corrected MLE)	2.203
Theta hat (MLE)	0.0502	Theta star (bias corrected MLE)	0.0518
nu hat (MLE)	400	nu star (bias corrected)	387.7
MLE Mean (bias corrected)	0.114	MLE Sd (bias corrected)	0.0768
		Adjusted Level of Significance (β)	0.0473
Approximate Chi Square Value (387.66, α)	343	Adjusted Chi Square Value (387.66, β)	342.3
95% Gamma Approximate UCL (use when n>=50)	0.129	95% Gamma Adjusted UCL (use when n<50)	0.129

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0936	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	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	0.118	Mean in Log Scale	-2.281
SD in Original Scale	0.076	SD in Log Scale	0.524
95% t UCL (assumes normality of ROS data)	0.132	95% Percentile Bootstrap UCL	0.132
95% BCA Bootstrap UCL	0.135	95% Bootstrap t UCL	0.135
95% H-UCL (Log ROS)	0.13		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.283	95% H-UCL (KM -Log)	0.131
KM SD (logged)	0.534	95% Critical H Value (KM-Log)	1.867
KM Standard Error of Mean (logged)	0.0594		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.115	Mean in Log Scale	-2.355
SD in Original Scale	0.079	SD in Log Scale	0.63
95% t UCL (Assumes normality)	0.129	95% H-Stat UCL	0.132

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

95% KM (BCA) UCL	0.133

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

Result (uranium-238)

General Statistics

Total Number of Observations	88	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.9	Mean	2.473
Maximum	12	Median	2.05
SD	1.483	Std. Error of Mean	0.158
Coefficient of Variation	0.6	Skewness	3.662

Normal GOF Test

Shapiro Wilk Test Statistic	0.699	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0944	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2.735	95% Adjusted-CLT UCL (Chen-1995)	2.799
		95% Modified-t UCL (Johnson-1978)	2.746

Gamma GOF Test

A-D Test Statistic	2.494	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.151	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.0956	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.721	k star (bias corrected MLE)	4.568
Theta hat (MLE)	0.524	Theta star (bias corrected MLE)	0.541
nu hat (MLE)	830.9	nu star (bias corrected)	803.9
MLE Mean (bias corrected)	2.473	MLE Sd (bias corrected)	1.157
		Approximate Chi Square Value (0.05)	739.1
Adjusted Level of Significance	0.0473	Adjusted Chi Square Value	738.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.689	95% Adjusted Gamma UCL (use when n<50)	2.693

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.00855	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0944	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.105	Mean of logged Data	0.796
Maximum of Logged Data	2.485	SD of logged Data	0.437

Assuming Lognormal Distribution

95% H-UCL	2.653	90% Chebyshev (MVUE) UCL	2.789
95% Chebyshev (MVUE) UCL	2.949	97.5% Chebyshev (MVUE) UCL	3.172
99% Chebyshev (MVUE) UCL	3.61		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.733	95% Jackknife UCL	2.735
95% Standard Bootstrap UCL	2.723	95% Bootstrap-t UCL	2.843
95% Hall's Bootstrap UCL	2.975	95% Percentile Bootstrap UCL	2.73
95% BCA Bootstrap UCL	2.792		
90% Chebyshev(Mean, Sd) UCL	2.947	95% Chebyshev(Mean, Sd) UCL	3.162
97.5% Chebyshev(Mean, Sd) UCL	3.46	99% Chebyshev(Mean, Sd) UCL	4.045

Suggested UCL to Use

95% Student's-t UCL	2.735	or 95% Modified-t UCL	2.746

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX C

Excess Lifetime Cancer Risk Hazard Index Calculations (Chemicals)

Appendix C, Table C-1 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Current/Future Outdoor Commercial/Industrial Worker
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NON-CANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	3.01E+01	1.40E+09 P	2.2E-06	3.1E-06	6.1E-09	5.3E-06	100%	1.5E-02	2.1E-02	2.9E-04	3.7E-02	24%
Copper	D	1.23E+04	1.40E+09 P	NA	NA	NA	–		1.2E-01	–	NA	1.2E-01	76%
Lead	B2	2.67E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				2E-06	3E-06	6E-09			0.1	0.02	0.0003		
Total						**Total ELCR**	5E-06				**Total HI**	0.2	
						Group A Total ELCR	5E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:

[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-2 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Current/Future Outdoor Commercial/Industrial Worker
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NON-CANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	3.01E+01	1.40E+09 P	2.2E-06	3.1E-06	3.0E-09	5.3E-06	100%	1.5E-02	2.1E-02	1.5E-04	3.7E-02	24%
Copper	D	1.23E+04	1.40E+09 P	NA	NA	NA	–		1.2E-01	–	NA	1.2E-01	76%
Lead	B2	2.67E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				2E-06	3E-06	3E-09			0.1	0.02	0.0001		
Total						**Total ELCR**	5E-06				**Total HI**	0.2	
						Group A Total ELCR	5E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:

[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
- Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
- Group B: Probable Human Carcinogen.
  - B1 - Limited evidence of carcinogenicity in humans.
  - B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
- Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
- Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).

[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-3 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Adolescent Trespasser
Former CLEAR Plant - Shallow Soil (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	3.01E+01	1.40E+09 P	3.7E-07	1.7E-07	7.0E-11	5.5E-07	100%	6.5E-03	3.0E-03	8.5E-06	9.5E-03	16%
Copper	D	1.23E+04	1.40E+09 P	NA	NA	NA	–		5.0E-02	–	NA	5.0E-02	84%
Lead	B2	2.67E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				4E-07	2E-07	7E-11			0.06	0.003	0.000009		
Total						**Total ELCR**	5E-07				**Total HI**	0.06	
						Group A Total ELCR	5E-07						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 52 x 10 x RBA x CSFo) / (1,000,000 x 44 x 28470)
ELCRd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10 x CSFa) / (1,000,000 x 44 x 28470)
ELCRi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 52 x 10 x RBA) / (1,000,000 x 44 x 3650 x RfDo)
HQd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10) / (1,000,000 x 44 x 3650 x RfDa)
HQi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10) / (3650 x RfC)

Appendix C, Table C-4 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Outdoor Commercial/Industrial Worker
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NON-CANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	1.19E+01	1.40E+09 P	8.8E-07	1.2E-06	2.4E-09	2.1E-06	100%	6.1E-03	8.4E-03	1.2E-04	1.5E-02	16%
Copper	D	7.96E+03	1.40E+09 P	NA	NA	NA	–		7.7E-02	–	NA	7.7E-02	84%
Lead	B2	2.58E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				9E-07	1E-06	2E-09			0.08	0.008	0.0001		
Total						**Total ELCR**	2E-06				**Total HI**	0.09	
						Group A Total ELCR	2E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-5 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Outdoor Commercial/Industrial Worker
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NON-CANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	1.19E+01	1.40E+09 P	8.8E-07	1.2E-06	1.2E-09	2.1E-06	100%	6.1E-03	8.4E-03	5.8E-05	1.5E-02	16%
Copper	D	7.96E+03	1.40E+09 P	NA	NA	NA	–		7.7E-02	–	NA	7.7E-02	84%
Lead	B2	2.58E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				9E-07	1E-06	1E-09			0.08	0.008	0.00006		
Total						**Total ELCR**	2E-06				**Total HI**	0.09	
						Group A Total ELCR	2E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:

[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
- Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
- Group B: Probable Human Carcinogen.
  - B1 - Limited evidence of carcinogenicity in humans.
  - B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
- Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
- Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).

[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-6 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Adolescent Trespasser
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

					CANCER RISK					NONCANCER HAZARD				
					Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)		Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
					ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics														
Arsenic	A	1.19E+01	1.40E+09	P	1.5E-07	6.8E-08	2.8E-11	2.2E-07	100%	2.6E-03	1.2E-03	3.4E-06	3.7E-03	10%
Copper	D	7.96E+03	1.40E+09	P	NA	NA	NA	–		3.2E-02	–	NA	3.2E-02	90%
Lead	B2	2.58E+02	1.40E+09	P	NA	NA	NA	–		NA	NA	NA	–	
					1E-07	7E-08	3E-11			0.03	0.001	0.000003		
Total							**Total ELCR**	2E-07				**Total HI**	0.04	
							Group A Total ELCR	2E-07						
							Group B Total ELCR	–						
							Group C Total ELCR	–						
							Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 52 x 10 x RBA x CSFo) / (1,000,000 x 44 x 28470)
ELCRd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10 x CSFa) / (1,000,000 x 44 x 28470)
ELCRi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 52 x 10 x RBA) / (1,000,000 x 44 x 3650 x RfDo)
HQd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10) / (1,000,000 x 44 x 3650 x RfDa)
HQi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10) / (3650 x RfC)

Appendix C, Table C-7 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Outdoor Commercial/Industrial Worker
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

					CANCER RISK					NONCANCER HAZARD				
					Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)		Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
					ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics														
Arsenic	A	1.02E+01	1.40E+09	P	7.6E-07	1.0E-06	2.1E-09	1.8E-06	100%	5.2E-03	7.2E-03	1.0E-04	1.3E-02	17%
Copper	D	6.50E+03	1.40E+09	P	NA	NA	NA	–		6.3E-02	–	NA	6.3E-02	83%
Lead	B2	1.83E+02	1.40E+09	P	NA	NA	NA	–		NA	NA	NA	–	
					8E-07	1E-06	2E-09			0.07	0.007	0.0001		
Total							**Total ELCR**	2E-06				**Total HI**	0.08	
							Group A Total ELCR	2E-06						
							Group B Total ELCR	–						
							Group C Total ELCR	–						
							Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-8 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Outdoor Commercial/Industrial Worker
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	1.02E+01	1.40E+09 P	7.6E-07	1.0E-06	1.0E-09	1.8E-06	100%	5.2E-03	7.2E-03	5.0E-05	1.3E-02	17%
Copper	D	6.50E+03	1.40E+09 P	NA	NA	NA	–		6.3E-02	–	NA	6.3E-02	83%
Lead	B2	1.83E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				8E-07	1E-06	1E-09			0.07	0.007	0.0001		
Total						**Total ELCR**	2E-06				**Total HI**	0.08	
						Group A Total ELCR	2E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:

[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
- Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
- Group B: Probable Human Carcinogen.
  - B1 - Limited evidence of carcinogenicity in humans.
  - B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
- Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
- Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).

[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-9 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Adolescent Trespasser
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

					CANCER RISK					NON-CANCER HAZARD				
					Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)		Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
					ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics														
Arsenic	A	1.02E+01	1.40E+09	P	1.3E-07	5.9E-08	2.4E-11	1.9E-07	100%	2.2E-03	1.0E-03	2.9E-06	3.2E-03	11%
Copper	D	6.50E+03	1.40E+09	P	NA	NA	NA	–		2.6E-02	–	NA	2.6E-02	89%
Lead	B2	1.83E+02	1.40E+09	P	NA	NA	NA	–		NA	NA	NA	–	
					1E-07	6E-08	2E-11			0.03	0.001	0.000003		
Total							**Total ELCR**	2E-07				**Total HI**	0.03	
							Group A Total ELCR	2E-07						
							Group B Total ELCR	–						
							Group C Total ELCR	–						
							Group D Total ELCR	–						

Notes:

[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
- Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
- Group B: Probable Human Carcinogen.
  - B1 - Limited evidence of carcinogenicity in humans.
  - B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
- Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
- Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).

[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 52 x 10 x RBA x CSFo) / (1,000,000 x 44 x 28470)
ELCRd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10 x CSFa) / (1,000,000 x 44 x 28470)
ELCRi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 52 x 10 x RBA) / (1,000,000 x 44 x 3650 x RfDo)
HQd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10) / (1,000,000 x 44 x 3650 x RfDa)
HQi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10) / (3650 x RfC)

Appendix C, Table C-10 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Construction Worker
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Sierrita Mine
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	1.02E+01	1.40E+09 P	2.2E-07	5.8E-08	9.2E-11	2.8E-07	100%	3.8E-02	1.0E-02	1.1E-04	4.9E-02	10%
Copper	D	6.50E+03	1.40E+09 P	NA	NA	NA	–		4.6E-01	–	NA	4.6E-01	90%
Lead	B2	1.83E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
				2E-07	6E-08	9E-11			0.5	0.01	0.0001		
Total						**Total ELCR**	3E-07				**Total HI**	0.5	
						Group A Total ELCR	3E-07						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 330 x 250 x 1 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.19 x ABSd x 250 x 1 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 250 x 1 x IUR) / (28470)

HQo = (EPCs x 1 x 330 x 250 x 1 x RBA) / (1,000,000 x 80 x 365 x RfDo)
HQd = (EPCs x 6125 x 0.19 x ABSd x 250 x 1) / (1,000,000 x 80 x 365 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 250 x 1) / (365 x RfC)

Appendix C, Table C-11 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Current/Future Outdoor Commercial/Industrial Worker
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

					CANCER RISK					NON-CANCER HAZARD				
					Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)		Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
					ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics														
Arsenic	A	1.93E+01	1.40E+09	P	1.4E-06	2.0E-06	3.9E-09	3.4E-06	100%	9.9E-03	1.4E-02	1.9E-04	2.4E-02	14%
Molybdenum	NA	1.85E+03	1.40E+09	P	NA	NA	NA	–		1.4E-01	–	NA	1.4E-01	86%
					1E-06	2E-06	4E-09			0.2	0.01	0.0002		
Total							**Total ELCR**	3E-06				**Total HI**	0.2	
							Group A Total ELCR	3E-06						
							Group B Total ELCR	–						
							Group C Total ELCR	–						
							Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-12 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Current/Future Outdoor Commercial/Industrial Worker
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NON-CANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	1.93E+01	1.40E+09 P	1.4E-06	2.0E-06	2.0E-09	3.4E-06	100%	9.9E-03	1.4E-02	9.4E-05	2.4E-02	14%
Molybdenum	NA	1.85E+03	1.40E+09 P	NA	NA	NA	–		1.4E-01	–	NA	1.4E-01	86%
				1E-06	2E-06	2E-09			0.2	0.01	0.00009		
Total						**Total ELCR**	3E-06				**Total HI**	0.2	
						Group A Total ELCR	3E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-13 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Adolescent Trespasser
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	1.93E+01	1.40E+09 P	2.4E-07	1.1E-07	4.5E-11	3.5E-07	100%	4.2E-03	1.9E-03	5.5E-06	6.1E-03	9%
Molybdenum	NA	1.85E+03	1.40E+09 P	NA	NA	NA	–		6.0E-02	–	NA	6.0E-02	91%
				2E-07	1E-07	5E-11			0.06	0.002	0.000005		
Total						**Total ELCR**	4E-07				**Total HI**	0.07	
						Group A Total ELCR	4E-07						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 52 x 10 x RBA x CSFo) / (1,000,000 x 44 x 28470)
ELCRd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10 x CSFa) / (1,000,000 x 44 x 28470)
ELCRi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 52 x 10 x RBA) / (1,000,000 x 44 x 3650 x RfDo)
HQd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10) / (1,000,000 x 44 x 3650 x RfDa)
HQi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10) / (3650 x RfC)

Appendix C, Table C-14 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Outdoor Commercial/Industrial Worker
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	9.82E+00	1.40E+09 P	7.3E-07	1.0E-06	2.0E-09	1.7E-06	100%	5.0E-03	7.0E-03	9.6E-05	1.2E-02	12%
Lead	B2	1.33E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
Molybdenum	NA	1.13E+03	1.40E+09 P	NA	NA	NA	–		8.7E-02	–	NA	8.7E-02	88%
				7E-07	1E-06	2E-09			0.09	0.007	0.0001		
Total						**Total ELCR**	2E-06				**Total HI**	0.1	
						Group A Total ELCR	2E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:
ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25 x IUR) / (28470)
HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-15 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Outdoor Commercial/Industrial Worker
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	9.82E+00	1.40E+09 P	7.3E-07	1.0E-06	1.0E-09	1.7E-06	100%	5.0E-03	7.0E-03	4.8E-05	1.2E-02	12%
Lead	B2	1.33E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
Molybdenum	NA	1.13E+03	1.40E+09 P	NA	NA	NA	–		8.7E-02	–	NA	8.7E-02	88%
				7E-07	1E-06	1E-09			0.09	0.007	0.00005		
Total						**Total ELCR**	2E-06				**Total HI**	0.1	
						Group A Total ELCR	2E-06						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 225 x 25 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 225 x 25 x RBA) / (1,000,000 x 80 x 9125 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 225 x 25) / (1,000,000 x 80 x 9125 x RfDa)
HQi = ([EPCs / PEF] x 4 x 0.042 x 225 x 25) / (9125 x RfC)

Appendix C, Table C-16 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Adolescent Trespasser
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

					CANCER RISK					NON-CANCER HAZARD				
					Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)		Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
					ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics														
Arsenic	A	9.82E+00	1.40E+09	P	1.2E-07	5.7E-08	2.3E-11	1.8E-07	100%	2.1E-03	9.8E-04	2.8E-06	3.1E-03	8%
Lead	B2	1.33E+02	1.40E+09	P	NA	NA	NA	–		NA	NA	NA	–	
Molybdenum	NA	1.13E+03	1.40E+09	P	NA	NA	NA	–		3.6E-02	–	NA	3.6E-02	91%
					1E-07	6E-08	2E-11			0.04	0.001	0.000003		
Total							**Total ELCR**	2E-07				**Total HI**	0.04	
							Group A Total ELCR	2E-07						
							Group B Total ELCR	–						
							Group C Total ELCR	–						
							Group D Total ELCR	–						

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 50 x 52 x 10 x RBA x CSFo) / (1,000,000 x 44 x 28470)
ELCRd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10 x CSFa) / (1,000,000 x 44 x 28470)
ELCRi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10 x IUR) / (28470)

HQo = (EPCs x 1 x 50 x 52 x 10 x RBA) / (1,000,000 x 44 x 3650 x RfDo)
HQd = (EPCs x 4400 x 0.07 x ABSd x 52 x 10) / (1,000,000 x 44 x 3650 x RfDa)
HQi = ([EPCs / PEF] x 1 x 0.042 x 52 x 10) / (3650 x RfC)

Appendix C, Table C-17 (RME)
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Construction Worker
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK					NONCANCER HAZARD				
				Route-Specific Risk					Route-Specific Hazard				
Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	Oral	Dermal	Inhalation	Total ELCR	Percent Total ELCR	Oral	Dermal	Inhalation	Total Hazard	Percent Total HI
				ELCRo	ELCRd	ELCRi			HQo	HQd	HQi		
Inorganics													
Arsenic	A	9.82E+00	1.40E+09 P	2.1E-07	5.6E-08	8.9E-11	2.7E-07	100%	3.7E-02	9.6E-03	1.1E-04	4.7E-02	7%
Lead	B2	1.33E+02	1.40E+09 P	NA	NA	NA	–		NA	NA	NA	–	
Molybdenum	NA	1.13E+03	1.40E+09 P	NA	NA	NA	–		6.4E-01	–	NA	6.4E-01	93%
				2E-07	6E-08	9E-11			0.7	0.01	0.0001		
Total						**Total ELCR**	3E-07				**Total HI**	0.7	
						Group A Total ELCR	3E-07						
						Group B Total ELCR	–						
						Group C Total ELCR	–						
						Group D Total ELCR	–						

Notes:

[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
- Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
- Group B: Probable Human Carcinogen.
  - B1 - Limited evidence of carcinogenicity in humans.
  - B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
- Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
- Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).

[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.
RME: reasonable maximum exposure

Receptor-specific exposure parameters are presented in Table 6-1. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

ELCRo = (EPCs x 1 x 330 x 250 x 1 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.19 x ABSd x 250 x 1 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 8 x 0.042 x 250 x 1 x IUR) / (28470)

HQo = (EPCs x 1 x 330 x 250 x 1 x RBA) / (1,000,000 x 80 x 365 x RfDo)
HQd = (EPCs x 6125 x 0.19 x ABSd x 250 x 1) / (1,000,000 x 80 x 365 x RfDa)
HQi = ([EPCs / PEF] x 8 x 0.042 x 250 x 1) / (365 x RfC)

APPENDIX D

Excess Lifetime Cancer Risk Calculations (Radionuclides)

Appendix D, Table D-1 (RME)
Excess Lifetime Cancer Risk Calculations for a Current/Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.15E+00	1.40E+09	P	1.8E-07	4.9E-09	9.2E-05	9.2E-05	82%
Radium-228	2.66E+00	1.40E+09	P	1.6E-07	3.0E-09	1.7E-05	1.8E-05	16%
Uranium-238	2.57E+00	1.40E+09	P	4.1E-08	4.9E-09	1.6E-06	1.6E-06	1%
				4E-07	1E-08	1E-04		
Total						**Total ELCR**	1E-04	

Notes:

[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:

$ELCRo = (EPCs \times 50 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFo) / (1{,}000 \times 25 \times \lambda)$
$ELCRi = (EPCs \times 1{,}000 \times 60 \times 8 \times 0.042 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFi) / (1.40E{+}09 \times 25 \times \lambda)$
$ELCRe = (EPCs \times ACF \times [(8 \times 0.042 \times 1) + (0 \times 0.042 \times 0.4)] \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFe) / (365 \times 25 \times \lambda)$

Appendix D, Table D-2 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Current/Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.15E+00	1.40E+09	P	1.8E-07	2.4E-09	4.6E-05	4.6E-05	82%
Radium-228	2.66E+00	1.40E+09	P	1.6E-07	1.5E-09	8.7E-06	8.9E-06	16%
Uranium-238	2.57E+00	1.40E+09	P	4.1E-08	2.4E-09	7.8E-07	8.3E-07	1%
				4E-07	7E-09	6E-05		
Total						**Total ELCR**	6E-05	

Notes:

[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:

$ELCRo = (EPCs \times 50 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFo) / (1{,}000 \times 25 \times \lambda)$

$ELCRi = (EPCs \times 1{,}000 \times 60 \times 4 \times 0.042 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFi) / (1.40E{+}09 \times 25 \times \lambda)$

$ELCRe = (EPCs \times ACF \times [(4 \times 0.042 \times 1) + (0 \times 0.042 \times 0.4)] \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFe) / (365 \times 25 \times \lambda)$

Appendix D, Table D-3 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), Exposed Samples Only
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.15E+00	1.40E+09	P	1.6E-08	1.3E-11	1.1E-06	1.1E-06	72%
Radium-228	2.66E+00	1.40E+09	P	2.7E-08	1.4E-11	3.7E-07	4.0E-07	26%
Uranium-238	2.57E+00	1.40E+09	P	3.7E-09	1.3E-11	1.8E-08	2.2E-08	1%
				5E-08	4E-11	1E-06		
Total						**Total ELCR**	2E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
$ELCRo = (EPCs \times 50 \times 52 \times 10 \times [1 - \exp(-\lambda \times 10)] \times CSFo) / (1{,}000 \times 10 \times \lambda)$
$ELCRi = (EPCs \times 1{,}000 \times 60 \times 1 \times 0.042 \times 52 \times 10 \times [1 - \exp(-\lambda \times 10)] \times CSFi) / (1.40E+09 \times 10 \times \lambda)$
$ELCRe = (EPCs \times ACF \times [(1 \times 0.042 \times 1) + (0 \times 0.042 \times 0.4)] \times 52 \times 10 \times [1 - \exp(-\lambda \times 10)] \times CSFe) / (365 \times 10 \times \lambda)$

Appendix D, Table D-4 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.17E+00	1.40E+09	P	1.8E-07	4.9E-09	9.3E-05	9.3E-05	82%
Radium-228	2.63E+00	1.40E+09	P	1.6E-07	2.9E-09	1.7E-05	1.7E-05	15%
Uranium-235	1.79E-01	1.40E+09	P	2.5E-09	3.6E-10	5.3E-07	5.3E-07	<1%
Uranium-238	3.17E+00	1.40E+09	P	5.0E-08	6.1E-09	1.9E-06	2.0E-06	2%
				4E-07	1E-08	1E-04		
Total						**Total ELCR**	1E-04	

Notes:

[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:

$ELCRo = (EPCs \times 50 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFo) / (1{,}000 \times 25 \times \lambda)$
$ELCRi = (EPCs \times 1{,}000 \times 60 \times 8 \times 0.042 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFi) / (1.40E{+}09 \times 25 \times \lambda)$
$ELCRe = (EPCs \times ACF \times [(8 \times 0.042 \times 1) + (0 \times 0.042 \times 0.4)] \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFe) / (365 \times 25 \times \lambda)$

Appendix D, Table D-5 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.17E+00	1.40E+09	P	1.8E-07	2.5E-09	4.6E-05	4.7E-05	82%
Radium-228	2.63E+00	1.40E+09	P	1.6E-07	1.5E-09	8.6E-06	8.8E-06	15%
Uranium-235	1.79E-01	1.40E+09	P	2.5E-09	1.8E-10	2.6E-07	2.7E-07	<1%
Uranium-238	3.17E+00	1.40E+09	P	5.0E-08	3.0E-09	9.7E-07	1.0E-06	2%
				4E-07	7E-09	6E-05		
Total						**Total ELCR**	6E-05	

Notes:

[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:

ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 4 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(4 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-6 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former CLEAR Plant - Shallow Soil/Sediment (0 to 0.5 ft bgs), All Samples
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m³/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.17E+00	1.40E+09	P	1.7E-08	1.3E-11	1.1E-06	1.1E-06	72%
Radium-228	2.63E+00	1.40E+09	P	2.7E-08	1.4E-11	3.7E-07	4.0E-07	26%
Uranium-235	1.79E-01	1.40E+09	P	2.3E-10	9.5E-13	6.2E-09	6.4E-09	<1%
Uranium-238	3.17E+00	1.40E+09	P	4.6E-09	1.6E-11	2.3E-08	2.7E-08	2%
				5E-08	4E-11	1E-06		
Total						**Total ELCR**	2E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 52 × 10 × [1 - exp(-λ × 10)] × CSFo) / (1,000 × 10 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 52 × 10 × [1 - exp(-λ × 10)] × CSFi) / (1.40E+09 × 10 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 52 × 10 × [1 - exp(-λ × 10)] × CSFe) / (365 × 10 × λ)

Appendix D, Table D-7 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m³/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.41E+00	1.40E+09	P	2.0E-07	5.4E-09	1.0E-04	1.0E-04	85%
Radium-228	2.42E+00	1.40E+09	P	1.4E-07	2.7E-09	1.6E-05	1.6E-05	13%
Uranium-235	1.53E-01	1.40E+09	P	2.2E-09	3.1E-10	4.5E-07	4.6E-07	<1%
Uranium-238	2.87E+00	1.40E+09	P	4.5E-08	5.5E-09	1.8E-06	1.8E-06	1%
				4E-07	1E-08	1E-04		
Total						**Total ELCR**	1E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 8 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(8 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-8 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.41E+00	1.40E+09	P	2.0E-07	2.7E-09	5.2E-05	5.2E-05	85%
Radium-228	2.42E+00	1.40E+09	P	1.4E-07	1.3E-09	7.9E-06	8.1E-06	13%
Uranium-235	1.53E-01	1.40E+09	P	2.2E-09	1.5E-10	2.3E-07	2.3E-07	<1%
Uranium-238	2.87E+00	1.40E+09	P	4.5E-08	2.7E-09	8.8E-07	9.2E-07	2%
				4E-07	7E-09	6E-05		
Total						**Total ELCR**	6E-05	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 4 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(4 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-9 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.41E+00	1.40E+09	P	1.8E-08	1.4E-11	1.2E-06	1.2E-06	76%
Radium-228	2.42E+00	1.40E+09	P	2.4E-08	1.3E-11	3.4E-07	3.6E-07	23%
Uranium-235	1.53E-01	1.40E+09	P	2.0E-10	8.1E-13	5.3E-09	5.5E-09	<1%
Uranium-238	2.87E+00	1.40E+09	P	4.2E-09	1.4E-11	2.0E-08	2.5E-08	2%
				5E-08	4E-11	2E-06		
Total						**Total ELCR**	2E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 52 × 10 × [1 - exp(-λ × 10)] × CSFo) / (1,000 × 10 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 52 × 10 × [1 - exp(-λ × 10)] × CSFi) / (1.40E+09 × 10 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 52 × 10 × [1 - exp(-λ × 10)] × CSFe) / (365 × 10 × λ)

Appendix D, Table D-10 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Construction Worker Exposed to Radionuclides
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.41E+00	1.40E+09	P	5.9E-08	2.4E-10	4.6E-06	4.7E-06	67%
Radium-228	2.42E+00	1.40E+09	P	1.3E-07	3.6E-10	2.1E-06	2.2E-06	32%
Uranium-235	1.53E-01	1.40E+09	P	6.3E-10	1.4E-11	2.0E-08	2.1E-08	<1%
Uranium-238	2.87E+00	1.40E+09	P	1.3E-08	2.4E-10	7.8E-08	9.1E-08	1%
				2E-07	9E-10	7E-06		
Total						**Total ELCR**	7E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 330 × 250 × 1 × [1 - exp(-λ × 1)] × CSFo) / (1,000 × 1 × λ)
ELCRi = (EPCs × 1,000 × 60 × 8 × 0.042 × 250 × 1 × [1 - exp(-λ × 1)] × CSFi) / (1.40E+09 × 1 × λ)
ELCRe = (EPCs × ACF × [(8 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 250 × 1 × [1 - exp(-λ × 1)] × CSFe) / (365 × 1 × λ)

Appendix D, Table D-11 (RME)
Excess Lifetime Cancer Risk Calculations for a Current/Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m³/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.60E+00	1.40E+09	P	2.1E-07	5.9E-09	1.1E-04	1.1E-04	88%
Radium-228	2.18E+00	1.40E+09	P	1.3E-07	2.4E-09	1.4E-05	1.4E-05	11%
Uranium-238	2.10E+00	1.40E+09	P	3.3E-08	4.0E-09	1.3E-06	1.3E-06	1%
				4E-07	1E-08	1E-04		
Total						**Total ELCR**	1E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 8 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(8 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-12 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Current/Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK				Percent
				Route-Specific ELCR			Total	Total
Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		Ingestion ELCRo	Inhalation ELCRi	External ELCRe	ELCR	ELCR
Radionuclides								
Radium-226	2.60E+00	1.40E+09	P	2.1E-07	2.9E-09	5.6E-05	5.6E-05	88%
Radium-228	2.18E+00	1.40E+09	P	1.3E-07	1.2E-09	7.1E-06	7.3E-06	11%
Uranium-238	2.10E+00	1.40E+09	P	3.3E-08	2.0E-09	6.4E-07	6.8E-07	1%
				4E-07	6E-09	6E-05		
Total						**Total ELCR**	6E-05	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 4 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(4 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-13 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former Esperanza Mill - Shallow Soil/Sediment (0 to 0.5 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m³/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.60E+00	1.40E+09	P	2.0E-08	1.6E-11	1.3E-06	1.3E-06	79%
Radium-228	2.18E+00	1.40E+09	P	2.2E-08	1.2E-11	3.1E-07	3.3E-07	20%
Uranium-238	2.10E+00	1.40E+09	P	3.1E-09	1.1E-11	1.5E-08	1.8E-08	1%
				5E-08	4E-11	2E-06		
Total						**Total ELCR**	2E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 52 × 10 × [1 - exp(-λ × 10)] × CSFo) / (1,000 × 10 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 52 × 10 × [1 - exp(-λ × 10)] × CSFi) / (1.40E+09 × 10 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 52 × 10 × [1 - exp(-λ × 10)] × CSFe) / (365 × 10 × λ)

Appendix D, Table D-14 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.43E+00	1.40E+09	P	2.0E-07	5.5E-09	1.0E-04	1.0E-04	85%
Radium-228	2.50E+00	1.40E+09	P	1.5E-07	2.8E-09	1.6E-05	1.7E-05	13%
Uranium-235	1.33E-01	1.40E+09	P	1.9E-09	2.7E-10	3.9E-07	4.0E-07	<1%
Uranium-238	2.74E+00	1.40E+09	P	4.3E-08	5.2E-09	1.7E-06	1.7E-06	1%
				4E-07	1E-08	1E-04		
Total						**Total ELCR**	1E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 8 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(8 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-15 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.43E+00	1.40E+09	P	2.0E-07	2.7E-09	5.2E-05	5.2E-05	85%
Radium-228	2.50E+00	1.40E+09	P	1.5E-07	1.4E-09	8.2E-06	8.3E-06	14%
Uranium-235	1.33E-01	1.40E+09	P	1.9E-09	1.3E-10	2.0E-07	2.0E-07	<1%
Uranium-238	2.74E+00	1.40E+09	P	4.3E-08	2.6E-09	8.4E-07	8.8E-07	1%
				4E-07	7E-09	6E-05		
Total						**Total ELCR**	6E-05	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 4 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(4 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-16 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m³/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.43E+00	1.40E+09	P	1.9E-08	1.5E-11	1.2E-06	1.2E-06	75%
Radium-228	2.50E+00	1.40E+09	P	2.5E-08	1.3E-11	3.5E-07	3.8E-07	23%
Uranium-235	1.33E-01	1.40E+09	P	1.7E-10	7.1E-13	4.6E-09	4.8E-09	<1%
Uranium-238	2.74E+00	1.40E+09	P	4.0E-09	1.4E-11	1.9E-08	2.3E-08	1%
				5E-08	4E-11	2E-06		
Total						**Total ELCR**	2E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 52 × 10 × [1 - exp(-λ × 10)] × CSFo) / (1,000 × 10 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 52 × 10 × [1 - exp(-λ × 10)] × CSFi) / (1.40E+09 × 10 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 52 × 10 × [1 - exp(-λ × 10)] × CSFe) / (365 × 10 × λ)

Appendix D, Table D-17 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Construction Worker Exposed to Radionuclides
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.43E+00	1.40E+09	P	5.9E-08	2.5E-10	4.6E-06	4.7E-06	66%
Radium-228	2.50E+00	1.40E+09	P	1.3E-07	3.7E-10	2.2E-06	2.3E-06	32%
Uranium-235	1.33E-01	1.40E+09	P	5.5E-10	1.2E-11	1.7E-08	1.8E-08	<1%
Uranium-238	2.74E+00	1.40E+09	P	1.3E-08	2.3E-10	7.4E-08	8.7E-08	1%
				2E-07	9E-10	7E-06		
Total						**Total ELCR**	7E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 330 × 250 × 1 × [1 - exp(-λ × 1)] × CSFo) / (1,000 × 1 × λ)
ELCRi = (EPCs × 1,000 × 60 × 8 × 0.042 × 250 × 1 × [1 - exp(-λ × 1)] × CSFi) / (1.40E+09 × 1 × λ)
ELCRe = (EPCs × ACF × [(8 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 250 × 1 × [1 - exp(-λ × 1)] × CSFe) / (365 × 1 × λ)

Appendix D, Table D-18 (RME)
Excess Lifetime Cancer Risk Calculations for a Current/Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m³/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.60E+00	m	1.40E+09	P	2.1E-07	5.9E-09	9.1E-05	9.1E-05	91%
Radium-228	1.70E+00	m	1.40E+09	P	1.0E-07	1.9E-09	9.4E-06	9.5E-06	9%
					3E-07	8E-09	1E-04		
Total							**Total ELCR**	1E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 225 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 8 × 0.042 × 225 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(8 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 225 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-19 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Current/Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m³/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.60E+00	m	1.40E+09	P	1.1E-08	3.9E-11	6.1E-07	6.2E-07	90%
Radium-228	1.70E+00	m	1.40E+09	P	5.4E-09	1.3E-11	6.2E-08	6.8E-08	10%
					2E-08	5E-11	7E-07		
Total							**Total ELCR**	7E-07	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 12 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 12 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 12 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-20 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former Rhenium Ponds - Shallow Soil/Sediment (0 to 2 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m³/kg)		CANCER RISK: Route-Specific ELCR: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.60E+00	m	1.40E+09	P	2.0E-08	1.6E-11	1.1E-06	1.1E-06	83%
Radium-228	1.70E+00	m	1.40E+09	P	1.7E-08	9.2E-12	2.0E-07	2.2E-07	17%
					4E-08	2E-11	1E-06		
Total							**Total ELCR**	1E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 52 × 10 × [1 - exp(-λ × 10)] × CSFo) / (1,000 × 10 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 52 × 10 × [1 - exp(-λ × 10)] × CSFi) / (1.40E+09 × 10 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 52 × 10 × [1 - exp(-λ × 10)] × CSFe) / (365 × 10 × λ)

Appendix D, Table D-21 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m³/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.80E+00	m	1.40E+09	P	2.3E-07	6.3E-09	9.8E-05	9.8E-05	89%
Radium-228	1.90E+00	m	1.40E+09	P	1.1E-07	2.1E-09	1.0E-05	1.1E-05	10%
Uranium-238	3.20E+00	m	1.40E+09	P	5.1E-08	6.1E-09	1.8E-06	1.9E-06	2%
					4E-07	1E-08	1E-04		
Total							**Total ELCR**	1E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
$ELCRo = (EPCs \times 50 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFo) / (1{,}000 \times 25 \times \lambda)$
$ELCRi = (EPCs \times 1{,}000 \times 60 \times 8 \times 0.042 \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFi) / (1.40E+09 \times 25 \times \lambda)$
$ELCRe = (EPCs \times ACF \times [(8 \times 0.042 \times 1) + (0 \times 0.042 \times 0.4)] \times 225 \times 25 \times [1 - \exp(-\lambda \times 25)] \times CSFe) / (365 \times 25 \times \lambda)$

Appendix D, Table D-22 (Site-Specific Evaluation)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Outdoor Commercial / Industrial Worker Exposed to Radionuclides
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m³/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.80E+00	m	1.40E+09	P	1.2E-08	4.2E-11	6.5E-07	6.7E-07	88%
Radium-228	1.90E+00	m	1.40E+09	P	6.0E-09	1.4E-11	7.0E-08	7.6E-08	10%
Uranium-238	3.20E+00	m	1.40E+09	P	2.7E-09	4.1E-11	1.2E-08	1.5E-08	2%
					2E-08	1E-10	7E-07		
Total							**Total ELCR**	8E-07	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 12 × 25 × [1 - exp(-λ × 25)] × CSFo) / (1,000 × 25 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 12 × 25 × [1 - exp(-λ × 25)] × CSFi) / (1.40E+09 × 25 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 12 × 25 × [1 - exp(-λ × 25)] × CSFe) / (365 × 25 × λ)

Appendix D, Table D-23 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Adolescent Trespasser Exposed to Radionuclides
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m³/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.80E+00	m	1.40E+09	P	2.1E-08	1.7E-11	1.1E-06	1.2E-06	81%
Radium-228	1.90E+00	m	1.40E+09	P	1.9E-08	1.0E-11	2.2E-07	2.4E-07	17%
Uranium-238	3.20E+00	m	1.40E+09	P	4.7E-09	1.6E-11	2.1E-08	2.6E-08	2%
					5E-08	4E-11	1E-06		
Total							**Total ELCR**	1E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 50 × 52 × 10 × [1 - exp(-λ × 10)] × CSFo) / (1,000 × 10 × λ)
ELCRi = (EPCs × 1,000 × 60 × 1 × 0.042 × 52 × 10 × [1 - exp(-λ × 10)] × CSFi) / (1.40E+09 × 10 × λ)
ELCRe = (EPCs × ACF × [(1 × 0.042 × 1) + (0 × 0.042 × 0.4)] × 52 × 10 × [1 - exp(-λ × 10)] × CSFe) / (365 × 10 × λ)

Appendix D, Table D-24 (RME)
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Construction Worker Exposed to Radionuclides
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.80E+00	m	1.40E+09	P	6.8E-08	2.8E-10	4.4E-06	4.5E-06	74%
Radium-228	1.90E+00	m	1.40E+09	P	9.9E-08	2.8E-10	1.4E-06	1.5E-06	25%
Uranium-238	3.20E+00	m	1.40E+09	P	1.5E-08	2.7E-10	8.2E-08	9.7E-08	2%
					2E-07	8E-10	6E-06		
Total							**Total ELCR**	6E-06	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table 6-1.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.
RME: reasonable maximum exposure.

Receptor-specific exposure parameters are presented in Table 6-1.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
$ELCRo = (EPCs \times 330 \times 250 \times 1 \times [1 - \exp(-\lambda \times 1)] \times CSFo) / (1{,}000 \times 1 \times \lambda)$
$ELCRi = (EPCs \times 1{,}000 \times 60 \times 8 \times 0.042 \times 250 \times 1 \times [1 - \exp(-\lambda \times 1)] \times CSFi) / (1.40E{+}09 \times 1 \times \lambda)$
$ELCRe = (EPCs \times ACF \times [(8 \times 0.042 \times 1) + (0 \times 0.042 \times 0.4)] \times 250 \times 1 \times [1 - \exp(-\lambda \times 1)] \times CSFe) / (365 \times 1 \times \lambda)$

APPENDIX E

Lead Model Output

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Current/Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-0.5 feet below ground surface
Receptor Population: Outdoor Commercial/Industrial Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	87
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	225
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.1**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.7
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.005%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Current/Future
Exposure Area: Former Esperanza Mill
Soil/Sediment Data Set: 0-2 feet below ground surface
Receptor Population: Outdoor Commercial/Industrial Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	116
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	225
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.2**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.8
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.006%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-0.5 feet below ground surface
Receptor Population: Outdoor Commercial/Industrial Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	136
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	225
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.2**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.8
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.008%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-0.5 feet below ground surface
Receptor Population: Hypothetical Adolescent Trespasser

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	136
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.5
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.003%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-0.5 feet below ground surface
Receptor Population: Hypothetical Adolescent Trespasser

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	87
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.4
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.003%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Current/Future
Exposure Area: Former Esperanza Mill
Soil/Sediment Data Set: 0-2 feet below ground surface
Receptor Population: Hypothetical Adolescent Trespasser

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	116
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.5
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.003%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Outdoor Commercial/Industrial Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	100
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	225
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.1**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.7
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.006%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Hypothetical Adolescent Trespasser

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	100
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.4
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.003%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Hypothetical Construction Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	100
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.330
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	250
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**2.1**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	4.9
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.2%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former Esperanza Mill
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Outdoor Commercial/Industrial Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	116
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	225
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.2**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.8
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.006%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former Esperanza Mill
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Hypothetical Adolescent Trespasser

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	116
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.0**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.5
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.003%**

Appendix E
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former Esperanza Mill
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Hypothetical Construction Worker

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	116
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.330
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	250
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**2.3**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	5.3
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.3%**

APPENDIX F

Hypothetical Future Resident Evaluation

Appendix F
Hypothetical Future Resident Evaluation
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Introduction

In accordance with the Arizona Department of Environmental Quality (ADEQ) approved baseline human health risk assessment (BHHRA) Work Plan, this appendix presents an evaluation of the potential for human health risks to hypothetical future child/adult residents from exposure to soil and sediment (soil/sediment) at the Freeport-McMoRan Sierrita Copper Mine, Green Valley, Arizona (Site). A hypothetical future resident evaluation was performed to address potential unrestricted future land use for the property. The Site is an active open pit mine and mineral concentration facility and although it is highly unlikely it will ever be redeveloped for residential land use, per the Arizona Revised Statutes (A.R.S.) §R49-152(B,C), the hypothetical future resident evaluation is the basis for determining whether a "declaration of environmental use restriction" is required for commercial/industrial land use, or whether unrestricted land use may be suitable for the Site.

Methods

The hypothetical future resident evaluation used the same approach and methodology (e.g., soil/sediment data sets, exposure point concentrations, risk assessment equations, toxicity values, etc.) as was used for the receptors evaluated in the main portion of the BHHRA. The BHHRA was prepared consistent with United States Environmental Protection Agency (USEPA) and ADEQ risk assessment guidelines and followed the ADEQ approved BHHRA Work Plan (Arcadis 2015).

In accordance with ADEQ (2002) guidance, the shallow and deep soil/sediment interval (0 to 15 feet below ground surface) dataset was used to evaluate hypothetical future residential exposure at each of the three exposure areas (EAs): the former CLEAR Plant EA, the former Esperanza Mill EA, and the former Rhenium Ponds EA. Potentially complete exposure routes included incidental soil/sediment ingestion, dermal contact with soil/sediment, and inhalation of fugitive dust particulates. External exposure to ionizing radiation was also evaluated.

Tables F-1 through F-6 present the selection of constituents of potential concern (COPCs) in shallow and deep soil/sediment at each EA based on a comparison of maximum detected concentrations to risk-based screening levels for residential soil. The Arizona Soil Remediation Levels for residential land use (r-SRLs) (Arizona Administrative Code Title 18) were used for inorganic constituents, and the USEPA Preliminary Remediation Goals (PRGs) for residents were used for radionuclides (USEPA 2014). The following COPCs were identified for each EA:

- Former CLEAR Plant EA – antimony, arsenic, copper, lead, molybdenum, Ra-226, Ra-228, U-234, U-235, and U-238
- Former Esperanza Mill EA – antimony, arsenic, copper, lead, molybdenum, uranium, Ra-226, Ra-228, U-234, U-235, and U-238
- Former Rhenium Ponds EA – Ra-226, Ra-228, U-234, U-235, and U-238.

Table F-7 presents the exposure parameters specific to hypothetical future child/adult residents. Constituent-specific absorption parameters and toxicity values were presented in, respectively, the BHHRA Tables 6-2 and 7-1. Chronic reference doses and reference concentrations were used to assess potential noncancer hazards. Slope factors for radionuclide COPCs were presented in Table 7-2. The "Soil Ingestion" slope factors are lifetime values that were used for evaluating hypothetical future residential exposures.

Results and Discussion

Cancer Risks

The estimated excess lifetime cancer risks (ELCRs) and noncancer hazard indices (HIs) for hypothetical future residents exposed to the metal COPCs in soil/sediment are presented in Tables F-8 (former CLEAR Plant EA) and F-9 (former Esperanza Mill EA). ELCRs from exposure to the radionuclide COPCs in soil/sediment are presented in Tables F-10 (former CLEAR Plant EA), F-11 (former Esperanza Mill EA), and F-12 (former Rhenium Ponds EA).

Tables F-13, F-14, and F-15 summarize the estimated ELCRs and noncancer HIs for hypothetical future child/adult residents at each EA. The calculated cumulative ELCRs are 3×10^{-4} for the former CLEAR Plant and former Esperanza Mill EAs and 2×10^{-4} for the former Rhenium Ponds EA. The primary contributors to the calculated cancer risks are Ra-226 and Ra-228 in soil/sediment. These estimated ELCRs are greater than the USEPA and Arizona Administrative Code (R18-7-206) target risk range (i.e., 1×10^{-6} to 1×10^{-4}). USEPA (1997), however, clarified the interpretation of the $1x10^{-4}$ for radionuclides specifically:

> Cleanup should generally achieve a level of risk within the 10^{-4} to 10^{-6} carcinogenic risk ranges based on the reasonable maximum exposure for an individual….As noted in previous policy, "the upper boundary of the risk range is not a discrete line at $1x10^{-4}$, although EPA generally uses $1x10^{-4}$ in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions."
>
> If a dose assessment is conducted at the site, then 15 millirem per year (mrem/yr) effective dose equivalent (EDE) should generally be the maximum dose limit for humans. This level equates to approximately $3x10^{-4}$ increased lifetime risk and is consistent with levels generally considered protective in other governmental actions, particularly regulations and guidance developed by EPA in other radiation control programs.

As discussed in Sections 9.1.4 and 11.1 of the main report, it is important to note that radionuclides are naturally present in soils in this part of Arizona. Due to its size and charge, uranium is found at higher concentrations in silica-rich magmas such as rhyolites and granites (USEPA 2008). In Arizona, uranium is often found in minerals associated with porphyry copper deposits (USEPA 1990, 1999, 2008), and it most commonly occurs in granitic rocks associated with Precambrian outcrops and Laramide intrusives (ADEQ 1989). The porphyry copper deposit at the Sierrita mine is part of the Laramide physiographic province, and in the vicinity of the Sierrita mine, the bedrock units include a variety of silica-rich igneous units (see Arcadis 2013 for a summary of the individual units). Uranium activities measured in Arizona rock formations range from 0.80 picocuries per gram (pCi/g) in the Wilderness Granite near the Santa Catalina Mountains to 378.3 pCi/g in the Lawler Peak Granite (ADEQ 1989), and a map published by the Arizona Geological Survey (AZGS) showed that uranium activities around the Sierrita mine range from 1.7 pCi/g

to 3.4 pCi/g (AZGS 2002; data converted from parts per million [ppm] to pCi/g). In the Sierrita area, there appears to be a band of uranium-bearing minerals that runs across the Sierrita Mountains, and uranium has been found in minerals associated with a number of mines in the region (USEPA 1999).

Quaternary alluvium that was sampled for this BHHRA consists of soils and sediments generated from weathered bedrock material. Alluvial sediments in the Sierrita area are generated through erosion of the exposed bedrock of the Sierrita Mountains. Eroded material is transported downslope by gravity (rock falls and other mass movements) and by rain events, which can transport large quantities of sedimentary materials. These materials are deposited in low-lying and flat areas on the valley floor. Because alluvial sediments are derived from bedrock material, their mineralogical and chemical composition are similar to their bedrock source. Surface soil samples collected from the Former CLEAR Plant, Esperanza Mill, and the Rhenium Pond indeed contain Ra-226, Ra-228, U-235, and U-238 that is comparable to or lower than in the source bedrock (Figure 9-1 of main report). The presence of statistical outliers in the plots (Figure 9-1 of main report) is a reflection of the variability in material composition. In the Sierrita area, gullies, washes, and shallow, low-lying areas accumulate sediment from large geographic stretches of upslope, exposed bedrock from different formations and geologic units, creating sedimentological variability. Because the alluvial sediments are derived from local bedrock, it is expected that they contain comparable levels of metals and radiological materials as is seen in the Ruby Star Granodiorite, Tinaja Peak Formation, and the Harris Ranch Quartz Monzonite. These data indicate that there is not any enrichment in radionuclide content of the surface soil as compared to the bedrock material from which the surface soil is sourced.

Noncancer Hazards

In addition, the cumulative HIs for a hypothetical future child/adult resident are 3 and 4 for the former CLEAR Plant and the former Esperanza Mill EAs respectively. These HIs are greater than the target HI of 1. At the former CLEAR Plant EA, the primary contributors to the HI of 3 is copper with a hazard quotient (HQ) of 2 (rounded from 1.7), and molybdenum with an HQ of 0.8 (rounded from 0.77) (Table F-8). At the former Esperanza Mill EA, the primary contributors to the HI of 4 is copper with an HQ of 1 (rounded from 1.2), and molybdenum with an HQ of 2 (rounded from 2.3) (Table F-9). The risk estimates assumed 100 percent bioavailability, which based on our experience is overly conservative. Although no site specific bioavailability data exist for the Sierrita site, it is reasonable to expect that bioavailability data observed/reported from similar soils and similar sites (i.e., mining areas) would be expected in soil at the Sierrita site. For example, at Chino Mine in Southeast New Mexico, a similar mine to Sierrita with a porphyry copper deposit, bioaccessibility analyses were conducted in 2005 based on USEPA *in-vitro* methods. The mean copper bioaccessibility was estimated to be 65 percent. At Questa Mine, in New Mexico, the *in-vitro* bioaccessibility of molybdenum was determined to be 18-26 percent. Therefore, if the HQs were adjusted by the average bioavailability for copper and molybdenum, then the estimated HQs from this BHHRA would be reduced to less than or equal to 1.

Lead Exposure Evaluation

Lead was identified as a COPC for the former CLEAR Plant and former Esperanza Mill EAs. The USEPA's Adult Lead Methodology and Adult Lead Model (ALM) and Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children (USEPA 1994, 2002) were used to evaluate the potential for adverse health effects to hypothetical future residents from exposure to lead in soil/sediment at the Site.

The BHHRA Section 6.3.5 describes the general approach for evaluating lead exposures and specifics of the ALM. The ALM was used to predict blood lead (PbB) concentrations in hypothetical future resident adults exposed to lead in soil/sediment and to estimate the probability that the target PbB concentration of 10 micrograms per deciliter (µg/dL) would be exceeded.

For hypothetical future resident children exposed to lead in soil/sediment, the IEUBK model was used to predict PbB concentrations in children and estimate the probability that target PbB concentrations are exceeded. The focus of the IEUBK model is the prediction of PbB concentrations in young children exposed to lead from several sources and by ingestion and inhalation exposure routes. The model uses four interrelated modules (exposure, uptake, biokinetic, and probability distribution) to mathematically and statistically link environmental lead exposure to PbB concentrations for a population of young children (birth to 84 months of age). A plausible distribution of PbB concentrations, centered on a geometric mean PbB concentration, is predicted and used to estimate the probability that a child's or a population of children's PbB concentrations will exceed the target PbB concentration. The IEUBK model is intended for a residential exposure scenario, as it considers inhalation and ingestion exposures to indoor air and dust that result from tracking soil into the home, as well as dietary and drinking water exposures.

Based on the results of the ALM and IEUBK model, included in Appendix F, exposure to lead in soil/sediment at the former CLEAR Plant EA or the former Esperanza Mill EA is not likely to result in adverse health effects in hypothetical future resident adults or children. Lead was not evaluated for the Rhenium Ponds EA as it was not identified as a COPC.

References

ADEQ. 1989. Radionuclides in groundwater and their occurrences in Arizona, paper presented by Robin Jenkins at Arizona Hydrological Society annual symposium, Water Quality and Water Quantity Issues into the 1990s - Adaptation to Current Realities, Casa Grande, AZ, September 1989.

ADEQ. 2002. UST Program Release Reporting & Corrective Action Guidance. August 20. Available at: http://www.azdeq.gov/environ/waste/ust/lust/tg.htmlArcadis. 2013. Addendum to the Soil and Sediment Characterization Report. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. Voluntary Remediation Program – VRP Site Code: 100073-03. August 14.

Arcadis. 2015. Voluntary Remediation Program (VRP) Baseline Human Health Risk Assessment Work Plan. Prepared for Freeport-McMoRan Sierrita Operations, Green Valley, Arizona. April 24, 2015.

Arizona Administrative Code. Title 18, Environmental Quality, Chapter 7. Department of Environmental Quality - Remedial Action, Appendix A, Soil Remediation Levels, March 31, 2009, Appendix A made by final rulemaking at 13 A.A.R. 971, effective May 5, 2007 (Supp. 07-1).

AZGS. 2002. Arizona Uranium Levels. Data acquired by US Department of Energy (DOE) National Uranium Resource Evaluation (NURE). Distributed by USGS. Map compiled by AZGS, 2002.

USEPA. 1990. Report to Congress on Special Wastes from Mineral Processing. EPA/530-SW-90-070C, July 17, 1990.

USEPA. 1994. Guidance Manual for the IEUBK Model for Lead in Children. OSWER #9285.7-15-1. Office of Solid Waste and Emergency Response, Washington, DC. (February 1994).

USEPA. 1997. Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination. Memo from Stephen D. Luftig and Larry Weinstock. OSWER No. 9200.4-18. Office of Solid Waste and Emergency Response, Washington, DC. (August 1997).

USEPA. 1999. Technologically Enhanced Naturally Occurring Radioactive Materials in the Southwestern Copper Belt of Arizona. EPA 402-R-99-002.

USEPA. 2002. User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Window® Version - 32 Bit Version. EPA540-K-01-005. Office of Solid Waste and Emergency Response, Washington, DC. (May 2002).

USEPA. 2008. Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume 1: Mining and Reclamation Background. USEPA Office of Radiation and Indoor Air Radiation Protection Division (6608J), previously published on-line and printed as Vol. 1 of EPA 402-R-05-007, January 2006, Updated June 2007 and printed April 2008 as EPA 402-R-08-005.

USEPA. 2014. Preliminary Remediation Goals for Radionuclides. Available at: epa-prgs.ornl.gov/radionuclides/. U.S. Environmental Protection Agency, Office of Superfund and Oak Ridge National Laboratory. November.

Appendix F, Table F-1
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Residential Soil Screening Level [b]		Is Maximum Concentration > 10x r-SRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	62	116	53	1.00E+00	2.00E+00	2.00E-01	6.60E+01	CP-2 081304(8/13/2004)	2.27E+00	5.11E+00	3.10E+01	–	no	**YES**	ASL
Arsenic	216	226	96	2.50E+00	2.50E+00	7.00E-01	1.66E+02	CP-2 081304(8/13/2004)	8.35E+00	1.02E+01	1.00E+01	–	YES	**YES**	ASL
Barium	96	96	100	–	–	3.68E+01	6.54E+02	CP-JS-01-0-1_07152008(7/15/2008)	1.52E+02	1.65E+02	1.50E+04	–	no	no	BSL
Beryllium	118	131	90	1.00E+00	5.00E+00	1.10E-01	1.40E+00	CP-T-3-6 100504(10/5/2004)	5.75E-01	5.22E-01	1.50E+02	–	no	no	BSL
Cadmium	36	116	31	2.00E-01	8.00E+00	4.20E-01	2.49E+01	CP-9 081304(8/13/2004)	2.58E+00	2.34E+00	3.90E+01	–	no	no	BSL
Chromium	116	116	100	–	–	2.00E+00	4.70E+02	CP-T-4-18IN 100404(10/4/2004)	1.42E+01	3.18E+01	1.20E+05	Chromium III	no	no	BSL
Cobalt	101	101	100	–	–	3.00E+00	7.60E+01	CP-1 081304(8/13/2004)	1.10E+01	1.24E+01	9.00E+02	–	no	no	BSL
Copper	226	226	100	–	–	2.70E+01	1.09E+05	CP-16 081304(8/13/2004)	3.59E+03	6.50E+03	3.10E+03	–	YES	**YES**	ASL
Lead	226	226	100	–	–	1.20E+00	3.22E+03	CPS-SWN-D2-01_20120511(5/11/2012)	1.00E+02	1.83E+02	4.00E+02	–	no	**YES**	ASL
Manganese	115	116	99	4.00E-01	4.00E-01	7.10E+01	1.24E+03	CP-JS-01-10-12_07152008(7/15/2008)	3.30E+02	3.52E+02	3.30E+03	–	no	no	BSL
Mercury	21	116	18	3.30E-02	2.00E-01	3.70E-02	6.20E-01	CP-2 081304(8/13/2004)	1.70E-01	8.03E-02	2.30E+01	–	no	no	BSL
Molybdenum	131	131	100	–	–	2.00E+00	3.02E+03	CP-2 081304(8/13/2004)	2.46E+02	3.76E+02	3.90E+02	–	no	**YES**	ASL
Nickel	116	116	100	–	–	2.00E+00	7.00E+01	CP-T-4-18IN 100404(10/4/2004)	1.43E+01	1.90E+01	1.60E+03	–	no	no	BSL
Selenium	104	116	90	3.00E-01	4.00E+00	7.00E-02	5.00E+01	CP-2 081304(8/13/2004)	2.48E+00	5.00E+00	3.90E+02	–	no	no	BSL
Thallium	104	116	90	1.00E-01	1.50E+00	1.00E-01	5.20E+00	CP-2 081304(8/13/2004)	3.96E-01	4.18E-01	5.20E+00	–	no	no	BSL
Uranium	96	96	100	–	–	9.30E-01	1.60E+01	CP-JS-04-5-7_08272008(8/27/2008)	4.61E+00	5.02E+00	1.60E+01	–	no	no	BSL
Zinc	116	116	100	–	–	2.60E+01	6.21E+03	CP-9 081304(8/13/2004)	2.51E+02	5.87E+02	2.30E+04	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] The selected screening levels for inorganic constituents are the Arizona Department of Environmental Quality's Residential Soil Remediation Levels. 2007. Available online at: http://apps.azsos.gov/public_services/Title_18/18-07.pdf.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
r-SRL: residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Appendix F, Table F-2
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Residential Soil Screening Level [b]		Is Maximum Concentration > 10x r-SRL?	Is Constituent a COPC? [c]	
	Min - Max			Min - Max											
	No. of Detects	No. of Samples	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	86 /	114	75	2.00E-01 -	1.00E+00	2.00E-01 -	6.90E+01	EM-17 081304(8/13/2004)	1.99E+00	4.64E+00	3.10E+01	–	no	**YES**	ASL
Arsenic	112 /	119	94	1.01E+01 -	8.97E+01	1.00E+00 -	1.01E+02	EM-17 081304(8/13/2004)	9.90E+00	9.82E+00	1.00E+01	–	YES	**YES**	ASL
Barium	95 /	95	100	– -	–	3.92E+01 -	3.66E+02	CS-JS-02-5-7_08042008(8/4/2008)	1.13E+02	1.23E+02	1.50E+04	–	no	no	BSL
Beryllium	107 /	119	90	1.00E+00 -	5.00E+00	1.70E-01 -	6.20E+00	RA-JS-02-5-7_08112008(8/11/2008)	8.12E-01	8.07E-01	1.50E+02	–	no	no	BSL
Cadmium	51 /	114	45	2.00E+00 -	2.00E+00	2.60E-01 -	8.30E+00	CS-JS-02-10-11_08042008(8/4/2008)	1.86E+00	1.53E+00	3.90E+01	–	no	no	BSL
Chromium	114 /	114	100	– -	–	2.00E+00 -	1.93E+02	EM-JS-08-10-12_08122008(8/12/2008)	1.21E+01	2.03E+01	1.20E+05	Chromium III	no	no	BSL
Chromium VI	1 /	5	20	4.00E+00 -	9.00E+00	4.00E+00 -	4.00E+00	EM-JS-08-10-12_08122008(8/12/2008)	5.80E+00	–	3.00E+01	–	no	no	BSL
Cobalt	98 /	99	99	5.00E+00 -	5.00E+00	1.00E+00 -	4.20E+01	EM-JS-08-5-7_08122008(8/12/2008)	1.03E+01	1.13E+01	9.00E+02	–	no	no	BSL
Copper	119 /	119	100	– -	–	6.20E+01 -	3.02E+04	RA-JS-02-0-1_08112008(8/11/2008)	2.66E+03	4.66E+03	3.10E+03	–	no	**YES**	ASL
Lead	119 /	119	100	– -	–	2.81E+00 -	3.74E+03	C-JS-05-1-3_08052008(8/5/2008)	1.16E+02	1.33E+02	4.00E+02	–	no	**YES**	ASL
Manganese	114 /	114	100	– -	–	3.00E+01 -	9.32E+02	EM-JS-08-5-7_08122008(8/12/2008)	3.56E+02	3.89E+02	3.30E+03	–	no	no	BSL
Mercury	35 /	114	31	4.00E-02 -	2.00E-01	4.00E-02 -	6.00E-01	EM-JS-08-5-7_08122008(8/12/2008)	1.66E-01	1.01E-01	2.30E+01	–	no	no	BSL
Molybdenum	118 /	119	99	5.00E+00 -	5.00E+00	3.00E+00 -	6.83E+03	EM-JS-07-0-1_08132008(8/13/2008)	6.12E+02	1.13E+03	3.90E+02	–	YES	**YES**	ASL
Nickel	103 /	114	90	1.00E+00 -	5.00E+00	2.00E+00 -	3.30E+01	EM-JS-08-5-7_08122008(8/12/2008)	7.17E+00	7.81E+00	1.60E+03	–	no	no	BSL
Selenium	93 /	114	82	1.90E-01 -	1.11E+01	5.00E-02 -	9.40E+00	EM-3 081304(8/13/2004)	1.55E+00	1.92E+00	3.90E+02	–	no	no	BSL
Thallium	98 /	111	88	1.20E-01 -	3.00E-01	7.00E-02 -	1.10E+00	EM-T-2-2.5 100504(10/5/2004)	2.58E-01	2.76E-01	5.20E+00	–	no	no	BSL
Uranium	95 /	95	100	– -	–	1.17E+00 -	2.99E+01	RA-JS-02-5-7_08112008(8/11/2008)	5.42E+00	7.16E+00	1.60E+01	–	no	**YES**	ASL
Zinc	111 /	111	100	– -	–	2.50E+01 -	3.63E+03	CS-JS-02-10-11_08042008(8/4/2008)	2.63E+02	2.96E+02	2.30E+04	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] The selected screening levels for inorganic constituents are the Arizona Department of Environmental Quality's Residential Soil Remediation Levels. 2007. Available online at: http://apps.azsos.gov/public_services/Title_18/18-07.pdf.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
r-SRL: residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Appendix F, Table F-3
Statistical Summary and Selection of Chemical Constituents of Potential Concern:
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Residential Soil Screening Level [b]		Is Maximum Concentration > 10x r-SRL?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (mg/kg)	Max (mg/kg)	Min (mg/kg)	Max (mg/kg)		(mg/kg)	(mg/kg)	(mg/kg)	Surrogate	(YES/no)	(YES/no)	Rationale
Inorganics															
Antimony	2	8	25	1.00E+00	1.00E+00	2.00E-01	3.00E-01	RP-JS-02-10-12_08122008(8/12/2008)	8.13E-01	–	3.10E+01	–	no	no	BSL
Arsenic	8	8	100	–	–	1.90E+00	5.20E+00	RP-JS-02-5-7_08122008(8/12/2008)	3.33E+00	3.96E+00	1.00E+01	–	no	no	BSL
Barium	8	8	100	–	–	4.61E+01	3.03E+02	RP-JS-02-0-1_08122008(8/12/2008)	1.08E+02	2.53E+02	1.50E+04	–	no	no	BSL
Beryllium	6	8	75	1.00E+00	1.00E+00	2.00E-01	1.60E+00	RP-JS-02-0-1_08122008(8/12/2008)	7.50E-01	8.97E-01	1.50E+02	–	no	no	BSL
Chromium	8	8	100	–	–	2.00E+00	7.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	3.50E+00	4.63E+00	1.20E+05	Chromium III	no	no	BSL
Cobalt	8	8	100	–	–	2.00E+00	1.60E+01	RP-JS-02-10-12_08122008(8/12/2008)	7.25E+00	1.02E+01	9.00E+02	–	no	no	BSL
Copper	8	8	100	–	–	6.30E+01	4.66E+02	RP-JS-01-10-12_08122008(8/12/2008)	1.87E+02	2.80E+02	3.10E+03	–	no	no	BSL
Lead	8	8	100	–	–	6.43E+00	1.45E+01	RP-JS-02-10-12_08122008(8/12/2008)	1.02E+01	1.20E+01	4.00E+02	–	no	no	BSL
Manganese	8	8	100	–	–	1.60E+02	1.25E+03	RP-JS-02-5-7_08122008(8/12/2008)	5.06E+02	1.09E+03	3.30E+03	–	no	no	BSL
Mercury	4	8	50	2.00E-01	2.00E-01	4.00E-02	7.00E-02	RP-JS-01-0-1_08122008(8/12/2008), RP-JS-02-10-12_08122008(8/12/2008)	1.30E-01	–	2.30E+01	–	no	no	BSL
Molybdenum	8	8	100	–	–	6.00E+00	1.26E+02	RP-JS-01-10-12_08122008(8/12/2008)	6.85E+01	9.82E+01	3.90E+02	–	no	no	BSL
Nickel	7	8	88	5.00E+00	5.00E+00	2.00E+00	6.00E+00	RP-JS-02-0-1_08122008(8/12/2008)	3.50E+00	5.78E+00	1.60E+03	–	no	no	BSL
Selenium	8	8	100	–	–	3.40E-01	1.04E+00	RP-JS-01-10-12_08122008(8/12/2008)	7.58E-01	9.05E-01	3.90E+02	–	no	no	BSL
Thallium	8	8	100	–	–	8.00E-02	2.50E-01	RP-JS-02-0-1_08122008(8/12/2008)	1.38E-01	1.74E-01	5.20E+00	–	no	no	BSL
Uranium	8	8	100	–	–	1.07E+00	9.12E+00	RP-JS-02-10-12_08122008(8/12/2008)	2.88E+00	5.34E+00	1.60E+01	–	no	no	BSL
Zinc	8	8	100	–	–	2.30E+01	1.39E+02	RP-JS-02-10-12_08122008(8/12/2008)	5.64E+01	8.06E+01	2.30E+04	–	no	no	BSL

Notes:
[a] All detected constituents are presented.
[b] The selected screening levels for inorganic constituents are the Arizona Department of Environmental Quality's Residential Soil Remediation Levels. 2007. Available online at: http://apps.azsos.gov/public_services/Title_18/18-07.pdf.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (HTSPT) (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency. Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
mg/kg: milligram(s) per kilogram.
min: minimum.
No.: number.
r-SRL: residential Soil Remediation Level.
UCL: upper confidence limit of the arithmetic mean.

Appendix F, Table F-4
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Resident PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (pCi/g)	Max (pCi/g)	Min (pCi/g)	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	80 /	82	98	4.00E-01	8.40E-01	4.30E-01	5.30E+00	CP-JS-03-5-7_07142008(7/14/2008)	2.20E+00	2.41E+00	6.4E-03	YES	**YES**	ASL
Radium-228	82 /	82	100	–	–	1.20E+00	7.60E+00	CP-O09-0-1_07112008(7/11/2008)	2.26E+00	2.42E+00	1.2E-02	YES	**YES**	ASL
Uranium-234	82 /	82	100	–	–	8.40E-01	1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.51E+00	2.72E+00	6.6E-02	YES	**YES**	ASL
Uranium-235	63 /	82	77	3.90E-02	2.30E-01	2.00E-02	7.40E-01	CP-JS-02-0-1_07112008(7/11/2008)	1.49E-01	1.53E-01	4.9E-02	YES	**YES**	ASL
Uranium-238	82 /	82	100	–	–	8.40E-01	1.20E+01	CP-JS-02-0-1_07112008(7/11/2008)	2.59E+00	2.87E+00	5.0E-02	YES	**YES**	ASL

Notes:

[a] Only detected constituents are presented.

[b] The selected screening levels for radiological constituents are the United States Environmental Protection Agency's Preliminary Remediation Goals (PRGs) for Radionuclides (USEPA 2014). PRGs for residents were used. Available online at: epa- prgs.ornl.gov/radionuclides/.

[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Appendix F, Table F-5
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits		Detected Concentrations		Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Resident PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (pCi/g)	Max (pCi/g)	Min (pCi/g)	Max (pCi/g)		(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides														
Radium-226	88 /	88	100	–	–	5.40E-01	5.80E+00	RA-JS-03-0-1_08072008(8/7/2008)	2.24E+00	2.43E+00	6.4E-03	YES	**YES**	ASL
Radium-228	85 /	88	97	2.00E+00	2.50E+00	1.00E+00	8.90E+00	RA-JS-02-1-3_08112008(8/11/2008)	2.30E+00	2.50E+00	1.2E-02	YES	**YES**	ASL
Uranium-234	88 /	88	100	–	–	8.50E-01	1.20E+01	EM-JS-08-10-12_08122008(8/12/2008)	2.43E+00	2.69E+00	6.6E-02	YES	**YES**	ASL
Uranium-235	68 /	88	77	4.20E-02	2.00E-01	4.20E-02	5.70E-01	EM-JS-08-10-12_08122008(8/12/2008)	1.25E-01	1.33E-01	4.9E-02	YES	**YES**	ASL
Uranium-238	88 /	88	100	–	–	9.00E-01	1.20E+01	EM-JS-08-10-12_08122008(8/12/2008)	2.47E+00	2.74E+00	5.0E-02	YES	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] The selected screening levels for radiological constituents are the United States Environmental Protection Agency's Preliminary Remediation Goals (PRGs) for Radionuclides (USEPA 2014). PRGs for residents were used. Available online at: epa- prgs.ornl.gov/radionuclides/.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Appendix F, Table F-6
Statistical Summary and Selection of Radionuclide Constituents of Potential Concern:
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent [a]	Frequency of Detection			Reporting Limits			Detected Concentrations			Sample Identification of Maximum Concentration (Sample Date)	Mean Detected Concentration	95% UCL	Resident PRG for Soil [b]	Is Maximum Concentration > 10x PRG?	Is Constituent a COPC? [c]	
	No. of Detects	No. of Samples	(%)	Min (pCi/g)	Max (pCi/g)		Min (pCi/g)	Max (pCi/g)			(pCi/g)	(pCi/g)	(pCi/g)	(YES/no)	(YES/no)	Rationale
Radionuclides																
Radium-226	7 /	7	100	–	–		1.50E+00	2.80E+00		RP-JS-01-10-12_08122008(8/12/2008)	2.21E+00	–	6.4E-03	YES	**YES**	ASL
Radium-228	7 /	7	100	–	–		8.20E-01	1.90E+00		RP-JS-01-10-12_08122008(8/12/2008)	1.50E+00	–	1.2E-02	YES	**YES**	ASL
Uranium-234	7 /	7	100	–	–		7.00E-01	3.10E+00		RP-JS-02-10-12_08122008(8/12/2008)	1.43E+00	–	6.6E-02	YES	**YES**	ASL
Uranium-235	2 /	7	29	4.20E-02	1.80E-01		4.60E-02	5.70E-02		RP-JS-01-10-12_08122008(8/12/2008)	8.49E-02	–	4.9E-02	no	**YES**	ASL
Uranium-238	7 /	7	100	–	–		8.00E-01	3.20E+00		RP-JS-02-10-12_08122008(8/12/2008)	1.42E+00	–	5.0E-02	YES	**YES**	ASL

Notes:
[a] Only detected constituents are presented.
[b] The selected screening levels for radiological constituents are the United States Environmental Protection Agency's Preliminary Remediation Goals (PRGs) for Radionuclides (USEPA 2014). PRGs for residents were used. Available online at: epa- prgs.ornl.gov/radionuclides/.
[c] Constituents detected at a maximum concentration above their screening level (ASL) are designated as COPCs unless the frequency of detection (FOD) is less than or equal to 5%. However, constituents detected in hotspots (at a maximum concentration greater than 10x the respective screening level) were designated as COPCs regardless of the detection frequency (HTSPT). Constituents with maximum detected concentrations below the screening levels (BSL) are not designated as COPCs.

–: not available or not applicable.
%: percent.
COPC: constituent of potential concern.
ft bgs: feet below ground surface.
max: maximum.
min: minimum.
No.: number.
pCi/g: picoCurie(s) per gram.
PRG: preliminary remediation goal.
UCL: upper confidence limit of the arithmetic mean.

Appendix F, Table F-7
Human Health Exposure Parameters
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Parameter	Symbol	Units	Resident					
			Child (1 through 6 years)		Adult (27 years)		Age-Averaged Radiological Exposure Only	
General Factors								
Averaging Time (cancer)	ATc	days	28,470	[1]	28,470	[1]	–	
Averaging Time (noncancer)	ATnc	days	2,190	[2]	12,045	[2]	–	
Body Weight	BW	kg	19	[3]	80	[4]	–	
Exposure Frequency	EF	days/year	350	[5]	350	[5]	350	[5]
Exposure Duration	ED	years	6	[6]	27	[7]	33	[7]
Inhalation								
Exposure Time	ET	hours/day	24	[8]	24	[8]	24	[8]
Exposure Time, indoor	ET_i	hours/day	–		–		16.416	[9]
Exposure Time, outdoor	ET_o	hours/day	–		–		1.753	[9]
Conversion Factor	CF	day/hour	0.042		0.042		0.042	
Particulate Emission Factor	PEF	m^3/kg	1.396E +09	[10]	1.396E +09	[10]	1.396E +09	[10]
Inhalation Rate	InhR	m^3/day	–		–		–	
Age-Adjusted Inhalation Rate	$InhR_{adj}$	m^3/day	–		–		18	[11]
Soil - Ingestion (Oral)								
Incidental Soil Ingestion Rate	IRs	mg/day	200	[12]	50	[13]	–	
Age-Adjusted Soil Ingestion Rate	IR_{adj}	mg/day	–		–		77	[14]
Soil - Dermal Contact								
Exposed Skin Surface Area	SA	cm^2	2,350	[15]	6,125	[16]	–	
Soil-to-Skin Adherence Rate	SAR	$mg/cm^2/day$	0.19	[17]	0.15	[18]	–	

Notes:

[1] The averaging time for assessing cancer risk is the average expected lifespan of 78 years (Table 18-1, USEPA 2011) expressed in days.

[2] The averaging time for evaluating non-cancer health effects is the exposure duration expressed in days (e.g., 25 years x 365 days/year = 9,125 days) (USEPA 1989).

[3] Professional Judgment: Represents the age-weighted average of the mean body weights for boys and girls, ages 1 through 6 years (Table 8-1, USEPA 2011).

[4] Mean recommended body weight for adults (Table 8-1, USEPA 2011).

[5] Standard default residential exposure frequency (ADHS 2003; ADEQ 2002).

[6] Standard default exposure duration for a resident child (ADHS 2003; ADEQ 2002).

[7] The total exposure duration is 33 years, based on the 95th percentile residential occupancy period (Table 16-5, USEPA 2011). Cancer risks for the resident adult are calculated assuming 6 years at the child's rate of exposure and 27 years at the adult's rate of exposure.

[8] Professional Judgment: Assumes continuous exposure.

[9] Recommended default exposure parameter (USEPA 2015g).

[10] Standard default particulate emission factor (ADHS 2003; ADEQ 2002).

[11] Based on an age-weighted average of recommended default inhalation rates for a resident child ($10 m^3$/day) and resident adult ($20 m^3$/day) (USEPA 2015g).

[12] Recommended upper percentile soil and dust ingestion rate for an individual between the ages of 1 to <6 years (Table 5-1, USEPA 2011).

[13] Recommended central tendency soil and dust ingestion rate for an adult (Table 5-1, USEPA 2011). There is no upper percentile soil and dust ingestion rate for an adult available in Table 5-1 (USEPA, 2011).

[14] Based on an age-weighted average of recommended default soil ingestion rates for a resident child (100 mg/day) and resident adult (200 mg/day) (USEPA 2015g).

[15] Based on an age-weighted average of 95th percentile total skin surface areas for combined males and females, ages 1 through 6 (0.94 m^2 or 9,400 cm^2) (Table 7-9; USEPA 2011). The exposed skin surface area was assumed to be 25% of the total skin surface area (ADEQ, 2002); 9,400 cm^2 x 0.25 = 2,350 cm^2.

[16] Based on an age-weighted average of 95th percentile total skin surface areas for combined males and females, ages 18 to 60 (2.45 m^2 or 24,500 cm^2) (Table 7-9; USEPA 2011). The exposed skin surface area was assumed to be 25% of the total skin surface area (ADEQ, 2002); 24,500 cm^2 x 0.25 = 6,125 cm^2.

[17] Average of recommended values for mean solids adherence to skin for children's hands (0.17 mg/cm^2) and feet (0.20 mg/cm^2), during "activities with soil" (Table 7-4, USEPA 2011).

[18] Average of recommended values for mean solids adherence to skin for adult hands (0.1595 mg/cm^2) and feet (0.1393 mg/cm^2), during "activities with soil" (Table 7-4, USEPA 2011).

References:

Arizona Department of Environmental Quality. 2002. Appendix P, Table 1: Standard Default Factors. UST Program Release Reporting and Corrective Action Guidance. Accessed online: http://www.azdeq.gov/environ/waste/ust/lust/rbca/appp.pdf

Arizona Department of Health Services. 2003. Table 1: Standard Default Factors. Deterministic Risk Assessment Guidance. ADHS Office of Environmental Health. Accessed online: http://www.azdhs.gov/phs/oeh/pdf/guidance.pdf

U.S. Environmental Protection Agency. 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). EPA/540/1-89/002. Office of Emergency and Remedial Response, USEPA, Washington, DC. (December)

U.S. Environmental Protection Agency. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. National Center for Environmental Assessment, Office of Research and Development, USEPA, Washington, DC. (September)

U.S. Environmental Protection Agency. 2015g. Preliminary Remediation Goals for Radionuclides, User's Guide. Accessed online: http://epa-prgs.ornl.gov/radionuclides/prg_guide.html.

ADEQ: Arizona Department of Environmental Quality.
ADHS: Arizona Department of Health Services.
cm^2: square centimeter(s).
kg: kilogram(s).
m^2: square meter(s).
m^3: cubic meter(s).
mg: milligram(s).
USEPA: United States Environmental Protection Agency.

Appendix F, Table F-8
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Child/Adult Resident
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	CANCER RISK: Age-Specific Risk for Carcinogenic Constituents: 1 through 6 years: Oral (ELCRo)	Dermal (ELCRd)	Inhalation (ELCRi)	27 years: Oral (ELCRo)	Dermal (ELCRd)	Inhalation (ELCRi)	TOTAL CANCER RISK: Route-Specific Risk: 33 years: Oral (ELCRo)	Dermal (ELCRd)	Inhalation (ELCRi)	Total ELCR	Percent Total ELCR	NONCANCER HAZARD: Route-Specific Hazard: 1 through 6 years: Oral (HQo)	Dermal (HQd)	Inhalation (HQi)	Total Hazard (Child)	Percent Total HI (Child)	NONCANCER HAZARD: Route-Specific Hazard: 27 years: Oral (HQo)	Dermal (HQd)	Inhalation (HQi)	Total Hazard (Adult)	Percent Total HI (Adult)
Inorganics																								
Antimony	NA	5.11E+00	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		1.3E-01	–	NA	1.3E-01	5%	6.3E-03	–	NA	6.3E-03	5%
Arsenic	A	1.02E+01	1.40E+09 P	4.8E-06	8.0E-07	2.3E-09	1.3E-06	1.7E-06	1.0E-08	6.1E-06	2.5E-06	1.3E-08	8.6E-06	100%	1.4E-01	2.3E-02	4.7E-04	1.6E-01	6%	6.7E-03	9.2E-03	3.8E-04	1.6E-02	12%
Copper	D	6.50E+03	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		1.7E+00	–	NA	1.7E+00	61%	8.0E-02	–	NA	8.0E-02	57%
Lead	B2	1.83E+02	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		NA	NA	NA	–		NA	NA	NA	–	
Molybdenum	NA	3.76E+02	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		7.7E-01	–	NA	7.7E-01	28%	3.7E-02	–	NA	3.7E-02	27%
				5E-06	8E-07	2E-09	1E-06	2E-06	1E-08	6E-06	3E-06	1E-08			3	0.02	0.0005			0.1	0.009	0.0004		

Total **Total ELCR** 9E-06 **Total Child HI** **3** **Total Adult HI** 0.1

Group A Total ELCR	9E-06
Group B Total ELCR	–
Group C Total ELCR	–
Group D Total ELCR	–

HI (skin)	0.2
HI (circulatory)	1
HI (gastrointestinal)	**2**
HI (neurological)	0.0005
HI (development)	0.0005
HI (kidney)	0.8
HI (whole body)	0.9

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table F-7.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: Relative Bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table F-7. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

Child (1 through 6 years):
ELCRo = (EPCs x 1 x 200 x 350 x 6 x RBA x CSFo) / (1,000,000 x 19 x 28470)
ELCRd = (EPCs x 2350 x 0.19 x ABSd x 350 x 6 x CSFa) / (1,000,000 x 19 x 28470)
ELCRi = ([EPCs / PEF] x 24 x 0.042 x 350 x 6 x IUR) / (28470)

Adult (7 through 33 years):
ELCRo = (EPCs x 1 x 50 x 350 x 27 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 350 x 27 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 24 x 0.042 x 350 x 27 x IUR) / (28470)

Child (1 through 6 years):
HQo = (EPCs x 1 x 200 x 350 x 6 x RBA) / (1,000,000 x 19 x 2190 x RfDo)
HQd = (EPCs x 2350 x 0.19 x ABSd x 350 x 6) / (1,000,000 x 19 x 2190 x RfDa)
HQi = ([EPCs / PEF] x 24 x 0.042 x 350 x 6) / (2190 x RfC)

Adult (7 through 33 years):
HQo = (EPCs x 1 x 50 x 350 x 27 x RBA) / (1,000,000 x 80 x 12045 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 350 x 27) / (1,000,000 x 80 x 12045 x RfDa)
HQi = ([EPCs / PEF] x 24 x 0.042 x 350 x 27) / (12045 x RfC)

Appendix F, Table F-9
Excess Lifetime Cancer Risk and Noncancer Hazard Index Calculations for a Hypothetical Future Child/Adult Resident
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	Cancer Group [a]	EPCs (mg/kg)	PEF [b] (m^3/kg)	CANCER RISK: Age-Specific Risk for Carcinogenic Constituents — 1 through 6 years: Oral ELCRo	Dermal ELCRd	Inhalation ELCRi	27 years: Oral ELCRo	Dermal ELCRd	Inhalation ELCRi	TOTAL CANCER RISK: Route-Specific Risk — 33 years: Oral ELCRo	Dermal ELCRd	Inhalation ELCRi	Total ELCR	Percent Total ELCR	NONCANCER HAZARD: Route-Specific Hazard — 1 through 6 years: Oral HQo	Dermal HQd	Inhalation HQi	Total Hazard (Child)	Percent Total HI (Child)	NONCANCER HAZARD: Route-Specific Hazard — 27 years: Oral HQo	Dermal HQd	Inhalation HQi	Total Hazard (Adult)	Percent Total HI (Adult)
Inorganics																								
Antimony	NA	4.64E+00	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		1.2E-01	–	NA	1.2E-01	3%	5.7E-03	–	NA	5.7E-03	3%
Arsenic	A	9.82E+00	1.40E+09 P	4.6E-06	7.7E-07	2.2E-09	1.2E-06	1.7E-06	1.0E-08	5.8E-06	2.5E-06	1.2E-08	8.3E-06	100%	1.3E-01	2.2E-02	4.5E-04	1.6E-01	4%	6.4E-03	8.8E-03	3.7E-04	1.6E-02	8%
Copper	D	4.66E+03	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		1.2E+00	–	NA	1.2E+00	31%	5.7E-02	–	NA	5.7E-02	30%
Lead	B2	1.33E+02	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		NA	NA	NA	–		NA	NA	NA	–	
Molybdenum	NA	1.13E+03	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		2.3E+00	–	NA	2.3E+00	61%	1.1E-01	–	NA	1.1E-01	58%
Uranium [c]	NA	7.16E+00	1.40E+09 P	NA	NA	NA	NA	NA	NA	–	–	–	–		2.4E-02	–	1.2E-04	2.4E-02	<1%	1.2E-03	–	1.0E-04	1.3E-03	<1%
				5E-06	8E-07	2E-09	1E-06	2E-06	1E-08	6E-06	2E-06	1E-08			4	0.02	0.0006			0.2	0.009	0.0005		
Total													**Total ELCR**	8E-06				**Total Child HI**	**4**				**Total Adult HI**	0.2
													Group A Total ELCR	8E-06				HI (developmental)	0.0004					
													Group B Total ELCR	–				HI (circulatory)	**3**					
													Group C Total ELCR	–				HI (skin)	0.2					
													Group D Total ELCR	–				HI (neurological)	0.0004					
																			HI (kidney)	**2**					
																			HI (whole body)	**2**					
																			HI (GI)	1					

Notes:
[a] United States Environmental Protection Agency (USEPA) cancer weight-of-evidence groups are as follows:
Group A: Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B: Probable Human Carcinogen.
B1 - Limited evidence of carcinogenicity in humans.
B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C: Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D: Not Classifiable as to Human Carcinogenicity (inadequate data or no evidence).
[b] Default particulate emission factor ([PEF] identified with [P]) provided in Table F-7.

–: not applicable.
%: percent.
ABSd: dermal absorption factor.
CSFa: dermal cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRd: excess lifetime cancer risk, dermal pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPC: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
HI: hazard index.
HQd: hazard quotient, dermal pathway.
HQi: hazard quotient, inhalation pathway.
HQo: hazard quotient, oral pathway.
IUR: inhalation unit risk.
m^3/kg: cubic meter(s) per kilogram.
mg/kg: milligram(s) per kilogram.
NA: not available or not applicable.
RBA: relative bioavailability.
RfC: reference concentration.
RfDa: dermal reference dose.
RfDo: oral reference dose.

Receptor-specific exposure parameters are presented in Table F-7. Constituent specific absorption parameters are presented in Table 6-2.
Constituent-specific toxicity values are presented in Table 7-1.

Equations:

Child (1 through 6 years):
ELCRo = (EPCs x 1 x 200 x 350 x 6 x RBA x CSFo) / (1,000,000 x 19 x 28470)
ELCRd = (EPCs x 2350 x 0.19 x ABSd x 350 x 6 x CSFa) / (1,000,000 x 19 x 28470)
ELCRi = ([EPCs / PEF] x 24 x 0.042 x 350 x 6 x IUR) / (28470)

Adult (7 through 33 years):
ELCRo = (EPCs x 1 x 50 x 350 x 27 x RBA x CSFo) / (1,000,000 x 80 x 28470)
ELCRd = (EPCs x 6125 x 0.15 x ABSd x 350 x 27 x CSFa) / (1,000,000 x 80 x 28470)
ELCRi = ([EPCs / PEF] x 24 x 0.042 x 350 x 27 x IUR) / (28470)

Child (1 through 6 years):
HQo = (EPCs x 1 x 200 x 350 x 6 x RBA) / (1,000,000 x 19 x 2190 x RfDo)
HQd = (EPCs x 2350 x 0.19 x ABSd x 350 x 6) / (1,000,000 x 19 x 2190 x RfDa)
HQi = ([EPCs / PEF] x 24 x 0.042 x 350 x 6) / (2190 x RfC)

Adult (7 through 33 years):
HQo = (EPCs x 1 x 50 x 350 x 27 x RBA) / (1,000,000 x 80 x 12045 x RfDo)
HQd = (EPCs x 6125 x 0.15 x ABSd x 350 x 27) / (1,000,000 x 80 x 12045 x RfDa)
HQi = ([EPCs / PEF] x 24 x 0.042 x 350 x 27) / (12045 x RfC)

Appendix F, Table F-10
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Child/Adult Resident Exposed to Radionuclides
Former CLEAR Plant - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides								
Radium-226	2.41E+00	1.40E+09	P	1.4E-06	1.0E-08	2.2E-04	2.2E-04	87%
Radium-228	2.42E+00	1.40E+09	P	1.1E-06	3.9E-09	2.6E-05	2.7E-05	11%
Uranium-234	2.72E+00	1.40E+09	P	3.6E-07	1.1E-08	7.5E-09	3.8E-07	<1%
Uranium-235	1.53E-01	1.40E+09	P	2.1E-08	5.7E-10	9.7E-07	9.9E-07	<1%
Uranium-238	2.87E+00	1.40E+09	P	5.0E-07	1.0E-08	3.7E-06	4.3E-06	2%
				3E-06	4E-08	3E-04		
Total						**Total ELCR**	3E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table F-7.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table F-7.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 77 × 350 × 33 × [1 - exp(-λ × 33)] × CSFo) / (1,000 × 33 × λ)
ELCRi = (EPCs × 1,000 × 18 × 24 × 0.042 × 350 × 33 × [1 - exp(-λ × 33)] × CSFi) / (1.40E+09 × 33 × λ)
ELCRe = (EPCs × ACF × [(1.752 × 0.042 × 1) + (16.416 × 0.042 × 0.4)] × 350 × 33 × [1 - exp(-λ × 33)] × CSFe) / (365 × 33 × λ)

Appendix F, Table F-11
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Child/Adult Resident Exposed to Radionuclides
Former Esperanza Mill - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

				CANCER RISK				
				Route-Specific Risk			Total	Percent
Constituent	EPCs (pCi/g)	PEF [a] (m^3/kg)		Ingestion ELCRo	Inhalation ELCRi	External ELCRe	ELCR	Total ELCR
Radionuclides								
Radium-226	2.43E+00	1.40E+09	P	1.5E-06	1.0E-08	2.2E-04	2.2E-04	87%
Radium-228	2.50E+00	1.40E+09	P	1.1E-06	4.0E-09	2.7E-05	2.8E-05	11%
Uranium-234	2.69E+00	1.40E+09	P	3.5E-07	1.1E-08	7.5E-09	3.7E-07	<1%
Uranium-235	1.33E-01	1.40E+09	P	1.8E-08	5.0E-10	8.4E-07	8.6E-07	<1%
Uranium-238	2.74E+00	1.40E+09	P	4.8E-07	9.7E-09	3.6E-06	4.1E-06	2%
				3E-06	4E-08	3E-04		
Total						**Total ELCR**	3E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table F-7.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table F-7.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 77 × 350 × 33 × [1 - exp(-λ × 33)] × CSFo) / (1,000 × 33 × λ)
ELCRi = (EPCs × 1,000 × 18 × 24 × 0.042 × 350 × 33 × [1 - exp(-λ × 33)] × CSFi) / (1.40E+09 × 33 × λ)
ELCRe = (EPCs × ACF × [(1.752 × 0.042 × 1) + (16.416 × 0.042 × 0.4)] × 350 × 33 × [1 - exp(-λ × 33)] × CSFe) / (365 × 33 × λ)

Appendix F, Table F-12
Excess Lifetime Cancer Risk Calculations for a Hypothetical Future Resident Exposed to Radionuclides
Former Rhenium Ponds - Shallow and Deep Soil/Sediment (0 to 15 ft bgs)
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Constituent	EPCs (pCi/g)		PEF [a] (m^3/kg)		CANCER RISK: Route-Specific Risk: Ingestion ELCRo	Inhalation ELCRi	External ELCRe	Total ELCR	Percent Total ELCR
Radionuclides									
Radium-226	2.80E+00	m	1.40E+09	P	1.7E-06	1.2E-08	2.1E-04	2.1E-04	90%
Radium-228	1.90E+00	m	1.40E+09	P	8.3E-07	3.1E-09	1.7E-05	1.8E-05	8%
Uranium-234	3.10E+00	m	1.40E+09	P	4.1E-07	1.3E-08	8.6E-09	4.3E-07	<1%
Uranium-235	5.70E-02	m	1.40E+09	P	7.8E-09	2.1E-10	3.4E-07	3.5E-07	<1%
Uranium-238	3.20E+00	m	1.40E+09	P	5.6E-07	1.1E-08	3.9E-06	4.5E-06	2%
					3E-06	4E-08	2E-04		
Total							**Total ELCR**	2E-04	

Notes:
[a] Default particulate emission factor ([PEF] identified with [P]) provided in Table F-7.

%: percent.
ACF: area correction factor.
CSFe: external cancer slope factor.
CSFi: inhalation cancer slope factor.
CSFo: oral cancer slope factor.
ELCR: excess lifetime cancer risk.
ELCRe: excess lifetime cancer risk, external pathway.
ELCRi: excess lifetime cancer risk, inhalation pathway.
ELCRo: excess lifetime cancer risk, oral pathway.
EPCs: exposure point concentration in soil/sediment.
ft bgs: feet below ground surface.
m: maximum concentration.
m^3/kg: cubic meter(s) per kilogram.
pCi/g: picoCurie(s) per gram.

Receptor-specific exposure parameters are presented in Table F-7.
Radionuclide-specific parameters and slope factors are presented in Table 7-2.

Equations:
ELCRo = (EPCs × 77 × 350 × 33 × [1 - exp(-λ × 33)] × CSFo) / (1,000 × 33 × λ)
ELCRi = (EPCs × 1,000 × 18 × 24 × 0.042 × 350 × 33 × [1 - exp(-λ × 33)] × CSFi) / (1.40E+09 × 33 × λ)
ELCRe = (EPCs × ACF × [(1.752 × 0.042 × 1) + (16.416 × 0.042 × 0.4)] × 350 × 33 × [1 - exp(-λ × 33)] × CSFe) / (365 × 33 × λ)

Appendix F, Table F-13
Summary of Calculated Excess Lifetime Cancer Risks and Noncancer Hazard Indices:
Former CLEAR Plant, Hypothetical Future Residential Scenario
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

		TOTAL EXCESS LIFETIME CANCER RISK		NONCANCER HAZARD INDEX	
Human Receptors	**Exposure Type (Table Reference)**	**Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)**	**COPCs accounting for >10% of ELCR (if ELCR >1E-04)**	**Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)**	**COPCs accounting for >10% of HI (if HI >1)**
Former CLEAR Plant Exposure Area					
Hypothetical Future Scenario					
Hypothetical Child/Adult Resident	Chemical (Table F-8)	9E-06	–	**3**	Copper (61%) Molybdenum (28%)
	Radiological (Table F-10)	**3E-04**	Ra-226 (87%) Ra-228 (11%)	–	–
	Receptor Total	**3E-04**	Ra-226 (87%) Ra-228 (11%)	**3**	Copper (61%) Molybdenum (28%)

Notes:

The hypothetical future scenarios evaluated for the Former CLEAR Plant Exposure Area are based on soil and sediment data from sample locations that are currently exposed at the surface and from sample locations that are currently covered (i.e., paved or developed) at the surface. This assumes that the currently covered soils will become exposed in the future.

Excess lifetime cancer risks exceeding 1E-04 and noncancer hazard indices exceeding 1 are shown in bold.

– : not applicable.
%: percent.
COPC: constituent of potential concern.
ELCR: excess lifetime cancer risk.
ft bgs: feet below ground surface.
HI: hazard index.

Appendix F, Table F-14
Summary of Calculated Excess Lifetime Cancer Risks and Noncancer Hazard Indices:
Former Esperanza Mill, Hypothetical Future Residential Scenario
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

		TOTAL EXCESS LIFETIME CANCER RISK		NONCANCER HAZARD INDEX	
Human Receptors	**Exposure Type (Table Reference)**	**Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)**	**COPCs accounting for >10% of ELCR (if ELCR >1E-04)**	**Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)**	**COPCs accounting for >10% of HI (if HI >1)**
Former Esperanza Mill Exposure Area					
Hypothetical Future Scenario					
Hypothetical Child/Adult Resident	Chemical (Table F-3)	8E-06	–	**4**	Copper (31%) Molybdenum (61%)
	Radiological (Table F-5)	**3E-04**	Ra-226 (87%) Ra-228 (11%)	–	–
	Receptor Total	**3E-04**	Ra-226 (88%) Ra-228 (11%)	**4**	Copper (31%) Molybdenum (61%)

Notes:
Excess lifetime cancer risks exceeding 1E-04 and noncancer hazard indices exceeding 1 are shown in bold.

– : not applicable.
%: percent.
COPC: constituent of potential concern.
ELCR: excess lifetime cancer risk.
ft bgs: feet below ground surface.
HI: hazard index.

Appendix F, Table F-15
Summary of Calculated Excess Lifetime Cancer Risks and Noncancer Hazard Indices:
Former Rhenium Ponds, Hypothetical Future Residential Scenario
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

		TOTAL EXCESS LIFETIME CANCER RISK		NONCANCER HAZARD INDEX	
Human Receptors	**Exposure Type (Table Reference)**	**Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)**	**COPCs accounting for >10% of ELCR (if ELCR >1E-04)**	**Direct Contact with Shallow and Deep Soil/Sediment (0 to 15 ft bgs)**	**COPCs accounting for >10% of HI (if HI >1)**
Former Rhenium Ponds Exposure Area					
Hypothetical Future Scenario					
Hypothetical Child/Adult Resident	Chemical	No COPCs	–	No COPCs	–
	Radiological (Table F-6)	**2E-04**	Ra-226 (90%) Ra-228 (8%)	–	–
	Receptor Total	**2E-04**	Ra-226 (90%) Ra-228 (8%)	–	–

Notes:
Excess lifetime cancer risks exceeding 1E-04 and noncancer hazard indices exceeding 1 are shown in bold.

– : not applicable.
%: percent.
COPC: constituent of potential concern.
ELCR: excess lifetime cancer risk.
ft bgs: feet below ground surface.
HI: hazard index.

Appendix F
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former CLEAR Plant
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Hypothetical Resident Adult

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	100
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	350
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.2**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	2.9
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.009%**

Appendix F
Adult Lead Model Worksheets
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09 **EDIT RED CELLS**

Exposure Scenario: Future
Exposure Area: Former Esperanza Mill
Soil/Sediment Data Set: 0-15 feet below ground surface
Receptor Population: Hypothetical Resident Adult

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
PbS	Soil lead concentration	ug/g or ppm	116
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	ug/dL	1.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	350
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**1.3**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	3.0
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	**10.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.01%**

Appendix F
IEUBK Model Output
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

LEAD MODEL FOR WINDOWS Version 1.1

==========

Model Version: 1.1 Build11
User Name: ARCADIS
Date: September 2015
Site Name: Sierrita Mine, Green Valley, Arizona
Operable Unit: Former CLEAR Plant (0-15 feet below ground surface)
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	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** 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

Appendix F
IEUBK Model Output
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

****** 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: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 80.000 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	100.000	80.000
1-2	100.000	80.000
2-3	100.000	80.000
3-4	100.000	80.000
4-5	100.000	80.000
5-6	100.000	80.000
6-7	100.000	80.000

****** 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

Appendix F
IEUBK Model Output
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

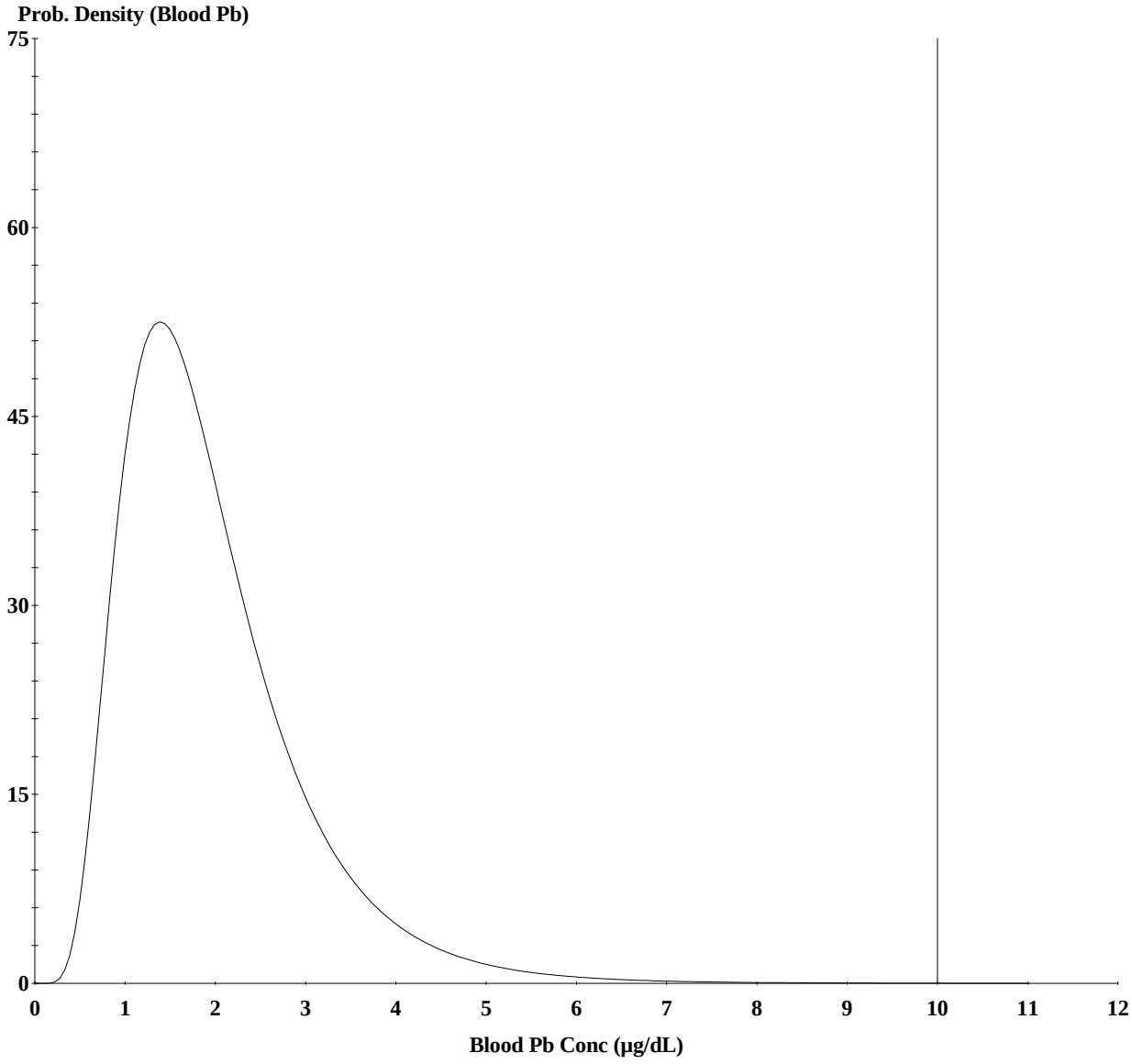
****** Maternal Contribution: Infant Model ******

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	0.021	1.084	0.000	0.384
1-2	0.034	0.935	0.000	0.955
2-3	0.062	1.023	0.000	0.999
3-4	0.067	0.985	0.000	1.024
4-5	0.067	0.951	0.000	1.073
5-6	0.093	1.003	0.000	1.135
6-7	0.093	1.088	0.000	1.157

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	2.178	3.667	2.0
1-2	3.441	5.365	2.2
2-3	3.461	5.544	2.1
3-4	3.481	5.557	2.0
4-5	2.604	4.693	1.7
5-6	2.351	4.583	1.4
6-7	2.225	4.563	1.3



Cutoff = 10.000 µg/dl
Geo Mean = 1.802
GSD = 1.600
% Above = 0.013
% Below = 99.987

Age Range = 0 to 84 months

Run Mode = Research

Appendix F
IEUBK Model Output
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

LEAD MODEL FOR WINDOWS Version 1.1

==========

Model Version: 1.1 Build11
User Name: ARCADIS
Date: September 2015
Site Name: Sierrita Mine, Green Valley, Arizona
Operable Unit: Former Esperanza Mill (0-15 feet below ground surface)
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	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** 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

Appendix F
IEUBK Model Output
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

****** 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: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 91.200 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	116.000	91.200
1-2	116.000	91.200
2-3	116.000	91.200
3-4	116.000	91.200
4-5	116.000	91.200
5-6	116.000	91.200
6-7	116.000	91.200

****** 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

Appendix F
IEUBK Model Output
Baseline Human Health Risk Assessment
Freeport-McMoRan Sierrita
Sierrita Mine, Green Valley, Arizona

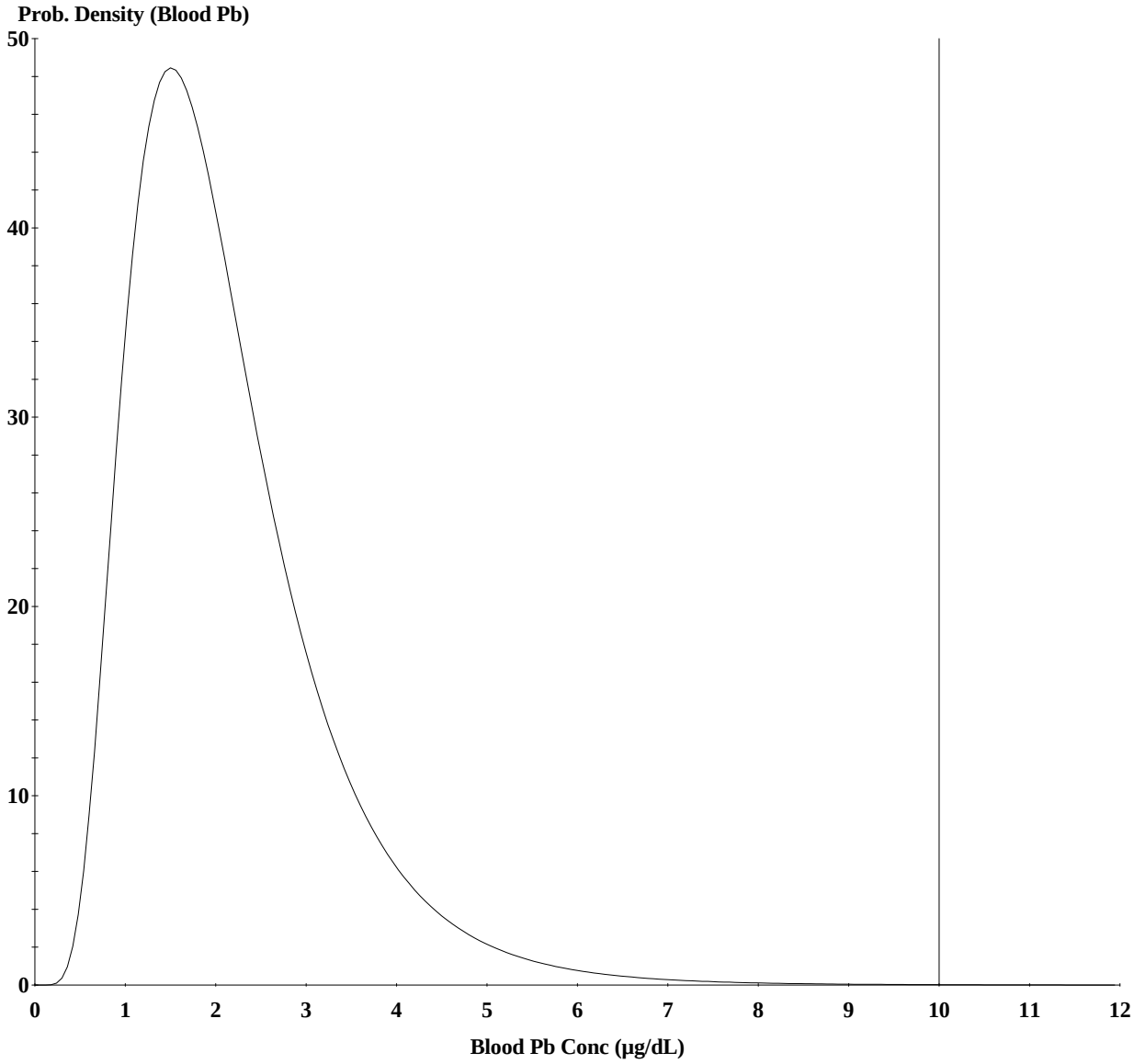
****** Maternal Contribution: Infant Model ******

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	0.021	1.080	0.000	0.382
1-2	0.034	0.931	0.000	0.950
2-3	0.062	1.019	0.000	0.995
3-4	0.067	0.982	0.000	1.021
4-5	0.067	0.949	0.000	1.070
5-6	0.093	1.001	0.000	1.133
6-7	0.093	1.087	0.000	1.155

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	2.496	3.979	2.2
1-2	3.940	5.856	2.4
2-3	3.966	6.041	2.3
3-4	3.991	6.060	2.1
4-5	2.988	5.074	1.8
5-6	2.700	4.928	1.6
6-7	2.555	4.890	1.4



Cutoff = 10.000 µg/dl
Geo Mean = 1.954
GSD = 1.600
% Above = 0.026
% Below = 99.974

Age Range = 0 to 84 months

Run Mode = Research

Arcadis U.S., Inc.

410 N. 44th Street

Suite 1000

Phoenix, Arizona 85008

Tel 602 438 0883

Fax 602 438 0102

www.arcadis.com