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Revised Site-Specific Cleanup Goal Report

Former Kast Property
Carson, California

Prepared by:

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Project Number: SB0484-04-2

October 21, 2013

Geosyntec consultants

REVISED SITE-SPECIFIC CLEANUP GOAL REPORT

Former Kast Property
Carson, California

Prepared for:

Shell Oil Products US

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CERTIFICATION

REVISED SITE-SPECIFIC CLEANUP GOAL REPORT

FORMER KAST PROPERTY

CARSON, CALIFORNIA

I am the Project Manager for Equilon Enterprises LLC doing business as Shell Oil Products US for this project. I am informed and believe that the matters stated in the Revised Site-Specific Cleanup Goal Report dated October 21, 2013 are true, and on that ground I declare, under penalty of perjury in accordance with Water Code section 13267, that the statements contained therein are true and correct.

Doug Weimer
Project Manager
Shell Oil Products US
October 21, 2013

Geosyntec consultants

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

APPENDIX A

Soil, Sub-Slab Soil Vapor, and Soil Vapor Site-Specific Cleanup Goal Derivation

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

This appendix presents the approach and methodologies that were used to derive Site-specific cleanup goals (SSCGs) for constituents of concern (COCs) detected in soil, sub-slab soil vapor, and soil vapor at the former Kast Property (Site) located in Carson, California. The Site is a former oil storage facility that was sold by Shell Oil Company in the late 1960s and later redeveloped into the Carousel subdivision containing 285 single family houses. Based on historical operations, the primary Site COCs are related to crude oil and bunker oil.

Site-specific cleanup goals were derived to provide target cleanup goals for the development of a Site remediation strategy. The SSCG calculation approach is consistent with current United States Environmental Protection Agency (USEPA) and California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC) guidance documents (USEPA, 1989; 1991a; 2002; 2009; 2013a,b; Cal-EPA 1999; 2011a) including the withdrawn *Interim Guidance on Evaluating Human Health Risks from Total Petroleum Hydrocarbons (TPH)* (Cal-EPA, 2009a)[1]. Risk-based SSCGs for human health, SSCGs for potential migration to groundwater through leaching, and SSCGs based on local and regional background have been developed for the Site. A discussion of the input parameters, the algorithms, and SSCGs are included in this appendix.

2.0 DATA EVALUATION AND COC SELECTION

An initial step in the risk assessment process is an evaluation of available data to identify media-specific COCs. A variety of samples have been collected as a part of the Site investigation process. Detected compounds include inorganics, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and metals. These compounds, if they were detected in at least one sample in a given media (soil or soil vapor), were included in the COC selection process. A toxicity-concentration screen was then used to focus the list of COCs to those chemicals that have the potential to contribute significantly to potential risk at the Site, as discussed below.

COC screening was conducted using risk-based screening levels (RBSLs) that were calculated assuming potential residential exposures to COCs in soil and soil vapor as part of the human health screening risk evaluation (HHSRE) process (Geosyntec, 2009, 2010, 2011). The RBSLs represent chemical-specific concentrations in the relevant environmental media that would be consistent with a target risk level for the current land use under

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[1] Note that the Cal-EPA *Interim Guidance on Evaluating Human Health Risks from Total Petroleum Hydrocarbons (TPH)* is no longer active; however, information provided in this document is considered in this evaluation.

conservative (i.e., protective) exposure conditions. For soil vapor, the screening levels were developed to address potential sub-slab soil vapor migration to indoor air. This is the most sensitive land-use and conservative for construction and maintenance worker exposures. For carcinogenic PAHs and metals, a background comparison value was used along with the calculated RBSLs for COC selection.

An additional screening criterion for soil was if the chemical was detected in five or less samples it was excluded from the SSCG derivation. Due to the large number of soil samples collected (over 10,000) this equates to less than or equal to 0.05 percent of soil samples.

In the first step of COC selection, a list of detected chemicals in each media was identified. Tables 4.1 through 4.4 of the main report present the prevalence and range of concentrations of all chemicals that were detected at least once in soil, soil vapor, indoor air, and groundwater, respectively across the Site. As discussed in the main report, quantitative SSCGs are being developed for soil and sub-slab soil vapor for onsite residents, soil and soil vapor for construction and utility maintenance workers and migration from soil to groundwater through leaching. Therefore, chemicals detected in these media were carried forward into the COC selection.

To identify COCs for each media, the maximum concentration for that media was compared to one-tenth of its respective RBSL. One-tenth of the RBSL was used as a conservative approach to screen chemicals for further analysis and to address potential cumulative effects. If the maximum concentration was greater than one-tenth of the RBSL it was selected as a COC for the Site. In addition to the RBSL screen, background concentrations for metals and carcinogenic PAHs (cPAHs as benzo(a)pyrene equivalents) were considered.

For the selection of soil COCs to address the leaching to groundwater pathway, chemicals that were detected in groundwater above their respective maximum contaminant level (MCL) or notification level (NL) were carried forward into the SSCG derivation process. Based on the site conceptual model (SCM) presented in Section 2 of the main report and the age of potential petroleum releases at the Site, groundwater impacts from leaching from Site soils are not expected to change appreciably. This is discussed further in Section 8 of the main report and supported by the plume stability analysis. As a result, the inclusion of chemicals that have been detected above MCLs and NLs is considered appropriate for COC selection.

Tables 4.5 and 4.6 of the main report present the COCs that have been identified for each media to be carried forward into the RAP.

3.0 EXPOSURE ASSESSMENT

To evaluate whether the levels of COCs present in soil and soil vapor would pose a risk to human populations, it is necessary to (i) identify the populations that may potentially be exposed to these COCs, and (ii) define the pathways by which the exposures may occur. The following table summarizes the receptor, exposure media, and potential exposure pathways that were considered in deriving the SSCGs. The following table summarizes the exposure scenarios that were evaluated.

Receptor	Exposure Medium	Potentially Complete Exposure Pathway
Onsite Resident	Shallow Surface Soil (0-2 ft bgs)	• Incidental Ingestion • Dermal Contact • Outdoor Air Inhalation
	Shallow Subsurface Soil (>2-10 ft bgs)	• Infrequent Incidental Ingestion • Infrequent Dermal Contact • Infrequent Outdoor Air Inhalation
	Sub-Slab Soil Vapor	• Vapor Inhalation in Indoor Air via Vapor Intrusion
Construction and Utility Maintenance Worker	Shallow Soil (0-10 ft bgs)	• Incidental Ingestion • Dermal Contact • Outdoor Air Inhalation
	Soil Vapor	• Vapor Inhalation in Outdoor Air
Groundwater	Shallow Soil (0-10 ft bgs)	• Leaching to Groundwater

The soil SSCGs for the residential scenario are based on surface soil (0-2 feet below ground surface [ft bgs]) and subsurface soil (>2-10 ft bgs) exposure assumptions. SSCGs were derived for onsite residents who may typically contact surface soils using the Cal-EPA and USEPA default exposure frequency (EF) of 350 days per year. Surface soils are considered for typical residential exposures, whereas subsurface soils are considered for infrequent contact, because the likelihood of a resident contacting soils at deeper depths is very low given the developed nature of the Site and typical residential activities where exposure to soil could occur (e.g., lawn care, recreational activities, landscaping). Typical lawn care and gardening would occur in the surface soil horizon.

The potential does exist for deeper soils to be contacted (e.g., if a sizable tree is planted), but this would not occur on a regular basis for a given property. To address the unlikely, infrequent exposure to subsurface soils (>2-10 ft bgs), SSCGs were developed for residents assuming a lower frequency of exposure of 4 days per year. The exposure frequency of 4 days per year is based on $1/10^{th}$ of the USEPA recommended event frequency of 40 events per year for an adult resident gardening outdoors on a more routine basis (USEPA, 1997). Since the value of 40 days per year is based on routine gardening, an adjustment was considered reasonable to account for infrequent contact to account for instances where a resident may contact deeper soil (e.g. planting a tree). In addition, it is unlikely that residents would contact soils unearthed from a deeper excavation (such as during a major renovation or utility repair work) as these soils could not be placed onsite due to the developed nature of the neighborhood and lack of open area to place the excavated soils. The conceptual model for this assumption includes institutional controls (e.g., a notification requirement triggered when an excavation permit is applied for) to prevent redistribution of deep soils at the surface. A Soil Management Plan will be prepared either as a part of, or subsequent to, the RAP that will provide the detailed approach to preventing residential exposure to subsurface soils impacted by Site COCs.

A summary of the exposure parameters used to derive the SSCGs for the receptors identified above is presented in **Table A-1.** These parameters are consistent with those recommended by Cal-EPA and USEPA and include separate child and adult exposure parameters that are used in an integrated child/adult exposure scenario consistent with guidance.

3.1 Fate and Transport Modeling

Fate and transport modeling was employed to predict the movement of COCs from impacted soil and soil vapor to points of exposure for human populations. Fate and transport modeling was employed to develop transfer factors for the following transport mechanisms:

- Transport of particulate-phase chemicals from soil matrix to outdoor air;
- Transport of vapor-phase chemicals from soil matrix to outdoor air;
- Transport of vapor-phase chemicals from soil vapor to outdoor air; and
- Transport of vapor-phase chemicals from sub-slab soil vapor to indoor air.

Fate and transport modeling for migration from soil to outdoor air was conducted using the models presented in the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (Soil Screening Guidance) (USEPA, 2002). Standard equations presented in the Soil Screening Guidance were used, incorporating local meteorological conditions for the Los Angeles area, for derivation of COC-specific volatilization factors (VFs) and the particulate emission factor (PEF). The definitions for each of the transfer factors listed above are presented in **Table A-2**. Calculations for the VF and PEF are summarized in **Table A-3a** for a resident and in **Table A-3b** for a construction and utility maintenance worker, and are discussed below. Additional details regarding these transfer factors were discussed in the HHSE Work Plan (Geosyntec, 2009; 2010). Fate and transport modeling for leaching to groundwater is discussed in Section 5.3 of this Appendix.

3.1.1 Fugitive Dust Emissions into Outdoor Air

COCs at the Site may become airborne due to fugitive dust emissions. Compounds (e.g., SVOCs) can adhere to soil particles then become airborne due to wind erosion, which could generate dust containing COCs. Exposure to these chemicals may then occur via inhalation of airborne fugitive dust. Inhalation exposure to non-volatile compounds is typically minor in fugitive dust when compared to direct ingestion exposure (USEPA, 2002). Nevertheless, a relationship can be estimated between the COC concentration in soil and the corresponding concentration in air (secondary media) attributable to fugitive dust emissions from soil.

Potential exposure to airborne dust is estimated using a particulate emission factor (PEF) that relates the concentration of soil constituents to the concentration of dust particles in air. The PEF represents an annual average emission rate based on wind erosion. The PEF equation described in the Soil Screening Guidance (USEPA, 2002) was used in this evaluation. The emissions part of the PEF equation is based on the “unlimited reservoir” model developed to estimate PM_{10} emissions (particulate matter less than 10 micrometers in diameter [PM_{10}]) due to wind erosion (Cowherd et al., 1985).

3.1.1.1 Onsite Residential Scenario

For onsite residents, the following equation was used to estimate their PEF:

$$PEF = \frac{(Q/C \times CF)}{[0.036 \times (1 - G) \times \left(\frac{U_M}{U_T}\right)^3 \times F_x]}$$

Where:

PEF	=	particulate emission factor as cubic meters per kilogram (m^3/kg)
Q/C	=	inverse of mean concentration at center of source (g/m^2-s per kg/m^3)
CF	=	units conversion factor (3600 s/hr)
0.036	=	respirable fraction (g/m^2-hr)
G	=	fraction of vegetative or other cover (0.5 unitless; USEPA, 2002)
U_M	=	mean annual wind speed (3.31 m/s, average for Los Angeles; NCDC, 2011)
U_T	=	equivalent threshold value of wind speed at 7 meters above ground surface (11.32 m/s; USEPA, 2002)

F_x = function dependent on U_M/U_T (0.00474 unitless; USEPA, 1996)

The dispersion part of the PEF equation includes a dispersion coefficient (Q/C) in units of grams per square meter-second per kilogram per cubic meter (g/m^2-s per kg/m^3). The Q/C term was generated using the Industrial Source Complex model and varies depending on the source area, city, and climatic zone. This term accounts for the dispersion of particulate matter, once emitted and was estimated using the following equation (USEPA, 2002):

$$(Q/C) = A \times \exp\left[\frac{(\ln A_{SITE} - B)^2}{C}\right]$$

Where:

A_{SITE} = areal extent of soil impact (0.5 acres)

A = constant = 11.911, based on air dispersion modeling (USEPA, 2002)

B = constant = 18.4385 (USEPA, 2002)

C = constant = 209.7845 (USEPA, 2002)

The coefficients A, B, and C for the Los Angeles area are published in the Soil Screening Guidance (USEPA, 2002). A Q/C value of 68.18 g/m^2-s per kg/m^3 was estimated as the inverse of the mean concentration at the center of a 0.5-acre source. The resulting PEF for onsite residents was estimated at $1.2\times10^{+11}$ m^3/kg (see **Table A-3a**).

3.1.1.2 Construction and Utility Maintenance Worker Scenario

Existing utilities that supply the residential properties with water, communications, and natural gas, and sewer lines are present at the Site. Therefore, a construction and utility maintenance worker may contact soils during repair or maintenance of these utilities both on residential properties as well as in the streets. It is assumed that construction and utility workers may be exposed to COCs in the upper 10 feet of soil. Fugitive dust can also be generated during the use of heavy equipment such as backhoes during utility work in trenches. As a conservative exposure assumption, a dust concentration equal to 1 mg/m^3 or 1×10^{-6} kg/m^3 (Cal-EPA, 2011a)[2] was assumed for the construction and utility maintenance worker. The PEF is related to the concentration of particulate matter (dust) in air:

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[2] The respirable dust concentration of 1 mg/m^3 is based on a maximum concentration of dust in air of 10 mg/m^3 recommended by the American Conference of Governmental Industrial Hygienists (ACGIH 2004, Threshold Limit Values and Biological Exposure Indices), and the assumption that 10 percent of the mass of particles are in the respirable PM_{10} range.

$$PEF = \frac{1}{CD}$$

Where:

CD = concentration of dust in air, 1×10^{-6} (kg/m^3) (Cal-EPA, 2011a)

The resulting PEF for the construction and utility maintenance worker is $1\times10^{+6}$ m^3/kg (see **Table A-3b**).

3.1.2 Vapor Emissions into Outdoor Air

Because VOCs were detected in soil and soil vapor at the Site, individuals could potentially be exposed to vapors migrating through the soil to the surface. Outdoor vapor concentrations are typically negligible considering the significant quantity of ambient air diluting the vapor emissions. Although this pathway is considered potentially insignificant, outdoor air exposures were evaluated for VOCs detected in soil matrix and soil vapor as discussed below.

3.1.2.1 Onsite Residential Scenario

Soil to Outdoor Air

For onsite residents, potential migration of vapors from shallow soil to outdoor air was estimated using the following VF equation, as presented in Section 4.2.3 of the Soil Screening Guidance (USEPA, 2002; Equation 4-8: *Derivation of the VF*):

$$VF_{soil} = Q/C \times \left(10^{-4}\ \frac{m^2}{cm^2}\right) \times \frac{\left(3.14 \times D_A \times T_{resident}\right)^{1/2}}{2 \times P_b \times D_A}$$

The equation for the COC-specific apparent diffusivity, D_A, is as follows:

$$D_A = \frac{\left(\theta_a^{\ 3.33} \times D_{air} \times H' + \theta_w^{\ 3.33} \times D_{water}\right) / \theta_T^{\ 2}}{P_b \times K_d + \theta_w + \theta_a \times H'}$$

Where:

D_{air} = COC-specific diffusivity in air (cm^2/s);
D_{water} = COC-specific diffusivity in water (cm^2/s);
θ_a = air-filled porosity (0.28 cm^3-air/cm^3-soil);
θ_w = water-filled porosity (0.15 cm^3-water/cm^3-soil);
θ_T = total soil porosity (0.43 cm^3-air/cm^3-soil);
H' = COC-specific Henry’s law coefficient (unitless);

P_b	=	soil bulk density (1.5 g/cm^3);
K_{oc}	=	COC-specific soil organic carbon partition coefficient (cm^3/g); and
f_{oc}	=	fraction organic carbon in soil (0.006 g/g).

To be consistent with the other SSCG calculations presented in this report, the equations presented below were used. The equation for the COC-specific effective diffusion coefficients for vadose-zone soils, D_{eff} (ASTM, 2004) is as follows:

$$D_{eff} = \frac{\left[\theta_a^{3.33} \times D_{air} \times H' + \theta_w^{3.33} \times D_{water}\right]}{\theta_T^{2}}$$

Where:

D_{air}	=	COC-specific diffusivity in air (cm^2/s);
D_{water}	=	COC-specific diffusivity in water (cm^2/s);
θ_a	=	air-filled porosity (0.28 cm^3-air/cm^3-soil);
θ_w	=	water-filled porosity (0.15 cm^3-water/cm^3-soil);
θ_T	=	total soil porosity (0.43 cm^3-air/cm^3-soil); and
H'	=	COC-specific Henry's law coefficient (unitless).

The equation for the soil to water partition coefficient, K_{sw} (ASTM, 2004) is as follows:

$$K_{sw} = \frac{\theta_a \times H' + \theta_w + Pb \times K_d}{Pb}$$

Where:

θ_a	=	air-filled porosity (0.28 cm^3-air/cm^3-soil);
H'	=	COC-specific Henry's law coefficient (unitless);
θ_w	=	water-filled porosity (0.15 cm^3-water/cm^3-soil);
Pb	=	soil bulk density (1.5 g/cm^3); and
K_d	=	soil-organic carbon distribution coefficient (where K_d = fraction organic carbon [f_{oc}] × organic carbon partition coefficient [K_{oc}]) (cm^3/g).

Substituting the equations for D_{eff} and K_{sw} into the apparent diffusivity D_A equation yields the following:

$$D_A = \frac{D_{eff} \times H'}{K_{sw} \times Pb}$$

Substituting this equation for D_A into the VF_{soil} equation presented above yields the following:

$$VF_{soil} = Q/C \times \left(10^{-4}\ \frac{m^2}{cm^2}\right) \times \frac{\left(3.14 \times \frac{D_{eff} \times H'}{K_{sw} \times Pb} \times T_{resident}\right)^{1/2}}{2 \times P_b \times \frac{D_{eff} \times H'}{K_{sw} \times Pb}}$$

$$VF_{soil} = Q/C \times \left(10^{-4}\ \frac{m^2}{cm^2}\right) \times \frac{1}{P_b} \left[\frac{3.14 \times \frac{D_{eff} \times H'}{K_{sw} \times Pb} \times T_{resident}}{4 \times \left(\frac{D_{eff} \times H'}{K_{sw} \times Pb}\right)^2}\right]^{1/2}$$

$$VF_{soil} = Q/C \times \left(10^{-4}\ \frac{m^2}{cm^2}\right) \times \frac{1}{P_b} \left[\frac{3.14 \times T_{resident}}{4 \times \left(\frac{D_{eff} \times H'}{K_{sw} \times Pb}\right)}\right]^{1/2}$$

$$VF_{soil} = Q/C \times \left(10^{-4}\ \frac{m^2}{cm^2}\right) \times \left(\frac{1}{P_b}\right) \left(\frac{3.14 \times T_{resident} \times K_{sw} \times P_b}{4 \times D_{eff} \times H'}\right)^{1/2}$$

This final equation was used to estimate the COC-specific VF_{soil} for onsite residential exposures, where:

Q/C	=	inverse of mean concentration at center of source (g/m^2-sec per kg/m^3);
$T_{resident}$	=	exposure interval ($9.5\times10^{+8}$ sec = 30 years);
K_{sw}	=	soil to water partition coefficient, defined above (cm^3-water/g-soil);
Pb	=	dry soil bulk density (1.5 g/cm^3);
D_{eff}	=	COC-specific effective diffusion coefficient for vadose-zone soils, defined above (cm^2/sec); and
H'	=	COC-specific Henry's law coefficient (unitless).

A Q/C value of 68.18 g/m^2-s per kg/m^3 was estimated using the equations presented in Section 3.1.1.2 above.

The derivation of COC-specific VF_{soil} for onsite residents is presented in **Table A-3a**.

3.1.2.2 Onsite Construction and Utility Maintenance Worker Scenarios

Soil to Outdoor Air

For the construction and utility maintenance worker scenario, VOC emissions into a utility trench and subsequent mixing in air were estimated using the volatilization factor (VF) for transport of COCs from soil to outdoor air from the ASTM *Standard Guide For Provisional Risk-Based Corrective Action* (ASTM, 2004). The soil to outdoor air volatilization factor, $VF_{soil\text{-}OA}$, is the ratio of the outdoor air exposure point concentration ($EPC_{soil\text{-}OA}$) to the soil exposure point concentration (EPC_{soil}):

$$VF_{soil\text{-}OA} = \frac{EPC_{soil}}{EPC_{soil\text{-}OA}}$$

The COC-specific $VF_{soil\text{-}OA}$ for construction and utility maintenance worker exposures was derived using the following equation (ASTM, 2004):

$$VF_{soil\text{-}OA} = \frac{DF_{amb}}{Pb} \times \left[\frac{(3.14 \times T_{CUW} \times K_{sw} \times Pb)}{(4 \times D_{eff} \times H')} \right]^{1/2} \times CF_1 \times CF_2$$

Where:

$VF_{soil\text{-}OA}$	=	volatilization factor, surficial soils to outdoor (ambient) air (m^3-air/kg-soil);
DF_{amb}	=	dispersion factor for outdoor (ambient) air (cm/s);
Pb	=	dry soil bulk density (1.5 g/cm^3);
T_{CUW}	=	averaging time for surface emission vapor flux ($7.9\times10^{+8}$ sec);
K_{sw}	=	soil to water partition coefficient (cm^3-water/g-soil);
D_{eff}	=	COC-specific effective diffusion coefficient for vadose-zone soils (cm^2/sec);
H'	=	COC-specific Henry's law coefficient (unitless);
CF_1	=	conversion factor ($1\times10^{+3}$ g/kg); and
CF_2	=	conversion factor (1×10^{-6} m^3/cm^3).

The following equation was used to estimate the dispersion factor for outdoor air, DF_{amb}, assuming a trench is 91 centimeters (cm) wide by 457 cm long by 183 cm deep. These dimensions are an estimate of what a typical trench size could be:

$$DF_{amb} = \frac{U_{air} \times W \times H}{A}$$

Where:

U_{air}	=	outdoor air velocity in mixing zone (cm/s);
W	=	width of source-zone area (457 cm; assume length of trench = 15 ft);
H	=	mixing zone height (183 cm; assume depth of trench = 6 ft); and
A	=	source-zone area (assume 4 sidewalls and bottom area of trench = $2.4\times10^{+5}$cm^2).

The outdoor air velocity in the mixing zone, U_{air}, is estimated using the following equation:

$$U_{air} = \frac{ACH \times W_t}{3600}$$

Where:

ACH	=	air changes per hour (20 hr^{-1});
W_t	=	length of shortest side of trench (91 cm; assume width of trench = 3 ft); and
3600	=	conversion (1 hour = 3600 seconds).

To develop the air exchange rate, a site-specific computational fluid dynamic (CFD) model was constructed to model air flow within the trench as defined above. CFD models have been used to evaluate air dispersion within urban canyon environments and can provide a more refined evaluation of potential air exchange within a trench. Using the CFD model (Ansys, 2011), air flow was calculated using the geometry of the trench and a conservative (i.e. results in higher trench air concentrations) reference velocity of 1.3 m/s which is the lowest monthly average wind speed reported for Long Beach from the last several years (January 2009 to April 2011) (NCDC, 2011) at a height of 10 m. The CFD model was used to monitor the decrease in concentration of a tracer uniformly distributed in the trench. The model assumed an initial concentration of 1 in the trench and zero within the atmosphere. Convection and diffusion of the tracer out of the trench was evaluated, and the reduction in the concentration in the trench over time was calculated.

The ACH was calculated following the calculation methods presented for the air exchange rate from ASTM (2011):

$$ACH = -\frac{\left[\ln(Ct_2) - \ln(Ct_1)\right]}{t_2 - t_1}$$

where:

ACH	=	air exchange rate per hour (hr^{-1})
C_{t2}	=	final tracer concentration at time 2

Ct_1	=	initial tracer concentration at time 1
t_2 - t_1	=	time interval of simulation (hr)

An ACH of approximately 20 hr^{-1} was calculated for the trench. Derivation of the COC-specific $VF_{soil\text{-}OA}$ for the construction and utility maintenance worker is presented in **Table A-3a**.

Soil Vapor to Outdoor Air

The conceptual exposure scenario for the construction and utility maintenance worker receptor is the same as that considered for the soil to outdoor air scenario – exposure during excavation. The volatilization factor for soil vapor to a trench was calculated using the same relationships as those used for soil, except a soil vapor source term was used. This section details the methodology for deriving the volatilization factor for the soil vapor to outdoor air pathway. The soil vapor to outdoor air $VF_{SV\text{-}OA}$ represents the ratio of the outdoor air exposure point concentration ($EPC_{SV\text{-}OA}$) to the soil vapor exposure point concentration (EPC_{SV}) presented in the equation below:

$$VF_{SV\text{-}OA} = \frac{EPC_{SV}}{EPC_{SV\text{-}OA}}$$

Where:

$VF_{SV\text{-}OA}$	=	soil vapor to outdoor air volatilization factor (mg/m^3 soil vapor per mg/m^3outdoor air);
$EPC_{SV\text{-}OA}$	=	exposure point concentration of COC in outdoor air from soil vapor (mg/m^3); and
EPC_{SV}	=	exposure point concentration, soil vapor (mg/m^3).

This section presents the approach used to model vapor migration from the subsurface (using soil vapor data) to outdoor air within a utility trench where workers could potentially be exposed via inhalation. The soil vapor exposure point concentration, EPC_{SV}, was calculated from soil exposure point concentration, EPC_{soil}, using the following partitioning relationship proposed by Feenstra et al. (1991):

$$EPC_{SV} = EPC_{soil} \times \frac{H'}{K_{sw}} \times CF_1 \times CF_2$$

Where:

EPC_{SV}	=	COC concentration in soil vapor (mg/m^3);
EPC_{soil}	=	COC concentration in soil (mg/kg);
H'	=	COC-specific Henry's law coefficient (unitless);

K_{sw} = soil to water partition coefficient, defined above (cm^3-water/g-soil);
CF_1 = conversion factor (1×10^{-3} kg/g); and
CF_2 = conversion factor ($1\times10^{+6}$ cm^3/m^3).

The outdoor air concentrations of vapors from soil for a construction and utility maintenance worker can be estimated using the following relationship:

$$EPC_{OA} = \frac{EPC_{soil}}{VF_{soil\text{-}OA}}$$

Where:

EPC_{OA} = COC concentration in outdoor air (mg/m^3) (either from soil or from soil vapor);
EPC_{soil} = COC concentration in soil (mg/kg); and
$VF_{soil\text{-}OA}$ = volatilization factor, surficial soils to outdoor (ambient) air (m^3-air/kg-soil).

Rearranging these two equations results in the following:

$$EPC_{OA} = \frac{EPC_{soil}}{VF_{soil\text{-}OA}} = \frac{EPC_{SV}}{VF_{soil\text{-}OA}} \times \frac{K_{sw}}{H'} \times \left(\frac{1}{CF_1 \times CF_2}\right)$$

This equation was then rearranged to calculate the ratio of $EPC_{SV\text{-}OA}$ and EPC_{SV} and provide the equation for the soil vapor to outdoor air volatilization factor, $VF_{SV\text{-}OA}$, for a construction and utility maintenance worker:

$$VF_{SV\text{-}OA} = \frac{EPC_{SV}}{EPC_{SV\text{-}OA}} = VF_{soil\text{-}OA} \times \frac{H'}{K_{sw}} \times (CF_1 \times CF_2)$$

Where:

$VF_{SV\text{-}OA}$ = soil vapor to outdoor air volatilization factor ($\mu g/m^3$ per $\mu g/m^3$);
$EPC_{SV\text{-}OA}$ = exposure point concentration of COC in outdoor air from soil vapor ($\mu g/m^3$); and
EPC_{SV} = exposure point concentration, soil vapor ($\mu g/m^3$).

Derivation of the COC-specific $VF_{SV\text{-}OA}$ for the construction and utility maintenance worker is presented in **Table A-3b**.

3.1.3 Vapor Emissions into Indoor Air

Because VOCs were detected in sub-slab soil vapor at the Site, onsite residents could potentially be exposed to vapors migrating from the subsurface into indoor air. To investigate the relationship between indoor air and sub-slab soil vapor concentrations, a single regression analysis method was applied to the Site data as described in Appendix B of the main SSCG report. This analysis evaluated the relationship between indoor air concentrations and sub-slab soil vapor concentrations for a filtered dataset of sub-slab soil vapor data with concentrations ≥100 μg/m3. Based on the analysis, an upper-bound vapor intrusion attenuation factor of 0.001 was identified. This conservative upper-bound vapor intrusion attenuation factor was used to derive sub-slab soil vapor SSCGs described in Section 5.1 below.

4.0 TOXICITY ASSESSMENT

The toxicity assessment characterizes the relationship between the magnitude of exposure to a COC and the nature and magnitude of adverse health effects that may result from such exposure. Consistent with regulatory risk assessment policy, adverse health effects resulting from potential chemical exposures are classified into two broad categories: carcinogens and noncarcinogens. Toxicity criteria are generally developed based on the threshold approach for noncarcinogenic effects and the non-threshold approach for carcinogenic effects.

For carcinogens, it is assumed that there is no level of exposure that does not have a finite possibility of causing cancer (i.e., there is no threshold dose for carcinogenic effects). That is, a single exposure of a carcinogen may, at any level, result in an increased probability of developing cancer. For chemicals exhibiting noncarcinogenic effects, it is believed that organisms have protective mechanisms that must be overcome before the toxic endpoint results (i.e., there is a threshold dose for these effects). For example, if a large number of cells perform the same or similar functions, it would be necessary for significant damage or depletion of these cells to occur before a toxic effect could be seen. As a result, a range of exposures exists from zero to some finite value that can be tolerated by the organism with essentially no chance of expression of adverse effects (USEPA, 1989). Some chemicals may elicit both carcinogenic and noncarcinogenic effects.

The key dose-response criteria are (i) cancer slope factors (CSFs) or inhalation unit risk factors (IURs) for estimating cancer risks from exposure to carcinogens; and (ii) reference doses (RfDs) or inhalation reference concentrations (RfCs) for estimating hazard from exposure to noncarcinogens. In addition, Cal-EPA Office of Environmental Health Hazard Assessment (OEHHA; Cal-EPA 2013) has developed chronic Reference Exposure Levels (RELs) for noncarcinogenic effects from inhalation exposures. For developing SSCGs, cancer toxicity criteria (except for trichloroethene [TCE] as discussed below) were selected from the following sources, in order of preference:

1) Cal-EPA OEHHA Toxicity Criteria Database, online (Cal-EPA, 2013);
2) USEPA's (2013a) Integrated Risk Information System (IRIS);
3) USEPA RSLs for Chemical Contaminants at Superfund Sites (USEPA, 2013b);
4) USEPA National Center of Environmental Assessment (USEPA, 2013b);
5) Agency for Toxic Substances Disease Registry (as reported in USEPA, 2013b); and
6) Health Effects Assessment Summary Tables (as reported in USEPA, 2013b).

The noncancer toxicity criteria were selected from the following sources, in order of preference:

1) USEPA's (2013a) IRIS database; and
2) Cal-EPA OEHHA Toxicity Criteria Database online (Cal-EPA, 2013).

For TCE, the USEPA inhalation IUR of 4.1×10^{-6} $(\mu g/m^3)^{-1}$ and oral CSF of 4.6×10^{-2} (mg/kg-day)$^{-1}$ were used for derivation of SSCGs, which are consistent with the most recent USEPA published toxicity values for TCE (USEPA, 2011). Moreover, because TCE is considered carcinogenic by a mutagenic mode of action for kidney effects, separate cancer risk equations are presented for mutagens as outlined in the USEPA RSL User's Guide (USEPA, 2013c). These equations were used for TCE for the residential scenario.

At the present time, Cal-EPA and USEPA have only developed toxicity criteria for the oral and inhalation routes of exposure. As recommended by Cal-EPA and USEPA, in the absence of values specific to the dermal route, the oral toxicity criteria were used to evaluate dermal exposures. In addition, route-to-route extrapolation between ingestion and inhalation routes of exposure was used for those chemicals for which toxicity criteria are extrapolated in the USEPA Region 9 Preliminary Remedial Goal (PRG) table (USEPA, 2004a). This can be considered a conservative approach as current USEPA RSL guidance (USEPA, 2013b) does not include the route-to-route extrapolation. For some of the COCs, neither Cal-EPA nor USEPA have identified a toxicity value. In these cases, a surrogate chemical approach was employed in which the toxicity value developed for a structurally similar compound was assigned to the COC which is lacking the toxicity value (e.g., hexane for heptane).

Toxicity values for TPH have not been published by Cal-EPA OEHHA or USEPA. Toxicity factors for TPH have been suggested by Cal-EPA Department of Toxic Substances Control (Cal-EPA, 2009a). Even though these toxicity factors for TPH have not gone through the same level of peer review as the other toxicity factor references used for the other COCs, the toxicity factors presented in Cal-EPA DTSC TPH guidance were used for TPH SSCGs. These values were presented in a letter from Geosyntec dated August 15, 2011 describing the derivation of RBSLs for TPH (TPH RBSL Letter; Geosyntec, 2011), which was approved by the LARWQCB on November 14, 2011.

The traditional RfD approach to the evaluation of chemicals is not applied to lead because most adverse human health effects data associated with exposure to lead have been correlated with concentrations of lead in blood and not with intake of lead by an individual (Cal-EPA, 1996). In the absence of RfDs, Cal-EPA uses a 1 microgram per deciliter (µg/dL) benchmark for source-specific incremental change in blood lead levels for protection of children and fetuses (Cal-EPA, 2007) as the revised health criterion for lead. This benchmark is the estimated incremental increase in a child's blood lead level that would reduce their IQ by up to 1 point. Based on this revised benchmark of 1 µg/dL, Cal-EPA has recommended a revised residential California Human Health Screening Level (CHHSL) of 80 mg/kg.

For the resident potentially exposed to deeper soils for a limited time and the construction and utility maintenance worker, the SSCGs were calculated using the CHHSL methodology for residential and industrial/commercial worker adjusted for exposure frequency and ingestion rate using the Adult Lead Model (ALM) as recommended by Cal-EPA. According to USEPA's 2003 guidance *Assessing Intermittent or Variable Exposures at Lead Sites* and supporting documentation for the ALM, a minimum exposure frequency and exposure duration of 1 day per week for 3 months should be used to account for the model's steady-state assumption. In addition, a central tendency ingestion rate value of 100 mg/day is recommended for construction workers. Therefore, these input parameters were used for adult lead exposures. For the residential exposure it was assumed that an adult resident would be the most likely individual to contact deeper soils while conducting activities such as planting a tree.

A summary of the cancer and noncancer toxicity criteria for the COCs is presented in **Table A-4**.

5.0 SITE-SPECIFIC CLEANUP GOALS

This section presents the methodology that was used to derive SSCGs for onsite residents and for the construction and utility maintenance worker that may be present at the Site and have the potential to be exposed to residual chemicals present in soil and soil vapor.

5.1 Risk-based SSCG Methodology

Deriving risk-based SSCGs for COCs in soil, sub-slab soil vapor, and soil vapor requires information regarding the level of human intake of the COC (exposure assessment), the relationship between intake of the chemical and its toxicity (toxicity assessment), and the acceptable target risk. The sections below present the equations that were used in the development of the SSCGs for soil, sub-slab soil vapor, and soil vapor. The methodology that was used to derive SSCGs is based principally on guidelines provided by the USEPA in *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual*

(Part A), Interim Final (USEPA, 1989) and in the *Soil Screening Guidance* (USEPA, 2002) and by the DTSC in *Preliminary Endangerment Assessment Guidance Manual* and in *Recommended DTSC Default Exposure Factors For Use In Risk Assessment At California Military Facilities* (Cal-EPA, 1999 and 2011a).

Various demarcations of acceptable risk have been established by regulatory agencies. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 CFR 300) indicates that lifetime incremental cancer risks posed by a site should not exceed a range of one in one million (1×10^{-6}) to one hundred in one million (1×10^{-4}) and noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a Hazard Index [HI] greater than 1). In addition, other relevant guidance (USEPA, 1991b) states that sites posing a cumulative cancer risk of less than 10^{-4} and hazard indices less than unity (1) for noncancer endpoints are generally not considered to pose a significant risk warranting remediation. The California Hazardous Substances Account Act (HSAA) incorporates the NCP by reference, and thus also incorporates the acceptable risk range set forth in the NCP. The Safe Drinking Water and Toxic Enforcement Act of 1986 (California Proposition 65) regulates chemical exposures to the general population and is based on an acceptable risk level of 1×10^{-5}. The DTSC considers the 1×10^{-6} risk level as the generally accepted point of departure for unrestricted land use.

Under most situations, cancer risks in the range of 1×10^{-6} to 1×10^{-4} may be considered to be acceptable with cancer risks less than 10^{-6} considered insignificant. The risk range between 10^{-6} and 10^{-4} is commonly called the "discretionary risk range." This risk range is in addition to the background risk of Americans in the general population developing cancer from causes unrelated to a Site-specific exposure. The background risk is one chance in three (0.3 or 3×10^{-1}) for an American female, and one chance in two (0.5 or 5×10^{-1}) for an American male of eventually developing cancer (ACS, 2013).

A target cancer risk level of 1×10^{-6} was used to derive SSCGs for onsite residents. For the construction and utility maintenance worker, the SSCGs were derived using a target cancer risk level of 1×10^{-5} (the "mid-point" of the risk management range and commonly used for managing commercial/industrial land uses). A target HI of 1 was used for noncarcinogens for all exposure scenarios. These risk levels are used to provide context to the risk results and to support the following discussion which focuses on those pathways and chemicals that contribute the majority to the risk estimates. It is acknowledged that additional risk management considerations such as technical feasibility, economic, social, political, and legal factors may be part of the final risk management decision. The results of the risk characterization are really the starting point for risk management considerations for a site (USEPA, 1995).

5.1.1 SSCGs Based on Cancer Health Effects

The SSCG equations below describe the established relationship between estimated intake, toxicity, and potential risk for cancer health effects (USEPA, 1989).

For COCs in soil:

$$SSCG_{soil\text{-}c} = \frac{TR}{(CSF_{oral}) \times (IF_{oral} + IF_{dermal}) + (IUR) \times (EC_{inh,soil})}$$

For COCs in soil vapor for the construction and utility maintenance worker:

$$SSCG_{sv\text{-}c} = \frac{TR}{(IUR) \times (EC_{SV\text{-}OA})}$$

For COCs in sub-slab soil vapor for the onsite resident:

$$SSCG_{ss\text{-}sv\text{-}c} = \frac{TR}{(IUR) \times (EC_{SS\text{-}SV\text{-}IA})}$$

Where:

$SSCG_{soil\text{-}c}$	=	Site-specific cleanup goal for soil based on cancer effects (mg/kg);
TR	=	target cancer risk level (unitless);
CSF_{oral}	=	cancer slope factor for oral (ingestion and dermal contact) exposures $(mg/kg \cdot d)^{-1}$;
IF_{oral}	=	intake factor for ingestion (kg soil per kg body weight per day);
IF_{dermal}	=	intake factor for dermal contact (kg soil per kg body weight per day);
IUR	=	inhalation unit risk factor $(\mu g/m^3)^{-1}$;
$EC_{inh,soil}$	=	exposure concentration for inhalation of COCs from soil (mg/m^3 per mg/kg);
$SSCG_{sv\text{-}c}$	=	Site-specific cleanup goal for soil vapor to outdoor air based on cancer effects (mg/m^3);
$EC_{SV\text{-}OA}$	=	exposure concentration for outdoor inhalation (mg/m^3 per mg/m^3);
$SSCG_{ss\text{-}sv\text{-}c}$	=	Site-specific cleanup goal for sub-slab soil vapor to indoor air based on cancer effects (mg/m^3); and
$EC_{SS\text{-}SV\text{-}IA}$	=	exposure concentration for indoor inhalation (mg/m^3 per mg/m^3).

The formulas for developing the soil intake factors for ingestion and dermal contact, as well as for developing the exposure concentrations for soil, sub-slab soil vapor, and soil vapor are presented in **Tables A-5** through **A-9**. The exposure parameters that were used to estimate the intake factors and exposure concentrations are presented in **Table A-1**. The SSCGs for soil and sub-slab soil vapor are presented in **Tables A-10** and **A-11**, respectively, for the onsite resident. The SSCGs for soil and soil vapor are presented in **Tables A-12** and **A-13**, respectively, for the construction and utility maintenance worker. SSCG calculations are presented in **Attachment A1**.

5.1.2 SSCGs Based on Noncancer Health Effects

The SSCG equations below describe the established relationship between estimated intake, toxicity, and risk for noncancer health effects (USEPA, 1989).

For COCs in soil:

$$SSCG_{soil\text{-}nc} = \frac{THI}{\left(\frac{IF_{oral}}{RfD_{oral}}\right) + \left(\frac{IF_{dermal}}{RfD_{oral}}\right) + \left(\frac{EC_{inh,soil}}{RfC}\right)}$$

For COCs in soil vapor for the construction and utility maintenance worker:

$$SSCG_{sv\text{-}c} = \frac{THI}{\left(\frac{EC_{SV\text{-}OA}}{RfC}\right)}$$

For COCs in sub-slab soil vapor for the onsite resident:

$$SSCG_{ss\text{-}sv\text{-}nc} = \frac{TR}{(IUR) \times (EC_{SS\text{-}SV\text{-}IA})}$$

Where:

$SSCG_{soil\text{-}nc}$ = Site-specific cleanup goal for soil based on noncancer effects (mg/kg);

THI = target noncancer hazard index (unitless);

IF_{oral} = intake factor for ingestion (kg soil per kg body weight per day);

RfD_{oral} = noncancer reference dose for oral (ingestion and direct-contact) exposures (mg/kg·d);

IF_{dermal} = intake factor for dermal contact (kg soil per kg body weight per day);

$EC_{inh,soil}$ = exposure concentration for inhalation of COCs from soil (mg/m^3 per mg/kg from soil);

RfC = noncancer reference concentration for inhalation exposure (mg/m^3);

$SSCG_{sv\text{-}nc}$ = Site-specific cleanup goal for soil vapor to outdoor air based on noncancer effects (mg/m^3);

$EC_{SV\text{-}OA}$	=	exposure concentration for outdoor inhalation of COCs (mg/m^3 soil vapor per mg/m^3 outdoor air);
$SSCG_{ss\text{-}sv\text{-}nc}$	=	Site-specific cleanup goal for sub-slab soil vapor to indoor air based on noncancer effects (mg/m^3); and
$EC_{SS\text{-}SV\text{-}IA}$	=	exposure concentration for indoor inhalation (mg/m^3 per mg/m^3).

The formulas for developing the soil intake factors for ingestion and dermal contact, as well as for developing the exposure concentrations for soil, sub-slab soil vapor, and soil vapor are presented in **Tables A-5** through **A-9**. The exposure parameters that were used to estimate the intake factors and exposure concentrations are presented in **Table A-1**. The SSCGs for soil and sub-slab soil vapor are presented in **Tables A-10** and **A-11**, respectively, for the onsite resident. The SSCGs for soil and soil vapor are presented in **Tables A-12** and **A-13**, respectively, for the construction and utility maintenance worker. SSCG calculations are presented in **Attachment A1**.

5.1.3 TPH Fraction-Specific SSCGs

TPH compounds include a wide range of chemicals that are found in crude oils, petroleum products, and other petroleum-related materials. Because TPH mixtures can encompass a large range of hydrocarbons, chemical properties and environmental behavior vary widely among the many hundreds of compounds present in these mixtures. Methods to evaluate potential risks associated with TPH analytical results have been published in state and national working group guidance documents including the DTSC (Cal-EPA, 2009a), the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG, 1997ab; 1998ab; 1999), and Massachusetts Department of Environmental Protection (MADEP, 2002; 2003). Approaches presented in these documents were used to develop SSCGs for comparison to TPH data collected at the Site.

TPH may refer to a variety of products or wastes, but for the soil samples collected at the Site and analyzed by USEPA Method 8015B (M)[3], analytical results are grouped into three product ranges according to the number of carbon chain atoms:

[3] Results from USEPA Method 8015B (M) are equivalent to USEPA Method 8015C for TPH analysis.

TPH Product Range	Carbon Chain Range
$TPH_{gasoline}$ (TPH_g)	$C_4 – C_{12}$
TPH_{diesel}, (TPH_d)	$C_{10} – C_{22}$
$TPH_{motor\ oil}$ (TPH_{mo})	$C_{17} – C_{44}$

TPH product range concentrations reported (i.e., TPH_g, TPH_d or TPH_{mo}) do not necessarily indicate the presence of gasoline, diesel, or motor oil, only that there are hydrocarbons present that fall in those specific carbon-chain length ranges. In addition, there is some variability in the carbon chain range reported by the analytical laboratories.

For each of the carbon chain ranges, two different types of compounds or fractions may be present: aliphatic or aromatic. Therefore, TPH fractionation analysis was performed on soil and soil vapor samples to refine the TPH characterization. In the TPH fractionation analysis, aliphatic and aromatic fractions are quantified consistent with the Cal-EPA Interim TPH Guidance (Cal-EPA, 2009a). These TPH fractions are:

TPH Product Range	Aliphatic Fraction	Aromatic Fraction
Light	$C_5 – C_8$	$C_6 – C_8$
Medium	$C_9 – C_{18}$	$C_9 – C_{16}$
Heavy	$C_{19} – C_{32}$	$C_{17} – C_{32}$

Both types of analyses (i.e., product range analysis and fractionation analysis) have been conducted at the Site, and the TPH fractionation analytical results are used in the derivation of SSCGs for product-range TPH results as described in later sections.

The fraction-specific SSCGs for soil, sub-slab soil vapor, and soil vapor are presented below:

TPH Fractions	Onsite Resident			Construction and Utility Maintenance Worker	
	Soil SSCG (EF350) (mg/kg)	Soil SSCG (EF4) (mg/kg)	Sub-Slab Soil Vapor SSCG ($\mu g/m^3$)	Soil SSCG (mg/kg)	Soil Vapor SSCG ($\mu g/m^3$)
Aliphatic: C_5-C_8	7.1E+02	6.2E+04	7.3E+05	8.3E+02	1.2E+09
Aliphatic: C_9-C_{18}	1.4E+03	1.3E+05	3.1E+05	1.6E+03	1.2E+08
Aliphatic: C_{19}-C_{32}	1.1E+05	1.0E+07	--	5.5E+06	--
Aromatic: C_6-C_8	--	--	--	--	--
Aromatic: C_9-C_{16}	6.0E+02	5.3E+04	5.2E+04	7.5E+02	6.7E+06
Aromatic: C_{17}-C_{32}	1.7E+03	1.5E+05	--	8.3E+04	--

Notes:

- EF: exposure frequency; 350 days/year for a typical resident and 4 days/year for a resident who infrequently contacts subsurface soils.
- " – " not calculated
- SSCGs for the C_6-C_8 aromatic fraction are not calculated because individual constituents in this fraction (i.e., benzene, toluene, ethylbenzene) were analyzed.
- Sub-slab soil vapor and soil vapor SSCGs for the C_{19}-C_{32} aliphatic and C_{17}-C_{32} aromatic fractions are not calculated because the volatility of these fractions are low and no RfC is available for these fractions.

5.1.4 SSCGs for TPH Product Ranges

Fraction-specific soil, sub-slab soil vapor, and soil vapor SSCGs for the different TPH fraction ranges presented above are used to derive soil, sub-slab soil vapor, and soil vapor SSCGs for TPH product ranges: TPH gasoline (TPH_g), TPH diesel (TPH_d), and TPH motor oil (TPH_{mo}). Fractionation results from soil samples collected through February 24, 2011 were used to evaluate the aromatic/aliphatic composition of the different TPH ranges. The analytical results correlation analysis was presented in a letter to the RWQCB dated August 15, 2011 (Geosyntec, 2011). The aromatic/aliphatic ratios for each TPH range are as follows:

- Light Range TPH = 0.03
- Medium Range TPH = 1.3
- Heavy Range TPH = 1.0

The carbon number ranges used in the TPH product range (TPH_g, TPH_d, and TPH_{mo}) analyses are different from those used in the TPH fractionation analyses. As a result, there is overlap in the product range carbon-chain values and what is encompassed by the fraction results. Consequently, the contribution to the TPH product range from the different aliphatic and aromatic fractions was estimated based on a comparison of the carbon ranges encompassed by the different analyses (Geosyntec, 2011). The following contributions were assumed:

- TPH_g: 50% contribution from the light fractions and 50% contribution from the medium fractions;
- TPH_d: 50% contribution from the medium fractions and 50% contribution from the heavy fractions; and
- TPH_{mo}: 100% contribution from the heavy fractions.

The following equation was used to derive the SSCGs for TPH_g, TPH_d, and TPH_{mo}:

$$SSCG\ (TPH_g, TPH_d, TPH_{mo}) = 100\% \times \left[\sum \frac{\text{Fraction }\%}{\text{Fraction SSCG}} \right]^{-1}$$

Where:

Fraction % = % contribution of TPH fraction to product range TPH (unitless); and

Fraction SSCG = Site-specific cleanup goal determined above for the different TPH fraction (soil in mg/kg; sub-slab soil vapor and soil vapor in $\mu g/m^3$).

The following table summarizes the SSCG calculations for TPH_g, TPH_d, and TPH_{mo}:

TPH Product Ranges	% Contribution to Product Range TPH	Aromatic/ Aliphatic Ratio	% Contribution of TPH Fraction	Onsite Resident			Construction and Utility Maintenance Worker	
				Soil SSCG (EF350) (mg/kg)	Soil SSCG (EF4) (mg/kg)	Sub-Slab Soil Vapor SSCG (µg/m^3)	Soil SSCG (mg/kg)	Soil Vapor SSCG (µg/m^3)
TPH-g								
Light Fraction	50%	0.03						
Aliphatic: C_5-C_8			49%	7.1E+02	6.2E+04	7.3E+05	8.3E+02	1.2E+09
Aromatic: C_6-C_8			1%	6.0E+02	5.3E+04	5.2E+04	7.5E+02	6.7E+06
Medium Fraction	50%	1.3						
Aliphatic: C_9-C_{18}			22%	1.4E+03	1.3E+05	3.1E+05	1.6E+03	1.2E+08
Aromatic: C_9-C_{16}			28%	6.0E+02	5.3E+04	5.2E+04	7.5E+02	6.7E+06
			TPH-g =	**7.6E+02**	**6.6E+04**	**1.4E+05**	**9.0E+02**	**2.2E+07**
TPH-d								
Medium Fraction	50%	1.3						
Aliphatic: C_9-C_{18}			22%	1.4E+03	1.3E+05	3.1E+05	1.6E+03	1.2E+08
Aromatic: C_9-C_{16}			28%	6.0E+02	5.3E+04	5.2E+04	7.5E+02	6.7E+06
Heavy Fraction	50%	1.0						
Aliphatic: C_{19}-C_{32}			25%	1.1E+05	1.0E+07	--	5.5E+06	--
Aromatic: C_{17}-C_{32}			25%	1.7E+03	1.5E+05	--	8.3E+04	--
			TPH-d =	**1.3E+03**	**1.1E+05**	**1.6E+05**	**1.9E+03**	**2.3E+07**
TPH-mo								
Heavy Fraction	100%	1.0						
Aliphatic: C_{19}-C_{32}			49%	1.1E+05	1.0E+07	--	5.5E+06	--
Aromatic: C_{17}-C_{32}			51%	1.7E+03	1.5E+05	--	8.3E+04	--
			TPH-mo =	**3.3E+03**	**2.9E+05**	**--**	**1.6E+05**	**--**

Note: Because individual C_6-C_8 aromatic constituents are evaluated separately, SSCG for C_9-C_{16} aromatic fraction used for evaluation

5.2 Background-based SSCG Methodology

Metals may be naturally occurring in the environment. According to the DTSC (Cal-EPA DTSC 1997, 2009a, 2009c, 2009d, 2011b) for naturally occurring materials such as metals, an evaluation of background concentrations is important to evaluate whether the metals concentrations on the property are consistent with naturally occurring levels in the area, and whether they should be included in the risk assessment. If concentrations of a metal are within background, the metal is not considered a COC and is not evaluated further.

In addition to metals, cPAHs can be naturally occurring or present at ambient levels not associated with former Site activities. A background dataset and methodology has been developed by DTSC that can be used to evaluate the presence of cPAHs in soil as benzo(a)pyrene equivalents (Cal-EPA DTSC, 2009c). Soil samples collected from the Site were analyzed by USEPA Method 8270 and USEPA Method 8270SIM and include the carcinogenic PAHs (cPAHs) that are commonly considered in the benzo(a)pyrene equivalents calculation as presented in the Cal-EPA DTSC background PAH methodology document (Cal-EPA DTSC, 2009c) as well as other PAHs that are considered carcinogenic (e.g. naphthalene).

Benzo(a)pyrene equivalent concentrations are calculated for this Site data using a toxicity equivalency factor (TEF) approach. TEFs are based on shared characteristics that can be used to rank the class of chemicals by carcinogenic potency. The ranking procedure is accomplished by referencing the chemicals to the characteristics and potency of benzo(a)pyrene, which is often used as the reference chemical for expressing the carcinogenic potency of the other cPAHs. Therefore, the cPAHs are indexed to benzo(a)pyrene to generate their TEFs. The TEFs are listed below for the seven cPAHs based on Cal-EPA guidance (Cal-EPA, 2009c):

cPAHs	**TEFs**
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1.0
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Dibenzo(a,h)anthracene	0.34
Indeno(1,2,3-cd)pyrene	0.1

Background-based SSCGs for metals and cPAHs were developed for the Site consistent with USEPA and Cal-EPA methodologies as presented in **Attachment A2** using local and regional background datasets. The background-based SSCGs are presented in **Table A-14**. These values represent Background Threshold Values (BTVs) which are single-point background thresholds that represent an upper plausible limit of the background distributions of individual compounds (USEPA, 2009a; 2009b; Helsel, 2005). These values are commonly used to evaluate site data and to determine if site concentrations are above background. In addition to the BTVs, Site data can be evaluated using guidance from Cal-EPA (Cal-EPA, 1997) to determine if Site concentrations are consistent with background.

Due to the preponderance of Site data (over 10,000 samples and 265 individual study areas), a streamlined approach was developed to evaluate background at the Site. In the first step, an upper-bound concentration from Site samples will be compared to the BTVs to evaluate whether onsite metal or cPAH concentrations are above or below background concentrations. In the second step, for chemicals that are present at concentrations above the BTV, a one-sample proportion test will be used to compare the Site data with the BTVs. This is consistent with agency guidance that states that when BTVs and cleanup standards are known, one-sample hypotheses are used to compare site data with the known and pre-established threshold values (USEPA, 2010). If warranted, additional analysis using Site data and methodologies using guidance from Cal-EPA (Cal-EPA, 1997) will be used.

If onsite concentrations are below background, the area will not be evaluated further in the risk assessment process for that chemical. The background comparison will be conducted as part of the full Human Health Risk Assessment (HHRA) that will be conducted for preparation of the RAP. It is anticipated that the HHRA will be included in the RAP.

5.3 Soil Leaching to Groundwater Methodology

5.3.1 The LARWQCB Attenuation Factor Method for VOCs

The Attenuation Factor Method for VOCs, described in the Los Angeles Regional Water Quality Control Board "Interim Site Assessment & Cleanup Guidebook" (the Water Board approach, LARWQCB, 1996), provides an approach to estimate soil cleanup goals for the protection of groundwater quality based on physical properties of a site and chemical properties of the VOCs. A soil-to-soil-leachate attenuation factor is calculated in a three-step process:

1) Estimate a liquid phase contaminant concentration (C_i) that is in equilibrium with the solid phase and the air phase in the vadose zone soil, using the site-specific soil physical parameters as well as the partitioning coefficients between the three phases (i.e., soil/water partitioning coefficient, Kd, and the Henry's Law Constant, K_H):

$$C_i = \frac{C_T}{\theta_W + \rho_b f_{oc} K_{oc} + (n - \theta_W) K_H}$$

where C_T is the total soil concentration, θ_W is the soil water content by volume, n is the soil porosity, and f_{oc} is the soil organic content. Then an AF, the ratio of the liquid phase concentration and the total soil concentration, can be calculated as:

$$\mathrm{AF} = 1 + \frac{\rho_b}{\theta_W} f_{oc} K_{oc} + (n - \theta_W) \frac{K_H}{\theta_W}$$

for chemicals where site-specific Kd is available, the $f_{oc}K_{oc}$ term in the above equation can be simply replaced by Kd.

2) Adjust the AF due to distance above groundwater. The hydrogeological information in the Los Angeles area suggests that the soil column can be divided into three zones: (1) a "smear zone", due to groundwater level fluctuation, immediately above groundwater table (0 - 40 ft above water table); (2) a second modification zone between 40 and 150 ft above water table; (3) No-modification zone (distance greater than 150 ft above water table). Based on a VLEACH modeling study, the AF at the top of the smear zone is reduced as one-tenth of the original AF calculated in step one. Subsequently the AF at each specific depth (AF_D) can be quantified by linear interpolation. The equations used are listed below:

For D>150: $AF_D = AF$

For 40<D≤150: $AF_D = \left(\frac{0.9(D-40)}{110} + 0.1\right) \times AF$

For D≤40: $AF_D = D(\frac{0.1AF-1}{40}) + 1$

where D is the total depth of the site soil.

3) Modify AF_D according to site lithology. The steady infiltration rates of different soil types are reported to have a 1:5:10:20 ratio between clay:silt/clay:sand/silt:gravel/sand. Therefore, once the site lithology is known, the final AF (AF_T) can be obtained by adjusting AF_D based on the following equation:

$$\mathrm{AF_T} = \frac{\mathrm{AF_D}}{\mathrm{D}}\left(\frac{\mathrm{TGR}}{20} + \frac{\mathrm{TSA}}{10} + \frac{\mathrm{TSI}}{5} + \frac{\mathrm{TCL}}{1}\right)$$

where D is the total depth of the site soil, TRG, TSA, TSI, and TCL are the total depths of gravel, sand, silt/clay, and clay, respectively. Note that since site-specific soil physical data are available and used in Step One, and the Site soil type is assumed to be entirely sand, Step Three was not conducted in the calculation for the Kast Site to avoid double-counting the effect of soil type.

5.3.2 The USEPA RSL Soil Cleanup Goal Method for Metals

Since the LARWQCB approach is only suitable for VOCs, the USEPA Regional Screening Level (RSL) approach (USEPA, 2013c) for the soil-to-groundwater pathway soil screening level was adapted for metals SSCG development. The RSL approach employs a partitioning equation that considers both the contaminant equilibrium between the solid, liquid, and air phase in soil and the dilution of leachate when entering the groundwater. The equation is listed below:

$$C_{cleanup} = C_W \times DAF \times \left[Kd + \frac{\theta_W + \theta_a K_H}{\rho_b}\right]$$

Where Cw is the groundwater quality criterion, DAF is the leachate-to-groundwater dilution attenuation factor (described in the next section), Kd is the soil/water partitioning coefficient, and θ_a is air-filled porosity. Kd can be calculated by:

$$Kd = Koc \times foc$$

5.3.3 SAM Model DAF Method

The Soil Attenuation Model (SAM), developed by Connor, et al., 1997, uses a simple box model to quantify the dilution of dissolved COCs when soil leachate mixes with lateral groundwater flow. When leachate vertically migrates to the water-bearing unit through infiltration, a contaminant will be diluted by the lateral groundwater flow in the mixing zone. Assuming perfect mixing, the groundwater concentration can be calculated based on mass balance. Infiltration rate, mixing zone height, and groundwater Darcy velocity are required for such a mass-balance accounting.

To estimate the infiltration rate (I_f), an empirical relationship between net infiltration and annual precipitation has been developed based upon a database of 140 sites from 18 geographic regions (Connor, et al., 1997). For the sand soil type of the Site, the relationship is:

$$I_f = 0.0018 \times P^2$$

where P is the annual precipitation.

To estimate the mixing zone height (δ_{gw}), the following equation (adapted from the USEPA Soil Screening Guidance) is used:

$$\delta_{gw} = \sqrt{2 \cdot \alpha_v \cdot W} + b[1 - exp(\frac{-I_f \cdot W}{U_{gw} \cdot b})]$$

where α_v is the vertical groundwater dispersivity, W is the lateral width of affected soil zone in direction of groundwater flow, b is the aquifer thickness, U_{gw} is the groundwater Darcy velocity. In the case where equation 5 results in a δ_{gw} that is larger than the aquifer thickness b, b is used as the mixing zone height.

$\alpha_{v,}$ and U_{gw} are calculated by:

$$\alpha_V = 0.0056 \times W$$

$$U_{gw} = K \cdot i$$

where K is the hydraulic conductivity, and i is the hydraulic gradient of the water-bearing unit.

Finally the Dilution Attenuation Factor (DAF) can be obtained by:

$$DAF = 1 + \frac{U_{gw} \cdot \delta_{gw}}{I_f \cdot W}$$

Parameters used for the LARWQCB and USEPA methods are listed in **Table A-15**. SAM DAF calculation is presented in **Table A-16**. The site-specific cleanup goals based on soil leaching to groundwater are summarized in **Table A-17**, and the detailed calculations are appended in **Attachment A-3**.

5.3.4 Example Calculation

An example calculation is provided below for benzene:

1). AF calculation.

First, the unadjusted AF is calculated using Site soil data and the physical properties of benzene:

$$AF = 1 + \frac{\rho_b}{\theta_W} K_d + (n - \theta_W)\frac{K_H}{\theta_W}$$

$$= 1 + \frac{1.54\ g/cm^3}{0.239} \times 28\frac{mL}{g} + (0.421 - 0.239)\frac{0.227}{0.239}$$

$$= 180$$

Second, the depth adjusted AF_D is calculated. For example, for 50 ft depth:

$$AF_{D,50} = \left(\frac{0.9(D-40)}{110} + 0.1\right) \times AF = \left(\frac{0.9(50-40)}{110} + 0.1\right) \times 180$$

$$= 33$$

The Site groundwater table is between 50 to 60 ft bgs. Therefore, as a conservative measure, the AF_D at 50 ft of 33 is used to calculate the soil cleanup goal.

2). DAF calculation

The annual precipitation at the Site is estimated as 34.5 cm/yr based on the meteorological data from the Torrance, CA weather Station in the SESOIL meteorological database. The infiltration rate is then calculated as:

$$I_f = 0.0018 \times 34.5\ cm/yr^2 = 0.0214\ m/yr$$

The lateral width of affected soil zone in the direction of the groundwater flow is estimated as 184 m based on the area of highest benzene concentrationsfrom 2011 2nd quarter and 2013 2nd quarter groundwater monitoring data. Using this, the vertical groundwater dispersivity is obtained:

$$\alpha_V = 0.0056 \times 184m = 1.03\ m$$

Using a default hydraulic conductivity of 2.5 m/day for the fine sand soil type (Todd, 1980), and the Site hydraulic gradient of 0.002 m/m (estimated using the 2013 2nd quarter groundwater monitoring data), groundwater Darcy velocity is calculated as:

$$U_{gw} = K \cdot i = 2.5\,\frac{m}{day} \times 0.002\,\frac{m}{m} = 1.8\,\frac{m}{yr}$$

The aquifer thickness, b, was estimated as 11.3 m assuming the top of the Gage aquifer is the lower boundary of the shallow water-bearing unit. Subsequently the mixing zone height, δ_{gw}, can be obtained:

$$\delta_{gw} = \sqrt{2 \cdot \alpha_v \cdot W} + b[1 - exp(\frac{-I_f \cdot W}{U_{gw} \cdot b})]$$

$$= \sqrt{2 \cdot 1.03m \cdot 184m} + 11.3m \times [1 - exp(\frac{-0.0214m/yr \cdot 184m}{1.8m/yr \cdot 11.3m})]$$

$$= 21.4\,m$$

Since this value is larger than the aquifer thickness, the aquifer thickness, 11.3 m, is then used as the mixing zone height. The DAF is finally calculated as:

$$DAF = 1 + \frac{U_{gw} \cdot \delta_{gw}}{I_f \cdot W} = 1 + \frac{1.8m/yr \cdot 21.4m}{0.0214m.yr \cdot 184m} = 6.24$$

3). Soil cleanup goal calculation

For benzene, the California MCL is 1 µg/L, therefore the soil cleanup goal is finally calculated as:

$$C_{cleanup} = \frac{MCL \times DAF \times AF}{\rho_b} = \frac{1\mu g/L \times 6.24 \times 33}{1.54\,kg/L} = 133\,mg/kg$$

6.0 REFERENCES

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TABLES

Table A-1
Exposure Parameters
Former Kast Property
Carson, California

Parameter		Units	Onsite Resident		Source	Onsite Construction and Utility Maintenance Worker	Source
			Adult	Child			
IR	Soil ingestion rate	mg/d	100	200	(1,2)	330	(1)
SA	Skin surface area	cm^2	5,700	2,800	(1,3)	5,700	(1)
AF	Soil-to-skin adherence factor	–	0.07	0.2	(1,3)	0.8	(1)
EF	Exposure frequency	d/yr	350	350	(1,2)	10	PJ
	Infrequent exposure to subsurface soils	d/yr	4	4	PJ	--	
ED	Exposure duration	yr	24	6	(1,2)	25	(2)
ET	Exposure time	hours	24	24	(2)	20 m^3/day for the 8 hour workday	(1)
BW	Body weight	kg	70	15	(1,2)	70	(1,2)
AT_C	Averaging time for carcinogenic effects	d	25,550	25,550	(1,2)	25,550	(1,2)
AT_{NC}	Averaging time for noncarcinogenic effects	d	8,760	2,190	(1,2)	9,125	(1,2)

Note:

"--" not applicable; " PJ " Professional Judgement

Source:

(1) Cal-EPA 2011a. Human Health Risk Assessment (HHRA) Note. Office of Human and Ecological Risk (HERO) HHRA Note Number 1. Recommended DTSC Default Exposure Factors For Use In Risk Assessment At California Hazardous Waste Sites and Permitted Facilities. Issued: May 20, 2011.

(2) USEPA 1991c. RAGS. Volume I: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

(3) USEPA 2004b. RAGS. Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance. EPA/540/R-99/005

Table A-2
Definition of Transfer Factors
Former Kast Property
Carson, California

Exposure Route	Transfer Factor	Definition
Inhalation of particulates in outdoor air	Particulate emission factor (PEF) (kg/m^3)	Ratio of chemical concentration in outdoor air (mg/m^3) to chemical concentration in soil (mg/kg)
Inhalation of vapors in outdoor air	Soil-to-outdoor air volatilization factor ($VF_{soil-OA}$ or VF_{soil}) (kg/m^3)	Ratio of chemical concentration in outdoor air (mg/m^3) to chemical concentration in soil (mg/kg)
	Soil vapor-to-outdoor air volatilization factor (VF_{SV-OA}) (µg/m^3 per µg/m^3)	Ratio of chemical concentration in outdoor air (µg/m^3) to chemical concentration in soil vapor (µg/m^3)

Table A-3a
Derivation of Particulate Emission and Volatilization Factors, Onsite Resident
Former Kast Property
Carson, California

Parameter	Value	Units	Reference
Water-filled soil porosity (θw)	1.50E-01	(Lwater-Lsoil)	USEPA 2012 RSL default
Total soil porosity (θ_T)	4.30E-01	(Lpore-Lsoil)	USEPA 2012 RSL default
Air-filled soil porosity (θa)	2.80E-01	(Lair-Lsoil)	USEPA 2012 RSL default
Soil bulk density (Pb)	1.5	g/cm^3	USEPA 2012 RSL default
Fraction organic carbon in soil (foc)	0.006	unitless	USEPA 2012 RSL default
Exposure interval ($T_{resident}$)	9.46E+08	sec	30 year exposure duration
Inverse of mean conc, $Q/C_{resident}$	68.18	(g/m^2-s per kg/m^3)	Calculated for a 0.5-acre site in Los Angeles (USEPA 2002)
Fraction of vegetative cover, $G_{resident}$	0.5	unitless	Default (USEPA 2002)
Mean annual windspeed (Um)	3.31	m/s	Average for Los Angeles, 7.4 mph (NCDC 2011)
Equivalent threshold value of windspeed at 7m (Ut)	11.32	m/s	Default (USEPA 2002)
Function dependent on Um/Ut (Fx)	4.74E-03	unitless	Los Angeles-Specific (Appendix D, Table 2 in USEPA 1996)
Particulate Emission Factor, $PEF_{resident}$	1.2E+11	(m^3/kg)	Estimated for a limited area, 0.5-acre (USEPA 2002)

Particulate Emission Factor; $PEF_{resident}$ (USEPA 2002): PEF = $[(Q/C_{resident} * 3600) / (0.036 * (1-G_{resident}) * (Um/Ut)^3 * Fx)]$

CAS Number	Chemical of Concern	Diffusivity in Air (D_{air}) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_{water}) (cm^2/s)	Organic Carbon Partition Coefficient (K_{oc}) (cm^3/g)	Soil-Water Partition Coefficient (Kd) (cm^3/g)	Apparent Diffusivity (D_A) (cm^2/s)	Effective Diffusion Coefficient (D_{eff}) (cm^2/s)	Soil-water partition coefficient (K_{sw}) (cm^3/g)	**Onsite Resident VF_{soil} (m^3/kg)**
79-34-5	1,1,2,2-Tetrachloroethane	7.1E-02	1.4E-02	7.9E-06	9.3E+01	5.6E-01	7.8E-05	5.5E-03	6.6E-01	**1.4E+04**
96-18-4	1,2,3-Trichloropropane	7.1E-02	1.7E-02	7.9E-06	2.2E+01	1.3E-01	2.6E-04	5.5E-03	2.4E-01	**7.6E+03**
95-63-6	1,2,4-Trimethylbenzene	6.1E-02	2.5E-01	7.9E-06	1.4E+03	8.1E+00	9.6E-05	4.7E-03	8.3E+00	**1.3E+04**
78-87-5	1,2-Dichloropropane	7.8E-02	1.1E-01	8.7E-06	4.4E+01	2.6E-01	1.2E-03	6.1E-03	3.8E-01	**3.6E+03**
108-67-8	1,3,5-Trimethylbenzene	6.0E-02	2.4E-01	8.7E-06	1.4E+03	8.1E+00	9.1E-05	4.7E-03	8.3E+00	**1.3E+04**
106-46-7	1,4-Dichlorobenzene	6.9E-02	9.8E-02	7.9E-06	6.2E+02	3.7E+00	9.2E-05	5.4E-03	3.8E+00	**1.3E+04**
71-43-2	Benzene	8.8E-02	2.3E-01	9.8E-06	5.9E+01	3.5E-01	2.1E-03	6.9E-03	5.0E-01	**2.7E+03**
75-27-4	Bromodichloromethane	3.0E-02	6.5E-02	1.1E-05	5.5E+01	3.3E-01	2.3E-04	2.3E-03	4.4E-01	**8.2E+03**
74-83-9	Bromomethane	7.3E-02	2.6E-01	1.2E-05	1.1E+01	6.3E-02	4.6E-03	5.7E-03	2.1E-01	**1.8E+03**
100-41-4	Ethylbenzene	7.5E-02	3.2E-01	7.8E-06	3.6E+02	2.2E+00	5.4E-04	5.9E-03	2.3E+00	**5.3E+03**
75-09-2	Methylene chloride	1.0E-01	9.0E-02	1.2E-05	1.2E+01	7.0E-02	2.5E-03	7.9E-03	1.9E-01	**2.5E+03**
127-18-4	Tetrachloroethene	7.2E-02	7.5E-01	8.2E-06	1.6E+02	9.3E-01	2.4E-03	5.6E-03	1.2E+00	**2.5E+03**
79-01-6	Trichloroethene	7.9E-02	4.2E-01	9.1E-06	1.7E+02	1.0E+00	1.5E-03	6.2E-03	1.2E+00	**3.2E+03**
75-01-4	Vinyl chloride	1.1E-01	1.1E+00	1.2E-05	1.9E+01	1.1E-01	1.5E-02	8.3E-03	4.2E-01	**1.0E+03**

Volatilization Factor; VF_{soil}:

$$VF_{soil} = Q/C \times \left(10^{-4}\,\frac{m^2}{cm^2}\right) \times \left(\frac{1}{P_b}\right)\left(\frac{3.14 \times T_{resident} \times K_{sw} \times P_b}{4 \times D_{eff} \times H'}\right)^{1/2}$$

Table A-3b

Derivation of Particulate Emission and Volatilization Factors, Onsite Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

Parameter	Value	Units	Reference
Water-filled soil porosity (θw)	1.5E-01	(Lwater-Lsoil)	USEPA 2012 RSL default
Total soil porosity (θ_T)	4.3E-01	(Lpore-Lsoil)	USEPA 2012 RSL default
Air-filled soil porosity (θa)	2.8E-01	(Lair-Lsoil)	USEPA 2012 RSL default
Soil bulk density (Pb)	1.5	g/cm^3	USEPA 2012 RSL default
Fraction organic carbon in soil (foc)	0.006	unitless	USEPA 2012 RSL default
Exposure interval (T_{CUW})	7.9E+08	sec	25 year exposure duration for the construction/utility maintenance worker
Ambient air velocity in mixing zone (U_{air})	5.1E-01	cm/s	Based on an air exchange rate of 20 hr^{-1}, wind direction parallel to the short side of the trench (3 ft or 91 cm), professional judgment
Width of source-zone area (W)	457	cm	Assume length of trench = 4.57 meters
Mixing zone height (H)	183	cm	Assume depth of trench = 1.83 meters
Width of trench (W_t)	91	cm	Assume width of trench = 0.91 meters
Source-zone area (A)	2.4E+05	cm^2	4 sidewalls and bottom area of trench
Dispersion factor for ambient air (DF_{amb})	1.7E-01	cm/s	Calculated (ASTM 2004)
Particulate Emission Factor, PEF_{CUW}	1.0E+06	(m^3/kg)	DTSC HERO HHRA Note Number 1 (Cal-EPA, 2011)

CAS Number	Chemical of Concern	Diffusivity in Air (D_{air}) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_{water}) (cm^2/s)	Organic Carbon Partition Coefficient (K_{oc}) (cm^3/g)	Soil-Water Partition Coefficient (Kd) (cm^3/g)	Apparent Diffusivity (D_A) (cm^2/s)	Effective Diffusion Coefficient (D_{eff}) (cm^2/s)	Soil-water partition coefficient (K_{sw}) (cm^3/g)	**Construction and Utility Maintenance Worker $VF_{soil-OA}$** (m^3/kg)	**Construction and Utility Maintenance Worker VF_{SV-OA}** (µg/m^3 per µg/m^3)
71-55-6	1,1,1-Trichloroethane	7.8E-02	7.0E-01	8.8E-06	1.1E+02	6.6E-01	3.2E-03	6.1E-03	8.9E-01	**--**	**4.0E+04**
79-34-5	1,1,2,2-Tetrachloroethane	7.1E-02	1.4E-02	7.9E-06	9.3E+01	5.6E-01	7.8E-05	5.5E-03	6.6E-01	**--**	**7.0E+03**
79-00-5	1,1,2-Trichloroethane	7.8E-02	3.7E-02	8.8E-06	5.0E+01	3.0E-01	3.7E-04	6.1E-03	4.1E-01	**--**	**1.4E+04**
75-34-3	1,1-Dichloroethane	7.4E-02	2.3E-01	1.1E-05	3.2E+01	1.9E-01	2.7E-03	5.8E-03	3.3E-01	**--**	**3.9E+04**
96-18-4	1,2,3-Trichloropropane	7.1E-02	1.7E-02	7.9E-06	2.2E+01	1.3E-01	2.6E-04	5.5E-03	2.4E-01	**1.8E+02**	**1.3E+04**
120-82-1	1,2,4-Trichlorobenzene	3.0E-02	5.8E-02	8.2E-06	1.8E+03	1.1E+01	8.4E-06	2.3E-03	1.1E+01	**--**	**5.4E+03**
95-63-6	1,2,4-Trimethylbenzene	6.1E-02	2.5E-01	7.9E-06	1.4E+03	8.1E+00	9.6E-05	4.7E-03	8.3E+00	**3.0E+02**	**9.0E+03**
107-06-2	1,2-Dichloroethane	1.0E-01	4.0E-02	9.9E-06	1.7E+01	1.0E-01	1.0E-03	8.1E-03	2.1E-01	**--**	**1.7E+04**

Table A-3b

Derivation of Particulate Emission and Volatilization Factors, Onsite Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Diffusivity in Air (D_{air}) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_{water}) (cm^2/s)	Organic Carbon Partition Coefficient (K_{oc}) (cm^3/g)	Soil-Water Partition Coefficient (Kd) (cm^3/g)	Apparent Diffusivity (D_A) (cm^2/s)	Effective Diffusion Coefficient (D_{eff}) (cm^2/s)	Soil-water partition coefficient (K_{sw}) (cm^3/g)	**Construction and Utility Maintenance Worker $VF_{soil\text{-}OA}$** (m^3/kg)	**Construction and Utility Maintenance Worker $VF_{SV\text{-}OA}$** ($\mu g/m^3$ per $\mu g/m^3$)
78-87-5	1,2-Dichloropropane	7.8E-02	1.1E-01	8.7E-06	4.4E+01	2.6E-01	1.2E-03	6.1E-03	3.8E-01	**--**	**2.5E+04**
108-67-8	1,3,5-Trimethylbenzene	6.0E-02	2.4E-01	8.7E-06	1.4E+03	8.1E+00	9.1E-05	4.7E-03	8.3E+00	**3.0E+02**	**8.8E+03**
106-99-0	1,3-Butadiene	2.5E-01	3.0E+00	1.1E-05	1.9E+01	1.1E-01	5.0E-02	1.9E-02	7.8E-01	**--**	**5.0E+04**
106-46-7	1,4-Dichlorobenzene	6.9E-02	9.8E-02	7.9E-06	6.2E+02	3.7E+00	9.2E-05	5.4E-03	3.8E+00	**--**	**7.8E+03**
123-91-1	1,4-Dioxane	2.3E-01	2.3E-04	1.0E-05	1.0E+00	6.0E-03	2.6E-05	1.8E-02	1.1E-01	**--**	**1.2E+03**
540-84-1	2,2,4-Trimethylpentane	1.0E-01	1.8E+02	1.0E-05	1.5E+05	9.0E+02	1.0E-03	7.8E-03	9.3E+02	**--**	**1.8E+04**
591-78-6	2-Hexanone	7.5E-02	3.8E-03	8.4E-06	9.4E+00	5.7E-02	9.4E-05	5.8E-03	1.6E-01	**--**	**7.2E+03**
622-96-8	4-Ethyltoluene	6.8E-02	2.1E-01	7.3E-06	1.8E+03	1.1E+01	6.7E-05	5.3E-03	1.1E+01	**--**	**6.7E+03**
71-43-2	Benzene	8.8E-02	2.3E-01	9.8E-06	5.9E+01	3.5E-01	2.1E-03	6.9E-03	5.0E-01	**6.3E+01**	**2.9E+04**
75-27-4	Bromodichloromethane	3.0E-02	6.5E-02	1.1E-05	5.5E+01	3.3E-01	2.3E-04	2.3E-03	4.4E-01	**--**	**2.8E+04**
74-83-9	Bromomethane	7.3E-02	2.6E-01	1.2E-05	1.1E+01	6.3E-02	4.6E-03	5.7E-03	2.1E-01	**--**	**5.2E+04**
75-15-0	Carbon disulfide	1.0E-01	1.2E+00	1.0E-05	4.6E+01	2.7E-01	1.1E-02	8.1E-03	6.1E-01	**--**	**5.6E+04**
56-23-5	Carbon tetrachloride	7.8E-02	1.2E+00	8.8E-06	1.7E+02	1.0E+00	3.6E-03	6.1E-03	1.4E+00	**--**	**4.3E+04**
67-66-3	Chloroform	1.0E-01	1.5E-01	1.0E-05	4.0E+01	2.4E-01	2.2E-03	8.1E-03	3.7E-01	**--**	**2.5E+04**
74-87-3	Chloromethane	1.3E-01	3.6E-01	6.5E-06	2.1E+00	1.3E-02	1.3E-02	9.8E-03	1.8E-01	**--**	**5.1E+04**
110-82-7	Cyclohexane	7.4E-02	7.9E+00	8.5E-06	1.7E+02	9.9E-01	1.2E-02	5.7E-03	2.6E+00	**--**	**8.2E+04**
124-48-1	Dibromochloromethane	2.0E-02	3.2E-02	1.1E-05	6.3E+01	3.8E-01	6.7E-05	1.5E-03	4.8E-01	**--**	**2.3E+04**
156-59-2	Dichloroethene, cis-1,2-	7.4E-02	1.7E-01	1.1E-05	3.6E+01	2.1E-01	1.8E-03	5.7E-03	3.4E-01	**--**	**3.3E+04**
156-60-5	Dichloroethene, trans-1,2-	7.1E-02	3.8E-01	1.2E-05	5.3E+01	3.2E-01	2.9E-03	5.5E-03	4.9E-01	**--**	**4.2E+04**
10061-02-6	Dichloropropene, trans-1,3-	6.3E-02	7.2E-01	1.0E-05	4.6E+01	2.7E-01	4.6E-03	4.9E-03	5.1E-01	**--**	**6.1E+04**
64-17-5	Ethanol	1.5E-01	1.9E-04	1.6E-05	1.0E+00	6.0E-03	1.5E-05	1.3E-02	1.1E-01	**--**	**1.3E+03**
100-41-4	Ethylbenzene	7.5E-02	3.2E-01	7.8E-06	3.6E+02	2.2E+00	5.4E-04	5.9E-03	2.3E+00	**1.2E+02**	**1.7E+04**
142-82-5	Heptane	9.3E-02	8.2E+01	7.6E-06	2.7E+02	1.6E+00	2.3E-02	7.2E-03	1.7E+01	**--**	**9.2E+04**
87-68-3	Hexachloro-1,3-butadiene	5.6E-02	3.3E-01	6.2E-06	5.4E+04	3.2E+02	3.0E-06	4.4E-03	3.2E+02	**--**	**1.7E+03**
110-54-3	Hexane	2.0E-01	6.8E+01	7.8E-06	4.3E+01	2.6E-01	5.4E-02	1.6E-02	1.3E+01	**--**	**6.5E+04**
67-63-0	Isopropanol	8.0E-02	3.6E-04	9.3E-06	6.9E+00	4.2E-02	1.1E-05	6.5E-03	1.4E-01	**--**	**2.2E+03**

Table A-3b

Derivation of Particulate Emission and Volatilization Factors, Onsite Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Diffusivity in Air (D_{air}) (cm^2/s)	Henry's Law Constant (H') (unitless)	Diffusivity in Water (D_{water}) (cm^2/s)	Organic Carbon Partition Coefficient (K_{oc}) (cm^3/g)	Soil-Water Partition Coefficient (Kd) (cm^3/g)	Apparent Diffusivity (D_A) (cm^2/s)	Effective Diffusion Coefficient (D_{eff}) (cm^2/s)	Soil-water partition coefficient (K_{sw}) (cm^3/g)	**Construction and Utility Maintenance Worker $VF_{soil\text{-}OA}$** (m^3/kg)	**Construction and Utility Maintenance Worker $VF_{SV\text{-}OA}$** ($\mu g/m^3$ per $\mu g/m^3$)
98-82-8	Isopropylbenzene (cumene)	6.5E-02	4.7E+01	7.1E-06	4.9E+02	2.9E+00	1.3E-02	5.1E-03	1.2E+01	--	**1.0E+05**
78-93-3	Methyl ethyl ketone (2-butanone)	8.1E-02	2.3E-03	9.8E-06	2.3E+00	1.4E-02	8.4E-05	6.3E-03	1.1E-01	--	**6.3E+03**
75-09-2	Methylene chloride	1.0E-01	9.0E-02	1.2E-05	1.2E+01	7.0E-02	2.5E-03	7.9E-03	1.9E-01	--	**2.8E+04**
1634-04-4	Methyl-tert-butyl ether	1.0E-01	2.6E-02	1.1E-05	7.3E+00	4.4E-02	9.1E-04	8.0E-03	1.5E-01	--	**1.6E+04**
103-65-1	Propylbenzene	6.0E-02	4.4E-01	7.8E-06	5.6E+02	3.4E+00	3.8E-04	4.7E-03	3.6E+00	--	**1.8E+04**
75-65-0	tert-Butyl Alcohol (TBA)	8.5E-02	3.0E-03	9.1E-06	4.2E+00	2.5E-02	1.1E-04	6.7E-03	1.3E-01	--	**6.7E+03**
127-18-4	Tetrachloroethene	7.2E-02	7.5E-01	8.2E-06	1.6E+02	9.3E-01	2.4E-03	5.6E-03	1.2E+00	--	**3.8E+04**
109-99-9	Tetrahydrofuran	9.8E-02	2.9E-03	1.1E-05	9.5E-01	5.7E-03	1.4E-04	7.7E-03	1.1E-01	--	**6.7E+03**
108-88-3	Toluene	8.7E-02	2.7E-01	8.6E-06	1.8E+02	1.1E+00	9.8E-04	6.8E-03	1.2E+00	--	**2.0E+04**
79-01-6	Trichloroethene	7.9E-02	4.2E-01	9.1E-06	1.7E+02	1.0E+00	1.5E-03	6.2E-03	1.2E+00	--	**2.7E+04**
75-01-4	Vinyl chloride	1.1E-01	1.1E+00	1.2E-05	1.9E+01	1.1E-01	1.5E-02	8.3E-03	4.2E-01	--	**6.3E+04**
108-38-3	Xylene, m-	7.0E-02	3.0E-01	7.8E-06	4.1E+02	2.4E+00	4.2E-04	5.5E-03	2.6E+00	--	**1.6E+04**
95-47-6	Xylene, o-	8.7E-02	2.1E-01	1.0E-05	3.6E+02	2.2E+00	4.1E-04	6.8E-03	2.3E+00	--	**1.3E+04**
106-42-3	Xylene, p-	7.7E-02	3.1E-01	8.4E-06	3.9E+02	2.3E+00	5.0E-04	6.0E-03	2.5E+00	--	**1.6E+04**
1330-20-7	Xylenes, total	8.5E-02	2.7E-01	9.9E-06	4.4E+02	2.7E+00	4.2E-04	6.6E-03	2.8E+00	**1.4E+02**	**1.4E+04**
91-20-3	Naphthalene	5.9E-02	2.0E-02	7.5E-06	2.0E+03	1.2E+01	5.0E-06	4.6E-03	1.2E+01	--	**2.1E+03**

Note:

--: Not selected as COC for this medium.

Volatilization Factor: $VF_{soil\text{-}OA} = \frac{DF_{amb}}{Pb} \times \left[\frac{(3.14 \times T_{CUW} \times K_{sw} \times Pb)}{(4 \times D_{eff} \times H')} \right]^{1/2} \times CF_1 \times CF_2$ and $VF_{SV\text{-}OA} = VF_{soil\text{-}OA} \times \frac{H'}{K_{sw}} \times (CF_1 \times CF_2)$

Table A-4

Chronic Toxicity Criteria

CAS Number	Chemical of Concern	Dermal ABS^	GI ABS^	Cancer Toxicity Criteria: Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Dermal Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Source	Noncancer Toxicity Criteria: Oral RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Source	Inhalation RfC or REL (mg/m^3)	Source
	Inorganics												
7440-36-0	Antimony	NA	0.15	NC		NC	NC		4.0E-04	6.0E-05	I	NA	
7440-38-2	Arsenic	0.03	1	9.5E+00	C	9.5E+00	3.3E-03	C	3.0E-04	3.0E-04	I	1.5E-05	C
7440-43-9	Cadmium	0.001	0.025	NC		NC	4.2E-03	C	1.0E-03	2.5E-05	I	2.0E-05	C
18540-29-9	Chromium, hexavalent	NA	0.025	5.0E-01	J	NC	1.5E-01	C	3.0E-03	7.5E-05	I	1.0E-04	I
7440-48-4	Cobalt	NA	1	NC		NC	9.0E-03	P	3.0E-04	3.0E-04	P	6.0E-06	P
7440-50-8	Copper	NA	1	NC		NC	NC		4.0E-02	4.0E-02	H	NA	
7439-92-1	Lead	NA	1	NC		NC	NC		NA	NA		NA	
7440-28-0	Thallium	NA	1	NC		NC	NC		1.0E-05	1.0E-05	X	NA	
7440-62-2	Vanadium	NA	1	NC		NC	NC		5.0E-03	5.0E-03	S	1.0E-04	A
7440-66-6	Zinc	NA	1	NC		NC	NC		3.0E-01	3.0E-01	I	NA	
	PAHs												
56-55-3	Benzo (a) anthracene	0.13	1	2.9E-01	C*	2.9E-01	1.1E-04	C	NA	NA		NA	
50-32-8	Benzo (a) pyrene	0.13	1	2.9E+00	C*	2.9E+00	1.1E-03	C	NA	NA		NA	
205-99-2	Benzo (b) fluoranthene	0.13	1	2.9E-01	C*	2.9E-01	1.1E-04	C	NA	NA		NA	
207-08-9	Benzo (k) fluoranthene	0.13	1	2.9E-01	C*	2.9E-01	1.1E-04	C	NA	NA		NA	
218-01-9	Chrysene	0.13	1	2.9E-02	C*	2.9E-02	1.1E-05	C	NA	NA		NA	
53-70-3	Dibenz (a,h) anthracene	0.13	1	4.1E+00	C	4.1E+00	1.2E-03	C	NA	NA		NA	
193-39-5	Indeno (1,2,3-cd) pyrene	0.13	1	2.9E-01	C*	2.9E-01	1.1E-04	C	NA	NA		NA	
90-12-0	Methylnaphthalene, 1-	0.13	1	2.9E-02	P	2.9E-02	NC		7.0E-02	7.0E-02	A	NA	
91-57-6	Methylnaphthalene, 2-	0.13	1	NC		NC	NC		4.0E-03	4.0E-03	I	NA	
91-20-3	Naphthalene	0.13	1	NC		NC	3.4E-05	C	2.0E-02	2.0E-02	I	3.0E-03	I
129-00-0	Pyrene	0.13	1	NC		NC	NC		3.0E-02	3.0E-02	I	1.1E-01	R
	TPH												
	TPH Aliphatic: C5-C8	0.13	1	NC		NC	NC		4.0E-02	4.0E-02	B	7.0E-01	B
	TPH Aliphatic: C9-C18	0.13	1	NC		NC	NC		1.0E-01	1.0E-01	B	3.0E-01	B
	TPH Aliphatic: C19-C32	0.13	1	NC		NC	NC		2.0E+00	2.0E+00	B	--	B
	TPH Aromatic: C6-C8	0.13	1	NC		NC	NC		--	--	B	--	B
	TPH Aromatic: C9-C16	0.13	1	NC		NC	NC		3.0E-02	3.0E-02	B	5.0E-02	B
	TPH Aromatic: C17-C32	0.13	1	NC		NC	NC		3.0E-02	3.0E-02	B	--	B
	SVOCs												
121-14-2	2,4-Dinitrotoluene	0.102	1	3.1E-01	C	3.1E-01	8.9E-05	C	2.0E-03	2.0E-03	I	7.0E-03	R
117-81-7	Bis(2-Ethylhexyl) Phthalate	0.1	1	1.4E-02	I	1.4E-02	2.4E-06	C	2.0E-02	2.0E-02	I	7.0E-02	R

Table A-4
Chronic Toxicity Criteria

CAS Number	Chemical of Concern	Dermal ABS^	GI ABS^	Cancer Toxicity Criteria					Noncancer Toxicity Criteria				
				Oral Cancer Slope Factor (mg/kg-day)$^{-1}$	Source	Dermal Cancer Slope Factor (mg/kg-day)$^{-1}$	Inhalation Unit Risk (μg/m^3)$^{-1}$	Source	Oral RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Source	Inhalation RfC or REL (mg/m^3)	Source
	VOCs												
71-55-6	1,1,1-Trichloroethane	NA	1	NC		NC	NC		2.0E+00	2.0E+00	I	5.0E+00	I
79-34-5	1,1,2,2-Tetrachloroethane	NA	1	2.7E-01	C	2.7E-01	5.8E-05	C	2.0E-02	2.0E-02	I	7.0E-02	R
79-00-5	1,1,2-Trichloroethane	NA	1	7.2E-02	C	7.2E-02	1.6E-05	C	4.0E-03	4.0E-03	I	2.0E-04	X
75-34-3	1,1-Dichloroethane	NA	1	5.7E-03	C	5.7E-03	1.6E-06	C	2.0E-01	2.0E-01	P	7.0E-01	R
96-18-4	1,2,3-Trichloropropane	NA	1	3.0E+01	I	3.0E+01	NC		4.0E-03	4.0E-03	I	3.0E-04	I
120-82-1	1,2,4-Trichlorobenzene	NA	1	3.6E-03	C	3.6E-03	NC		1.0E-02	1.0E-02	I	2.0E-03	P
95-63-6	1,2,4-Trimethylbenzene	NA	1	NC		NC	NC		1.0E-02	1.0E-02	X	7.0E-03	P
107-06-2	1,2-Dichloroethane	NA	1	4.7E-02	C	4.7E-02	2.1E-05	C	6.0E-03	6.0E-03	X	7.0E-03	P
78-87-5	1,2-Dichloropropane	NA	1	3.6E-02	C	3.6E-02	1.0E-05	C	9.0E-02	9.0E-02	A	4.0E-03	I
108-67-8	1,3,5-Trimethylbenzene	NA	1	NC		NC	NC		1.0E-02	1.0E-02	X	7.0E-03	P
106-99-0	1,3-Butadiene	NA	1	3.4E+00	C	3.4E+00	1.7E-04	C	5.7E-04	5.7E-04	R	2.0E-03	I
106-46-7	1,4-Dichlorobenzene	NA	1	5.4E-03	C	5.4E-03	1.1E-05	C	7.0E-02	7.0E-02	A	8.0E-01	C
123-91-1	1,4-Dioxane	0.1	1	2.7E-02	C	2.7E-02	7.7E-06	C	3.0E-02	3.0E-02	I	3.0E+00	C
540-84-1	2,2,4-Trimethylpentane	NA	1	NC		NC	NC		NA	NA		1.0E+00	D
591-78-6	2-Hexanone	NA	1	NC		NC	NC		5.0E-03	5.0E-03	I	3.0E-02	I
622-96-8	4-Ethyltoluene*	NA	1	NC		NC	NC		2.0E-01	2.0E-01	S	1.0E-01	S
71-43-2	Benzene	NA	1	1.0E-01	C	1.0E-01	2.9E-05	C	4.0E-03	4.0E-03	I	3.0E-02	I
75-27-4	Bromodichloromethane	NA	1	1.3E-01	C	1.3E-01	3.7E-05	C	2.0E-02	2.0E-02	I	7.0E-02	R
74-83-9	Bromomethane	NA	1	NC		NC	NC		1.4E-03	1.4E-03	I	5.0E-03	C
75-15-0	Carbon disulfide	NA	1	NC		NC	NC		1.0E-01	1.0E-01	I	7.0E-01	I
56-23-5	Carbon tetrachloride	NA	1	1.5E-01	C	1.5E-01	4.2E-05	C	4.0E-03	4.0E-03	I	1.0E-01	I
67-66-3	Chloroform	NA	1	3.1E-02	C	3.1E-02	5.3E-06	C	1.0E-02	1.0E-02	I	9.8E-02	A
74-87-3	Chloromethane	NA	1	NC		NC	NC		2.6E-02	2.6E-02	R	9.0E-02	I
110-82-7	Cyclohexane	NA	1	NC		NC	NC		1.7E+00	1.7E+00	R	6.0E+00	I
124-48-1	Dibromochloromethane	0.1	1	9.4E-02	C	9.4E-02	2.7E-05	C	2.0E-02	2.0E-02	I	7.0E-02	R
156-59-2	Dichloroethene, cis-1,2-	NA	1	NC		NC	NC		2.0E-03	2.0E-03	I	7.0E-03	R
156-60-5	Dichloroethene, trans-1,2-	NA	1	NC		NC	NC		2.0E-02	2.0E-02	I	6.0E-02	P
10061-02-6	Dichloropropene, trans-1,3-*	NA	1	9.1E-02	C	9.1E-02	1.6E-05	C	3.0E-02	3.0E-02	I	2.0E-02	I
64-17-5	Ethanol*	NA	1	NC		NC	NC		5.0E-01	5.0E-01	I	4.0E+00	C
100-41-4	Ethylbenzene	NA	1	1.1E-02	C	1.1E-02	2.5E-06	C	1.0E-01	1.0E-01	I	1.0E+00	I
142-82-5	Heptane*	NA	1	NC		NC	NC		6.0E-02	6.0E-02	H	7.0E-01	I
87-68-3	Hexachloro-1,3-butadiene	0.1	1	7.8E-02	I	7.8E-02	2.2E-05	I	1.0E-03	1.0E-03	P	3.5E-03	R

Table A-4
Chronic Toxicity Criteria

CAS Number	Chemical of Concern	Dermal ABS^	GI ABS^	Cancer Toxicity Criteria: Oral Cancer Slope Factor (mg/kg-day)$^{-1}$	Source	Dermal Cancer Slope Factor (mg/kg-day)$^{-1}$	Inhalation Unit Risk (μg/m^3)$^{-1}$	Source	Noncancer Toxicity Criteria: Oral RfD (mg/kg-day)	Dermal RfD (mg/kg-day)	Source	Inhalation RfC or REL (mg/m^3)	Source
110-54-3	Hexane	NA	1	NC		NC	NC		6.0E-02	6.0E-02	H	7.0E-01	I
67-63-0	Isopropanol	0.1	1	NC		NC	NC		NA	NA		7.0E+00	C
98-82-8	Isopropylbenzene (cumene)	NA	1	NC		NC	NC		1.0E-01	1.0E-01	I	4.0E-01	I
78-93-3	Methyl ethyl ketone (2-butanone)	NA	1	NC		NC	NC		6.0E-01	6.0E-01	I	5.0E+00	I
75-09-2	Methylene chloride	NA	1	1.4E-02	C	1.4E-02	1.0E-06	C	6.0E-03	6.0E-03	I	6.0E-01	I
1634-04-4	Methyl-tert-butyl ether	NA	1	1.8E-03	C	1.8E-03	2.6E-07	C	8.6E-01	8.6E-01	R	3.0E+00	I
103-65-1	Propylbenzene	0.1	1	NC		NC	NC		1.0E-01	1.0E-01	X	1.0E+00	X
75-65-0	tert-Butyl Alcohol (TBA)*	0.1	1	NC		NC	NC		3.0E-01	3.0E-01	I	1.1E+00	R
127-18-4	Tetrachloroethene	NA	1	5.4E-01	C	5.4E-01	5.9E-06	C	6.0E-03	6.0E-03	I	4.0E-02	I
109-99-9	Tetrahydrofuran	0.1	1	NC		NC	NC		9.0E-01	9.0E-01	I	2.0E+00	I
108-88-3	Toluene	NA	1	NC		NC	NC		8.0E-02	8.0E-02	I	5.0E+00	I
79-01-6	Trichloroethene	NA	1	4.6E-02	I	4.6E-02	4.1E-06	I	5.0E-04	5.0E-04	I	2.0E-03	I
75-01-4	Vinyl chloride	NA	1	2.7E-01	C	2.7E-01	7.8E-05	C	3.0E-03	3.0E-03	I	1.0E-01	I
108-38-3	Xylene, m-	NA	1	NC		NC	NC		2.0E-01	2.0E-01	S	1.0E-01	S
95-47-6	Xylene, o-	NA	1	NC		NC	NC		2.0E-01	2.0E-01	S	1.0E-01	S
106-42-3	Xylene, p-	NA	1	NC		NC	NC		2.0E-01	2.0E-01	S	1.0E-01	S

Notes:

" NA " not available; " -- " not applicable; " NC " not considered a carcinogen; " ABS " absorption; " GI " gastrointestinal; " PAH " Polycyclic Aromatic Hydrocarbons; " RfD " reference dose; " RfC " reference concentration; " REL " reference exposure level

Surrogates: * p-Xylene for 4-Ethyltoluene; Hexane for Heptane; Isobutyl alcohol for tert-Butyl Alcohol; 1,3-Dichloropropene for trans-1,3-Dichloropropene; Methanol for Ethanol

^ Source of Dermal ABS and GI ABS: USEPA 2013b. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May. http://www.epa.gov/region9/superfund//prg/index.html

Key:

C* = Cal-EPA 2010

C = Cal-EPA 2013

A = Agency For Toxic Substances And Disease Registry (ATSDR) as reported in USEPA 2013b

B = Cal-EPA 2009. Interim Guidance: Evaluating Human Health Risks from Total Petroleum Hydrocarbons.

D = TPHCWG, 1997. Develoment of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for TPH

H = Health Effects Assessment Summary Tables (HEAST). July. EPA 540/R-97-036-PB97-921199 as reported in USEPA 2013b

I = Integrated Risk Information System Database, IRIS in USEPA 2013a

J = New Jersey; reported in USEPA 2013b

P = Provisional Peer Reviewed Toxicity Value (PPRTV) as reported in USEPA 2013b

R = route-to-route extrapolation

S = reported in USEPA 2013b

X = PPRTV Appendix; reported in USEPA 2013b

Table A-5
Exposure Concentration for Outdoor Inhalation of Particulates/Vapors from Soil
Former Kast Property
Carson, California

(1) Exposure Concentration Equations

a) Noncarcinogenic Chemicals

$$EC_{inh,soil} = \frac{EF \times ED \times ET}{AT_{NC} \times \left(VF_{soil} \text{ or } VF_{soil\text{-}OA}\right)}$$

b) Carcinogenic Chemicals – Onsite Resident

$$EC_{inh,soil} = \left[\frac{EF \times ED \times ET}{AT_{C} \times VF_{soil}}\right]_{CHILD} + \left[\frac{EF \times ED \times ET}{AT_{C} \times VF_{soil}}\right]_{ADULT}$$

c) Carcinogenic Chemicals – Construction and Utility Maintenance Worker

$$EC_{inh,soil} = \frac{EF \times ED \times ET}{AT_{C} \times VF_{soil\text{-}OA}}$$

(2) Explanation of Variables

Variable	Description	Units
$EC_{inh,soil}$	Exposure concentration outdoor inhalation of chemicals from soil	mg/m^3 per mg/kg
PEF	Particulate emission factor for non-VOCs	m^3/kg
VF_{soil}	Volatilization factor, onsite resident	mg/m^3 per mg/kg
$VF_{soil\text{-}OA}$	Volatilization factor for VOCs, construction and utility maintenance worker	mg/m^3 per mg/kg
EF	Exposure frequency	day/yr
ED	Exposure duration	yr
ET	Exposure time	hour/hour
AT_C	Averaging time – cancer effects	day
AT_{NC}	Averaging time – noncancer effects	day

Table A-6
Exposure Concentration for Outdoor Inhalation from Soil Vapor
Former Kast Property
Carson, California

(1) Exposure Concentration Equations

a) Noncarcinogenic Chemicals – Construction and Utility Maintenance Worker

$$EC_{SV\text{-}OA} = \frac{EF \times ED \times ET}{AT_{NC} \times CF \times VF_{SV\text{-}OA}}$$

b) Carcinogenic Chemicals – Construction and Utility Maintenance Worker

$$EC_{SV\text{-}OA} = \frac{EF \times ED \times ET}{AT_{C} \times CF \times VF_{SV\text{-}OA}}$$

(2) Explanation of Variables

Variable	Description	Units
$EC_{SV\text{-}OA}$	Exposure concentration for outdoor inhalation of chemicals from soil vapor	mg/m^3 per mg/m^3
$VF_{SV\text{-}OA}$	Volatilization factor	$\mu g/m^3$ per $\mu g/m^3$
EF	Exposure frequency	day/yr
ED	Exposure duration	yr
ET	Exposure time	hour/hour
CF	Units conversion factor	µg/mg
AT_C	Averaging time – cancer effects	day
AT_{NC}	Averaging time – noncancer effects	day

Table A-7
Exposure Concentration for Indoor Inhalation from Sub-Slab Soil Vapor
Former Kast Property
Carson, California

(1) Exposure Concentration Equations

a) Noncarcinogenic Chemicals – Onsite Resident

$$EC_{SS\text{-}SV\text{-}IA} = \frac{EF \times ED \times ET}{AT_{NC}}$$

b) Carcinogenic Chemicals – Onsite Resident

$$EC_{SS\text{-}SV\text{-}IA} = \frac{EF \times ED \times ET}{AT_{C}}$$

(2) Explanation of Variables

Variable	Description	Units
$EC_{SS\text{-}SV\text{-}IA}$	Exposure concentration for indoor inhalation of chemicals (sub-slab soil vapor into indoor air)	mg/m^3 per mg/m^3
EF	Exposure frequency	day/yr
ED	Exposure duration	yr
ET	Exposure time	hour/hour
AT_C	Averaging time – cancer effects	day
AT_{NC}	Averaging time – noncancer effects	day

Table A-8
Intake Factor for Dermal Contact with Soil
Former Kast Property
Carson, California

(1) Intake Factor Equations

a) Noncarcinogenic Chemicals

$$IF_{dermal} = \frac{SA \times AF \times ABS \times CF \times EF \times ED}{BW \times AT_{NC}}$$

b) Carcinogenic Chemicals – Onsite Resident

$$IF_{dermal} = \left[\frac{SA \times AF \times ABS \times CF \times EF \times ED}{BW \times AT_C}\right]_{CHILD} + \left[\frac{SA \times AF \times ABS \times CF \times EF \times ED}{BW \times AT_C}\right]_{ADULT}$$

c) Carcinogenic Chemicals – Construction and Utility Maintenance Worker

$$IF_{dermal} = \frac{SA \times AF \times ABS \times CF \times EF \times ED}{BW \times AT_C}$$

(2) Explanation of Variables

Variable	Description	Units
IF_{dermal}	Intake factor for dermal contact with soil	kg soil / kg body weight per day
SA	Surface area of exposed skin	cm^2/day
AF	Soil-to-skin adherence factor	mg/cm^2
ABS	Absorption factor	–
CF	Units conversion factor	kg/mg
EF	Exposure frequency	day/yr
ED	Exposure duration	yr
BW	Body weight	kg
AT_C	Averaging time – cancer effects	day
AT_{NC}	Averaging time – noncancer effects	day

Table A-9
Intake Factor for Incidental Soil Ingestion
Former Kast Property
Carson, California

(1) Intake Factor Equations

a) Noncarcinogenic Chemicals

$$IF_{oral} = \frac{IR \times CF \times EF \times ED}{BW \times AT_{NC}}$$

b) Carcinogenic Chemicals – Onsite Resident

$$IF_{oral} = \left[\frac{IR \times CF \times EF \times ED}{BW \times AT_{C}}\right]_{CHILD} + \left[\frac{IR \times CF \times EF \times ED}{BW \times AT_{C}}\right]_{ADULT}$$

c) Carcinogenic Chemicals – Construction and Utility Maintenance Worker

$$IF_{oral} = \frac{IR \times CF \times EF \times ED}{BW \times AT_{C}}$$

(2) Explanation of Variables

Variable	Description	Units
IF_{oral}	Intake factor for soil ingestion	kg soil / kg body weight per day
IR	Ingestion rate of soil	mg/day
CF	Units conversion factor	kg/mg
EF	Exposure frequency	day/yr
ED	Exposure duration	yr
BW	Body weight	kg
AT_C	Averaging time – cancer effects	day
AT_{NC}	Averaging time – noncancer effects	day

Table A-10

Site-Specific Cleanup Goals for Soil, Onsite Resident

Chemical of Concern	CAS Number	Onsite Resident			
		Soil (mg/kg)			
		EF = 350 d/y*		EF = 4 d/y*	
		$SSCG_{nc}$	$SSCG_c$	$SSCG_{nc}$	$SSCG_c$
Inorganics					
Antimony	7440-36-0	3.1E+01	--	2.7E+03	--
Arsenic	7440-38-2	2.2E+01	6.1E-02	1.9E+03	5.4E+00
Cadmium	7440-43-9	7.0E+01	6.7E+04	6.2E+03	5.8E+06
Chromium VI	18540-29-9	2.3E+02	1.3E+00	2.1E+04	1.1E+02
Cobalt	7440-48-4	2.3E+01	3.1E+04	2.1E+03	2.7E+06
Copper	7440-50-8	3.1E+03	--	2.7E+05	--
Lead	7439-92-1	8.0E+01[(a)]	--	8.2E+02[(b)]	--
Thallium	7440-28-0	7.8E-01	--	6.8E+01	--
Vanadium	7440-62-2	3.9E+02	--	3.4E+04	--
Zinc	7440-66-6	2.3E+04	--	2.1E+06	--
PAHs					
Benz[a]anthracene	56-55-3	--	1.6E+00	--	1.4E+02
Benzo[a]pyrene	50-32-8	--	1.6E-01	--	1.4E+01
Benzo[b]fluoranthene	205-99-2	--	1.6E+00	--	1.4E+02
Benzo[k]fluoranthene	207-08-9	--	1.6E+00	--	1.4E+02
Chrysene	218-01-9	--	1.6E+01	--	1.4E+03
Dibenz[a,h]anthracene	53-70-3	--	1.1E-01	--	9.7E+00
Indeno[1,2,3-cd]pyrene	193-39-5	--	1.6E+00	--	1.4E+02
Methylnaphthalene, 1-	90-12-0	4.0E+03	1.6E+01	3.5E+05	1.4E+03
Methylnaphthalene, 2-	91-57-6	2.3E+02	--	2.0E+04	--
Naphthalene	91-20-3	1.5E+02	4.0E+00	1.3E+04	3.5E+02
Pyrene	129-00-0	1.7E+03	--	1.5E+05	--
TPH					
Aliphatic: C_5-C_8		7.1E+02	--	6.2E+04	--
Aliphatic: C_9-C_{18}		1.4E+03	--	1.3E+05	--
Aliphatic: C_{19}-C_{32}		1.1E+05	--	1.0E+07	--
Aromatic: C_6-C_8		--	--	--	--
Aromatic: C_9-C_{16}		6.0E+02	--	5.3E+04	--
Aromatic: C_{17}-C_{32}		1.7E+03	--	1.5E+05	--
TPHg		7.6E+02	--	6.6E+04	--
TPHd		1.3E+03	--	1.1E+05	--
TPHmo		3.3E+03	--	2.9E+05	--
SVOCs					
2,4-Dinitrotoluene	121-14-2	1.2E+02	1.6E+00	1.1E+04	1.4E+02
Bis(2-Ethylhexyl) Phthalate	117-81-7	1.2E+03	3.5E+01	1.1E+05	3.0E+03
VOCs					
1,1,2,2-Tetrachloroethane	79-34-5	6.2E+02	4.7E-01	5.4E+04	4.1E+01
1,2,3-Trichloropropane	96-18-4	2.4E+00	2.1E-02	2.1E+02	1.9E+00
1,2,4-Trimethylbenzene	95-63-6	8.3E+01	--	7.2E+03	--
1,2-Dichloropropane	78-87-5	1.5E+01	8.3E-01	1.3E+03	7.2E+01
1,3,5-Trimethylbenzene	108-67-8	8.5E+01	--	7.4E+03	--

Table A-10

Site-Specific Cleanup Goals for Soil, Onsite Resident

Chemical of Concern	CAS Number	Onsite Resident			
		Soil (mg/kg)			
		EF = 350 d/y*		EF = 4 d/y*	
		$SSCG_{nc}$	$SSCG_c$	$SSCG_{nc}$	$SSCG_c$
1,4-Dichlorobenzene	106-46-7	3.6E+03	2.8E+00	3.2E+05	2.4E+02
Benzene	71-43-2	6.7E+01	2.2E-01	5.8E+03	1.9E+01
Bromodichloromethane	75-27-4	4.3E+02	4.9E-01	3.8E+04	4.2E+01
Bromomethane	74-83-9	8.8E+00	--	7.7E+02	--
Ethylbenzene	100-41-4	3.3E+03	4.8E+00	2.9E+05	4.2E+02
Methylene chloride	75-09-2	3.6E+02	5.3E+00	3.2E+04	4.7E+02
Tetrachloroethene	127-18-4	8.6E+01	5.5E-01	7.5E+03	4.9E+01
Trichloroethene	79-01-6	5.8E+00	1.2E+00	5.0E+02	1.0E+02
Vinyl chloride	75-01-4	7.4E+01	3.2E-02	6.4E+03	2.8E+00

Notes:

" -- " not applicable; " na " not available

* EF: exposure frequency; 350 days/year (d/y) for a typical resident and 4 days/year for a resident who infrequently contacts subsurface soils.

" $SSCG_{nc}$ " Site-Specific cleanup goal using a target noncancer hazard = 1

" $SSCG_c$ " Site-Specific cleanup goal using a target cancer risk = 1×10^{-6} for residents

Soil SSCGs based on incidental ingestion, dermal contact with soil, and outdoor air inhalation

[a] Cal-EPA 2009b. Revised California Human Health Screening Levels for Lead. September 2009.

[b] Based on USEPA adult lead model, similar parameters used for the residential CHHSL, and a lower exposure frequency.

Table A-11
Site-Specific Cleanup Goals for Sub-Slab Soil Vapor, Onsite Resident
Former Kast Property
Carson, California

Chemical of Concern	CAS Number	Onsite Resident	
		Sub-Slab Soil Vapor (µg/m³)	
		$SSCG_{nc}$	$SSCG_{c}$
VOCs			
1,1,1-Trichloroethane	71-55-6	5.2E+06	--
1,1,2,2-Tetrachloroethane	79-34-5	7.3E+04	4.2E+01
1,1,2-Trichloroethane	79-00-5	2.1E+02	1.5E+02
1,1-Dichloroethane	75-34-3	7.3E+05	1.5E+03
1,2,4-Trichlorobenzene	120-82-1	2.1E+03	--
1,2,4-Trimethylbenzene	95-63-6	7.3E+03	--
1,2-Dichloroethane	107-06-2	7.3E+03	1.2E+02
1,2-Dichloropropane	78-87-5	4.2E+03	2.4E+02
1,3,5-Trimethylbenzene	108-67-8	7.3E+03	--
1,3-Butadiene	106-99-0	2.1E+03	1.4E+01
1,4-Dichlorobenzene	106-46-7	8.3E+05	2.2E+02
1,4-Dioxane	123-91-1	3.1E+06	3.2E+02
2,2,4-Trimethylpentane	540-84-1	1.0E+06	--
2-Hexanone	591-78-6	3.1E+04	--
4-Ethyltoluene	622-96-8	1.0E+05	--
Benzene	71-43-2	3.1E+04	8.4E+01
Bromodichloromethane	75-27-4	7.3E+04	6.6E+01
Bromomethane	74-83-9	5.2E+03	--
Carbon disulfide	75-15-0	7.3E+05	--
Carbon tetrachloride	56-23-5	1.0E+05	5.8E+01
Chloroform	67-66-3	1.0E+05	4.6E+02
Chloromethane	74-87-3	9.4E+04	--
Cyclohexane	110-82-7	6.3E+06	--
Dibromochloromethane	124-48-1	7.3E+04	9.0E+01
Dichloroethene, cis-1,2-	156-59-2	7.3E+03	--
Dichloroethene, trans-1,2-	156-60-5	6.3E+04	--
Dichloropropene, trans-1,3-	10061-02-6	2.1E+04	1.5E+02
Ethanol	64-17-5	4.2E+06	--
Ethylbenzene	100-41-4	1.0E+06	9.7E+02
Heptane	142-82-5	7.3E+05	--
Hexachloro-1,3-butadiene	87-68-3	3.7E+03	1.1E+02
Hexane	110-54-3	7.3E+05	--
Isopropanol	67-63-0	7.3E+06	--
Isopropylbenzene (cumene)	98-82-8	4.2E+05	--
Methyl ethyl ketone (2-butanone)	78-93-3	5.2E+06	--
Methylene chloride	75-09-2	6.3E+05	2.4E+03
Methyl-tert-butyl ether	1634-04-4	3.1E+06	9.4E+03
Naphthalene	91-20-3	3.1E+03	7.2E+01
Propylbenzene	103-65-1	1.0E+06	--

Table A-11
Site-Specific Cleanup Goals for Sub-Slab Soil Vapor, Onsite Resident
Former Kast Property
Carson, California

Chemical of Concern	CAS Number	Onsite Resident	
		Sub-Slab Soil Vapor (µg/m^3)	
		$SSCG_{nc}$	$SSCG_c$
tert-Butyl Alcohol (TBA)	75-65-0	1.1E+06	--
Tetrachloroethene	127-18-4	4.2E+04	4.1E+02
Tetrahydrofuran	109-99-9	2.1E+06	--
Toluene	108-88-3	5.2E+06	--
Trichloroethene	79-01-6	2.1E+03	4.3E+02
Vinyl chloride	75-01-4	1.0E+05	3.1E+01
Xylene, m-	108-38-3	1.0E+05	--
Xylene, o-	95-47-6	1.0E+05	--
Xylene, p-	106-42-3	1.0E+05	--
TPH			
Aliphatic: C_5-C_8		7.3E+05	--
Aliphatic: C_9-C_{18}		3.1E+05	--
Aliphatic: C_{19}-C_{32}		--	--
Aromatic: C_6-C_8		--	--
Aromatic: C_9-C_{16}		5.2E+04	--
Aromatic: C_{17}-C_{32}		--	--
TPHg		1.4E+05	--
TPHd		1.6E+05	--
TPHmo		--	--

Notes:

" -- " not applicable or not available

" $SSCG_{nc}$ " Site-Specific cleanup goal using a target noncancer hazard = 1

" $SSCG_c$ " Site-Specific cleanup goal using a target cancer = 1×10^{-6} for onsite residents

Sub-Slab Soil Vapor SSCGs based on indoor air inhalation of vapors

Table A-12

Site-Specific Cleanup Goals for Soil,
Construction and Utility Maintenance Worker

Chemical of Concern	CAS Number	Construction and Utility Maintenance Worker Soil (mg/kg)	
		$SSCG_{nc}$	$SSCG_c$
Inorganics			
Antimony	7440-36-0	3.1E+03	--
Arsenic	7440-38-2	4.1E+02	1.5E+01
Cadmium	7440-43-9	6.4E+02	2.4E+02
Chromium VI	18540-29-9	3.2E+03	6.7E+00
Cobalt	7440-48-4	2.0E+02	1.1E+02
Copper	7440-50-8	3.1E+05	--
Lead	7439-92-1	8.2E+02[(a)]	--
Thallium	7440-28-0	7.7E+01	--
Vanadium	7440-62-2	3.3E+03	--
Zinc	7440-66-6	2.3E+06	--
PAHs			
Benz[a]anthracene	56-55-3	--	2.6E+02
Benzo[a]pyrene	50-32-8	--	2.6E+01
Benzo[b]fluoranthene	205-99-2	--	2.6E+02
Benzo[k]fluoranthene	207-08-9	--	2.6E+02
Chrysene	218-01-9	--	2.6E+03
Dibenz[a,h]anthracene	53-70-3	--	1.9E+01
Indeno[1,2,3-cd]pyrene	193-39-5	--	2.6E+02
Methylnaphthalene, 1-	90-12-0	1.9E+05	2.7E+03
Methylnaphthalene, 2-	91-57-6	1.1E+04	--
Naphthalene	91-20-3	1.4E+02	3.9E+01
Pyrene	129-00-0	6.7E+04	--
TPH			
Aliphatic: C_5-C_8		8.3E+02	--
Aliphatic: C_9-C_{18}		1.6E+03	--
Aliphatic: C_{19}-C_{32}		5.5E+06	--
Aromatic: C_6-C_8		--	--
Aromatic: C_9-C_{16}		7.5E+02	--
Aromatic: C_{17}-C_{32}		8.3E+04	--
TPHg		9.0E+02	
TPHd		1.9E+03	
TPHmo		1.6E+05	
SVOCs			
2,4-Dinitrotoluene	121-14-2	6.3E+03	2.8E+02
Bis(2-Ethylhexyl) Phthalate	117-81-7	6.3E+04	6.4E+03
VOCs			
1,1,2,2-Tetrachloroethane	79-34-5	8.3E+02	5.7E+00
1,2,3-Trichloropropane	96-18-4	2.0E+00	7.2E+00
1,2,4-Trimethylbenzene	95-63-6	7.5E+01	--
1,2-Dichloropropane	78-87-5	1.2E+01	8.5E+00
1,3,5-Trimethylbenzene	108-67-8	7.7E+01	--

Table A-12

Site-Specific Cleanup Goals for Soil, Construction and Utility Maintenance Worker

Chemical of Concern	CAS Number	Construction and Utility Maintenance Worker	
		Soil (mg/kg)	
		$SSCG_{nc}$	$SSCG_c$
1,4-Dichlorobenzene	106-46-7	8.7E+03	2.8E+01
Benzene	71-43-2	6.9E+01	2.2E+00
Bromodichloromethane	75-27-4	4.9E+02	5.3E+00
Bromomethane	74-83-9	7.8E+00	--
Ethylbenzene	100-41-4	4.5E+03	5.1E+01
Methylene chloride	75-09-2	1.2E+03	5.9E+01
Tetrachloroethene	127-18-4	8.6E+01	1.0E+01
Trichloroethene	79-01-6	5.5E+00	1.9E+01
Vinyl chloride	75-01-4	8.7E+01	3.1E-01

Notes:

" -- " not applicable or not available

" $SSCG_{nc}$ " Site-Specific cleanup goal using a target noncancer hazard = 1

" $SSCG_c$ " Site-Specific cleanup goal using a target cancer = 1×10^{-5} for workers

Soil SSCGs based on incidental ingestion, dermal contact with soil, and outdoor air inhalation

[a] Based on USEPA adult lead model, similar parameters used for the industrial worker CHHSL, and a lower exposure frequency.

Table A-13

Site-Specific Cleanup Goals for Soil Vapor,
Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

Chemical of Concern	CAS Number	Construction and Utility Maintenance Worker Soil Vapor (µg/m^3)	
		$SSCG_{nc}$	$SSCG_c$
VOCs			
1,1,1-Trichloroethane	71-55-6	7.4E+09	--
1,1,2,2-Tetrachloroethane	79-34-5	1.8E+07	1.2E+05
1,1,2-Trichloroethane	79-00-5	1.0E+05	8.6E+05
1,1-Dichloroethane	75-34-3	9.9E+08	2.5E+07
1,2,4-Trichlorobenzene	120-82-1	3.9E+05	--
1,2,4-Trimethylbenzene	95-63-6	2.3E+06	--
1,2-Dichloroethane	107-06-2	4.4E+06	8.5E+05
1,2-Dichloropropane	78-87-5	3.6E+06	2.5E+06
1,3,5-Trimethylbenzene	108-67-8	2.3E+06	--
1,3-Butadiene	106-99-0	3.7E+06	3.0E+05
1,4-Dichlorobenzene	106-46-7	2.3E+08	7.2E+05
1,4-Dioxane	123-91-1	1.3E+08	1.6E+05
2,2,4-Trimethylpentane	540-84-1	6.5E+08	--
2-Hexanone	591-78-6	7.9E+06	--
4-Ethyltoluene	622-96-8	2.5E+07	--
Benzene	71-43-2	3.2E+07	1.0E+06
Bromodichloromethane	75-27-4	7.2E+07	7.8E+05
Bromomethane	74-83-9	9.5E+06	--
Carbon disulfide	75-15-0	1.4E+09	--
Carbon tetrachloride	56-23-5	1.6E+08	1.1E+06
Chloroform	67-66-3	9.0E+07	4.9E+06
Chloromethane	74-87-3	1.7E+08	--
Cyclohexane	110-82-7	1.8E+10	--
Dibromochloromethane	124-48-1	6.0E+07	8.8E+05
Dichloroethene, cis-1,2-	156-59-2	8.3E+06	--
Dichloroethene, trans-1,2-	156-60-5	9.3E+07	--
Dichloropropene, trans-1,3-	10061-02-6	4.4E+07	3.9E+06
Ethanol	64-17-5	1.9E+08	--
Ethylbenzene	100-41-4	6.3E+08	7.0E+06
Heptane	142-82-5	2.3E+09	--
Hexachloro-1,3-butadiene	87-68-3	2.2E+05	8.0E+04
Hexane	110-54-3	1.7E+09	--
Isopropanol	67-63-0	5.7E+08	--
Isopropylbenzene (cumene)	98-82-8	1.5E+09	--
Methyl ethyl ketone (2-butanone)	78-93-3	1.1E+09	--
Methylene chloride	75-09-2	6.1E+08	2.8E+07
Methyl-tert-butyl ether	1634-04-4	1.8E+09	6.5E+07
Naphthalene	91-20-3	2.3E+05	6.3E+04
Propylbenzene	103-65-1	6.6E+08	--

Table A-13

Site-Specific Cleanup Goals for Soil Vapor,
Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

Chemical of Concern	CAS Number	Construction and Utility Maintenance Worker	
		Soil Vapor (µg/m^3)	
		$SSCG_{nc}$	$SSCG_c$
tert-Butyl Alcohol (TBA)	75-65-0	2.6E+08	--
Tetrachloroethene	127-18-4	5.5E+07	6.6E+06
Tetrahydrofuran	109-99-9	4.9E+08	--
Toluene	108-88-3	3.7E+09	--
Trichloroethene	79-01-6	2.0E+06	6.7E+06
Vinyl chloride	75-01-4	2.3E+08	8.3E+05
Xylene, m-	108-38-3	6.0E+07	--
Xylene, o-	95-47-6	4.8E+07	--
Xylene, p-	106-42-3	5.9E+07	--
TPH			
Aliphatic: C_5-C_8		1.2E+09	--
Aliphatic: C_9-C_{18}		1.2E+08	--
Aliphatic: C_{19}-C_{32}		--	--
Aromatic: C_6-C_8		--	--
Aromatic: C_9-C_{16}		6.7E+06	--
Aromatic: C_{17}-C_{32}		--	--
TPHg		2.2E+07	--
TPHd		2.3E+07	--
TPHmo		--	--

Notes:

" -- " not applicable or not available

" $SSCG_{nc}$ " Site-Specific cleanup goal using a target noncancer hazard = 1

" $SSCG_c$ " Site-Specific cleanup goal using a target cancer = 1×10^{-5} for workers

Soil Vapor SSCGs based on outdoor air inhalation of vapors emanating from the subsurface

Table A-14
Site-Specific Cleanup Goals for Soil, Background
Former Kast Property
Carson, California

Chemical of Concern	CAS Number	SSCG (mg/kg)
Inorganics		
Antimony	7440-36-0	0.74
Arsenic	7440-38-2	12
Barium	7440-39-3	267
Beryllium	7440-41-7	0.56
Cadmium	7440-43-9	3.81
Chromium	16065-83-1	32.5
Chromium VI	18540-29-9	--
Cobalt	7440-48-4	10.9
Copper	7440-50-8	59.0
Lead	7439-92-1	61.5
Mercury	7439-97-6	0.13
Molybdenum	7439-98-7	0.41
Nickel	7440-02-0	20.2
Selenium	7782-49-2	0.78
Silver	7440-22-4	1.29
Thallium	7440-28-0	0.23
Vanadium	7440-62-2	45.7
Zinc	7440-66-6	291
PAHs		
Bap-TEQ		0.9

Notes:
" -- " not available
" SSCG " Site-Specific cleanup goal

Table A-15

LARWQCB Attenuation Factor Method and USEPA RSL Soil Cleanup Goal Method Parameters

Former Kast Property

Carson, California

Parameter	Unit	Value	Rationale
Chemical Properties			
Koc	(µg/g) / (µg/mL)	chemical-specific	USEPA RSL Database
Kd	(µg/g) / (µg/mL)	chemical-specific	WET data, or Kd = Koc × foc if WET data not available
K_H	unitless	chemical-specific	USEPA RSL Database
Stratum Property			
Porosity	unitless	0.421	Site-specifc data
Soil water content by volume	unitless	0.239	Site-specifc data
foc	unitless	0.00825	Site-specifc data
Bulk Density	g/cm^3	1.54	Site soil physical data
Soil type	-	sand	Conservative assumption based on boring logs

Reference:

USEPA 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. May. URL: http://www.epa.gov/region9/superfund//prg/index.html

Table A-16

. SAM model DAF calculation

Former Kast Property

Carson, California

Parameter		Value	Unit	Rationale
P	Annual precipitation	34.5	cm/yr	From SEVIEW database
I_f	Net infiltration	0.0214	m/yr	Assumed sand soil type, Eqn. 1
W	Lateral width of affected soil zone in direction of GW flow	184	m	elevated benzene plume length along GW flow using 2011 and 2013 2nd quarter data
a_v	Vertical groundwater dispersivity	1.03	m	Eqn. 2
K	Hydraulic conductivity of water-bearing unit	2.5	m/day	default value for fine sand, Todd, Groundwater Hydrogeology, 1980
i	Hydraulic gradient of water-bearing unit	0.002	m/m	2013 2nd quarter GW monitoring report
b	Aquifer thickness	11.3	m	37 ft, assumed the top of Gage aquifer is the lower boundary of the shallow GW zone
U_{gw}	Groundwater darcy velocity	1.83	m/yr	Eqn. 3
δ_{gw}	Groundwater mixing zone thickness	11.3	m	Eqn. 4 or the aquifer thickness, whichever is smaller.
LDF	Leachate Dilution Factor	6	unitless	Eqn. 5

Notes:

Eqn. 1. $I_f = 0.0018 \times P^2$

Eqn. 2. $\alpha_v = 0.0056 \times W$

Eqn. 3. $U_{gw} = K \cdot i$

Eqn. 4. $\delta_{gw} = \sqrt{2 \cdot \alpha_v \cdot W} + b[1 - exp(\frac{-I_f \cdot W}{U_{gw} \cdot b})]$

Eqn. 5. $DAF = 1 + \frac{U_{gw} \cdot \delta_{gw}}{I_f \cdot W}$

Table A-17

Site-Specific Cleanup Goal based on Soil Leaching to Groundwater

Former Kast Property

Carson, California

Chemical of Potential Concern	Site Specific Kd (L/kg)	Groundwater quality criterion (μg/L)	Source	Dilution Attenuation Factor (DAF)	Soil Cleanup Goals (mg/kg)
Site-related Soil COCs					
Arsenic	NM	10	MCL	6.2	1.8
Benzene	28	1.0	MCL	6.2	0.13
Naphthalene	1093	17	CDPH NL	6.2	88
TPH as Diesel	4119	200	ESL-nc	6.2	3900
TPH as Gasoline	374	410	ESL-nc	6.2	730
TPH as Motor Oil	6957	6200	ESL-nc	6.2	50,000 **
Non-site-related Soil COC					
1,2,3-Trichloropropane	NM	0.005	CDPH NL	6.2	0.000026
1,2-Dichloroethane	NM	0.5	MCL	6.2	0.0020
1,4-Dichlorobenzene	NM	5.0	MCL	6.2	0.077
Antimony	NM	6.0	MCL	6.2	1.7
cis-1,2-Dichloroethylene	NM	6.0	MCL	6.2	0.024
tert-Butyl Alcohol	NM	12	CDPH NL	6.2	0.049
Tetrachloroethene	NM	5.0	MCL	6.2	0.036
Thallium	NM	2.0	MCL	6.2	0.89
Trichloroethene	NM	5.0	MCL	6.2	0.020
Vinyl Chloride	NM	0.50	MCL	6.2	0.0020

Note:

NM - Not measured

ND - Not detected

MCL - Maximum Contaminant Level.

ESL - San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels, Groundwater Screening Levels for Drinking Water.

ESL -nc: ESL level based on non-cancer health effect.

CDPH NL - California Department of Public Health Notification Level..

PHG - California Public Health Goal.

* ESL value for 2-methylnaphthalene was used.

** Calculated cleanup level exceeded the maximum immobile residual NAPL phase concentration of 53,067 mg/kg ($C_{res,soil}$), therefore $C_{res,soil}$ was used. Cres,soil obtained from: Brost, E.J. and Devaull, G.E., Non-Aqueous Phase Liquid (NAPL) Mobility Limits in Soil. Americal Petroleum Institute Research Bulletin No. 9. June 2000.

ATTACHMENTS

ATTACHMENT A1

SSCG Derivation Spreadsheets

Attachment A1, Table A1-1
Derivation of Site-Specific Cleanup Goals, Soil
Onsite Resident
Former Kast Property
Carson, California

CAS Number	Chemical of Concern	Noncancer Effects							Cancer Effects						
		Ingestion		Dermal Contact		Outdoor Inhalation			Ingestion		Dermal Contact		Outdoor Inhalation		
		IF_{oral} (mg/kg-day)	Reference Dose (mg/kg-day)	IF_{dermal} (mg/kg-day)	Reference Dose (mg/kg-day)	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Reference Concentration (mg/m^3)	**$SSCG_{soil-nc}$** (mg/kg)	IF_{oral} (mg/kg-day)	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	IF_{dermal} (mg/kg-day)	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	**$SSCG_{soil-c}$** (mg/kg)
	Inorganics														
7440-36-0	Antimony	1.3E-05	4.0E-04	--	6.0E-05	8.3E-12	NA	**3.1E+01**	1.6E-06	NC	--	NC	3.6E-12	NC	**--**
7440-38-2	Arsenic	1.3E-05	3.0E-04	1.1E-06	3.0E-04	8.3E-12	1.5E-05	**2.2E+01**	1.6E-06	9.5E+00	1.5E-07	9.5E+00	3.6E-12	3.3E-03	**6.1E-02**
7440-43-9	Cadmium	1.3E-05	1.0E-03	3.6E-08	2.5E-05	8.3E-12	2.0E-05	**7.0E+01**	1.6E-06	NC	4.9E-09	NC	3.6E-12	4.2E-03	**6.7E+04**
18540-29-9	Chromium VI	1.3E-05	3.0E-03	--	7.5E-05	8.3E-12	1.0E-04	**2.3E+02**	1.6E-06	5.0E-01	--	NC	3.6E-12	1.5E-01	**1.3E+00**
7440-48-4	Cobalt	1.3E-05	3.0E-04	--	3.0E-04	8.3E-12	6.0E-06	**2.3E+01**	1.6E-06	NC	--	NC	3.6E-12	9.0E-03	**3.1E+04**
7440-50-8	Copper	1.3E-05	4.0E-02	--	4.0E-02	8.3E-12	NA	**3.1E+03**	1.6E-06	NC	--	NC	3.6E-12	NC	**--**
7439-92-1	Lead	1.3E-05	NA	--	NA	8.3E-12	NA	**--**	1.6E-06	NC	--	NC	3.6E-12	NC	**--**
7440-28-0	Thallium	1.3E-05	1.0E-05	--	1.0E-05	8.3E-12	NA	**7.8E-01**	1.6E-06	NC	--	NC	3.6E-12	NC	**--**
7440-62-2	Vanadium	1.3E-05	5.0E-03	--	5.0E-03	8.3E-12	1.0E-04	**3.9E+02**	1.6E-06	NC	--	NC	3.6E-12	NC	**--**
7440-66-6	Zinc	1.3E-05	3.0E-01	--	3.0E-01	8.3E-12	NA	**2.3E+04**	1.6E-06	NC	--	NC	3.6E-12	NC	**--**
	PAHs														
56-55-3	Benz[a]anthracene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	2.9E-01	6.4E-07	2.9E-01	3.6E-12	1.1E-04	**1.6E+00**
50-32-8	Benzo[a]pyrene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	2.9E+00	6.4E-07	2.9E+00	3.6E-12	1.1E-03	**1.6E-01**
205-99-2	Benzo[b]fluoranthene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	2.9E-01	6.4E-07	2.9E-01	3.6E-12	1.1E-04	**1.6E+00**
207-08-9	Benzo[k]fluoranthene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	2.9E-01	6.4E-07	2.9E-01	3.6E-12	1.1E-04	**1.6E+00**
218-01-9	Chrysene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	2.9E-02	6.4E-07	2.9E-02	3.6E-12	1.1E-05	**1.6E+01**
53-70-3	Dibenz[a,h]anthracene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	4.1E+00	6.4E-07	4.1E+00	3.6E-12	1.2E-03	**1.1E-01**
193-39-5	Indeno[1,2,3-cd]pyrene	1.3E-05	NA	4.7E-06	NA	8.3E-12	NA	**--**	1.6E-06	2.9E-01	6.4E-07	2.9E-01	3.6E-12	1.1E-04	**1.6E+00**
90-12-0	Methylnaphthalene, 1-	1.3E-05	7.0E-02	4.7E-06	7.0E-02	1.4E-05	NA	**4.0E+03**	1.6E-06	2.9E-02	6.4E-07	2.9E-02	5.9E-06	NC	**1.6E+01**
91-57-6	Methylnaphthalene, 2-	1.3E-05	4.0E-03	4.7E-06	4.0E-03	1.4E-05	NA	**2.3E+02**	1.6E-06	NC	6.4E-07	NC	6.1E-06	NC	**--**
91-20-3	Naphthalene	1.3E-05	2.0E-02	4.7E-06	2.0E-02	1.7E-05	3.0E-03	**1.5E+02**	1.6E-06	NC	6.4E-07	NC	7.4E-06	3.4E-05	**4.0E+00**
129-00-0	Pyrene	1.3E-05	3.0E-02	4.7E-06	3.0E-02	2.5E-07	1.1E-01	**1.7E+03**	1.6E-06	NC	6.4E-07	NC	1.1E-07	NC	**--**
	TPH														
1	Aliphatic: C5-C8	1.3E-05	4.0E-02	4.7E-06	4.0E-02	6.8E-04	7.0E-01	**7.1E+02**	1.6E-06	NC	6.4E-07	NC	2.9E-04	NC	**--**
2	Aliphatic: C9-C18	1.3E-05	1.0E-01	4.7E-06	1.0E-01	1.6E-04	3.0E-01	**1.4E+03**	1.6E-06	NC	6.4E-07	NC	6.7E-05	NC	**--**
3	Aliphatic: C19-C32	1.3E-05	2.0E+00	4.7E-06	2.0E+00	--	NA	**1.1E+05**	1.6E-06	NC	6.4E-07	NC	--	NC	**--**
4	Aromatic: C6-C8	1.3E-05	NA	4.7E-06	NA	2.2E-04	NA	**--**	1.6E-06	NC	6.4E-07	NC	9.6E-05	NC	**--**

Attachment A1, Table A1-1

Derivation of Site-Specific Cleanup Goals, Soil

Onsite Resident

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Noncancer Effects							Cancer Effects						
		Ingestion		Dermal Contact		Outdoor Inhalation			Ingestion		Dermal Contact		Outdoor Inhalation		
		IF_{oral} (mg/kg-day)	Reference Dose (mg/kg-day)	IF_{dermal} (mg/kg-day)	Reference Dose (mg/kg-day)	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Reference Concentration (mg/m^3)	**$SSCG_{soil-nc}$** (mg/kg)	IF_{oral} (mg/kg-day)	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	IF_{dermal} (mg/kg-day)	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	**$SSCG_{soil-c}$** (mg/kg)
5	Aromatic: C9-C16	1.3E-05	3.0E-02	4.7E-06	3.0E-02	5.3E-05	5.0E-02	**6.0E+02**	1.6E-06	NC	6.4E-07	NC	2.3E-05	NC	**--**
6	Aromatic: C17-C32	1.3E-05	3.0E-02	4.7E-06	3.0E-02	--	NA	**1.7E+03**	1.6E-06	NC	6.4E-07	NC	--	NC	**--**
	SVOCs														
121-14-2	2,4-Dinitrotoluene	1.3E-05	2.0E-03	3.7E-06	2.0E-03	8.3E-12	7.0E-03	**1.2E+02**	1.6E-06	3.1E-01	5.0E-07	3.1E-01	3.6E-12	8.9E-05	**1.6E+00**
117-81-7	Bis(2-Ethylhexyl) Phthalate	1.3E-05	2.0E-02	3.6E-06	2.0E-02	8.3E-12	7.0E-02	**1.2E+03**	1.6E-06	1.4E-02	4.9E-07	1.4E-02	3.6E-12	2.4E-06	**3.5E+01**
	VOCs														
79-34-5	1,1,2,2-Tetrachloroethane	1.3E-05	2.0E-02	--	2.0E-02	6.9E-05	7.0E-02	**6.2E+02**	1.6E-06	2.7E-01	--	2.7E-01	2.9E-05	5.8E-05	**4.7E-01**
96-18-4	1,2,3-Trichloropropane	1.3E-05	4.0E-03	--	4.0E-03	1.3E-04	3.0E-04	**2.4E+00**	1.6E-06	3.0E+01	--	3.0E+01	5.4E-05	NC	**2.1E-02**
95-63-6	1,2,4-Trimethylbenzene	1.3E-05	1.0E-02	--	1.0E-02	7.6E-05	7.0E-03	**8.3E+01**	1.6E-06	NC	--	NC	3.2E-05	NC	**--**
78-87-5	1,2-Dichloropropane	1.3E-05	9.0E-02	--	9.0E-02	2.7E-04	4.0E-03	**1.5E+01**	1.6E-06	3.6E-02	--	3.6E-02	1.2E-04	1.0E-05	**8.3E-01**
108-67-8	1,3,5-Trimethylbenzene	1.3E-05	1.0E-02	--	1.0E-02	7.4E-05	7.0E-03	**8.5E+01**	1.6E-06	NC	--	NC	3.2E-05	NC	**--**
106-46-7	1,4-Dichlorobenzene	1.3E-05	7.0E-02	--	7.0E-02	7.4E-05	8.0E-01	**3.6E+03**	1.6E-06	5.4E-03	--	5.4E-03	3.2E-05	1.1E-05	**2.8E+00**
71-43-2	Benzene	1.3E-05	4.0E-03	--	4.0E-03	3.5E-04	3.0E-02	**6.7E+01**	1.6E-06	1.0E-01	--	1.0E-01	1.5E-04	2.9E-05	**2.2E-01**
75-27-4	Bromodichloromethane	1.3E-05	2.0E-02	--	2.0E-02	1.2E-04	7.0E-02	**4.3E+02**	1.6E-06	1.3E-01	--	1.3E-01	5.0E-05	3.7E-05	**4.9E-01**
74-83-9	Bromomethane	1.3E-05	1.4E-03	--	1.4E-03	5.2E-04	5.0E-03	**8.8E+00**	1.6E-06	NC	--	NC	2.2E-04	NC	**--**
100-41-4	Ethylbenzene	1.3E-05	1.0E-01	--	1.0E-01	1.8E-04	1.0E+00	**3.3E+03**	1.6E-06	1.1E-02	--	1.1E-02	7.7E-05	2.5E-06	**4.8E+00**
75-09-2	Methylene chloride	1.3E-05	6.0E-03	--	6.0E-03	3.9E-04	6.0E-01	**3.6E+02**	1.6E-06	1.4E-02	--	1.4E-02	1.7E-04	1.0E-06	**5.3E+00**
127-18-4	Tetrachloroethene	1.3E-05	6.0E-03	--	6.0E-03	3.8E-04	4.0E-02	**8.6E+01**	1.6E-06	5.4E-01	--	5.4E-01	1.6E-04	5.9E-06	**5.5E-01**
79-01-6	Trichloroethene	1.3E-05	5.0E-04	--	5.0E-04	3.0E-04	2.0E-03	**5.8E+00**	8.3E-06	4.6E-02	--	4.6E-02	4.5E-04	4.1E-06	**1.2E+00**
75-01-4	Vinyl chloride	1.3E-05	3.0E-03	--	3.0E-03	9.3E-04	1.0E-01	**7.4E+01**	1.6E-06	2.7E-01	--	2.7E-01	4.0E-04	7.8E-05	**3.2E-02**

Note: " -- " not applicable

Attachment A1, Table A1-2
Derivation of Site-Specific Cleanup Goals, Soil
Onsite Resident, Infrequent Exposure to Subsurface Soils
Former Kast Property
Carson, California

CAS Number	Chemical of Concern	Noncancer Effects							Cancer Effects						
		Ingestion		Dermal Contact		Outdoor Inhalation			Ingestion		Dermal Contact		Outdoor Inhalation		
		IF_{oral} (mg/kg-day)	Reference Dose (mg/kg-day)	IF_{dermal} (mg/kg-day)	Reference Dose (mg/kg-day)	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Reference Concentration (mg/m^3)	**$SSCG_{soil-nc}$** (mg/kg)	IF_{oral} (mg/kg-day)	Cancer Slope Factor $(mg/kg-day)^{-1}$	IF_{dermal} (mg/kg-day)	Cancer Slope Factor $(mg/kg-day)^{-1}$	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	**$SSCG_{soil-c}$** (mg/kg)
	Inorganics														
7440-36-0	Antimony	1.5E-07	4.0E-04	--	6.0E-05	9.5E-14	NA	**2.7E+03**	1.8E-08	NC	--	NC	4.1E-14	NC	**--**
7440-38-2	Arsenic	1.5E-07	3.0E-04	1.2E-08	3.0E-04	9.5E-14	1.5E-05	**1.9E+03**	1.8E-08	9.5E+00	1.7E-09	9.5E+00	4.1E-14	3.3E-03	**5.4E+00**
7440-43-9	Cadmium	1.5E-07	1.0E-03	4.1E-10	2.5E-05	9.5E-14	2.0E-05	**6.2E+03**	1.8E-08	NC	5.6E-11	NC	4.1E-14	4.2E-03	**5.8E+06**
18540-29-9	Chromium VI	1.5E-07	3.0E-03	--	7.5E-05	9.5E-14	1.0E-04	**2.1E+04**	1.8E-08	5.0E-01	--	NC	4.1E-14	1.5E-01	**1.1E+02**
7440-48-4	Cobalt	1.5E-07	3.0E-04	--	3.0E-04	9.5E-14	6.0E-06	**2.1E+03**	1.8E-08	NC	--	NC	4.1E-14	9.0E-03	**2.7E+06**
7440-50-8	Copper	1.5E-07	4.0E-02	--	4.0E-02	9.5E-14	NA	**2.7E+05**	1.8E-08	NC	--	NC	4.1E-14	NC	**--**
7439-92-1	Lead	1.5E-07	NA	--	NA	9.5E-14	NA	**--**	1.8E-08	NC	--	NC	4.1E-14	NC	**--**
7440-28-0	Thallium	1.5E-07	1.0E-05	--	1.0E-05	9.5E-14	NA	**6.8E+01**	1.8E-08	NC	--	NC	4.1E-14	NC	**--**
7440-62-2	Vanadium	1.5E-07	5.0E-03	--	5.0E-03	9.5E-14	1.0E-04	**3.4E+04**	1.8E-08	NC	--	NC	4.1E-14	NC	**--**
7440-66-6	Zinc	1.5E-07	3.0E-01	--	3.0E-01	9.5E-14	NA	**2.1E+06**	1.8E-08	NC	--	NC	4.1E-14	NC	**--**
	PAHs														
56-55-3	Benz[a]anthracene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	2.9E-01	7.3E-09	2.9E-01	4.1E-14	1.1E-04	**1.4E+02**
50-32-8	Benzo[a]pyrene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	2.9E+00	7.3E-09	2.9E+00	4.1E-14	1.1E-03	**1.4E+01**
205-99-2	Benzo[b]fluoranthene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	2.9E-01	7.3E-09	2.9E-01	4.1E-14	1.1E-04	**1.4E+02**
207-08-9	Benzo[k]fluoranthene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	2.9E-01	7.3E-09	2.9E-01	4.1E-14	1.1E-04	**1.4E+02**
218-01-9	Chrysene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	2.9E-02	7.3E-09	2.9E-02	4.1E-14	1.1E-05	**1.4E+03**
53-70-3	Dibenz[a,h]anthracene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	4.1E+00	7.3E-09	4.1E+00	4.1E-14	1.2E-03	**9.7E+00**
193-39-5	Indeno[1,2,3-cd]pyrene	1.5E-07	NA	5.3E-08	NA	9.5E-14	NA	**--**	1.8E-08	2.9E-01	7.3E-09	2.9E-01	4.1E-14	1.1E-04	**1.4E+02**
90-12-0	Methylnaphthalene, 1-	1.5E-07	7.0E-02	5.3E-08	7.0E-02	1.6E-07	NA	**3.5E+05**	1.8E-08	2.9E-02	7.3E-09	2.9E-02	6.7E-08	NC	**1.4E+03**
91-57-6	Methylnaphthalene, 2-	1.5E-07	4.0E-03	5.3E-08	4.0E-03	1.6E-07	NA	**2.0E+04**	1.8E-08	NC	7.3E-09	NC	7.0E-08	NC	**--**
91-20-3	Naphthalene	1.5E-07	2.0E-02	5.3E-08	2.0E-02	2.0E-07	3.0E-03	**1.3E+04**	1.8E-08	NC	7.3E-09	NC	8.5E-08	3.4E-05	**3.5E+02**
129-00-0	Pyrene	1.5E-07	3.0E-02	5.3E-08	3.0E-02	2.9E-09	1.1E-01	**1.5E+05**	1.8E-08	NC	7.3E-09	NC	1.2E-09	NC	**--**
	TPH														
1	Aliphatic: C5-C8	1.5E-07	4.0E-02	5.3E-08	4.0E-02	7.8E-06	7.0E-01	**6.2E+04**	1.8E-08	NC	7.3E-09	NC	3.3E-06	NC	**--**
2	Aliphatic: C9-C18	1.5E-07	1.0E-01	5.3E-08	1.0E-01	1.8E-06	3.0E-01	**1.3E+05**	1.8E-08	NC	7.3E-09	NC	7.6E-07	NC	**--**
3	Aliphatic: C19-C32	1.5E-07	2.0E+00	5.3E-08	2.0E+00	--	NA	**1.0E+07**	1.8E-08	NC	7.3E-09	NC	--	NC	**--**
4	Aromatic: C6-C8	1.5E-07	NA	5.3E-08	NA	2.6E-06	NA	**--**	1.8E-08	NC	7.3E-09	NC	1.1E-06	NC	**--**

Attachment A1, Table A1-2

Derivation of Site-Specific Cleanup Goals, Soil

Onsite Resident, Infrequent Exposure to Subsurface Soils

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Noncancer Effects							Cancer Effects						
		Ingestion		Dermal Contact		Outdoor Inhalation			Ingestion		Dermal Contact		Outdoor Inhalation		
		IF_{oral} (mg/kg-day)	Reference Dose (mg/kg-day)	IF_{dermal} (mg/kg-day)	Reference Dose (mg/kg-day)	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Reference Concentration (mg/m^3)	**$SSCG_{soil-nc}$** (mg/kg)	IF_{oral} (mg/kg-day)	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	IF_{dermal} (mg/kg-day)	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	**$SSCG_{soil-c}$** (mg/kg)
5	Aromatic: C9-C16	1.5E-07	3.0E-02	5.3E-08	3.0E-02	6.1E-07	5.0E-02	**5.3E+04**	1.8E-08	NC	7.3E-09	NC	2.6E-07	NC	**--**
6	Aromatic: C17-C32	1.5E-07	3.0E-02	5.3E-08	3.0E-02	--	NA	**1.5E+05**	1.8E-08	NC	7.3E-09	NC	--	NC	**--**
	SVOCs														
121-14-2	2,4-Dinitrotoluene	1.5E-07	2.0E-03	4.2E-08	2.0E-03	9.5E-14	7.0E-03	**1.1E+04**	1.8E-08	3.1E-01	5.8E-09	3.1E-01	4.1E-14	8.9E-05	**1.4E+02**
117-81-7	Bis(2-Ethylhexyl) Phthalate	1.5E-07	2.0E-02	4.1E-08	2.0E-02	9.5E-14	7.0E-02	**1.1E+05**	1.8E-08	1.4E-02	5.6E-09	1.4E-02	4.1E-14	2.4E-06	**3.0E+03**
	VOCs														
79-34-5	1,1,2,2-Tetrachloroethane	1.5E-07	2.0E-02	--	2.0E-02	7.8E-07	7.0E-02	**5.4E+04**	1.8E-08	2.7E-01	--	2.7E-01	3.4E-07	5.8E-05	**4.1E+01**
96-18-4	1,2,3-Trichloropropane	1.5E-07	4.0E-03	--	4.0E-03	1.4E-06	3.0E-04	**2.1E+02**	1.8E-08	3.0E+01	--	3.0E+01	6.1E-07	NC	**1.9E+00**
95-63-6	1,2,4-Trimethylbenzene	1.5E-07	1.0E-02	--	1.0E-02	8.7E-07	7.0E-03	**7.2E+03**	1.8E-08	NC	--	NC	3.7E-07	NC	**--**
78-87-5	1,2-Dichloropropane	1.5E-07	9.0E-02	--	9.0E-02	3.1E-06	4.0E-03	**1.3E+03**	1.8E-08	3.6E-02	--	3.6E-02	1.3E-06	1.0E-05	**7.2E+01**
108-67-8	1,3,5-Trimethylbenzene	1.5E-07	1.0E-02	--	1.0E-02	8.4E-07	7.0E-03	**7.4E+03**	1.8E-08	NC	--	NC	3.6E-07	NC	**--**
106-46-7	1,4-Dichlorobenzene	1.5E-07	7.0E-02	--	7.0E-02	8.5E-07	8.0E-01	**3.2E+05**	1.8E-08	5.4E-03	--	5.4E-03	3.6E-07	1.1E-05	**2.4E+02**
71-43-2	Benzene	1.5E-07	4.0E-03	--	4.0E-03	4.0E-06	3.0E-02	**5.8E+03**	1.8E-08	1.0E-01	--	1.0E-01	1.7E-06	2.9E-05	**1.9E+01**
75-27-4	Bromodichloromethane	1.5E-07	2.0E-02	--	2.0E-02	1.3E-06	7.0E-02	**3.8E+04**	1.8E-08	1.3E-01	--	1.3E-01	5.7E-07	3.7E-05	**4.2E+01**
74-83-9	Bromomethane	1.5E-07	1.4E-03	--	1.4E-03	6.0E-06	5.0E-03	**7.7E+02**	1.8E-08	NC	--	NC	2.6E-06	NC	**--**
100-41-4	Ethylbenzene	1.5E-07	1.0E-01	--	1.0E-01	2.0E-06	1.0E+00	**2.9E+05**	1.8E-08	1.1E-02	--	1.1E-02	8.8E-07	2.5E-06	**4.2E+02**
75-09-2	Methylene chloride	1.5E-07	6.0E-03	--	6.0E-03	4.4E-06	6.0E-01	**3.2E+04**	1.8E-08	1.4E-02	--	1.4E-02	1.9E-06	1.0E-06	**4.7E+02**
127-18-4	Tetrachloroethene	1.5E-07	6.0E-03	--	6.0E-03	4.3E-06	4.0E-02	**7.5E+03**	1.8E-08	5.4E-01	--	5.4E-01	1.9E-06	5.9E-06	**4.9E+01**
79-01-6	Trichloroethene	1.5E-07	5.0E-04	--	5.0E-04	3.4E-06	2.0E-03	**5.0E+02**	**9.5E-08**	4.6E-02	--	4.6E-02	**5.1E-06**	4.1E-06	**1.0E+02**
75-01-4	Vinyl chloride	1.5E-07	3.0E-03	--	3.0E-03	1.1E-05	1.0E-01	**6.4E+03**	1.8E-08	2.7E-01	--	2.7E-01	4.6E-06	7.8E-05	**2.8E+00**

Note: " -- " not applicable

Attachment A1, Table A1-3

Derivation of Site-Specific Cleanup Goal, Lead in Soil
Onsite Resident, Infrequent Exposure to Subsurface Soils

Former Kast Property

Carson, California

Calculations of Preliminary Remediation Goals (PRGs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
$PbB_{fetal, 0.90}$	90^{th} percentile PbB in fetus	ug/dL	1
$R_{fetal/maternal}$	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	0.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	12
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	90
PRG		**mg/kg**	**818**

Attachment A1, Table A1-4

Derivation of Site-Specific Cleanup Goals, Sub-Slab Soil Vapor

Onsite Resident

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Noncancer Effects			Cancer Effects		
		Reference Concentration (mg/m^3)	Indoor Air SSCG$_{nc}$ (µg/m^3)	**Sub-Slab Soil Vapor SSCG$_{nc}$ (µg/m^3)**	Inhalation Unit Risk (µg/m^3)$^{-1}$	Indoor Air SSCG$_c$ (µg/m^3)	**Sub-Slab Soil Vapor SSCG$_c$ (µg/m^3)**
71-55-6	1,1,1-Trichloroethane	5.0E+00	5.2E+03	**5.2E+06**	NC	--	**--**
79-34-5	1,1,2,2-Tetrachloroethane	7.0E-02	7.3E+01	**7.3E+04**	5.8E-05	4.2E-02	**4.2E+01**
79-00-5	1,1,2-Trichloroethane	2.0E-04	2.1E-01	**2.1E+02**	1.6E-05	1.5E-01	**1.5E+02**
75-34-3	1,1-Dichloroethane	7.0E-01	7.3E+02	**7.3E+05**	1.6E-06	1.5E+00	**1.5E+03**
120-82-1	1,2,4-Trichlorobenzene	2.0E-03	2.1E+00	**2.1E+03**	NC	--	**--**
95-63-6	1,2,4-Trimethylbenzene	7.0E-03	7.3E+00	**7.3E+03**	NC	--	**--**
107-06-2	1,2-Dichloroethane	7.0E-03	7.3E+00	**7.3E+03**	2.1E-05	1.2E-01	**1.2E+02**
78-87-5	1,2-Dichloropropane	4.0E-03	4.2E+00	**4.2E+03**	1.0E-05	2.4E-01	**2.4E+02**
108-67-8	1,3,5-Trimethylbenzene	7.0E-03	7.3E+00	**7.3E+03**	NC	--	**--**
106-99-0	1,3-Butadiene	2.0E-03	2.1E+00	**2.1E+03**	1.7E-04	1.4E-02	**1.4E+01**
106-46-7	1,4-Dichlorobenzene	8.0E-01	8.3E+02	**8.3E+05**	1.1E-05	2.2E-01	**2.2E+02**
123-91-1	1,4-Dioxane	3.0E+00	3.1E+03	**3.1E+06**	7.7E-06	3.2E-01	**3.2E+02**
540-84-1	2,2,4-Trimethylpentane	1.0E+00	1.0E+03	**1.0E+06**	NC	--	**--**
591-78-6	2-Hexanone	3.0E-02	3.1E+01	**3.1E+04**	NC	--	**--**
622-96-8	4-Ethyltoluene	1.0E-01	1.0E+02	**1.0E+05**	NC	--	**--**
71-43-2	Benzene	3.0E-02	3.1E+01	**3.1E+04**	2.9E-05	8.4E-02	**8.4E+01**
75-27-4	Bromodichloromethane	7.0E-02	7.3E+01	**7.3E+04**	3.7E-05	6.6E-02	**6.6E+01**
74-83-9	Bromomethane	5.0E-03	5.2E+00	**5.2E+03**	NC	--	**--**
75-15-0	Carbon disulfide	7.0E-01	7.3E+02	**7.3E+05**	NC	--	**--**
56-23-5	Carbon tetrachloride	1.0E-01	1.0E+02	**1.0E+05**	4.2E-05	5.8E-02	**5.8E+01**
67-66-3	Chloroform	9.8E-02	1.0E+02	**1.0E+05**	5.3E-06	4.6E-01	**4.6E+02**
74-87-3	Chloromethane	9.0E-02	9.4E+01	**9.4E+04**	NC	--	**--**
110-82-7	Cyclohexane	6.0E+00	6.3E+03	**6.3E+06**	NC	--	**--**
124-48-1	Dibromochloromethane	7.0E-02	7.3E+01	**7.3E+04**	2.7E-05	9.0E-02	**9.0E+01**
156-59-2	Dichloroethene, cis-1,2-	7.0E-03	7.3E+00	**7.3E+03**	NC	--	**--**
156-60-5	Dichloroethene, trans-1,2-	6.0E-02	6.3E+01	**6.3E+04**	NC	--	**--**
10061-02-6	Dichloropropene, trans-1,3-	2.0E-02	2.1E+01	**2.1E+04**	1.6E-05	1.5E-01	**1.5E+02**
64-17-5	Ethanol	4.0E+00	4.2E+03	**4.2E+06**	NC	--	**--**
100-41-4	Ethylbenzene	1.0E+00	1.0E+03	**1.0E+06**	2.5E-06	9.7E-01	**9.7E+02**

Attachment A1, Table A1-4

Derivation of Site-Specific Cleanup Goals, Sub-Slab Soil Vapor

Onsite Resident

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Noncancer Effects			Cancer Effects		
		Reference Concentration (mg/m^3)	Indoor Air $SSCG_{nc}$ ($\mu g/m^3$)	**Sub-Slab Soil Vapor $SSCG_{nc}$ ($\mu g/m^3$)**	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Indoor Air $SSCG_c$ ($\mu g/m^3$)	**Sub-Slab Soil Vapor $SSCG_c$ ($\mu g/m^3$)**
142-82-5	Heptane	7.0E-01	7.3E+02	**7.3E+05**	NC	--	**--**
87-68-3	Hexachloro-1,3-butadiene	3.5E-03	3.7E+00	**3.7E+03**	2.2E-05	1.1E-01	**1.1E+02**
110-54-3	Hexane	7.0E-01	7.3E+02	**7.3E+05**	NC	--	**--**
67-63-0	Isopropanol	7.0E+00	7.3E+03	**7.3E+06**	NC	--	**--**
98-82-8	Isopropylbenzene (cumene)	4.0E-01	4.2E+02	**4.2E+05**	NC	--	**--**
78-93-3	Methyl ethyl ketone (2-butanone)	5.0E+00	5.2E+03	**5.2E+06**	NC	--	**--**
75-09-2	Methylene chloride	6.0E-01	6.3E+02	**6.3E+05**	1.0E-06	2.4E+00	**2.4E+03**
1634-04-4	Methyl-tert-butyl ether	3.0E+00	3.1E+03	**3.1E+06**	2.6E-07	9.4E+00	**9.4E+03**
91-20-3	Naphthalene	3.0E-03	3.1E+00	**3.1E+03**	3.4E-05	7.2E-02	**7.2E+01**
103-65-1	Propylbenzene	1.0E+00	1.0E+03	**1.0E+06**	NC	--	**--**
75-65-0	tert-Butyl Alcohol (TBA)	1.1E+00	1.1E+03	**1.1E+06**	NC	--	**--**
127-18-4	Tetrachloroethene	4.0E-02	4.2E+01	**4.2E+04**	5.9E-06	4.1E-01	**4.1E+02**
109-99-9	Tetrahydrofuran	2.0E+00	2.1E+03	**2.1E+06**	NC	--	**--**
108-88-3	Toluene	5.0E+00	5.2E+03	**5.2E+06**	NC	--	**--**
79-01-6	Trichloroethene	2.0E-03	2.1E+00	**2.1E+03**	4.1E-06	4.3E-01	**4.3E+02**
75-01-4	Vinyl chloride	1.0E-01	1.0E+02	**1.0E+05**	7.8E-05	3.1E-02	**3.1E+01**
108-38-3	Xylene, m-	1.0E-01	1.0E+02	**1.0E+05**	NC	--	**--**
95-47-6	Xylene, o-	1.0E-01	1.0E+02	**1.0E+05**	NC	--	**--**
106-42-3	Xylene, p-	1.0E-01	1.0E+02	**1.0E+05**	NC	--	**--**
	TPH						
	Aliphatic: C5-C8	7.0E-01	7.3E+02	**7.3E+05**	NC	--	**--**
	Aliphatic: C9-C18	3.0E-01	3.1E+02	**3.1E+05**	NC	--	**--**
	Aliphatic: C19-C32	NA	--	**--**	NC	--	**--**
	Aromatic: C6-C8	NA	--	**--**	NC	--	**--**
	Aromatic: C9-C16	5.0E-02	5.2E+01	**5.2E+04**	NC	--	**--**
	Aromatic: C17-C32	NA	--	**--**	NC	--	**--**

Note: " -- " not applicable or not available

Attachment A1, Table A1-5

Derivation of Site-Specific Cleanup Goals, Soil

Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	Noncancer Effects							Cancer Effects						
		Ingestion		Dermal Contact		Outdoor Inhalation			Ingestion		Dermal Contact		Outdoor Inhalation		
		IF_{oral} (mg/kg-day)	Reference Dose (mg/kg-day)	IF_{dermal} (mg/kg-day)	Reference Dose (mg/kg-day)	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Reference Concentration (mg/m^3)	**$SSCG_{soil-nc}$** (mg/kg)	IF_{oral} (mg/kg-day)	Cancer Slope Factor (mg/kg-day)$^{-1}$	IF_{dermal} (mg/kg-day)	Cancer Slope Factor (mg/kg-day)$^{-1}$	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Inhalation Unit Risk (μg/m^3)$^{-1}$	**$SSCG_{soil-c}$** (mg/kg)
	Inorganics														
7440-36-0	Antimony	1.3E-07	4.0E-04	--	6.0E-05	2.7E-08	NA	**3.1E+03**	4.6E-08	NC	--	NC	9.8E-09	NC	**--**
7440-38-2	Arsenic	1.3E-07	3.0E-04	5.4E-08	3.0E-04	2.7E-08	1.5E-05	**4.1E+02**	4.6E-08	9.5E+00	1.9E-08	9.5E+00	9.8E-09	3.3E-03	**1.5E+01**
7440-43-9	Cadmium	1.3E-07	1.0E-03	1.8E-09	2.5E-05	2.7E-08	2.0E-05	**6.4E+02**	4.6E-08	NC	6.4E-10	NC	9.8E-09	4.2E-03	**2.4E+02**
18540-29-9	Chromium VI	1.3E-07	3.0E-03	--	7.5E-05	2.7E-08	1.0E-04	**3.2E+03**	4.6E-08	5.0E-01	--	NC	9.8E-09	1.5E-01	**6.7E+00**
7440-48-4	Cobalt	1.3E-07	3.0E-04	--	3.0E-04	2.7E-08	6.0E-06	**2.0E+02**	4.6E-08	NC	--	NC	9.8E-09	9.0E-03	**1.1E+02**
7440-50-8	Copper	1.3E-07	4.0E-02	--	4.0E-02	2.7E-08	NA	**3.1E+05**	4.6E-08	NC	--	NC	9.8E-09	NC	**--**
7439-92-1	Lead	1.3E-07	NA	--	NA	2.7E-08	NA	**--**	4.6E-08	NC	--	NC	9.8E-09	NC	**--**
7440-28-0	Thallium	1.3E-07	1.0E-05	--	1.0E-05	2.7E-08	NA	**7.7E+01**	4.6E-08	NC	--	NC	9.8E-09	NC	**--**
7440-62-2	Vanadium	1.3E-07	5.0E-03	--	5.0E-03	2.7E-08	1.0E-04	**3.3E+03**	4.6E-08	NC	--	NC	9.8E-09	NC	**--**
7440-66-6	Zinc	1.3E-07	3.0E-01	--	3.0E-01	2.7E-08	NA	**2.3E+06**	4.6E-08	NC	--	NC	9.8E-09	NC	**--**
	PAHs														
56-55-3	Benz[a]anthracene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	2.9E-01	8.3E-08	2.9E-01	9.8E-09	1.1E-04	**2.6E+02**
50-32-8	Benzo[a]pyrene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	2.9E+00	8.3E-08	2.9E+00	9.8E-09	1.1E-03	**2.6E+01**
205-99-2	Benzo[b]fluoranthene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	2.9E-01	8.3E-08	2.9E-01	9.8E-09	1.1E-04	**2.6E+02**
207-08-9	Benzo[k]fluoranthene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	2.9E-01	8.3E-08	2.9E-01	9.8E-09	1.1E-04	**2.6E+02**
218-01-9	Chrysene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	2.9E-02	8.3E-08	2.9E-02	9.8E-09	1.1E-05	**2.6E+03**
53-70-3	Dibenz[a,h]anthracene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	4.1E+00	8.3E-08	4.1E+00	9.8E-09	1.2E-03	**1.9E+01**
193-39-5	Indeno[1,2,3-cd]pyrene	1.3E-07	NA	2.3E-07	NA	2.7E-08	NA	**--**	4.6E-08	2.9E-01	8.3E-08	2.9E-01	9.8E-09	1.1E-04	**2.6E+02**
90-12-0	Methylnaphthalene, 1-	1.3E-07	7.0E-02	2.3E-07	7.0E-02	1.7E-05	NA	**1.9E+05**	4.6E-08	2.9E-02	8.3E-08	2.9E-02	6.0E-06	NC	**2.7E+03**
91-57-6	Methylnaphthalene, 2-	1.3E-07	4.0E-03	2.3E-07	4.0E-03	1.7E-05	NA	**1.1E+04**	4.6E-08	NC	8.3E-08	NC	6.2E-06	NC	--
91-20-3	Naphthalene	1.3E-07	2.0E-02	2.3E-07	2.0E-02	2.1E-05	3.0E-03	**1.4E+02**	4.6E-08	NC	8.3E-08	NC	7.6E-06	3.4E-05	**3.9E+01**
129-00-0	Pyrene	1.3E-07	3.0E-02	2.3E-07	3.0E-02	3.1E-07	1.1E-01	**6.7E+04**	4.6E-08	NC	8.3E-08	NC	1.1E-07	NC	--
	TPH														
1	Aliphatic: C5-C8	1.3E-07	4.0E-02	2.3E-07	4.0E-02	8.4E-04	7.0E-01	**8.3E+02**	4.6E-08	NC	8.3E-08	NC	3.0E-04	NC	**--**
2	Aliphatic: C9-C18	1.3E-07	1.0E-01	2.3E-07	1.0E-01	1.9E-04	3.0E-01	**1.6E+03**	4.6E-08	NC	8.3E-08	NC	6.8E-05	NC	**--**
3	Aliphatic: C19-C32	1.3E-07	2.0E+00	2.3E-07	2.0E+00	--	NA	**5.5E+06**	4.6E-08	NC	8.3E-08	NC	--	NC	**--**
4	Aromatic: C6-C8	1.3E-07	NA	2.3E-07	NA	2.8E-04	NA	**--**	4.6E-08	NC	8.3E-08	NC	9.8E-05	NC	**--**
5	Aromatic: C9-C16	1.3E-07	3.0E-02	2.3E-07	3.0E-02	6.6E-05	5.0E-02	**7.5E+02**	4.6E-08	NC	8.3E-08	NC	2.3E-05	NC	**--**

Attachment A1, Table A1-5
Derivation of Site-Specific Cleanup Goals, Soil
Construction and Utility Maintenance Worker
Former Kast Property
Carson, California

CAS Number	Chemical of Concern	Noncancer Effects							Cancer Effects						
		Ingestion		Dermal Contact		Outdoor Inhalation			Ingestion		Dermal Contact		Outdoor Inhalation		
		IF_{oral} (mg/kg-day)	Reference Dose (mg/kg-day)	IF_{dermal} (mg/kg-day)	Reference Dose (mg/kg-day)	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Reference Concentration (mg/m^3)	**$SSCG_{soil-nc}$** (mg/kg)	IF_{oral} (mg/kg-day)	Cancer Slope Factor $(mg/kg-day)^{-1}$	IF_{dermal} (mg/kg-day)	Cancer Slope Factor $(mg/kg-day)^{-1}$	$EC_{inh,soil}$ (mg/m^3-mg/kg)	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	**$SSCG_{soil-c}$** (mg/kg)
6	Aromatic: C17-C32	1.3E-07	3.0E-02	2.3E-07	3.0E-02	--	NA	**8.3E+04**	4.6E-08	NC	8.3E-08	NC	--	NC	**--**
	SVOCs														
121-14-2	2,4-Dinitrotoluene	1.3E-07	2.0E-03	1.8E-07	2.0E-03	2.7E-08	7.0E-03	**6.3E+03**	4.6E-08	3.1E-01	6.5E-08	3.1E-01	9.8E-09	8.9E-05	**2.8E+02**
117-81-7	Bis(2-Ethylhexyl) Phthalate	1.3E-07	2.0E-02	1.8E-07	2.0E-02	2.7E-08	7.0E-02	**6.3E+04**	4.6E-08	1.4E-02	6.4E-08	1.4E-02	9.8E-09	2.4E-06	**6.4E+03**
	VOCs														
79-34-5	1,1,2,2-Tetrachloroethane	1.3E-07	2.0E-02	--	2.0E-02	8.4E-05	7.0E-02	**8.3E+02**	4.6E-08	2.7E-01	--	2.7E-01	3.0E-05	5.8E-05	**5.7E+00**
96-18-4	1,2,3-Trichloropropane	1.3E-07	4.0E-03	--	4.0E-03	1.5E-04	3.0E-04	**2.0E+00**	4.6E-08	3.0E+01	--	3.0E+01	5.5E-05	NC	**7.2E+00**
95-63-6	1,2,4-Trimethylbenzene	1.3E-07	1.0E-02	--	1.0E-02	9.3E-05	7.0E-03	**7.5E+01**	4.6E-08	NC	--	NC	3.3E-05	NC	**--**
78-87-5	1,2-Dichloropropane	1.3E-07	9.0E-02	--	9.0E-02	3.3E-04	4.0E-03	**1.2E+01**	4.6E-08	3.6E-02	--	3.6E-02	1.2E-04	1.0E-05	**8.5E+00**
108-67-8	1,3,5-Trimethylbenzene	1.3E-07	1.0E-02	--	1.0E-02	9.0E-05	7.0E-03	**7.7E+01**	4.6E-08	NC	--	NC	3.2E-05	NC	**--**
106-46-7	1,4-Dichlorobenzene	1.3E-07	7.0E-02	--	7.0E-02	9.1E-05	8.0E-01	**8.7E+03**	4.6E-08	5.4E-03	--	5.4E-03	3.2E-05	1.1E-05	**2.8E+01**
71-43-2	Benzene	1.3E-07	4.0E-03	--	4.0E-03	4.3E-04	3.0E-02	**6.9E+01**	4.6E-08	1.0E-01	--	1.0E-01	1.5E-04	2.9E-05	**2.2E+00**
75-27-4	Bromodichloromethane	1.3E-07	2.0E-02	--	2.0E-02	1.4E-04	7.0E-02	**4.9E+02**	4.6E-08	1.3E-01	--	1.3E-01	5.1E-05	3.7E-05	**5.3E+00**
74-83-9	Bromomethane	1.3E-07	1.4E-03	--	1.4E-03	6.4E-04	5.0E-03	**7.8E+00**	4.6E-08	NC	--	NC	2.3E-04	NC	**--**
100-41-4	Ethylbenzene	1.3E-07	1.0E-01	--	1.0E-01	2.2E-04	1.0E+00	**4.5E+03**	4.6E-08	1.1E-02	--	1.1E-02	7.8E-05	2.5E-06	**5.1E+01**
75-09-2	Methylene chloride	1.3E-07	6.0E-03	--	6.0E-03	4.7E-04	6.0E-01	**1.2E+03**	4.6E-08	1.4E-02	--	1.4E-02	1.7E-04	1.0E-06	**5.9E+01**
127-18-4	Tetrachloroethene	1.3E-07	6.0E-03	--	6.0E-03	4.6E-04	4.0E-02	**8.6E+01**	4.6E-08	5.4E-01	--	5.4E-01	1.7E-04	5.9E-06	**1.0E+01**
79-01-6	Trichloroethene	1.3E-07	5.0E-04	--	5.0E-04	3.6E-04	2.0E-03	**5.5E+00**	4.6E-08	4.6E-02	--	4.6E-02	1.3E-04	4.1E-06	**1.9E+01**
75-01-4	Vinyl chloride	1.3E-07	3.0E-03	--	3.0E-03	1.1E-03	1.0E-01	**8.7E+01**	4.6E-08	2.7E-01	--	2.7E-01	4.1E-04	7.8E-05	**3.1E-01**

Note: " -- " not applicable

Attachment A1, Table A1-6

Derivation of Site-Specific Cleanup Goals, Soil Vapor

Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	VF_{SV-OA} ($\mu g/m^3$-$\mu g/m^3$)	Noncancer Effects			Cancer Effects		
			Exposure Concentration (EC_{SV-OA}) (mg/m^3)	Reference Concentration (mg/m^3)	**Soil Vapor $SSCG_{nc}$** ($\mu g/m^3$)	Exposure Concentration (EC_{SV-OA}) (mg/m^3)	Inhalation Unit Risk ($\mu g/m^3$)$^{-1}$	**Soil Vapor $SSCG_c$** ($\mu g/m^3$)
71-55-6	1,1,1-Trichloroethane	4.0E+04	6.8E-10	5.0E+00	**7.4E+09**	2.4E-10	NC	--
79-34-5	1,1,2,2-Tetrachloroethane	7.0E+03	3.9E-09	7.0E-02	**1.8E+07**	1.4E-09	5.8E-05	**1.2E+05**
79-00-5	1,1,2-Trichloroethane	1.4E+04	2.0E-09	2.0E-04	**1.0E+05**	7.1E-10	1.6E-05	**8.6E+05**
75-34-3	1,1-Dichloroethane	3.9E+04	7.1E-10	7.0E-01	**9.9E+08**	2.5E-10	1.6E-06	**2.5E+07**
120-82-1	1,2,4-Trichlorobenzene	5.4E+03	5.1E-09	2.0E-03	**3.9E+05**	1.8E-09	NC	--
95-63-6	1,2,4-Trimethylbenzene	9.0E+03	3.0E-09	7.0E-03	**2.3E+06**	1.1E-09	NC	--
107-06-2	1,2-Dichloroethane	1.7E+04	1.6E-09	7.0E-03	**4.4E+06**	5.7E-10	2.1E-05	**8.5E+05**
78-87-5	1,2-Dichloropropane	2.5E+04	1.1E-09	4.0E-03	**3.6E+06**	3.9E-10	1.0E-05	**2.5E+06**
108-67-8	1,3,5-Trimethylbenzene	8.8E+03	3.1E-09	7.0E-03	**2.3E+06**	1.1E-09	NC	--
106-99-0	1,3-Butadiene	5.0E+04	5.5E-10	2.0E-03	**3.7E+06**	2.0E-10	1.7E-04	**3.0E+05**
106-46-7	1,4-Dichlorobenzene	7.8E+03	3.5E-09	8.0E-01	**2.3E+08**	1.3E-09	1.1E-05	**7.2E+05**
123-91-1	1,4-Dioxane	1.2E+03	2.3E-08	3.0E+00	**1.3E+08**	8.1E-09	7.7E-06	**1.6E+05**
540-84-1	2,2,4-Trimethylpentane	1.8E+04	1.5E-09	1.0E+00	**6.5E+08**	5.5E-10	NC	--
591-78-6	2-Hexanone	7.2E+03	3.8E-09	3.0E-02	**7.9E+06**	1.4E-09	NC	--
622-96-8	4-Ethyltoluene	6.7E+03	4.1E-09	1.0E-01	**2.5E+07**	1.5E-09	NC	--
71-43-2	Benzene	2.9E+04	9.5E-10	3.0E-02	**3.2E+07**	3.4E-10	2.9E-05	**1.0E+06**
75-27-4	Bromodichloromethane	2.8E+04	9.7E-10	7.0E-02	**7.2E+07**	3.5E-10	3.7E-05	**7.8E+05**
74-83-9	Bromomethane	5.2E+04	5.3E-10	5.0E-03	**9.5E+06**	1.9E-10	NC	--
75-15-0	Carbon disulfide	5.6E+04	4.9E-10	7.0E-01	**1.4E+09**	1.7E-10	NC	--
56-23-5	Carbon tetrachloride	4.3E+04	6.3E-10	1.0E-01	**1.6E+08**	2.3E-10	4.2E-05	**1.1E+06**
67-66-3	Chloroform	2.5E+04	1.1E-09	9.8E-02	**9.0E+07**	3.9E-10	5.3E-06	**4.9E+06**
74-87-3	Chloromethane	5.1E+04	5.4E-10	9.0E-02	**1.7E+08**	1.9E-10	NC	--
110-82-7	Cyclohexane	8.2E+04	3.3E-10	6.0E+00	**1.8E+10**	1.2E-10	NC	--
124-48-1	Dibromochloromethane	2.3E+04	1.2E-09	7.0E-02	**6.0E+07**	4.2E-10	2.7E-05	**8.8E+05**
156-59-2	Dichloroethene, cis-1,2-	3.3E+04	8.4E-10	7.0E-03	**8.3E+06**	3.0E-10	NC	--
156-60-5	Dichloroethene, trans-1,2-	4.2E+04	6.5E-10	6.0E-02	**9.3E+07**	2.3E-10	NC	--
10061-02-6	Dichloropropene, trans-1,3-	6.1E+04	4.5E-10	2.0E-02	**4.4E+07**	1.6E-10	1.6E-05	**3.9E+06**
64-17-5	Ethanol	1.3E+03	2.1E-08	4.0E+00	**1.9E+08**	7.4E-09	NC	--
100-41-4	Ethylbenzene	1.7E+04	1.6E-09	1.0E+00	**6.3E+08**	5.7E-10	2.5E-06	**7.0E+06**

Attachment A1, Table A1-6

Derivation of Site-Specific Cleanup Goals, Soil Vapor

Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

CAS Number	Chemical of Concern	VF_{SV-OA} ($\mu g/m^3$-$\mu g/m^3$)	Noncancer Effects			Cancer Effects		
			Exposure Concentration (EC_{SV-OA}) (mg/m^3)	Reference Concentration (mg/m^3)	**Soil Vapor $SSCG_{nc}$** ($\mu g/m^3$)	Exposure Concentration (EC_{SV-OA}) (mg/m^3)	Inhalation Unit Risk ($(\mu g/m^3)^{-1}$)	**Soil Vapor $SSCG_c$** ($\mu g/m^3$)
142-82-5	Heptane	9.2E+04	3.0E-10	7.0E-01	**2.3E+09**	1.1E-10	NC	--
87-68-3	Hexachloro-1,3-butadiene	1.7E+03	1.6E-08	3.5E-03	**2.2E+05**	5.7E-09	2.2E-05	**8.0E+04**
110-54-3	Hexane	6.5E+04	4.2E-10	7.0E-01	**1.7E+09**	1.5E-10	NC	--
67-63-0	Isopropanol	2.2E+03	1.2E-08	7.0E+00	**5.7E+08**	4.4E-09	NC	--
98-82-8	Isopropylbenzene (cumene)	1.0E+05	2.8E-10	4.0E-01	**1.5E+09**	9.8E-11	NC	--
78-93-3	Methyl ethyl ketone (2-butanone)	6.3E+03	4.3E-09	5.0E+00	**1.1E+09**	1.6E-09	NC	--
75-09-2	Methylene chloride	2.8E+04	9.9E-10	6.0E-01	**6.1E+08**	3.5E-10	1.0E-06	**2.8E+07**
1634-04-4	Methyl-tert-butyl ether	1.6E+04	1.7E-09	3.0E+00	**1.8E+09**	5.9E-10	2.6E-07	**6.5E+07**
91-20-3	Naphthalene	2.1E+03	1.3E-08	3.0E-03	**2.3E+05**	4.6E-09	3.4E-05	**6.3E+04**
103-65-1	Propylbenzene	1.8E+04	1.5E-09	1.0E+00	**6.6E+08**	5.4E-10	NC	--
75-65-0	tert-Butyl Alcohol (TBA)	6.7E+03	4.1E-09	1.1E+00	**2.6E+08**	1.5E-09	NC	--
127-18-4	Tetrachloroethene	3.8E+04	7.2E-10	4.0E-02	**5.5E+07**	2.6E-10	5.9E-06	**6.6E+06**
109-99-9	Tetrahydrofuran	6.7E+03	4.1E-09	2.0E+00	**4.9E+08**	1.5E-09	NC	--
108-88-3	Toluene	2.0E+04	1.4E-09	5.0E+00	**3.7E+09**	4.9E-10	NC	--
79-01-6	Trichloroethene	2.7E+04	1.0E-09	2.0E-03	**2.0E+06**	3.6E-10	4.1E-06	**6.7E+06**
75-01-4	Vinyl chloride	6.3E+04	4.3E-10	1.0E-01	**2.3E+08**	1.5E-10	7.8E-05	**8.3E+05**
108-38-3	Xylene, m-	1.6E+04	1.7E-09	1.0E-01	**6.0E+07**	6.0E-10	NC	--
95-47-6	Xylene, o-	1.3E+04	2.1E-09	1.0E-01	**4.8E+07**	7.5E-10	NC	--
106-42-3	Xylene, p-	1.6E+04	1.7E-09	1.0E-01	**5.9E+07**	6.0E-10	NC	--
	TPH							
	Aliphatic: C5-C8	4.7E+04	5.8E-10	7.0E-01	**1.2E+09**	2.1E-10	NC	--
	Aliphatic: C9-C18	1.1E+04	2.5E-09	3.0E-01	**1.2E+08**	9.0E-10	NC	--
	Aliphatic: C19-C32	--	--	NA	**--**	--	NC	--
	Aromatic: C6-C8	1.6E+04	1.8E-09	NA	**--**	6.3E-10	NC	--
	Aromatic: C9-C16	3.7E+03	7.4E-09	5.0E-02	**6.7E+06**	2.6E-09	NC	--
	Aromatic: C17-C32	--	--	NA	**--**	--	NC	--

Note: " -- " not applicable or not available

Attachment A1, Table A1-7

Derivation of Site-Specific Cleanup Goal, Lead in Soil
Construction and Utility Maintenance Worker

Former Kast Property

Carson, California

Calculations of Preliminary Remediation Goals (PRGs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004
$PbB_{fetal, 0.90}$	90^{th} percentile PbB in fetus	ug/dL	1
$R_{fetal/maternal}$	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	0.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	12
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	90
PRG		**mg/kg**	**818**

ATTACHMENT A2

Background Evaluation

Attachment A2
Detailed Background Evaluation
Former Kast Property
Carson, California

Introduction

This attachment presents the background evaluation methodology and results used to derive background-based Site-specific cleanup goals (SSCGs) for metals and carcinogenic polyaromatic hydrocarbons (cPAHs) detected in soil at the former Kast Property (Site) located in Carson, California. The evaluation builds upon the preliminary evaluation presented previously (Geosyntec, 2011) and includes samples from locations not anticipated to be affected by the Site and that represent local and regional background.

Purpose

The purpose of this report is to *i)* identify locally representative background data for metals and cPAHs from locations that are not affected by Site impacts; *ii)* evaluate the selected background datasets graphically and statistically including outlier analysis to develop a representative background dataset; *iii)* develop background threshold values for metals and cPAHs for use in background evaluation using local and regulatory approved regional background datasets; and *iv)* present the methodology that will be used to compare Site datasets with background thresholds to determine if metals or cPAHs are above or below background and should be carried forward for further risk evaluation.

Approach

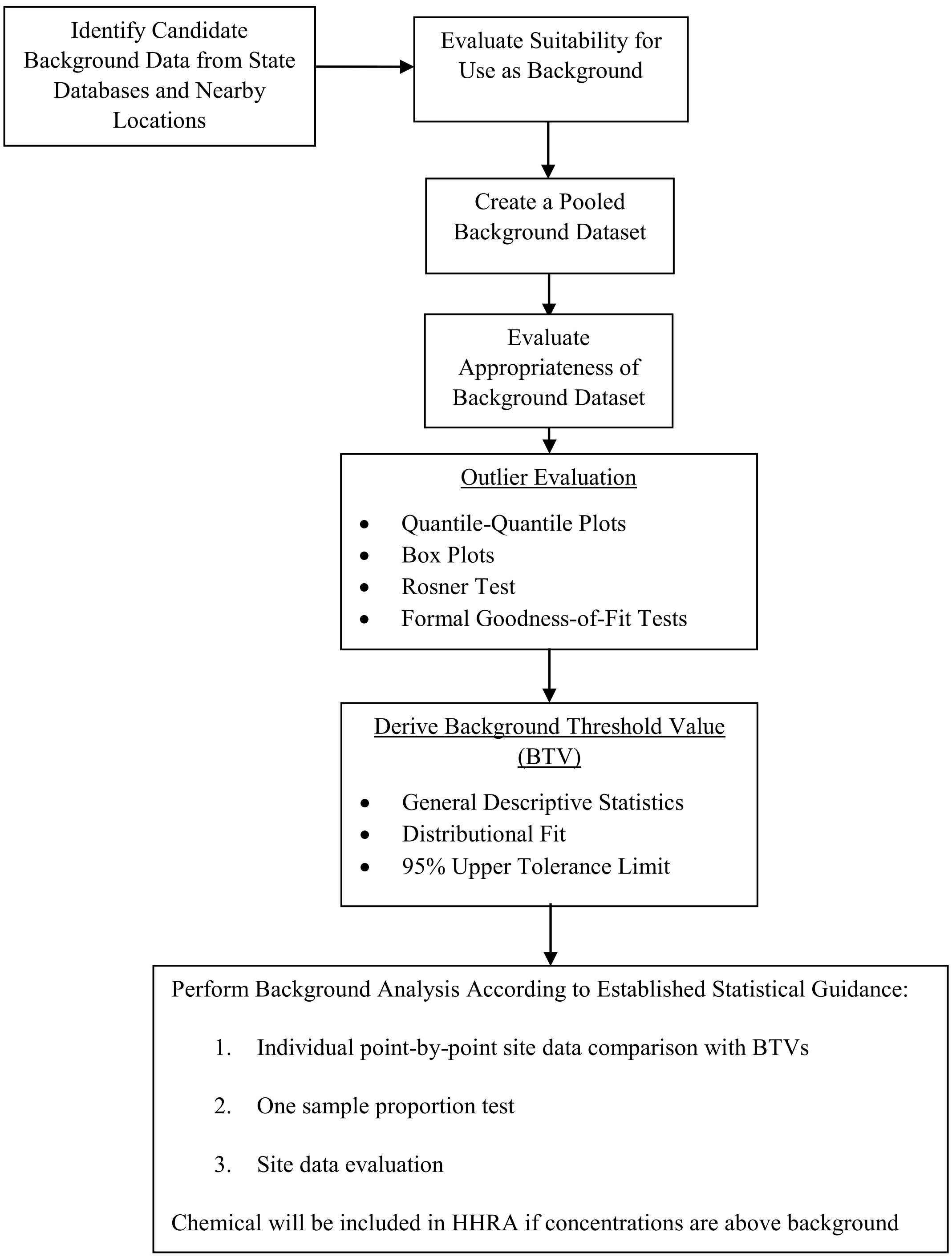
Metals may be naturally occurring in the environment. According to the California Department of Toxic Substances (DTSC) (Cal-EPA DTSC 2009a, 2009b, Cal-EPA, 1997) for naturally occurring materials such as metals, an evaluation of background concentrations is important to evaluate whether the metals concentrations on the property are consistent with naturally occurring levels in the area, and whether they should be included in the risk assessment. If concentrations of a metal are within background, the metal is not considered a Chemical of Concern (COC) and is not evaluated further.

In addition to metals, cPAHs can be naturally occurring or present at ambient levels not associated with former site activities. A background dataset and methodology has been developed by DTSC that can be used to evaluate the presence of cPAHs in soil (Cal-EPA DTSC, 2009c).

The background evaluation considered:

1. Offsite background data collected for the project;
2. Data collected from nearby locations that represent local background; and
3. Regulatory approved regional background concentrations for southern California soils.

The approach that was used to perform the background data evaluation is illustrated in the flow chart below.



Background Site Selection

The background locations used to create a local background database include:

- Banning Park,
- Banning Elementary School,
- Wilmington Middle School, and
- Wilmington Recreation Center.

These locations were previously identified in the Background Soil Evaluation Work Plan (Geosyntec 2010). The use of background datasets from nearby locations in the vicinity of the Site is consistent with the approaches and methodologies used by DTSC and other agencies to evaluate regional background datasets such as arsenic or cPAHs both for southern and northern California regions (DTSC, 2009a; DTSC, 2009c). The regional datasets show that background values can vary by location. The use of several background datasets is anticipated to capture these variabilities and provide a more representative background value.

Banning Park

Banning Park was selected as a potential background location as the site did not appear to have been developed for commercial or industrial use and according to the review of historical aerial photographs from the Los Angeles Regional Water Quality Control Board's (LARWQCB) Geotracker database (Geotracker); the site was not impacted by nearby historical operations. The park is developed with a museum situated on 20-acres of parkland. The museum was formerly a residence built in 1864. The residence and parkland were acquired by the City of Los Angeles in 1927. A total of 30 soil samples were collected from ten soil borings placed at 0.5, 2 and 5 feet (ft) below ground surface (bgs). The Banning Park background samples were analyzed for metals and cPAHs.

Banning Elementary School and Wilmington Middle School

Data previously collected to support site characterization at nearby school locations including Banning Elementary School and Wilmington Middle School were considered for inclusion in the background dataset. At Banning Elementary school, 63 soil samples were collected at depths 0, 0.5, 1 and 5 ft bgs and analyzed for metals; while at Wilmington Middle School five soil samples were collected at 0.5 and 5 ft bgs and analyzed for metals and cPAHs.

Wilmington Recreation Center

Eight background soil samples were collected at Wilmington Recreation Center as part of the environmental investigations performed for the LAUSD new schools construction program. These data are reported in the PEA for Banning Elementary School. The samples were collected at 0.5 and 2.5 to 3 ft bgs and analyzed for metals.

Evaluation of Background Datasets

Comparison of Background Samples by Depth

The background samples were obtained from several depths ranging from 0 to 5 ft bgs. To evaluate whether the samples could be combined into a single dataset, the samples were evaluated for significant difference by depth to determine if shallower samples were statistically different than surface samples. Samples between 0 to 2 ft bgs (surface) and >2 to 5 ft bgs (shallow), and with percent detection above 50%, were statistically compared using the non-parametric Mann-Whitney method at 0.05 significance level. The results show that the majority of metals concentrations (except cadmium, copper, lead and zinc) are not significantly different by depth. The Mann Whitney analysis was not suitable for comparison of equality for cPAHs as B(a)P-equivalents by depth, as samples >2 to 5 ft bgs have more than an 85% frequency of non-detect samples. A two-sample proportions test, applicable for comparing samples with high degree of non-detection, however indicates that cPAHs are statistically different by depth. This may be due to higher near surface ambient concentrations as a result of anthropogenic sources. While there were some differences by depth, datasets were combined to reflect the depth interval of interest for exposure potential and to provide for a larger dataset. The statistical analysis report (Minitab software output) is presented in Attachment A2-1.

Outlier Evaluation

Since two of the datasets were from investigations for school sites and were not specifically background sample datasets, an outlier analysis was conducted consistent with DTSC guidance for evaluating background (DTSC, 2009a). The background datasets were screened for suspect or potential outliers using *(i)* box plots, *(ii)* Q-Q plots, *(iii)* probability plots or underlying distributions (Goodness of fit test), *(iv)* Rosner outlier test, and *(v)* professional judgment based on established regional background thresholds and historical land use.

Samples higher than the three-interquartile range (3IR) on box plots were identified as suspect outliers and were further evaluated using the formal outlier test (Rosner test). Suspect outliers were also evaluated using Q-Q plots and goodness-of-fit tests on detected datasets. The Q-Q probability plots for the best fit distribution for each metal and cPAH (as benzo(a)pyrene equivalent) were examined for the presence of inflections and break-points, which could be used to identify multiple populations or outlier concentrations. A probability-plot (i.e., normal, lognormal, or gamma) partitioning was used to identify outliers as well as other patterns in the data that could signify the presence of multiple statistical populations. A weight of evidence approach based on the results of all the above methodologies was considered when determining whether a suspect outlier was eliminated or included in the background dataset. Suspect outliers that were persistently identified in all of these methods were further evaluated with respect to sample location, depth or correlation to known contaminated locations or other pertinent evidence. Outlier evaluation of each chemical, as part of a background metals evaluation is provided in Attachment A2-1.

Development of a Background Threshold Value

Background Threshold Values (BTVs) are single-point background thresholds that represent an upper plausible limit of the background distributions of individual compounds (EPA 2009a, 2009b; Helsel 2005). Threshold limits are most often based on an upper percentile of the background distribution (such as 90th, 95th, or 99th percentile), an upper confidence limit of an upper percentile (that is, an upper tolerance limit or UTL). Consistent with Cal-EPA guidance (Cal-EPA DTSC 2009a), the UTL was derived. Following EPA's guidance, a minimum of 8 to 10 or more samples are required to estimate BTVs. When detected observations are less than 4 to 6, the maximum detected sample could be used to estimate the BTV. When all the background samples are non-detects, the BTV will also be a non-detect. The smaller of the sample maximum and calculated BTV were used as the chemical BTV. Development of the BTV for each chemical is presented in Attachment A2-1.

Background Thresholds from State Regulatory Datasets

In addition to the BTVs derived from the data discussed above, well established regulatory approved regional background thresholds for arsenic and cPAHs in soil were considered. These thresholds have been used for many sites within the Los Angeles Area to identify chemicals of potential concern for risk assessments as well as used as remedial goals for site cleanups for unrestricted or residential land use. For arsenic, the DTSC background concentration for southern California sites of 12 mg/kg (Cal-EPA DTSC, 2007) will be used. In addition to metals, PAHs can be naturally occurring or present at ambient levels not associated with former site activities. A background dataset and methodology has been developed that can be used to evaluate the presence of PAHs in soil (Cal-EPA DTSC, 2009c). Consistent with agency-approved risk assessment practice in California, the DTSC-developed background concentration of 0.9 mg/kg benzo(a)pyrene equivalents (Bap-eq) will be used to evaluate cPAHs results. These values will be used as the BTVs for the Site.

Comparison of Site and Background Datasets

Due to the preponderance of Site data (over 10,000 samples and 285 individual study areas), a streamlined approach was developed to evaluate background at the Site. In the first step, Site samples will be compared to the BTVs to evaluate whether onsite metal or cPAH concentrations are above or below background concentrations. In the second step, for those areas where samples are above the BTV, a proportion test will be conducted to further evaluate whether observed concentrations are above background. If onsite concentrations are below background, the area will not be evaluated further in the risk assessment process. The background comparison will be conducted as part of the full Human Health Risk Assessment (HHRA) that will be conducted once the Phase II Site Characterization work is complete. It is anticipated that the HHRA will be included in the Remedial Action Plan (RAP).

As mentioned above, the approach used to compare Site datasets against background thresholds includes:

- Point by point comparison of Site datasets and BTV;
- One-sample hypothesis testing (Proportion test); and
- Site data evaluation

Point-by-Point Comparison

The point-by-point comparison method will initially be used as a conservative screen to identify chemicals that may be present at concentrations above background. If a chemical is found to be above background, the proportion test will be used to further evaluate the data.

One-sample proportion test

For chemicals that are present at concentrations above the BTV, a one-sample proportion test will be used to compare the Site data with the BTVs. This is consistent with agency guidance that states that when BTVs and cleanup standards are known, one-sample hypotheses are used to compare site data with the known and pre-established threshold values (USEPA, 2010). The one-sample proportion test is a test for proportion and will be used to compare the proportion of Site data exceeding the BTV with a pre-specified allowable proportion of exceedance (5%). The proportion test is non-parametric and therefore can be used with censored datasets in which there is a large proportion on non-detect values. The proportion test is used to detect a significant difference or a shift in the upper tail of the site data distribution. A significant shift in the upper tail of the site dataset as compared to background may indicate that the site has been impacted for that particular chemical. A 5% level of significance ($p < 0.05$) will be used to evaluate all tests.

Site Data Evaluation

A more detailed analysis may be conducted to further evaluate if chemicals are present at the Site above background, especially for chemicals that do not have local or regional background datasets or were nondetect in the background datasets. Methods described in Cal-EPA guidance *Selecting Inorganic Constituents as Chemicals of Potential Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities* (Cal-EPA, 1997) describe ways that the Site data can be evaluated to determine if observed concentrations are consistent with background. Natural metals distributions are widely observed to be normal or to have a low to moderate skewness that is well approximated by a lognormal distribution (Cal-EPA 1997). Cal-EPA also states that samples from such distributions generally range by no more than one order of magnitude and that the sample coefficients of variation (CV, standard deviation/mean) are also no greater than one. Substantial departures from these traits, referred to here as natural population indicators, will be used to indicate the presence of multiple populations in the sample, which may indicate the presence of chemical concentrations above background. As a part of the evaluation, visual observation of the data will be conducted using probability plots to determine if multiple populations are present.

If the concentrations of a chemical are found to be above background after these three steps the chemical will be included in the HHRA.

References

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Attachment A2-1
Detailed Background Evaluation

1. Background Metals Data Evaluation

The summary statistics of the metals and cPAH background databases are provided in Table A2-1. Background Threshold Values (BTVs) are presented in Tables A2-2 and A2-3. Box plots and probability plots of the background datasets are provided in Figures A2-1 through A2-3.

Box plots based on three times the interquartile range (3IR), Q-Q plots and probability plots for outlier evaluation are shown on Figures A2-4-1 through A2-4-18. ProUCL output of the Rosner outlier test is provided in Attachment A2-1.

Goodness of fit test of background samples before and after elimination of suspect outliers is shown in Attachment A2-1. Summary of the background threshold values (BTV) after elimination of suspect outliers is provided in Table A2-2. ProUCL output of the upper threshold analysis is shown in Attachment A2-1.

Antimony (N=106, ND=99.06%)

Antimony has 106 samples all obtained from 0 to 5 ft bgs. There is only one detected sample at 0.74 mg/kg (99% non-detection). Since the %ND is significantly large, there is no reliable statistical analysis that can be performed on antimony. No samples were eliminated as outliers. The detection levels were 0.306 and 0.5 mg/kg. The detected sample was obtained from Banning Park at 0.5 ft bgs.

Due to large %ND, no reliable 95% UTL can be estimated. The maximum value of 0.741 mg/kg is used as BTV for antimony.

Arsenic (N=106, ND=2.83%)

Outlier evaluation based on above 3IR box plot indicates that arsenic has three suspect outliers including 9, 11.9 and 127, while a test for one Rosner outlier at 1% significance level indicates that 127 may be a potential outlier. Graphic evaluation using a Q-Q plot indicates that the arsenic sample with a concentration of 127 mg/kg may be a suspect outlier. A goodness of fit test was performed, and arsenic does not fit normal or lognormal distribution. The GOF test however shows that the arsenic sample concentration of 127 mg/kg is considerably offset from the general linear trend indicating that the sample may be an outlier. The sample was obtained from the surface (at 0 ft bgs) at the Wilmington School, and may not represent background distribution. Moreover, the value is significantly above the Southern California arsenic background threshold of 12 mg/kg and above the background range reported of 2.2 mg/kg to 19 mg/kg reported in the regional study conducted by UC Riverside (1991) and the range of 0.15 mg/kg to 19.63 mg/kg that was observed in the Southern California background dataset presented by DTSC in its

Arsenic Strategies Document (DTSC, 2009a). The sample 127 mg/kg therefore was eliminated as an outlier.

After elimination of the outlier, detected arsenic follow an approximate gamma distribution, and therefore a Gamma distribution based UTL was selected from the ProUCL results to estimate the 95% UTL at 10.4 mg/kg.

The local threshold BTV, 10.41 mg/kg, is less than the well-established Southern California arsenic BTV of 12 mg/kg developed by DTSC. The maximum value in the local background dataset is 11.9, close to the value of 12 mg/kg. The Southern California background arsenic dataset is made up of a much larger database across several areas within the Los Angeles basin and as a result anticipated to be more representative of background within the Los Angeles area. In addition, this value has been commonly used for COC selection and as a cleanup level for unrestricted land use and residential sites. Therefore, the DTSC arsenic threshold value of 12 mg/kg is used as the BTV in this report.

Barium (N=106, ND=0%)
Barium has four suspect outliers including concentrations of 203, 267, 428 and 575 mg/kg based on above 3IR box plot evaluation. A test for one Rosner outlier at 1% significance level indicates that 575 may be a potential outlier while a graphic evaluation using a Q-Q plot indicates that 267, 428 and 575 may be potential outliers. A GOF test was performed and barium data does not fit normal nor lognormal distribution. The test based on lognormal distribution however shows that barium samples 428 and 575 mg/kg may be considered as deviating from the general linear trend indicating that they may be outliers. The weight of evidence presented suggests that 428 and 575 mg/kg may be outliers, and were removed from the background evaluation.

After elimination of the two suspect outliers, barium appears to fit lognormal distribution. Based on lognormal distribution after elimination of suspect outliers (N=105, %ND = 0%), the 95% UTL was 195.4 mg/kg.

Beryllium (N=106, ND=16.98%)
With 106 samples and 17% non-detection, 3IR based box plot indicates that concentrations of 0.6, 0.7, 0.7 and 0.8 may be suspect outliers while a one outlier Rosner test shows that 0.8 may be an outlier. Graphic evaluation using a Q-Q plot does not show an obvious or significant outlier. A GOF test shows that beryllium does not fit normal or lognormal distributions. There is however a general linear trend based on a lognormal distribution particularly among the detected datasets. In addition, these concentrations fall within the range of background concentrations of 0.1 to 0.9 mg/kg reported in the regional study conducted by UC Riverside (1991). There is no strong evidence to suggest that these are outliers, and therefore no beryllium samples are eliminated as outliers.

Since Beryllium samples do not fit a normal or lognormal distribution, a non-parametric 95% KM UTL with 99% coverage of 0.56 mg/kg was selected as the BTV for the background dataset.

Cadmium (N=106, ND=53.77%)
Based on above 3IR samples on a box plot, seven cadmium samples from 1.0 to 3.81 mg/kg are suspect outliers. A test for one Rosner outlier at 1% significance level indicates 3.81 as a potential outlier while a graphic evaluation using a Q-Q plot apparently shows two populations as indicated by the shift from linearity which may imply that the upper tail of the distribution may be impacted. However it has to be noted that cadmium has more than 50% non-detects that constitutes the lower tail of the population distribution while the detected samples make the upper distribution. So the Q-Q plot departure from linearity is more of a distinction between detected and non-detected samples rather than discrimination between background and impacted samples. The three highest suspect outliers 1.63, 1.8 and 3.81 mg/kg are obtained from Banning Park at 0.5 ft bgs. A GOF test on the detected samples indicates cadmium fits a lognormal distribution. Using the above weight of evidence, no cadmium sample was eliminated as an outlier.

A value of 3.81 mg/kg is selected as a BTV using a 95% Bootstrap (%) UTL with 99% coverage ProUCL output.

Chromium (N=106, ND=0%)
Chromium has three suspect outliers including 29.3, 36.5 and 38.6 mg/kg based on above 3IR box plot evaluation. A test for one Rosner outlier at 1% significance level indicates that 38.6 may be a potential outlier while a graphic evaluation using a Q-Q plot does not indicate a significant outlier. A GOF test was performed and indicates the data fit a lognormal distribution indicating there may be no outlier chromium samples. The samples 29.3, 36.5 were obtained from Banning Elementary School (at 0.5 ft bgs), while sample 38.6 was obtained from Wilmington Recreation Center (at 0.5 ft bgs). Based on the weight of evidence presented, no dataset was eliminated from chromium samples as outlier.

Since chromium is log-normally distributed, a 95% UTL of 32.54 mg/kg is selected from PROUCL output.

Cobalt (N=106, ND=3.77%)
Cobalt has three suspect outliers including 13.1, 13.5 and 15.7 mg/kg based on above 3IR box plot evaluation. A test for one Rosner outlier at 1% significance level indicates that 15.7 may be a potential outlier. A GOF test indicates that Cobalt samples are log-normally distributed. Though the Box plot and Rosner test indicate three suspect outliers (13.1, 13.5, 15.7), the GOF test and Q-Q plot did not show a significant break of these datasets from the body of samples. The suspect outliers 13.1, 13.5 and 15.7 were obtained from Banning Elementary School at 0.5 ft, 5 ft and 1 ft bgs respectively. Based on the above weight of evidence, no samples were eliminated as outlier.

A non-parametric based 95% KM UTL with 99% coverage at 10.91 mg/kg will be used as the sample BTV.

Copper (N=106, ND=0%)

Copper has one suspect outlier at 59 mg/kg based on above 3IR box plot evaluation. A test for one Rosner outlier at 1% significance level indicates that the sample 59 mg/kg may be a potential outlier while a graphic evaluation using a Q-Q plot does not indicate a significant outlier. A GOF test was performed and indicates copper fit a fairly strong lognormal distribution showing there may be no outliers. The sample 59 mg/kg was obtained from Banning Park (at 0.5 ft bgs). Based on the weight of evidence presented, no copper dataset was eliminated as outlier.

Based on lognormal distribution, a threshold value of 95% UTL is 64.62. However, since this value is higher than sample max at 59, the BTV will be taken as 59 mg/kg.

Lead (N=106, ND=5.66%)

Based on above 3IR samples on a box plot, twelve (12) lead samples from 43.3 to 112 mg/kg are suspect outliers. A test for one Rosner outlier at 1% significance level indicates 112 as a potential outlier while a graphic evaluation using a Q-Q plot apparently shows two populations which is partly a reflection of lead distribution by depth. A GOF test on the detected samples indicates lead does not follow a normal or lognormal distribution. The linear pattern of the probability plot using lognormal distribution at different depths (0 to 0.5 ft, and >0. 5 ft bgs) however indicates that lead may not have an outlier. Moreover, lead has been detected at background level concentrations ranging from 7.7 to 189.4 mg/kg in Southern California region. Using the above weight of evidence, no lead sample was eliminated as an outlier.

Since lead samples do not follow a discernible distribution, a non-parametric 95% KM UTL with 99% coverage BTV at 61.46 mg/kg is selected from PROUCL output.

Mercury (N=106, ND=71.7%)

Mercury has a large proportion of non-detects (ND=71.7%), and therefore outlier evaluation is performed using the detected datasets only. There is one suspect outlier (0.324) based on above 3IR box plot and one Rosner outlier test at 1% significance. The Q-Q plot however did not appear to indicate a significant departure or break of this sample from the body of the samples. A GOF tests shows that detected mercury samples do not follow a normal or lognormal distribution, though the shift from linearity was small. The suspect outlier was obtained from Banning Park at 0.5 ft bgs. Based on the above weight of evidence, no sample was eliminated as an outlier.

Since mercury does not follow a discernible distribution, a non-parametric BTV of 0.131 mg/kg based on 95% KM UTL with 99% coverage is selected from PROUCL output.

Molybdenum (N=106, ND=84.91%)
Molybdenum has a large proportion of non-detects (ND=84.9%), and therefore outlier evaluation is performed using the detected datasets only. There is no suspect outlier based on above 3IR box plot evaluation. The Rosner outlier test at 1% significance indicates no outlier either. The Q-Q plot indicates a slight departure from linearity. A GOF tests shows that detected molybdenum samples do not follow a normal or lognormal distribution, though the shift from linearity was not significant. Based on the above weight of evidence, no sample was eliminated as an outlier.

Since molybdenum does not follow a discernible distribution, a non-parametric BTV of 0.409 mg/kg based on 95% KM UTL with 99% coverageis selected from PROUCL output.

Nickel (N=106, ND=10.38%)
Based on above 3IR samples on a box plot, two nickel samples 25.3 and 27.2 mg/kg are suspect outliers. A test for one Rosner outlier at 1% significance level indicates 27.2 as a potential outlier while a graphic evaluation using a Q-Q plot apparently shows no suspect outlier. A GOF test indicates nickel fits a lognormal distribution. Both suspect outliers (25.3 and 27.2) were obtained from Banning Elementary School at 5 and 1 ft bgs respectively. Using the above weight of evidence, no samples were eliminated as outliers.

A BTV of 20.17 mg/kg based on a non-parametric approach of 95% KM UTL with 99% Coverage is selected from PROUCL output.

Selenium (N=106, ND=99.06%)
Selenium has 106 samples all obtained from 0 to 5 ft bgs. There is only one detected sample at 0.78 mg/kg (99% non-detection). No reliable statistics can be performed on Selenium as the %ND is significantly large. No samples were eliminated as outliers.

Due to large %ND, no reliable 95% UTL can be estimated. The maximum value of 0.78 mg/kg is used as BTV for selenium.

Silver (N=106, ND=91.51%)
Silver has 91.5% non-detects. Statistical evaluation was performed only on detected samples (9 samples). The outlier tests show no indication of suspect outliers, and therefore no sample was eliminated.

Silver data appear log-normally distributed. Since the corresponding potential BTV (6.87) was greater than the sample max of 1.29, the BTV selected was 1.29 mg/kg.

Thallium (N=106, ND=100%)
All 106 thallium data were non-detects. No statistical analysis was performed on thallium. At 100% non-detection, the BTV of thallium was also a non-detect and assessed at 0.23 mg/kg.

Vanadium (N=106, ND=0%)
Vanadium has no suspect outlier based on above 3IR box plot evaluation. A test for one Rosner outlier at 1% significance level indicates no suspect outlier either. The Q-Q plot shows a fairly linear trend indicating no potential outlier. A GOF test shows that vanadium follows a strong lognormal distribution. Based on the above weight of evidence, no suspect outliers were identified for vanadium.

Based on lognormal distribution, BTV at 95% UTL is 50.07 mg/kg. However, since this value is higher than sample maximum (47.01), BTV was assessed at 47.01 mg/kg.

Zinc(N=106, ND=0%)
Zinc has four suspect outliers including 151, 172, 291and 525 mg/kg based on above 3IR box plot evaluation. A test for one Rosner outlier at 1% significance level indicates that 525 may be a potential outlier while a graphic evaluation using a Q-Q plot also indicates that 525 may be a potential outlier. A GOF test was performed and zinc data does not fit normal nor lognormal distributions though the deviation of the probability plot from linear trend is only slight. The sample 525 was obtained from Wilmington Recreation Center at 0 ft bgs. The weight of evidence presented suggests that 525 mg/kg may be an outlier and was eliminated from further background evaluation.

Zinc samples did not follow a discernible distribution even after the elimination of the outlier. Therefore a non-parametric 95% Percentile Bootstrap UTL BTV of 291 mg/kg was used from ProUCL output.

2. **Background cPAH Evaluation**

cPAH (N=35, ND=37.14%)
cPAH samples were obtained from Banning Park (N=30) and Wilmington Middle School (N= 5). Using a weight-of-evidence of above 3IR based box plot evaluation and Rosner test, the value of 0.179 mg/kg appears to be a suspect outlier. The Q-Q plot and GOF test suggests that the concentration of 0.179 mg/kg may be an outlier. The sample was collected at 0.5 feet bgs at Wilmington Middle School. A review of the sample data indicate that low levels of total petroleum hydrocarbons (< 60 mg/kg) were detected which may have contributed to the cPAH concentrations. However, since the value of 0.179 mg/kg is well within the range of background reported for Southern California (Cal-EPA, 2009c), and the concentrations of TPH are considered negligible (<60 mg/kg) and not from a known onsite source, the sample was included in the analysis as what may be represented in the soils from anthropogenic non site-related sources.

To further evaluate background cPAH, these local background datasets were evaluated against the backdrop of 22 background sites in Southern California (N=185) used in developing the regional cPAH BTV (Cal-EPA DTSC, 2009c). Side by side graphical evaluation including box plots and probability plots were used to compare local and Southern California representative datasets (Figure A2-5). The evaluation indicates that, Banning Park and Wilmington Middle School datasets are in the low end/tail distribution of Southern California Background datasets.

The Southern California analysis used a much larger pool of background sites, and a relatively larger number of samples. As a result, the Southern California evaluation is anticipated to be more robust and more representative of the true background condition of the region. The local background dataset is consistent with a selection of subsamples from the broader regional dataset where some samples are expected to be higher and some lower than the regional mean. Moreover, the Southern California statistical analysis benefits from a higher statistical power due to higher number of samples than Banning Park and WMS background samples collected as part of a site investigation.

Therefore, considering the above and the common use of the regional dataset for remedial decision making at sites, the cPAH BTV of 0.9 mg/kg, derived from the southern California cPAH background analysis is selected at the cPAH BTV for use at the Site. This value has been used as a remedial goal at unrestricted land use and residential sites throughout southern California. The BTV of 0.9 mg/kg will be used along with the comparison methodology outlined in the main document to determine if Site concentrations are above background. Additional evaluation as discussed in guidance (Cal-EPA, 2009c) may be conducted if warranted

Tables

Table A2-1
Summary Statistics of Background Metals and cPAHs
Former Kast Property
Carson, California

Site ID	Analyte	Variable	Depth (ft bgs)	# of Samples	% NDs	Minimum[1]	Maximum[1]	Mean[1]	Median[1]	SD[1]	CV[1]
Banning Park	cPAH	BaP-TEQ	0.5 - 5	30	30%	0.00106	0.0183	0.0042	0.0026	0.0048	1.1310
	Metals	Antimony	0.5 - 5	30	96.67%	0.741	0.741	0.741	0.741	--	--
		Arsenic	0.5 - 5	30	0%	1.11	11.9	2.35	1.69	1.97	0.84
		Barium	0.5 - 5	30	0%	38.3	267	73.83	71.50	39.08	0.53
		Beryllium	0.5 - 5	30	0%	0.18	0.30	0.23	0.22	0.03	0.13
		Cadmium	0.5 - 5	30	43.33%	0.11	3.81	0.83	0.61	0.93	1.12
		Chromium	0.5 - 5	30	0%	6.76	28.2	11.64	9.60	4.55	0.39
		Cobalt	0.5 - 5	30	0%	3.66	6.53	4.77	4.72	0.54	0.11
		Copper	0.5 - 5	30	0%	2.69	59	10.77	6.57	11.09	1.03
		Lead	0.5 - 5	30	0%	2.3	68.1	13.40	6.46	17.07	1.27
		Mercury	0.5 - 5	30	0%	0.02	0.32	0.05	0.03	0.06	1.22
		Molybdenum	0.5 - 5	30	50%	0.10	0.40	0.16	0.14	0.07	0.46
		Nickel	0.5 - 5	30	0%	3.68	20.8	6.6	5.7	3.0	0.5
		Selenium	0.5 - 5	30	100%	--	--	--	--	--	--
		Silver	0.5 - 5	30	70%	0.132	1.29	0.58	0.29	0.47	0.81
		Thallium	0.5 - 5	30	100%	--	--	--	--	--	--
		Vanadium	0.5 - 5	30	0%	12.6	22.8	16.28	16.25	1.92	0.12
		Zinc	0.5 - 5	30	0%	11.5	86.3	29.03	18.95	19.95	0.69
Banning Elementary School	Metals	Antimony	0 - 5	63	100%	--	--	--	--	--	--
		Arsenic	0 - 5	63	4.76%	0.4	9	1.91	1.7	1.27	0.67
		Barium	0 - 5	63	0%	17.7	575	69.04	47.8	86.41	1.25
		Beryllium	0 - 5	63	25.4%	0.2	0.8	0.306	0.3	0.15	0.48
		Cadmium	0 - 5	63	61.9%	0.2	0.7	0.375	0.35	0.15	0.39
		Chromium	0 - 5	63	0%	4.4	36.5	11.24	10.6	5.95	0.53
		Cobalt	0 - 5	63	6.35%	2.5	15.7	5.52	5	2.70	0.49
		Copper	0 - 5	63	0%	3.5	44.1	15.51	14.1	8.99	0.58
		Lead	0 - 5	63	6.35%	2.6	112	13.06	6	18.57	1.42
		Mercury	0 - 5	63	100%	--	--	--	--	--	--
		Molybdenum	0 - 5	63	100%	--	--	--	--	--	--
		Nickel	0 - 5	63	17.46%	3	27.2	8.92	7.35	5.46	0.61
		Selenium	0 - 5	63	100%	--	--	--	--	--	--
		Silver	0 - 5	63	100%	--	--	--	--	--	--
		Thallium	0 - 5	63	100%	--	--	--	--	--	--
		Vanadium	0 - 5	63	0%	6.2	47.1	20.07	19.7	9.58	0.48
		Zinc	0 - 5	63	0%	9.7	291	44.93	30.6	44.02	0.98

Table A2-1
Summary Statistics of Background Metals and cPAHs
Former Kast Property
Carson, California

Site ID	Analyte	Variable	Depth (ft bgs)	# of Samples	% NDs	Minimum[1]	Maximum[1]	Mean[1]	Median[1]	SD[1]	CV[1]
Wilimington Middle School	cPAH	BaP-TEQ	0.5 - 5	5	80%	0.179	0.179	0.179	0.179	--	--
	Metals	Antimony	0.5 - 5	5	100%	--	--	--	--	--	--
		Arsenic	0.5 - 5	5	0%	1.52	127	27.86	3.41	55.43	1.99
		Barium	0.5 - 5	5	0%	66.30	92.2	75.42	72	10.2	0.14
		Beryllium	0.5 - 5	5	20%	0.30	0.48	0.37	0.34	0.08	0.22
		Cadmium	0.5 - 5	5	100%	--	--	--	--	--	--
		Chromium	0.5 - 5	5	0%	9.04	17.4	12.6	13	3.5	0.28
		Cobalt	0.5 - 5	5	0%	5.18	6.92	6.33	6.57	0.7	0.11
		Copper	0.5 - 5	5	0%	5.34	14.70	9.21	7.07	4.06	0.44
		Lead	0.5 - 5	5	0%	3.48	57.50	14.96	4.11	23.8	1.59
		Mercury	0.5 - 5	5	100%	--	--	--	--	--	--
		Molybdenum	0.5 - 5	5	80%	0.625	0.625	0.625	0.625	--	--
		Nickel	0.5 - 5	5	0%	6.19	12.00	8.22	7.15	2.44	0.30
		Selenium	0.5 - 5	5	80%	0.78	0.78	0.78	0.78	--	--
		Silver	0.5 - 5	5	100%	--	--	--	--	--	--
		Thallium	0.5 - 5	5	100%	--	--	--	--	--	--
		Vanadium	0.5 - 5	5	0%	15.8	29.1	22.9	24	4.8	0.2
		Zinc	0.5 - 5	5	0%	20.1	151	52.2	27.8	55.6	1.1
Wilmington Recreation Center	Metals	Antimony	0 - 2.5	8	100%	--	--	--	--	--	--
		Arsenic	0 - 2.5	8	0%	0.3	2.1	1.35	1.35	0.64	0.47
		Barium	0 - 2.5	8	0%	31.9	91	58.24	56.00	16.58	0.29
		Beryllium	0 - 2.5	8	12.5%	0.2	0.3	0.23	0.20	0.05	0.21
		Cadmium	0 - 2.5	8	0%	0.2	1.0	0.49	0.30	0.36	0.73
		Chromium	0 - 2.5	8	0%	6.2	38.6	13.34	10.05	10.40	0.78
		Cobalt	0 - 2.5	8	0%	2.5	5.6	3.96	3.90	1.02	0.26
		Copper	0 - 2.5	8	0%	6.9	32.5	16.41	15.20	7.89	0.48
		Lead	0 - 2.5	8	25%	3.3	57.0	20.5	5.8	24.9	1.22
		Mercury	0 - 2.5	8	100%	--	--	--	--	--	--
		Molybdenum	0 - 2.5	8	100%	--	--	--	--	--	--
		Nickel	0 - 2.5	8	0%	4.10	16.40	9.50	8.85	4.46	0.47
		Selenium	0 - 2.5	8	100%	--	--	--	--	--	--
		Silver	0 - 2.5	8	100%	--	--	--	--	--	--
		Thallium	0 - 2.5	8	100%	--	--	--	--	--	--
		Vanadium	0 - 2.5	8	0%	10.50	28.80	18.19	17.80	5.72	0.32
		Zinc	0 - 2.5	8	0%	29.80	525.00	122.50	41.20	169.50	1.38

Notes:
[1]Summary statistics based on detected samples
- Summary statistics shown before outlier analysis

Table A2-2
Summary Outlier Evaliuation based on Weight of Evidence Approach for Metals and cPAHs
Former Kast Property
Carson, California

Analyte	% NDs	3IR	Rosner Test	Q-Q Plot	GOF Test	Suspect Outlier	Sample Location	Sample Depth (ft, bgs)	WOE Outlier
Antimony	99.06%	NA	NA	NA	NA	0.741	Banning Park	0.5	None
Arsenic	2.86%	>9	127	127	No Discernible Distribution	127	Willmington School	0	127
Barium	0.00%	>203	575	>267	No Discernible Distribution	>428	Banning Elementary School	0 and 0.5	428 and 525
Beryllium	16.98%	>0.6	0.8	None	No Discernible Distribution, close to LN	0.7 and 0.8	Banning Elementary School	0.5, 1 and 5	None
Cadmium	53.77%	>1	3.81	3.81	Lognormal	1.63, 1.8 and 3.81	Banning Park	0.5	None
Chromium	0.00%	>29.3	38.6	None	Lognormal	29.3, 36.5	Banning Elementary School	0.5	None
Cobalt	3.77%	>13.1	15.7	None	Lognormal	13.1, 13.5 and 15.7	Banning Elementary School	0.5, 5 and 1	None
Copper	0.00%	59	59	None	Lognormal or Gamma	59	Banning Park	0.5	None
Lead	5.66%	>43.3	112	112	No Discernible Distribution	None	NA	NA	None
Mercury	71.70%	0.324	None	None	No Discernible Distribution, close to LN	0.324	Banning Park	0.5	None
Molybdenum	84.91%	None	None	None	No Discernible Distribution, close to LN	None	NA	NA	None
Nickel	10.38%	>25.3	27.2	None	Lognormal	25.3 and 27.2	Banning Elementary School	5 and 1	None
Selenium	99.06%	NA	NA	NA	NA	NA	NA	NA	None
Silver	91.51%	NA	NA	NA	NA	NA	NA	NA	None
Thallium	100.00%	NA	NA	NA	NA	NA	NA	NA	None
Vanadium	0.00%	None	None	None	Lognormal	None	NA	NA	None
Zinc	0.00%	>151	525	525	No Discernible Distribution, close to LN	525	Willmington Reacreation Center	0	525
BaP TEQ	37.14%	0.179	0.179	0.179	No Discernible Distribution	0.179	Wilimington Middle School	0.5	None

Notes:

NA - Not applicable

3IR - Three Interquartile Range

WOE - Weight of Evidence

GOF - Goodness of fit test

LN - Lognormal

Table A2-3
Summary Background Threshold Values of Metals and cPAHs
Former Kast Property
Carson, California

Analyte	# Samples	% NDs	Maximum	95%-tile 99% UTL	BTV	SoCal BTV	Selected BTV
Antimony	106	99.06%	0.741	0.74	0.74	--	0.74
Arsenic	105	2.86%	11.9	10.41	10.41	12	12
Barium	104	0.00%	267	267.00	267.00	--	267.00
Beryllium	106	16.98%	0.8	0.562	0.56	--	0.56
Cadmium	106	53.77%	3.81	3.81	3.81	--	3.81
Chromium	106	0.00%	38.6	32.54	32.54	--	32.54
Cobalt	106	3.77%	15.7	10.91	10.91	--	10.91
Copper	106	0.00%	59	64.62	59.00	--	59.00
Lead	106	5.66%	112	61.46	61.46	--	61.46
Mercury	106	71.70%	0.324	0.13	0.13	--	0.13
Molybdenum	106	84.91%	0.625	0.41	0.41	--	0.41
Nickel	106	10.38%	27.2	20.17	20.17	--	20.17
Selenium	106	99.06%	0.78	0.78	0.78	--	0.78
Silver	106	91.51%	1.29	2.32	1.29	--	1.29
Thallium	106	100.00%	N/A	0.23	0.23	--	0.23
Vanadium	106	0.00%	47.1	45.66	45.66	--	45.66
Zinc	105	0.00%	291	291.00	291.00	--	291.00
BaP TEQ	35	37.14%	0.179	0.10	0.10	0.9	0.9

Notes:
Values shown are based on background datasets after elimination of outliers
ND: Non detects
UTL: Upper Tolerance Limit
BTV: Background Threshold Value

Figures

Figure A2-1: Box Plots of Metals Background Datasets

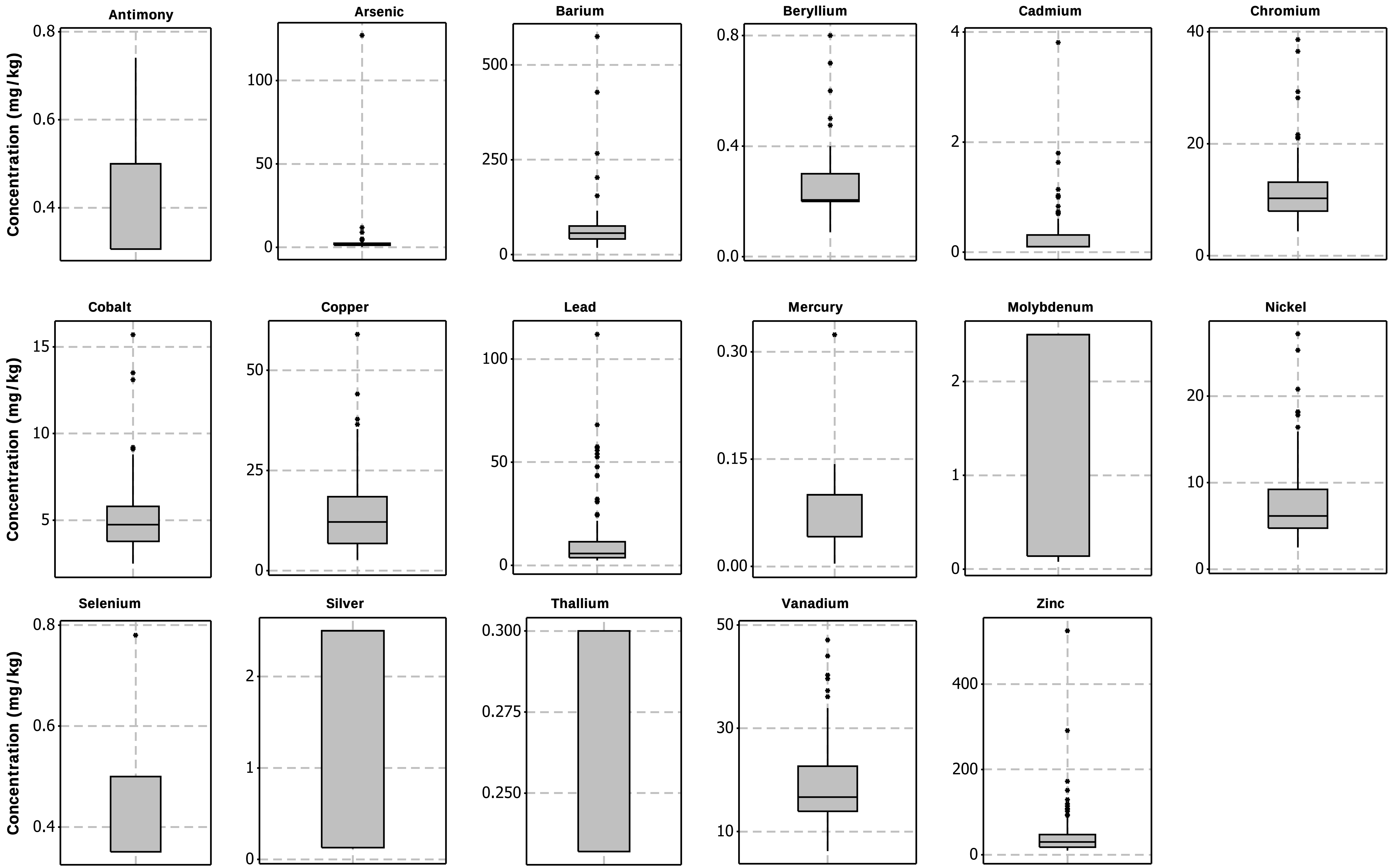


Figure A2-2: Probability Plots of Metals Background Datasets

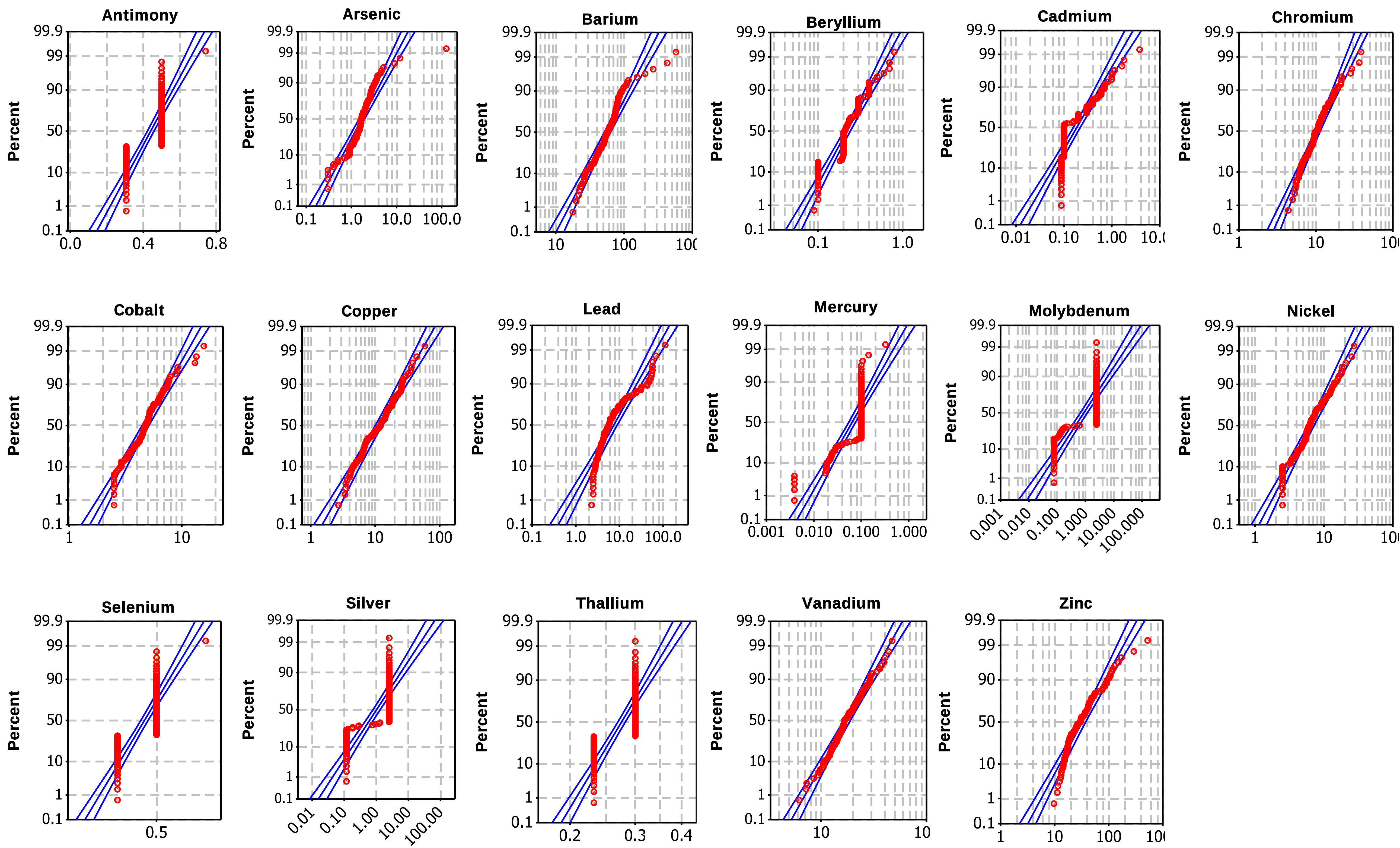
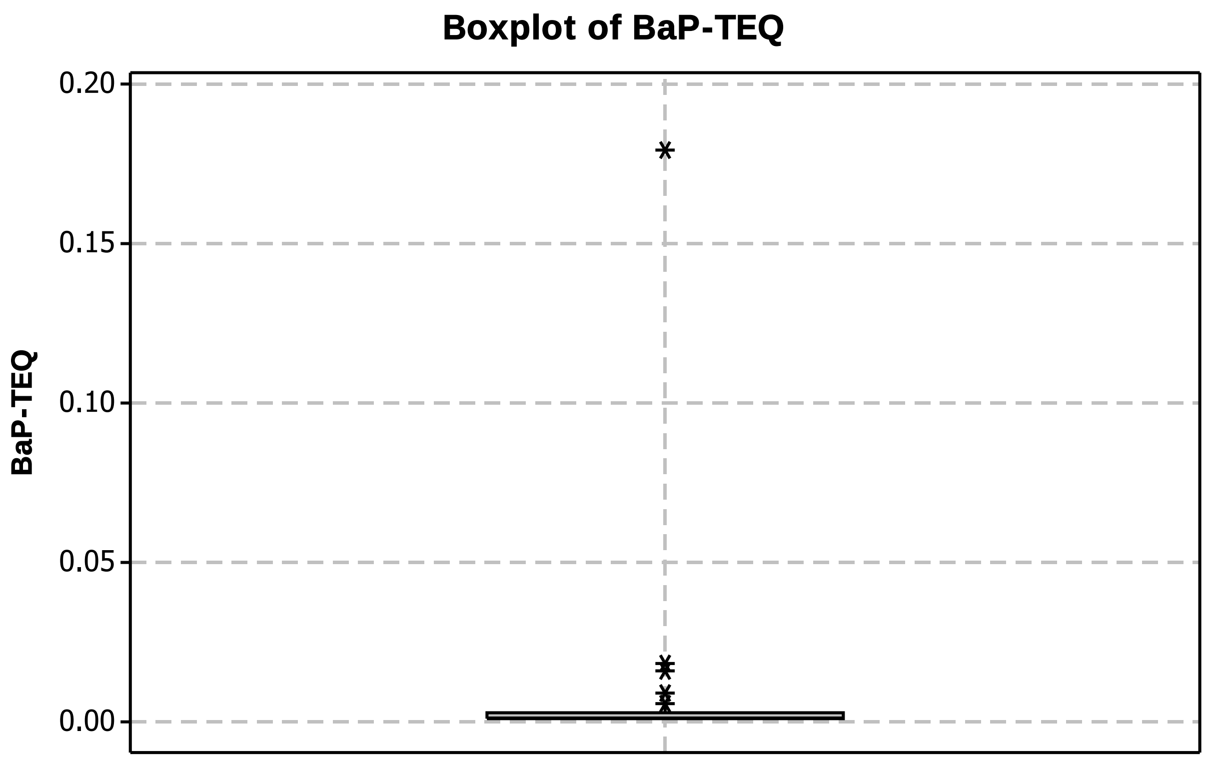
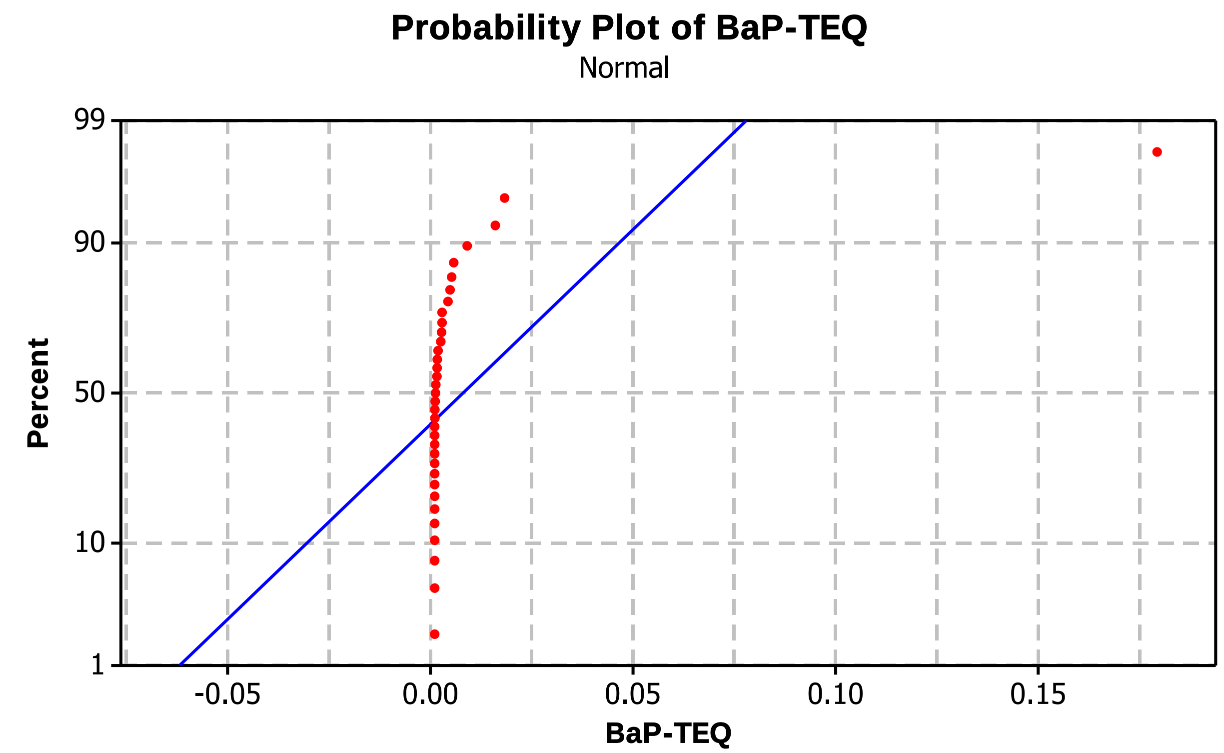


Figure A2-3: Box Plot and Probability Plots of cPAH Background Datasets





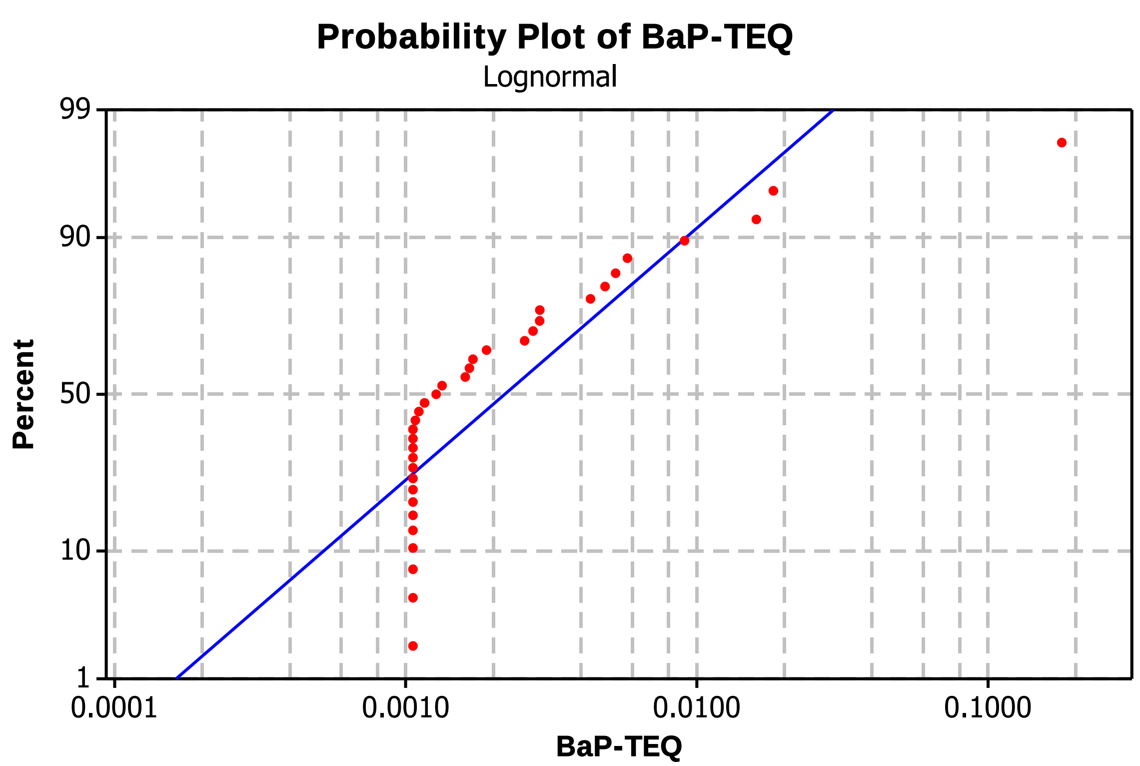
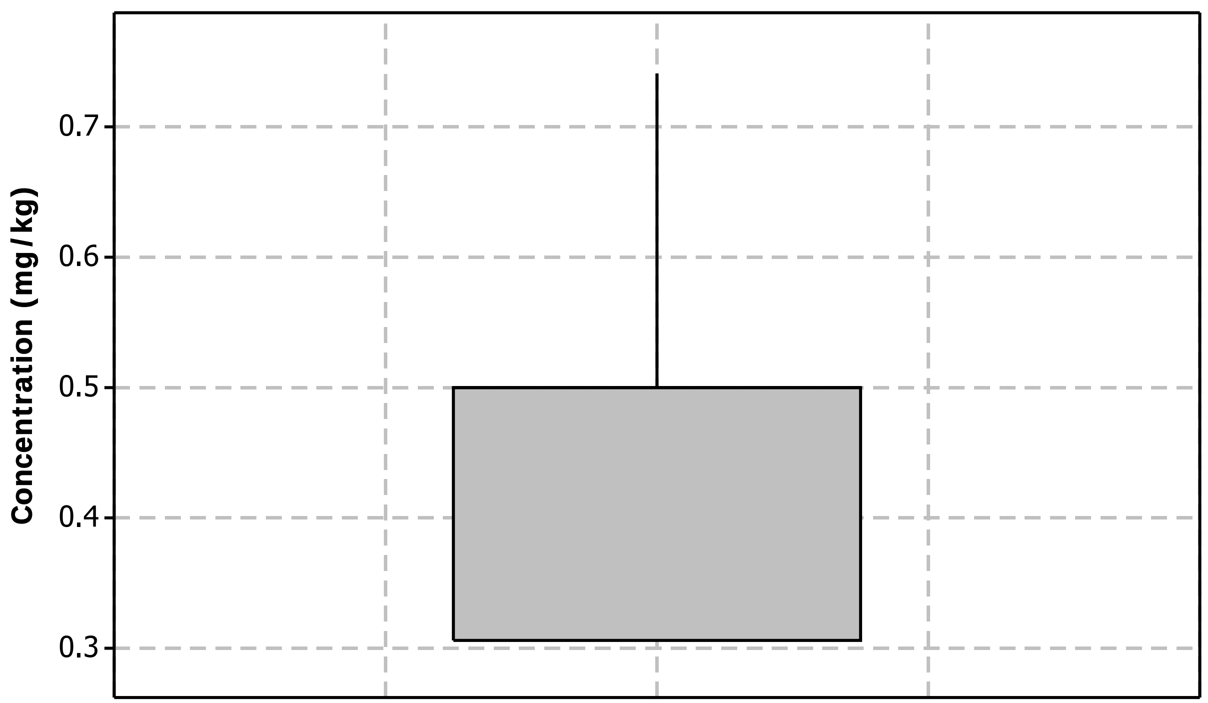
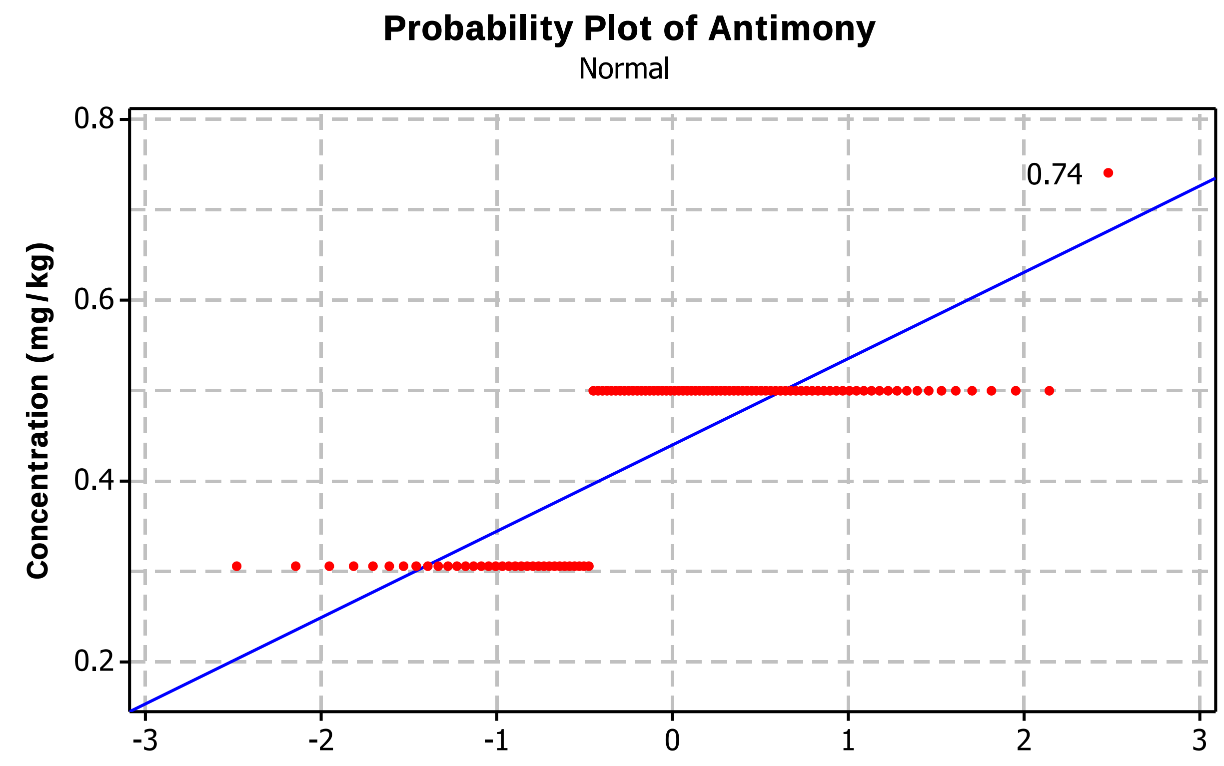
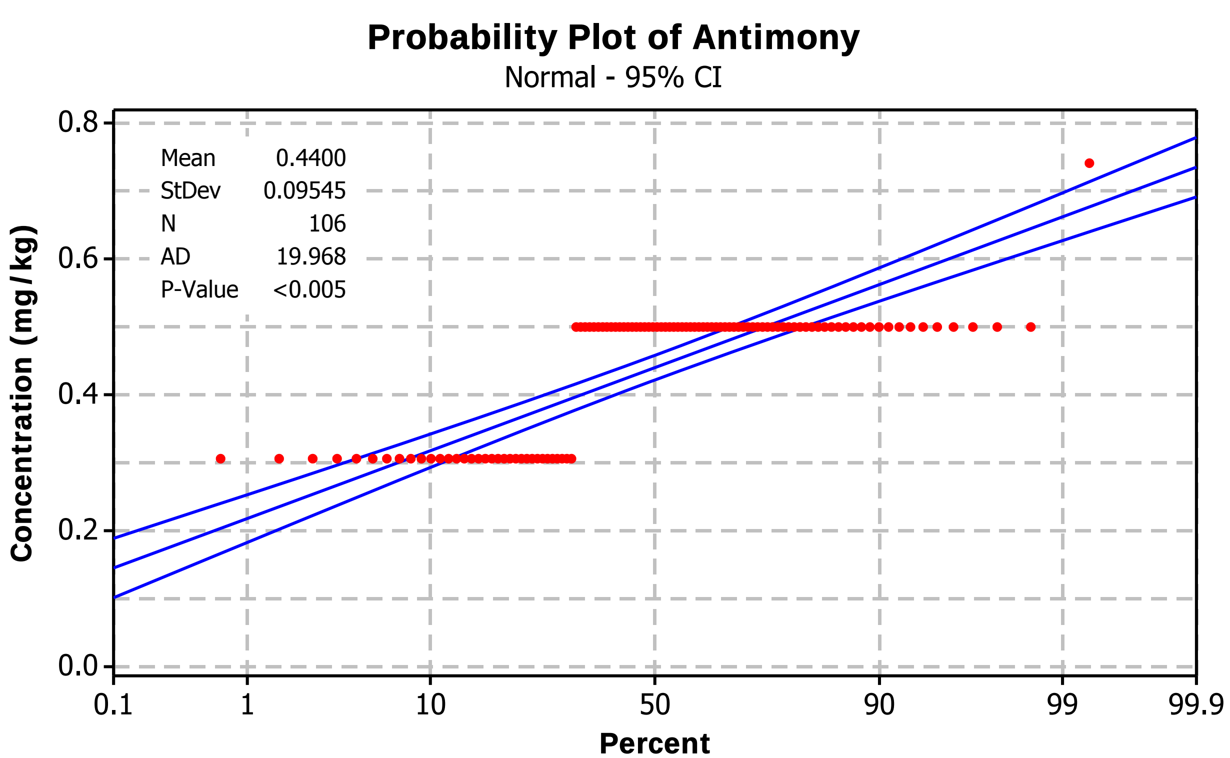


Figure A2-4-1: Antimony Outlier Evaluation





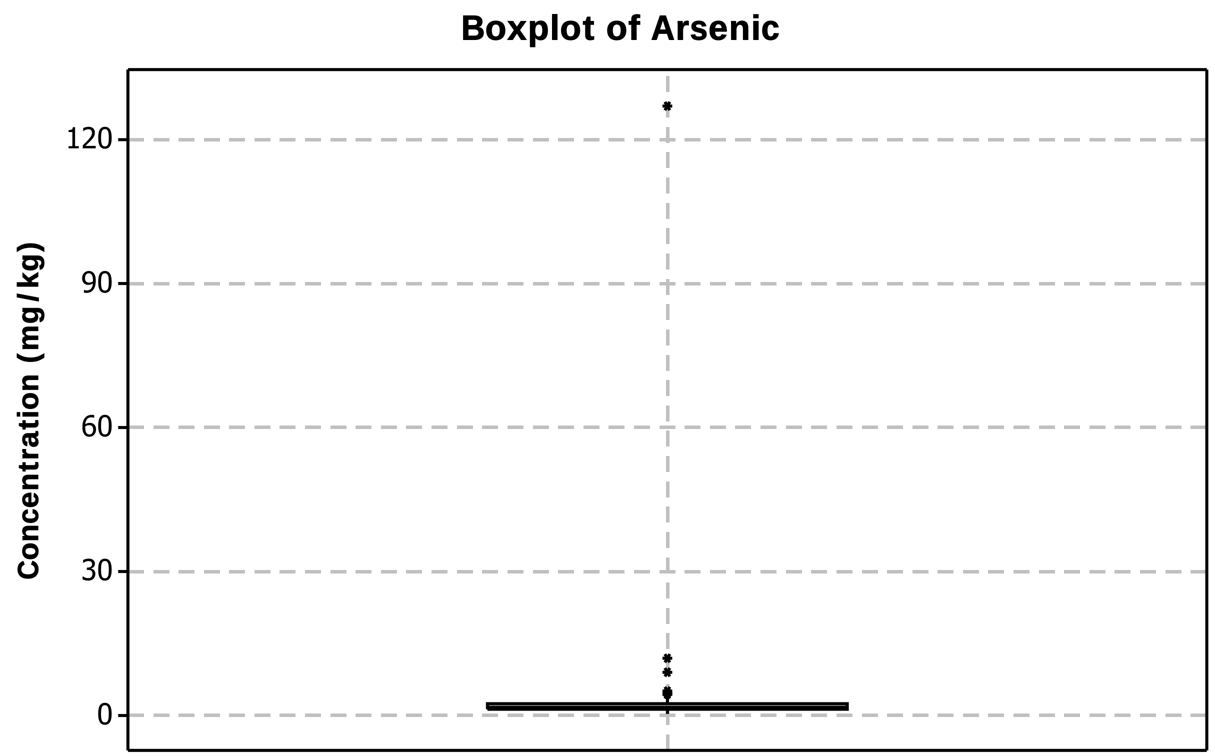


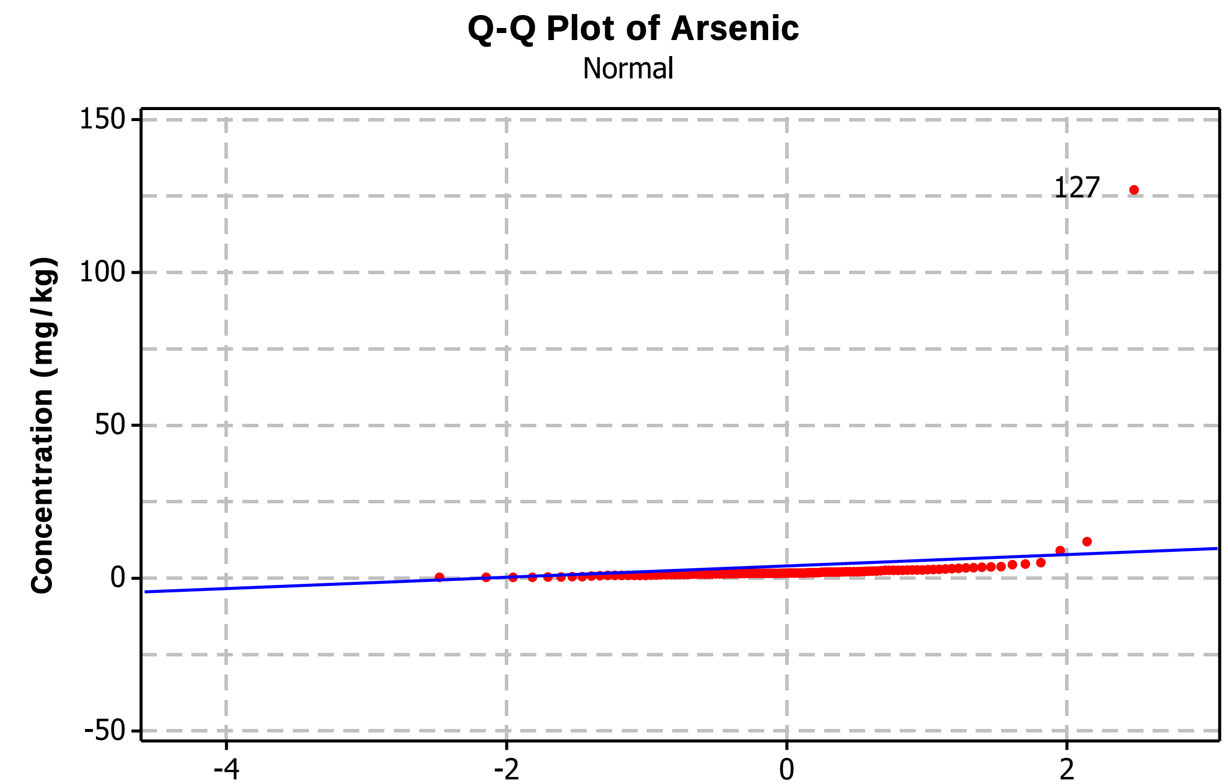
Note: Samples 99% ND (only 1 sample detected)

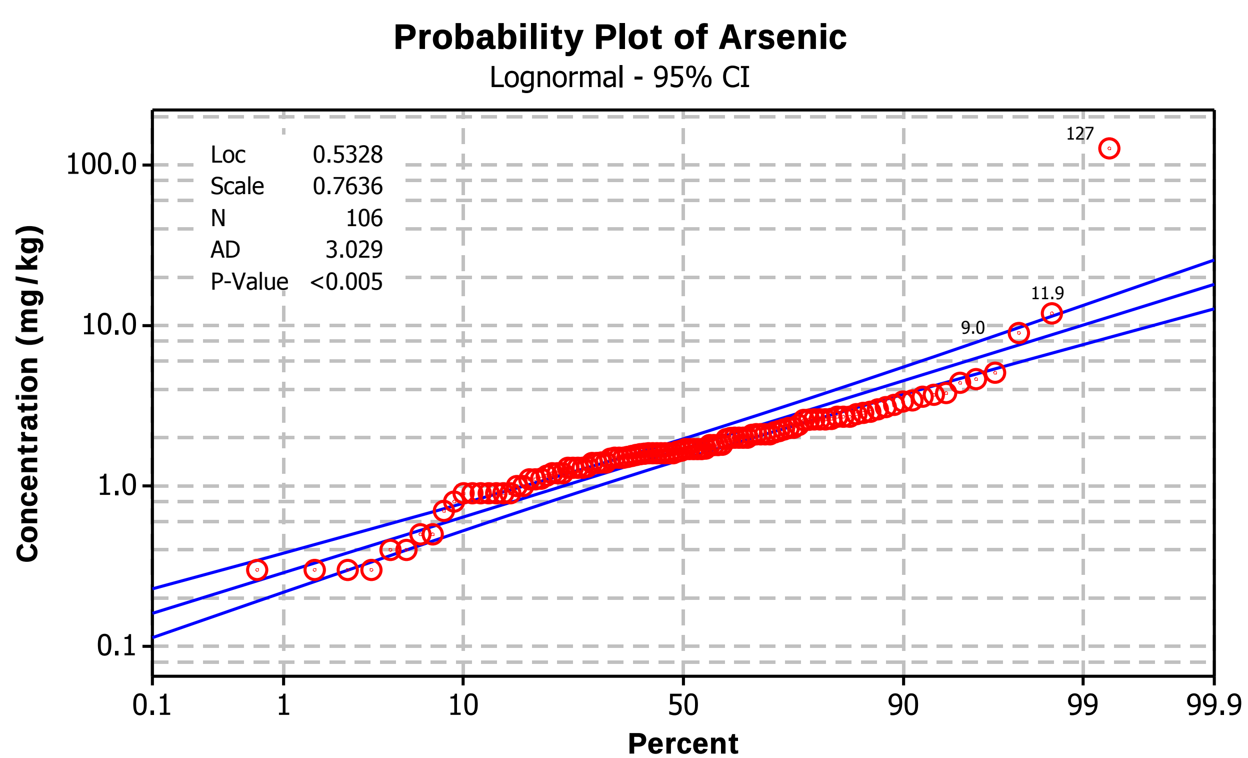
- No reliable statistical tests

- No samples were eliminated as outliers

Figure A2-4-2: Arsenic Outlier Evaluation







- 3IR box plot Tests indicate outliers: 9, 11.9 and 127.

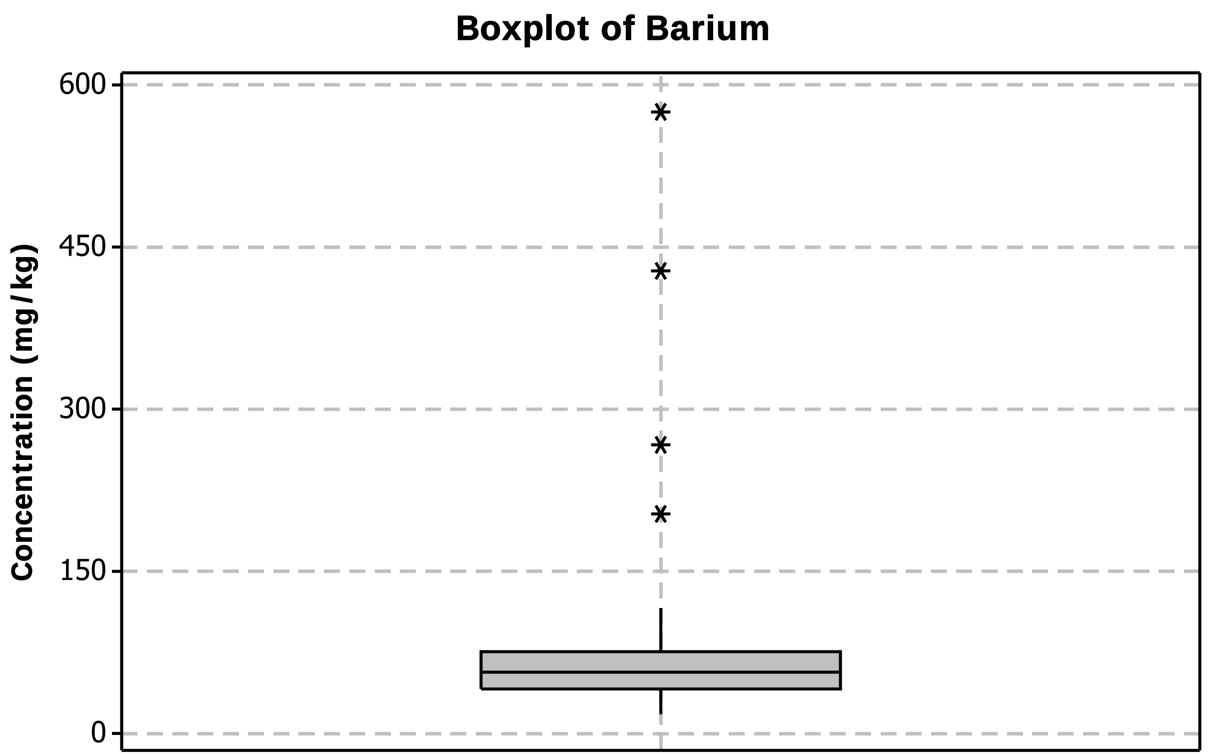
- Rosner Test indicates outlier 127.

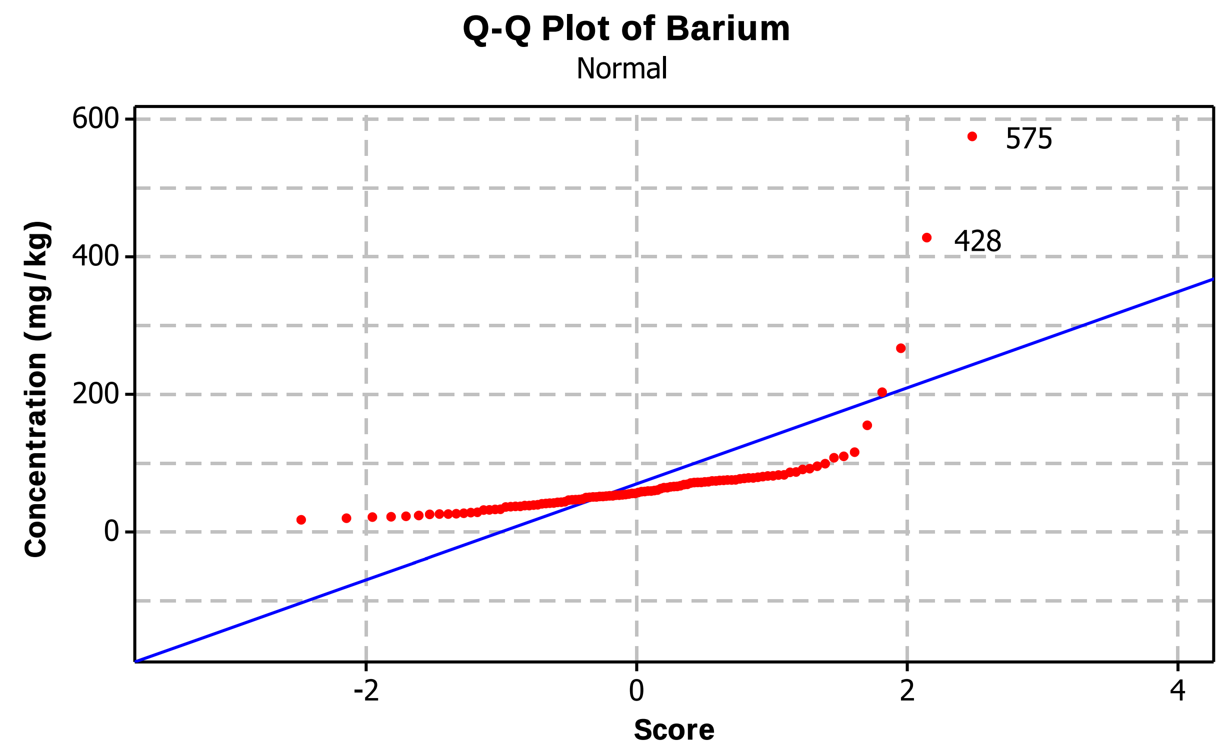
- Q-Q plot indicates one suspected outlier 127.

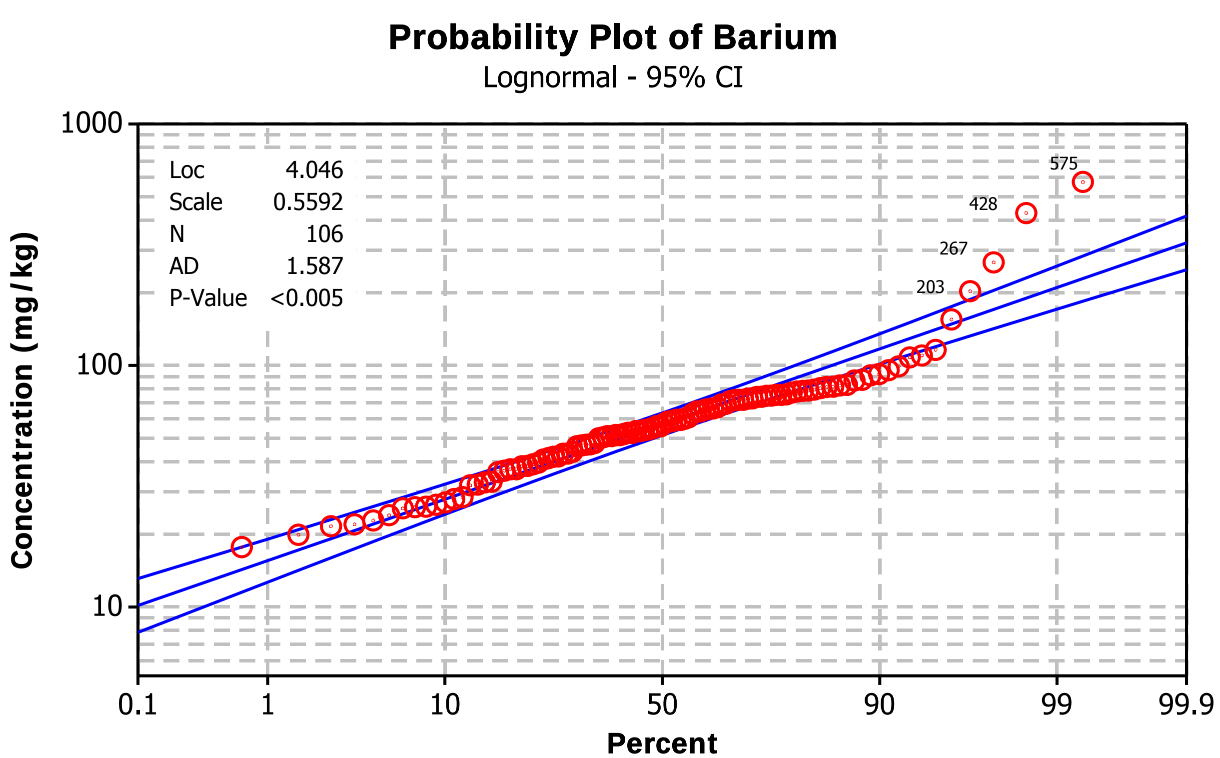
- GOF test: not normal or lognormal distribution. But the Lognormal fit shows strong linearity except one point: 127 may be considered an outlier.

-

Figure A2-4-3: Barium Outlier Evaluation







- 3IR suspected outliers - 203, 267, 428 and 575

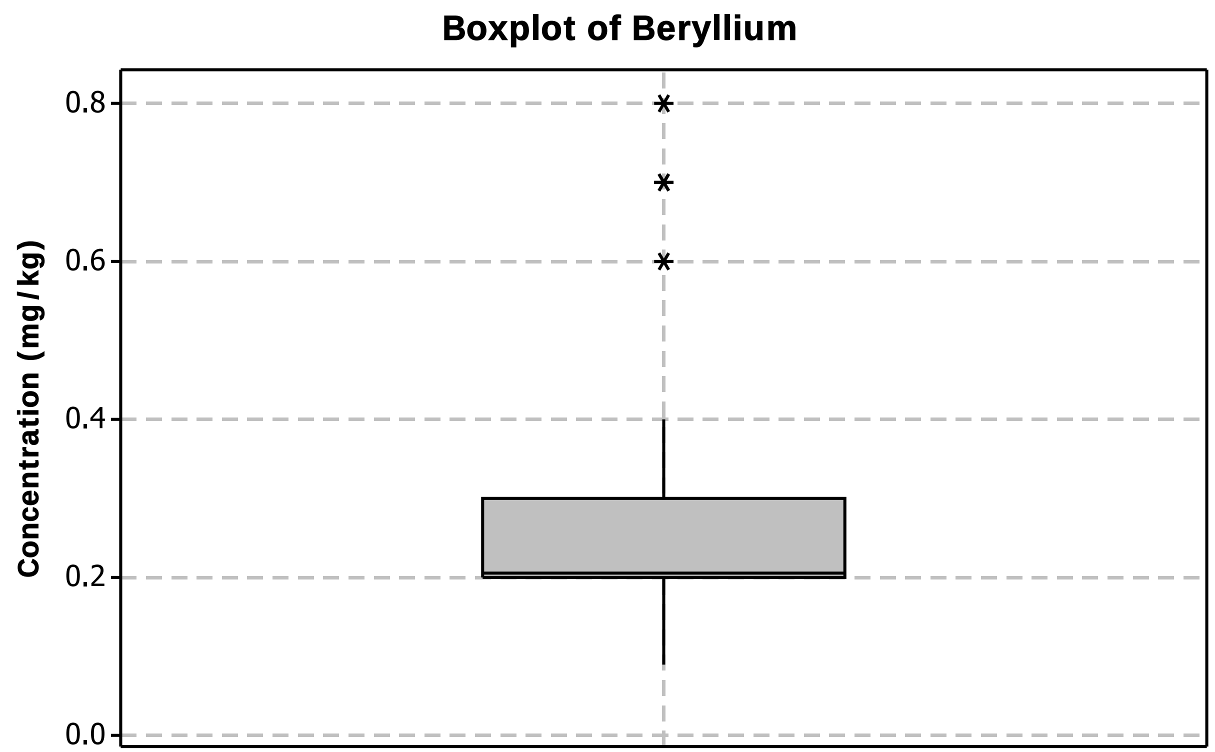
- Rosner test suspect outlier: 575

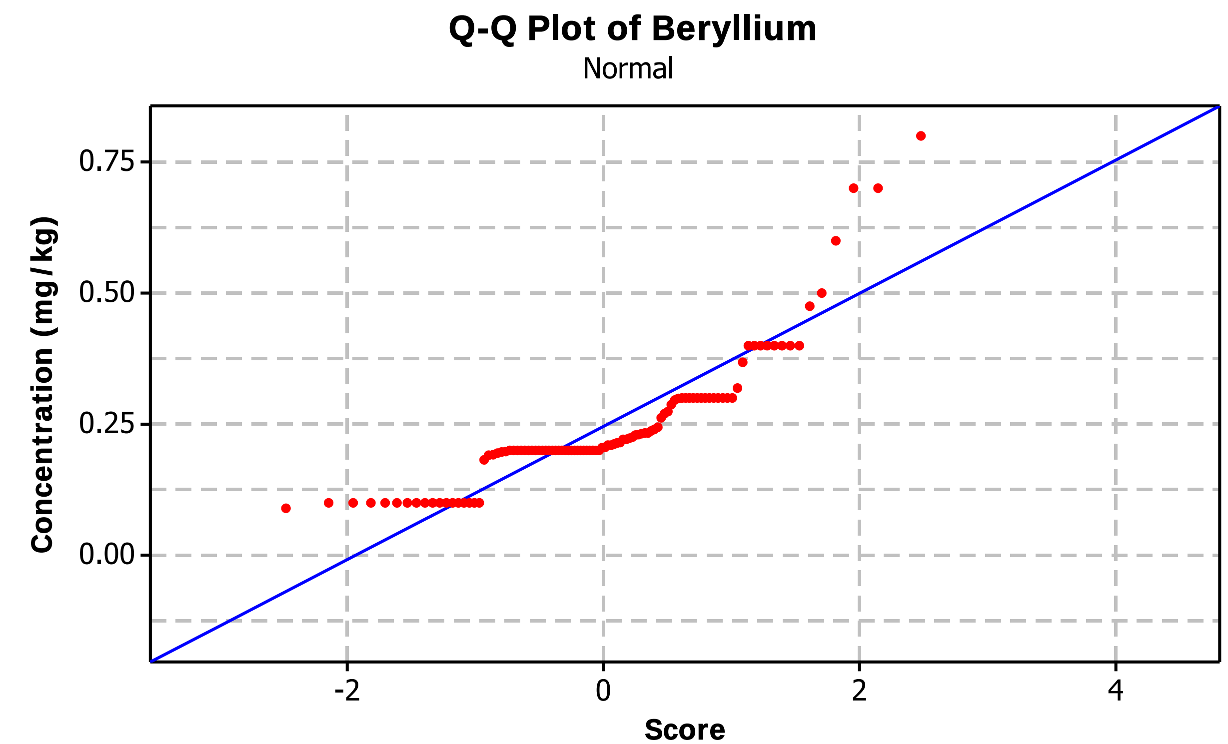
- Q-Q plot based suspected outliers - 428 and 575

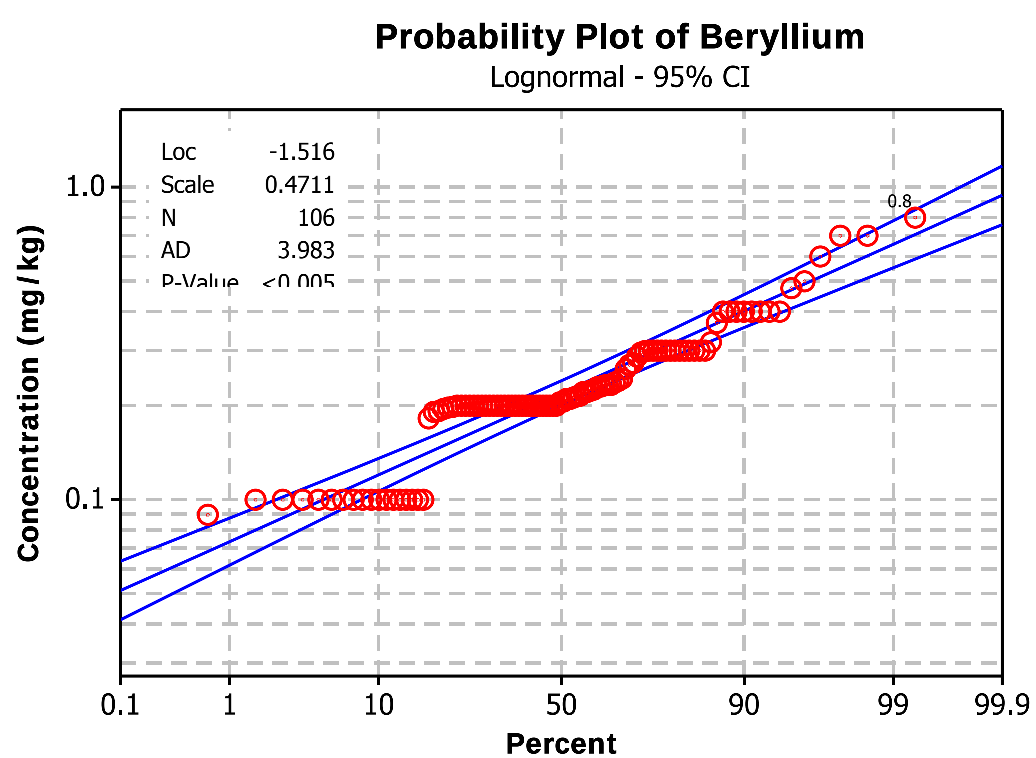
- Goodness of fit test: data does not fit normal, lognormal or gamma

-

Figure A2-4-4: Beryllium Outlier Evaluation

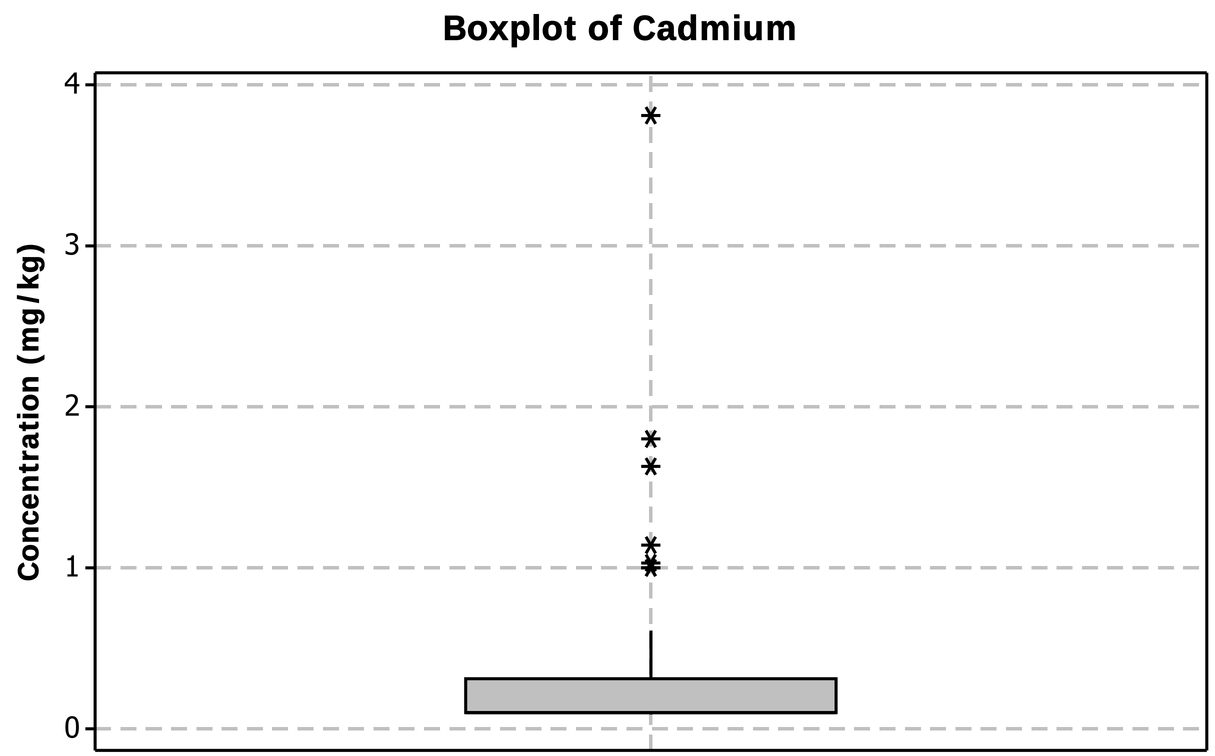


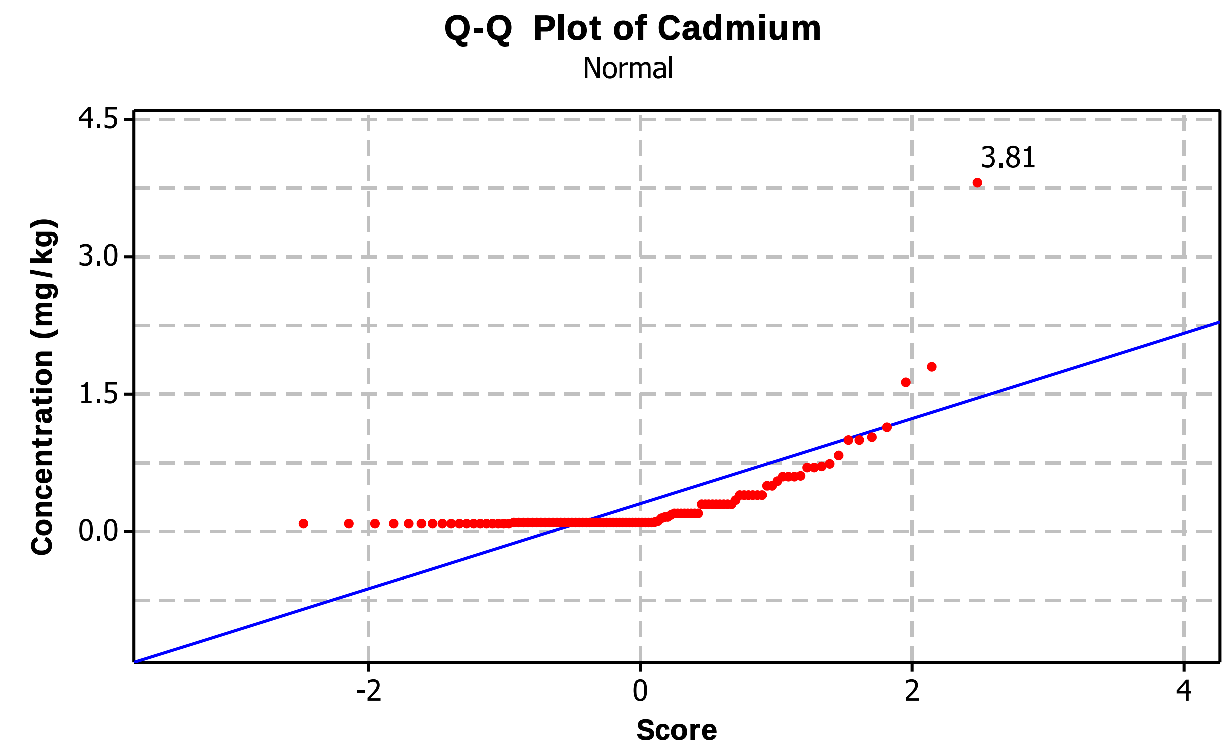


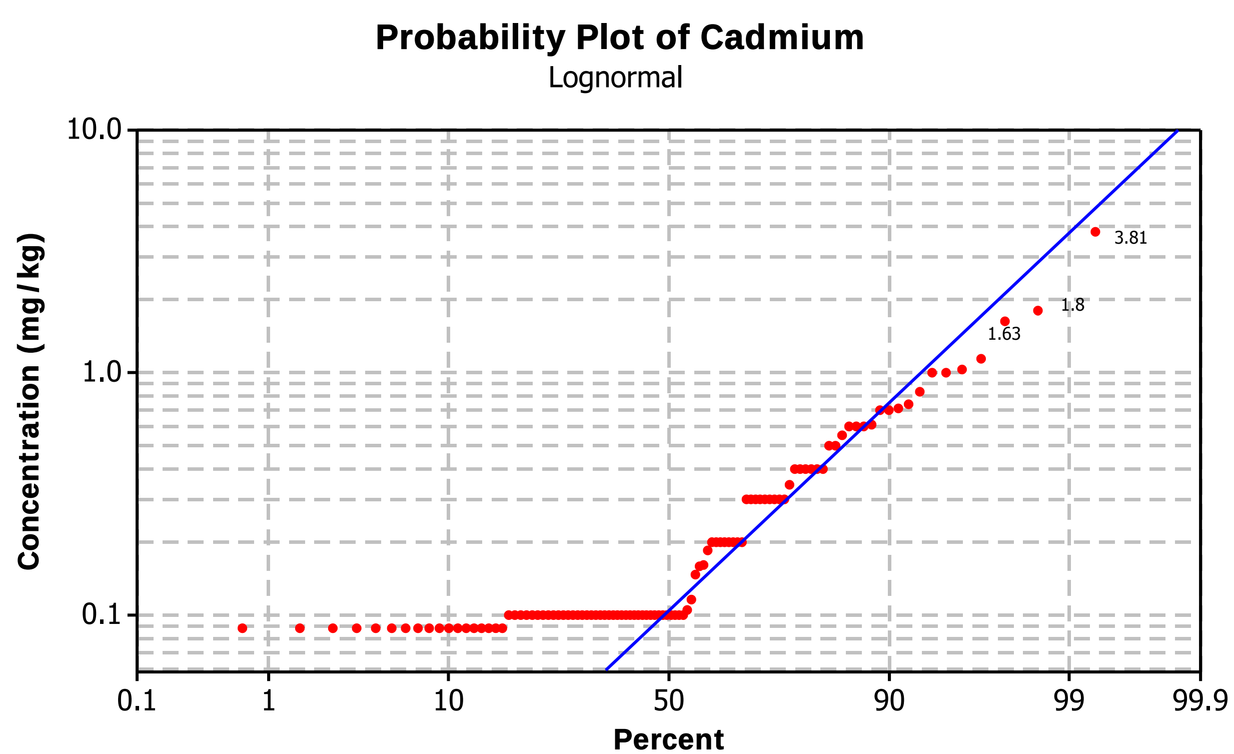


- 3IR suspect outliers - 0.6, 0.7, 0.7 and 0.8
- Rosner test suspect outlier - 0.8
- Q-Q plot based suspected outliers - None
- GOF test: not N, LN, GM (close to LN)
- No outlier

Figure A2-4-5: Cadmium Outlier Evaluation

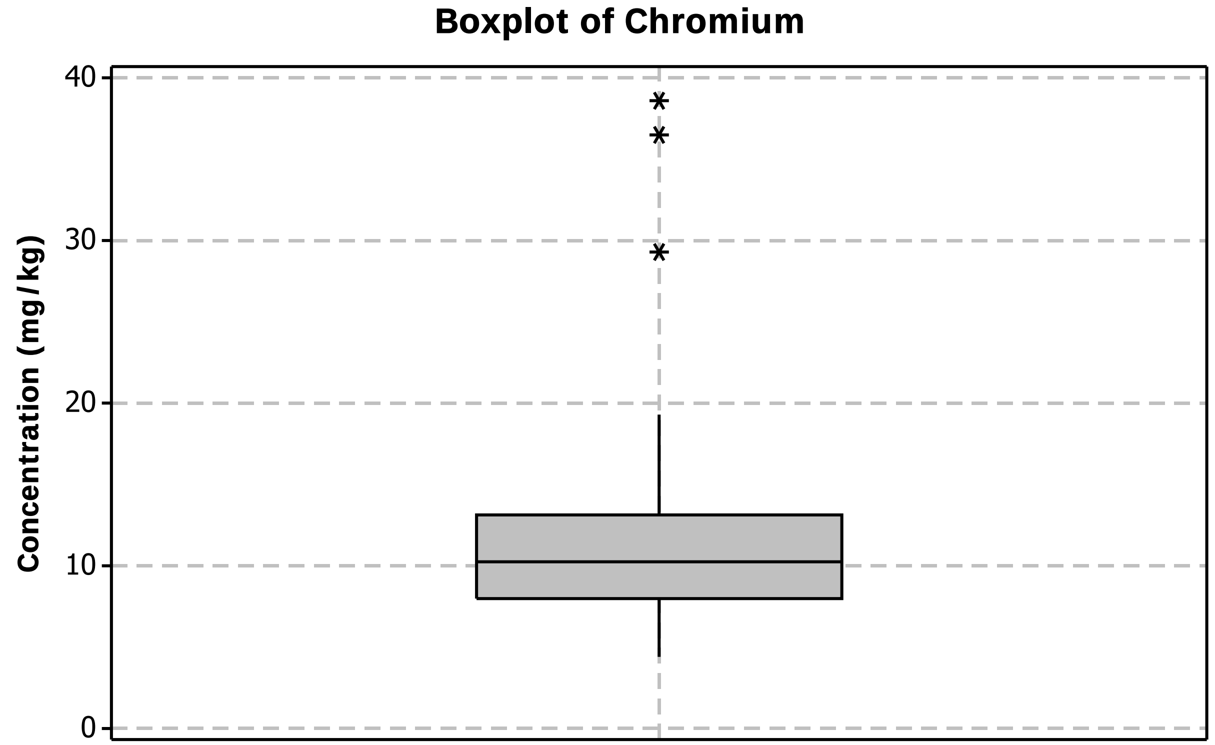


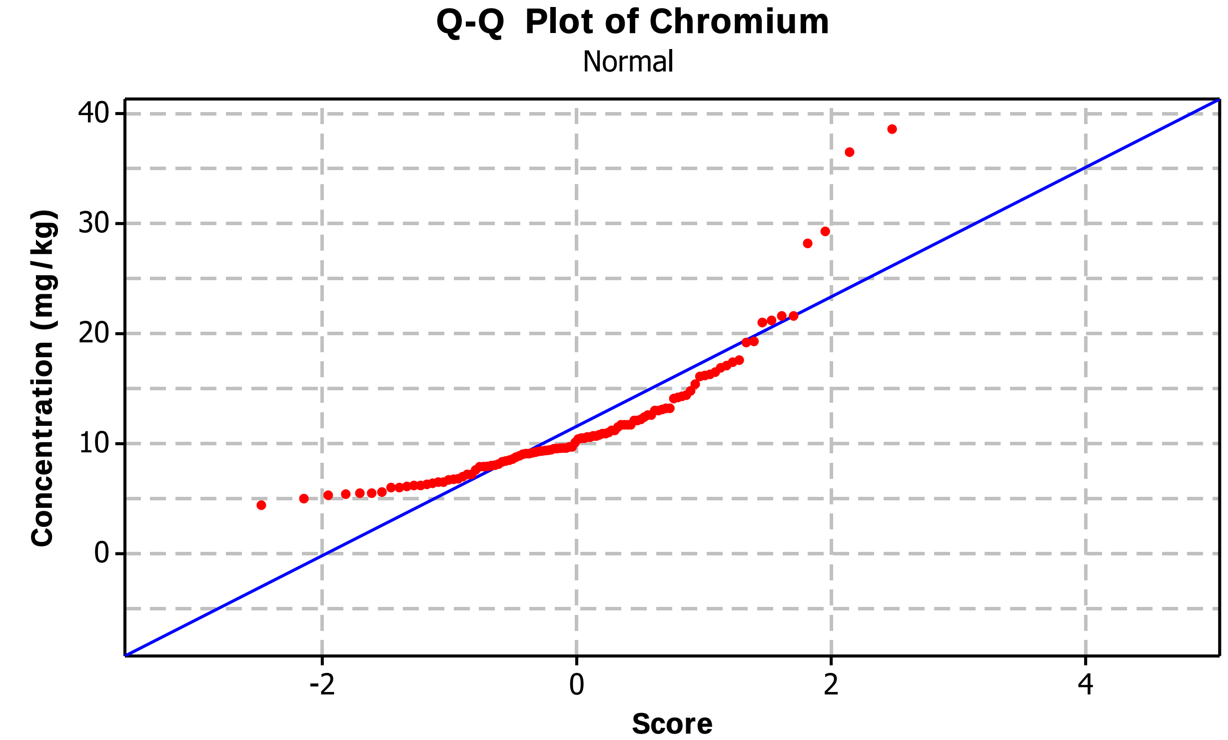


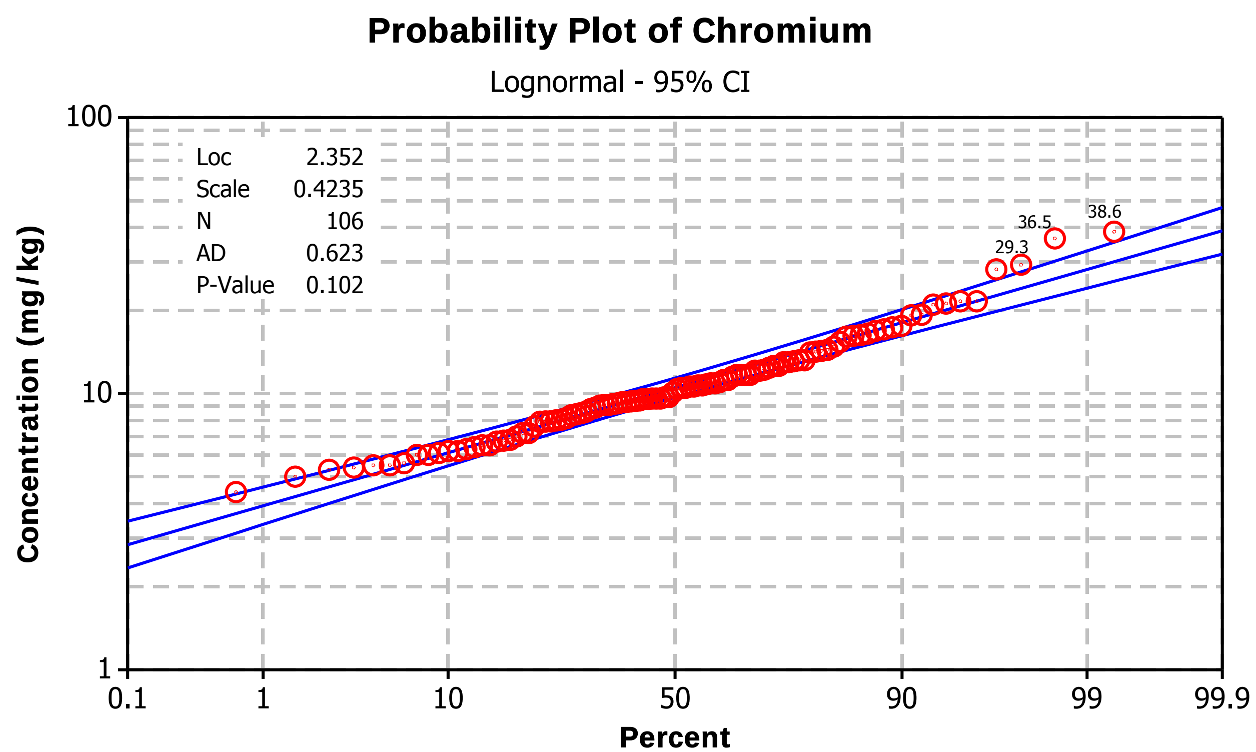


- 3IR suspected outliers - 1.0 to 3.81
- Rosner test outlier - 3.81
- Q-Q plot based suspected outliers - 3.81
- GOF test: Data appear LN
- No outlier

Figure A2-4-6: Chromium Outlier Evaluation

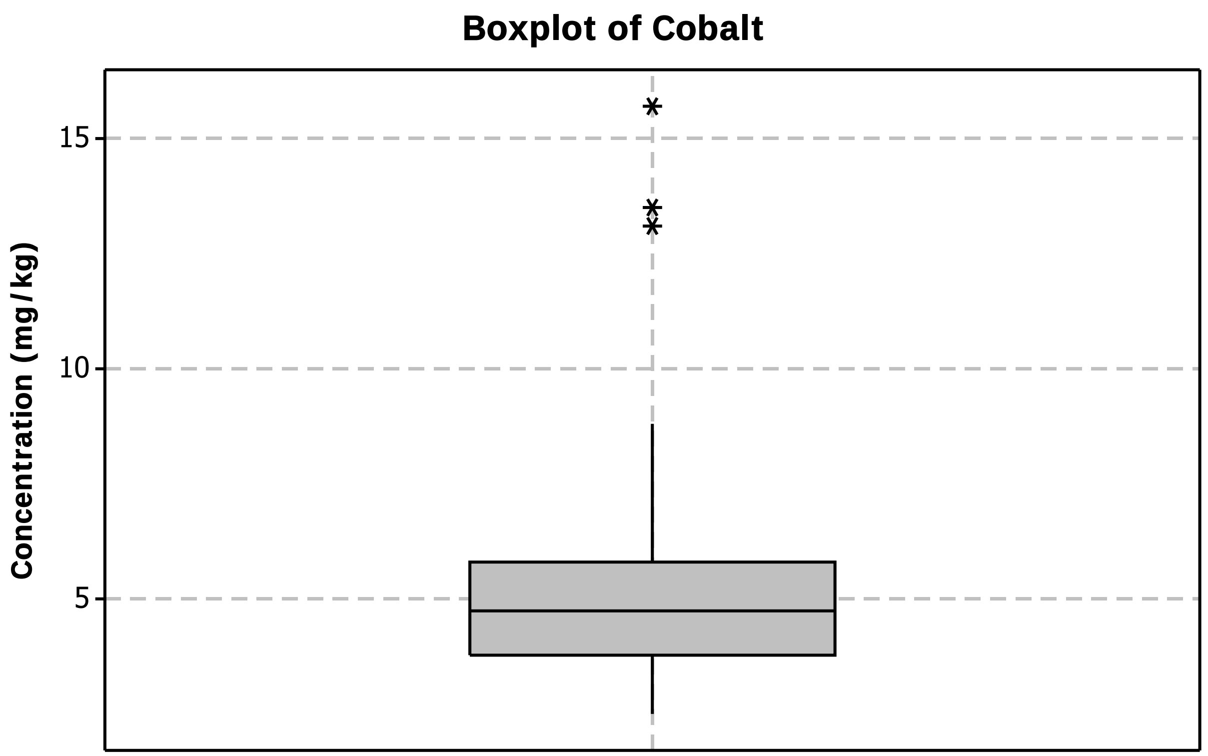


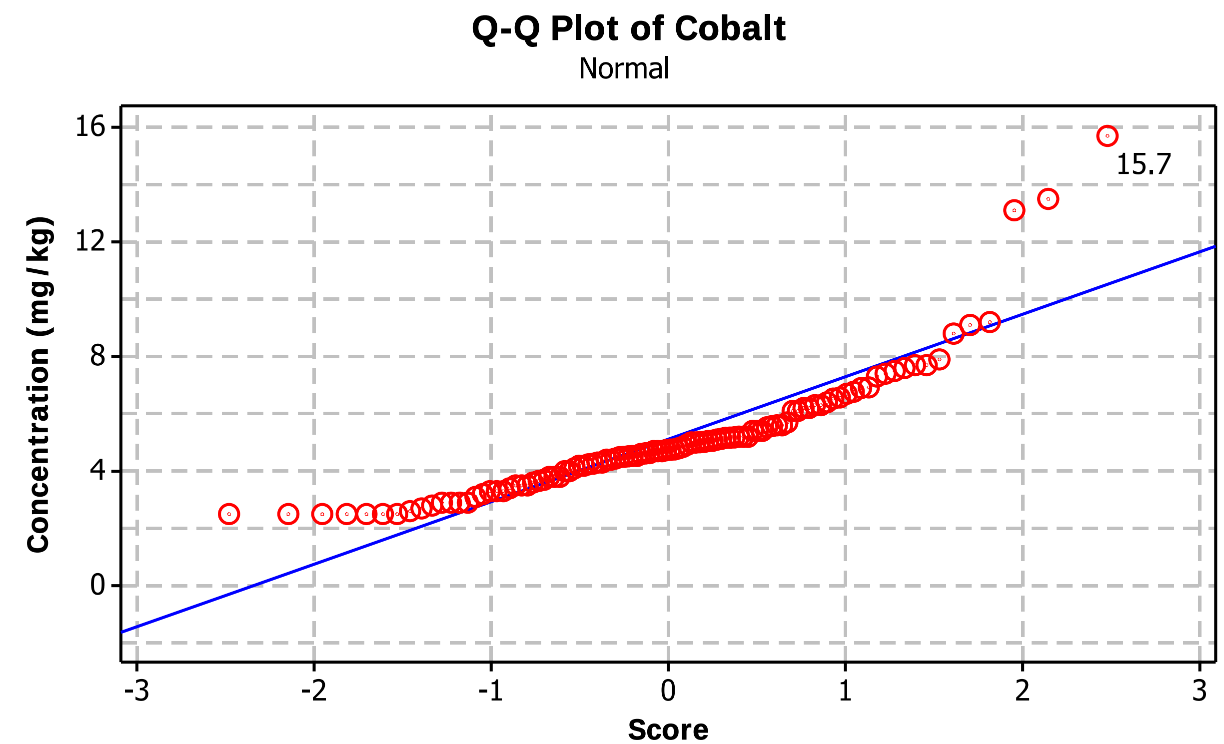


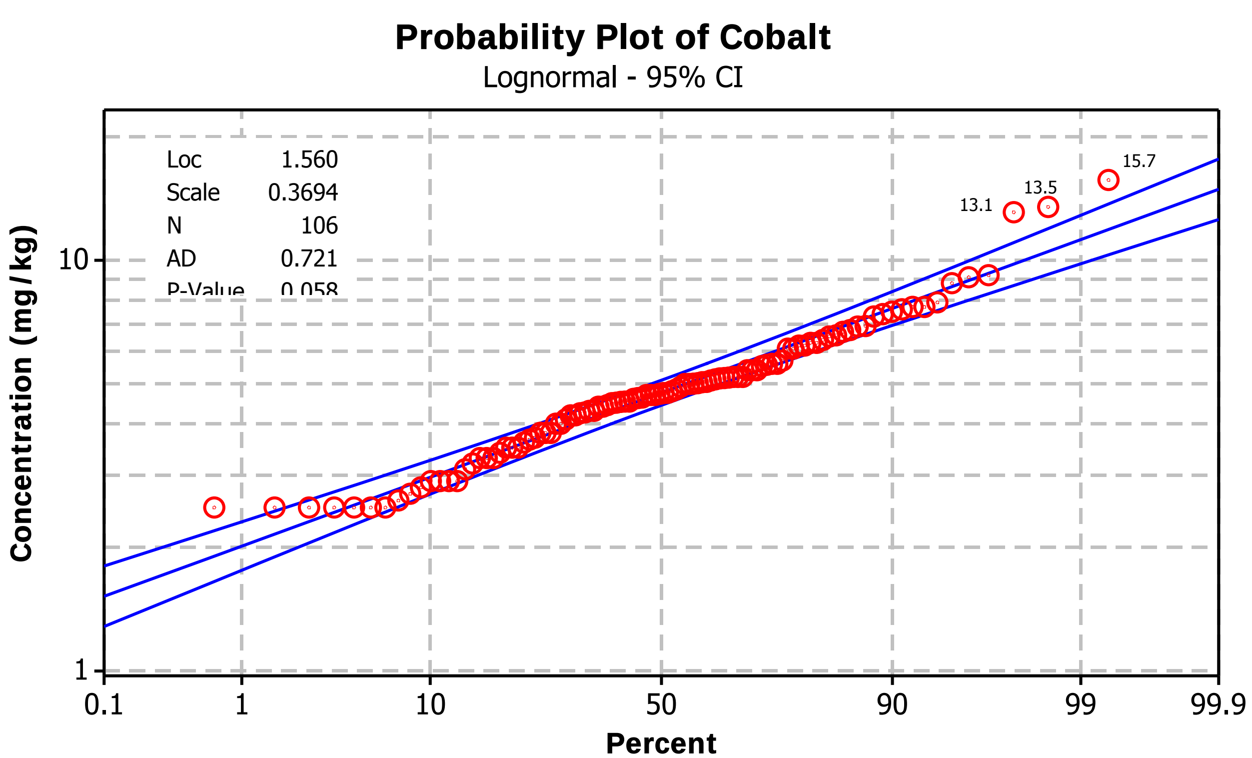


- 3IR suspected outliers -29.3, 36.5 and 38.6
- Rosner test: 38.6
- Q-Q plot based suspected outliers - None
- GOF: Data appear LN
- No outlier

Figure A2-4-7: Cobalt Outlier Evaluation

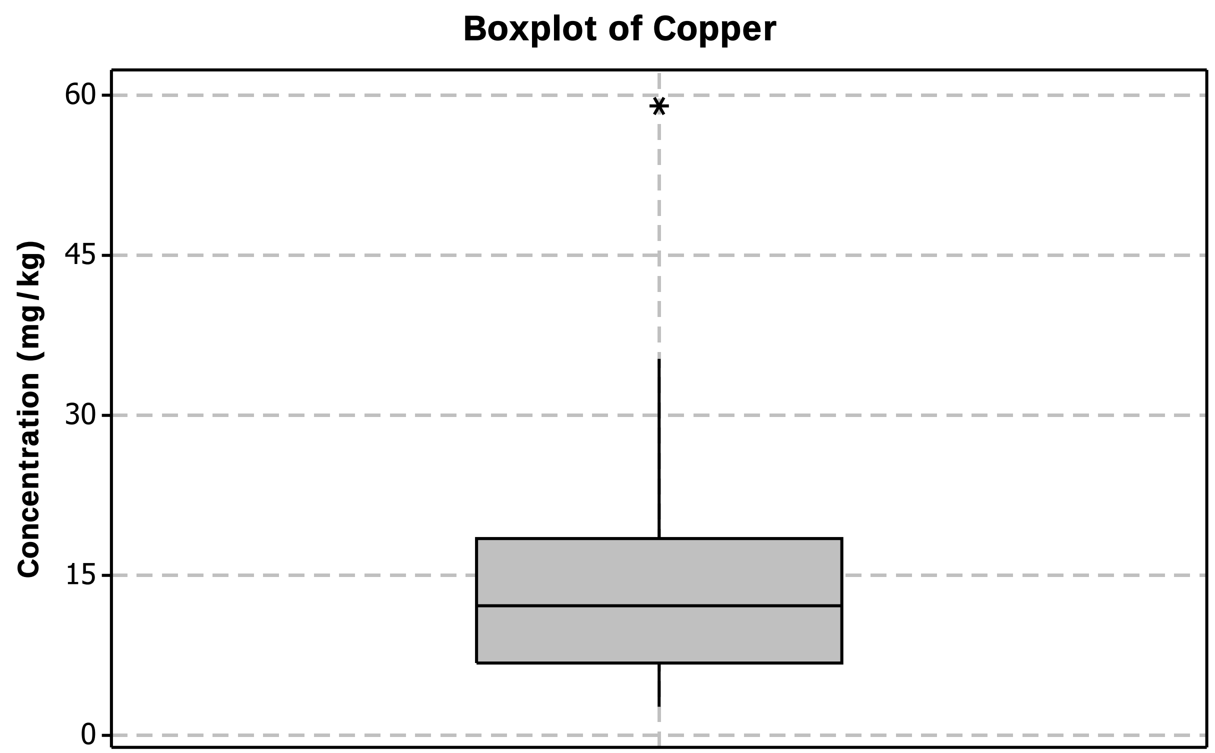


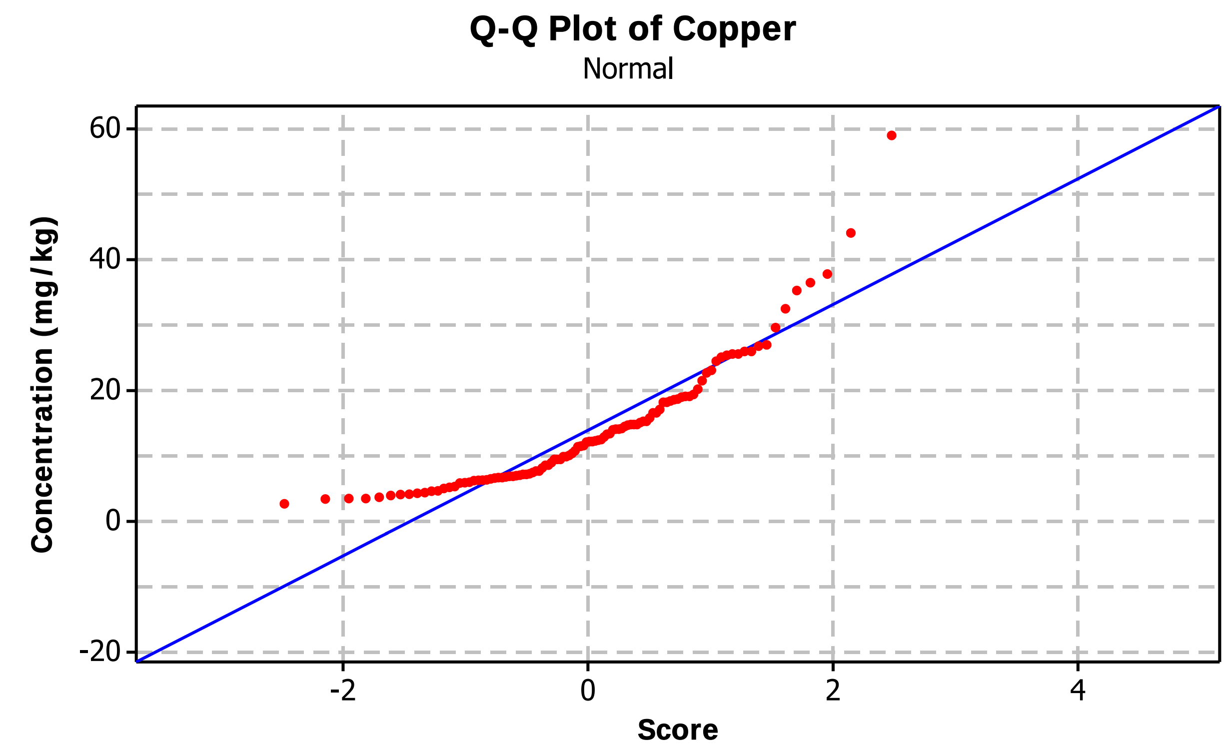


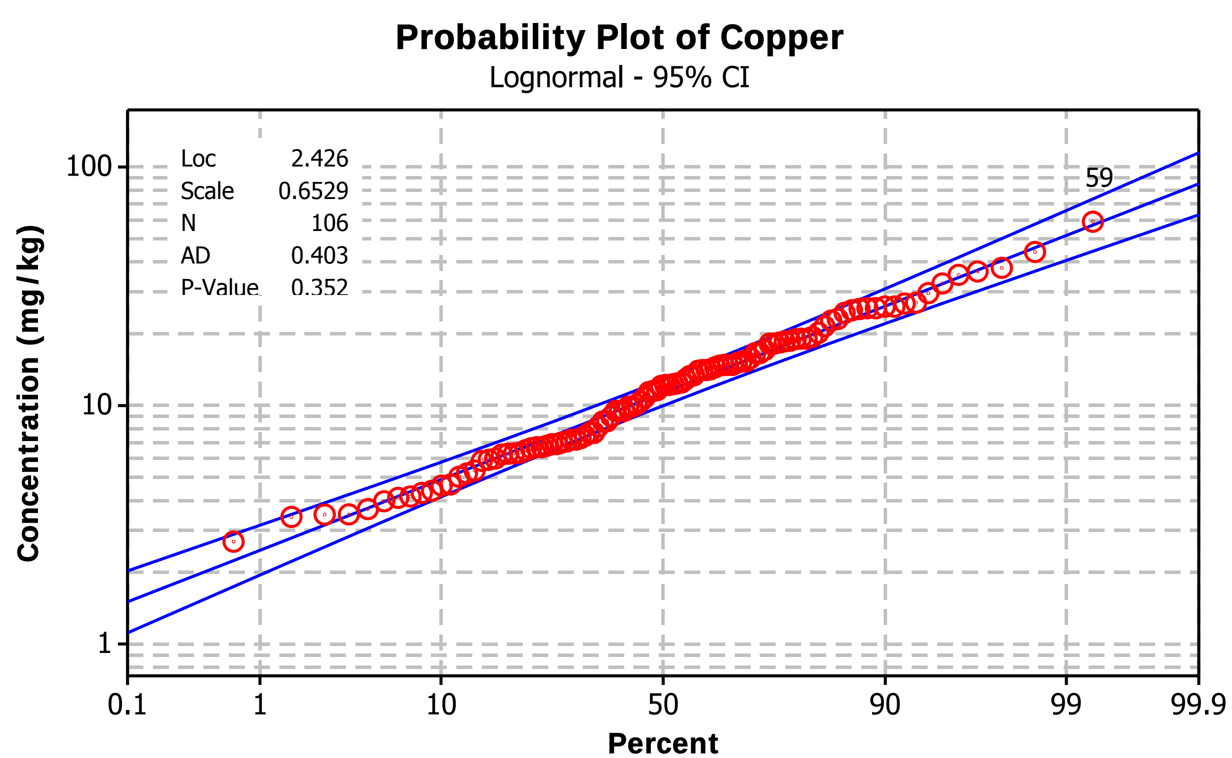


- 3IR suspected outliers - 13.1, 13.5, 15.7
- Rosner test: 15.7
- Q-Q plot based suspected outliers - None
- GOF test: Lognormal
- No outlier

Figure A2-4-8: Copper Outlier Evaluation

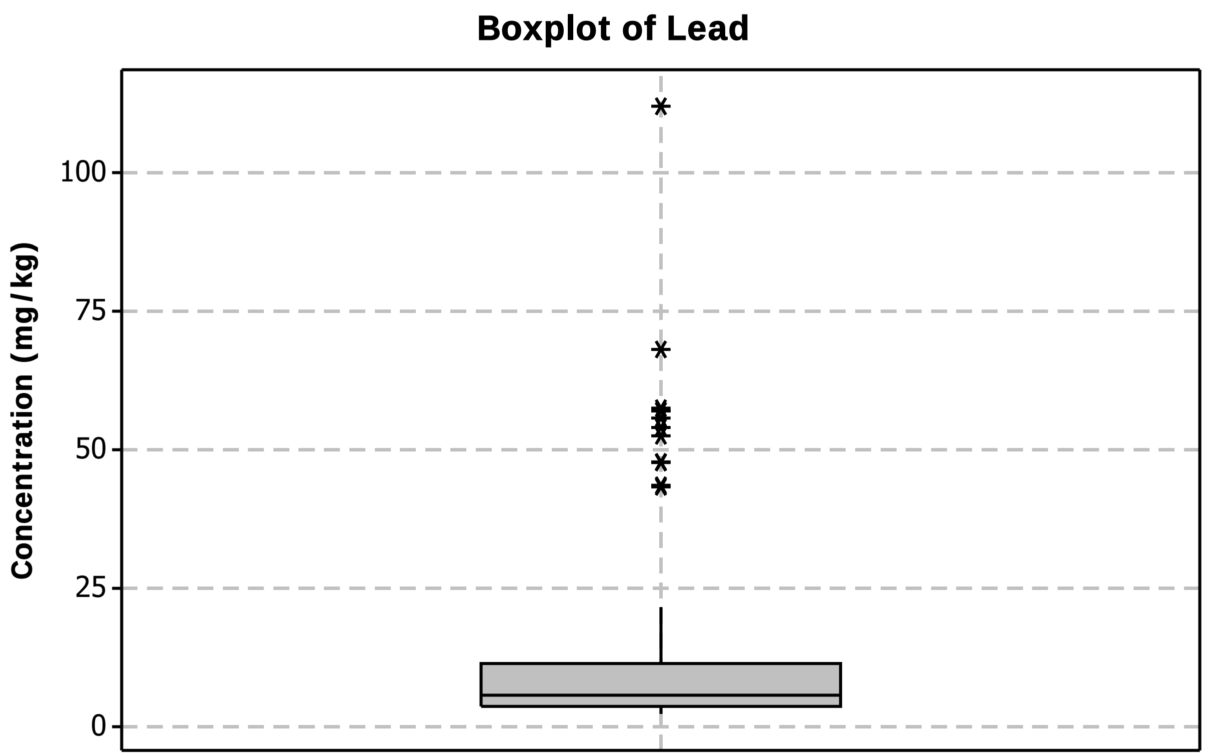


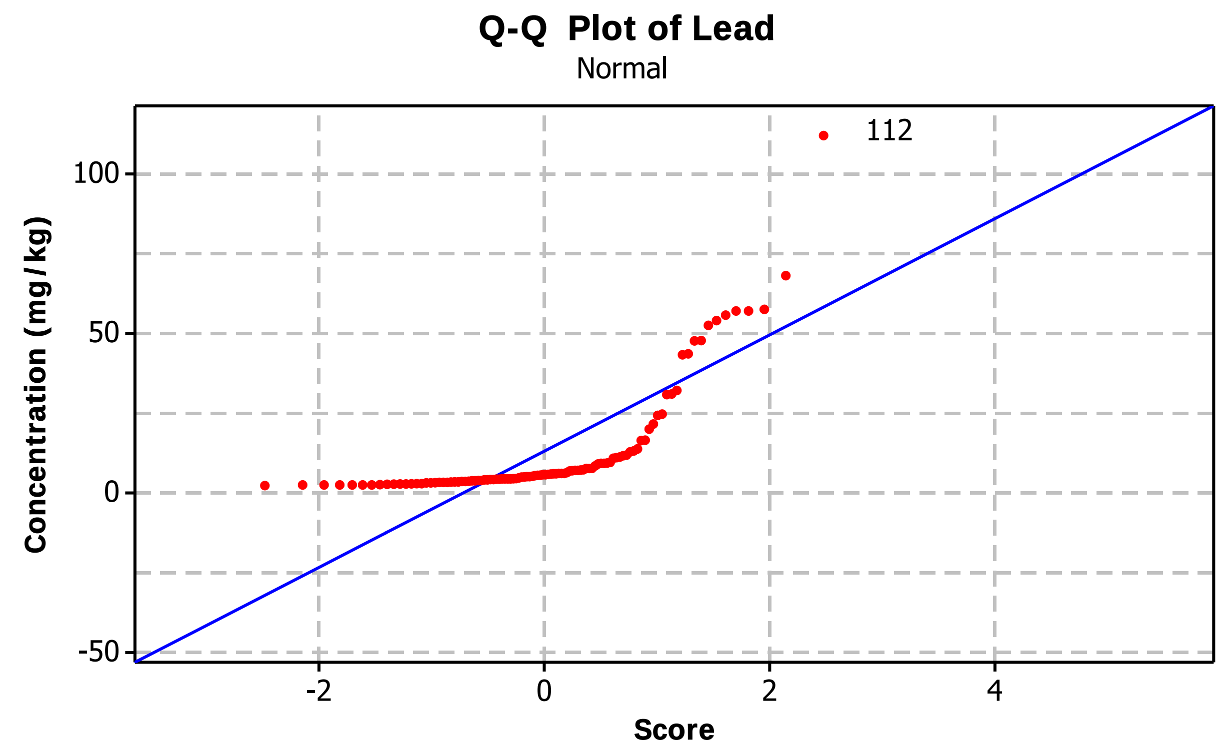


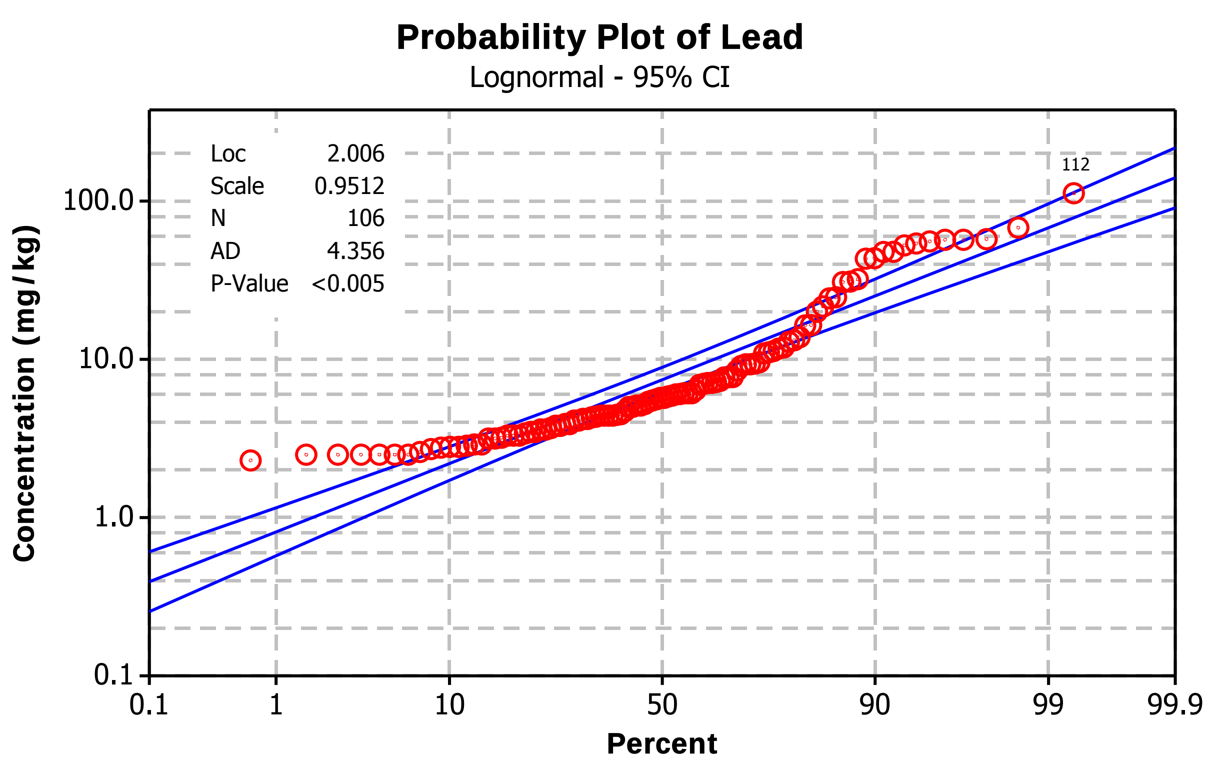


- 3IR suspected outliers - 59
- Rosner test = 59
- Q-Q plot based suspected outliers - None
- GOF test: Lognormal or gamma
- No outlier

Figure A2-4-9: Lead Outlier Evaluation







- 3IR suspected outliers - 43.3 to 112

- Rosner test outlier = 112

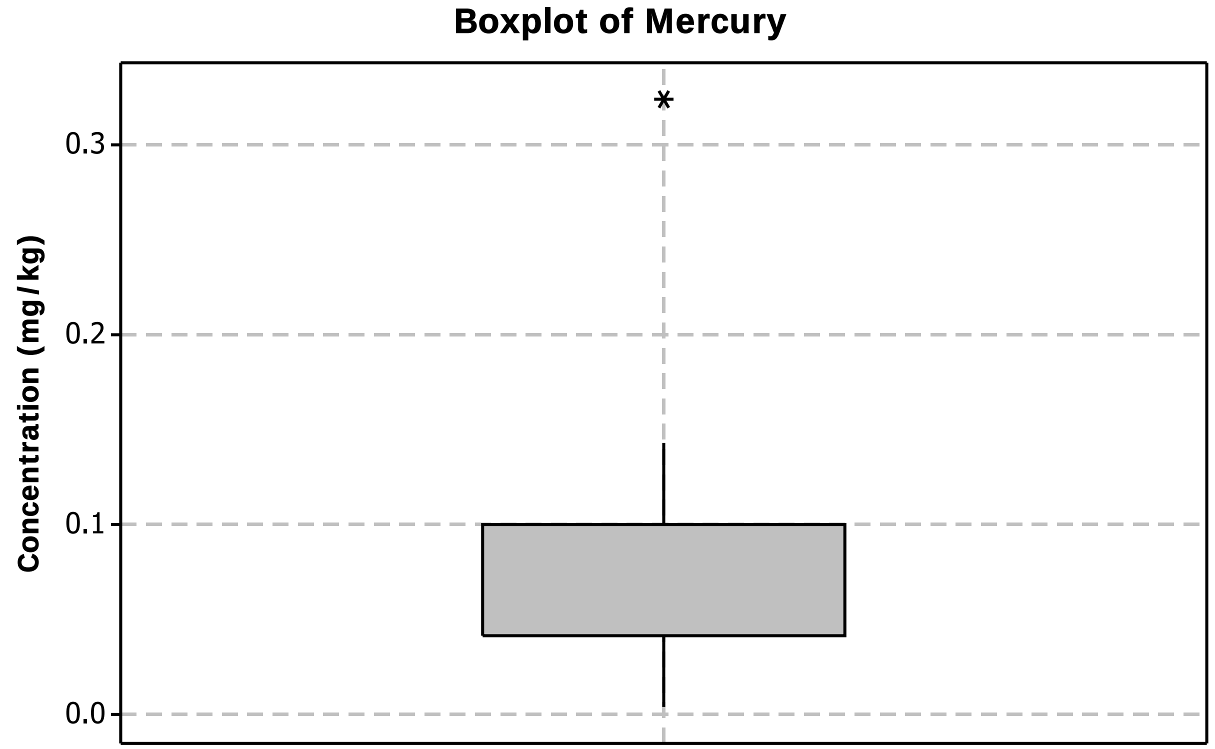
- Q-Q plot based suspected outliers - 112

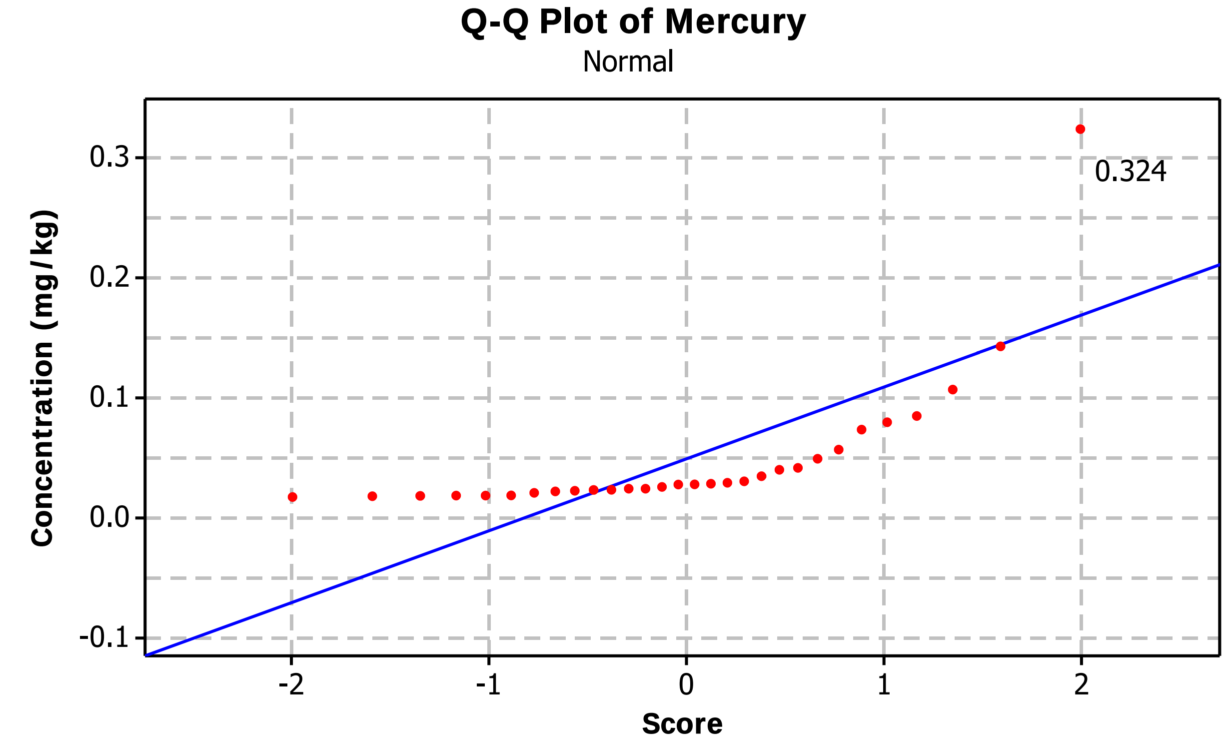
- GOF test: not N, LN or GM

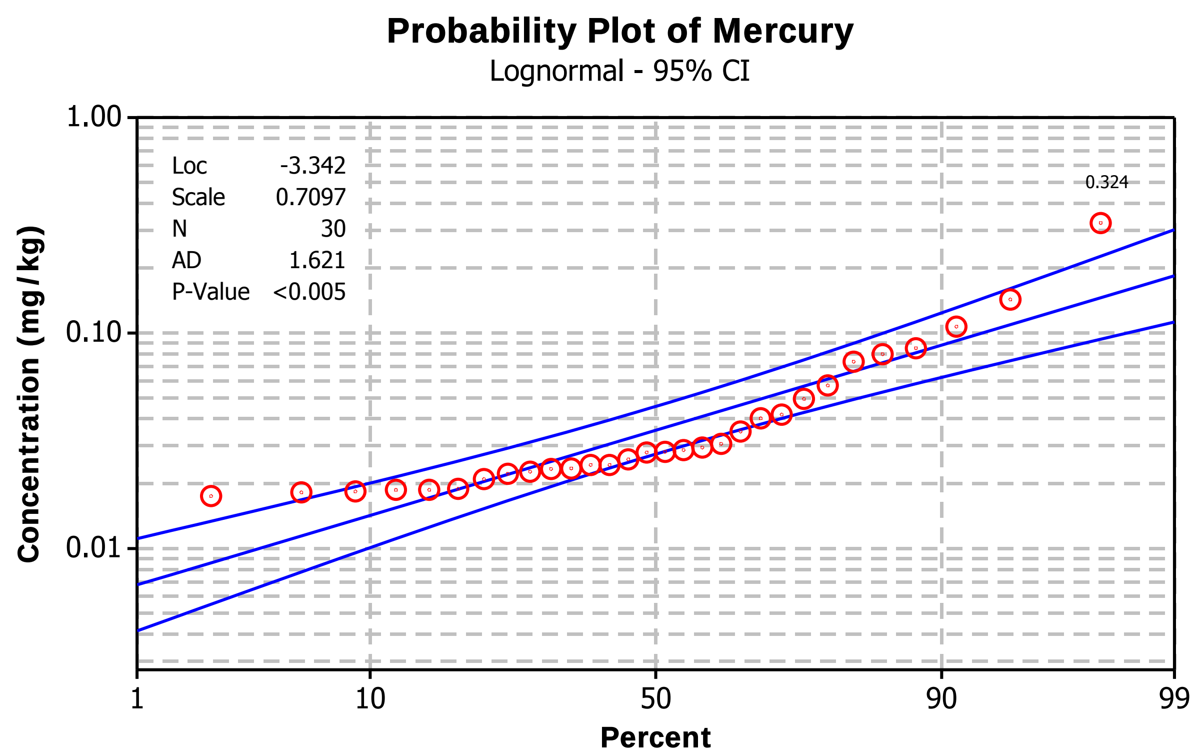
- Suspected outlier 112 does not appear to be significantly elevated than rest of data

- No outlier

Figure A2-4-10: Mercury Outlier Evaluation







- Rosner test and 3IR suspected outliers - 0.324

- Q-Q plot based suspected outliers - none

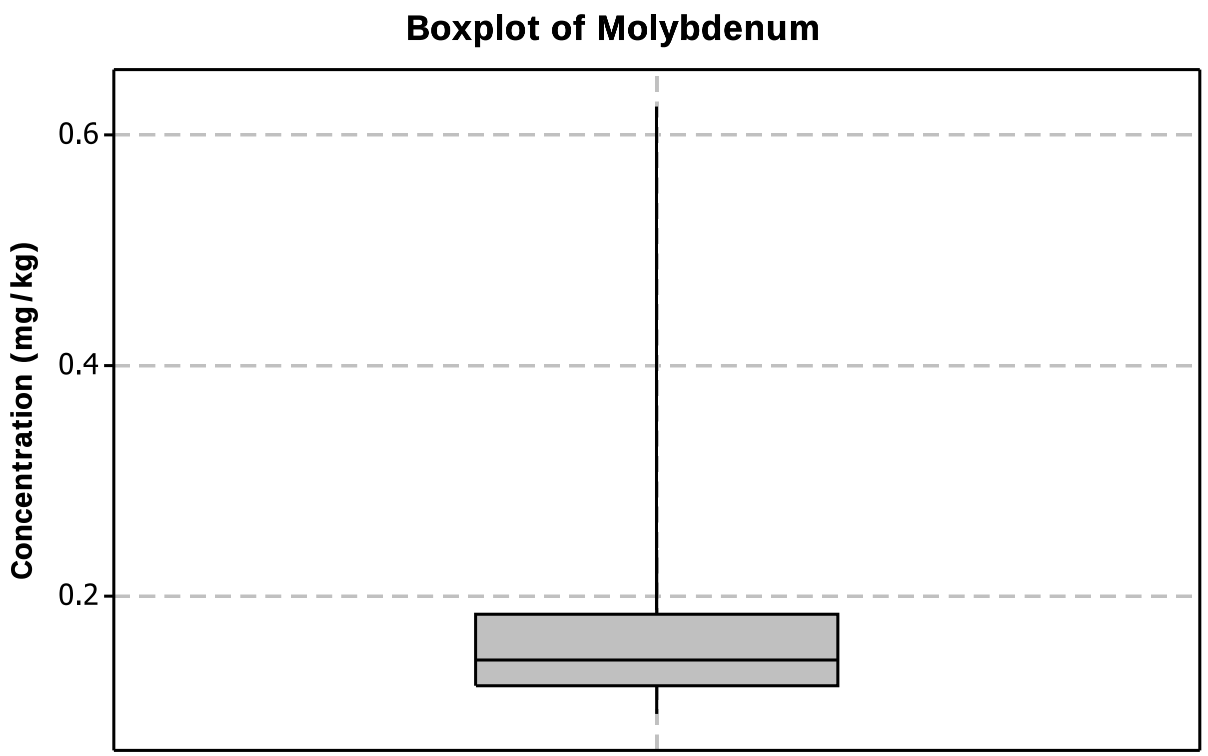
- GOF: not N or LN. Data appears fairly linear under LN.

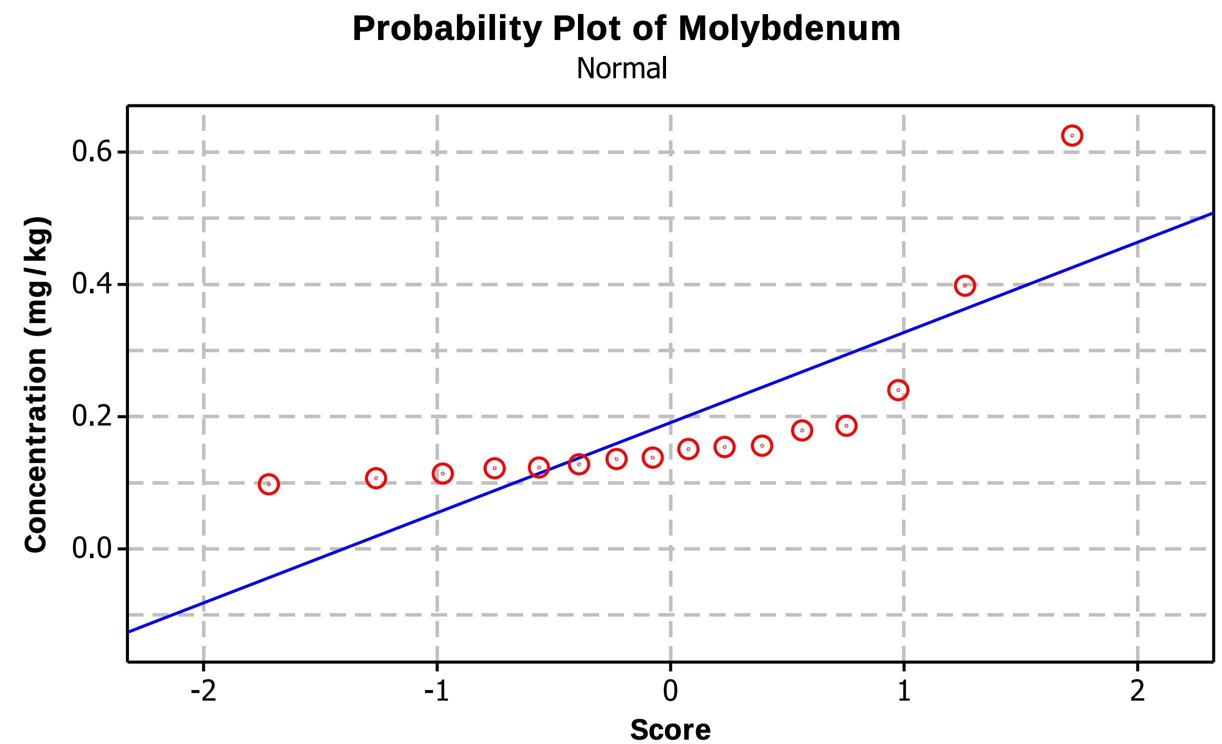
Note: %ND = 71.7%.

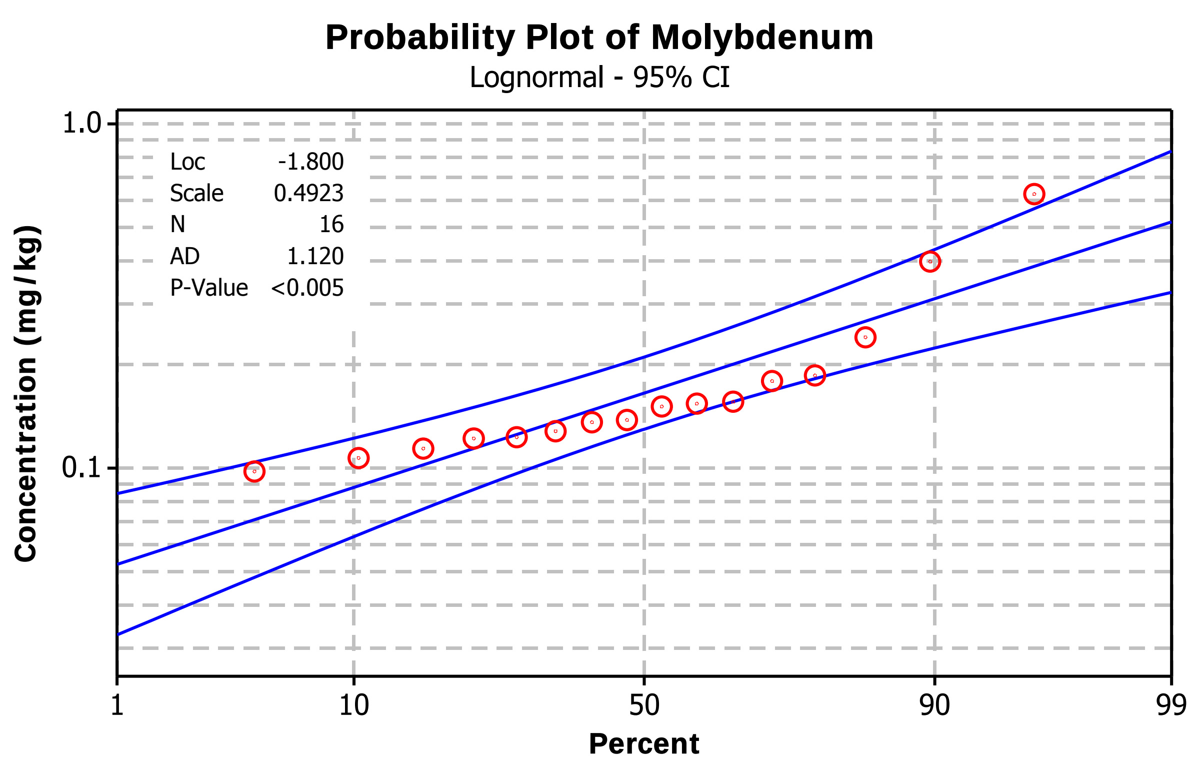
- Only detected values used in probability plot

- No outlier

Figure A2-4-11: Molybdenum Outlier Evaluation







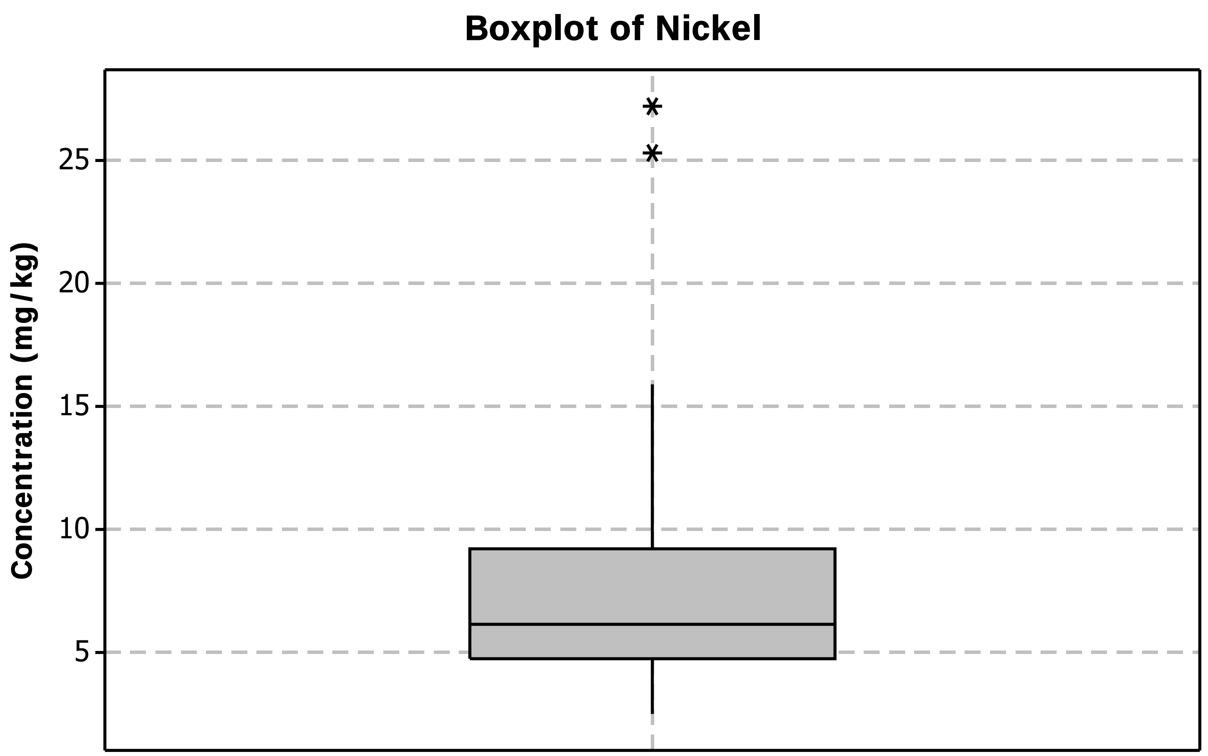
- Rosner test and 3IR suspected outliers - none

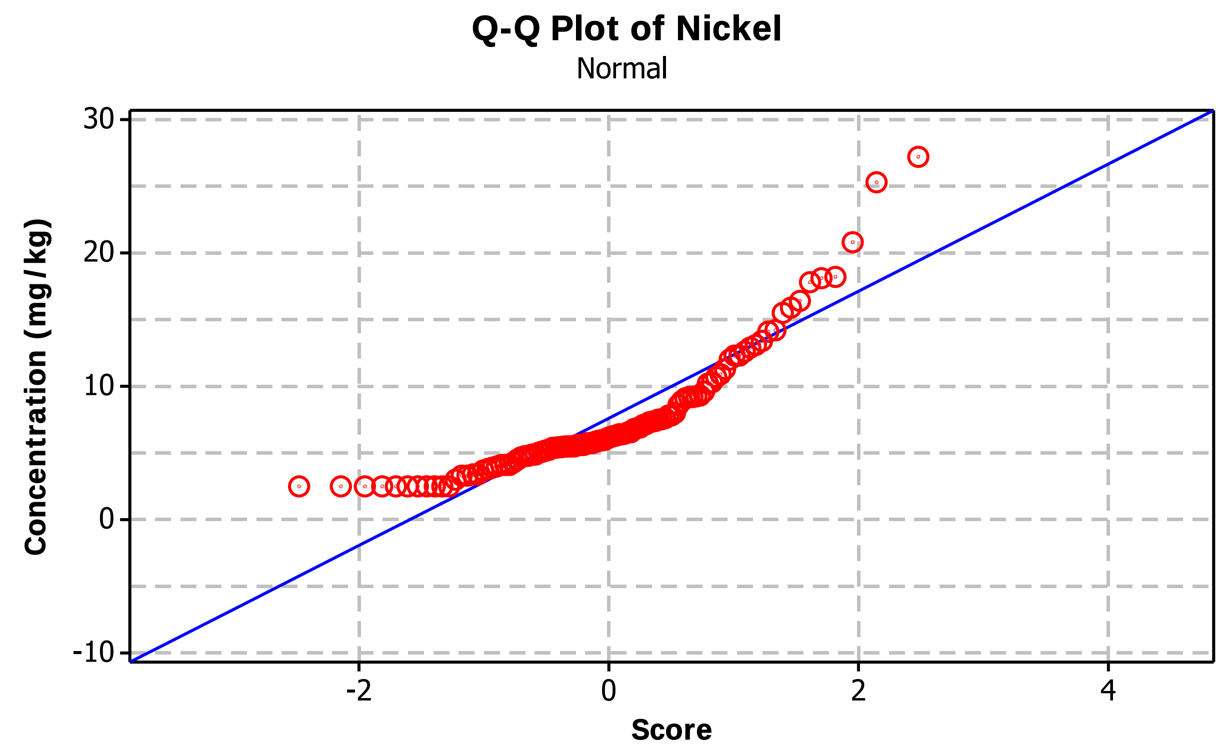
- Probability plot based suspected outliers - none

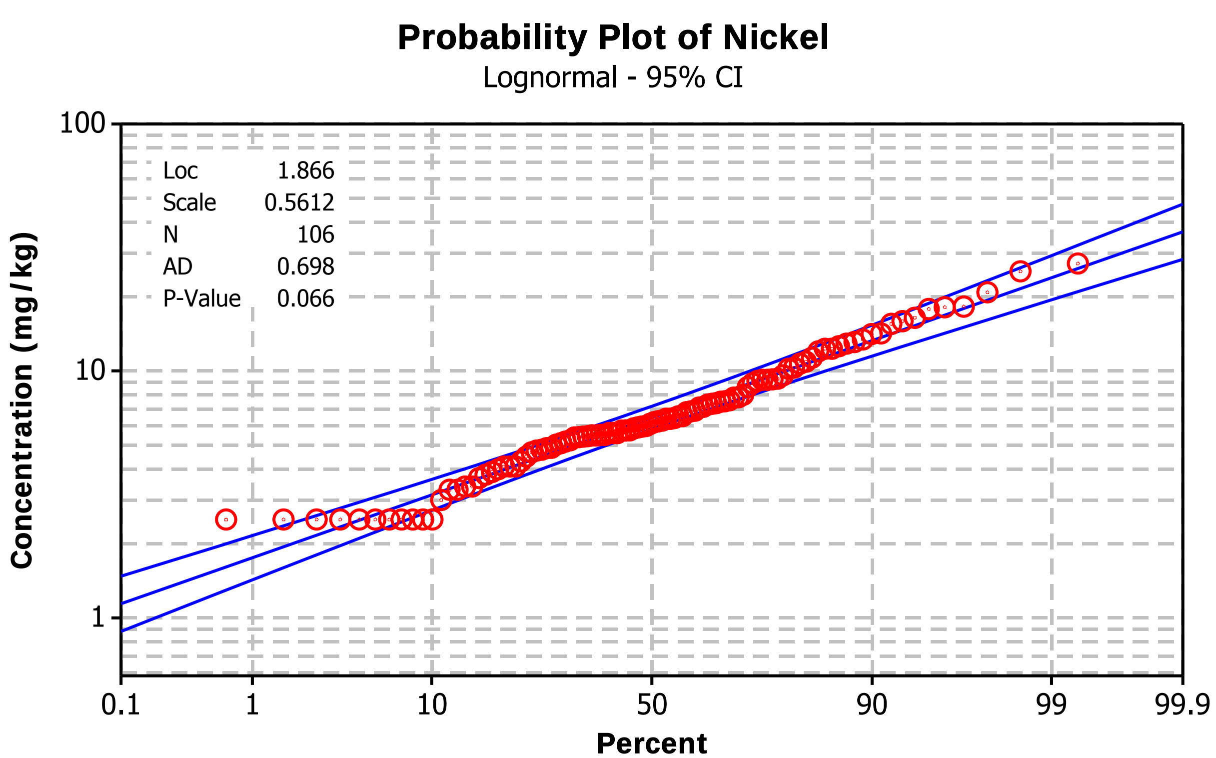
Note: %ND = 84.9%.

- Only detected values used in probability plot

Figure A2-4-12: Nickel Outlier Evaluation

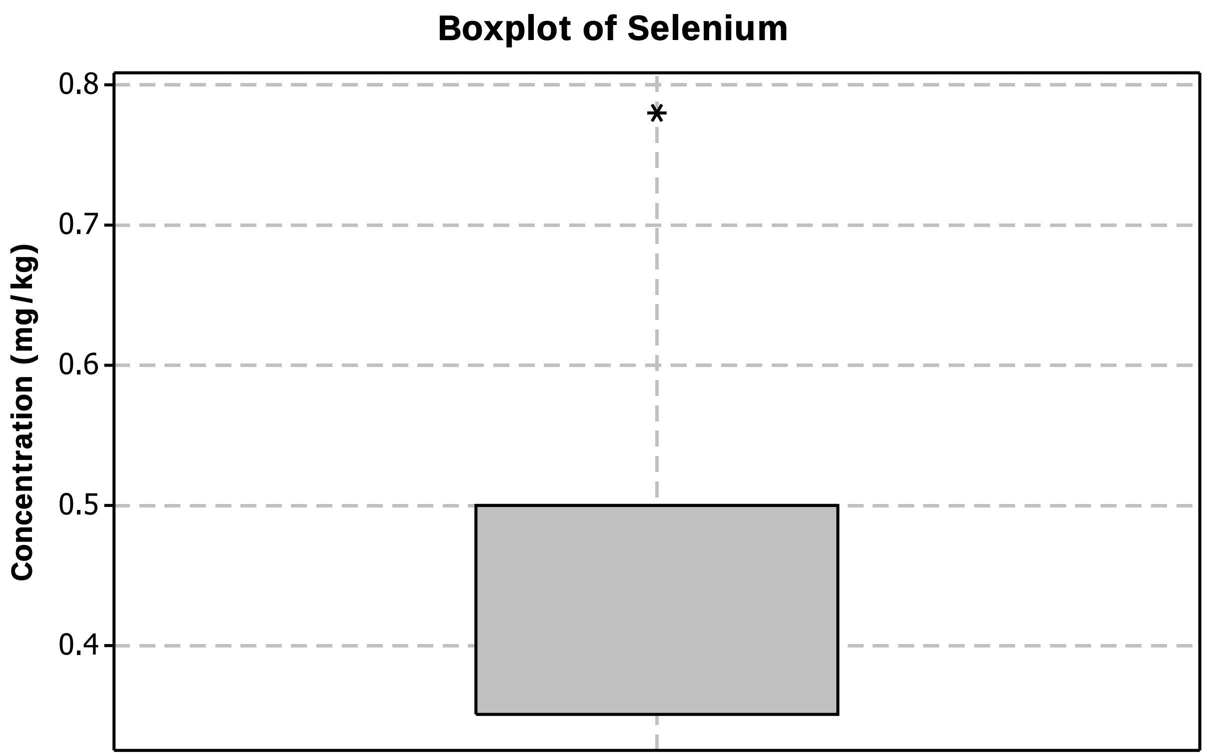


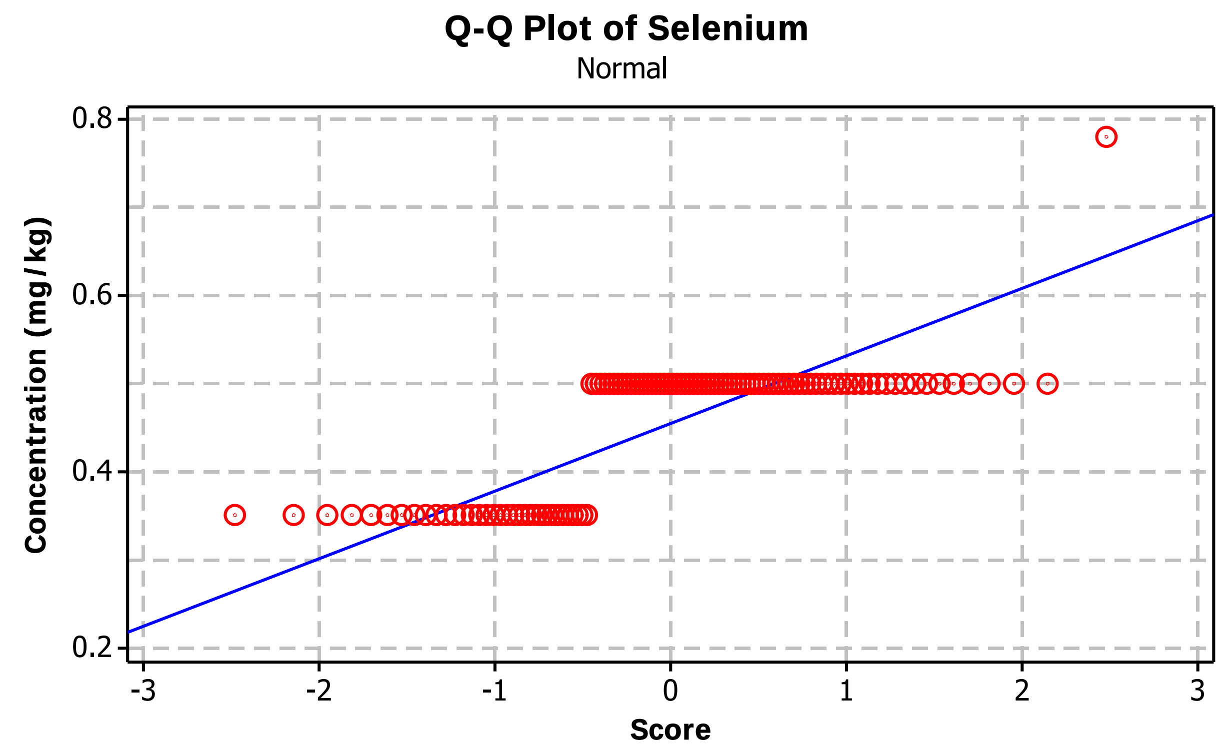


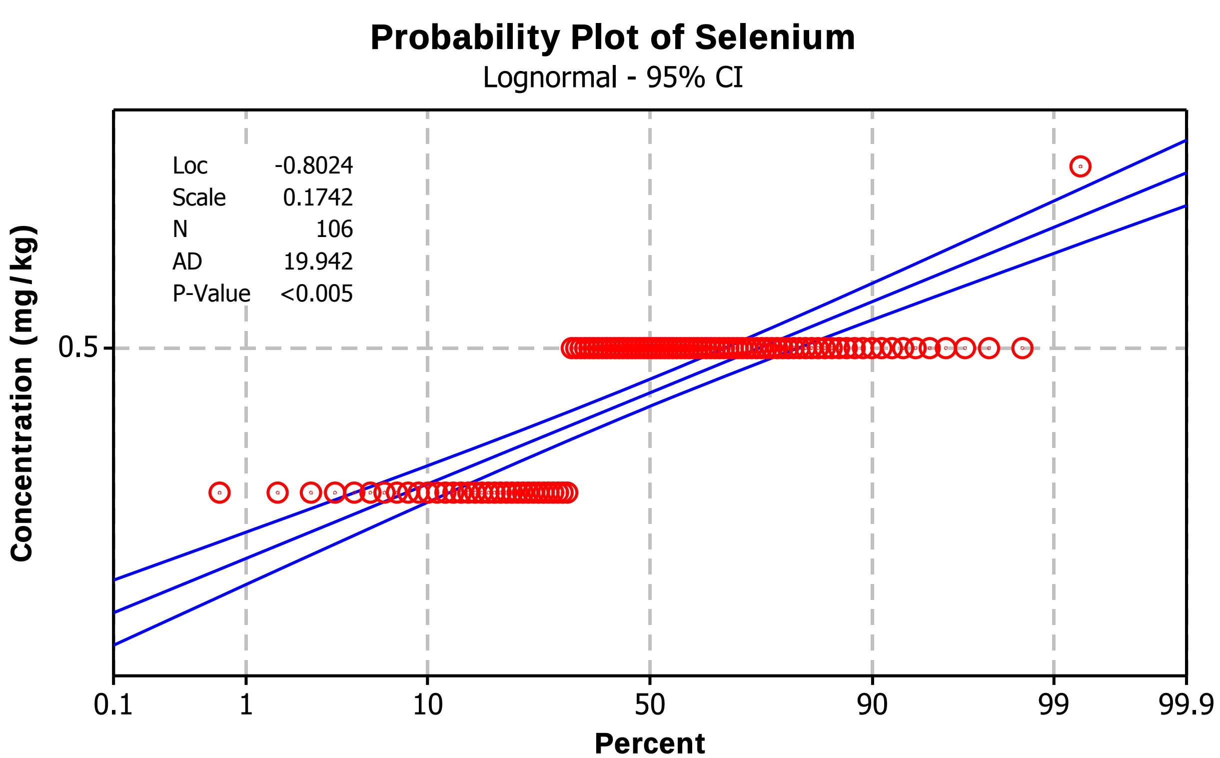


- 3IR suspected outliers -25.3, 27.2
- Rosner test 27.2
- Q-Q plot based suspected outliers - none
- GOF test: Lognormal
- No outlier

Figure A2-4-13: Selenium Outlier Evaluation







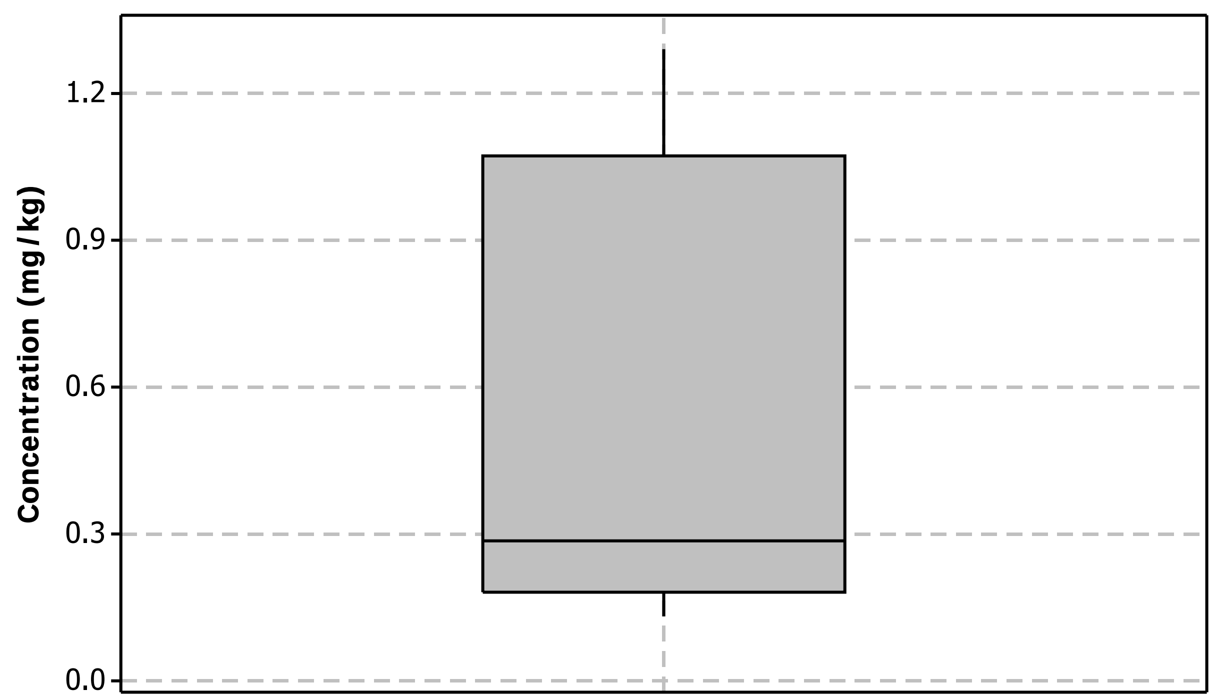
Note: Samples 99% ND (only 1 sample detected)

- No reliable statistical tests

- No samples were eliminated as outliers

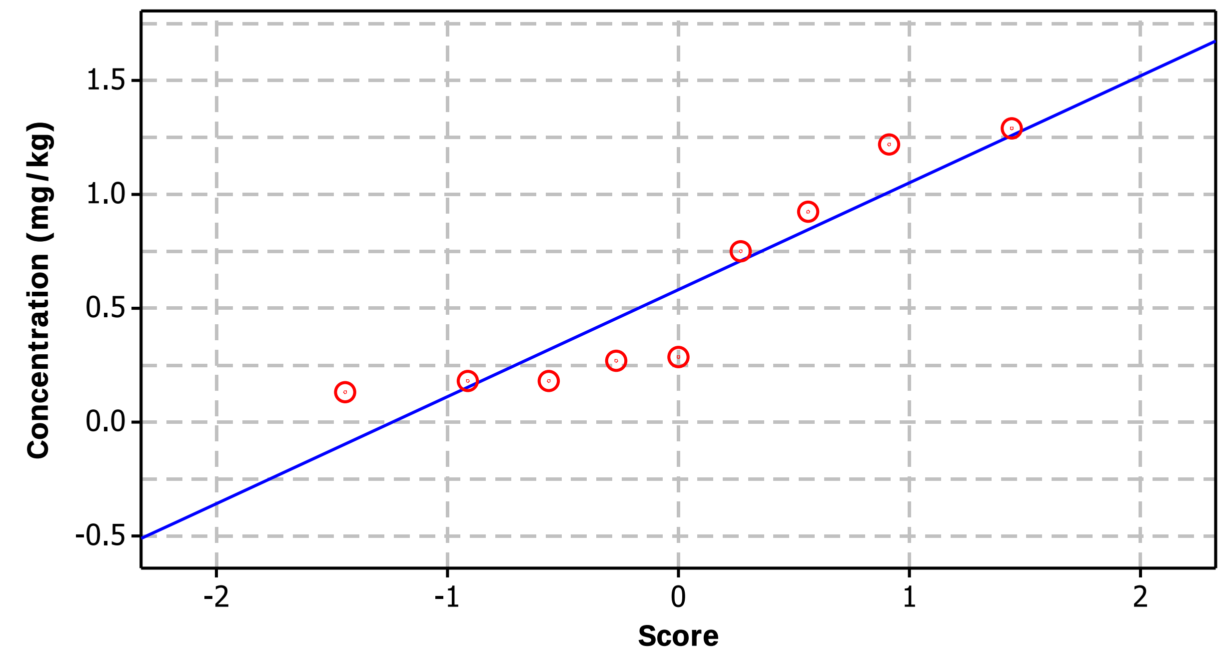
Figure A2-4-14: Silver Outlier Evaluation

Boxplot of Silver



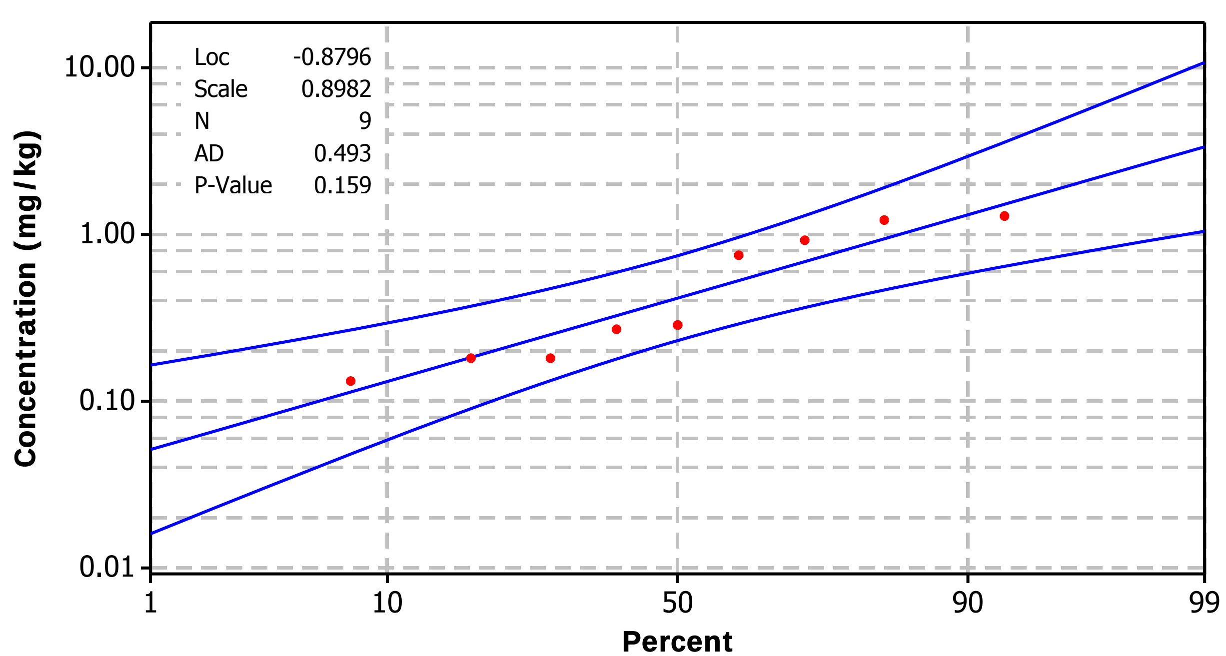
Q-Q Plot of Silver

Normal



Probability Plot of Silver

Lognormal - 95% CI



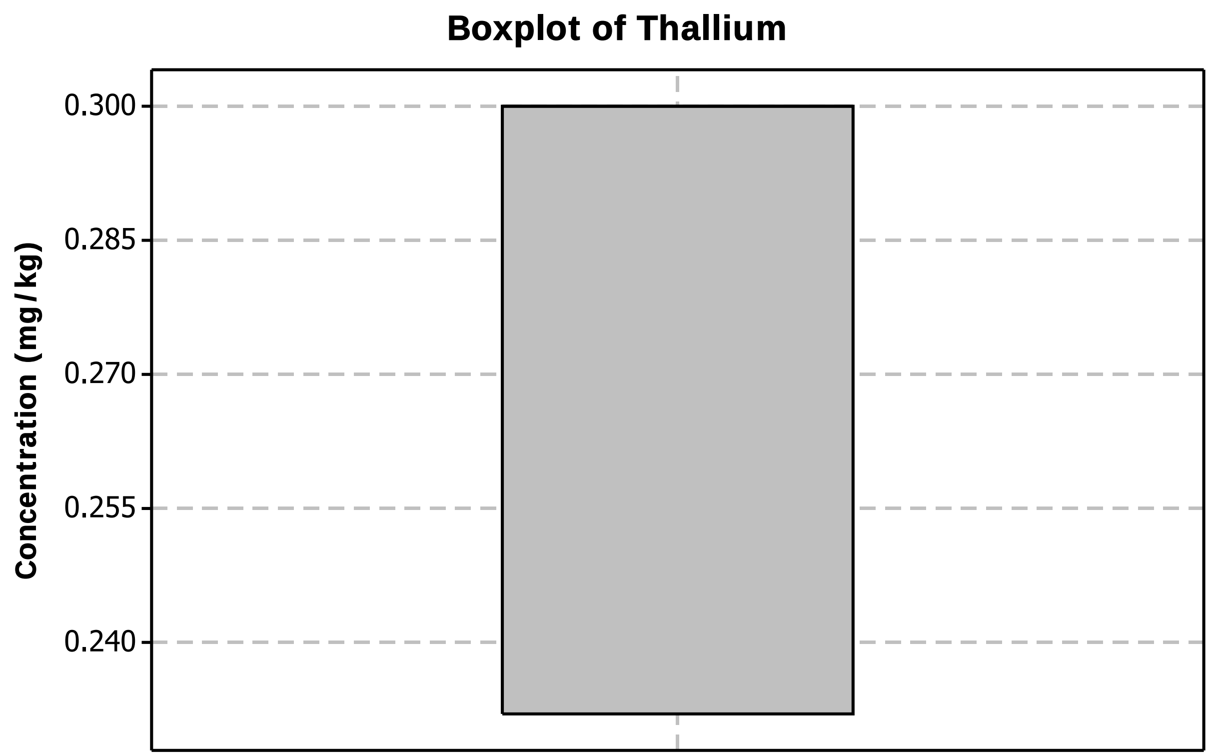
- Rosner test and 3IR suspected outliers - none

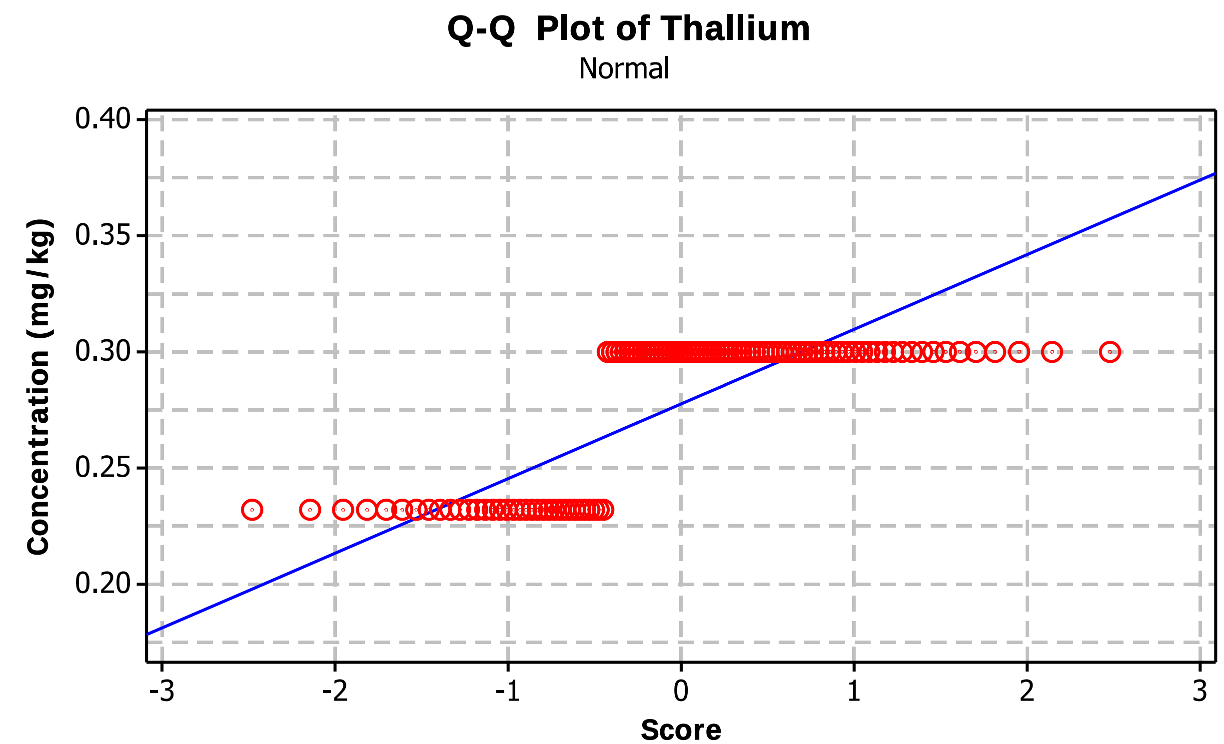
- Q-Q plot based suspected outliers - none

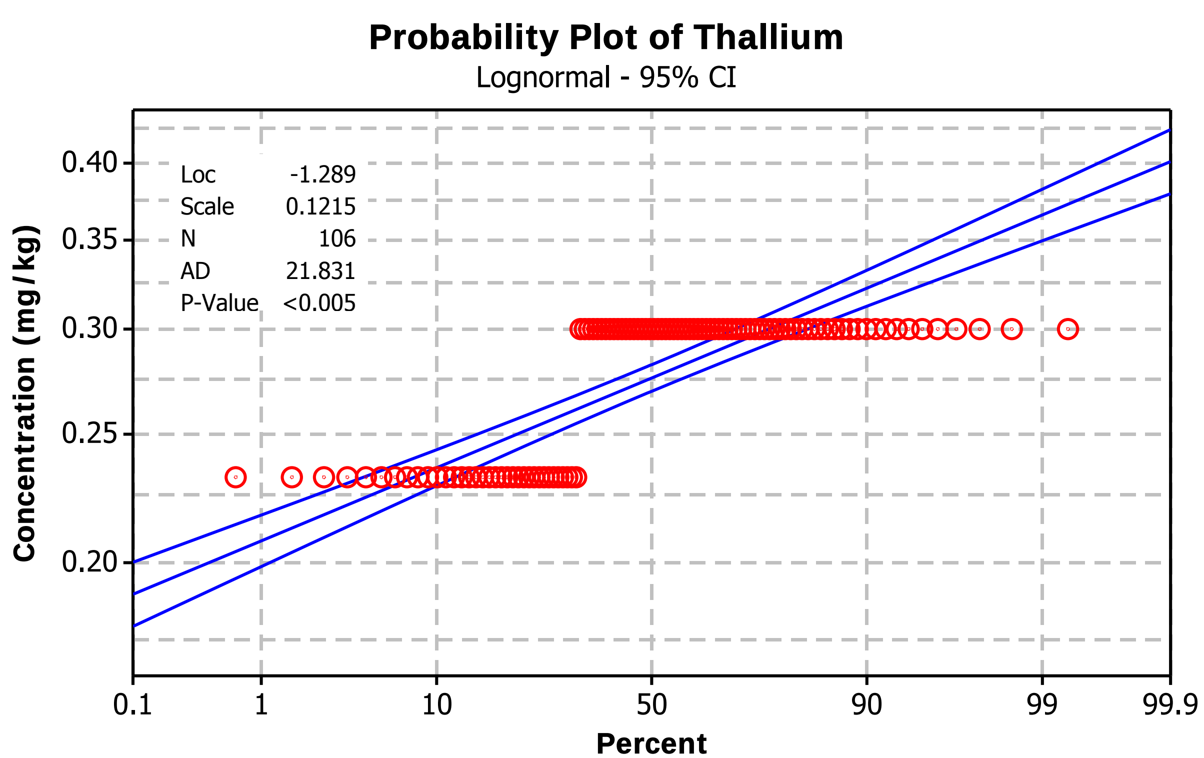
Note: %ND = 91.5%.
- Only detected values used in probability plot

- No outlier

Figure A2-4-15: Thallium Outlier Evaluation

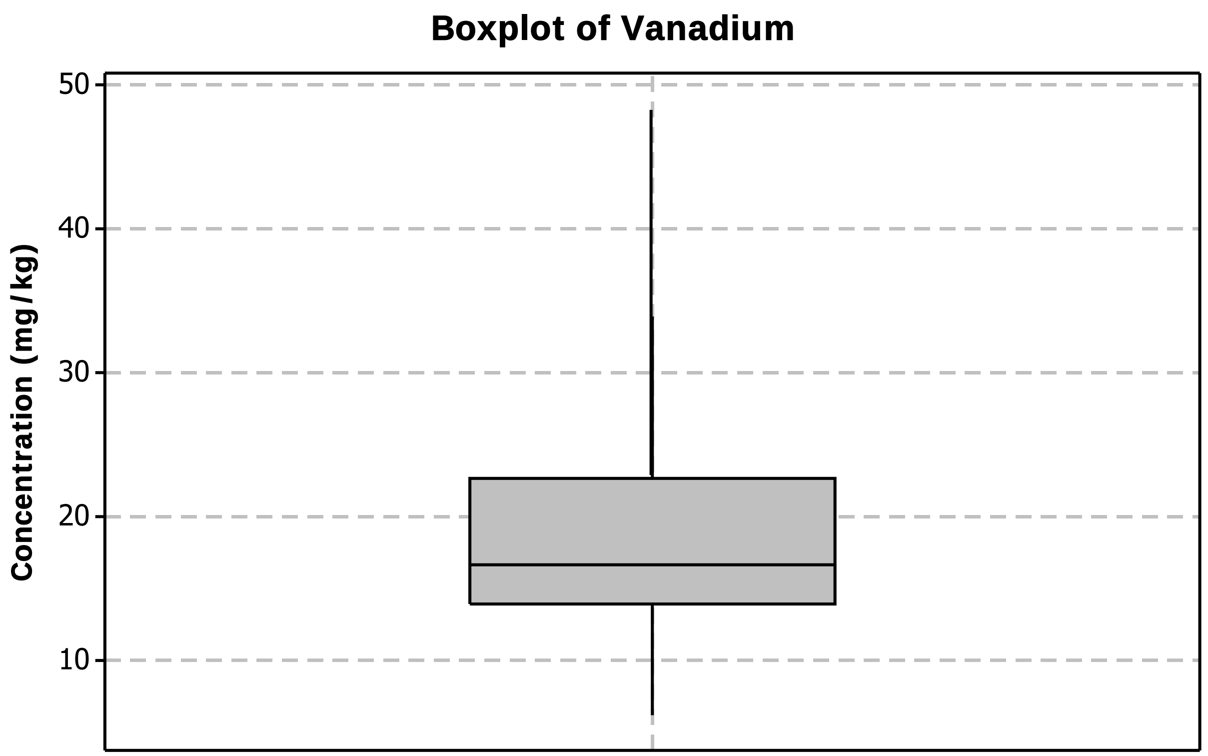


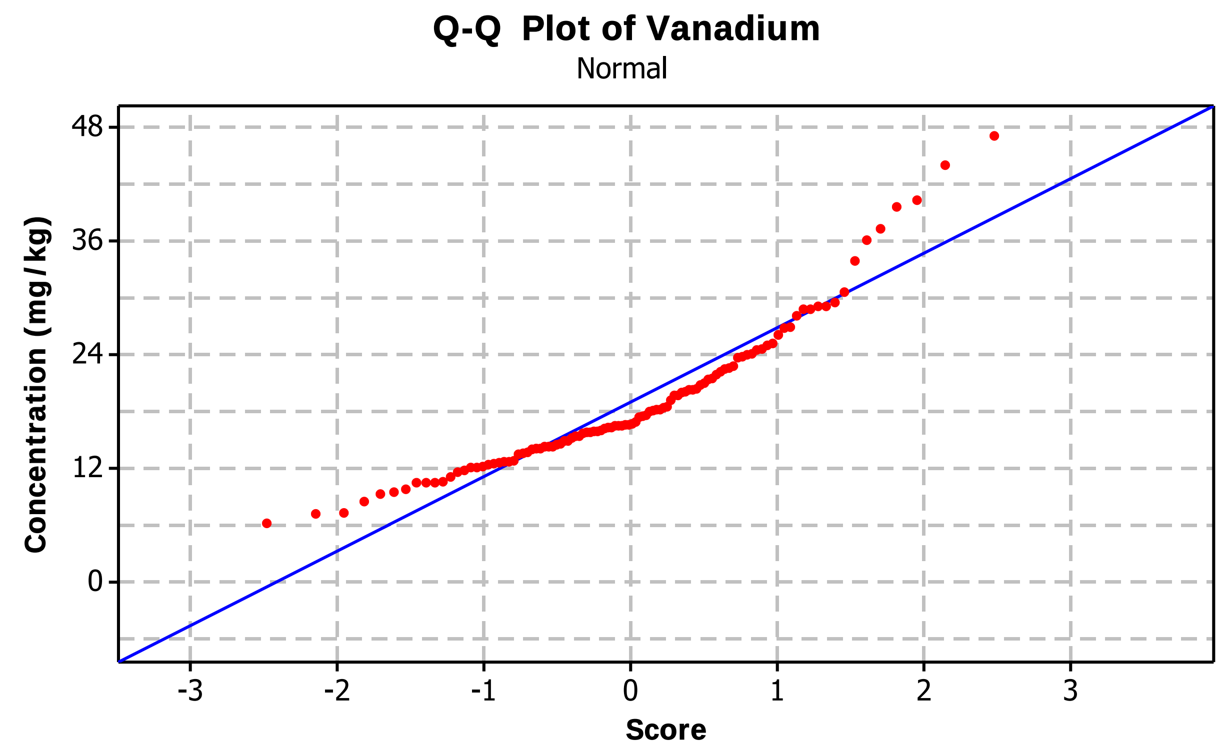


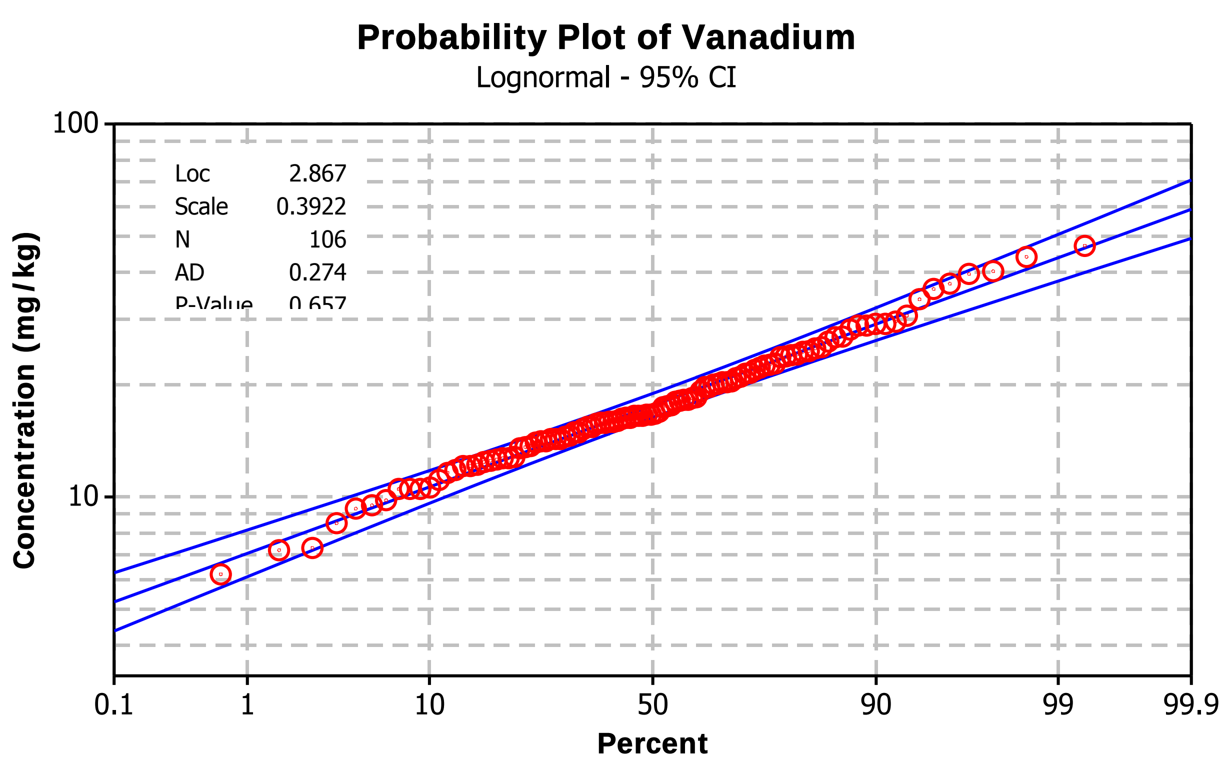


%ND = 100%

Figure A2-4-16: Vanadium Outlier Evaluation

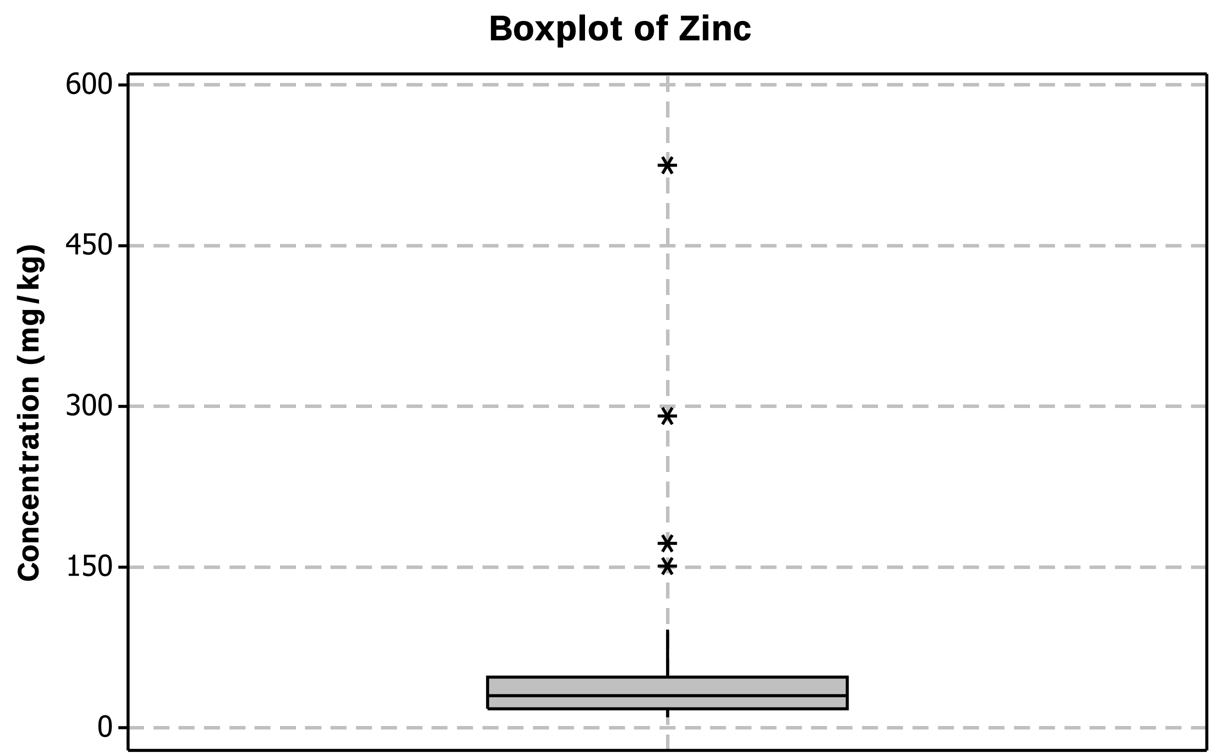


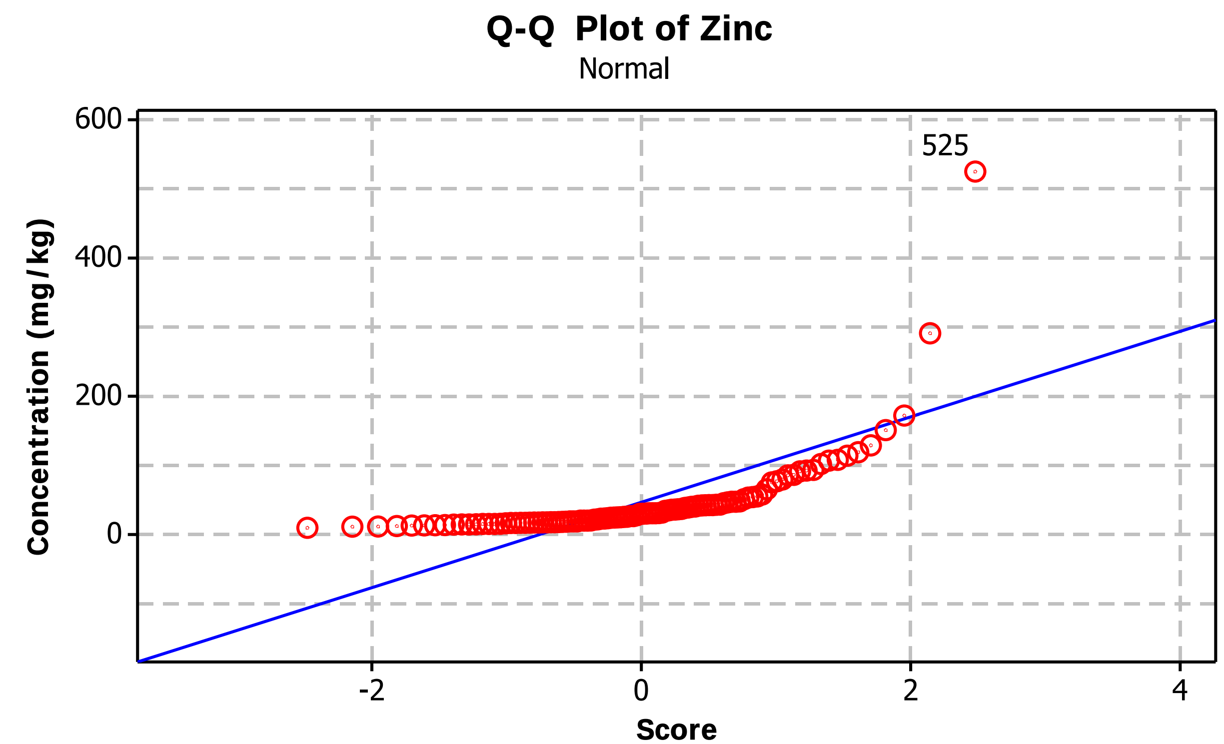


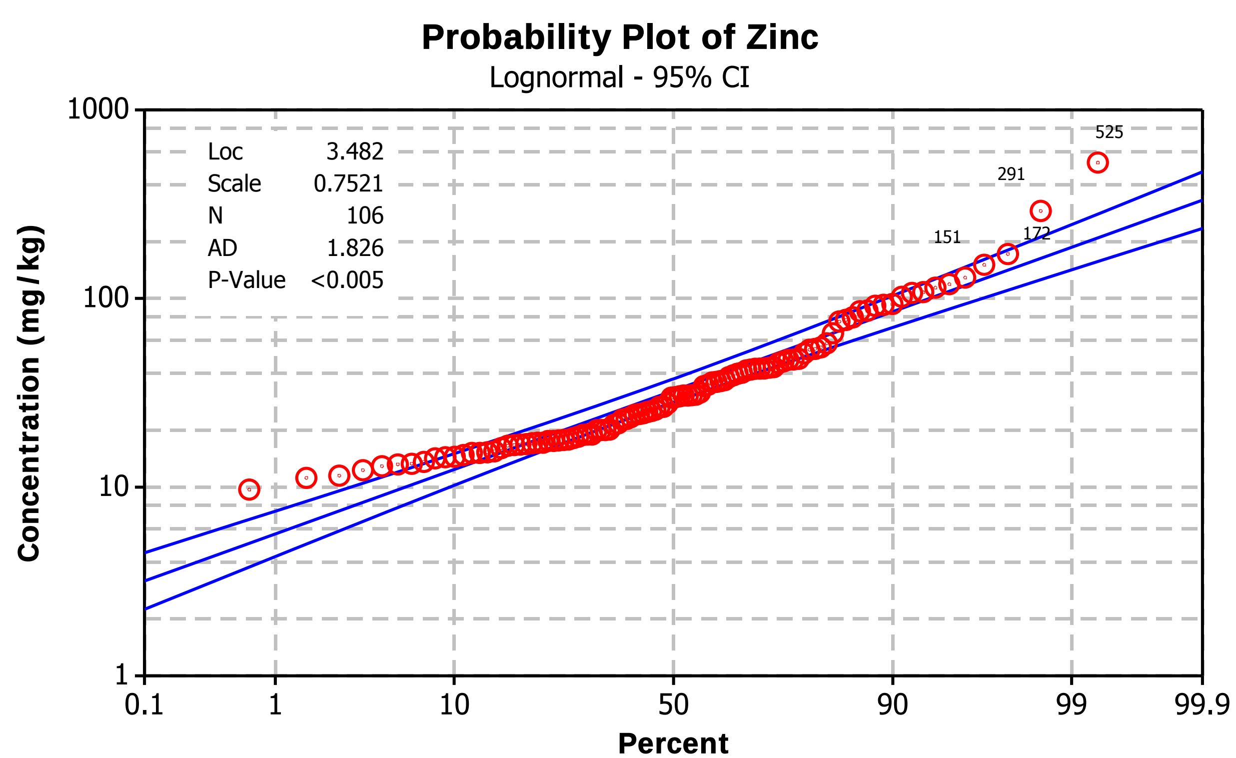


- Rosner test and 3IR suspected outliers - none
- Q-Q plot based suspected outliers - None
- GOF Test : Lognormal
- No outlier

Figure A2-4-17: Zinc Outlier Evaluation







-3IR suspected outliers - 151, 172, 291, 525

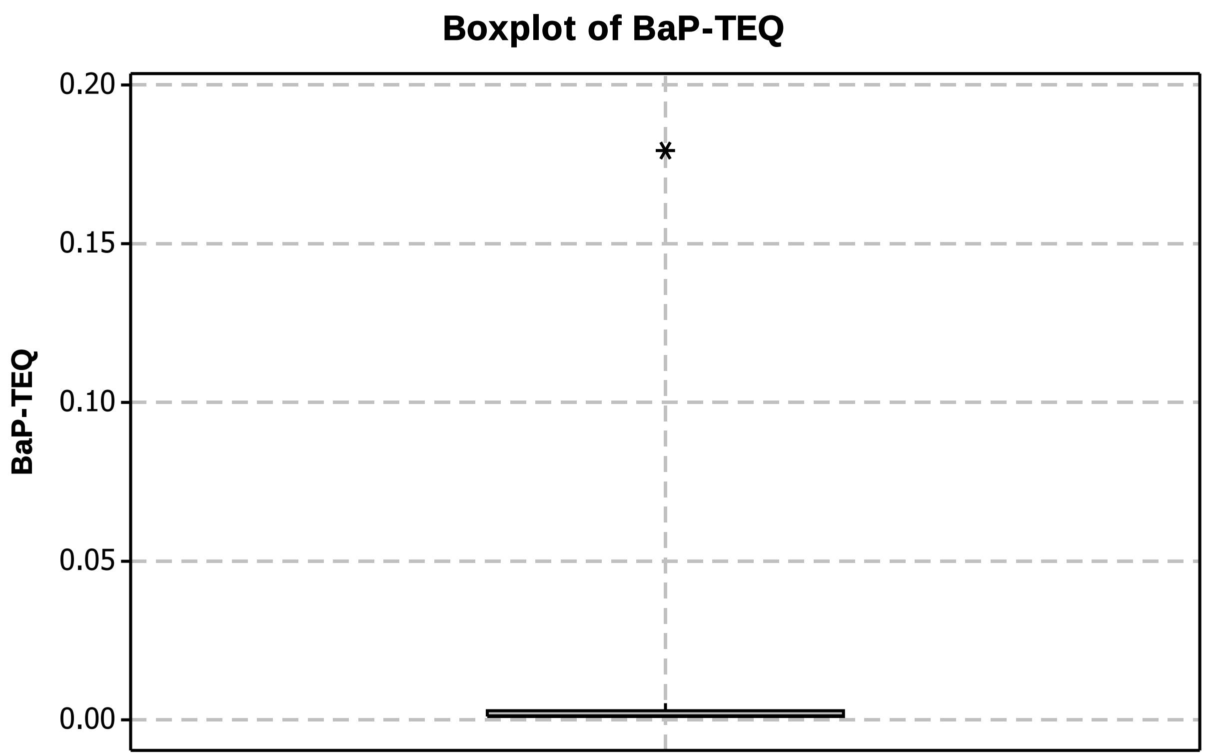
Rosner test: 525

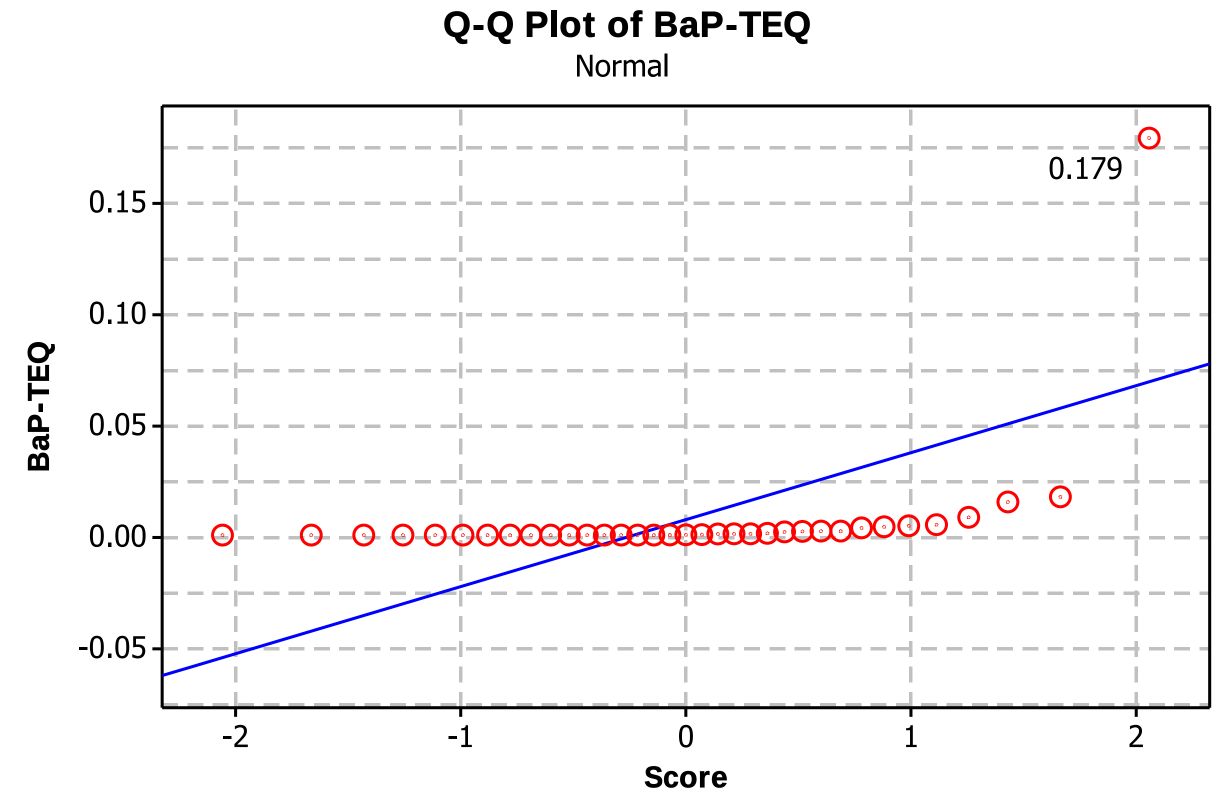
- Q-Q plot based suspected outliers - 525

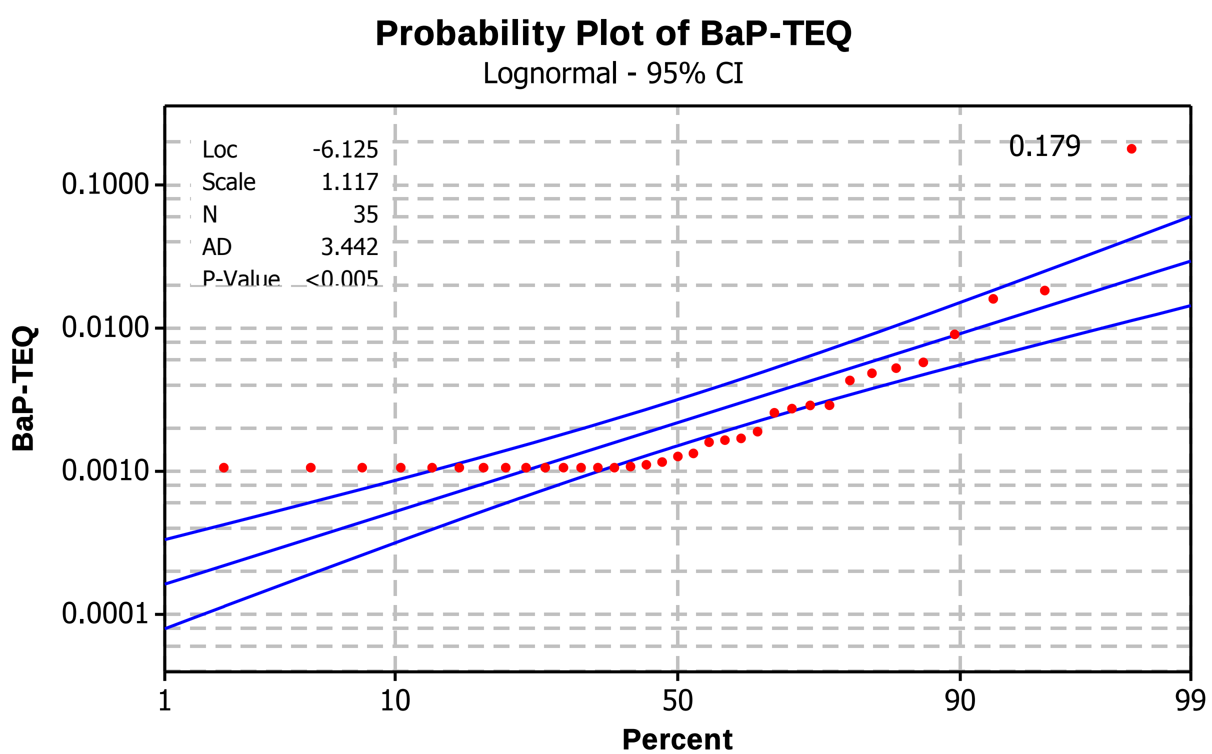
- GOF test: not LN, N or GM (close to LN)

- potential suspect outlier = 525

Figure A2-4-18: cPAH Outlier Evaluation

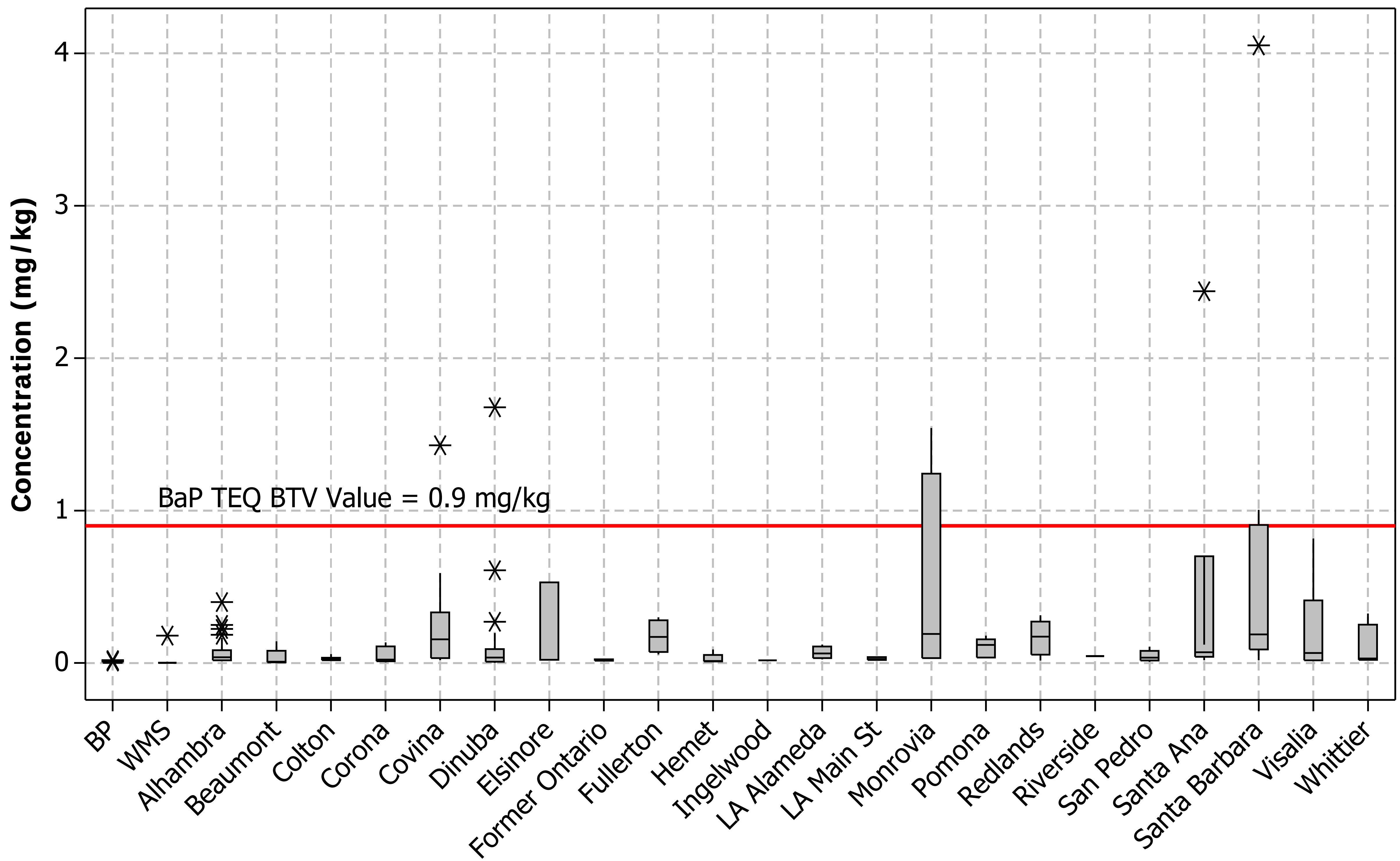






- 3IR suspected outliers - 0.179
- Rosner test = 0.179
- Q-Q plot based suspected outliers - 0.179
- GOF test: No discernible distribution (not N, LN or GM)
- No outlier

Figure A2-5: Boxplots of Local Background and Southern California Background cPAH Datasets



ProUCL Output

General Background Statistics for Data Sets with Non-Detects

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	99%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Antimony

General Statistics

Number of Valid Data	106	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	105

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Antimony was not processed!

Arsenic

General Statistics

Number of Valid Data	105	Number of Detected Data	102
Number of Distinct Detected Data	61	Number of Non-Detect Data	3
Tolerance Factor	2.671	Percent Non-Detects	2.86%
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.3	Minimum Detected	-1.204
Maximum Detected	11.9	Maximum Detected	2.477
Mean of Detected	2.041	Mean of Detected	0.542
SD of Detected	1.511	SD of Detected	0.577
Minimum Non-Detect	0.3	Minimum Non-Detect	-1.204
Maximum Non-Detect	0.3	Maximum Non-Detect	-1.204

Background Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Lilliefors Test Statistic	0.181	Lilliefors Test Statistic	0.0886
5% Lilliefors Critical Value	0.0877	5% Lilliefors Critical Value	0.0877
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.987	Mean (Log Scale)	0.472
SD	1.522	SD (Log Scale)	0.7
95% UTL 99% Coverage	6.053	95% UTL 99% Coverage	10.38
95% UPL (t)	4.526	95% UPL (t)	5.148
90% Percentile (z)	3.938	90% Percentile (z)	3.929

95% Percentile (z)	4.491	95% Percentile (z)	5.067
99% Percentile (z)	5.529	99% Percentile (z)	8.162
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.969	Mean in Original Scale	1.995
SD	1.545	SD in Original Scale	1.513
95% UTL with 99% Coverage	6.095	95% UTL with 99% Coverage	8.536
		95% BCA UTL with 99% Coverage	11.9
		95% Bootstrap (%) UTL with 99% Coverage	11.9
95% UPL (t)	4.545	95% UPL (t)	4.605
90% Percentile (z)	3.949	90% Percentile (z)	3.632
95% Percentile (z)	4.51	95% Percentile (z)	4.542
99% Percentile (z)	5.563	99% Percentile (z)	6.907
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.978	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.685		
nu star	607.6		
A-D Test Statistic	1.627	**Nonparametric Statistics**	
5% A-D Critical Value	0.758	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.101	Mean	1.992
5% K-S Critical Value	0.0895	SD	1.51
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.148
		95% KM UTL with 99% Coverage	6.025
Assuming Gamma Distribution		95% KM Chebyshev UPL	8.605
Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	4.51
Mean	1.983	90% Percentile (z)	3.927
Median	1.66	95% Percentile (z)	4.476
SD	1.528	99% Percentile (z)	5.505
k star	1.015		
Theta star	1.953	**Gamma ROS Limits with Extrapolated Data**	
Nu star	213.2	95% Wilson Hilferty (WH) Approx. Gamma UPL	4.962
95% Percentile of Chisquare (2k)	6.051	95% Hawkins Wixley (HW) Approx. Gamma UPL	5.684
		95% WH Approx. Gamma UTL with 99% Coverage	8.224
90% Percentile	4.549	95% HW Approx. Gamma UTL with 99% Coverage	10.41
95% Percentile	5.909		
99% Percentile	9.063		
Note: DL/2 is not a recommended method.			
Barium			
General Statistics			
Total Number of Observations	104	Number of Distinct Observations	95
Tolerance Factor	2.672	Number of Missing Values	2
Raw Statistics		**Log-Transformed Statistics**	
Minimum	17.7	Minimum	2.874
Maximum	267	Maximum	5.587
Second Largest	203	Second Largest	5.313
First Quartile	41.25	First Quartile	3.72

	A–E	F	G–K	L
107	Median	56	Median	4.025
108	Third Quartile	74.85	Third Quartile	4.315
109	Mean	61.58	Mean	4.005
110	SD	34.25	SD	0.475
111	Coefficient of Variation	0.556		
112	Skewness	2.953		
113				
114	Background Statistics			
115	Normal Distribution Test		Lognormal Distribution Test	
116	Lilliefors Test Statistic	0.15	Lilliefors Test Statistic	0.0764
117	Lilliefors Critical Value	0.0869	Lilliefors Critical Value	0.0869
118	Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
119				
120	Assuming Normal Distribution		Assuming Lognormal Distribution	
121	95% UTL with 99% Coverage	153.1	95% UTL with 99% Coverage	195.4
122	95% UPL (t)	118.7	95% UPL (t)	121.2
123	90% Percentile (z)	105.5	90% Percentile (z)	100.9
124	95% Percentile (z)	117.9	95% Percentile (z)	119.9
125	99% Percentile (z)	141.3	99% Percentile (z)	165.8
126				
127	Gamma Distribution Test		Data Distribution Test	
128	k star	4.356	Data appear Lognormal at 5% Significance Level	
129	Theta Star	14.14		
130	MLE of Mean	61.58		
131	MLE of Standard Deviation	29.51		
132	nu star	906		
133				
134	A-D Test Statistic	0.826	Nonparametric Statistics	
135	5% A-D Critical Value	0.755	90% Percentile	87.05
136	K-S Test Statistic	0.091	95% Percentile	106.7
137	5% K-S Critical Value	0.0887	99% Percentile	201.6
138	Data not Gamma Distributed at 5% Significance Level			
139				
140	Assuming Gamma Distribution		95% UTL with 99% Coverage	267
141	90% Percentile	101.1	95% Percentile Bootstrap UTL with 99% Coverage	267
142	95% Percentile	116.7	95% BCA Bootstrap UTL with 99% Coverage	267
143	99% Percentile	150	95% UPL	109.5
144			95% Chebyshev UPL	211.6
145	95% WH Approx. Gamma UPL	116.6	Upper Threshold Limit Based upon IQR	125.3
146	95% HW Approx. Gamma UPL	117.3		
147	95% WH Approx. Gamma UTL with 99% Coverage	167.4		
148	95% HW Approx. Gamma UTL with 99% Coverage	172.2		
149				
150				
151				
152	Beryllium			
153				
154	General Statistics			
155	Number of Valid Data	106	Number of Detected Data	88
156	Number of Distinct Detected Data	38	Number of Non-Detect Data	18
157	Tolerance Factor	2.669	Percent Non-Detects	16.98%
158				
159	Raw Statistics		Log-transformed Statistics	

	A–E	F	G–K	L
160	Minimum Detected	0.182	Minimum Detected	-1.704
161	Maximum Detected	0.8	Maximum Detected	-0.223
162	Mean of Detected	0.276	Mean of Detected	-1.353
163	SD of Detected	0.119	SD of Detected	0.333
164	Minimum Non-Detect	0.0894	Minimum Non-Detect	-2.415
165	Maximum Non-Detect	0.1	Maximum Non-Detect	-2.303
166				
167	**Data with Multiple Detection Limits**		**Single Detection Limit Scenario**	
168	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	18
169	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	88
170	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	16.98%
171				
172	**Background Statistics**			
173	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
174	Lilliefors Test Statistic	0.237	Lilliefors Test Statistic	0.19
175	5% Lilliefors Critical Value	0.0944	5% Lilliefors Critical Value	0.0944
176	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
177				
178	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
179	DL/2 Substitution Method		DL/2 Substitution Method	
180	Mean	0.237	Mean (Log Scale)	-1.633
181	SD	0.138	SD (Log Scale)	0.692
182	95% UTL 99% Coverage	0.605	95% UTL 99% Coverage	1.238
183	95% UPL (t)	0.467	95% UPL (t)	0.619
184	90% Percentile (z)	0.414	90% Percentile (z)	0.474
185	95% Percentile (z)	0.464	95% Percentile (z)	0.609
186	99% Percentile (z)	0.558	99% Percentile (z)	0.977
187				
188	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
189	Mean	0.232	Mean in Original Scale	0.25
190	SD	0.147	SD in Original Scale	0.122
191	95% UTL with 99% Coverage	0.624	95% UTL with 99% Coverage	0.687
192			95% BCA UTL with 99% Coverage	0.795
193			95% Bootstrap (%) UTL with 99% Coverage	0.8
194	95% UPL (t)	0.477	95% UPL (t)	0.455
195	90% Percentile (z)	0.42	90% Percentile (z)	0.388
196	95% Percentile (z)	0.474	95% Percentile (z)	0.451
197	99% Percentile (z)	0.574	99% Percentile (z)	0.597
198				
199	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
200	k star (bias corrected)	7.677	Data do not follow a Discernable Distribution (0.05)	
201	Theta Star	0.0359		
202	nu star	1351		
203				
204	A-D Test Statistic	6.767	**Nonparametric Statistics**	
205	5% A-D Critical Value	0.753	Kaplan-Meier (KM) Method	
206	K-S Test Statistic	0.201	Mean	0.26
207	5% K-S Critical Value	0.0954	SD	0.113
208	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0111
209			95% KM UTL with 99% Coverage	0.562
210	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	0.756
211	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.449
212	Mean	0.232	90% Percentile (z)	0.405

Median	0.206	95% Percentile (z)	0.446
SD	0.145	99% Percentile (z)	0.523
k star	0.512		
Theta star	0.453	**Gamma ROS Limits with Extrapolated Data**	
Nu star	108.6	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.742
95% Percentile of Chisquare (2k)	3.903	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.961
		95% WH Approx. Gamma UTL with 99% Coverage	1.379
90% Percentile	0.625	95% HW Approx. Gamma UTL with 99% Coverage	2.113
95% Percentile	0.884		
99% Percentile	1.52		

Note: DL/2 is not a recommended method.

Cadmium

General Statistics			
Number of Valid Data	106	Number of Detected Data	49
Number of Distinct Detected Data	24	Number of Non-Detect Data	57
Tolerance Factor	2.669	Percent Non-Detects	53.77%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.105	Minimum Detected	-2.254
Maximum Detected	3.81	Maximum Detected	1.338
Mean of Detected	0.551	Mean of Detected	-0.917
SD of Detected	0.599	SD of Detected	0.749
Minimum Non-Detect	0.0883	Minimum Non-Detect	-2.427
Maximum Non-Detect	0.1	Maximum Non-Detect	-2.303
Data with Multiple Detection Limits		**Single Detection Limit Scenario**	
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	57
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	49
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	53.77%
Background Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.623	Shapiro Wilk Test Statistic	0.962
5% Shapiro Wilk Critical Value	0.947	5% Shapiro Wilk Critical Value	0.947
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.28	Mean (Log Scale)	-2.056
SD	0.477	SD (Log Scale)	1.177
95% UTL 99% Coverage	1.554	95% UTL 99% Coverage	2.958
95% UPL (t)	1.076	95% UPL (t)	0.91
90% Percentile (z)	0.892	90% Percentile (z)	0.578
95% Percentile (z)	1.065	95% Percentile (z)	0.887
99% Percentile (z)	1.39	99% Percentile (z)	1.977
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	-0.0672	Mean in Original Scale	0.288
SD	0.794	SD in Original Scale	0.474

Row	A–E	F	G–K	L
266	95% UTL with 99% Coverage	2.052	95% UTL with 99% Coverage	4.055
267			95% BCA UTL with 99% Coverage	3.81
268			95% Bootstrap (%) UTL with 99% Coverage	3.81
269	95% UPL (t)	1.257	95% UPL (t)	1.114
270	90% Percentile (z)	0.95	90% Percentile (z)	0.677
271	95% Percentile (z)	1.239	95% Percentile (z)	1.082
272	99% Percentile (z)	1.78	99% Percentile (z)	2.607
273				
274	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
275	k star (bias corrected)	1.62	Data appear Lognormal at 5% Significance Level	
276	Theta Star	0.34		
277	nu star	158.7		
278				
279	A-D Test Statistic	1.429	**Nonparametric Statistics**	
280	5% A-D Critical Value	0.765	Kaplan-Meier (KM) Method	
281	K-S Test Statistic	0.165	Mean	0.311
282	5% K-S Critical Value	0.129	SD	0.461
283	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0452
284			95% KM UTL with 99% Coverage	1.54
285	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	2.328
286	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	1.079
287	Mean	0.254	90% Percentile (z)	0.901
288	Median	0.000001	95% Percentile (z)	1.068
289	SD	0.49	99% Percentile (z)	1.382
290	k star	0.125		
291	Theta star	2.038	**Gamma ROS Limits with Extrapolated Data**	
292	Nu star	26.47	95% Wilson Hilferty (WH) Approx. Gamma UPL	1.083
293	95% Percentile of Chisquare (2k)	1.417	95% Hawkins Wixley (HW) Approx. Gamma UPL	1.292
294			95% WH Approx. Gamma UTL with 99% Coverage	2.919
295	90% Percentile	0.729	95% HW Approx. Gamma UTL with 99% Coverage	4.69
296	95% Percentile	1.445		
297	99% Percentile	3.609		
298				
299	**Note: DL/2 is not a recommended method.**			
300				
301				
302	Chromium			
303				
304	**General Statistics**			
305	Total Number of Observations	106	Number of Distinct Observations	86
306	Tolerance Factor	2.669		
307				
308	**Raw Statistics**		**Log-Transformed Statistics**	
309	Minimum	4.4	Minimum	1.482
310	Maximum	38.6	Maximum	3.653
311	Second Largest	36.5	Second Largest	3.597
312	First Quartile	8.013	First Quartile	2.081
313	Median	10.25	Median	2.327
314	Third Quartile	13.08	Third Quartile	2.571
315	Mean	11.58	Mean	2.352
316	SD	5.884	SD	0.424
317	Coefficient of Variation	0.508		
318	Skewness	2.235		

Row	A–E	F	G–K	L
319				
320	Background Statistics			
321	Normal Distribution Test		Lognormal Distribution Test	
322	Lilliefors Test Statistic	0.165	Lilliefors Test Statistic	0.0696
323	Lilliefors Critical Value	0.0861	Lilliefors Critical Value	0.0861
324	Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
325				
326	Assuming Normal Distribution		Assuming Lognormal Distribution	
327	95% UTL with 99% Coverage	27.28	95% UTL with 99% Coverage	32.54
328	95% UPL (t)	21.39	95% UPL (t)	21.29
329	90% Percentile (z)	19.12	90% Percentile (z)	18.08
330	95% Percentile (z)	21.25	95% Percentile (z)	21.09
331	99% Percentile (z)	25.26	99% Percentile (z)	28.14
332				
333	Gamma Distribution Test		Data Distribution Test	
334	k star	5.177	Data appear Lognormal at 5% Significance Level	
335	Theta Star	2.236		
336	MLE of Mean	11.58		
337	MLE of Standard Deviation	5.088		
338	nu star	1098		
339				
340	A-D Test Statistic	1.551	Nonparametric Statistics	
341	5% A-D Critical Value	0.754	90% Percentile	17.5
342	K-S Test Statistic	0.103	95% Percentile	21.5
343	5% K-S Critical Value	0.088	99% Percentile	36.14
344	Data not Gamma Distributed at 5% Significance Level			
345				
346	Assuming Gamma Distribution		95% UTL with 99% Coverage	38.6
347	90% Percentile	18.39	95% Percentile Bootstrap UTL with 99% Coverage	38.6
348	95% Percentile	21.01	95% BCA Bootstrap UTL with 99% Coverage	38.6
349	99% Percentile	26.55	95% UPL	21.6
350			95% Chebyshev UPL	37.34
351	95% WH Approx. Gamma UPL	21.01	Upper Threshold Limit Based upon IQR	20.67
352	95% HW Approx. Gamma UPL	21.04		
353	95% WH Approx. Gamma UTL with 99% Coverage	29.43		
354	95% HW Approx. Gamma UTL with 99% Coverage	30.01		
355				
356				
357				
358	Cobalt			
359				
360	General Statistics			
361	Number of Valid Data	106	Number of Detected Data	102
362	Number of Distinct Detected Data	74	Number of Non-Detect Data	4
363	Tolerance Factor	2.669	Percent Non-Detects	3.77%
364				
365	Raw Statistics		Log-transformed Statistics	
366	Minimum Detected	2.5	Minimum Detected	0.916
367	Maximum Detected	15.7	Maximum Detected	2.754
368	Mean of Detected	5.215	Mean of Detected	1.585
369	SD of Detected	2.16	SD of Detected	0.353
370	Minimum Non-Detect	2.5	Minimum Non-Detect	0.916
371	Maximum Non-Detect	2.5	Maximum Non-Detect	0.916

Background Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.17	Lilliefors Test Statistic	0.0953
5% Lilliefors Critical Value	0.0877	5% Lilliefors Critical Value	0.0877
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.066	Mean (Log Scale)	1.534
SD	2.25	SD (Log Scale)	0.434
95% UTL 99% Coverage	11.07	95% UTL 99% Coverage	14.75
95% UPL (t)	8.818	95% UPL (t)	9.552
90% Percentile (z)	7.95	90% Percentile (z)	8.081
95% Percentile (z)	8.767	95% Percentile (z)	9.46
99% Percentile (z)	10.3	99% Percentile (z)	12.71
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	5.071	Mean in Original Scale	5.097
SD	2.239	SD in Original Scale	2.202
95% UTL with 99% Coverage	11.05	95% UTL with 99% Coverage	13.15
		95% BCA UTL with 99% Coverage	15.7
		95% Bootstrap (%) UTL with 99% Coverage	15.7
95% UPL (t)	8.803	95% UPL (t)	8.957
90% Percentile (z)	7.94	90% Percentile (z)	7.725
95% Percentile (z)	8.753	95% Percentile (z)	8.88
99% Percentile (z)	10.28	99% Percentile (z)	11.53
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	7.461	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.699		
nu star	1522		
A-D Test Statistic	1.318	**Nonparametric Statistics**	
5% A-D Critical Value	0.753	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.122	Mean	5.113
5% K-S Critical Value	0.089	SD	2.171
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.212
		95% KM UTL with 99% Coverage	10.91
Assuming Gamma Distribution		95% KM Chebyshev UPL	14.62
Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	8.732
Mean	5.021	90% Percentile (z)	7.895
Median	4.74	95% Percentile (z)	8.684
SD	2.337	99% Percentile (z)	10.16
k star	1.125		
Theta star	4.464	**Gamma ROS Limits with Extrapolated Data**	
Nu star	238.4	95% Wilson Hilferty (WH) Approx. Gamma UPL	11.5
95% Percentile of Chisquare (2k)	6.466	95% Hawkins Wixley (HW) Approx. Gamma UPL	13.64
		95% WH Approx. Gamma UTL with 99% Coverage	18.02
90% Percentile	11.23	95% HW Approx. Gamma UTL with 99% Coverage	23.83
95% Percentile	14.43		
99% Percentile	21.81		

Note: DL/2 is not a recommended method.

Copper

General Statistics			
Total Number of Observations	106	Number of Distinct Observations	89
Tolerance Factor	2.669		
Raw Statistics		**Log-Transformed Statistics**	
Minimum	2.69	Minimum	0.99
Maximum	59	Maximum	4.078
Second Largest	44.1	Second Largest	3.786
First Quartile	6.818	First Quartile	1.919
Median	12.15	Median	2.497
Third Quartile	18.35	Third Quartile	2.91
Mean	13.94	Mean	2.426
SD	9.607	SD	0.653
Coefficient of Variation	0.689		
Skewness	1.735		
Background Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.132	Lilliefors Test Statistic	0.0712
Lilliefors Critical Value	0.0861	Lilliefors Critical Value	0.0861
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 99% Coverage	39.58	95% UTL with 99% Coverage	64.62
95% UPL (t)	29.96	95% UPL (t)	33.6
90% Percentile (z)	26.25	90% Percentile (z)	26.12
95% Percentile (z)	29.74	95% Percentile (z)	33.11
99% Percentile (z)	36.29	99% Percentile (z)	51.67
Gamma Distribution Test		**Data Distribution Test**	
k star	2.482	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	5.618		
MLE of Mean	13.94		
MLE of Standard Deviation	8.85		
nu star	526.1		
A-D Test Statistic	0.689	**Nonparametric Statistics**	
5% A-D Critical Value	0.762	90% Percentile	25.8
K-S Test Statistic	0.0891	95% Percentile	31.78
5% K-S Critical Value	0.0888	99% Percentile	43.79
Data follow Appx. Gamma Distribution at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 99% Coverage	59
90% Percentile	25.8	95% Percentile Bootstrap UTL with 99% Coverage	59
95% Percentile	30.94	95% BCA Bootstrap UTL with 99% Coverage	59
99% Percentile	42.2	95% UPL	34.32
		95% Chebyshev UPL	56.02

	A–E	F	G–K	L
478	95% WH Approx. Gamma UPL	30.94	Upper Threshold Limit Based upon IQR	35.65
479	95% HW Approx. Gamma UPL	31.39		
480	95% WH Approx. Gamma UTL with 99% Coverage	48.4		
481	95% HW Approx. Gamma UTL with 99% Coverage	51.01		
482				
483				
484				
485	Lead			
486				
487	General Statistics			
488	Number of Valid Data	106	Number of Detected Data	100
489	Number of Distinct Detected Data	82	Number of Non-Detect Data	6
490	Tolerance Factor	2.669	Percent Non-Detects	5.66%
491				
492	Raw Statistics		Log-transformed Statistics	
493	Minimum Detected	2.3	Minimum Detected	0.833
494	Maximum Detected	112	Maximum Detected	4.718
495	Mean of Detected	13.7	Mean of Detected	2.071
496	SD of Detected	18.57	SD of Detected	0.94
497	Minimum Non-Detect	2.5	Minimum Non-Detect	0.916
498	Maximum Non-Detect	2.5	Maximum Non-Detect	0.916
499				
500				
501	Background Statistics			
502	Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
503	Lilliefors Test Statistic	0.299	Lilliefors Test Statistic	0.161
504	5% Lilliefors Critical Value	0.0886	5% Lilliefors Critical Value	0.0886
505	Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
506				
507	Assuming Normal Distribution		Assuming Lognormal Distribution	
508	DL/2 Substitution Method		DL/2 Substitution Method	
509	Mean	13	Mean (Log Scale)	1.966
510	SD	18.26	SD (Log Scale)	1.008
511	95% UTL 99% Coverage	61.73	95% UTL 99% Coverage	105.4
512	95% UPL (t)	43.44	95% UPL (t)	38.39
513	90% Percentile (z)	36.4	90% Percentile (z)	26.02
514	95% Percentile (z)	43.03	95% Percentile (z)	37.54
515	99% Percentile (z)	55.47	99% Percentile (z)	74.63
516				
517	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
518	Mean	12.27	Mean in Original Scale	12.99
519	SD	19	SD in Original Scale	18.27
520	95% UTL with 99% Coverage	62.97	95% UTL with 99% Coverage	111.1
521			95% BCA UTL with 99% Coverage	112
522			95% Bootstrap (%) UTL with 99% Coverage	112
523	95% UPL (t)	43.95	95% UPL (t)	39.49
524	90% Percentile (z)	36.62	90% Percentile (z)	26.51
525	95% Percentile (z)	43.52	95% Percentile (z)	38.58
526	99% Percentile (z)	56.47	99% Percentile (z)	77.98
527				
528	Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
529	k star (bias corrected)	1.025	Data do not follow a Discernable Distribution (0.05)	
530	Theta Star	13.36		

	A–E	F	G–K	L
531	nu star	205.1		
532				
533	A-D Test Statistic	7.995	**Nonparametric Statistics**	
534	5% A-D Critical Value	0.782	Kaplan-Meier (KM) Method	
535	K-S Test Statistic	0.227	Mean	13.06
536	5% K-S Critical Value	0.092	SD	18.14
537	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	1.77
538			95% KM UTL with 99% Coverage	61.46
539	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	92.48
540	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	43.29
541	Mean	12.93	90% Percentile (z)	36.3
542	Median	5.7	95% Percentile (z)	42.89
543	SD	18.31	99% Percentile (z)	55.25
544	k star	0.456		
545	Theta star	28.32	**Gamma ROS Limits with Extrapolated Data**	
546	Nu star	96.77	95% Wilson Hilferty (WH) Approx. Gamma UPL	41.9
547	95% Percentile of Chisquare (2k)	3.622	95% Hawkins Wixley (HW) Approx. Gamma UPL	47.27
548			95% WH Approx. Gamma UTL with 99% Coverage	83.28
549	90% Percentile	35.62	95% HW Approx. Gamma UTL with 99% Coverage	107
550	95% Percentile	51.29		
551	99% Percentile	90.15		
552				
553	**Note: DL/2 is not a recommended method.**			
554				
555				
556	**Mercury**			
557				
558	**General Statistics**			
559	Number of Valid Data	106	Number of Detected Data	30
560	Number of Distinct Detected Data	28	Number of Non-Detect Data	76
561	Tolerance Factor	2.669	Percent Non-Detects	71.70%
562				
563	**Raw Statistics**		**Log-transformed Statistics**	
564	Minimum Detected	0.0175	Minimum Detected	-4.046
565	Maximum Detected	0.324	Maximum Detected	-1.127
566	Mean of Detected	0.0493	Mean of Detected	-3.342
567	SD of Detected	0.0599	SD of Detected	0.71
568	Minimum Non-Detect	0.0039	Minimum Non-Detect	-5.547
569	Maximum Non-Detect	0.1	Maximum Non-Detect	-2.303
570				
571	**Data with Multiple Detection Limits**		**Single Detection Limit Scenario**	
572	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	103
573	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	3
574	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.17%
575				
576	**Background Statistics**			
577	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
578	Shapiro Wilk Test Statistic	0.54	Shapiro Wilk Test Statistic	0.84
579	5% Shapiro Wilk Critical Value	0.927	5% Shapiro Wilk Critical Value	0.927
580	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
581				
582	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
583	DL/2 Substitution Method		DL/2 Substitution Method	

	A–E	F	G–K	L
584	Mean	0.0475	Mean (Log Scale)	-3.247
585	SD	0.0331	SD (Log Scale)	0.782
586	95% UTL 99% Coverage	0.136	95% UTL 99% Coverage	0.313
587	95% UPL (t)	0.103	95% UPL (t)	0.143
588	90% Percentile (z)	0.0899	90% Percentile (z)	0.106
589	95% Percentile (z)	0.102	95% Percentile (z)	0.141
590	99% Percentile (z)	0.124	99% Percentile (z)	0.24
591				
592	Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
593	Mean	-0.368	Mean in Original Scale	0.0351
594	SD	0.245	SD in Original Scale	0.0371
595	95% UTL with 99% Coverage	0.286	95% UTL with 99% Coverage	0.187
596			95% BCA UTL with 99% Coverage	0.324
597			95% Bootstrap (%) UTL with 99% Coverage	0.324
598	95% UPL (t)	0.0409	95% UPL (t)	0.0893
599	90% Percentile (z)	-0.0537	90% Percentile (z)	0.0672
600	95% Percentile (z)	0.0354	95% Percentile (z)	0.0878
601	99% Percentile (z)	0.202	99% Percentile (z)	0.145
602				
603	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
604	k star (bias corrected)	1.511	Data do not follow a Discernable Distribution (0.05)	
605	Theta Star	0.0326		
606	nu star	90.69		
607				
608	A-D Test Statistic	2.521	**Nonparametric Statistics**	
609	5% A-D Critical Value	0.762	Kaplan-Meier (KM) Method	
610	K-S Test Statistic	0.25	Mean	0.0355
611	5% K-S Critical Value	0.163	SD	0.0359
612	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.00443
613			95% KM UTL with 99% Coverage	0.131
614	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	0.193
615	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.0953
616	Mean	0.0393	90% Percentile (z)	0.0815
617	Median	0.0284	95% Percentile (z)	0.0945
618	SD	0.0429	99% Percentile (z)	0.119
619	k star	0.283		
620	Theta star	0.139	**Gamma ROS Limits with Extrapolated Data**	
621	Nu star	59.92	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.16
622	95% Percentile of Chisquare (2k)	2.635	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.21
623			95% WH Approx. Gamma UTL with 99% Coverage	0.354
624	90% Percentile	0.117	95% HW Approx. Gamma UTL with 99% Coverage	0.575
625	95% Percentile	0.183		
626	99% Percentile	0.357		
627				
628	Note: DL/2 is not a recommended method.			
629				
630				
631	Molybdenum			
632				
633	**General Statistics**			
634	Number of Valid Data	106	Number of Detected Data	16
635	Number of Distinct Detected Data	16	Number of Non-Detect Data	90
636	Tolerance Factor	2.669	Percent Non-Detects	84.91%

Row	A–E	F	G–K	L
637				
638	**Raw Statistics**		**Log-transformed Statistics**	
639	Minimum Detected	0.0978	Minimum Detected	-2.325
640	Maximum Detected	0.625	Maximum Detected	-0.47
641	Mean of Detected	0.191	Mean of Detected	-1.8
642	SD of Detected	0.136	SD of Detected	0.492
643	Minimum Non-Detect	0.0777	Minimum Non-Detect	-2.555
644	Maximum Non-Detect	2.5	Maximum Non-Detect	0.916
645				
646	**Data with Multiple Detection Limits**		**Single Detection Limit Scenario**	
647	Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	106
648	For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	0
649	Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
650				
651	**Background Statistics**			
652	**Normal Distribution Test with Detected Values Only**		**Lognormal Distribution Test with Detected Values Only**	
653	Shapiro Wilk Test Statistic	0.629	Shapiro Wilk Test Statistic	0.816
654	5% Shapiro Wilk Critical Value	0.887	5% Shapiro Wilk Critical Value	0.887
655	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
656				
657	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
658	DL/2 Substitution Method		DL/2 Substitution Method	
659	Mean	0.873	Mean (Log Scale)	-0.704
660	SD	0.544	SD (Log Scale)	1.404
661	95% UTL 99% Coverage	2.324	95% UTL 99% Coverage	20.94
662	95% UPL (t)	1.779	95% UPL (t)	5.134
663	90% Percentile (z)	1.57	90% Percentile (z)	2.987
664	95% Percentile (z)	1.767	95% Percentile (z)	4.974
665	99% Percentile (z)	2.138	99% Percentile (z)	12.95
666				
667	Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
668			Mean in Original Scale	0.111
669			SD in Original Scale	0.109
670			Mean in Log Scale	-2.564
671			SD in Log Scale	0.867
672			95% UTL 99% Coverage	0.778
673			95% UPL (t)	0.327
674			90% Percentile (z)	0.234
675			95% Percentile (z)	0.32
676			99% Percentile (z)	0.578
677				
678	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
679	k star (bias corrected)	2.987	Data do not follow a Discernable Distribution (0.05)	
680	Theta Star	0.0639		
681	nu star	95.57		
682				
683	A-D Test Statistic	1.555	**Nonparametric Statistics**	
684	5% A-D Critical Value	0.743	Kaplan-Meier (KM) Method	
685	K-S Test Statistic	0.264	Mean	0.14
686	5% K-S Critical Value	0.216	SD	0.101
687	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.0176
688			95% KM UTL with 99% Coverage	0.409
689	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	0.581

Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.308
Mean	0.0863	90% Percentile (z)	0.269
Median	0.000001	95% Percentile (z)	0.306
SD	0.121	99% Percentile (z)	0.374
k star	0.136		
Theta star	0.635	**Gamma ROS Limits with Extrapolated Data**	
Nu star	28.79	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.384
95% Percentile of Chisquare (2k)	1.522	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.465
		95% WH Approx. Gamma UTL with 99% Coverage	1.026
90% Percentile	0.252	95% HW Approx. Gamma UTL with 99% Coverage	1.667
95% Percentile	0.483		
99% Percentile	1.17		

Note: DL/2 is not a recommended method.

Nickel

General Statistics

Number of Valid Data	106	Number of Detected Data	95
Number of Distinct Detected Data	84	Number of Non-Detect Data	11
Tolerance Factor	2.669	Percent Non-Detects	10.38%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	3	Minimum Detected	1.099
Maximum Detected	27.2	Maximum Detected	3.303
Mean of Detected	8.186	Mean of Detected	1.976
SD of Detected	4.689	SD of Detected	0.484
Minimum Non-Detect	2.5	Minimum Non-Detect	0.916
Maximum Non-Detect	2.5	Maximum Non-Detect	0.916

Background Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.194	Lilliefors Test Statistic	0.105
5% Lilliefors Critical Value	0.0909	5% Lilliefors Critical Value	0.0909
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	7.466	Mean (Log Scale)	1.794
SD	4.919	SD (Log Scale)	0.706
95% UTL 99% Coverage	20.6	95% UTL 99% Coverage	39.54
95% UPL (t)	15.67	95% UPL (t)	19.5
90% Percentile (z)	13.77	90% Percentile (z)	14.86
95% Percentile (z)	15.56	95% Percentile (z)	19.2
99% Percentile (z)	18.91	99% Percentile (z)	31.05
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	7.306	Mean in Original Scale	7.586
SD	5.173	SD in Original Scale	4.779
95% UTL with 99% Coverage	21.11	95% UTL with 99% Coverage	29.75
		95% BCA UTL with 99% Coverage	27.2

	A–E	F	G–K	L
743			95% Bootstrap (%) UTL with 99% Coverage	27.2
744	95% UPL (t)	15.93	95% UPL (t)	16.74
745	90% Percentile (z)	13.94	90% Percentile (z)	13.41
746	95% Percentile (z)	15.81	95% Percentile (z)	16.52
747	99% Percentile (z)	19.34	99% Percentile (z)	24.44
748				
749	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
750	k star (bias corrected)	3.991	Data do not follow a Discernable Distribution (0.05)	
751	Theta Star	2.051		
752	nu star	758.3		
753				
754	A-D Test Statistic	2.313	**Nonparametric Statistics**	
755	5% A-D Critical Value	0.756	Kaplan-Meier (KM) Method	
756	K-S Test Statistic	0.135	Mean	7.648
757	5% K-S Critical Value	0.0921	SD	4.69
758	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.458
759			95% KM UTL with 99% Coverage	20.17
760	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	28.19
761	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	15.47
762	Mean	7.336	90% Percentile (z)	13.66
763	Median	6.145	95% Percentile (z)	15.36
764	SD	5.097	99% Percentile (z)	18.56
765	k star	0.393		
766	Theta star	18.68	**Gamma ROS Limits with Extrapolated Data**	
767	Nu star	83.28	95% Wilson Hilferty (WH) Approx. Gamma UPL	23.91
768	95% Percentile of Chisquare (2k)	3.285	95% Hawkins Wixley (HW) Approx. Gamma UPL	31.7
769			95% WH Approx. Gamma UTL with 99% Coverage	45
770	90% Percentile	20.79	95% HW Approx. Gamma UTL with 99% Coverage	71.44
771	95% Percentile	30.67		
772	99% Percentile	55.58		
773				
774	**Note: DL/2 is not a recommended method.**			
775				
776				
777	**Selenium**			
778				
779	**General Statistics**			
780	Number of Valid Data	106	Number of Detected Data	1
781	Number of Distinct Detected Data	1	Number of Non-Detect Data	105
782				
783	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**			
784	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**			
785				
786	**The data set for variable Selenium was not processed!**			
787				
788				
789				
790	**Silver**			
791				
792	**General Statistics**			
793	Number of Valid Data	106	Number of Detected Data	9
794	Number of Distinct Detected Data	8	Number of Non-Detect Data	97
795	Tolerance Factor	2.669	Percent Non-Detects	91.51%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.132	Minimum Detected	-2.025
Maximum Detected	1.29	Maximum Detected	0.255
Mean of Detected	0.582	Mean of Detected	-0.88
SD of Detected	0.469	SD of Detected	0.898
Minimum Non-Detect	0.117	Minimum Non-Detect	-2.146
Maximum Non-Detect	2.5	Maximum Non-Detect	0.916
Data with Multiple Detection Limits		**Single Detection Limit Scenario**	
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect with Single DL	106
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected with Single DL	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%
Warning: There are only 9 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
Background Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.832	Shapiro Wilk Test Statistic	0.878
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.901	Mean (Log Scale)	-0.622
SD	0.533	SD (Log Scale)	1.329
95% UTL 99% Coverage	2.322	95% UTL 99% Coverage	18.65
95% UPL (t)	1.789	95% UPL (t)	4.927
90% Percentile (z)	1.584	90% Percentile (z)	2.951
95% Percentile (z)	1.777	95% Percentile (z)	4.782
99% Percentile (z)	2.14	99% Percentile (z)	11.83
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
		Mean in Original Scale	0.184
		SD in Original Scale	0.445
		Mean in Log Scale	-3.451
		SD in Log Scale	2.015
		95% UTL 99% Coverage	6.87
		95% UPL (t)	0.913
		90% Percentile (z)	0.42
		95% Percentile (z)	0.873
		99% Percentile (z)	3.445
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.159	Data appear Normal at 5% Significance Level	
Theta Star	0.502		
nu star	20.86		

	A–E	F	G–K	L
849	A-D Test Statistic	0.606	**Nonparametric Statistics**	
850	5% A-D Critical Value	0.733	Kaplan-Meier (KM) Method	
851	K-S Test Statistic	0.259	Mean	0.248
852	5% K-S Critical Value	0.284	SD	0.298
853	**Data appear Gamma Distributed at 5% Significance Level**		SE of Mean	0.0535
854			95% KM UTL with 99% Coverage	1.044
855	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	1.554
856	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.745
857	Mean	0.147	90% Percentile (z)	0.63
858	Median	0.000001	95% Percentile (z)	0.738
859	SD	0.335	99% Percentile (z)	0.942
860	k star	0.0956		
861	Theta star	1.541	**Gamma ROS Limits with Extrapolated Data**	
862	Nu star	20.26	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.481
863	95% Percentile of Chisquare (2k)	1.112	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.432
864			95% WH Approx. Gamma UTL with 99% Coverage	1.475
865	90% Percentile	0.384	95% HW Approx. Gamma UTL with 99% Coverage	1.851
866	95% Percentile	0.857		
867	99% Percentile	2.393		
868				
869	Note: DL/2 is not a recommended method.			
870				
871				
872	Thallium			
873				
874	**General Statistics**			
875	Number of Valid Data	106	Number of Detected Data	0
876	Number of Distinct Detected Data	0	Number of Non-Detect Data	106
877				
878	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**			
879	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**			
880	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**			
881				
882	**The data set for variable Thallium was not processed!**			
883				
884				
885				
886	Vanadium			
887				
888	**General Statistics**			
889	Total Number of Observations	106	Number of Distinct Observations	86
890	Tolerance Factor	2.669		
891				
892	**Raw Statistics**		**Log-Transformed Statistics**	
893	Minimum	6.2	Minimum	1.825
894	Maximum	47.1	Maximum	3.852
895	Second Largest	44	Second Largest	3.784
896	First Quartile	14.03	First Quartile	2.641
897	Median	16.65	Median	2.812
898	Third Quartile	22.58	Third Quartile	3.117
899	Mean	18.99	Mean	2.867
900	SD	7.863	SD	0.392
901	Coefficient of Variation	0.414		

Row	A–E	F	G–K	L
902	Skewness	1.276		
903				
904	**Background Statistics**			
905	**Normal Distribution Test**		**Lognormal Distribution Test**	
906	Lilliefors Test Statistic	0.129	Lilliefors Test Statistic	0.0615
907	Lilliefors Critical Value	0.0861	Lilliefors Critical Value	0.0861
908	**Data not Normal at 5% Significance Level**		**Data appear Lognormal at 5% Significance Level**	
909				
910	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
911	95% UTL with 99% Coverage	39.97	95% UTL with 99% Coverage	50.07
912	95% UPL (t)	32.1	95% UPL (t)	33.81
913	90% Percentile (z)	29.07	90% Percentile (z)	29.06
914	95% Percentile (z)	31.92	95% Percentile (z)	33.51
915	99% Percentile (z)	37.28	99% Percentile (z)	43.78
916				
917	**Gamma Distribution Test**		**Data Distribution Test**	
918	k star	6.467	**Data appear Gamma Distributed at 5% Significance Level**	
919	Theta Star	2.936		
920	MLE of Mean	18.99		
921	MLE of Standard Deviation	7.467		
922	nu star	1371		
923				
924	A-D Test Statistic	0.684	**Nonparametric Statistics**	
925	5% A-D Critical Value	0.754	90% Percentile	28.95
926	K-S Test Statistic	0.086	95% Percentile	35.55
927	5% K-S Critical Value	0.088	99% Percentile	43.82
928	**Data appear Gamma Distributed at 5% Significance Level**			
929				
930	**Assuming Gamma Distribution**		95% UTL with 99% Coverage	47.1
931	90% Percentile	28.96	95% Percentile Bootstrap UTL with 99% Coverage	47.1
932	95% Percentile	32.7	95% BCA Bootstrap UTL with 99% Coverage	47.1
933	99% Percentile	40.51	95% UPL	36.88
934			95% Chebyshev UPL	53.42
935	95% WH Approx. Gamma UPL	32.76	Upper Threshold Limit Based upon IQR	35.4
936	95% HW Approx. Gamma UPL	32.96		
937	95% WH Approx. Gamma UTL with 99% Coverage	44.61		
938	95% HW Approx. Gamma UTL with 99% Coverage	45.66		
939				
940				
941				
942	Zinc			
943				
944	**General Statistics**			
945	Total Number of Observations	105	Number of Distinct Observations	98
946	Tolerance Factor	2.671	Number of Missing Values	1
947				
948	**Raw Statistics**		**Log-Transformed Statistics**	
949	Minimum	9.7	Minimum	2.272
950	Maximum	291	Maximum	5.673
951	Second Largest	172	Second Largest	5.147
952	First Quartile	17.7	First Quartile	2.874
953	Median	29.8	Median	3.395
954	Third Quartile	46.4	Third Quartile	3.837

Row	A–E	F	G–K	L
955	Mean	42.07	Mean	3.455
956	SD	40.39	SD	0.704
957	Coefficient of Variation	0.96		
958	Skewness	3.14		
959				
960	**Background Statistics**			
961	**Normal Distribution Test**		**Lognormal Distribution Test**	
962	Lilliefors Test Statistic	0.224	Lilliefors Test Statistic	0.1
963	Lilliefors Critical Value	0.0865	Lilliefors Critical Value	0.0865
964	**Data not Normal at 5% Significance Level**		**Data not Lognormal at 5% Significance Level**	
965				
966	**Assuming Normal Distribution**		**Assuming Lognormal Distribution**	
967	95% UTL with 99% Coverage	149.9	95% UTL with 99% Coverage	207.6
968	95% UPL (t)	109.4	95% UPL (t)	102.5
969	90% Percentile (z)	93.83	90% Percentile (z)	78.07
970	95% Percentile (z)	108.5	95% Percentile (z)	100.8
971	99% Percentile (z)	136	99% Percentile (z)	162.9
972				
973	**Gamma Distribution Test**		**Data Distribution Test**	
974	k star	1.862	**Data do not follow a Discernable Distribution (0.05)**	
975	Theta Star	22.6		
976	MLE of Mean	42.07		
977	MLE of Standard Deviation	30.83		
978	nu star	390.9		
979				
980	A-D Test Statistic	3.522	**Nonparametric Statistics**	
981	5% A-D Critical Value	0.766	90% Percentile	92.1
982	K-S Test Statistic	0.124	95% Percentile	112.8
983	5% K-S Critical Value	0.0894	99% Percentile	171.2
984	**Data not Gamma Distributed at 5% Significance Level**			
985				
986	**Assuming Gamma Distribution**		95% UTL with 99% Coverage	291
987	90% Percentile	83.21	95% Percentile Bootstrap UTL with 99% Coverage	291
988	95% Percentile	102.1	95% BCA Bootstrap UTL with 99% Coverage	291
989	99% Percentile	144.1	95% UPL	117.5
990			95% Chebyshev UPL	219
991	95% WH Approx. Gamma UPL	100.7	Upper Threshold Limit Based upon IQR	89.45
992	95% HW Approx. Gamma UPL	100.6		
993	95% WH Approx. Gamma UTL with 99% Coverage	165.7		
994	95% HW Approx. Gamma UTL with 99% Coverage	172.2		
995				
996				

	A	B	C	D	E	F	G	H	I	J	K	L
1				General Background Statistics for Data Sets with Non-Detects								
2			User Selected Options									
3			From File	C:\Users\atesfamichael\Desktop\SB0484 KAST\Feb 2012 Analysis\July 2012 Reporting\PAH 0 to 5 wo outliers.w								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Coverage	99%								
7			Different or Future K Values	1								
8			Number of Bootstrap Operations	2000								
9												
10												
11	BaP-TEQ											
12												
13						General Statistics						
14					Number of Valid Data	35					Number of Detected Data	22
15					Number of Distinct Detected Data	22					Number of Non-Detect Data	13
16					Tolerance Factor	2.983					Percent Non-Detects	37.14%
17												
18				Raw Statistics					Log-transformed Statistics			
19					Minimum Detected	0.00106					Minimum Detected	-6.849
20					Maximum Detected	0.179					Maximum Detected	-1.718
21					Mean of Detected	0.0122					Mean of Detected	-5.696
22					SD of Detected	0.0376					SD of Detected	1.226
23					Minimum Non-Detect	0.00106					Minimum Non-Detect	-6.849
24					Maximum Non-Detect	0.00106					Maximum Non-Detect	-6.849
25												
26												
27						Background Statistics						
28				Normal Distribution Test with Detected Values Only					Lognormal Distribution Test with Detected Values Only			
29					Shapiro Wilk Test Statistic	0.303					Shapiro Wilk Test Statistic	0.823
30					5% Shapiro Wilk Critical Value	0.911					5% Shapiro Wilk Critical Value	0.911
31				Data not Normal at 5% Significance Level					Data not Lognormal at 5% Significance Level			
32												
33				Assuming Normal Distribution					Assuming Lognormal Distribution			
34					DL/2 Substitution Method						DL/2 Substitution Method	
35					Mean	0.00785					Mean (Log Scale)	-6.382
36					SD	0.0301					SD (Log Scale)	1.322
37					95% UTL 99% Coverage	0.0977					95% UTL 99% Coverage	0.0874
38					95% UPL (t)	0.0595					95% UPL (t)	0.0163
39					90% Percentile (z)	0.0464					90% Percentile (z)	0.00921
40					95% Percentile (z)	0.0574					95% Percentile (z)	0.0149
41					99% Percentile (z)	0.0779					99% Percentile (z)	0.0367
42												
43					Maximum Likelihood Estimate(MLE) Method						Log ROS Method	
44					Mean	-0.00432					Mean in Original Scale	0.00774
45					SD	0.0392					SD in Original Scale	0.0301
46					95% UTL with 99% Coverage	0.113					95% UTL with 99% Coverage	0.267
47											95% BCA UTL with 99% Coverage	0.179
48											95% Bootstrap (%) UTL with 99% Coverage	0.179
49					95% UPL (t)	0.0629					95% UPL (t)	0.0258
50					90% Percentile (z)	0.0459					90% Percentile (z)	0.0116
51					95% Percentile (z)	0.0601					95% Percentile (z)	0.0227
52					99% Percentile (z)	0.0868					99% Percentile (z)	0.0796

	A–E	F	G–K	L
53				
54	**Gamma Distribution Test with Detected Values Only**		**Data Distribution Test with Detected Values Only**	
55	k star (bias corrected)	0.457	Data do not follow a Discernable Distribution (0.05)	
56	Theta Star	0.0266		
57	nu star	20.11		
58				
59	A-D Test Statistic	3.184	**Nonparametric Statistics**	
60	5% A-D Critical Value	0.806	Kaplan-Meier (KM) Method	
61	K-S Test Statistic	0.307	Mean	0.00805
62	5% K-S Critical Value	0.196	SD	0.0296
63	**Data not Gamma Distributed at 5% Significance Level**		SE of Mean	0.00513
64			95% KM UTL with 99% Coverage	0.0965
65	**Assuming Gamma Distribution**		95% KM Chebyshev UPL	0.139
66	Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.0589
67	Mean	0.00765	90% Percentile (z)	0.046
68	Median	0.00127	95% Percentile (z)	0.0568
69	SD	0.0302	99% Percentile (z)	0.077
70	k star	0.195		
71	Theta star	0.0392	**Gamma ROS Limits with Extrapolated Data**	
72	Nu star	13.67	95% Wilson Hilferty (WH) Approx. Gamma UPL	0.0259
73	95% Percentile of Chisquare (2k)	2.025	95% Hawkins Wixley (HW) Approx. Gamma UPL	0.0269
74			95% WH Approx. Gamma UTL with 99% Coverage	0.0823
75	90% Percentile	0.0231	95% HW Approx. Gamma UTL with 99% Coverage	0.111
76	95% Percentile	0.0397		
77	99% Percentile	0.0854		
78				
79	**Note: DL/2 is not a recommended method.**			
80				

ATTACHMENT A3

Soil Leaching to Groundwater SSCG Derivation Spreadsheets

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: Benzene

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L): 1.0E-03

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	--	Value not used
Soil/Water Partition Coeff. (mL/g)	Kd	2.8E+01	Site-specific
Henry's Law Constant (-)	Kh	2.3E-01	USEPA RSL

Chemical-Specific Attenuation Factor	AF	180
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	33	33	1.3E-01
45	25	25	1.0E-01
40	18	18	7.3E-02
35	16	16	6.4E-02
30	14	14	5.6E-02
25	12	12	4.7E-02
24	11	11	4.5E-02
23	11	11	4.4E-02
22	10	10	4.2E-02
21	10	10	4.0E-02
20	10	10	3.9E-02
19	9	9	3.7E-02
18	9	9	3.5E-02
17	8	8	3.3E-02
16	8	8	3.2E-02
15	7	7	3.0E-02
14	7	7	2.8E-02
13	7	7	2.6E-02
12	6	6	2.5E-02
11	6	6	2.3E-02
10	5	5	2.1E-02
5	3	3	1.3E-02
0	1	1	4.1E-03

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: Naphthalene

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL CDPH NL (mg/L): 1.7E-02

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	--	Value not used
Soil/Water Partition Coeff. (mL/g)	Kd	1.1E+03	Site-specific
Henry's Law Constant (-)	Kh	1.8E-02	USEPA RSL

Chemical-Specific Attenuation Factor	AF	7,045
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1281	1281	8.8E+01
45	993	993	6.8E+01
40	705	705	4.9E+01
35	617	617	4.2E+01
30	529	529	3.6E+01
25	441	441	3.0E+01
24	423	423	2.9E+01
23	406	406	2.8E+01
22	388	388	2.7E+01
21	370	370	2.6E+01
20	353	353	2.4E+01
19	335	335	2.3E+01
18	318	318	2.2E+01
17	300	300	2.1E+01
16	282	282	1.9E+01
15	265	265	1.8E+01
14	247	247	1.7E+01
13	230	230	1.6E+01
12	212	212	1.5E+01
11	194	194	1.3E+01
10	177	177	1.2E+01
5	89	89	6.1E+00
0	1	1	8.1E-02

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: TPH as Diesel

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL ESL-nc (mg/L): 2.0E-01

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	--	Value not used
Soil/Water Partition Coeff. (mL/g)	Kd	4.1E+03	Site-specific
Henry's Law Constant (-)	Kh	1.7E-05	TPHCWG 1997

Chemical-Specific Attenuation Factor	AF	26,540
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	4825	4825	3.9E+03
45	3740	3740	3.0E+03
40	2654	2654	2.2E+03
35	2322	2322	1.9E+03
30	1991	1991	1.6E+03
25	1659	1659	1.3E+03
24	1593	1593	1.3E+03
23	1526	1526	1.2E+03
22	1460	1460	1.2E+03
21	1394	1394	1.1E+03
20	1327	1327	1.1E+03
19	1261	1261	1.0E+03
18	1195	1195	9.7E+02
17	1129	1129	9.1E+02
16	1062	1062	8.6E+02
15	996	996	8.1E+02
14	930	930	7.5E+02
13	863	863	7.0E+02
12	797	797	6.5E+02
11	731	731	5.9E+02
10	664	664	5.4E+02
5	333	333	2.7E+02
0	2	2	1.3E+00

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: TPH as Gasoline

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL ESL-nc (mg/L): 4.1E-01

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	--	Value not used
Soil/Water Partition Coeff. (mL/g)	Kd	3.7E+02	Site-specific
Henry's Law Constant (-)	Kh	1.7E-05	TPHCWG 1997

Chemical-Specific Attenuation Factor	AF	2,410
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATIO N FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	438	438	7.3E+02
45	340	340	5.6E+02
40	241	241	4.0E+02
35	211	211	3.5E+02
30	181	181	3.0E+02
25	151	151	2.5E+02
24	145	145	2.4E+02
23	139	139	2.3E+02
22	133	133	2.2E+02
21	127	127	2.1E+02
20	121	121	2.0E+02
19	115	115	1.9E+02
18	109	109	1.8E+02
17	103	103	1.7E+02
16	97	97	1.6E+02
15	91	91	1.5E+02
14	85	85	1.4E+02
13	79	79	1.3E+02
12	73	73	1.2E+02
11	67	67	1.1E+02
10	61	61	1.0E+02
5	31	31	5.2E+01
0	1	1	1.8E+00

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: TPH as Motor Oil

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL ESL-nc (mg/L): 6.2E+00

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	--	Value not used
Soil/Water Partition Coeff. (mL/g)	Kd	7.0E+03	Site-specific
Henry's Law Constant (-)	Kh	1.7E-05	TPHCWG 1997

Chemical-Specific Attenuation Factor	AF	44,831
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	8151	8151	2.0E+05
45	6317	6317	1.6E+05
40	4483	4483	1.1E+05
35	3923	3923	9.9E+04
30	3363	3363	8.4E+04
25	2802	2802	7.0E+04
24	2690	2690	6.8E+04
23	2578	2578	6.5E+04
22	2466	2466	6.2E+04
21	2354	2354	5.9E+04
20	2242	2242	5.6E+04
19	2130	2130	5.4E+04
18	2018	2018	5.1E+04
17	1906	1906	4.8E+04
16	1794	1794	4.5E+04
15	1682	1682	4.2E+04
14	1570	1570	3.9E+04
13	1458	1458	3.7E+04
12	1346	1346	3.4E+04
11	1234	1234	3.1E+04
10	1122	1122	2.8E+04
5	561	561	1.4E+04
0	2	2	5.3E+01

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: 1,2,3-Trichloropropane

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL CDPH NL (mg/L): 5.0E-06

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	1.2E+02	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	9.6E-01	Kd = Koc × foc
Henry's Law Constant (-)	Kh	1.4E-02	USEPA RSL

Chemical-Specific Attenuation Factor	AF	7
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1	1	2.6E-05
45	1	1	2.0E-05
40	1	1	2.0E-05
35	1	1	2.0E-05
30	1	1	2.0E-05
25	1	1	2.0E-05
24	1	1	2.0E-05
23	1	1	2.0E-05
22	1	1	2.0E-05
21	1	1	2.0E-05
20	1	1	2.0E-05
19	1	1	2.0E-05
18	1	1	2.0E-05
17	1	1	2.0E-05
16	1	1	2.0E-05
15	1	1	2.0E-05
14	1	1	2.0E-05
13	1	1	2.0E-05
12	1	1	2.0E-05
11	1	1	2.0E-05
10	1	1	2.0E-05
5	1	1	2.0E-05
0	1	1	2.0E-05

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: 1,2-Dichloroethane

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L): 5.0E-04

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	4.0E+01	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	3.3E-01	Kd = Koc × foc
Henry's Law Constant (-)	Kh	4.8E-02	USEPA RSL

Chemical-Specific Attenuation Factor	AF	3
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1	1	2.0E-03
45	1	1	2.0E-03
40	1	1	2.0E-03
35	1	1	2.0E-03
30	1	1	2.0E-03
25	1	1	2.0E-03
24	1	1	2.0E-03
23	1	1	2.0E-03
22	1	1	2.0E-03
21	1	1	2.0E-03
20	1	1	2.0E-03
19	1	1	2.0E-03
18	1	1	2.0E-03
17	1	1	2.0E-03
16	1	1	2.0E-03
15	1	1	2.0E-03
14	1	1	2.0E-03
13	1	1	2.0E-03
12	1	1	2.0E-03
11	1	1	2.0E-03
10	1	1	2.0E-03
5	1	1	2.0E-03
0	1	1	2.0E-03

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: 1,4-Dichlorobenzene

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L): 5.0E-03

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	3.8E+02	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	3.1E+00	Kd = Koc × foc
Henry's Law Constant (-)	Kh	9.9E-02	USEPA RSL

Chemical-Specific Attenuation Factor	AF	21
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATIO N FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	4	4	7.7E-02
45	3	3	6.0E-02
40	2	2	4.3E-02
35	2	2	4.0E-02
30	2	2	3.7E-02
25	2	2	3.4E-02
24	2	2	3.4E-02
23	2	2	3.3E-02
22	2	2	3.3E-02
21	2	2	3.2E-02
20	2	2	3.1E-02
19	2	2	3.1E-02
18	1	1	3.0E-02
17	1	1	3.0E-02
16	1	1	2.9E-02
15	1	1	2.9E-02
14	1	1	2.8E-02
13	1	1	2.8E-02
12	1	1	2.7E-02
11	1	1	2.6E-02
10	1	1	2.6E-02
5	1	1	2.3E-02
0	1	1	2.0E-02

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: cis-1,2-dichloroethylene

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L): 6.0E-03

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	4.0E+01	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	3.3E-01	Kd = Koc × foc
Henry's Law Constant (-)	Kh	1.7E-01	USEPA RSL

Chemical-Specific Attenuation Factor	AF	3
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1	1	2.4E-02
45	1	1	2.4E-02
40	1	1	2.4E-02
35	1	1	2.4E-02
30	1	1	2.4E-02
25	1	1	2.4E-02
24	1	1	2.4E-02
23	1	1	2.4E-02
22	1	1	2.4E-02
21	1	1	2.4E-02
20	1	1	2.4E-02
19	1	1	2.4E-02
18	1	1	2.4E-02
17	1	1	2.4E-02
16	1	1	2.4E-02
15	1	1	2.4E-02
14	1	1	2.4E-02
13	1	1	2.4E-02
12	1	1	2.4E-02
11	1	1	2.4E-02
10	1	1	2.4E-02
5	1	1	2.4E-02
0	1	1	2.4E-02

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: tert-butyl alcohol

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL CDPH NL (mg/L): 1.2E-02

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	3.7E+01	Toxnet, NIH
Soil/Water Partition Coeff. (mL/g)	Kd	3.5E-02	Kd = Koc × foc
Henry's Law Constant (-)	Kh	3.7E-04	SRC PhysProp Database

Chemical-Specific Attenuation Factor	AF	1
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1	1	4.9E-02
45	1	1	4.9E-02
40	1	1	4.9E-02
35	1	1	4.9E-02
30	1	1	4.9E-02
25	1	1	4.9E-02
24	1	1	4.9E-02
23	1	1	4.9E-02
22	1	1	4.9E-02
21	1	1	4.9E-02
20	1	1	4.9E-02
19	1	1	4.9E-02
18	1	1	4.9E-02
17	1	1	4.9E-02
16	1	1	4.9E-02
15	1	1	4.9E-02
14	1	1	4.9E-02
13	1	1	4.9E-02
12	1	1	4.9E-02
11	1	1	4.9E-02
10	1	1	4.9E-02
5	1	1	4.9E-02
0	1	1	4.9E-02

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: Tetrachloroethene

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L): 5.0E-03

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	1.6E+02	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	1.3E+00	Kd = Koc × foc
Henry's Law Constant (-)	Kh	7.5E-01	USEPA RSL

Chemical-Specific Attenuation Factor	AF	10
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	2	2	3.6E-02
45	1	1	2.8E-02
40	1	1	2.0E-02
35	1	1	2.0E-02
30	1	1	2.0E-02
25	1	1	2.0E-02
24	1	1	2.0E-02
23	1	1	2.0E-02
22	1	1	2.0E-02
21	1	1	2.0E-02
20	1	1	2.0E-02
19	1	1	2.0E-02
18	1	1	2.0E-02
17	1	1	2.0E-02
16	1	1	2.0E-02
15	1	1	2.0E-02
14	1	1	2.0E-02
13	1	1	2.0E-02
12	1	1	2.0E-02
11	1	1	2.0E-02
10	1	1	2.0E-02
5	1	1	2.0E-02
0	1	1	2.0E-02

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: Trichloroethene

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L):	5.0E-03

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	6.1E+01	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	5.0E-01	Kd = Koc × foc
Henry's Law Constant (-)	Kh	4.0E-01	USEPA RSL

Chemical-Specific Attenuation Factor	AF	5
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATIO N FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1	1	2.0E-02
45	1	1	2.0E-02
40	1	1	2.0E-02
35	1	1	2.0E-02
30	1	1	2.0E-02
25	1	1	2.0E-02
24	1	1	2.0E-02
23	1	1	2.0E-02
22	1	1	2.0E-02
21	1	1	2.0E-02
20	1	1	2.0E-02
19	1	1	2.0E-02
18	1	1	2.0E-02
17	1	1	2.0E-02
16	1	1	2.0E-02
15	1	1	2.0E-02
14	1	1	2.0E-02
13	1	1	2.0E-02
12	1	1	2.0E-02
11	1	1	2.0E-02
10	1	1	2.0E-02
5	1	1	2.0E-02
0	1	1	2.0E-02

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3
Determining Soil Cleanup Levels, LARWQCB Approach
Former Kast Property
Carson, CA

Compound: Vinyl Chloride

Soil lithology:

	% gravel	% sand	% silt	% clay	TOTAL
LITHOLOGY:		100%			100%

CHEMICAL MCL (mg/L): 5.0E-04

AF Calculation

			Source
Soil density (g/cm^3)	ρb	1.54	Site-specific
porosity (-)	n	0.421	Site-specific
water content (-)	qw	0.239	Site-specific
fract. Org. carbon (-)	foc	0.83%	Site-specific
Org. carbon/water Partition Coeff. (mL/g)	Koc	2.2E+01	USEPA RSL
Soil/Water Partition Coeff. (mL/g)	Kd	1.8E-01	Kd = Koc × foc
Henry's Law Constant (-)	Kh	1.1E+00	USEPA RSL

Chemical-Specific Attenuation Factor	AF	3
Dilution Attenuation Factor	DAF	6

Result Table

DEPTH (D) (ft) above GW	DEPTH FACTOR (AFd)	TOTAL ATTENUATION FACTOR (AFt)	SOIL CLEAN UP LEVEL (mg/kg)
50	1	1	2.0E-03
45	1	1	2.0E-03
40	1	1	2.0E-03
35	1	1	2.0E-03
30	1	1	2.0E-03
25	1	1	2.0E-03
24	1	1	2.0E-03
23	1	1	2.0E-03
22	1	1	2.0E-03
21	1	1	2.0E-03
20	1	1	2.0E-03
19	1	1	2.0E-03
18	1	1	2.0E-03
17	1	1	2.0E-03
16	1	1	2.0E-03
15	1	1	2.0E-03
14	1	1	2.0E-03
13	1	1	2.0E-03
12	1	1	2.0E-03
11	1	1	2.0E-03
10	1	1	2.0E-03
5	1	1	2.0E-03
0	1	1	2.0E-03

Notes:
AF = 1 + (rb/qw)*foc*Koc +(n-qw)*KH/qw
D = Depth of Contaminant above the groundwater level
AFd = D(0.1*AF - 1)/40 + 1 - Eqn. 7. For depths less than or equal to 40 feet.
AFd = (0.9(D-40)/110+0.1)AF - Eqn. 6. For depths 40<D<150 feet.
AFt = (AFd/D)*(TGR/20+TSA/10+TSI/5+TCL) - Eqn. 12
Soil Cleanup Level = C = Af_t x MCL - Eqn. 13

Attachment A3

Determining Soil Cleanup Levels, USEPA RSL Approach

Former Kast Property

Carson, CA

Compound	C_w (µg/L)	DAF	Kd (L/kg)	θw (-)	θa (-)	K_H (-)	ρb (kg/L)	Site Cleanup Goals (mg/kg)
Antimony	6	6.2	45	0.239	0.182	1.7E-05	1.54	1.7
Arsenic	10	6.2	29	0.239	0.182	1.7E-05	1.54	1.8
Thallium	2	6.2	71	0.239	0.182	1.7E-05	1.54	0.9

Note:

$$C_{cleanup} = C_W \times \mathrm{DAF} \times \left[Kd + \frac{\theta_W + \theta_a K_H}{\rho_b} \right]$$

Cw	Groundwater quality criterion
DAF	Dilution Attenuation Factor
Kd	Soil/Water partitioning coefficient
θw	Water content
θa	Air content
H'	Dimensionless Henry's Law Constant
ρb	Soil bulk density