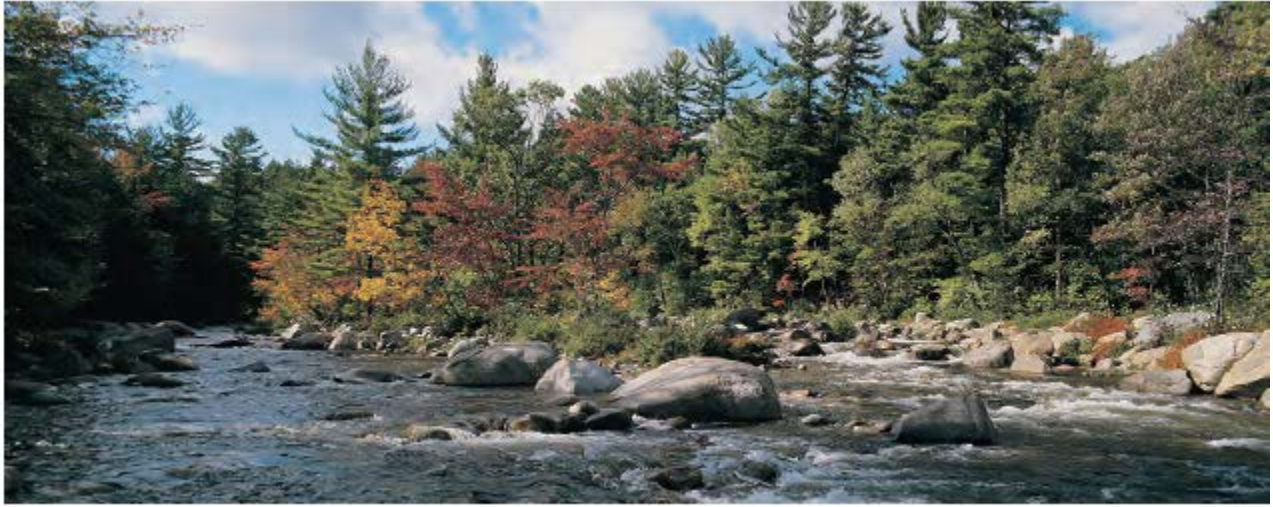




Appendix G to the Remedial Investigation Report

Human Health Risk Assessment

Former GM Corporation Wilmington Assembly Plant
Wilmington, Delaware

Prepared for: RACER Trust

Conestoga-Rovers & Associates

2055 Niagara Falls Boulevard, Suite 3
Niagara Falls, New York 14304

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Human Health Risk Assessment

Former GM Wilmington Assembly Plant
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Disclaimer – Please note, Conestoga-Rovers & Associates (CRA) changed its name to GHD Services Inc. on July 1, 2015. This document was originally submitted under the CRA name prior to this date. However, in the interest of continuity, the CRA name will remain on this document after July 1, 2015.

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List of Acronyms

AOI	Area of Interest
Bgs	Below Ground Surface
CDI	Chronic Daily Intake
COPC	Contaminant of Potential Concern
CRA	Conestoga-Rovers and Associates
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DNREC	Delaware Department of Natural Resources and Environmental Control
DRO	Diesel Range Organics
ED	Exposure Duration
EF	Exposure Frequency
EPC	Exposure Point Concentration
ESA	Environmental Site Assessment
FT	Fraction Time
HI	Hazard Index
HQ	Hazard Quotient
NFA	No Further Action
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEF	Particulate Emission Factor
RACER	Revitalizing Auto Communities Environmental Response
RAIS	Risk Assessment Information System
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
SIRS	Site Investigation and Restoration Section
TPH	Total Petroleum Hydrocarbons
UCLM	Upper Confidence Limit of the Mean
URF	Unit Risk Factor
USEPA	United States Environmental Protection Agency
VF	Volatilization Factor
XRF	X-Ray Fluorescence

Section 1.0 Introduction

Conestoga-Rovers & Associates (CRA), on behalf of RACER Trust (RACER), has prepared this Human Health Risk Assessment (HHRA) for the former General Motors Corporation (GM) Wilmington Assembly Plant located in Wilmington, Delaware [United States Environmental Protection Agency (U.S. EPA) ID DED 002369205] (Facility or Site) to support Remedial Investigation (RI) activities.

The purpose of this HHRA is as follows:

- Determine whether releases of chemicals to environmental media pose unacceptable risks to human health under specific exposure conditions
- Provide information to support risk management decisions concerning the need for further evaluation of remedial action based upon current and reasonably anticipated future land use

The HHRA has been conducted in accordance with the methodology presented in the DNREC-approved *Proposed Risk Assessment Approach for Remedial Investigation (RI) – Revised* (dated October 1, 2014) (HHRA Work Plan), which included the following four steps:

- 1) Identification of Exposure Areas (Section 2)
- 2) Identification of Contaminants of Potential Concern (COPCs) (Section 3)
- 3) Development of the Human Health Conceptual Site Model (CSM) (Section 4)
- 4) Calculation of Human Health Risks and Hazards (Section 5)

These HHRA steps are presented in the following sections.

Section 2.0 Identification of Exposure Areas

During CRA's 2010 Phase I Environmental Site Assessment (ESA), a total of 26 Areas of Interest (AOIs) were identified at the Site. No further assessment was required for eight of these AOIs (AOIs 2, 3, 8, 11, 15, 22, 24, 25). To further investigate the remaining AOIs, CRA prepared Work Plan (August 2011), Addendum to the RI Work Plan (September 2011), and Supplemental RI Work Plan (July 2012), which were approved by DNREC.

All RI work was conducted between 2011 and 2013, and included (but not limited to) the advancement of soil borings, installation of monitoring wells, collection of soil and groundwater samples, collection of vertical aquifer sample (VAS) groundwater samples, collection of sediment samples, collection of surface water samples, installation of temporary soil gas probes, and collection of soil gas samples. The reader is referred to previous sections of the RI Report for the site for detailed information regarding the RI activities that were conducted at the Site.

The Site has been divided into several exposure areas, termed Operable Units (OUs) (OU-1 to OU-6), as shown on Figure 1.

In 2004, DNREC issued a No Further Action (NFA) for OU-1 and therefore, further evaluation of OU-1 in the HHRA was not required. Investigation activities in the OU-2 Area resulted in approval of the document entitled "Report of Findings for OU-2 Bulk Product Area Tanks Soil Investigation", which requested written concurrence from DNREC that NFA is appropriate with regards to the soil in the OU-2 Area (CRA, 2006a). Based on subsequent discussions with DNREC SIRB, a NFA letter for the OU-2 Area soil will be issued once groundwater conditions within the OU-2 Area are addressed. For the purposes of the HHRA and at the recommendation provided by DNREC in response to the HHRA Work Plan, CRA evaluated the combined groundwater data from the entire Site (Site-Wide Groundwater), as indicated below. Therefore, further evaluation of OU-2 in the HHRA was not required.

The soil analytical data that was collected during the RI was separated by OU, as presented in the table below. The surface soil data set consists of all soils collected at depths less than or equal to 2 feet below ground surface (bgs). Subsurface soil consists of all soils collected at depths from greater than 2 feet bgs to 10 feet bgs, given that human exposure to soils below a depth of 10 feet bgs is not expected. Exposure to soil was assumed to occur either through surface soil or through combined surface and subsurface soil, as described further in Section 4. The soil data collected at the Site included samples analyzed by an accredited laboratory and samples analyzed using X-Ray Fluorescence (XRF). XRF data is typically used as a screening tool for the purposes of identifying locations requiring further assessment; and therefore, this data is in many cases unsuitable for HHRA. This is further supported by the fact that for many samples, there were large discrepancies in the results between the laboratory and XRF for the same soil samples. For the purposes of this HHRA, the results from the samples analyzed by both the laboratory and XRF were used for the identification of COPCs. However, only laboratory analyzed data were used in determining the exposure point concentration (EPCs) for calculating intake/dose and human health risks.

<i>OU</i>	<i>Description</i>	<i>AOI Included</i>
OU-3	Main Assembly Plant Area (excluding OU-1 and OU-2)	AOI-1, 4, 5, 6, 7, 9, 10, 13, 14, 19, 20, 21, and Parking Lot Area, USTs D, F, G, and H
OU-4	Former Petroleum Dispensing and UST Area	AOI-16 17, USTs D, F, G, and H
OU-5	Former Test Track Area	AOI-12 and 23
OU-6	Little Mill Creek/Wooded Area	AOI-26 and Outfall 001

The groundwater analytical data were not separated by OU, as described above for soil. Rather, the combined groundwater data from the entire Site (Site-Wide Groundwater) was evaluated in the HHRA, as recommended by DNREC during the development of the HHRA Work Plan. During the RI activities,

groundwater data were also collected from privately owned commercial and residential properties east of the Site (OU-16 off-Site). Therefore, off-Site groundwater has also been evaluated in the HHRA. It should be noted that total and dissolved groundwater metal data were screened separately to ensure that all metal COPCs were carried forward in the HHRA. However, all potential exposures were evaluated using only total metal groundwater concentrations, with the exception of selenium because the maximum detected concentration for selenium was based on a dissolved concentration.

Sediment and surface water analytical data were only collected from OU-6 (Little Mill Creek/Wooded Area), which consisted of AOI-26 and the Outfall 001 Swale.

The following table summarizes the OUs and media evaluated in the HHRA:

<i>OU</i>	<i>Media Evaluated</i>
OU-3	Surface Soil; Surface and Subsurface Soil
OU-4	Surface Soil; Surface and Subsurface Soil
OU-5	Surface Soil; Surface and Subsurface Soil
OU-6	Surface Soil; Sediment; Surface Water; Soil
Site-Wide	Groundwater
Off-Site	Groundwater

Section 3.0 Identification of Contaminants of Potential Concern

This section presents the screening process for establishing the COPCs by medium for the various exposure areas. COPCs are chemicals that are related to the Site and pose the greatest potential public health risk. In general, detected chemicals are identified as COPCs based on their concentrations and known toxicity characteristics.

For each chemical reported in each medium associated with the OUs, comparisons were made to the Screening Criteria presented in Appendix A: Screening Level Table, Delaware Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substances, Site Investigation and Restoration Section (SIRS), Updated October 2014 (DNREC, 2014). The Screening Criteria are chemical concentrations that correspond to fixed levels of risk [i.e., either a one-in-one million (10^{-6}) cancer risk or a non-carcinogenic hazard index (HI) of 0.1]. Only detected chemicals were carried through the COPC screening. All chemicals with a maximum detected concentration greater than the Screening Criteria and which had a level of detection frequency (LDF) greater than 5 percent (%), or those chemicals which did not have a Screening Criterion, were identified as COPCs consistent to USEPA Guidance (USEPA, 1989). All essential nutrients (e.g., calcium, magnesium, and potassium) and parameters reported at maximum detected concentrations below the Screening Criteria were not identified as COPCs, and therefore, not given further evaluation.

For soil, the identification of COPCs was conducted separately for surface soil (0 to 2 feet bgs) and subsurface soil (2 to 10 feet bgs).

All HHRA tables are presented by OU in the following appendices:

<i>OU</i>	<i>Appendix Reference</i>
OU-3	Appendix A
OU-4	Appendix B
OU-5	Appendix C
OU-6	Appendix D
Site-Wide Groundwater	Appendix E
Off-Site Groundwater	Appendix F

A summary of the COPC identified for each medium in each OU is presented in the sections below.

3.1 OU-3

Surface Soil (0 to 2 feet bgs)

As presented in Table A.1 of Appendix A, benzo(a)pyrene, antimony, arsenic, cobalt, lead, manganese, mercury, and nickel were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

Subsurface Soil (2 to 10 feet bgs)

As presented in Table A.2 of Appendix A, antimony, arsenic, cobalt, and manganese were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

3.2 OU-4

Surface Soil (0 to 2 feet bgs)

As presented in Table B.1 of Appendix B, cobalt and manganese were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

Subsurface Soil (2 to 10 feet bgs)

As presented in Table B.2 of Appendix B, 2-methylnaphthalene was detected at a maximum concentration greater than the screening criterion, and therefore was identified as a COPC.

3.3 OU-5

Surface Soil (0 to 2 feet bgs)

As presented in Table C.1 of Appendix C, 1,4-dichlorobenzene, ethylbenzene, xylenes (total), 2-methylnaphthalene, benzo(a)pyrene, naphthalene, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs. Thallium was only detected in the soil samples analyzed using XRF. Since only laboratory analyzed data were used for calculating human health risks and thallium was not detected in the laboratory analyzed data, thallium was not carried through the HHRA as a COPC for OU-5 surface soil.

Subsurface Soil (2 to 10 feet bgs)

As presented in Table C.2 of Appendix C, antimony, arsenic, barium, cadmium, cobalt, copper, iron, lead, manganese, mercury, and vanadium were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

3.4 OU-6

Surface Soil (0 to 2 feet bgs)

As presented in Table D.1 of Appendix D, benzo(a)pyrene, antimony, and lead were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

Sediment

As presented in Table D.2 of Appendix D, 2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, antimony, copper, lead, zinc, and total petroleum hydrocarbon C10-C28 diesel range organics (total petroleum hydrocarbons (TPH) [C10-C28] diesel range organics (DRO)) were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

Surface Water

As presented in Table D.3 of Appendix D, manganese was detected at a maximum concentration greater than the screening criterion, and therefore was identified as a COPC.

3.5 Site-Wide

Groundwater

As presented in Table E.1 of Appendix E, 1,1-dichloroethane, 1,2,4-trimethylbenzene, 1,2-dichloroethane, 1,4-dichlorobenzene, 2-hexanone, benzene, carbon tetrachloride, chloroform, cis-1,2-dichloroethene, ethylbenzene, isopropyl benzene, tetrachloroethene, toluene, trichloroethene, xylenes (total), 2-methylnaphthalene, biphenyl, dibenzofuran, naphthalene, aluminum, arsenic, barium, cobalt, iron, lead, manganese, selenium, vanadium, and aroclor-1260 (PCB-1260) were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

3.6 Off-Site

Groundwater

As presented in Table F.1 of Appendix F, 1,2,4-trimethylbenzene, benzene, chloroform, ethylbenzene, isopropyl benzene, methyl tert butyl ether, toluene, xylenes (total), 2-methylnaphthalene, and naphthalene were detected at maximum concentrations greater than the screening criteria, and therefore were identified as COPCs.

Section 4.0 Development of the Human Health Conceptual Site Model

In order to evaluate the significance of the impacted media at the Site, the potential pathways by which individuals may come in contact with these media must be determined. The combination of factors (chemical source, media of concern, release mechanisms, and potential receptors) that could produce a complete exposure pathway and lead to human uptake of chemicals at the Site is assessed in what is defined as the CSM.

The Site was evaluated under both residential and industrial land use scenarios. The residential exposure scenario assumes unrestricted human use, where frequent exposures may occur to both children and adult residents. If the Site was to meet acceptable risks and hazards under residential exposure assumptions, the Site would have no requirements in terms of activity or access restrictions. The industrial/commercial exposure scenario assumes exposures based on adult workers, including occupational receptors, trespassers, and construction/utility workers, but prohibits residential development or use. The CSM is presented on Figure 2.

4.1 Identification of Potentially Exposed Populations

The human receptors on Site that require quantitative evaluation in the HHRA include:

- Resident (child and adult)

- Trespasser (adolescent)
- Indoor Worker (adult)
- Outdoor Worker (adult)
- Utility Worker (adult)
- Construction Worker (adult)
- Off-Site Resident (child and adult)

The potential exposure pathways for the receptors are described further below.

Resident (On-Site)

The resident would be an infant/toddler (0-2 years), child (2-6 years), adolescent (6-16 years), and adult (16-30 years) that would be living at the Site. It is expected that the resident would be exposed to indoor air that may be impacted by volatile COPCs present in soil (surface and subsurface) and groundwater while indoors. During outdoor activities, dermal contact (through exposed skin on the head, hands, and forearms), incidental ingestion, and inhalation of air particulates and volatiles could occur as contact is made with surface soil. It is also assumed in the HHRA that the resident would be exposed to groundwater through tap water (household use) via ingestion and dermal contact and through ambient air via inhalation of volatiles.

Resident (Off-Site)

The resident would be an infant/toddler (0-2 years), child (2-6 years), adolescent (6-16 years), and adult (16-30 years) that is living in the off-Site adjacent residential properties. It is expected that the resident would be exposed to off-Site groundwater through tap water (household use) via ingestion and dermal contact and through ambient air via inhalation of volatiles. Off-Site vapor intrusion concerns are being addressed separately from the RI, and therefore not evaluated in this HHRA.

Trespasser

The trespasser receptor would be an adolescent aged 6 to 16 years, who would gain access to the Site via trespassing. As the exposure frequency for an adolescent trespasser would be equal to or greater than an adult trespasser, only the adolescent trespasser, the more sensitive receptor, is evaluated within the HHRA. The potential exposure pathways for trespassers are dermal contact (through exposed skin), incidental ingestion, and inhalation of air volatiles and/or particulates as contact is made with surface soil. In addition, the trespasser is also assumed to be exposed to OU-6 sediment through dermal contact and OU-6 surface water through incidental ingestion and dermal contact.

Indoor Worker

The indoor worker would be an adult working indoors within Site buildings. It is expected that the indoor worker would be exposed to indoor air that may be impacted by volatile COPCs present in soil (surface and subsurface) and groundwater while working indoors.

Outdoor Worker

The outdoor worker would be an adult working outdoors at the Site. During the outdoor activities, dermal contact (through exposed skin on the head, hands, and forearms), incidental ingestion, and inhalation of air particulates and volatiles could occur as contact is made with surface soil.

Utility Worker

Outdoor utility worker activities may occur during future development of the Site for industrial/commercial/residential purposes and during utility maintenance post development. Thus, a utility worker direct contact exposure to soil (surface and subsurface) and groundwater (through ingestion, dermal contact, and inhalation to particulates (soil only) and volatiles) was evaluated in the HHRA. Utility workers activities were assumed to involve ground intrusive activities, such as excavations or trenching for installing utilities during building construction or emergency utility repairs. The utility worker receptor is considered to be an adult repetitive short-term worker that may be present at the Site for short periods of time over a long duration of exposure.

Construction Worker

Outdoor construction worker activities may occur during future development of the Site for industrial/commercial/residential purposes. Thus, a construction worker direct contact exposure to soil and groundwater (through ingestion, dermal contact, and inhalation to particulates (soil only) and volatiles) was evaluated in the HHRA. Construction worker activities were assumed to involve ground intrusive activities, such as excavations or trenching for installing foundations. The construction worker receptor is considered to be an adult that may be present at the Site within a limited period (1 year) during the construction activities.

4.2 Summary of Complete Exposure Pathways

The following media and potential human exposures (i.e., complete pathways) have been identified for quantitative evaluation in the HHRA:

(1) Surface Soil (OU-3, OU-4, OU-5, OU-6):

- Dermal contact with surface soil by residents, trespassers, and outdoor workers

- Incidental ingestion of surface soil by residents, trespassers, and outdoor workers
 - Inhalation of airborne particulates and volatiles from surface soil by residents, trespassers, and outdoor workers
- (2) Surface and Subsurface Soil (OU-3, OU-4, OU-5, OU-6¹):
- Dermal contact with surface and subsurface soil by utility workers and construction workers
 - Incidental ingestion of surface soil and subsurface soil by utility workers and construction workers
 - Inhalation of airborne particulates and volatiles from surface and subsurface soil by utility workers and construction workers
 - Inhalation of airborne vapors in indoor air originating from surface and subsurface soil by residents and indoor workers
- (3) Sediment (OU-6):
- Dermal contact with sediment by trespasser
- (4) Surface Water (OU-6):
- Dermal contact with surface water by trespassers
 - Ingestion of surface water by trespassers
- (5) Site-Wide Groundwater:
- Dermal contact with groundwater by utility workers and construction workers during ground intrusive activities and by residents as tap water during household use
 - Ingestion of groundwater by utility workers and construction workers during ground intrusive activities and by residents as tap water during household use
 - Inhalation of airborne vapors within a trench/excavation originating from groundwater by utility workers and construction workers during ground intrusive activities and by residents as tap water during household use
 - Inhalation of airborne vapors in indoor air originating from groundwater by residents and indoor workers
- (6) Off-Site Groundwater:
- Dermal contact with groundwater by residents as tap water during household use
 - Ingestion of groundwater by residents as tap water during household use
 - Inhalation of airborne vapors in ambient air originating from groundwater by residents as tap water during household use

¹ Only surface soil data was collected at OU-6, and therefore, exposure to surface soil only was assumed for utility workers and construction workers for this OU.

Residents, trespassers, outdoor workers, utility workers, and construction workers could also be exposed to volatile vapors emitted from groundwater as it migrates through the undisturbed ground surface to the atmosphere and is inhaled. However, it is expected that vapors emitted to the atmosphere from groundwater are expected to be negligible following migration through the unsaturated zone, and through dispersion and dilution into ambient air. Therefore, groundwater vapor inhalation at the ground surface was not quantitatively evaluated in the HHRA.

Section 5.0 Calculation of Human Health Risks and Hazards

The human health risks and hazards were calculated using the Risk Assessment Information System (RAIS) Calculator, to the extent possible. The RAIS Calculator combines the quantification of exposure (Section 5.1) and chemical toxicity (Section 5.2) into a calculation of cancer risks and non-cancer hazards (Section 5.3). For scenarios where RAIS could not be used to calculate the human health risks and hazards, the methodology and assumptions used are outlined for the exposure scenarios below. As indicated in Section 3.0, all HHRA tables are presented by OU in the following appendices:

<i>OU</i>	<i>Appendix Reference</i>
OU-3	Appendix A
OU-4	Appendix B
OU-5	Appendix C
OU-6	Appendix D
Site-Wide	Appendix E
Off-Site	Appendix F

A list of the specific tables included in each appendix is provided at the front of the associated appendix.

5.1 Quantification of Exposure

Estimation of the human intake received through the various exposure pathways is based upon Chronic Daily Intakes (CDIs) expressed in terms of the mass of substance taken into the body per unit body weight per unit time (mg/kg-day). For each COPC, two different estimates of the CDI, one for non-carcinogenic (systemic) effects and a second for carcinogens are calculated. The CDI generally used in the assessment of non-carcinogenic effects is the average daily dose or exposure concentration an individual is likely to receive during the period of exposure. For carcinogens, the CDI is estimated by averaging the total cumulative intake over a lifetime.

The CDI for each COPC and exposure pathway was calculated by the RAIS Calculator, with the following Site-specific inputs:

- In the RAIS Calculator, media COPC concentrations are required for calculating the CDI. The media COPC concentrations were based on the 95% upper confidence limit of the mean (95% UCLM), which is calculated using USEPA's ProUCL software Version 5.0 (USEPA, 2013) (ProUCL). ProUCL contains statistical methods to address data sets both with and without non-detects and computes the 95% UCLM for a given data set by a variety of alternative statistical approaches (including several approaches that do not require the assumption of normality or log-normality). ProUCL then recommends specific 95% UCLM values as being the most appropriate for that particular data set. In cases where more than one 95% UCLM was calculated by ProUCL, the greater of the values was applied as the media concentration. For data sets containing less than four distinct detected values, ProUCL could not calculate a 95% UCLM and therefore the maximum detected concentration was used as the media COPC concentrations. For OU-4 soil, there were insufficient soil samples (laboratory analyzed) to calculate a 95% UCLM, and therefore, the maximum detected concentrations were applied as the media COPC concentrations. The ProUCL outputs for the COPCs in each media and OU are presented in the tables of Appendix G and the media COPC EPCs applied in the RAIS Calculator are summarized in the following tables:

<i>OU</i>	<i>Table Reference</i>
OU-3; Surface Soil	Table A.3 of Appendix A
OU-3; Surface and Subsurface Soil	Table A.4 of Appendix A
OU-4; Surface Soil	Table B.3 of Appendix B
OU-4; Surface and Subsurface Soil	Table B.4 of Appendix B
OU-5; Surface Soil	Table C.3 of Appendix C
OU-5; Surface and Subsurface Soil	Table C.4 of Appendix C
OU-6; Surface Soil	Table D.4 of Appendix D
OU-6; Sediment	Table D.5 of Appendix D
OU-6; Surface Water	Table D.6 of Appendix D
Site-Wide Groundwater	Table E.2 of Appendix E
Off-Site Groundwater	Table F.2 of Appendix F

- In calculating the CDI for inhalation exposure to soil, a particulate emission factor (PEF) is used for calculating exposure from inhalation of airborne particulates and a volatilization factor (VF) is used for calculating exposure from inhalation of airborne volatiles in the RAIS Calculator. The PEF and VF are calculated using default climate data or the user can select climate data for specific cities within the United States. The closest city to the Site for which the RAIS Calculator provides climate data is Philadelphia, Pennsylvania. Therefore, climate data for Philadelphia was selected in the RAIS Calculator.

- In the RAIS Calculator, indoor air COPC concentrations are required for calculating inhalation exposure to indoor air (from soil and groundwater) for residents and indoor workers. These indoor air COPC concentrations were calculated using soil (surface and subsurface) and groundwater COPC concentrations (media concentrations or 95% UCLM values as presented above) entered into USEPA's Microsoft Excel spreadsheets (soil - "SL-ADV-Feb04.xls, Version 3.1"; groundwater – GW-ADV-Feb04.xls Version 3.1") of the Johnson and Ettinger (1991) model (J&E Model), consistent with the methodology presented in Appendix H. The indoor air pathway was only evaluated for those COPCs identified as volatile in the RAIS Calculator. Since there were no volatile COPCs identified for OU-6 surface soil, the indoor air pathway was considered to be incomplete for OU-6. The J&E Model outputs that summarize the indoor air concentrations that were applied in the RAIS Calculator for each COPC are summarized in the following Appendix H tables:

<i>OU</i>	<i>Appendix H Table Reference</i>
OU-3 Soil (Surface and Subsurface) – Residential	Table H.1
OU-3 Soil (Surface and Subsurface) – Industrial/Commercial	Table H.2
OU-4 Soil (Surface and Subsurface) – Residential	Table H.3
OU-4 Soil (Surface and Subsurface) – Industrial/Commercial	Table H.4
OU-5 Soil (Surface and Subsurface) – Residential	Table H.5
OU-5 Soil (Surface and Subsurface) – Industrial/Commercial	Table H.6
Site-Wide Groundwater – Residential	Table H.7
Site-Wide Groundwater – Industrial/Commercial	Table H.8

There were some exposure pathways identified in Section 4.0 that are not included in the RAIS Calculator. These exposure pathways are identified below along with the tables that summarize the exposure assumptions and equations that were applied in the estimation of the CDI for each exposure pathway.

- Trespasser exposure to soil

Trespassers are not included as receptors in the RAIS Calculator. The exposure assumptions presented for the adolescent resident exposure to soil in the RAIS Calculator were applied with the following exceptions:

Exposure Assumption	Resident Value		Trespasser Value
Exposure Frequency (EF)	350 days/year	changed to	58 days/year ⁽¹⁾
Fraction Time Exposed (FT)	24 hours/hours	changed to	3.9 hours/hours ⁽²⁾

Notes:

- ⁽¹⁾ The basis for the EF is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total) from USEPA (2011). For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d /1440 total min/d)*365]. For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d /1440 total min/d)*365]. The average of the 6-11 and 11-16 ages groups of 29 days/year is a central tendency value that was doubled to 58 days/year to derive the reasonable maximum exposure (RME) value.
- ⁽²⁾ The basis for the FT is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors from USEPA (2011). For 6-11 years old, the time spent outdoors of 132 min/day equates to 2.2 hrs [132/60]. For 11-16 years old, the time spent outdoors of 100 min/day equates to 1.7 hrs [100/60]. The average of the 6-11 and 11-16 ages groups of 1.95 hours is a central tendency value that was doubled to 3.9 hours to derive the RME value.

- Utility worker exposure to soil

Utility workers are not included as receptors in the RAIS Calculator. However, the exposure assumptions presented for the excavation worker exposure to soil in the RAIS Calculator were applied with the following exception:

Exposure Assumption	Excavation Worker Value		Utility Worker Value
Exposure Duration (ED)	1 year	changed to	25 years ⁽¹⁾

Notes:

- ⁽¹⁾ Based on the outdoor worker exposure duration presented in RAIS (2014). Based on utility worker activities for a short exposure over a long term.

- Utility worker exposure to groundwater

Utility workers are not included as receptors in the RAIS Calculator. All exposure assumptions and equations utilized in the calculation of the magnitude of groundwater exposure for the utility worker are summarized in Table E.3 of Appendix E. The DA_{event} , which was used to represent the absorbed dose per event during utility worker dermal exposure to groundwater, was calculated using equations and inputs obtained from USEPA (2004), and is presented in Table E.5 of Appendix E. To determine the potential inhalation exposure to volatile COPCs in groundwater volatilizing to ambient air, a VF was used to estimate the ambient air concentrations based on groundwater concentrations. The VF is chemical-specific and was calculated using the approach presented in USEPA (1999). Site-specific groundwater and chemical-specific properties were used in calculating the VF. The equations and inputs for the calculated VF values for groundwater are presented in Table E.6 of Appendix E.

- Construction worker exposure to groundwater

Although construction workers are included as receptors in the RAIS Calculator, the construction worker exposure to groundwater is not included. All exposure assumptions and equations utilized in the calculation of the magnitude of exposure in groundwater for the construction worker are summarized in Table E.4 of Appendix E. The DA_{event} used to represent the absorbed dose per event during construction worker dermal exposure to groundwater and the VF used to estimate the ambient air concentrations based on groundwater concentrations are identical to those calculated for the utility worker above and are presented in Tables E.5 and E.6, respectively, of Appendix E.

- Trespasser exposure to sediment (dermal contact only)

Trespassers are not included as receptors in the RAIS Calculator. The exposure assumptions presented for the adolescent recreator exposure to sediment in the RAIS Calculator were applied with the following exceptions:

<i>Exposure Assumption</i>	<i>Recreator Value</i>		<i>Trespasser Value</i>
Exposure Frequency (EF)	75 days/year	changed to	58 days/year ⁽¹⁾

Notes:

⁽¹⁾ The basis for the EF is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total) from USEPA (2011). For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d /1440 total min/d)*365]. For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d /1440 total min/d)*365]. The average of the 6-11 and 11-16 ages groups of 29 days/year is a central tendency value that was doubled to 58 days/year to derive the RME value.

- Trespasser exposure to surface water (ingestion and dermal contact only)

Trespassers are not included as receptors in the RAIS Calculator. The exposure assumptions presented for the adolescent recreator exposure to surface water (ingestion and dermal only) in the RAIS Calculator were applied with the following exceptions:

<i>Exposure Assumption</i>	<i>Recreator Value</i>		<i>Trespasser Value</i>
Exposure Frequency (EF)	45 days/year	changed to	58 days/year ⁽¹⁾
Exposure Time (ET)	1 hour/event	changed to	3.9 hours/event ⁽²⁾

Notes:

⁽¹⁾ The basis for the EF is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total) from USEPA (2011). For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d /1440 total min/d)*365]. For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d /1440 total min/d)*365].

- The average of the 6-11 and 11-16 ages groups of 29 days/year is a central tendency value that was doubled to 58 days/year to derive the RME value.
- (2) The basis for the FT is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors from USEPA (2011). For 6-11 years old, the time spent outdoors of 132 min/day equates to 2.2 hrs [132/60]. For 11-16 years old, the time spent outdoors of 100 min/day equates to 1.7 hrs [100/60]. The average of the 6-11 and 11-16 ages groups of 1.95 hours is a central tendency value that was doubled to 3.9 hours to derive the RME value.

5.2 Identification of Toxicity Values

The toxicity values for potential carcinogenic COPCs are termed Cancer Slope Factors (CSFs) and Unit Risk Factors (URFs), and the toxicity values for potential non-carcinogenic COPCs are termed Reference Doses (RfDs) and Reference Concentrations (RfCs). The HHRA applied the chemical-specific toxicity values that are built into the RAIS Calculator for calculating risks/hazards for each COPC and exposure pathway.

TPH (C10-C28) DRO was identified as a COPC for OU-6 sediment. For TPH (C10-C28) DRO, the toxicity values for total petroleum hydrocarbons medium aliphatic (C9-C18), high aliphatic (C19-C32), medium aromatic (C9-C16), and high aromatic (C17-C32) were reviewed. In the RAIS Calculator, CRA applied aliphatic medium to represent the TPH (C10-C28) DRO detected in the OU-6 sediment. The medium aliphatic and medium and high aromatic toxicity values are based primarily on polynuclear aromatic hydrocarbons (PAHs), which have been assessed individually in the sediment samples, and therefore, would result in double counting.

5.3 Calculated Human Health Risks and Hazards

The calculation of human health risks and hazards integrates information from the quantification of exposure and identification of toxicity values into an evaluation of the potential human health risks associated with potentially completed exposures to potentially contaminated media. The human health risks and hazards were calculated using the RAIS Calculator, with the exception of those exposure pathways not included in the RAIS Calculator, as discussed above in Section 4.0. For these exposure pathways, risks and hazards were calculated as follows:

Non-Cancer Hazards: The potential for non-cancer health effect from exposure to a COPC was evaluated by comparing the CDI to a RfD or RfC. This ratio is termed the hazard quotient (HQ) (unitless). The Hazard Index (HI) for an exposure situation is the sum of the HQs estimated for the individual COPCs. An HI less than 1 is considered health protective for a lifetime exposure and is therefore not an exposure of concern. If the HI is greater than 1, it may be appropriate to re-evaluate the toxicity of the individual COPCs to determine if individual chemicals have the same or differing toxicological endpoints that would support conclusions that the HQs should or should not be added.

Cancer Risks: The potential carcinogenic health effect from exposure to a COPC was evaluated by multiplying the CDI by the CSF or URF. This product is termed the cancer risk, and is defined as the estimated upper bound on additional risk of cancer over a lifetime in an individual exposed to the carcinogen for a specified exposure period (unitless). The sum of the cancer risks from multiple carcinogens and multiple exposure routes is termed the cumulative cancer risk. The potential cumulative cancer risks resulting from exposure to the COPCs are compared to the target cancer risk level of 1×10^{-5} , which falls within the cumulative target risk range provided by USEPA of 1×10^{-6} or 1 in 1,000,000 to 1×10^{-4} or 1 in 10,000.

5.3.1 Summary of Calculated Risks and Hazards

The calculated non-cancer hazards and cancer risks for all potentially complete exposure pathways are summarized below. The RAIS Calculator output sheets and CRA calculated risk tables provide a summary of the exposure/dose (CDI), toxicity values, and calculated risk and HQ for each COPC in each medium for each receptor and complete exposure pathway. The RAIS Calculator output sheets also provide a summary of the COPC-specific properties (e.g., oral and dermal absorption factors, partition coefficients, Henry's law constants).

It should be noted that the non-cancer hazards presented in the sections below are based on the child receptor.

5.3.1.1 OU-3

The cancer risks and non-cancer hazards for all exposure pathways applicable to OU-3 are presented in the RAIS Calculator output sheets provided in Appendix A, and summarized in the table below.

<i>Medium</i>	<i>Receptor</i>	<i>Route</i>	<i>Cancer Risk</i>	<i>Risk > 10^{-5}?</i>	<i>Non-Cancer Hazard</i>	<i>HI > 1?</i>	<i>Appendix A Table Reference</i>
Surface Soil	Resident	Ingestion Dermal Inhalation	7.6E-05	Yes	9.2E-01	No	Table A.5
Surface Soil	Trespasser	Ingestion Dermal Inhalation	1.2E-06	No	1.5E-02	No	Table A.6
Surface Soil	Outdoor Worker	Ingestion Dermal Inhalation	5.4E-06	No	5.7E-02	No	Table A.7
Surface and Subsurface Soil	Utility Worker	Ingestion Dermal Inhalation	6.9E-07	No	1.5E-02	No	Table A.8
Surface and Subsurface Soil	Construction Worker	Ingestion Dermal Inhalation	2.7E-08	No	1.6E-02	No	Table A.9

Medium	Receptor	Route	Cancer Risk	Risk > 10⁻⁵?	Non-Cancer Hazard	HI > 1?	Appendix A Table Reference
Surface and Subsurface Soil (via Indoor Air)	Resident	Inhalation	- ⁽¹⁾	- ⁽¹⁾	8.0E-01	No	Table A.10
Surface and Subsurface Soil (via Indoor Air)	Indoor Worker	Inhalation	- ⁽¹⁾	- ⁽¹⁾	2.9E-01	No	Table A.11

Notes:

⁽¹⁾ Mercury was the only volatile COPC identified for OU-3 soil, and since mercury is not carcinogenic, a cancer risk was not calculated.

As indicated in the above table, health risks above acceptable levels were calculated for the resident direct contact exposure to OU-3 soil.

As indicated in Table A.5 of Appendix A, the major contributors to the calculated cancer risk (7.6E-05) for the resident direct contact with soil were arsenic (7.7E-06) and benzo(a)pyrene (6.4E-05). The arsenic EPC applied in the RAIS Calculator was 3.26 mg/kg, which is less than the Delaware soil screening level of 11 mg/kg. The Delaware soil screening level is based on the Delaware background soil concentration, which is greater than the risk-based screening level (i.e., USEPA residential screening level of 0.67 mg/kg). Since the EPC of arsenic in OU-3 soil is less than the Delaware background soil concentration, no further action would be required for arsenic in OU-3 soil.

5.3.1.2 OU-4

The cancer risks and non-cancer hazards for all exposure pathways applicable to OU-4 are presented in the RAIS Calculator output sheets provided in Appendix B, and summarized in the table below.

Medium	Receptor	Route	Cancer Risk	Risk > 10⁻⁵?	Non-Cancer Hazard	HI > 1?	Appendix B Table Reference
Surface Soil	Resident	Ingestion Dermal Inhalation	3.7E-09	No	2.6E-01	No	Table B.5
Surface Soil	Trespasser	Ingestion Dermal Inhalation	3.8E-11	No	4.1E-03	No	Table B.6
Surface Soil	Outdoor Worker	Ingestion Dermal Inhalation	7.6E-10	No	1.6E-02	No	Table B.7
Surface and Subsurface Soil	Utility Worker	Ingestion Dermal Inhalation	6.7E-11	No	4.9E-03	No	Table B.8

Medium	Receptor	Route	Cancer Risk	Risk > 10⁻⁵?	Non-Cancer Hazard	HI > 1?	Appendix B Table Reference
Surface and Subsurface Soil	Construction Worker	Ingestion Dermal Inhalation	2.7E-12	No	4.9E-03	No	Table B.9
Surface and Subsurface Soil (via Indoor Air)	Resident	Inhalation	– ⁽¹⁾	– ⁽¹⁾	– ⁽¹⁾	– ⁽¹⁾	Table B.10
Surface and Subsurface Soil (via Indoor Air)	Indoor Worker	Inhalation	– ⁽¹⁾	– ⁽¹⁾	– ⁽¹⁾	– ⁽¹⁾	Table B.11

Notes:

- ⁽¹⁾ For OU-4, the only volatile soil COPC identified was 2-methylnaphthalene, and since there are no available inhalation toxicity values available for this parameter, risks could not be calculated for indoor air inhalation (from soil) exposure to 2-methylnaphthalene.

As indicated in the above table, all calculated health risks were below acceptable levels for OU-4.

5.3.1.3 OU-5

The cancer risks and non-cancer hazards for all exposure pathways applicable to OU-5 are presented in the RAIS Calculator output sheets provided in Appendix C, and summarized in the table below.

Medium	Receptor	Route	Cancer Risk	Risk > 10⁻⁵?	Non-Cancer Hazard	HI > 1?	Appendix C Table Reference
Surface Soil	Resident	Ingestion Dermal Inhalation	2.7E-04	Yes	2.0E+01	Yes	Table C.5
Surface Soil	Trespasser	Ingestion Dermal Inhalation	5.3E-06	No	3.3E-01	No	Table C.6
Surface Soil	Outdoor Worker	Ingestion Dermal Inhalation	5.2E-05	Yes	1.3E+00	Yes	Table C.7
Surface and Subsurface Soil	Utility Worker	Ingestion Dermal Inhalation	1.2E-05	Yes	2.7E-01	No	Table C.8
Surface and Subsurface Soil	Construction Worker	Ingestion Dermal Inhalation	5.5E-07	No	3.1E-01	No	Table C.9
Surface and Subsurface Soil (via Indoor Air)	Resident	Inhalation	1.3E-02	Yes	1.2E+02	Yes	Table C.10

Medium	Receptor	Route	Cancer Risk	Risk > 10⁻⁵?	Non-Cancer Hazard	HI > 1?	Appendix C Table Reference
Surface and Subsurface Soil (via Indoor Air)	Indoor Worker	Inhalation	4.6E-03	Yes	4.1E+01	Yes	Table C.11

As indicated in the above table, health risks above acceptable levels were calculated for the following exposure pathways at OU-5:

- resident direct contact with soil
- outdoor worker direct contact with soil
- utility worker direct contact with soil
- resident inhalation of indoor air (from soil)
- indoor worker inhalation of indoor air (from soil)

Resident Direct Contact with Soil

As indicated in Table C.5 of Appendix C, the major contributors to the calculated cancer risk (2.7E-04) for the resident direct contact with soil were arsenic (1.1E-04), ethylbenzene (1.9E-05), lead (1.2E-04), and naphthalene (1.2E-05). The major contributors to the calculated hazard (20) for the resident direct contact with soil were antimony (7.3), arsenic (2.1), cadmium (5.9), and iron (1.4).

Outdoor Worker Direct Contact with Soil

As indicated in Table C.7 of Appendix C, the major contributors to the calculated cancer risk (5.2E-05) for the outdoor worker direct contact with soil were arsenic (2.1E-05) and lead (2.3E-05). The major contributors to the calculated hazard (1.3) for the outdoor worker direct contact with soil were antimony (0.44), arsenic (0.13), and cadmium (0.38). As indicated above, there were no individual COPCs with calculated hazards greater than the acceptable hazard level of 1.0.

Utility Worker Direct Contact with Soil

As indicated in Table C.8 of Appendix C, the major contributors to the calculated cancer risk (1.2E-05) for the utility worker direct contact with soil were arsenic (4.6E-06) and lead (6.7E-06).

Resident Inhalation of Indoor Air (from Soil)

As indicated in Table C.10 of Appendix C, the major contributors to the calculated cancer risk (1.3E-02) for the resident inhalation of indoor air (from soil) were 1,4-dichlorobenzene (1.3E-03), ethylbenzene

(1.1E-02), and naphthalene (9.6E-04). The major contributors to the calculated hazard (116) for the resident inhalation of indoor air (from soil) were ethylbenzene (12), mercury (2.1), naphthalene (25), and xylenes (76).

Indoor Worker Inhalation of Indoor Air (from Soil)

As indicated in Table C.11 of Appendix C, the major contributors to the calculated cancer risk (4.6E-03) for the indoor worker inhalation of indoor air (from soil) were 1,4-dichlorobenzene (4.3E-04), ethylbenzene (3.8E-03), and naphthalene (3.3E-04). The major contributors to the calculated hazard (41) for the indoor worker inhalation of indoor air (from soil) were ethylbenzene (4.3), naphthalene (9.1), and xylenes (27).

5.3.1.4 OU-6

The cancer risks and non-cancer hazards for all exposure pathways applicable to OU-6 are presented in the RAIS Calculator output sheets provided in Appendix D, and summarized in the table below.

Medium	Receptor	Route	Cancer Risk	Risk > 10⁻⁵?	Non-Cancer Hazard	HI > 1?	Appendix D Table Reference
Surface Soil	Resident	Ingestion Dermal Inhalation	5.7E-06	No	1.8E-01	No	Table D.7
Surface Soil	Trespasser	Ingestion Dermal Inhalation	1.0E-07	No	2.8E-03	No	Table D.8
Surface Soil	Outdoor Worker	Ingestion Dermal Inhalation	7.5E-07	No	1.1E-02	No	Table D.9
Surface Soil	Utility Worker	Ingestion Dermal Inhalation	2.2E-07	No	3.2E-03	No	Table D.10
Surface Soil	Construction Worker	Ingestion Dermal Inhalation	8.7E-09	No	3.2E-03	No	Table D.11
Sediment	Trespasser	Dermal	1.9E-05	Yes	2.1E-05	No	Table D.12
Surface Water	Trespasser	Ingestion Dermal	– ⁽¹⁾	– ⁽¹⁾	1.2E-02	No	Table D.13

Notes:

⁽¹⁾ Manganese was the only COPC identified for surface water, and since manganese is not carcinogenic, a cancer risk was not calculated.

As indicated in the above table, health risks above acceptable levels were calculated for the trespasser direct contact exposure to OU-6 sediment.

As indicated in Table D.12 of Appendix D, the major contributor to the calculated cancer risk ($1.9\text{E-}05$) for the trespasser direct contact exposure to sediment was benzo(a)pyrene ($1.5\text{E-}05$).

5.3.1.5 Site-Wide Groundwater

The cancer risks and non-cancer hazards for all exposure pathways involving Site-wide groundwater are presented in the RAIS Calculator output sheets provided in Appendix E, and summarized in the table below. The utility worker and construction worker exposure to groundwater are pathways not included in the RAIS Calculator. Tables E.10 and E.12 of Appendix E present the calculated cancer risks and non-cancer hazards for the utility worker and construction worker exposure to groundwater, respectively, which have been summarized in Tables E.11 and E.13 of Appendix E and in the table below.

<i>Medium</i>	<i>Receptor</i>	<i>Route</i>	<i>Cancer Risk</i>	<i>Risk > 10^{-5}?</i>	<i>Non-Cancer Hazard</i>	<i>HI > 1?</i>	<i>Appendix E Table Reference</i>
Groundwater (via Indoor Air)	Resident	Inhalation	9.9E-05	Yes	6.0E+00	Yes	Table E.7
Groundwater (via Indoor Air)	Indoor Worker	Inhalation	1.8E-05	Yes	1.1E+00	Yes	Table E.8
Groundwater (Tap Water – Household Use)	Resident	Ingestion Dermal Inhalation	1.5E-03	Yes	1.3E+02	Yes	Table E.9
Groundwater	Utility Worker	Ingestion Dermal Inhalation	7.5E-05	Yes	6.2E-01	No	Table E.11
Groundwater	Construction Worker	Ingestion Dermal Inhalation	3.0E-06	No	6.2E-01	No	Table E.13

As indicated in the above table, health risks above acceptable levels were calculated for the following exposure pathways for Site-Wide Groundwater:

- Resident inhalation of indoor air (from groundwater)
- Indoor worker inhalation of indoor air (from groundwater)
- Resident potable groundwater exposure
- Utility worker direct contact with groundwater

Resident Inhalation of Indoor Air (from groundwater)

As indicated in Table E.7 of Appendix E, the major contributors to the calculated risk ($9.9\text{E-}05$) for the resident inhalation exposure to indoor air (from groundwater) were benzene ($6.1\text{E-}05$) and

ethylbenzene (3.1E-05). The major contributors to the calculated hazard (6) for the resident inhalation exposure to indoor air (from groundwater) were 1,2,4-trimethylbenzene (3.8) and xylenes (1.2).

Indoor Worker Inhalation of Indoor Air (from groundwater)

As indicated in Table E.8 of Appendix E, the major contributors to the calculated risk (1.8E-05) for the indoor worker inhalation exposure to indoor air (from groundwater) were benzene (1.2E-05) and ethylbenzene (5.8E-06). The major contributors to the calculated hazard (1.1) for the indoor worker inhalation exposure to indoor air (from groundwater) were 1,2,4-trimethylbenzene (0.7) and xylenes (0.24). As indicated above, there were no individual COPCs with calculated hazards greater than the acceptable hazard level of 1.0.

Resident Potable Groundwater Exposure

As indicated in Table E.9, the major contributors to the calculated risk (1.5E-03) for the resident potable groundwater exposure were aroclor-1260 (3.1E-05), arsenic (1.0E-04), benzene (6.3E-04), chloroform (1.1E-05), 1,2-dichloroethane (2.1E-05), ethylbenzene (2.7E-04), and naphthalene (4.2E-04). The major contributors to the calculated hazard (129) for the resident potable groundwater exposure were benzene (8.6), 1,1-biphenyl (11), cobalt (9.5), iron (3), manganese (32), naphthalene (11), 1,2,4-trimethylbenzene (38), and xylene (11).

Utility Worker Direct Contact with Groundwater

As indicated in Table E.11 of Appendix E, the major contributor to the calculated risk (7.5E-05) for the utility worker direct contact exposure to groundwater was aroclor-1260 (6.5E-05).

5.3.1.6 Off-Site Groundwater

The cancer risks and non-cancer hazards for all exposure pathways involving off-Site groundwater are presented in the RAIS Calculator output sheets provided in Appendix F, and summarized in the table below.

<i>Medium</i>	<i>Receptor</i>	<i>Route</i>	<i>Cancer Risk</i>	<i>Risk > 10⁻⁵?</i>	<i>Non-Cancer Hazard</i>	<i>HI > 1?</i>	<i>Appendix F Table Reference</i>
Groundwater (Tap Water – Household Use)	Resident	Ingestion Dermal Inhalation	3.2E-04	Yes	2.0E+01	Yes	Table F.3

As indicated in the above table, health risks above acceptable levels were calculated for the off-Site resident exposure to off-Site groundwater through potable groundwater use.

As indicated in Table F.3 of Appendix F, the major contributors to the calculated risk ($3.2\text{E-}04$) for the off-Site resident potable groundwater exposure were ethylbenzene ($9.7\text{E-}05$) and naphthalene ($2.2\text{E-}04$). The major contributors to the calculated hazard (20) for the off-Site resident potable groundwater exposure were naphthalene (5.9), 1,2,4-trimethylbenzene (12), and xylene (1.5).

Section 6.0 Uncertainty Analysis

6.1 Sampling Procedure Bias

The sampling strategy is a factor that impacts the health evaluation for chemicals at the Site. Often in the sampling procedures, samples are taken from locations that are visibly contaminated or where contamination would be expected and not from areas of the Site that are potentially uncontaminated. This creates a sampling bias toward worst-case (higher) exposure point concentrations in the media sampled. The utilization of such biased data in the HHRA increases the conservative or health-protective nature of the health risk and hazard assessment.

The data used to estimate the EPCs for the Site were primarily collected in a biased manner. The media samples were collected from areas of known contamination, and should represent the highest COPC concentrations. Sampling rounds usually focused on additional characterization and delineation of the more heavily contaminated areas, thus introducing a high bias in the EPCs. Therefore, these methods were utilized as a conservative measure of exposure and likely overestimate actual exposure and risks and hazards.

6.2 Exposure Point Concentration Estimates

Data that were qualified as estimated (J value) were treated as detected concentrations. However, given that these data were estimated this could lead to either an under- or over-estimation of risk. EPCs for media that were not measured directly have more uncertainty because they have been estimated using modeling. The uncertainty in the estimation of COPC concentration of media such as ambient air is different for each model. USEPA approved models were used to estimate these media concentration. There is uncertainty associated with the estimation of EPCs, especially when there were less than ten distinct data points that were detected in a given dataset. However, the impact of this uncertainty in the risk assessment is generally to estimate upper bound concentrations. In cases where the 95% UCLM exceeded the maximum concentration of a given dataset, the 95% UCLM was used as the EPC. Furthermore, the maximum concentration was used when there were less than four distinct data points that were detected in a dataset. The COPC concentrations were assumed to remain constant over the

exposure duration when in fact they would likely decrease over this time. Overall, the use of the 95% UCLM as the EPC likely overestimates actual exposure and risks and hazards.

6.3 Exposure Scenario Assumptions

This section discusses the uncertainty associated with the primary exposure scenario assumptions such as land use and frequency of exposure. Because the exposure scenarios are often not based on actual exposure data, but rather on assumptions about future exposure patterns, based on professional judgment of typical exposures.

For most of the exposure pathways, default exposure assumptions presented in the RAIS Calculator were applied. The use of these assumptions could lead to over- or under-estimation of risk to an unknown degree if the human receptors are present less or more than the assumed exposure assumptions.

Although indoor air exposure through inhalation to volatile contaminants originating from soil can occur and was quantitatively evaluated in the HHRA, there is significant uncertainty with assessing this exposure pathway, and as such, some states do not recommend bulk soil sampling for assessment of vapor intrusion (USEPA, 2012). Some of the uncertainties with respect to the soil to indoor air pathway include:

- The soil to soil vapor partitioning model is highly uncertain, and typically overestimates potential soil vapor concentrations.
- Volatile chemical loss on sampling may be significant and can cause an underestimation of vapor concentrations

Given these uncertainties, it is generally not recommended to use soil for assessing potential human health risks from vapor intrusion.

The major uncertainties regarding the physical exposure scenarios used in the HHRA are summarized as follows:

- i) Long-term exposure point concentrations are inherently uncertain because COPC concentrations are assumed to remain constant over time. The assumptions that the measured concentrations are equivalent during sampling and exposure over the duration of exposure will overestimate the intake and resulting risk.
- ii) For most COPCs, the HHRA assumed that 100% absorption occurs after oral ingestion. Actual absorption rates of ingested contaminants may vary based on individual COPC absorption rates. Thus, assumption of 100% absorption of ingested COPCs overestimates the associated risks.

- iii) For all COPCs, the HHRA assumed that 100% absorption occurs after inhalation. Actual lung absorption rates may vary based on individual COPC absorption rates. Thus, assumption of 100% lung absorption COPCs likely overestimates the associated risks.

6.4 Dose Response

One of the major uncertainties in estimating site-specific risk is the application of published toxicity information. Factors introducing uncertainty associated with toxicity value application are as follows:

- i) Applicability of animal toxicity data - chemicals may be assumed to be human carcinogens based on animal studies even when there is limited or no available evidence that the chemical is a human carcinogen.
- ii) Differences in chemical concentrations-CSFs are derived from high concentration animal studies and therefore may not be applicable to low concentration exposures.
- iii) In general, assumptions in toxicity values - CSFs are developed in a conservative manner, so there is uncertainty in the outcome. Often USEPA will include uncertainty factors to account for this uncertainty in the extrapolation from animal exposure to human outcome.
- iv) Assumptions in toxicity values (non-carcinogenic Hazard) - RfDs are also established with uncertainty safety factors when extrapolating to human outcome.
- v) Compounds lacking toxicity data could not be included in the toxicity assessment. Ultimately, this lack of data results in the exclusion of these compounds from the risk characterization portion of the HHRA. However, the exclusion of detected compounds from the risk assessment due to a lack of toxicity factors could lead to an underestimation of the risk to human receptors.

6.5 Theoretical Nature of Risk Estimates

A human health risk assessment assigns a numerical value to the excess probability (above background cancer rates) of a case of cancer developing in a population exposed to a specified amount of chemical that is a known or suspect carcinogen. CRA used the human health cumulative excess lifetime carcinogenic risk goal of 1.0×10^{-5} , or one additional cancer case in 10,000 people exposed to the chemical and at the specific chemical concentration for their entire lifetime, which is assumed to be 70 years. The model that is applied to calculate this numerical risk value is a combination of the exposure estimate and dose response values, and so potentially includes the uncertainty in each set of values. The cancer risk model and the assumptions used to estimate exposure are expected to be protective of the most sensitive populations. The true risk is expected to be lower than that calculated, and may quite reasonably approach zero. Thus risk estimates are overestimated by the HHRA methodology itself. However, for certain individuals, who engage in activities at rates higher than those assumed in the HHRA, exposure and risk may be higher.

Section 7.0 Summary and Conclusions

The HHRA was conducted in accordance with the methodology presented in the DNREC-approved *Proposed Risk Assessment Approach for Remedial Investigation (RI) – Revised* (dated October 1, 2014) (HHRA Work Plan).

The purpose of the HHRA was to determine whether releases of chemicals to environmental media pose unacceptable risks to human health under specific exposure conditions. The HHRA also provides information to support risk management decisions concerning the need for further evaluation of remedial action based upon current and reasonably anticipated future land use.

COPCs were identified in the various media through a comparison to the Delaware screening levels. Surface soil, soil (including surface and subsurface soil), groundwater, sediment, and surface water were quantitatively evaluated within the HHRA as follows:

Medium	Receptor
Surface soil	• Resident (direct contact) • Trespasser (direct contact) • Outdoor Worker (direct contact)
Soil (surface and subsurface soil)	• Resident (inhalation of indoor air) • Indoor Worker (inhalation of indoor air) • Utility Worker (direct contact) • Construction Worker (direct contact)
Groundwater	• Resident (potable) • Resident (inhalation of indoor air) • Indoor Worker (inhalation of indoor air) • Utility Worker (direct contact) • Construction Worker (direct contact)
Sediment	• Trespasser (direct contact)
Surface Water	• Trespasser (direct contact)

Cancer risks and non-carcinogenic hazards were calculated using the RAIS Calculator and compared to the target cancer risk level of 1×10^{-5} and target hazard of 1.0. The table below provides a summary of the results.

OU-3

Medium	Receptor	Route	Risk > 10⁻⁵?	HI > 1?
Surface Soil	Resident	Direct Contact	Yes	No
	Trespasser	Direct Contact	No	No
	Outdoor Worker	Direct Contact	No	No
Surface and Subsurface Soil	Resident	Inhalation of Indoor Air	Not Calculated	No
	Indoor Worker	Inhalation of Indoor Air	Not Calculated	No
	Utility Worker	Direct Contact	No	No
	Construction Worker	Direct Contact	No	No

OU-4

Medium	Receptor	Route	Risk > 10⁻⁵?	HI > 1?
Surface Soil	Resident	Direct Contact	No	No
	Trespasser	Direct Contact	No	No
	Outdoor Worker	Direct Contact	No	No
Surface and Subsurface Soil	Resident	Inhalation of Indoor Air	No	No
	Indoor Worker	Inhalation of Indoor Air	No	No
	Utility Worker	Direct Contact	No	No
	Construction Worker	Direct Contact	No	No

OU-5

Medium	Receptor	Route	Risk > 10⁻⁵?	HI > 1?
Surface Soil	Resident	Direct Contact	Yes	Yes
	Trespasser	Direct Contact	No	No
	Outdoor Worker	Direct Contact	Yes	Yes
Surface and Subsurface Soil	Resident	Inhalation of Indoor Air	Yes	Yes
	Indoor Worker	Inhalation of Indoor Air	Yes	Yes
	Utility Worker	Direct Contact	Yes	No
	Construction Worker	Direct Contact	No	No

OU-6

Medium	Receptor	Route	Risk > 10⁻⁵?	HI > 1?
Surface Soil	Resident	Direct Contact	No	No
	Trespasser	Direct Contact	No	No
	Outdoor Worker	Direct Contact	No	No
	Utility Worker	Direct Contact	No	No
	Construction Worker	Direct Contact	No	No
Sediment	Trespasser	Direct Contact	Yes	No
Surface Water	Trespasser	Direct Contact	Not Calculated	No

Site-Wide Groundwater

<i>Medium</i>	<i>Receptor</i>	<i>Route</i>	<i>Risk > 10⁻⁵?</i>	<i>HI > 1?</i>
Groundwater	Resident	Potable Exposure	Yes	Yes
	Resident	Inhalation of Indoor Air	Yes	Yes
	Indoor Worker	Inhalation of Indoor Air	Yes	Yes
	Utility Worker	Direct Contact	Yes	No
	Construction Worker	Direct Contact	No	No

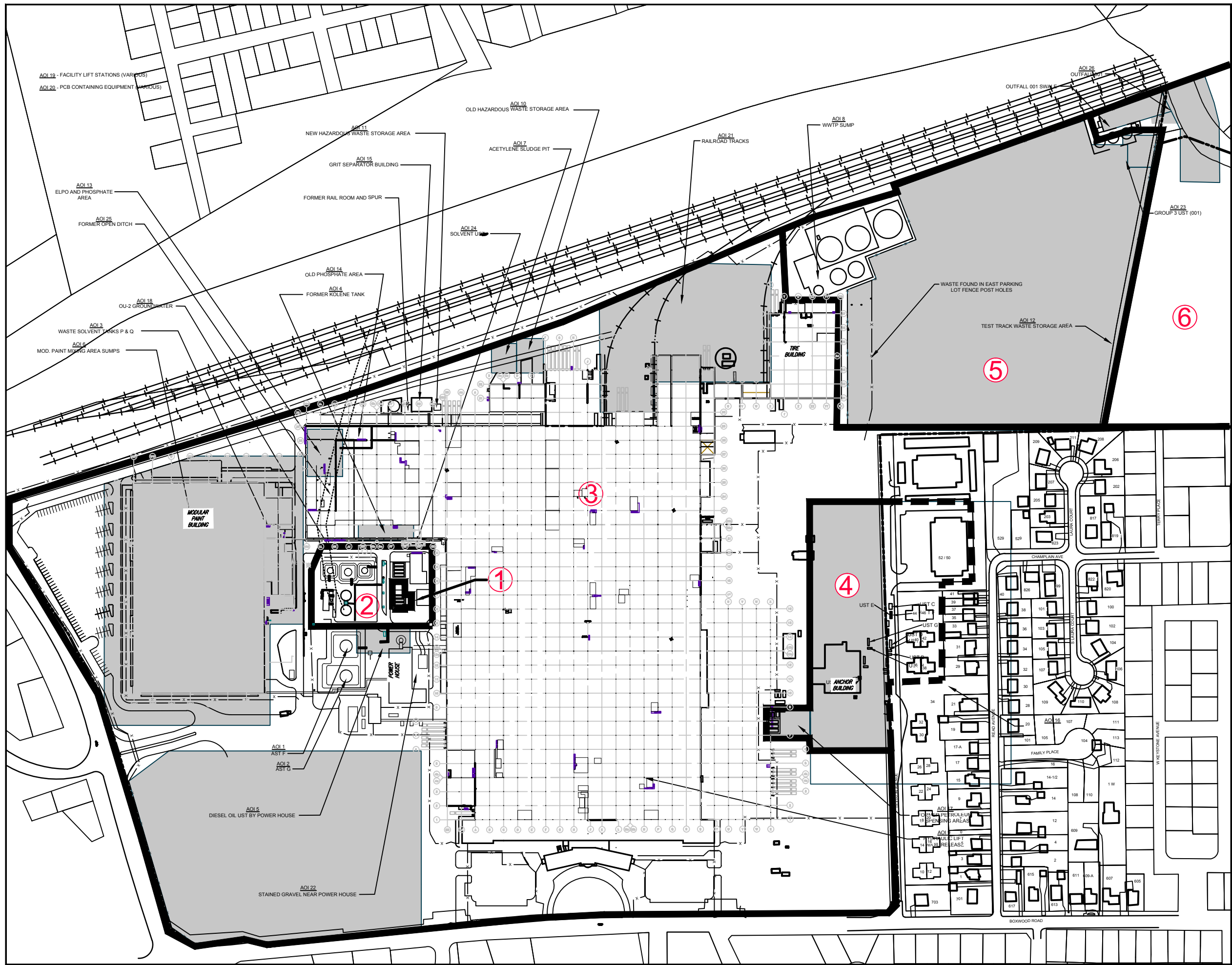
Off-Site Groundwater

<i>Medium</i>	<i>Receptor</i>	<i>Route</i>	<i>Risk > 10⁻⁵?</i>	<i>HI > 1?</i>
Groundwater	Resident	Potable Exposure	Yes	Yes

Section 8.0 References

- DNREC, 2014. Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.
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- USEPA, 2004. USEPA Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment), Final, July.
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- USEPA, 2013. ProUCL Version 5.0, EPA/600/R-07/041, September 2013.

Figures



0 50 150ft

LEGEND

- APPROXIMATE FACILITY BOUNDARY
- FENCELINE
- RAILWAY
- APPROXIMATE LOCATION OF FORMER OPEN DITCH
- APPROXIMATE EXTENT OF AREA OF INTEREST

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

**FORMER GM WILMINGTON
ASSEMBLY PLANT**

HUMAN HEALTH RISK ASSESSMENT

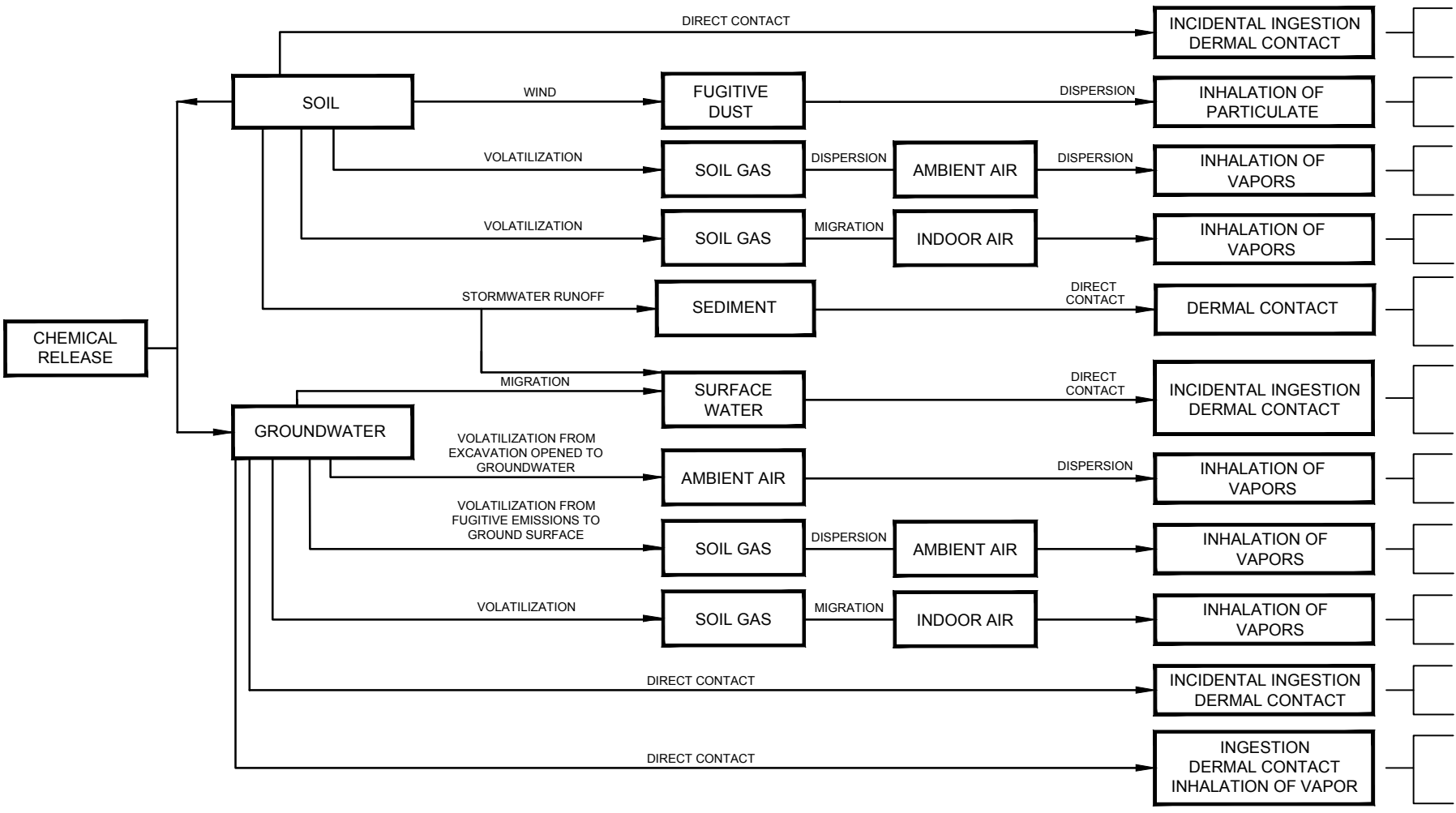
**RISK ASSESSMENT
OPERABLE UNITS**

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

Project Manager: G. CARLI	Reviewed By: C. BARTON	Date: DECEMBER 2014
Scale: 1:150	Project N#: 017338-T04	Report N#: 021
		Drawing N#: 1

017338-00(021)GN-BU001 MAR 17/2015



POTENTIALLY EXPOSED RECEPTORS						
CURRENT/FUTURE						
RESIDENT	TRESPASSER	UTILITY WORKER	CONSTRUCTION WORKER	INDOOR WORKER	OUTDOOR WORKER	OFF-SITE RESIDENT
●	●	●	●	□	●	□
●	●	●	●	□	●	□
●	●	●	●	□	●	□
●	□	□	□	●	□	□
□	●	□	□	□	□	□
□	●	□	□	□	□	□
□	□	●	●	□	□	□
● ⁽²⁾	● ⁽²⁾	● ⁽²⁾	● ⁽²⁾	□	● ⁽²⁾	□
●	□	□	□	●	□	□ ⁽¹⁾
□	□	●	●	□	□	□
●	□	□	□	□	□	●

LEGEND

- POTENTIALLY COMPLETE EXPOSURE PATHWAY EVALUATED QUANTITATIVELY
- INCOMPLETE EXPOSURE PATHWAY

NOTES:

- (1) OFF-SITE SOIL VAPOR INTRUSION ISSUES ARE BEING ADDRESSED SEPARATELY FROM THE RI.
- (2) EVALUATED QUALITATIVELY ONLY.

figure 2
HUMAN HEALTH CONCEPTUAL SITE MODEL
HUMAN HEALTH RISK ASSESSMENT
FORMER GM WILMINGTON ASSEMBLY PLANT
Wilmington, Delaware



Appendices

Appendix A

OU-3 Risk Tables

Appendix A

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TABLE A.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	VOCs												
75-34-3	1,1-Dichloroethane	0.0098	J	0.0098	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.091 - 0.23	0.0098	3.6	C	BSC
108-87-2	Methyl cyclohexane	0.0069	J	0.0069	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.091 - 0.23	0.0069	650 (5)	N	BSC
108-88-3	Toluene	0.0046	J	0.0046	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.091 - 0.23	0.0046	490	N	BSC
	SVOCs												
50-32-8	Benzo(a)pyrene	0.012	J	0.43		mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	2/6	0.036 - 0.041	0.43	0.09	C	ASC
205-99-2	Benzo(b)fluoranthene	0.012	J	0.42		mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	2/6	0.036 - 0.041	0.42	0.9	C	BSC
191-24-2	Benzo(g,h,i)perylene	0.27	J	0.27	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.36 - 0.41	0.27	1 (6)	N	BSC
207-08-9	Benzo(k)fluoranthene	0.19		0.19		mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.036 - 0.041	0.19	9	C	BSC
218-01-9	Chrysene	0.19	J	0.19	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.36 - 0.41	0.19	87	C	BSC
53-70-3	Dibenz(a,h)anthracene	0.055		0.055		mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.036 - 0.041	0.055	0.09	C	BSC
206-44-0	Fluoranthene	0.11	J	0.11	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.36 - 0.41	0.11	310	N	BSC
193-39-5	Indeno(1,2,3-cd)pyrene	0.01	J	0.33		mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	2/6	0.036 - 0.041	0.33	0.9	C	BSC
129-00-0	Pyrene	0.12	J	0.12	J	mg/kg	AOI 10: MW26-11, 0-2 ftbgs (09/21/11)	1/6	0.36 - 0.41	0.12	230	N	BSC
	Metals												
7429-90-5	Aluminum	5970		19900		mg/kg	AOI 5: BH5-11, 0-2 ftbgs (09/15/11)	7/7	--	19900	51200	N	BSC
7440-36-0	Antimony	3.3		12.8		mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	2/28	0.5 - 19.8	12.8	3.1	N	ASC
7440-38-2	Arsenic	0.81		17.04		mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	28/28	0.99	17.04	11	C	ASC
7440-39-3	Barium	16.8	J	1252		mg/kg	AOI 21: BH48-11, 0-2 ftbgs (09/21/11)	28/28	--	1252	1500	N	BSC
7440-41-7	Beryllium	0.18	J	0.49		mg/kg	AOI 5: BH5-11, 0-2 ftbgs (09/15/11)	7/7	--	0.49	16	N	BSC
7440-43-9	Cadmium	2.6		2.6		mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	1/28	0.1 - 2.5	2.6	7	N	BSC
7440-70-2	Calcium	371	J	106658		mg/kg	AOI 6: BH6-11, 0-2 ftbgs (10/10/11)	28/28	--	106658	--		NTX; NUT
7440-47-3	Chromium	4.9		197.3		mg/kg	AOI 7: BH51-11, 0-2 ftbgs (09/20/11)	28/28	--	197.3	12000	N	BSC
7440-48-4	Cobalt	1.4	J	71.9		mg/kg	AOI 21: BH48-11, 0-2 ftbgs (09/21/11)	20/28	1.2 - 313	71.9	34	N	ASC
7440-50-8	Copper	4.1	J	30.7		mg/kg	AOI 6: BH6-11, 0-2 ftbgs (10/10/11)	27/28	2.9 - 5.5	30.7	310	N	BSC
7439-89-6	Iron	3640		33654		mg/kg	AOI 6: BH7-11, 0-2 ftbgs (10/10/11)	28/28	--	33654	74767	N	BSC
7439-92-1	Lead	4.2		467		mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	28/28	--	467	400	C	ASC
7439-95-4	Magnesium	292	J	3440		mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	7/7	--	3440	--		NTX; NUT
7439-96-5	Manganese	44.1	J	2808.5		mg/kg	AOI 6: BH7-11, 0-2 ftbgs (10/10/11)	28/28	--	2808.5	2100	N	ASC
7439-97-6	Mercury	0.057		7.63		mg/kg	AOI 5: BH3-11, 0-2 ftbgs (09/15/11)	3/28	0.032 - 6.5	7.63	0.94	N	ASC
7440-02-0	Nickel	2.3	J	167.3		mg/kg	AOI 7: BH57-11, 0-2 ftbgs (09/20/11)	28/28	--	167.3	150	N	ASC
7440-09-7	Potassium	155	J	2860		mg/kg	AOI 6: BH7-11, 0-2 ftbgs (10/10/11)	7/7	--	2860	--		NTX; NUT
7782-49-2	Selenium	1.3	J	1.3	J	mg/kg	AOI 6: BH7-11, 0-2 ftbgs (10/10/11)	1/28	0 - 3	1.3	39	N	BSC
7440-22-4	Silver	0.44	J	1.94		mg/kg	Parking Lot: BH59-11, 0-2 ftbgs (09/19/11)	2/28	0.1 - 3	1.94	39	N	BSC
7440-23-5	Sodium	102	J	227	J	mg/kg	Parking Lot: BH62-11, 0-2 ftbgs (09/19/11)	2/7	991 - 1140	227	--		NTX; NUT
7440-32-6	Titanium	411.6		6227		mg/kg	AOI 21: BH47-11, 0-2 ftbgs (09/21/11)	27/27	--	6227	--		NTX
7440-62-6	Vanadium	7.3	J	69.7		mg/kg	AOI 5: BH3-11, 0-2 ftbgs (09/15/11)	15/28	1.9 - 56	69.7	134	N	BSC
7440-66-6	Zinc	7.2		110		mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	28/28	--	110	2300	N	BSC

TABLE A.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future Medium: Surface Soil (0-2 ftbgs) Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
11097-69-1	<u>PCBs</u> Aroclor-1254 (PCB-1254)	0.034	J	0.034	J	mg/kg	AOI 21: BH52-11, 0-2 ftbgs (09/22/11)	1/7	0.072 - 0.083	0.034	0.11	C	BSC
50-29-3	<u>Pesticides</u> 4,4'-DDT	0.0061	J	0.0061	J	mg/kg	AOI 9: BH12-11, 0-2 ftbgs (09/14/11)	1/5	0.0072 - 0.0083	0.0061	1.9	C	BSC

Notes:

C Carcinogenic; analyte considered to be a carcinogen.

N Non-Carcinogenic; analyte considered to be a non-carcinogen.

-- Not Available

J Result is an estimated value.

(1) Minimum/maximum detected concentration.

(2) Based on data collected from sampling locations: BH1-11, BH2-11, BH3-11, BH4-11, BH5-11, BH6-11, BH7-11, BH8-11, BH12-11, BH36-11, BH37-11, BH47-11, BH48-11, BH49-11, BH50-11, BH51-11, BH52-11, BH57-11, BH58-11, BH59-11, BH60-11, BH61-11, BH62-11, BH63-11, BH64-11, MW25-11, MW26-11, MW32-11.

(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.

(4) Rationale Codes

Selection Reason Maximum detected above Screening Criterion (ASC)

Deletion Reason Maximum detected below Screening Criterion (BSC)

No Toxicity Data (NTX)

Essential Nutrient (NUT)

(5) No screening criterion available for this analyte, substituted cyclohexane screening criterion.

(6) No screening criterion available for this analyte, substituted lowest non-carcinogenic (2-methylnaphthalene) screening criterion.

TABLE A.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Subsurface Soil (2-10 ftbgs)
Exposure Medium: Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
VOCs													
75-15-0	Carbon disulfide	0.044	J	0.044	J	mg/kg	AOI 10: MW26-11, 7-9 ftbgs (09/21/11)	1/4	0.089 - 0.096	0.044	77	N	BSC
100-41-4	Ethylbenzene	0.023	J	0.023	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/4	0.085 - 0.096	0.023	5.8	C	BSC
79-20-9	Methyl acetate	0.83		0.83		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/4	0.17 - 0.19	0.83	7800	N	BSC
1330-20-7	Xylenes (total)	0.1	J	0.1	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/4	0.26 - 0.29	0.1	58	N	BSC
SVOCs													
91-57-6	2-Methylnaphthalene	0.065	J	0.065	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	0.065	1	N	BSC
56-55-3	Benzo(a)anthracene	0.048		0.048		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.038 - 0.039	0.048	0.9	C	BSC
50-32-8	Benzo(a)pyrene	0.025	J	0.025	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.038 - 0.039	0.025	0.09	C	BSC
205-99-2	Benzo(b)fluoranthene	0.043		0.043		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.038 - 0.039	0.043	0.9	C	BSC
207-08-9	Benzo(k)fluoranthene	0.014	J	0.014	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.038 - 0.039	0.014	9	C	BSC
117-81-7	bis(2-Ethylhexyl)phthalate (DEHP)	0.74		0.74		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	0.74	38	C	BSC
85-68-7	Butyl benzylphthalate (BBP)	4.8		4.8		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	4.8	280	C	BSC
206-44-0	Fluoranthene	0.11	J	0.11	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	0.11	310	N	BSC
193-39-5	Indeno(1,2,3-cd)pyrene	0.01	J	0.01	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.038 - 0.039	0.01	0.9	C	BSC
91-20-3	Naphthalene	0.059	J	0.059	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	0.059	5	C	BSC
85-01-8	Phenanthrene	0.13	J	0.13	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	0.13	1000	N	BSC
129-00-0	Pyrene	0.074	J	0.074	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.38 - 0.39	0.074	230	N	BSC
Metals													
7429-90-5	Aluminum	5120		33100		mg/kg	AOI 6: BH10-11, 4-5 ftbgs (09/15/11)	4/4	--	33100	51200	N	BSC
7440-36-0	Antimony	19.8		19.8		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/15	0.7 - 19.8	19.8	3.1	N	ASC
7440-38-2	Arsenic	0.91		34.63		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	15/15	1.1	34.63	11	C	ASC
7440-39-3	Barium	23.4	J	1006		mg/kg	AOI 7: BH11-11, 4-5 ftbgs (09/15/11)	15/15	--	1006	1500	N	BSC
7440-41-7	Beryllium	0.24	J	0.54		mg/kg	AOI 21: BH51-11, 9-11 ftbgs (09/22/11)	4/4	--	0.54	16	N	BSC
7440-43-9	Cadmium	0.43	J	0.43	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/15	0.3 - 1.8	0.43	7	N	BSC
7440-70-2	Calcium	499	J	18166		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	15/15	--	18166	--		NTX; NUT
7440-47-3	Chromium	8.2		136		mg/kg	AOI 6: BH10-11, 4-5 ftbgs (09/15/11)	15/15	--	136	12000	N	BSC
7440-48-4	Cobalt	1.3	J	62.3		mg/kg	AOI 21: BH49-11, 7-9 ftbgs (09/21/11)	9/15	0.3 - 313	62.3	34	N	ASC
7440-50-8	Copper	3.3	J	23.7		mg/kg	AOI 5: BH4-11, 7-9 ftbgs (09/15/11)	14/15	5	23.7	310	N	BSC
7439-89-6	Iron	2180		28551		mg/kg	AOI 21: BH49-11, 7-9 ftbgs (09/21/11)	15/15	--	28551	74767	N	BSC
7439-92-1	Lead	4.2		358.3		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	15/15	--	358.3	400	C	BSC
7439-95-4	Magnesium	406	J	2000		mg/kg	AOI 21: BH51-11, 9-11 ftbgs (09/22/11)	4/4	--	2000	--		NTX; NUT
7439-96-5	Manganese	20		2271.1		mg/kg	AOI 6: BH7-11, 8-10 ftbgs (10/10/11)	15/15	--	2271.1	2100	N	ASC
7439-97-6	Mercury	0.039		0.039		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/15	0.037 - 6.5	0.039	0.94	N	BSC
7440-02-0	Nickel	3.4	J	40.2		mg/kg	AOI 21: BH49-11, 7-9 ftbgs (09/21/11)	15/15	--	40.2	150	N	BSC
7440-09-7	Potassium	247	J	695	J	mg/kg	AOI 21: BH51-11, 9-11 ftbgs (09/22/11)	4/4	--	695	--		NTX; NUT
7440-23-5	Sodium	104	J	1190		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	3/4	1100	1190	--		NTX; NUT
7440-28-0	Thallium	0.062		0.068		mg/kg	AOI 6: BH10-11, 4-5 ftbgs (09/15/11)	2/15	0.0009 - 4.4	0.068	0.078	N	BSC
7440-32-6	Titanium	378.3		7534		mg/kg	AOI 10: MW26-11, 7-9 ftbgs (09/21/11)	15/15	--	7534	--		NTX
7440-62-6	Vanadium	12.4		92.4		mg/kg	AOI 5: BH3-11, 7-9 ftbgs (09/15/11)	12/15	2.9 - 56	92.4	134	N	BSC
7440-66-6	Zinc	7.5		174		mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	15/15	--	174	2300	N	BSC

TABLE A.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future Medium: Subsurface Soil (2-10 ftbgs) Exposure Medium: Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
11097-69-1	PCBs Aroclor-1254 (PCB-1254)	0.051	J	0.051	J	mg/kg	AOI 7: BH58-11, 5-7 ftbgs (09/20/11)	1/3	0.077 - 0.08	0.051	0.11	C	BSC

Notes:

C Carcinogenic; analyte considered to be a carcinogen.

N Non-Carcinogenic; analyte considered to be a non-carcinogen.

-- Not Available

J Result is an estimated value.

(1) Minimum/maximum detected concentration.

(2) Based on data collected from sampling locations: BH3-11, BH4-11, BH5-11, BH7-11, BH10-11, BH11-11, BH47-11, BH48-11, BH49-11, BH50-11, BH51-11, BH57-11, BH58-11, MW25-11, MW26-11.

(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.

(4) Rationale Codes

Selection Reason Maximum detected above Screening Criterion (ASC)

Deletion Reason Maximum detected below Screening Criterion (BSC)

No Toxicity Data (NTX)

Essential Nutrient (NUT)

TABLE A.3

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL

OU3

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future

Medium: Surface Soil (0-2 ftbgs)

Exposure Medium: Surface Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
SVOCs									
Benzo(a)pyrene	mg/kg	8.17E-02	(a)	4.30E-01		mg/kg	9.77E-01	99% KM (Chebyshev) UCL	(4)
Metals									
Antimony	mg/kg	--	--	1.28E+01		mg/kg	1.28E+01	Maximum Detected	(5)
Arsenic	mg/kg	2.36E+00	(d)	4.30E+00		mg/kg	3.26E+00	95% KM (t) UCL	(4)
Cobalt	mg/kg	4.34E+00	(d)	6.80E+00		mg/kg	5.77E+00	95% Student's-t UCL	(4)
Lead	mg/kg	7.66E+01	(b)	4.67E+02		mg/kg	3.61E+02	95% Chebyshev(Mean, Sd) UCL	(6)
Manganese	mg/kg	1.44E+02	(d)	2.02E+02		mg/kg	1.72E+02	95% Student's-t UCL	(4)
Mercury	mg/kg	4.11E-02	(a)	7.10E-02		mg/kg	5.67E-02	95% KM (t) UCL	(4)
Nickel	mg/kg	7.56E+00	(d)	1.20E+01		mg/kg	9.99E+00	95% Student's-t UCL	(4)

Notes:

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% Student's-t UCL = 95% UCL of the mean based upon the student's-t statistic

95% Chebyshev (Mean, Sd) UCL = 95% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

99% KM (Chebyshev) UCL = 99% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

(5) ProUCL identified only one distinct detected value. ProUCL (or any other software) should not be used on such a data set and therefore the maximum detected concentration is the EPC value.

(6) ProUCL recommended method is 95% H-UCL. H-statistic often results in unstable (both high and low) values, therefore USEPA (2013) recommends Chebyshev inequality based UCL (pg.54) USEPA, September 2013. ProUCL Version 5.0.00 Technical Guide. United States Environmental Protection Agency, Office of Research and Development, Washington DC. EPA/600/R 07/041.

TABLE A.4

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE AND SUBSURFACE SOIL

OU3

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Surface and Subsurface Soil (0-10 ftbgs)
Exposure Medium: Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
<u>SVOCs</u>									
Benzo(a)pyrene	mg/kg	6.42E-02	(d)	4.30E-01		mg/kg	1.63E-01	95% KM (t) UCL	(4)
<u>Metals</u>									
Antimony	mg/kg	--	--	1.28E+01		mg/kg	1.28E+01	Maximum Detected	(5)
Arsenic	mg/kg	2.29E+00	(d)	4.30E+00		mg/kg	2.88E+00	95% KM (t) UCL	(4)
Cobalt	mg/kg	4.17E+00	(d)	6.80E+00		mg/kg	5.21E+00	95% Student's-t UCL	(4)
Lead	mg/kg	6.26E+01	(b)	4.67E+02		mg/kg	2.45E+02	95% Chebyshev (Mean, Sd) UCL	(4)
Manganese	mg/kg	1.23E+02	(d)	2.02E+02		mg/kg	1.51E+02	95% Student's-t UCL	(4)
Mercury	mg/kg	3.85E-02	(d)	7.10E-02		mg/kg	4.69E-02	95% KM (t) UCL	(4)
Nickel	mg/kg	9.53E+00	(c)	3.18E+01		mg/kg	1.55E+01	95% Adjusted Gamma UCL	(4)

Notes:

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% Student's-t UCL = 95% UCL of the mean based upon the student's-t statistic

95% Chebyshev (Mean, Sd) UCL = 95% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

95% Adjusted Gamma KM-UCL = adjusted gamma UCL based upon Kaplan-Meier Estimates for non-detects using chi-square

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

(5) ProUCL identified only one distinct detected value. ProUCL (or any other software) should not be used on such a data set and therefore the maximum detected concentration is the EPC value.

TABLE A.5

SUMMARY OF RESIDENT RISK FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H[*]</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	25900	3.23E+09	3.13
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Child Ingestion Noncarcinogenic CDI</i>	<i>Child Inhalation Noncarcinogenic CDI</i>	<i>Child Dermal Noncarcinogenic CDI</i>	<i>Adult Ingestion Noncarcinogenic CDI</i>	<i>Adult Inhalation Noncarcinogenic CDI</i>	<i>Adult Dermal Noncarcinogenic CDI</i>	<i>Adjusted Ingestion Noncarcinogenic CDI</i>	<i>Adjusted Inhalation Noncarcinogenic CDI</i>	<i>Adjusted Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		1.28E+01	1.64E-04	3.80E-09	-	1.53E-05	3.80E-09	-	4.96E-05	3.80E-09	-	1.84E-05	1.41E-06	-
Arsenic		3.26E+00	4.17E-05	9.67E-10	3.36E-06	3.91E-06	9.67E-10	4.95E-07	1.26E-05	9.67E-10	1.16E-06	4.69E-06	3.59E-07	4.30E-07
Benzo(a)pyrene		9.77E-01	1.25E-05	2.90E-10	4.37E-06	1.17E-06	2.90E-10	6.43E-07	3.78E-06	2.90E-10	1.50E-06	6.38E-06	2.98E-07	2.36E-06
Cobalt		5.77E+00	7.38E-05	1.71E-09	-	6.92E-06	1.71E-09	-	2.23E-05	1.71E-09	-	8.30E-06	6.36E-07	-
Lead		3.61E+02	4.62E-03	1.07E-07	-	4.33E-04	1.07E-07	-	1.40E-03	1.07E-07	-	5.19E-04	3.98E-05	-
Manganese		1.72E+02	2.20E-03	5.10E-08	-	2.06E-04	5.10E-08	-	6.66E-04	5.10E-08	-	2.47E-04	1.89E-05	-
Mercury		5.67E-02	7.25E-07	2.10E-06	-	6.80E-08	2.10E-06	-	2.20E-07	2.10E-06	-	8.16E-08	7.78E-04	-
Nickel		9.99E+00	1.28E-04	2.96E-09	-	1.20E-05	2.96E-09	-	3.87E-05	2.96E-09	-	1.44E-05	1.10E-06	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Child Ingestion HQ</i>	<i>Child Inhalation HQ</i>	<i>Child Dermal HQ</i>	<i>Child Total HI</i>	<i>Adult Ingestion HQ</i>	<i>Adult Inhalation HQ</i>	<i>Adult Dermal HQ</i>	<i>Adult Total HI</i>	<i>Adjusted Ingestion HQ</i>	<i>Adjusted Inhalation HQ</i>	<i>Adjusted Dermal HQ</i>	<i>Adjusted Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		4.09E-01	-	-	4.09E-01	3.84E-02	-	-	3.84E-02	1.24E-01	-	-	1.24E-01	-	-	-	-
Arsenic		1.39E-01	6.45E-05	1.12E-02	1.50E-01	1.30E-02	6.45E-05	1.65E-03	1.47E-02	4.21E-02	6.45E-05	3.86E-03	4.60E-02	7.03E-06	1.54E-09	6.45E-07	7.68E-06
Benzo(a)pyrene		-	-	-	-	-	-	-	-	-	-	-	-	4.66E-05	3.28E-10	1.73E-05	6.38E-05
Cobalt		2.46E-01	2.85E-04	-	2.46E-01	2.31E-02	2.85E-04	-	2.33E-02	7.45E-02	2.85E-04	-	7.48E-02	-	5.72E-09	-	5.72E-09
Lead		-	-	-	-	-	-	-	-	-	-	-	-	4.41E-06	4.77E-10	-	4.41E-06
Manganese		9.16E-02	1.02E-03	-	9.26E-02	8.59E-03	1.02E-03	-	9.61E-03	2.78E-02	1.02E-03	-	2.88E-02	-	-	-	-
Mercury		4.53E-03	6.99E-03	-	1.15E-02	4.25E-04	6.99E-03	-	7.41E-03	1.37E-03	6.99E-03	-	8.36E-03	-	-	-	-
Nickel		6.39E-03	3.29E-05	-	6.42E-03	5.99E-04	3.29E-05	-	6.32E-04	1.93E-03	3.29E-05	-	1.97E-03	-	2.86E-10	-	2.86E-10
*Total Risk/HI		8.97E-01	8.39E-03	1.12E-02	9.16E-01	8.40E-02	8.39E-03	1.65E-03	9.41E-02	2.72E-01	8.39E-03	3.86E-03	2.84E-01	5.80E-05	8.36E-09	1.79E-05	7.59E-05

TABLE A.6

SUMMARY OF TRESPASSER RISK FOR SURFACE SOIL

OU3

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	16100	3.23E+09	3.13
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		1.28E+01	2.54E-06	1.02E-10	-	3.63E-07	1.46E-08	-
Arsenic		3.26E+00	6.48E-07	2.60E-11	8.20E-08	9.25E-08	3.72E-09	1.17E-08
Benzo(a)pyrene		9.77E-01	1.94E-07	7.80E-12	1.07E-07	8.32E-08	3.34E-09	4.57E-08
Cobalt		5.77E+00	1.15E-06	4.61E-11	-	1.64E-07	6.58E-09	-
Lead		3.61E+02	7.17E-05	2.88E-09	-	1.02E-05	4.12E-07	-
Manganese		1.72E+02	3.42E-05	1.37E-09	-	4.88E-06	1.96E-07	-
Mercury		5.67E-02	1.13E-08	9.10E-08	-	1.61E-09	1.30E-05	-
Nickel		9.99E+00	1.98E-06	7.98E-11	-	2.83E-07	1.14E-08	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		6.36E-03	-	-	6.36E-03	-	-	-	-
Arsenic		2.16E-03	1.74E-06	2.73E-04	2.43E-03	1.39E-07	1.60E-11	1.76E-08	1.56E-07
Benzo(a)pyrene		-	-	-	-	6.07E-07	3.68E-12	3.33E-07	9.40E-07
Cobalt		3.82E-03	7.68E-06	-	3.83E-03	-	5.93E-11	-	5.93E-11
Lead		-	-	-	-	8.71E-08	4.94E-12	-	8.71E-08
Manganese		1.42E-03	2.75E-05	-	1.45E-03	-	-	-	-
Mercury		7.04E-05	3.03E-04	-	3.74E-04	-	-	-	-
Nickel		9.92E-05	8.87E-07	-	1.00E-04	-	2.96E-12	-	2.96E-12
*Total Risk/HI		1.39E-02	3.41E-04	2.73E-04	1.45E-02	8.33E-07	8.68E-11	3.51E-07	1.18E-06

TABLE A.7

SUMMARY OF OUTDOOR WORKER RISK FOR SURFACE SOIL

OU3

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	25400	3.23E+09	3.13
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		1.28E+01	9.86E-06	8.14E-10	-	3.52E-06	2.91E-07	-
Arsenic		3.26E+00	2.51E-06	2.07E-10	3.14E-07	8.97E-07	7.40E-08	1.12E-07
Benzo(a)pyrene		9.77E-01	7.53E-07	6.21E-11	4.08E-07	2.69E-07	2.22E-08	1.46E-07
Cobalt		5.77E+00	4.45E-06	3.67E-10	-	1.59E-06	1.31E-07	-
Lead		3.61E+02	2.78E-04	2.29E-08	-	9.93E-05	8.19E-06	-
Manganese		1.72E+02	1.33E-04	1.09E-08	-	4.73E-05	3.90E-06	-
Mercury		5.67E-02	4.37E-08	4.58E-07	-	1.56E-08	1.64E-04	-
Nickel		9.99E+00	7.70E-06	6.35E-10	-	2.75E-06	2.27E-07	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		2.47E-02	-	-	2.47E-02	-	-	-	-
Arsenic		8.37E-03	1.38E-05	1.05E-03	9.43E-03	1.35E-06	3.18E-10	1.68E-07	1.51E-06
Benzo(a)pyrene		-	-	-	-	1.96E-06	2.44E-11	1.06E-06	3.03E-06
Cobalt		1.48E-02	6.11E-05	-	1.49E-02	-	1.18E-09	-	1.18E-09
Lead		-	-	-	-	8.44E-07	9.83E-11	-	8.45E-07
Manganese		5.52E-03	2.19E-04	-	5.74E-03	-	-	-	-
Mercury		2.73E-04	1.53E-03	-	1.80E-03	-	-	-	-
Nickel		3.85E-04	7.05E-06	-	3.92E-04	-	5.90E-11	-	5.90E-11
*Total Risk/HI		5.40E-02	1.83E-03	1.05E-03	5.69E-02	4.15E-06	1.68E-09	1.23E-06	5.39E-06

TABLE A.8

SUMMARY OF UTILITY WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H`</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	25400	3.23E+09	3.13
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		1.28E+01	2.89E-06	7.23E-11	-	1.03E-06	2.58E-08	-
Arsenic		2.88E+00	6.51E-07	1.63E-11	6.16E-08	2.32E-07	5.81E-09	2.20E-08
Benzo(a)pyrene		1.63E-01	3.68E-08	9.21E-13	1.51E-08	1.32E-08	3.29E-10	5.40E-09
Cobalt		5.21E+00	1.18E-06	2.94E-11	-	4.21E-07	1.05E-08	-
Lead		2.45E+02	5.54E-05	1.38E-09	-	1.98E-05	4.94E-07	-
Manganese		1.51E+02	3.41E-05	8.53E-10	-	1.22E-05	3.05E-07	-
Mercury		4.69E-02	1.06E-08	3.37E-08	-	3.79E-09	1.20E-05	-
Nickel		1.55E+01	3.50E-06	8.76E-11	-	1.25E-06	3.13E-08	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		7.23E-03	-	-	7.23E-03	-	-	-	-
Arsenic		2.17E-03	1.08E-06	2.05E-04	2.38E-03	3.49E-07	2.50E-11	3.30E-08	3.82E-07
Benzo(a)pyrene		-	-	-	-	9.61E-08	3.62E-13	3.94E-08	1.35E-07
Cobalt		3.93E-03	4.91E-06	-	3.93E-03	-	9.46E-11	-	9.46E-11
Lead		-	-	-	-	1.68E-07	5.93E-12	-	1.68E-07
Manganese		1.42E-03	1.71E-05	-	1.44E-03	-	-	-	-
Mercury		6.63E-05	1.12E-04	-	1.79E-04	-	-	-	-
Nickel		1.75E-04	9.73E-07	-	1.76E-04	-	8.13E-12	-	8.13E-12
*Total Risk/HI		1.50E-02	1.36E-04	2.05E-04	1.53E-02	6.13E-07	1.34E-10	7.24E-08	6.85E-07

TABLE A.9

SUMMARY OF CONSTRUCTION WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	5090	3.23E+09	3.13
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		1.28E+01	2.89E-06	7.23E-11	-	4.13E-08	1.03E-09	-
Arsenic		2.88E+00	6.51E-07	1.63E-11	6.16E-08	9.30E-09	2.32E-10	8.80E-10
Benzo(a)pyrene		1.63E-01	3.68E-08	9.21E-13	1.51E-08	5.26E-10	1.32E-11	2.16E-10
Cobalt		5.21E+00	1.18E-06	2.94E-11	-	1.68E-08	4.20E-10	-
Lead		2.45E+02	5.54E-05	1.38E-09	-	7.91E-07	1.98E-08	-
Manganese		1.51E+02	3.41E-05	8.53E-10	-	4.88E-07	1.22E-08	-
Mercury		4.69E-02	1.06E-08	1.68E-07	-	1.51E-10	2.41E-06	-
Nickel		1.55E+01	3.50E-06	8.76E-11	-	5.00E-08	1.25E-09	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		7.23E-03	-	-	7.23E-03	-	-	-	-
Arsenic		2.17E-03	1.08E-06	2.05E-04	2.38E-03	1.39E-08	9.99E-13	1.32E-09	1.53E-08
Benzo(a)pyrene		-	-	-	-	3.84E-09	1.45E-14	1.58E-09	5.42E-09
Cobalt		3.93E-03	4.91E-06	-	3.93E-03	-	3.78E-12	-	3.78E-12
Lead		-	-	-	-	6.72E-09	2.37E-13	-	6.72E-09
Manganese		1.42E-03	1.71E-05	-	1.44E-03	-	-	-	-
Mercury		6.63E-05	5.61E-04	-	6.28E-04	-	-	-	-
Nickel		1.75E-04	9.73E-07	-	1.76E-04	-	3.25E-13	-	3.25E-13
*Total Risk/HI		1.50E-02	5.85E-04	2.05E-04	1.58E-02	2.45E-08	5.36E-12	2.90E-09	2.74E-08

TABLE A.10

SUMMARY OF RESIDENT RISK FOR INDOOR AIR
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Mercury	No	Yes	-		0.0003	IRIS

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Soil Concentration ($\mu\text{g}/\text{kg}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Mercury	4.69E+01	2.50E-01	2.40E-04	8.90E-02

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Mercury		7.99E-01	-
*Total Risk/HI		7.99E-01	-

TABLE A.11

**SUMMARY OF INDOOR WORKER RISK FOR INDOOR AIR
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Mercury	No	Yes	-		0.0003	IRIS

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Soil Concentration ($\mu\text{g}/\text{kg}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Mercury	4.69E+01	3.74E-01	8.54E-05	3.05E-02

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Mercury		2.85E-01	-
*Total Risk/HI		2.85E-01	-

Appendix B

OU-4 Risk Tables

Appendix B

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TABLE B.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	<u>Metals</u>												
7440-36-0	Antimony	1.97		2.4		mg/kg	AOI 16: BH39-11, 0-2 ftbgs (09/26/11)	2/9	0.4 - 19.8	2.4	3.1	N	BSC
7440-38-2	Arsenic	0.58		3.36		mg/kg	AOI 17: BH46-11, 0-2 ftbgs (09/26/11)	9/9	--	3.36	11	C	BSC
7440-39-3	Barium	456.9		1128.8		mg/kg	AOI 17: BH46-11, 0-2 ftbgs (09/26/11)	9/9	--	1128.8	1500	N	BSC
7440-43-9	Cadmium	1.95		2.12		mg/kg	AOI 16: BH41-11, 0-2 ftbgs (09/27/11)	2/9	0.21 - 1.7	2.12	7	N	BSC
7440-70-2	Calcium	850		30910		mg/kg	AOI 16: BH42-11, 0-2 ftbgs (09/27/11)	9/9	--	30910	--		NTX; NUT
7440-47-3	Chromium	16.9		75.4		mg/kg	AOI 17: BH45-11, 0-2 ftbgs (09/26/11)	9/9	--	75.4	12000	N	BSC
7440-48-4	Cobalt	36.7		68.3		mg/kg	AOI 17: BH44-11, 0-2 ftbgs (09/26/11)	3/9	313	68.3	34	N	ASC
7440-50-8	Copper	9.2		22.3		mg/kg	AOI 17: BH44-11, 0-2 ftbgs (09/26/11)	8/9	8.6	22.3	310	N	BSC
7439-89-6	Iron	10853		33616		mg/kg	AOI 17: BH46-11, 0-2 ftbgs (09/26/11)	9/9	--	33616	74767	N	BSC
7439-92-1	Lead	9.4		23.8		mg/kg	AOI 16: BH39-11, 0-2 ftbgs (09/26/11)	9/9	--	23.8	400	C	BSC
7439-96-5	Manganese	229.4		2552.2		mg/kg	AOI 17: BH46-11, 0-2 ftbgs (09/26/11)	9/9	--	2552.2	2100	N	ASC
7440-02-0	Nickel	9.2		41.8		mg/kg	AOI 17: BH44-11, 0-2 ftbgs (09/26/11)	9/9	--	41.8	150	N	BSC
7440-22-4	Silver	1.82		1.82		mg/kg	AOI 16: BH42-11, 0-2 ftbgs (09/27/11)	1/9	0.2 - 3	1.82	39	N	BSC
7440-32-6	Titanium	208		6483		mg/kg	AOI 17: BH43-11, 0-2 ftbgs (09/26/11)	9/9	--	6483	--		NTX
7440-62-6	Vanadium	14.5		65.3		mg/kg	AOI 17: BH44-11, 0-2 ftbgs (09/26/11)	3/9	56	65.3	134	N	BSC
7440-66-6	Zinc	9.5		195.7		mg/kg	AOI 16: BH39-11, 0-2 ftbgs (09/26/11)	9/9	--	195.7	2300	N	BSC

Notes:

- C Carcinogenic; analyte considered to be a carcinogen.
N Non-Carcinogenic; analyte considered to be a non-carcinogen.
-- Not Available

- (1) Minimum/maximum detected concentration.
(2) Based on data collected from sampling locations: BH38-11, BH39-11, BH40-11, BH41-11, BH42-11, BH43-11, BH44-11, BH45-11, BH46-11.
(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.
(4) Rationale Codes
Selection Reason Maximum detected above Screening Criterion (ASC)
Deletion Reason Maximum detected below Screening Criterion (BSC)
No Toxicity Data (NTX)
Essential Nutrient (NUT)

TABLE B.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Subsurface Soil (2-10 ftbgs)
Exposure Medium: Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
VOCs													
71-43-2	Benzene	0.033	J	0.033	J	mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	1/3	0.078 - 0.085	0.033	1.2	C	BSC
67-66-3	Chloroform (Trichloromethane)	0.029	J	0.029	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.082 - 0.088	0.029	0.32	C	BSC
110-82-7	Cyclohexane	0.5		1.4		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/3	0.082	1.4	650	N	BSC
100-41-4	Ethylbenzene	0.4		0.4		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.082 - 0.088	0.4	5.8	C	BSC
98-82-8	Isopropyl benzene	0.33		0.33		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.082 - 0.088	0.33	190	N	BSC
108-87-2	Methyl cyclohexane	0.55		1.9		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/3	0.082	1.9	650 (5)	N	BSC
SVOCs													
91-57-6	2-Methylnaphthalene	0.15	J	1.7		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/3	0.36	1.7	1	N	X ASC
205-99-2	Benzo(b)fluoranthene	0.014	J	0.014	J	mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	1/3	0.036 - 0.073	0.014	0.9	C	BSC
92-52-4	Biphenyl (1,1-Biphenyl)	0.31	J	0.31	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.36 - 0.37	0.31	4.7	N	BSC
117-81-7	bis(2-Ethylhexyl)phthalate (DEHP)	0.43	J	0.43	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.36 - 0.37	0.43	38	C	BSC
86-73-7	Fluorene	0.93		0.93		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.36 - 0.37	0.93	300	N	BSC
91-20-3	Naphthalene	0.23	J	0.23	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.36 - 0.37	0.23	5	C	BSC
85-01-8	Phenanthrene	0.092	J	1.7		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/3	0.36	1.7	1000	N	BSC
129-00-0	Pyrene	0.44	J	0.44	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	1/3	0.36 - 0.37	0.44	230	N	BSC
Metals													
7429-90-5	Aluminum	5280		8330		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/2	--	8330	51200	N	BSC
7440-38-2	Arsenic	1.28		2.03		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	2/3	1.3 - 1.7	2.03	11	C	BSC
7440-39-3	Barium	21.7	J	1030.5		mg/kg	AOI 16: BH40-11, 9-10 ftbgs (09/26/11)	3/3	--	1030.5	1500	N	BSC
7440-41-7	Beryllium	0.36	J	0.37	J	mg/kg	AOI 16: BH40-11, 9-10 ftbgs (09/26/11)	2/2	--	0.37	16	N	BSC
7440-70-2	Calcium	2305		7360		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	3/3	1080	7360	--		NTX; NUT
7440-47-3	Chromium	21.2		50.7		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	2/3	6.2 - 11.7	50.7	12000	N	BSC
7440-48-4	Cobalt	3.2	J	3.7	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/3	313	3.7	34	N	BSC
7440-50-8	Copper	2.9	J	8.8		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	3/3	3.4	8.8	310	N	BSC
7439-89-6	Iron	7930		23540		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	3/3	--	23540	74767	N	BSC
7439-92-1	Lead	10.6		17.4		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	3/3	3.7	17.4	400	C	BSC
7439-95-4	Magnesium	282	J	3900		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/2	--	3900	--		NTX; NUT
7439-96-5	Manganese	124	J	2014.6		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	3/3	--	2014.6	2100	N	BSC
7440-02-0	Nickel	3.7	J	28.5		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	3/3	--	28.5	150	N	BSC
7440-09-7	Potassium	126	J	399	J	mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/2	--	399	--		NTX; NUT
7440-22-4	Silver	1.9		1.9		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	1/3	0.84 - 2.2	1.9	39	N	BSC

TABLE B.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Subsurface Soil (2-10 ftbgs)
Exposure Medium: Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	<u>Metals (cont.'d)</u>												
7440-32-6	Titanium	232.2		522		mg/kg	AOI 16: BH38-11, 9-10 ftbgs (09/26/11)	2/2	--	522	--		NTX
7440-62-6	Vanadium	12.3		17.2		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	2/3	56	17.2	134	N	BSC
7440-66-6	Zinc	9.4		56.4		mg/kg	AOI 16: BH39-11, 4-5 ftbgs (09/26/11)	3/3	--	56.4	2300	N	BSC

Notes:

C Carcinogenic; analyte considered to be a carcinogen.

N Non-Carcinogenic; analyte considered to be a non-carcinogen.

-- Not Available

J Result is an estimated value.

(1) Minimum/maximum detected concentration.

(2) Based on data collected from sampling locations: BH38-11, BH39-11, BH40-11.

(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.

(4) Rationale Codes Selection Reason Maximum detected above Screening Criterion (ASC)

Deletion Reason Maximum detected below Screening Criterion (BSC)

No Toxicity Data (NTX)

Essential Nutrient (NUT)

(5) No screening criterion available for this analyte, substituted cyclohexane screening criterion.

TABLE B.3

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL

OU4

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future

Medium: Surface Soil (0-2 ftbgs)

Exposure Medium: Surface Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
<u>Metals</u>									
Cobalt	mg/kg	--	--	3.70E+00		mg/kg	3.70E+00	Maximum Detected	(1)
Manganese	mg/kg	--	--	1.95E+02		mg/kg	1.95E+02	Maximum Detected	(1)

Notes:

(1) ProUCL identified data set is too small to compute reliable and meaningful statistics and estimates therefore the maximum detected concentration is the EPC value.

TABLE B.4

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE AND SUBSURFACE SOIL

OU4

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Surface and Subsurface Soil (0-10 ftbgs)
Exposure Medium: Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
SVOCs									
2-Methylnaphthalene	mg/kg	4.60E-01	(a)	1.70E+00		mg/kg	2.91E+00	97.5% KM (Chebyshev) UCL	(4)
Metals									
Cobalt	mg/kg	--	--	3.70E+00		mg/kg	3.70E+00	Maximum Detected	(5)
Manganese	mg/kg	--	--	1.95E+02		mg/kg	1.95E+02	Maximum Detected	(5)

Notes:

- (1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).
- (2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):
- (a) Data set is neither normally, gamma or lognormally distributed.
 - (b) Data set is lognormally distributed.
 - (c) Data set is gamma distributed.
 - (d) Data set is normally distributed.
- (3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):
- 97.5% KM (Chebyshev) UCL = 97.5% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality
- (4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.
- (5) ProUCL identified data set is too small to compute reliable and meaningful statistics and estimates therefore the maximum detected concentration is the EPC value.

TABLE B.5

SUMMARY OF RESIDENT RISK FOR SURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H[*]</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Child Ingestion Noncarcinogenic CDI</i>	<i>Child Inhalation Noncarcinogenic CDI</i>	<i>Child Dermal Noncarcinogenic CDI</i>	<i>Adult Ingestion Noncarcinogenic CDI</i>	<i>Adult Inhalation Noncarcinogenic CDI</i>	<i>Adult Dermal Noncarcinogenic CDI</i>	<i>Adjusted Ingestion Noncarcinogenic CDI</i>	<i>Adjusted Inhalation Noncarcinogenic CDI</i>	<i>Adjusted Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Cobalt		3.70E+00	4.73E-05	1.10E-09	-	4.43E-06	1.10E-09	-	1.43E-05	1.10E-09	-	5.32E-06	4.08E-07	-
Manganese		1.95E+02	2.49E-03	5.78E-08	-	2.34E-04	5.78E-08	-	7.55E-04	5.78E-08	-	2.80E-04	2.15E-05	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Child Ingestion HQ</i>	<i>Child Inhalation HQ</i>	<i>Child Dermal HQ</i>	<i>Child Total HI</i>	<i>Adult Ingestion HQ</i>	<i>Adult Inhalation HQ</i>	<i>Adult Dermal HQ</i>	<i>Adult Total HI</i>	<i>Adjusted Ingestion HQ</i>	<i>Adjusted Inhalation HQ</i>	<i>Adjusted Dermal HQ</i>	<i>Adjusted Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Cobalt		1.58E-01	1.83E-04	-	1.58E-01	1.48E-02	1.83E-04	-	1.50E-02	4.78E-02	1.83E-04	-	4.79E-02	-	3.67E-09	-	3.67E-09
Manganese		1.04E-01	1.16E-03	-	1.05E-01	9.74E-03	1.16E-03	-	1.09E-02	3.15E-02	1.16E-03	-	3.26E-02	-	-	-	-
*Total Risk/HI		2.62E-01	1.34E-03	-	2.63E-01	2.45E-02	1.34E-03	-	2.59E-02	7.92E-02	1.34E-03	-	8.06E-02	-	3.67E-09	-	3.67E-09

TABLE B.6

SUMMARY OF TRESPASSER RISK FOR SURFACE SOIL

OU4

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (μg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Cobalt		3.70E+00	7.35E-07	2.96E-11	-	1.05E-07	4.22E-09	-
Manganese		1.95E+02	3.87E-05	1.56E-09	-	5.53E-06	2.22E-07	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Cobalt		2.45E-03	4.93E-06	-	2.45E-03	-	3.80E-11	-	3.80E-11
Manganese		1.61E-03	3.11E-05	-	1.65E-03	-	-	-	-
*Total Risk/HI		4.06E-03	3.61E-05	-	4.10E-03	-	3.80E-11	-	3.80E-11

TABLE B.7

SUMMARY OF OUTDOOR WORKER RISK FOR SURFACE SOIL

OU4

FORMER GM WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (μg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Cobalt		3.70E+00	2.85E-06	2.35E-10	-	1.02E-06	8.40E-08	-
Manganese		1.95E+02	1.50E-04	1.24E-08	-	5.37E-05	4.43E-06	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Cobalt		9.50E-03	3.92E-05	-	9.54E-03	-	7.56E-10	-	7.56E-10
Manganese		6.26E-03	2.48E-04	-	6.51E-03	-	-	-	-
*Total Risk/HI		1.58E-02	2.87E-04	-	1.61E-02	-	7.56E-10	-	7.56E-10

TABLE B.8

SUMMARY OF UTILITY WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H[*]</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	28300	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Cobalt		3.70E+00	8.36E-07	2.09E-11	-	2.99E-07	7.47E-09	-
Manganese		1.95E+02	4.41E-05	1.10E-09	-	1.57E-05	3.93E-07	-
Methylnaphthalene, 2-		2.91E+00	6.58E-07	1.88E-06	2.70E-07	2.35E-07	6.71E-04	9.63E-08

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Cobalt		2.79E-03	3.48E-06	-	2.79E-03	-	6.72E-11	-	6.72E-11
Manganese		1.84E-03	2.20E-05	-	1.86E-03	-	-	-	-
Methylnaphthalene, 2-		1.64E-04	-	6.74E-05	2.32E-04	-	-	-	-
*Total Risk/HI		4.79E-03	2.55E-05	6.74E-05	4.88E-03	-	6.72E-11	-	6.72E-11

TABLE B.9

SUMMARY OF CONSTRUCTION WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{hw}	H [*]	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	5660	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

Chemical		Concentration (mg/kg)	Ingestion Noncarcinogenic CDI	Inhalation Noncarcinogenic CDI	Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Cobalt		3.70E+00	8.36E-07	2.09E-11	-	1.19E-08	2.99E-10	-
Manganese		1.95E+02	4.41E-05	1.10E-09	-	6.30E-07	1.57E-08	-
Methylnaphthalene, 2-		2.91E+00	6.58E-07	9.39E-06	2.70E-07	9.40E-09	1.34E-04	3.85E-09

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Cobalt		2.79E-03	3.48E-06	-	2.79E-03	-	2.69E-12	-	2.69E-12
Manganese		1.84E-03	2.20E-05	-	1.86E-03	-	-	-	-
Methylnaphthalene, 2-		1.64E-04	-	6.74E-05	2.32E-04	-	-	-	-
*Total Risk/HI		4.79E-03	2.55E-05	6.74E-05	4.88E-03	-	2.69E-12	-	2.69E-12

TABLE B.10

SUMMARY OF RESIDENT RISK FOR INDOOR AIR
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Methylnaphthalene, 2-	No	Yes	-		-	

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Soil Concentration ($\mu\text{g}/\text{kg}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Methylnaphthalene, 2-	2.91E+03	6.49E+00	6.22E-03	2.31E+00

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Mercury		-	-
*Total Risk/HI		-	-

TABLE B.11

SUMMARY OF INDOOR WORKER RISK FOR INDOOR AIR
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Methylnaphthalene, 2-	No	Yes	-		-	

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Soil Concentration ($\mu\text{g}/\text{kg}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Methylnaphthalene, 2-	2.91E+03	9.72E+00	2.22E-03	7.93E-01

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Methylnaphthalene, 2-		-	-
*Total Risk/HI		-	-

Appendix C

OU-5 Risk Tables

Appendix C

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TABLE C.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
VOCs													
120-82-1	1,2,4-Trichlorobenzene	0.92		0.92		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	1/5	0.082 - 0.12	0.92	5.8	N	BSC
541-73-1	1,3-Dichlorobenzene	0.14		0.14		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	1/5	0.082 - 0.12	0.14	180 (5)	N	BSC
106-46-7	1,4-Dichlorobenzene	5.1		5.1		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	1/5	0.082 - 0.12	5.1	2.6	C	ASC
71-43-2	Benzene	0.29		0.75		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	2/5	0.082 - 0.1	0.75	1.2	C	BSC
156-59-2	cis-1,2-Dichloroethene	0.065	J	0.065	J	mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	1/5	0.082 - 0.12	0.065	16	N	BSC
110-82-7	Cyclohexane	0.13		1.1		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	2/5	0.082 - 0.1	1.1	650	N	BSC
100-41-4	Ethylbenzene	0.26		22		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	2/5	0.082 - 0.1	22	5.8	C	ASC
98-82-8	Isopropyl benzene	0.16		3.1		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	2/5	0.082 - 0.1	3.1	190	N	BSC
108-87-2	Methyl cyclohexane	0.081	J	13		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	3/5	0.082 - 0.087	13	650 (6)	N	BSC
108-88-3	Toluene	0.051	J	12		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	3/5	0.082 - 0.087	12	490	N	BSC
79-01-6	Trichloroethene	0.18		0.18		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	1/5	0.082 - 0.12	0.18	0.41	N	BSC
1330-20-7	Xylenes (total)	0.059		100		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	3/5	0.25 - 0.26	100	58	N	ASC
SVOCs													
91-57-6	2-Methylnaphthalene	4.2	J	4.2	J	mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	1/6	0.35 - 0.44	4.2	1	N	ASC
106-44-5	4-Methylphenol	0.089	J	0.089	J	mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	1/6	0.35 - 8.7	0.089	620	N	BSC
56-55-3	Benzo(a)anthracene	0.11		0.19		mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	2/6	0.035 - 0.87	0.19	0.9	C	BSC
50-32-8	Benzo(a)pyrene	0.019	J	0.2		mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	4/6	0.035 - 0.87	0.2	0.09	C	ASC
205-99-2	Benzo(b)fluoranthene	0.021	J	0.3		mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	4/6	0.035 - 0.87	0.3	0.9	C	BSC
191-24-2	Benzo(g,h,i)perylene	0.082	J	0.27	J	mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	2/6	0.35 - 8.7	0.27	1 (7)	N	BSC
207-08-9	Benzo(k)fluoranthene	0.13		0.13		mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	1/6	0.035 - 0.87	0.13	9	C	BSC
117-81-7	bis(2-Ethylhexyl)phthalate (DEHP)	0.16	J	2		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	2/6	0.35 - 8.7	2	38	C	BSC
85-68-7	Butyl benzylphthalate (BBP)	0.17	J	0.76		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	3/6	0.35 - 8.7	0.76	280	C	BSC
218-01-9	Chrysene	0.07	J	0.24	J	mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	3/6	0.35 - 8.7	0.24	87	C	BSC
53-70-3	Dibenz(a,h)anthracene	0.014	J	0.045		mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	3/6	0.035 - 0.87	0.045	0.09	C	BSC
84-74-2	Di-n-butylphthalate (DBP)	150		150		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	1/6	0.35 - 0.75	150	620	N	BSC
206-44-0	Fluoranthene	0.12	J	0.32	J	mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	3/6	0.35 - 8.7	0.32	310	N	BSC
193-39-5	Indeno(1,2,3-cd)pyrene	0.014	J	0.27	J	mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	4/6	0.035 - 0.87	0.27	0.9	C	BSC
91-20-3	Naphthalene	22		22		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	1/6	0.35 - 0.44	22	5	C	ASC
85-01-8	Phenanthrene	0.12	J	0.14	J	mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	2/6	0.35 - 8.7	0.14	1000	N	BSC
129-00-0	Pyrene	0.12	J	0.33	J	mg/kg	AOI 12: BH19-11, 0-2 ftbgs (09/29/11)	3/6	0.35 - 8.7	0.33	230	N	BSC
Metals													
7429-90-5	Aluminum	5200		12300		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	14/14	--	12300	51200	N	BSC
7440-36-0	Antimony	1.7	J	1896		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	14/35	0.1 - 94	1896	3.1	N	ASC
7440-38-2	Arsenic	0.68		3578		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	--	3578	11	C	ASC
7440-39-3	Barium	54.9		688400		mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	85/85	--	688400	1500	N	ASC
7440-41-7	Beryllium	0.19	J	0.66		mg/kg	AOI 12: BH20-11, 0-2 ftbgs (10/03/11)	13/14	2.7	0.66	16	N	BSC
7440-43-9	Cadmium	0.24	J	2946		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	63/82	0.2 - 2.5	2946	7	N	ASC
7440-70-2	Calcium	380	J	59740		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	35/35	--	59740	--		NTX; NUT
7440-47-3	Chromium	11.2		25200		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	17.4 - 18	25200	12000	N	ASC

TABLE C.1

**OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
7440-48-4	<u>Metals (cont.'d)</u>	1.5	J	778		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	29/35	7.1 - 313	778	34	N	ASC
7440-50-8	Cobalt	2		3200		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	--	3200	310	N	ASC
7439-89-6	Copper	1.8935		264440		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	--	264440	74767	N	ASC
7439-92-1	Iron	5.9		35480		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	--	35480	400	C	ASC
7439-95-4	Lead	497	J	14000		mg/kg	AOI 12: BH20-11, 0-2 ftbgs (10/03/11)	14/14	--	14000	--		NTX; NUT
7439-96-5	Magnesium	23.6		3130		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	--	3130	2100	N	ASC
7439-97-6	Manganese	0.045		52.5		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	61/82	0.31 - 6.5	52.5	0.94	N	ASC
7440-02-0	Mercury	3.1	J	468		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	35/35	--	468	150	N	ASC
7440-09-7	Nickel	269	J	1330		mg/kg	AOI 12: TT-52, 0-2 ftbgs (09/10/12)	14/14	--	1330	--		NTX; NUT
7782-49-2	Potassium	0.48		177.9		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	8/35	0.05 - 39	177.9	39	N	ASC
7440-22-4	Selenium	1.5	J	1.8	J	mg/kg	AOI 12: BH34-11, 0-2 ftbgs (09/29/11)	3/35	0.07 - 13.3	1.8	39	N	BSC
7440-23-5	Silver	167	J	932	J	mg/kg	AOI 12: MW29-11, 0-2 ftbgs (09/27/11)	11/14	1060 - 1240	932	--		NTX; NUT
7440-28-0	Sodium	0.91		19.1		mg/kg	AOI 12: BH23-11, 0-2 ftbgs (09/27/11)	4/35	0.002 - 13.3	19.1	0.078	N	ASC
7440-32-6	Thallium	476.1		118610		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	28/28	--	118610	--		NTX
7440-62-6	Titanium	17		383		mg/kg	AOI 12: BH34-11, 0-2 ftbgs (09/29/11)	26/35	0.6 - 56	383	134	N	ASC
7440-66-6	Vanadium	11.3		105200		mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	85/85	--	105200	2300	N	ASC
50-29-3	<u>Pesticides</u>												
7421-93-4	4,4'-DDT	0.0059	J	0.0059	J	mg/kg	AOI 12: BH14-11, 0-2 ftbgs (09/26/11)	1/6	0.0081 - 0.0089	0.0059	1.9	C	BSC
53494-70-5	Endrin aldehyde	0.021		0.07	J	mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	2/6	0.0072 - 0.0089	0.07	1.8 (8)	N	BSC
72-43-5	Endrin ketone	0.029	J	0.029	J	mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	1/6	0.0072 - 0.0089	0.029	1.8 (8)	N	BSC
	Methoxychlor	0.013	J	0.013	J	mg/kg	AOI 12: BH27-11, 0-2 ftbgs (09/29/11)	1/6	0.0072 - 0.0089	0.013	31	N	BSC

Notes:

- C Carcinogenic; analyte considered to be a carcinogen.
N Non-Carcinogenic; analyte considered to be a non-carcinogen.
-- Not Available
J Result is an estimated value.

- (1) Minimum/maximum detected concentration.
(2) Based on data collected from sampling locations: BH13-11, BH14-11, BH15-11, BH16-11, BH17-11, BH18-11, BH19-11, BH20-11, BH21-11, BH22-11, BH23-11, BH24-11, BH25-11, BH26-11, BH27-11, BH28-11, BH29-11, BH30-11, BH31-11, BH32-11, BH33-11, BH34-11, BH35-11, BH53-11, BH54-11, BH55-11, BH56-11, MW29-11, TT-1, TT-2, TT-3, TT-4, TT-5, TT-6, TT-7, TT-8, TT-9, TT-10, TT-11, TT-12, TT-13, TT-14, TT-15, TT-16, TT-17, TT-18, TT-19, TT-20, TT-21, TT-22, TT-23, TT-24, TT-25, TT-26, TT-27, TT-28, TT-29, TT-30, TT-31, TT-32, TT-33, TT-34, TT-35, TT-36, TT-37, TT-38, TT-39, TT-40, TT-41, TT-42, TT-43, TT-44, TT-45, TT-46, TT-47, TT-48, TT-49, TT-50, TT-51, TT-52, TT-53, TT-54.
(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.
(4) Rationale Codes
Selection Reason Maximum detected above Screening Criterion (ASC)
Deletion Reason Maximum detected below Screening Criterion (BSC)
No Toxicity Data (NTX)
Essential Nutrient (NUT)
(5) No screening criterion available for this analyte, substituted 1,2-dichlorobenzene screening criterion.
(6) No screening criterion available for this analyte, substituted cyclohexane screening criterion.
(7) No screening criterion available for this analyte, substituted lowest non-carcinogenic (2-methylnaphthalene) screening criterion.
(8) No screening criterion available for the isomer, substituted endrin screening criterion.

TABLE C.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Subsurface Soil (2-10 ftbgs)
Exposure Medium: Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection	
	<u>SVOCs</u>													
117-81-7	bis(2-Ethylhexyl)phthalate (DEHP)	0.12	J	0.12	J	mg/kg	AOI 12: BH27-11, 7-9 ftbgs (09/29/11)	1/4	0.37 - 0.4	0.12	38	C	BSC	
85-68-7	Butyl benzylphthalate (BBP)	0.18	J	0.18	J	mg/kg	AOI 12: BH27-11, 7-9 ftbgs (09/29/11)	1/4	0.37 - 0.4	0.18	280	C	BSC	
	<u>Metals</u>													
7429-90-5	Aluminum	5390		19600		mg/kg	AOI 12: TT-50, 2-4 ftbgs (09/06/12)	11/11	--	19600	51200	N	BSC	
7440-36-0	Antimony	1.5	J	13.9		mg/kg	AOI 12: BH18-11, 7-9 ftbgs (10/03/11)	4/30	0.2 - 19.8	13.9	3.1	N	X	ASC
7440-38-2	Arsenic	1.12		37		mg/kg	AOI 12: TT-13, 4-6 ftbgs (08/23/12)	54/54	1.2	37	11	C	X	ASC
7440-39-3	Barium	44.6	J	2443.75		mg/kg	AOI 12: TT-28, 2-4 ftbgs (08/29/12)	54/54	--	2443.75	1500	N	X	ASC
7440-41-7	Beryllium	0.19	J	1.4		mg/kg	AOI 12: TT-22, 2-4 ftbgs (08/29/12)	11/11	--	1.4	16	N		BSC
7440-43-9	Cadmium	0.24	J	22.75		mg/kg	AOI 12: TT-16, 2-4 ftbgs (08/23/12)	31/53	0 - 3.3	22.75	7	N	X	ASC
7440-70-2	Calcium	354	J	43063		mg/kg	AOI 12: BH23-11, 8-10 ftbgs (09/27/11)	30/30	--	43063	--			NTX; NUT
7440-47-3	Chromium	8.3		316.8		mg/kg	AOI 12: BH24-11, 6-8 ftbgs (10/03/11)	53/54	17.4	316.8	12000	N		BSC
7440-48-4	Cobalt	1.3	J	519		mg/kg	AOI 12: BH22-11, 8-10 ftbgs (10/03/11)	27/30	9.6 - 313	519	34	N	X	ASC
7440-50-8	Copper	4.4	J	311.75		mg/kg	AOI 12: TT-16, 2-4 ftbgs (08/23/12)	54/54	--	311.75	310	N	X	ASC
7439-89-6	Iron	5210		123620		mg/kg	AOI 12: BH22-11, 8-10 ftbgs (10/03/11)	54/54	--	123620	74767	N	X	ASC
7439-92-1	Lead	4.4		808.75		mg/kg	AOI 12: TT-27, 4-6 ftbgs (08/29/12)	52/54	2.7 - 6.6	808.75	400	C	X	ASC
7439-95-4	Magnesium	476	J	4500		mg/kg	AOI 12: BH53-11, 7-9 ftbgs (10/04/11)	11/11	--	4500	--			NTX; NUT
7439-96-5	Manganese	27.3		11074		mg/kg	AOI 12: BH22-11, 8-10 ftbgs (10/03/11)	54/54	--	11074	2100	N	X	ASC
7439-97-6	Mercury	0.027	J	6.5		mg/kg	AOI 12: TT-34, 2-4 ftbgs (08/30/12)	30/53	0.036 - 6.5	6.5	0.94	N	X	ASC
7440-02-0	Nickel	2.5	J	136.1		mg/kg	AOI 12: BH22-11, 8-10 ftbgs (10/03/11)	30/30	--	136.1	150	N		BSC
7440-09-7	Potassium	172	J	2520		mg/kg	AOI 12: BH16-11, 8-10 ftbgs (09/29/11)	11/11	--	2520	--			NTX; NUT
7782-49-2	Selenium	0.49		0.49		mg/kg	AOI 12: BH18-11, 7-9 ftbgs (10/03/11)	1/30	0.02 - 3	0.49	39	N		BSC
7440-23-5	Sodium	75.9	J	314	J	mg/kg	AOI 12: TT-34, 2-4 ftbgs (08/30/12)	8/11	1130 - 1250	314	--			NTX; NUT
7440-28-0	Thallium	0.062		0.062		mg/kg	AOI 12: BH35-11, 7-9 ftbgs (09/28/11)	1/30	0.003 - 4.4	0.062	0.078	N		BSC
7440-32-6	Titanium	1877		13654		mg/kg	AOI 12: BH22-11, 8-10 ftbgs (10/03/11)	22/22	--	13654	--			NTX
7440-62-6	Vanadium	15.5		198		mg/kg	AOI 12: BH22-11, 8-10 ftbgs (10/03/11)	29/30	56	198	134	N	X	ASC
7440-66-6	Zinc	18.5		735.5		mg/kg	AOI 12: TT-11, 4-6 ftbgs (08/23/12)	54/54	--	735.5	2300	N		BSC

TABLE C.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Subsurface Soil (2-10 ftbgs)
Exposure Medium: Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
72-54-8	<u>Pesticides</u> 4,4'-DDD	0.01		0.01		mg/kg	AOI 12: BH32-11, 5-7 ftbgs (09/29/11)	1/4	0.0074 - 0.0083	0.01	2.2	C	BSC
50-29-3	4,4'-DDT	0.019		0.019		mg/kg	AOI 12: BH32-11, 5-7 ftbgs (09/29/11)	1/4	0.0074 - 0.0083	0.019	1.9	C	BSC
7421-93-4	Endrin aldehyde	0.0086		0.0086		mg/kg	AOI 12: BH27-11, 7-9 ftbgs (09/29/11)	1/4	0.0074 - 0.0082	0.0086	1.8 (5)	N	BSC

Notes:

- C Carcinogenic; analyte considered to be a carcinogen.
N Non-Carcinogenic; analyte considered to be a non-carcinogen.
-- Not Available
J Result is an estimated value.

- (1) Minimum/maximum detected concentration.
(2) Based on data collected from sampling locations: BH13-11, BH14-11, BH15-11, BH16-11, BH18-11, BH19-11, BH20-11, BH22-11, BH23-11, BH24-11, BH26-11, BH27-11, BH28-11, BH30-11, BH31-11, BH32-11, BH33-11, BH34-11, BH35-11, BH53-11, BH54-11, BH55-11, BH56-11, TT-2, TT-3, TT-4, TT-5, TT-9, TT-10, TT-11, TT-12, TT-13, TT-16, TT-20, TT-21, TT-22, TT-23, TT-26, TT-27, TT-28, TT-30, TT-33, TT-34, TT-35, TT-37, TT-39, TT-41, TT-50.
(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.
(4) Rationale Codes
Selection Reason Maximum detected above Screening Criterion (ASC)
Deletion Reason Maximum detected below Screening Criterion (BSC)
No Toxicity Data (NTX)
Essential Nutrient (NUT)
(5) No screening criterion available for the isomer, substituted endrin screening criterion.

TABLE C.3

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
<u>VOCs</u>									
1,4-Dichlorobenzene	mg/kg	--	--	5.10E+00		mg/kg	5.10E+00	Maximum Detected	(5)
Ethylbenzene	mg/kg	4.50E+00	(a)	2.20E+01		mg/kg	5.96E+01	99% KM (Chebyshev) UCL	(4)
Xylenes (total)	mg/kg	2.04E+01	(d)	1.00E+02		mg/kg	6.69E+01	95% KM (t) UCL	(4)
<u>SVOCs</u>									
2-Methylnaphthalene	mg/kg	--	--	4.20E+00	J	mg/kg	4.20E+00	Maximum Detected	(5)
Benzo(a)pyrene	mg/kg	7.50E-02	(d)	2.00E-01		mg/kg	1.45E-01	95% KM (t) UCL	(4)
Naphthalene	mg/kg	--	--	2.20E+01		mg/kg	2.20E+01	Maximum Detected	(5)
<u>Metals</u>									
Antimony	mg/kg	1.18E+02	(d)	6.56E+02		mg/kg	2.28E+02	95% KM (t) UCL	(4)
Arsenic	mg/kg	1.72E+01	(b)	9.21E+01		mg/kg	4.48E+01	95% Chebyshev (Mean, Sd) UCL	(4)
Barium	mg/kg	3.01E+03	(b)	1.64E+04		mg/kg	1.60E+04	99% Chebyshev (Mean, Sd) UCL	(4)
Cadmium	mg/kg	5.53E+01	(c)	5.86E+02		mg/kg	4.15E+02	95% Adjusted Gamma KM-UCL	(4)
Chromium	mg/kg	5.04E+01	(c)	2.48E+02		mg/kg	1.24E+02	95% KM (Chebyshev) UCL	(4)
Cobalt	mg/kg	5.86E+00	(d)	1.00E+01		mg/kg	6.92E+00	95% Student's-t UCL	(4)
Copper	mg/kg	6.65E+01	(c)	2.71E+02		mg/kg	1.47E+02	95% Adjusted Gamma UCL	(4)
Iron	mg/kg	2.55E+04	(d)	8.24E+04		mg/kg	7.47E+04	95% Student's-t UCL	(4)
Lead	mg/kg	3.15E+03	(c)	1.37E+04		mg/kg	9.90E+03	95% Adjusted Gamma UCL	(4)
Manganese	mg/kg	2.87E+02	(d)	6.55E+02		mg/kg	3.80E+02	95% Student's-t UCL	(4)
Mercury	mg/kg	9.63E-02	(d)	2.70E-01		mg/kg	1.31E-01	95% Student's-t UCL	(4)
Nickel	mg/kg	2.12E+01	(b)	7.62E+01		mg/kg	4.69E+01	95% Chebyshev(Mean, Sd) UCL	(6)
Selenium	mg/kg	1.14E+01	(d)	1.10E+02		mg/kg	2.65E+01	95% KM (t) UCL	(4)
Vanadium	mg/kg	2.60E+01	(d)	4.03E+01		mg/kg	2.85E+01	95% Student's-t UCL	(4)
Zinc	mg/kg	2.78E+03	(b)	1.69E+04		mg/kg	1.65E+04	99% Chebyshev (Mean, Sd) UCL	(4)

Notes:

J - Result is an estimated value.

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% KM (Chebyshev) UCL = 95% UCL based upon Kaplan-Meier Estimates using the Chebyshev Inequality

95% Chebyshev (Mean, Sd) UCL = 95% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

95% Student's-t UCL = 95% UCL of the mean based upon the student's-t statistic

95% Adjusted Gamma KM-UCL = adjusted gamma UCL based upon Kaplan-Meier Estimates for non-detects using chi-square

95% Adjusted Gamma UCL = adjusted gamma UCL using chi-square

99% KM (Chebyshev) UCL = 99% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

99% Chebyshev (Mean, Sd) UCL = 99% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

(5) ProUCL identified only one distinct detected value. ProUCL (or any other software) should not be used on such a data set and therefore the maximum detected concentration is the EPC value.

(6) ProUCL recommended method is 95% H-UCL. H-statistic often results in unstable (both high and low) values, therefore USEPA (2013) recommends Chebyshev inequality based UCL (pg.54) USEPA, September 2013. ProUCL Version 5.0.00 Technical Guide. United States Environmental Protection Agency, Office of Research and Development, Washington DC. EPA/600/R 07/041

TABLE C.4

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE AND SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Surface and Subsurface Soil (0-10 ftbgs)
Exposure Medium: Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
<u>VOCs</u>									
1,4-Dichlorobenzene	mg/kg	--	--	5.10E+00	J	mg/kg	5.10E+00	Maximim Detected	(5)
Ethylbenzene	mg/kg	2.54E+00	(a)	2.20E+01		mg/kg	3.48E+01	99% KM (Chebyshev) UCL	(4)
Xylenes (total)	mg/kg	1.14E+01	(d)	1.00E+02		mg/kg	3.52E+01	95% KM (t) UCL	(4)
<u>SVOCs</u>									
2-Methylnaphthalene	mg/kg	--	--	4.20E+00	J	mg/kg	4.20E+00	Maximim Detected	(5)
Benzo(a)pyrene	mg/kg	5.01E-02	(d)	2.00E-01		mg/kg	9.05E-02	95% KM (t) UCL	(4)
Naphthalene	mg/kg	--	--	2.20E+01		mg/kg	2.20E+01	Maximim Detected	(5)
<u>Metals</u>									
Antimony	mg/kg	6.65E+01	(c)	6.56E+02	J	mg/kg	2.25E+02	95% Adjusted Gamma KM-UCL	(4)
Arsenic	mg/kg	1.13E+01	(b)	9.21E+01		mg/kg	3.43E+01	97.5% KM (Chebyshev) UCL	(4)
Barium	mg/kg	1.73E+03	(a)	1.64E+04		mg/kg	5.13E+03	95% Chebyshev (Mean, Sd) UCL	(4)
Cadmium	mg/kg	3.11E+01	(a)	5.86E+02		mg/kg	2.66E+02	99% KM (Chebyshev) UCL	(4)
Chromium	mg/kg	4.10E+01	(b)	2.48E+02		mg/kg	8.29E+01	95% KM (Chebyshev) UCL	(4)
Cobalt	mg/kg	7.55E+00	(b)	6.59E+01		mg/kg	1.84E+01	95% KM (Chebyshev) UCL	(4)
Copper	mg/kg	4.15E+01	(b)	2.71E+02		mg/kg	1.05E+02	95% Chebyshev (Mean, Sd) UCL	(4)
Iron	mg/kg	2.33E+04	(d)	8.24E+04		mg/kg	2.85E+04	95% Student's-t UCL	(4)
Lead	mg/kg	1.77E+03	(a)	1.37E+04		mg/kg	9.80E+03	99% Chebyshev (Mean, Sd) UCL	(4)
Manganese	mg/kg	2.76E+02	(b)	1.95E+03		mg/kg	4.27E+02	95% Adjusted Gamma UCL	(4)
Mercury	mg/kg	7.04E-02	(b)	2.70E-01		mg/kg	1.24E-01	95% KM (Chebyshev) UCL	(4)
Nickel	mg/kg	1.59E+01	(b)	7.62E+01		mg/kg	3.14E+01	95% Chebyshev(Mean, Sd) UCL	(6)
Selenium	mg/kg	7.29E+00	(d)	1.10E+02		mg/kg	1.57E+01	95% KM (t) UCL	(4)
Vanadium	mg/kg	3.12E+01	(c)	6.15E+01		mg/kg	3.57E+01	95% Adjusted Gamma UCL	(4)
Zinc	mg/kg	1.57E+03	(a)	1.69E+04		mg/kg	6.62E+03	97.5% Chebyshev (Mean, Sd) UCL	(4)

Notes:

J - Result is an estimated value.

VOCs - Volatile Organic Compounds

SVOCs - Semi-volatile Organic Compounds

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% KM (Chebyshev) UCL = 95% UCL based upon Kaplan-Meier Estimates using the Chebyshev Inequality

95% Chebyshev (Mean, Sd) UCL = 95% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

95% Student's-t UCL = 95% UCL of the mean based upon the student's-t statistic

95% Adjusted Gamma KM-UCL = adjusted gamma UCL based upon Kaplan-Meier Estimates for non-detects using chi-square

95% Adjusted Gamma UCL = adjusted gamma UCL using chi-square

97.5% KM (Chebyshev) UCL = 97.5% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

99% KM (Chebyshev) UCL = 99% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

99% Chebyshev (Mean, Sd) UCL = 99% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

(5) ProUCL identified only one distinct detected value. ProUCL (or any other software) should not be used on such a data set and therefore the maximum detected concentration is the EPC value.

(6) ProUCL recommended method is 95% H-UCL. H-statistic often results in unstable (both high and low) values, therefore USEPA (2013) recommends Chebyshev inequality based UCL (pg.54) USEPA, September 2013. ProUCL Version 5.0.00 Technical Guide. United States Environmental Protection Agency, Office of Research and Development, Washington DC. EPA/600/R 07/041

TABLE C.5
SUMMARY OF RESIDENT RISK FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA																			
Chemical	Mutagen ?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{iw}	H ⁺	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Barium	No	No	0.2	IRIS	0.0005	HEAST	-		-		0.07	-	-	-	-	41	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cadmium	No	No	0.001	IRIS	0.00001	ATSDR F	-		0.0018	IRIS	0.025	0.001	-	-	-	75	-	3.23E+09	-
Chromium	No	No	1.5	IRIS	-		-		-		0.013	-	-	-	-	1800000	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Copper	No	No	0.04	HEAST	-		-		-		1	-	-	-	-	35	-	3.23E+09	-
Dichlorobenzene, 1,4-	No	Yes	0.07	ATSDR F	0.8	IRIS	0.0054	CALEPA	0.000011	CALEPA	1	-	0.055	0.00000868	0.0985	0.7506	5230	3.23E+09	-
Ethylbenzene	No	Yes	0.1	IRIS	1	IRIS	0.011	CALEPA	0.0000025	CALEPA	1	-	0.0685	0.00000846	0.322	0.8922	2880	3.23E+09	167
Iron	No	No	0.7	PPRTV C	-		-		-		1	-	-	-	-	25	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	25900	3.23E+09	3.13
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	28800	3.23E+09	-
Naphthalene	No	Yes	0.02	IRIS	0.003	IRIS	-		0.000034	CALEPA	1	0.13	0.0605	0.00000838	0.018	3.088	23100	3.23E+09	-
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-
Selenium	No	No	0.005	IRIS	0.02	CALEPA	-		-		1	-	-	-	-	5	-	3.23E+09	-
Vanadium	No	No	0.00504	SURROGA	0.0001	ATSDR F	-		-		0.026	-	-	-	-	1000	-	3.23E+09	-
Xylenes (total)	No	Yes	0.2	IRIS	0.1	IRIS	-		-		1	-	0.0847	0.0000099	0.212	0.7658	2940	3.23E+09	88.9
Zinc	No	No	0.3	IRIS	-		-		-		1	-	-	-	-	62	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)														
Chemical		Concentration (mg/kg)	Child Ingestion Noncarcinogenic CDI	Child Inhalation Noncarcinogenic CDI	Child Dermal Noncarcinogenic CDI	Adult Ingestion Noncarcinogenic CDI	Adult Inhalation Noncarcinogenic CDI	Adult Dermal Noncarcinogenic CDI	Adjusted Ingestion Noncarcinogenic CDI	Adjusted Inhalation Noncarcinogenic CDI	Adjusted Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Antimony		2.28E+02	2.92E-03	6.76E-08	-	2.73E-04	6.76E-08	-	8.83E-04	6.76E-08	-	3.28E-04	2.51E-05	-
Arsenic		4.48E+01	5.73E-04	1.33E-08	4.62E-05	5.37E-05	1.33E-08	6.80E-06	1.73E-04	1.33E-08	1.59E-05	6.44E-05	4.94E-06	5.91E-06
Barium		1.60E+04	2.05E-01	4.75E-06	-	1.92E-02	4.75E-06	-	6.20E-02	4.75E-06	-	2.30E-02	1.76E-03	-
Benzo(a)pyrene		1.45E-01	1.85E-06	4.30E-11	6.48E-07	1.74E-07	4.30E-11	9.54E-08	5.62E-07	4.30E-11	2.23E-07	9.47E-07	4.42E-08	3.51E-07
Cadmium		4.15E+02	5.31E-03	1.23E-07	1.43E-05	4.97E-04	1.23E-07	2.10E-06	1.61E-03	1.23E-07	4.91E-06	5.97E-04	4.57E-05	1.82E-06
Chromium		1.24E+02	1.59E-03	3.68E-08	-	1.49E-04	3.68E-08	-	4.80E-04	3.68E-08	-	1.78E-04	1.37E-05	-
Cobalt		6.92E+00	8.85E-05	2.05E-09	-	8.29E-06	2.05E-09	-	2.68E-05	2.05E-09	-	9.95E-06	7.62E-07	-
Copper		1.47E+02	1.88E-03	4.36E-08	-	1.76E-04	4.36E-08	-	5.69E-04	4.36E-08	-	2.11E-04	1.62E-05	-
Dichlorobenzene, 1,4-		5.10E+00	6.52E-05	9.35E-04	-	6.11E-06	9.35E-04	-	1.97E-05	9.35E-04	-	7.34E-06	3.47E-01	-
Ethylbenzene		5.96E+01	7.62E-04	1.99E-02	-	7.14E-05	1.99E-02	-	2.31E-04	1.99E-02	-	8.57E-05	7.38E+00	-
Iron		7.47E+04	9.55E-01	2.22E-05	-	8.95E-02	2.22E-05	-	2.89E-01	2.22E-05	-	1.07E-01	8.23E-03	-
Lead		9.90E+03	1.27E-01	2.94E-06	-	1.19E-02	2.94E-06	-	3.83E-02	2.94E-06	-	1.42E-02	1.09E-03	-
Manganese		3.80E+02	4.86E-03	1.13E-07	-	4.55E-04	1.13E-07	-	1.47E-03	1.13E-07	-	5.47E-04	4.19E-05	-
Mercury		1.31E-01	1.67E-06	4.84E-06	-	1.57E-07	4.84E-06	-	5.07E-07	4.84E-06	-	1.88E-07	1.80E-03	-
Methylnaphthalene, 2-		4.20E+00	5.37E-05	1.40E-04	1.88E-05	5.03E-06	1.40E-04	2.76E-06	1.63E-05	1.40E-04	6.46E-06	6.04E-06	5.19E-02	2.40E-06
Naphthalene		2.20E+01	2.81E-04	9.15E-04	9.84E-05	2.64E-05	9.15E-04	1.45E-05	8.52E-05	9.15E-04	3.38E-05	3.16E-05	3.40E-01	1.26E-05
Nickel		4.69E+01	6.00E-04	1.39E-08	-	5.62E-05	1.39E-08	-	1.82E-04	1.39E-08	-	6.75E-05	5.17E-06	-
Selenium		2.65E+01	3.39E-04	7.86E-09	-	3.18E-05	7.86E-09	-	1.03E-04	7.86E-09	-	3.81E-05	2.92E-06	-
Vanadium		2.85E+01	3.64E-04	8.45E-09	-	3.42E-05	8.45E-09	-	1.10E-04	8.45E-09	-	4.10E-05	3.14E-06	-
Xylenes (total)		6.69E+01	8.55E-04	2.18E-02	-	8.02E-05	2.18E-02	-	2.59E-04	2.18E-02	-	9.62E-05	8.10E+00	-
Zinc		1.65E+04	2.11E-01	4.89E-06	-	1.98E-02	4.89E-06	-	6.39E-02	4.89E-06	-	2.37E-02	1.82E-03	-

TABLE C.5
SUMMARY OF RESIDENT RISK FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Child Ingestion HQ</i>	<i>Child Inhalation HQ</i>	<i>Child Dermal HQ</i>	<i>Child Total HI</i>	<i>Adult Ingestion HQ</i>	<i>Adult Inhalation HQ</i>	<i>Adult Dermal HQ</i>	<i>Adult Total HI</i>	<i>Adjusted Ingestion HQ</i>	<i>Adjusted Inhalation HQ</i>	<i>Adjusted Dermal HQ</i>	<i>Adjusted Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		7.29E+00	-	-	7.29E+00	6.83E-01	-	-	6.83E-01	2.21E+00	-	-	2.21E+00	-	-	-	-
Arsenic		1.91E+00	8.86E-04	1.54E-01	2.06E+00	1.79E-01	8.86E-04	2.27E-02	2.03E-01	5.78E-01	8.86E-04	5.30E-02	6.32E-01	9.67E-05	2.12E-08	8.86E-06	1.06E-04
Barium		1.02E+00	9.49E-03	-	1.03E+00	9.59E-02	9.49E-03	-	1.05E-01	3.10E-01	9.49E-03	-	3.19E-01	-	-	-	-
Benzo(a)pyrene		-	-	-	-	-	-	-	-	-	-	-	-	6.91E-06	4.87E-11	2.56E-06	9.47E-06
Cadmium		5.31E+00	1.23E-02	5.71E-01	5.89E+00	4.97E-01	1.23E-02	8.40E-02	5.94E-01	1.61E+00	1.23E-02	1.96E-01	1.82E+00	-	8.23E-08	-	8.23E-08
Chromium		1.06E-03	-	-	1.06E-03	9.91E-05	-	-	9.91E-05	3.20E-04	-	-	3.20E-04	-	-	-	-
Cobalt		2.95E-01	3.42E-04	-	2.95E-01	2.76E-02	3.42E-04	-	2.80E-02	8.93E-02	3.42E-04	-	8.97E-02	-	6.86E-09	-	6.86E-09
Copper		4.70E-02	-	-	4.70E-02	4.40E-03	-	-	4.40E-03	1.42E-02	-	-	1.42E-02	-	-	-	-
Dichlorobenzene, 1,4-		9.32E-04	1.17E-03	-	2.10E-03	8.73E-05	1.17E-03	-	1.26E-03	2.82E-04	1.17E-03	-	1.45E-03	3.96E-08	3.82E-06	-	3.86E-06
Ethylbenzene		7.62E-03	1.99E-02	-	2.75E-02	7.14E-04	1.99E-02	-	2.06E-02	2.31E-03	1.99E-02	-	2.22E-02	9.43E-07	1.84E-05	-	1.94E-05
Iron		1.36E+00	-	-	1.36E+00	1.28E-01	-	-	1.28E-01	4.13E-01	-	-	4.13E-01	-	-	-	-
Lead		-	-	-	-	-	-	-	-	-	-	-	-	1.21E-04	1.31E-08	-	1.21E-04
Manganese		2.02E-01	2.25E-03	-	2.05E-01	1.90E-02	2.25E-03	-	2.12E-02	6.13E-02	2.25E-03	-	6.36E-02	-	-	-	-
Mercury		1.05E-02	1.61E-02	-	2.66E-02	9.81E-04	1.61E-02	-	1.71E-02	3.17E-03	1.61E-02	-	1.93E-02	-	-	-	-
Methylnaphthalene, 2-		1.34E-02	-	4.69E-03	1.81E-02	1.26E-03	-	6.91E-04	1.95E-03	4.07E-03	-	1.61E-03	5.68E-03	-	-	-	-
Naphthalene		1.41E-02	3.05E-01	4.92E-03	3.24E-01	1.32E-03	3.05E-01	7.24E-04	3.07E-01	4.26E-03	3.05E-01	1.69E-03	3.11E-01	-	1.16E-05	-	1.16E-05
Nickel		3.00E-02	1.55E-04	-	3.01E-02	2.81E-03	1.55E-04	-	2.97E-03	9.08E-03	1.55E-04	-	9.24E-03	-	1.34E-09	-	1.34E-09
Selenium		6.78E-02	3.93E-07	-	6.78E-02	6.35E-03	3.93E-07	-	6.35E-03	2.05E-02	3.93E-07	-	2.05E-02	-	-	-	-
Vanadium		7.23E-02	8.45E-05	-	7.24E-02	6.78E-03	8.45E-05	-	6.86E-03	2.19E-02	8.45E-05	-	2.20E-02	-	-	-	-
Xylenes (total)		4.28E-03	2.18E-01	-	2.22E-01	4.01E-04	2.18E-01	-	2.18E-01	1.30E-03	2.18E-01	-	2.19E-01	-	-	-	-
Zinc		7.03E-01	-	-	7.03E-01	6.59E-02	-	-	6.59E-02	2.13E-01	-	-	2.13E-01	-	-	-	-
*Total Risk/HI		1.84E+01	5.86E-01	7.35E-01	1.97E+01	1.72E+00	5.86E-01	1.08E-01	2.42E+00	5.56E+00	5.86E-01	2.53E-01	6.40E+00	2.26E-04	3.39E-05	1.14E-05	2.71E-04

TABLE C.6

SUMMARY OF TRESPASSER RISK FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Barium	No	No	0.2	IRIS	0.0005	HEAST	-		-		0.07	-	-	-	-	41	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cadmium	No	No	0.001	IRIS	0.00001	ATSDR F	-		0.0018	IRIS	0.025	0.001	-	-	-	75	-	3.23E+09	-
Chromium	No	No	1.5	IRIS	-		-		-		0.013	-	-	-	-	1800000	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Copper	No	No	0.04	HEAST	-		-		-		1	-	-	-	-	35	-	3.23E+09	-
Dichlorobenzene, 1,4-	No	Yes	0.07	ATSDR F	0.8	IRIS	0.0054	CALEPA	0.000011	CALEPA	1	-	0.055	0.00000868	0.0985	0.7506	3240	3.23E+09	-
Ethylbenzene	No	Yes	0.1	IRIS	1	IRIS	0.011	CALEPA	0.0000025	CALEPA	1	-	0.0685	0.00000846	0.322	0.8922	1780	3.23E+09	167
Iron	No	No	0.7	PPRTV C	-		-		-		1	-	-	-	-	25	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	16100	3.23E+09	3.13
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	17900	3.23E+09	-
Naphthalene	No	Yes	0.02	IRIS	0.003	IRIS	-		0.000034	CALEPA	1	0.13	0.0605	0.00000838	0.018	3.088	14300	3.23E+09	-
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-
Selenium	No	No	0.005	IRIS	0.02	CALEPA	-		-		1	-	-	-	-	5	-	3.23E+09	-
Vanadium	No	No	0.00504	SURROGA	0.0001	ATSDR F	-		-		0.026	-	-	-	-	1000	-	3.23E+09	-
Xylenes (total)	No	Yes	0.2	IRIS	0.1	IRIS	-		-		1	-	0.0847	0.0000099	0.212	0.7658	1820	3.23E+09	88.9
Zinc	No	No	0.3	IRIS	-		-		-		1	-	-	-	-	62	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		2.28E+02	4.53E-05	1.82E-09	-	6.47E-06	2.60E-07	-
Arsenic		4.48E+01	8.90E-06	3.58E-10	1.13E-06	1.27E-06	5.11E-08	1.61E-07
Barium		1.60E+04	3.18E-03	1.28E-07	-	4.54E-04	1.83E-05	-
Benzo(a)pyrene		1.45E-01	2.88E-08	1.16E-12	1.58E-08	1.23E-08	4.96E-10	6.78E-09
Cadmium		4.15E+02	8.24E-05	3.31E-09	3.48E-07	1.18E-05	4.74E-07	4.97E-08
Chromium		1.24E+02	2.46E-05	9.90E-10	-	3.52E-06	1.41E-07	-
Cobalt		6.92E+00	1.37E-06	5.53E-11	-	1.96E-07	7.90E-09	-
Copper		1.47E+02	2.92E-05	1.17E-09	-	4.17E-06	1.68E-07	-
Dichlorobenzene, 1,4-		5.10E+00	1.01E-06	4.06E-05	-	1.45E-07	5.80E-03	-
Ethylbenzene		5.96E+01	1.18E-05	8.62E-04	-	1.69E-06	1.23E-01	-
Iron		7.47E+04	1.48E-02	5.97E-07	-	2.12E-03	8.52E-05	-
Lead		9.90E+03	1.97E-03	7.91E-08	-	2.81E-04	1.13E-05	-
Manganese		3.80E+02	7.55E-05	3.04E-09	-	1.08E-05	4.34E-07	-
Mercury		1.31E-01	2.60E-08	2.10E-07	-	3.72E-09	3.00E-05	-
Methylnaphthalene, 2-		4.20E+00	8.34E-07	6.06E-06	4.58E-07	1.19E-07	8.66E-04	6.54E-08
Naphthalene		2.20E+01	4.37E-06	3.97E-05	2.40E-06	6.24E-07	5.68E-03	3.43E-07
Nickel		4.69E+01	9.32E-06	3.75E-10	-	1.33E-06	5.35E-08	-
Selenium		2.65E+01	5.26E-06	2.12E-10	-	7.52E-07	3.02E-08	-
Vanadium		2.85E+01	5.66E-06	2.28E-10	-	8.09E-07	3.25E-08	-
Xylenes (total)		6.69E+01	1.33E-05	9.47E-04	-	1.90E-06	1.35E-01	-
Zinc		1.65E+04	3.28E-03	1.32E-07	-	4.68E-04	1.88E-05	-

TABLE C.6
SUMMARY OF TRESPASSER RISK FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS									
Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		1.13E-01	-	-	1.13E-01	-	-	-	-
Arsenic		2.97E-02	2.39E-05	3.76E-03	3.34E-02	1.91E-06	2.20E-10	2.42E-07	2.15E-06
Barium		1.59E-02	2.56E-04	-	1.61E-02	-	-	-	-
Benzo(a)pyrene		-	-	-	-	9.01E-08	5.46E-13	4.95E-08	1.40E-07
Cadmium		8.24E-02	3.31E-04	1.39E-02	9.67E-02	-	8.52E-10	-	8.52E-10
Chromium		1.64E-05	-	-	1.64E-05	-	-	-	-
Cobalt		4.58E-03	9.21E-06	-	4.59E-03	-	7.11E-11	-	7.11E-11
Copper		7.30E-04	-	-	7.30E-04	-	-	-	-
Dichlorobenzene, 1,4-		1.45E-05	5.07E-05	-	6.52E-05	7.81E-10	6.38E-08	-	6.46E-08
Ethylbenzene		1.18E-04	8.62E-04	-	9.81E-04	1.86E-08	3.08E-07	-	3.27E-07
Iron		2.12E-02	-	-	2.12E-02	-	-	-	-
Lead		-	-	-	-	2.39E-06	1.36E-10	-	2.39E-06
Manganese		3.14E-03	6.07E-05	-	3.21E-03	-	-	-	-
Mercury		1.63E-04	7.01E-04	-	8.63E-04	-	-	-	-
Methylnaphthalene, 2-		2.09E-04	-	1.14E-04	3.23E-04	-	-	-	-
Naphthalene		2.18E-04	1.32E-02	1.20E-04	1.36E-02	-	1.93E-07	-	1.93E-07
Nickel		4.66E-04	4.16E-06	-	4.70E-04	-	1.39E-11	-	1.39E-11
Selenium		1.05E-03	1.06E-08	-	1.05E-03	-	-	-	-
Vanadium		1.12E-03	2.28E-06	-	1.13E-03	-	-	-	-
Xylenes (total)		6.64E-05	9.47E-03	-	9.53E-03	-	-	-	-
Zinc		1.09E-02	-	-	1.09E-02	-	-	-	-
*Total Risk/HI		2.85E-01	2.50E-02	1.79E-02	3.28E-01	4.40E-06	5.66E-07	2.91E-07	5.26E-06

TABLE C.7

SUMMARY OF OUTDOOR WORKER RISK FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Barium	No	No	0.2	IRIS	0.0005	HEAST	-		-		0.07	-	-	-	-	41	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cadmium	No	No	0.001	IRIS	0.00001	ATSDR F	-		0.0018	IRIS	0.025	0.001	-	-	-	75	-	3.23E+09	-
Chromium	No	No	1.5	IRIS	-		-		-		0.013	-	-	-	-	1800000	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Copper	No	No	0.04	HEAST	-		-		-		1	-	-	-	-	35	-	3.23E+09	-
Dichlorobenzene, 1,4-	No	Yes	0.07	ATSDR F	0.8	IRIS	0.0054	CALEPA	0.000011	CALEPA	1	-	0.055	0.00000868	0.0985	0.7506	5130	3.23E+09	-
Ethylbenzene	No	Yes	0.1	IRIS	1	IRIS	0.011	CALEPA	0.0000025	CALEPA	1	-	0.0685	0.00000846	0.322	0.8922	2820	3.23E+09	167
Iron	No	No	0.7	PPRTV C	-		-		-		1	-	-	-	-	25	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	25400	3.23E+09	3.13
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	28300	3.23E+09	-
Naphthalene	No	Yes	0.02	IRIS	0.003	IRIS	-		0.000034	CALEPA	1	0.13	0.0605	0.00000838	0.018	3.088	22600	3.23E+09	-
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-
Selenium	No	No	0.005	IRIS	0.02	CALEPA	-		-		1	-	-	-	-	5	-	3.23E+09	-
Vanadium	No	No	0.00504	SURROGA	0.0001	ATSDR F	-		-		0.026	-	-	-	-	1000	-	3.23E+09	-
Xylenes (total)	No	Yes	0.2	IRIS	0.1	IRIS	-		-		1	-	0.0847	0.0000099	0.212	0.7658	2880	3.23E+09	88.9
Zinc	No	No	0.3	IRIS	-		-		-		1	-	-	-	-	62	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		2.28E+02	1.76E-04	1.45E-08	-	6.27E-05	5.18E-06	-
Arsenic		4.48E+01	3.45E-05	2.85E-09	4.31E-06	1.23E-05	1.02E-06	1.54E-06
Barium		1.60E+04	1.23E-02	1.02E-06	-	4.40E-03	3.63E-04	-
Benzo(a)pyrene		1.45E-01	1.12E-07	9.22E-12	6.05E-08	3.99E-08	3.29E-09	2.16E-08
Cadmium		4.15E+02	3.20E-04	2.64E-08	1.33E-06	1.14E-04	9.42E-06	4.76E-07
Chromium		1.24E+02	9.55E-05	7.88E-09	-	3.41E-05	2.81E-06	-
Cobalt		6.92E+00	5.33E-06	4.40E-10	-	1.90E-06	1.57E-07	-
Copper		1.47E+02	1.13E-04	9.34E-09	-	4.05E-05	3.34E-06	-
Dichlorobenzene, 1,4-		5.10E+00	3.93E-06	2.04E-04	-	1.40E-06	7.29E-02	-
Ethylbenzene		5.96E+01	4.59E-05	4.34E-03	-	1.64E-05	1.55E+00	-
Iron		7.47E+04	5.76E-02	4.75E-06	-	2.06E-02	1.70E-03	-
Lead		9.90E+03	7.63E-03	6.29E-07	-	2.72E-03	2.25E-04	-
Manganese		3.80E+02	2.93E-04	2.42E-08	-	1.05E-04	8.63E-06	-
Mercury		1.31E-01	1.01E-07	1.06E-06	-	3.61E-08	3.78E-04	-
Methylnaphthalene, 2-		4.20E+00	3.24E-06	3.05E-05	1.75E-06	1.16E-06	1.09E-02	6.26E-07
Naphthalene		2.20E+01	1.70E-05	2.00E-04	9.18E-06	6.05E-06	7.14E-02	3.28E-06
Nickel		4.69E+01	3.61E-05	2.98E-09	-	1.29E-05	1.06E-06	-
Selenium		2.65E+01	2.04E-05	1.68E-09	-	7.29E-06	6.02E-07	-
Vanadium		2.85E+01	2.20E-05	1.81E-09	-	7.84E-06	6.47E-07	-
Xylenes (total)		6.69E+01	5.15E-05	4.77E-03	-	1.84E-05	1.70E+00	-
Zinc		1.65E+04	1.27E-02	1.05E-06	-	4.54E-03	3.75E-04	-

TABLE C.7

SUMMARY OF OUTDOOR WORKER RISK FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Ingestion HQ</i>	<i>Inhalation HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		4.39E-01	-	-	4.39E-01	-	-	-	-
Arsenic		1.15E-01	1.90E-04	1.44E-02	1.30E-01	1.85E-05	4.37E-09	2.31E-06	2.08E-05
Barium		6.16E-02	2.03E-03	-	6.37E-02	-	-	-	-
Benzo(a)pyrene		-	-	-	-	2.91E-07	3.62E-12	1.58E-07	4.49E-07
Cadmium		3.20E-01	2.64E-03	5.33E-02	3.76E-01	-	1.70E-08	-	1.70E-08
Chromium		6.37E-05	-	-	6.37E-05	-	-	-	-
Cobalt		1.78E-02	7.33E-05	-	1.78E-02	-	1.41E-09	-	1.41E-09
Copper		2.83E-03	-	-	2.83E-03	-	-	-	-
Dichlorobenzene, 1,4-		5.61E-05	2.55E-04	-	3.11E-04	7.58E-09	8.02E-07	-	8.10E-07
Ethylbenzene		4.59E-04	4.34E-03	-	4.80E-03	1.80E-07	3.88E-06	-	4.06E-06
Iron		8.22E-02	-	-	8.22E-02	-	-	-	-
Lead		-	-	-	-	2.32E-05	2.70E-09	-	2.32E-05
Manganese		1.22E-02	4.83E-04	-	1.27E-02	-	-	-	-
Mercury		6.31E-04	3.53E-03	-	4.16E-03	-	-	-	-
Methylnaphthalene, 2-		8.09E-04	-	4.38E-04	1.25E-03	-	-	-	-
Naphthalene		8.48E-04	6.67E-02	4.59E-04	6.80E-02	-	2.43E-06	-	2.43E-06
Nickel		1.81E-03	3.31E-05	-	1.84E-03	-	2.77E-10	-	2.77E-10
Selenium		4.08E-03	8.42E-08	-	4.08E-03	-	-	-	-
Vanadium		4.36E-03	1.81E-05	-	4.38E-03	-	-	-	-
Xylenes (total)		2.58E-04	4.77E-02	-	4.79E-02	-	-	-	-
Zinc		4.24E-02	-	-	4.24E-02	-	-	-	-
*Total Risk/HI		1.11E+00	1.28E-01	6.85E-02	1.30E+00	4.21E-05	7.13E-06	2.47E-06	5.17E-05

TABLE C.8
SUMMARY OF UTILITY WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H`</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Barium	No	No	0.2	IRIS	0.0005	HEAST	-		-		0.07	-	-	-	-	41	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cadmium	No	No	0.001	IRIS	0.00001	ATSDR F	-		0.0018	IRIS	0.025	0.001	-	-	-	75	-	3.23E+09	-
Chromium	No	No	1.5	IRIS	-		-		-		0.013	-	-	-	-	1800000	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Copper	No	No	0.04	HEAST	-		-		-		1	-	-	-	-	35	-	3.23E+09	-
Dichlorobenzene, 1,4-	No	Yes	0.07	ATSDR F	0.8	IRIS	0.0054	CALEPA	0.000011	CALEPA	1	-	0.055	0.00000868	0.0985	0.7506	5130	3.23E+09	-
Ethylbenzene	No	Yes	0.1	IRIS	1	IRIS	0.011	CALEPA	0.0000025	CALEPA	1	-	0.0685	0.00000846	0.322	0.8922	2820	3.23E+09	167
Iron	No	No	0.7	PPRTV C	-		-		-		1	-	-	-	-	25	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	25400	3.23E+09	3.13
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	28300	3.23E+09	-
Naphthalene	No	Yes	0.02	IRIS	0.003	IRIS	-		0.000034	CALEPA	1	0.13	0.0605	0.00000838	0.018	3.088	22600	3.23E+09	-
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-
Selenium	No	No	0.005	IRIS	0.02	CALEPA	-		-		1	-	-	-	-	5	-	3.23E+09	-
Vanadium	No	No	0.00504	SURROGA	0.0001	ATSDR F	-		-		0.026	-	-	-	-	1000	-	3.23E+09	-
Xylenes (total)	No	Yes	0.2	IRIS	0.1	IRIS	-		-		1	-	0.0847	0.0000099	0.212	0.7658	2880	3.23E+09	88.9
Zinc	No	No	0.3	IRIS	-		-		-		1	-	-	-	-	62	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		2.25E+02	5.09E-05	1.27E-09	-	1.82E-05	4.54E-07	-
Arsenic		3.43E+01	7.75E-06	1.94E-10	7.34E-07	2.77E-06	6.92E-08	2.62E-07
Barium		5.13E+03	1.16E-03	2.90E-08	-	4.14E-04	1.04E-05	-
Benzo(a)pyrene		9.05E-02	2.05E-08	5.11E-13	8.39E-09	7.31E-09	1.83E-10	3.00E-09
Cadmium		2.66E+02	6.01E-05	1.50E-09	1.90E-07	2.15E-05	5.37E-07	6.77E-08
Chromium		8.29E+01	1.87E-05	4.68E-10	-	6.69E-06	1.67E-07	-
Cobalt		1.84E+01	4.16E-06	1.04E-10	-	1.49E-06	3.71E-08	-
Copper		1.05E+02	2.37E-05	5.93E-10	-	8.48E-06	2.12E-07	-
Dichlorobenzene, 1,4-		5.10E+00	1.15E-06	1.82E-05	-	4.12E-07	6.48E-03	-
Ethylbenzene		3.48E+01	7.87E-06	2.25E-04	-	2.81E-06	8.04E-02	-
Iron		2.85E+04	6.44E-03	1.61E-07	-	2.30E-03	5.75E-05	-
Lead		9.80E+03	2.22E-03	5.54E-08	-	7.91E-04	1.98E-05	-
Manganese		4.27E+02	9.65E-05	2.41E-09	-	3.45E-05	8.62E-07	-
Mercury		1.24E-01	2.80E-08	8.90E-08	-	1.00E-08	3.18E-05	-
Methylnaphthalene, 2-		4.20E+00	9.49E-07	2.71E-06	3.89E-07	3.39E-07	9.68E-04	1.39E-07
Naphthalene		2.20E+01	4.97E-06	1.78E-05	2.04E-06	1.78E-06	6.35E-03	7.28E-07
Nickel		3.14E+01	7.10E-06	1.77E-10	-	2.53E-06	6.34E-08	-
Selenium		1.57E+01	3.55E-06	8.87E-11	-	1.27E-06	3.17E-08	-
Vanadium		3.57E+01	8.07E-06	2.02E-10	-	2.88E-06	7.20E-08	-
Xylenes (total)		3.52E+01	7.96E-06	2.23E-04	-	2.84E-06	7.96E-02	-
Zinc		6.62E+03	1.50E-03	3.74E-08	-	5.34E-04	1.34E-05	-

TABLE C.8
SUMMARY OF UTILITY WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS									
Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		1.27E-01	-	-	1.27E-01	-	-	-	-
Arsenic		2.58E-02	1.29E-05	2.45E-03	2.83E-02	4.15E-06	2.98E-10	3.93E-07	4.55E-06
Barium		5.80E-03	5.80E-05	-	5.86E-03	-	-	-	-
Benzo(a)pyrene		-	-	-	-	5.33E-08	2.01E-13	2.19E-08	7.52E-08
Cadmium		6.01E-02	1.50E-04	7.59E-03	6.79E-02	-	9.66E-10	-	9.66E-10
Chromium		1.25E-05	-	-	1.25E-05	-	-	-	-
Cobalt		1.39E-02	1.73E-05	-	1.39E-02	-	3.34E-10	-	3.34E-10
Copper		5.93E-04	-	-	5.93E-04	-	-	-	-
Dichlorobenzene, 1,4-		1.65E-05	2.27E-05	-	3.92E-05	2.22E-09	7.13E-08	-	7.35E-08
Ethylbenzene		7.87E-05	2.25E-04	-	3.04E-04	3.09E-08	2.01E-07	-	2.32E-07
Iron		9.20E-03	-	-	9.20E-03	-	-	-	-
Lead		-	-	-	-	6.72E-06	2.37E-10	-	6.72E-06
Manganese		4.02E-03	4.82E-05	-	4.07E-03	-	-	-	-
Mercury		1.75E-04	2.97E-04	-	4.72E-04	-	-	-	-
Methylnaphthalene, 2-		2.37E-04	-	9.73E-05	3.35E-04	-	-	-	-
Naphthalene		2.49E-04	5.93E-03	1.02E-04	6.28E-03	-	2.16E-07	-	2.16E-07
Nickel		3.55E-04	1.97E-06	-	3.57E-04	-	1.65E-11	-	1.65E-11
Selenium		7.10E-04	4.43E-09	-	7.10E-04	-	-	-	-
Vanadium		1.60E-03	2.02E-06	-	1.60E-03	-	-	-	-
Xylenes (total)		3.98E-05	2.23E-03	-	2.27E-03	-	-	-	-
Zinc		4.99E-03	-	-	4.99E-03	-	-	-	-
*Total Risk/HI		2.55E-01	8.99E-03	1.02E-02	2.74E-01	1.10E-05	4.90E-07	4.15E-07	1.19E-05

TABLE C.9

SUMMARY OF CONSTRUCTION WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (µg/m³)⁻¹</i>	<i>IUR Reference</i>	<i>ABS_{gi}</i>	<i>ABS_{derm}</i>	<i>D_{ia}</i>	<i>D_{iw}</i>	<i>H⁺</i>	<i>K_d</i>	<i>Volatilization Factor (m³/kg)</i>	<i>Particulate Emission Factor (m³/kg)</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.03	-	-	-	29	-	3.23E+09	-
Barium	No	No	0.2	IRIS	0.0005	HEAST	-		-		0.07	-	-	-	-	41	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Cadmium	No	No	0.001	IRIS	0.00001	ATSDR F	-		0.0018	IRIS	0.025	0.001	-	-	-	75	-	3.23E+09	-
Chromium	No	No	1.5	IRIS	-		-		-		0.013	-	-	-	-	1800000	-	3.23E+09	-
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	-	-	-	-	45	-	3.23E+09	-
Copper	No	No	0.04	HEAST	-		-		-		1	-	-	-	-	35	-	3.23E+09	-
Dichlorobenzene, 1,4-	No	Yes	0.07	ATSDR F	0.8	IRIS	0.0054	CALEPA	0.000011	CALEPA	1	-	0.055	0.00000868	0.0985	0.7506	1030	3.23E+09	-
Ethylbenzene	No	Yes	0.1	IRIS	1	IRIS	0.011	CALEPA	0.0000025	CALEPA	1	-	0.0685	0.00000846	0.322	0.8922	564	3.23E+09	167
Iron	No	No	0.7	PPRTV C	-		-		-		1	-	-	-	-	25	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	-	-	-	-	65	-	3.23E+09	-
Mercury	No	Yes	0.00016	CALEPA	0.0003	IRIS	-		-		1	-	0.0307	0.0000063	0.467	52	5090	3.23E+09	3.13
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.13	0.0524	0.00000778	0.0212	4.956	5660	3.23E+09	-
Naphthalene	No	Yes	0.02	IRIS	0.003	IRIS	-		0.000034	CALEPA	1	0.13	0.0605	0.00000838	0.018	3.088	4520	3.23E+09	-
Nickel	No	No	0.02	IRIS	0.00009	ATSDR F	-		0.00026	CALEPA	0.04	-	-	-	-	65	-	3.23E+09	-
Selenium	No	No	0.005	IRIS	0.02	CALEPA	-		-		1	-	-	-	-	5	-	3.23E+09	-
Vanadium	No	No	0.00504	SURROGA	0.0001	ATSDR F	-		-		0.026	-	-	-	-	1000	-	3.23E+09	-
Xylenes (total)	No	Yes	0.2	IRIS	0.1	IRIS	-		-		1	-	0.0847	0.0000099	0.212	0.7658	577	3.23E+09	88.9
Zinc	No	No	0.3	IRIS	-		-		-		1	-	-	-	-	62	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/kg)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Inhalation Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony		2.25E+02	5.09E-05	1.27E-09	-	7.27E-07	1.82E-08	-
Arsenic		3.43E+01	7.75E-06	1.94E-10	7.34E-07	1.11E-07	2.77E-09	1.05E-08
Barium		5.13E+03	1.16E-03	2.90E-08	-	1.66E-05	4.14E-07	-
Benzo(a)pyrene		9.05E-02	2.05E-08	5.11E-13	8.39E-09	2.92E-10	7.30E-12	1.20E-10
Cadmium		2.66E+02	6.01E-05	1.50E-09	1.90E-07	8.59E-07	2.15E-08	2.71E-09
Chromium		8.29E+01	1.87E-05	4.68E-10	-	2.68E-07	6.69E-09	-
Cobalt		1.84E+01	4.16E-06	1.04E-10	-	5.94E-08	1.49E-09	-
Copper		1.05E+02	2.37E-05	5.93E-10	-	3.39E-07	8.47E-09	-
Dichlorobenzene, 1,4-		5.10E+00	1.15E-06	9.08E-05	-	1.65E-08	1.30E-03	-
Ethylbenzene		3.48E+01	7.87E-06	1.13E-03	-	1.12E-07	1.61E-02	-
Iron		2.85E+04	6.44E-03	1.61E-07	-	9.20E-05	2.30E-06	-
Lead		9.80E+03	2.22E-03	5.54E-08	-	3.16E-05	7.91E-07	-
Manganese		4.27E+02	9.65E-05	2.41E-09	-	1.38E-06	3.45E-08	-
Mercury		1.24E-01	2.80E-08	4.45E-07	-	4.00E-10	6.36E-06	-
Methylnaphthalene, 2-		4.20E+00	9.49E-07	1.36E-05	3.89E-07	1.36E-08	1.94E-04	5.56E-09
Naphthalene		2.20E+01	4.97E-06	8.89E-05	2.04E-06	7.10E-08	1.27E-03	2.91E-08
Nickel		3.14E+01	7.10E-06	1.77E-10	-	1.01E-07	2.53E-09	-
Selenium		1.57E+01	3.55E-06	8.87E-11	-	5.07E-08	1.27E-09	-
Vanadium		3.57E+01	8.07E-06	2.02E-10	-	1.15E-07	2.88E-09	-
Xylenes (total)		3.52E+01	7.96E-06	1.11E-03	-	1.14E-07	1.59E-02	-
Zinc		6.62E+03	1.50E-03	3.74E-08	-	2.14E-05	5.34E-07	-

TABLE C.9

SUMMARY OF CONSTRUCTION WORKER RISK FOR SURFACE AND SUBSURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS									
Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		1.27E-01	-	-	1.27E-01	-	-	-	-
Arsenic		2.58E-02	1.29E-05	2.45E-03	2.83E-02	1.66E-07	1.19E-11	1.57E-08	1.82E-07
Barium		5.80E-03	5.80E-05	-	5.86E-03	-	-	-	-
Benzo(a)pyrene		-	-	-	-	2.13E-09	8.03E-15	8.75E-10	3.01E-09
Cadmium		6.01E-02	1.50E-04	7.59E-03	6.79E-02	-	3.86E-11	-	3.86E-11
Chromium		1.25E-05	-	-	1.25E-05	-	-	-	-
Cobalt		1.39E-02	1.73E-05	-	1.39E-02	-	1.34E-11	-	1.34E-11
Copper		5.93E-04	-	-	5.93E-04	-	-	-	-
Dichlorobenzene, 1,4-		1.65E-05	1.13E-04	-	1.30E-04	8.89E-11	1.43E-08	-	1.44E-08
Ethylbenzene		7.87E-05	1.13E-03	-	1.20E-03	1.24E-09	4.02E-08	-	4.15E-08
Iron		9.20E-03	-	-	9.20E-03	-	-	-	-
Lead		-	-	-	-	2.69E-07	9.49E-12	-	2.69E-07
Manganese		4.02E-03	4.82E-05	-	4.07E-03	-	-	-	-
Mercury		1.75E-04	1.48E-03	-	1.66E-03	-	-	-	-
Methylnaphthalene, 2-		2.37E-04	-	9.73E-05	3.35E-04	-	-	-	-
Naphthalene		2.49E-04	2.96E-02	1.02E-04	3.00E-02	-	4.32E-08	-	4.32E-08
Nickel		3.55E-04	1.97E-06	-	3.57E-04	-	6.59E-13	-	6.59E-13
Selenium		7.10E-04	4.43E-09	-	7.10E-04	-	-	-	-
Vanadium		1.60E-03	2.02E-06	-	1.60E-03	-	-	-	-
Xylenes (total)		3.98E-05	1.11E-02	-	1.12E-02	-	-	-	-
Zinc		4.99E-03	-	-	4.99E-03	-	-	-	-
*Total Risk/HI		2.55E-01	4.38E-02	1.02E-02	3.09E-01	4.39E-07	9.77E-08	1.66E-08	5.53E-07

TABLE C.10

**SUMMARY OF RESIDENT RISK FOR INDOOR AIR
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Dichlorobenzene, 1,4-	No	Yes	0.000011	CALEPA	0.8	IRIS
Ethylbenzene	No	Yes	0.0000025	CALEPA	1	IRIS
Mercury	No	Yes	-		0.0003	IRIS
Methylnaphthalene, 2-	No	Yes	-		-	
Naphthalene	No	Yes	0.000034	CALEPA	0.003	IRIS
Xylenes (total)	No	Yes	-		0.1	IRIS

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Soil Concentration ($\mu\text{g}/\text{kg}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Dichlorobenzene, 1,4-	5.10E+03	3.22E+02	3.09E-01	1.15E+02
Ethylbenzene	3.48E+04	1.25E+04	1.20E+01	4.45E+03
Mercury	1.24E+02	6.60E-01	6.33E-04	2.35E-01
Methylnaphthalene, 2-	4.20E+03	9.36E+00	8.98E-03	3.33E+00
Naphthalene	2.20E+04	7.95E+01	7.62E-02	2.83E+01
Xylenes (total)	3.52E+04	7.90E+03	7.58E+00	2.81E+03

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Dichlorobenzene, 1,4-		3.86E-01	1.26E-03
Ethylbenzene		1.20E+01	1.11E-02
Mercury		2.11E+00	-
Methylnaphthalene, 2-		-	-
Naphthalene		2.54E+01	9.63E-04
Xylenes (total)		7.58E+01	-
*Total Risk/HI		1.16E+02	1.33E-02

TABLE C.11

**SUMMARY OF INDOOR WORKER RISK FOR INDOOR AIR
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Dichlorobenzene, 1,4-	No	Yes	0.000011	CALEPA	0.8	IRIS
Ethylbenzene	No	Yes	0.0000025	CALEPA	1	IRIS
Mercury	No	Yes	-		0.0003	IRIS
Methylnaphthalene, 2-	No	Yes	-		-	
Naphthalene	No	Yes	0.000034	CALEPA	0.003	IRIS
Xylenes (total)	No	Yes	-		0.1	IRIS

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Soil Concentration ($\mu\text{g}/\text{kg}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Dichlorobenzene, 1,4-	5.10E+03	4.84E+02	1.11E-01	3.95E+01
Ethylbenzene	3.48E+04	1.87E+04	4.27E+00	1.52E+03
Mercury	1.24E+02	9.89E-01	2.26E-04	8.06E-02
Methylnaphthalene, 2-	4.20E+03	1.40E+01	3.20E-03	1.14E+00
Naphthalene	2.20E+04	1.19E+02	2.72E-02	9.70E+00
Xylenes (total)	3.52E+04	1.18E+04	2.69E+00	9.62E+02

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Dichlorobenzene, 1,4-		1.38E-01	4.34E-04
Ethylbenzene		4.27E+00	3.81E-03
Mercury		7.53E-01	-
Methylnaphthalene, 2-		-	-
Naphthalene		9.06E+00	3.30E-04
Xylenes (total)		2.69E+01	-
*Total Risk/HI		4.12E+01	4.58E-03

Appendix D

OU-6 Risk Tables

Appendix D

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TABLE D.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	<u>VOCs</u>												
110-82-7	Cyclohexane	0.016	J	0.016	J	mg/kg	Station-007, 0-2 ftbgs (10/02/14)	1/16	0.04 - 0.25	0.016	650	N	BSC
98-82-8	Isopropyl benzene	0.004	J	0.004	J	mg/kg	Station-007, 0-2 ftbgs (10/02/14)	1/16	0.04 - 0.25	0.004	190	N	BSC
108-87-2	Methyl cyclohexane	0.0074	J	0.047	J	mg/kg	Station-007, 0-2 ftbgs (10/02/14)	5/16	0.051 - 0.25	0.047	650 (5)	N	BSC
108-88-3	Toluene	0.016	J	0.023	J	mg/kg	Station-007, 0-2 ftbgs (10/02/14)	2/16	0.051 - 0.25	0.023	490	N	BSC
1330-20-7	Xylenes (total)	0.024	J	0.038	J	mg/kg	Station-007, 0-2 ftbgs (10/02/14)	2/16	0.1 - 0.49	0.038	58	N	BSC
	<u>SVOCS</u>												
56-55-3	Benzo(a)anthracene	0.01		0.079		mg/kg	Station-001, 0-2 ftbgs (10/02/14)	9/16	0.038 - 0.047	0.079	0.9	C	BSC
50-32-8	Benzo(a)pyrene	0.005	J	0.1		mg/kg	Station-001, 0-2 ftbgs (10/02/14)	12/16	0.038 - 0.047	0.1	0.09	C	ASC
205-99-2	Benzo(b)fluoranthene	0.0067	J	0.2		mg/kg	Station-001, 0-2 ftbgs (10/02/14)	13/16	0.038 - 0.047	0.2	0.9	C	BSC
191-24-2	Benzo(g,h,i)perylene	0.034	J	0.088	J	mg/kg	Station-001, 0-2 ftbgs (10/02/14)	3/16	0.36 - 0.47	0.088	1 (6)	N	BSC
207-08-9	Benzo(k)fluoranthene	0.0075	J	0.054		mg/kg	Station-001, 0-2 ftbgs (10/02/14)	8/16	0.037 - 0.047	0.054	9	C	BSC
85-68-7	Butyl benzylphthalate (BBP)	0.041	J	2.7		mg/kg	Station-015, 0-2 ftbgs (10/02/14)	15/16	0.38	2.7	280	C	BSC
218-01-9	Chrysene	0.042	J	0.14	J	mg/kg	Station-001, 0-2 ftbgs (10/02/14)	4/16	0.37 - 0.47	0.14	87	C	BSC
53-70-3	Dibenz(a,h)anthracene	0.022	J	0.022	J	mg/kg	Station-001, 0-2 ftbgs (10/02/14)	1/16	0.036 - 0.047	0.022	0.09	C	BSC
84-74-2	Di-n-butylphthalate (DBP)	0.064	J	0.064	J	mg/kg	Station-002, 0-2 ftbgs (10/02/14)	1/16	0.36 - 0.47	0.064	620	N	BSC
206-44-0	Fluoranthene	0.069	J	0.25	J	mg/kg	Station-001, 0-2 ftbgs (10/02/14)	4/16	0.37 - 0.47	0.25	310	N	BSC
193-39-5	Indeno(1,2,3-cd)pyrene	0.0075	J	0.091		mg/kg	Station-001, 0-2 ftbgs (10/02/14)	8/16	0.038 - 0.047	0.091	0.9	C	BSC
85-01-8	Phenanthrene	0.091	J	0.091	J	mg/kg	Station-001, 0-2 ftbgs (10/02/14)	1/16	0.36 - 0.47	0.091	1000	N	BSC
129-00-0	Pyrene	0.054	J	0.19	J	mg/kg	Station-001, 0-2 ftbgs (10/02/14)	3/16	0.37 - 0.47	0.19	230	N	BSC
	<u>Metals</u>												
7429-90-5	Aluminum	7150		17000		mg/kg	Station-010, 0-2 ftbgs (10/03/14)	16/16	--	17000	51200	N	BSC
7440-36-0	Antimony	1.9	J	14	J	mg/kg	Station-009, 0-2 ftbgs (10/02/14)	6/10	2.1 - 2.4	14	3.1	N	ASC
7440-38-2	Arsenic	1.6		6.3		mg/kg	Station-004, 0-2 ftbgs (10/03/14)	16/16	--	6.3	11	C	BSC
7440-39-3	Barium	47.3		280		mg/kg	Station-006, 0-2 ftbgs (10/03/14)	16/16	--	280	1500	N	BSC
7440-41-7	Beryllium	0.39		1.1		mg/kg	Station-006, 0-2 ftbgs (10/03/14)	16/16	--	1.1	16	N	BSC
7440-43-9	Cadmium	0.42	J	1	J	mg/kg	Station-002, 0-2 ftbgs (10/02/14)	2/16	0.98 - 1.2	1	7	N	BSC
7440-70-2	Calcium	135	J	1240		mg/kg	Station-002, 0-2 ftbgs (10/02/14)	16/16	--	1240	--		NTX; NUT
7440-47-3	Chromium	14.6		38.5		mg/kg	Station-012, 0-2 ftbgs (10/02/14)	16/16	--	38.5	12000	N	BSC
7440-48-4	Cobalt	4	J	13.2		mg/kg	Station-006, 0-2 ftbgs (10/03/14)	16/16	--	13.2	34	N	BSC
7440-50-8	Copper	7.1		20		mg/kg	Station-011, 0-2 ftbgs (10/02/14)	16/16	--	20	310	N	BSC
7439-89-6	Iron	8110		22800		mg/kg	Station-012, 0-2 ftbgs (10/02/14)	16/16	--	22800	74767	N	BSC
7439-92-1	Lead	20.3	J	709	J	mg/kg	Station-009, 0-2 ftbgs (10/02/14)	16/16	--	709	400	C	ASC
7439-95-4	Magnesium	896	J	2080		mg/kg	Station-011, 0-2 ftbgs (10/02/14)	16/16	--	2080	--		NTX; NUT
7439-96-5	Manganese	37.1		485		mg/kg	Station-006, 0-2 ftbgs (10/03/14)	16/16	--	485	2100	N	BSC
7439-97-6	Mercury	0.04		0.13		mg/kg	Station-004, 0-2 ftbgs (10/03/14)	16/16	--	0.13	0.94	N	BSC
7440-02-0	Nickel	7.2	J	14.8		mg/kg	Station-011, 0-2 ftbgs (10/02/14)	16/16	--	14.8	150	N	BSC
7440-09-7	Potassium	242	J	733	J	mg/kg	Station-011, 0-2 ftbgs (10/02/14)	16/16	--	733	--		NTX; NUT
7782-49-2	Selenium	1.2	J	1.3	J	mg/kg	Station-011, 0-2 ftbgs (10/02/14)	2/16	2 - 2.5	1.3	39	N	BSC
7440-62-6	Vanadium	25.1		50.8		mg/kg	Station-006, 0-2 ftbgs (10/03/14)	16/16	--	50.8	134	N	BSC
7440-66-6	Zinc	25.4		124	J	mg/kg	Station-002, 0-2 ftbgs (10/02/14)	16/16	--	124	2300	N	BSC

TABLE D.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future Medium: Surface Soil (0-2 ftbgs) Exposure Medium: Surface Soil

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
50-29-3	<u>General Chemistry</u> Cyanide (total)	0.067	J	0.13		mg/kg	Station-011, 0-2 ftbgs (10/02/14)	10/16	0.11 - 0.13	0.13	2.1	N	BSC

Notes:

C Carcinogenic; analyte considered to be a carcinogen.

N Non-Carcinogenic; analyte considered to be a non-carcinogen.

-- Not Available

SVOCS Semi-volatile Organic Compounds

VOCs Volatile Organic Compounds

J Result is an estimated value.

(1) Minimum/maximum detected concentration.

(2) Based on data collected from sampling locations: Station-001, Station-002, Station-003, Station-004, Station-005, Station-006, Station-007, Station-008, Station-009, Station-010, Station-011, Station-012, Station-013, Station-014, Station-015

(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.

(4) Rationale Codes Selection Reason Maximum detected above Screening Criterion (ASC)

Deletion Reason Maximum detected below Screening Criterion (BSC)

No Toxicity Data (NTX)

Essential Nutrient (NUT)

(5) No screening criterion available for this analyte, substituted cyclohexane screening criterion.

(6) No screening criterion available for this analyte, substituted lowest non-carcinogenic (2-methylnaphthalene) screening criterion.

TABLE D.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
108-88-3	<u>Volatile Organic Compounds</u> Toluene	0.062	J	0.1		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	2/7	0.076 - 0.12	0.1	490	N	BSC
91-57-6	<u>Semi-volatile Organic Compounds</u> 2-Methylnaphthalene	0.59	J	1.5	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	3/12	0.39 - 0.49	1.5	1	N	ASC
83-32-9	Acenaphthene	2.9		8.1		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	3/12	0.39 - 0.49	8.1	270	N	BSC
120-12-7	Anthracene	0.067	J	14		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	6/12	0.39 - 0.47	14	1000	N	BSC
56-55-3	Benzo(a)anthracene	0.046		47		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	10/12	0.04 - 0.041	47	0.9	C	ASC
50-32-8	Benzo(a)pyrene	0.042	J	39		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	11/12	0.041	39	0.09	C	ASC
205-99-2	Benzo(b)fluoranthene	0.071		50		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	10/12	0.04 - 0.041	50	0.9	C	ASC
191-24-2	Benzo(g,h,i)perylene	0.032	J	29	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	9/12	0.4 - 0.47	29	1 (5)	N	ASC
207-08-9	Benzo(k)fluoranthene	0.025	J	26		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	9/12	0.039 - 0.041	26	9	C	ASC
117-81-7	bis(2-Ethylhexyl)phthalate (DEHP)	0.098	J	6.9		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	4/12	0.39 - 0.49	6.9	38	C	BSC
85-68-7	Butyl benzylphthalate (BBP)	0.12	J	9.7		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	6/12	0.39 - 0.47	9.7	280	C	BSC
86-74-8	Carbazole	0.058	J	11		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	6/12	0.39 - 0.47	11	--		NTX
218-01-9	Chrysene	0.062	J	51	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	10/12	0.4 - 0.41	51	87	C	BSC
53-70-3	Dibenz(a,h)anthracene	0.012	J	4.8		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	8/12	0.039 - 0.047	4.8	0.09	C	ASC
132-64-9	Dibenzofuran	1.6	J	3.1		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	3/12	0.39 - 0.49	3.1	7.2	N	BSC
117-84-0	Di-n-octyl phthalate (DnOP)	2.7	J	2.7		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	1/12	0.39 - 7.7	2.7	62	N	BSC
206-44-0	Fluoranthene	0.11	J	130	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	10/12	0.4 - 0.41	130	310	N	BSC
86-73-7	Fluorene	3	J	5.2		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	3/12	0.39 - 0.49	5.2	300	N	BSC
193-39-5	Indeno(1,2,3-cd)pyrene	0.023	J	33	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	10/12	0.04 - 0.041	33	0.9	C	ASC
91-20-3	Naphthalene	0.85	J	1.3		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	3/12	0.39 - 0.49	1.3	5	C	BSC
85-01-8	Phenanthrene	0.082	J	73	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	9/12	0.39 - 0.41	73	1000	N	BSC
129-00-0	Pyrene	0.099	J	81	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	10/12	0.4 - 0.41	81	230	N	BSC
7429-90-5	<u>Metals</u> Aluminum	1240		10000		mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	12/12	--	10000	51200	N	BSC
7440-36-0	Antimony	1.5	J	10.5		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	3/12	2.2 - 2.7	10.5	3.1	N	ASC
7440-38-2	Arsenic	2.4		6.7		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	3/12	1.1 - 3	6.7	11	C	BSC
7440-39-3	Barium	10.2	J	185		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	12/12	--	185	1500	N	BSC
7440-41-7	Beryllium	0.5	J	0.84		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	5/12	0.43 - 0.53	0.84	16	N	BSC
7440-43-9	Cadmium	0.43	J	4.1		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	3/12	1.1 - 1.3	4.1	7	N	BSC
7440-70-2	Calcium	350	J	51200		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	12/12	--	51200	--		NTX; NUT
7440-47-3	Chromium	5.8		117		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	11/12	6.9	117	12000	N	BSC
7440-48-4	Cobalt	1.7	J	12.8		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	11/12	11.6	12.8	34	N	BSC
7440-50-8	Copper	3.6	J	394		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	8/12	5.4 - 7.1	394	310	N	ASC
7439-89-6	Iron	2370		48400		mg/kg	SED 8, 0.5-1 ftbgs (09/17/12)	10/12	7430 - 7490	48400	74767	N	BSC
7439-92-1	Lead	2.2		526		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	12/12	--	526	400	C	ASC
7439-95-4	Magnesium	527	J	30500		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	12/12	--	30500	--		NTX; NUT
7439-96-5	Manganese	20.2		566		mg/kg	SED 10, 0.5-1 ftbgs (09/17/12)	12/12	--	566	2100	N	BSC
7439-97-6	Mercury	0.025	J	0.81		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	4/12	0.037 - 0.048	0.81	0.94	N	BSC

TABLE D.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future Medium: Sediment Exposure Medium: Sediment

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
7440-02-0	<u>Metals (cont. 'd')</u>												
	Nickel	2.5	J	42.6		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	12/12	--	42.6	150	N	BSC
7440-09-7	Potassium	151	J	1040		mg/kg	SED 8, 0.5-1 ftbgs (09/17/12)	12/12	--	1040	--		NTX; NUT
7440-23-5	Sodium	210	J	578	J	mg/kg	SED 1, 0-0.5 ftbgs (10/05/11)	4/12	1080 - 1330	578	--		NTX; NUT
7440-62-6	Vanadium	4.6	J	54		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	11/12	12.1	54	134	N	BSC
7440-66-6	Zinc	11.1		2370		mg/kg	SED 3, 0-0.5 ftbgs (10/05/11)	12/12	--	2370	2300	N	X ASC
	<u>Petroleum Products</u>												
--	TPH (C10-C28) DRO	310		7400	J	mg/kg	SED 4, 0-0.5 ftbgs (10/05/11)	4/7	33 - 42	7400	1000	N	X ASC

Notes:

C Carcinogenic; analyte considered to be a carcinogen.

N Non-Carcinogenic; analyte considered to be a non-carcinogen.

-- Not Available

J Result is an estimated value.

(1) Minimum/maximum detected concentration.

(2) Based on data collected from sampling locations: SED 1, SED 2, SED 3, SED 4, SED 5, SED 6, SED 7, SED 8, SED 9, SED 10, SED 11, SED 12.

(3) DNREC-SIRS Screening Level Table - Soil, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.

(4) Rationale Codes

Selection Reason Maximum detected above Screening Criterion (ASC)

Deletion Reason Maximum detected below Screening Criterion (BSC)

No Toxicity Data (NTX)

Essential Nutrient (NUT)

(5) No screening criterion available for this analyte, substituted lowest non-carcinogenic (2-methylnaphthalene) screening criterion.

TABLE D.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	<u>Metals</u>												
7440-39-3	Barium	113	J	232		µg/L	SW1 (09/17/12)	5/5	--	232	380	N	BSC
7440-70-2	Calcium	32600		35100		µg/L	SW1 (09/17/12)	5/5	--	35100	--		NTX; NUT
7439-89-6	Iron	317		564		µg/L	SW3 (09/17/12)	5/5	--	564	1400	N	BSC
7439-95-4	Magnesium	16200		20300		µg/L	SW1 (09/17/12)	5/5	--	20300	--		NTX; NUT
7439-96-5	Manganese	41.3		76.7		µg/L	SW1 (09/17/12)	5/5	--	76.7	43	N	ASC
7440-09-7	Potassium	3440	J	4530	J	µg/L	SW1 (09/17/12)	5/5	--	4530	--		NTX; NUT
7440-23-5	Sodium	30600		71600		µg/L	SW1 (09/17/12)	5/5	--	71600	--		NTX; NUT
7440-66-6	Zinc	6.9	J	141		µg/L	SW1 (09/17/12)	4/5	30	141	600	N	BSC
	<u>Dissolved Metals</u>												
7429-90-5	Aluminum	83.2	J	218		µg/L	SW4 (09/17/12)	2/5	200	218	2000	N	BSC
7440-39-3	Barium	108	J	227		µg/L	SW1 (09/17/12)	5/5	--	227	380	N	BSC
7440-70-2	Calcium	32300		35800		µg/L	SW1 (09/17/12)	5/5	--	35800	--		NTX; NUT
7439-89-6	Iron	161		576		µg/L	SW4 (09/17/12)	5/5	--	576	1400	N	BSC
7439-95-4	Magnesium	15500		20000		µg/L	SW1 (09/17/12)	5/5	--	20000	--		NTX; NUT
7439-96-5	Manganese	31.7		80.1		µg/L	SW4 (09/17/12)	5/5	--	80.1	43	N	ASC
7440-09-7	Potassium	3580	J	4680	J	µg/L	SW1 (09/17/12)	5/5	--	4680	--		NTX; NUT
7440-23-5	Sodium	30300		71800		µg/L	SW1 (09/17/12)	5/5	--	71800	--		NTX; NUT
7440-66-6	Zinc	32.2		130		µg/L	SW1 (09/17/12)	3/5	30	130	600	N	BSC

Notes:

- C Carcinogenic; analyte considered to be a carcinogen.
N Non-Carcinogenic; analyte considered to be a non-carcinogen.
-- Not Available
J Result is an estimated value.

- (1) Minimum/maximum detected concentration.
(2) Based on data collected from sampling locations: SW1, SW2, SW3, SW4, SW5.
(3) DNREC-SIRS Screening Level Table - Groundwater, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.
(4) Rationale Codes
Selection Reason Maximum detected above Screening Criterion (ASC)
Deletion Reason Maximum detected below Screening Criterion (BSC)
No Toxicity Data (NTX)
Essential Nutrient (NUT)

TABLE D.4
EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-2 ftbgs)
Exposure Medium: Surface Soil

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
SVOCs									
Benzo(a)pyrene	mg/kg	2.35E-02	(b)	1.00E-01		mg/kg	3.59E-02	95% KM (BCA) UCL	(4)
Metals									
Antimony	mg/kg	3.25E+00	(a)	1.40E+01	J	mg/kg	5.62E+00	95% KM (% Bootstrap) UCL	(4)
Lead	mg/kg	9.38E+01	(b)	7.09E+02	J	mg/kg	2.75E+02	95% Chebyshev (Mean, Sd) UCL	(4)

Notes:

J - Result is an estimated value.

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

- (a) Data set is neither normally, gamma or lognormally distributed.
- (b) Data set is lognormally distributed.
- (c) Data set is gamma distributed.
- (d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (% Bootstrap) UCL = 95% UCL based upon Kaplan-Meier Estimates using the Percentile Bootstrap Method.

95% KM (BCA) UCL = 95% UCL based on the Bias-corrected accelerated (BCA) Bootstrap method

95% Chebyshev (Mean, Sd) UCL = 95% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

TABLE D.5

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium	Medium	Medium
							EPC Value	EPC Statistic (3)	EPC Rationale
<u>Semi-volatile Organic Compounds</u>									
2-Methylnaphthalene	mg/kg	5.58E-01	(d)	1.50E+00		mg/kg	7.78E-01	95% KM (t) UCL	(4)
Benzo(a)anthracene	mg/kg	7.79E+00	(c)	4.70E+01		mg/kg	3.01E+01	95% Adjusted Gamma KM-UCL	(4)
Benzo(a)pyrene	mg/kg	6.64E+00	(b)	3.90E+01		mg/kg	4.28E+01	99% KM (Chebyshev) UCL	(4)
Benzo(b)fluoranthene	mg/kg	8.44E+00	(c)	5.00E+01		mg/kg	3.23E+01	95% Adjusted Gamma KM-UCL	(4)
Benzo(g,h,i)perylene	mg/kg	5.35E+00	(c)	2.90E+01		mg/kg	1.91E+01	95% Adjusted Gamma KM-UCL	(4)
Benzo(k)fluoranthene	mg/kg	4.27E+00	(c)	2.60E+01		mg/kg	1.67E+01	95% Adjusted Gamma KM-UCL	(4)
Dibenz(a,h)anthracene	mg/kg	8.65E-01	(c)	4.80E+00		mg/kg	3.09E+00	95% Adjusted Gamma KM-UCL	(4)
Indeno(1,2,3-cd)pyrene	mg/kg	5.43E+00	(c)	3.30E+01		mg/kg	2.09E+01	95% Adjusted Gamma KM-UCL	(4)
<u>Metals</u>									
Antimony	mg/kg	2.81E+00	(d)	1.05E+01		mg/kg	4.69E+00	95% KM (t) UCL	(4)
Copper	mg/kg	6.56E+01	(c)	3.94E+02		mg/kg	2.50E+02	95% Adjusted Gamma KM-UCL	(4)
Lead	mg/kg	9.50E+01	(b)	5.26E+02		mg/kg	6.00E+02	99% Chebyshev (Mean, Sd) UCL	(4)
Zinc	mg/kg	4.41E+02	(b)	2.37E+03		mg/kg	2.70E+03	99% Chebyshev (Mean, Sd) UCL	(4)
<u>Petroleum Products</u>									
TPH (C10-C28) DRO	mg/kg	1.73E+03	(d)	7.40E+03		mg/kg	3.94E+03	95% KM (t) UCL	(4)

Notes:

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% Adjusted Gamma KM-UCL = adjusted gamma UCL based upon Kaplan-Meier Estimates for non-detects using chi-square

99% Chebyshev (Mean, Sd) UCL = 99% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

99% KM (Chebyshev) UCL = 99% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

TPH - Total Petroleum Hydrocarbons

DRO - Diesel Range Organics

TABLE D.6

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN SURFACE WATER
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
<u>Metals</u> Manganese	µg/L	5.70E+01	(d)	7.60E+01		µg/L	7.02E+01	95% Student's-t UCL	(4)

Notes:

- (1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).
- (2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):
- (a) Data set is neither normally, gamma or lognormally distributed.
 - (b) Data set is lognormally distributed.
 - (c) Data set is gamma distributed.
 - (d) Data set is normally distributed.
- (3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):
- 95% Student's-t UCL = 95% UCL of the mean based upon the student's-t statistic
- (4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

TABLE D.7
SUMMARY OF RESIDENT RISK FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{iw}	H ⁺	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	0.00000556	0.0000187	-	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

Chemical		Concentration (mg/kg)	Child Ingestion Noncarcinogenic CDI	Child Inhalation Noncarcinogenic CDI	Child Dermal Noncarcinogenic CDI	Adult Ingestion Noncarcinogenic CDI	Adult Inhalation Noncarcinogenic CDI	Adult Dermal Noncarcinogenic CDI	Adjusted Ingestion Noncarcinogenic CDI	Adjusted Inhalation Noncarcinogenic CDI	Adjusted Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Antimony		5.62E+00	7.19E-05	1.67E-09	-	6.74E-06	1.67E-09	-	2.18E-05	1.67E-09	-	8.08E-06	6.19E-07	-
Benzo(a)pyrene		3.59E-02	4.59E-07	1.06E-11	1.61E-07	4.30E-08	1.06E-11	2.36E-08	1.39E-07	1.06E-11	5.52E-08	2.34E-07	1.10E-08	8.69E-08
Lead		2.75E+02	3.51E-03	8.14E-08	-	3.29E-04	8.14E-08	-	1.06E-03	8.14E-08	-	3.95E-04	3.02E-05	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Child Ingestion HQ	Child Inhalation HQ	Child Dermal HQ	Child Total HI	Adult Ingestion HQ	Adult Inhalation HQ	Adult Dermal HQ	Adult Total HI	Adjusted Ingestion HQ	Adjusted Inhalation HQ	Adjusted Dermal HQ	Adjusted Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		1.80E-01	-	-	1.80E-01	1.68E-02	-	-	1.68E-02	5.44E-02	-	-	5.44E-02	-	-	-	-
Benzo(a)pyrene		-	-	-	-	-	-	-	-	-	-	-	-	1.71E-06	1.20E-11	6.34E-07	2.35E-06
Lead		-	-	-	-	-	-	-	-	-	-	-	-	3.36E-06	3.63E-10	-	3.36E-06
*Total Risk/HI		1.80E-01	-	-	1.80E-01	1.68E-02	-	-	1.68E-02	5.44E-02	-	-	5.44E-02	5.07E-06	3.75E-10	6.34E-07	5.70E-06

TABLE D.8
SUMMARY OF TRESPASSER RISK FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen ?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{iw}	H ⁺	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	5.56E-06	0.0000187	-	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

Chemical		Concentration (mg/kg)	Ingestion Noncarcinogenic CDI	Inhalation Noncarcinogenic CDI	Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Antimony		5.62E+00	1.12E-06	4.49E-11	-	1.59E-07	6.41E-09	-
Benzo(a)pyrene		3.59E-02	7.13E-09	2.87E-13	3.91E-09	3.06E-09	1.23E-10	1.68E-09
Lead		2.75E+02	5.45E-05	2.19E-09	-	7.79E-06	3.13E-07	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		2.79E-03	-	-	2.79E-03	-	-	-	-
Benzo(a)pyrene		-	-	-	-	2.23E-08	1.35E-13	1.22E-08	3.46E-08
Lead		-	-	-	-	6.62E-08	3.76E-12	-	6.62E-08
*Total Risk/HI		2.79E-03	-	-	2.79E-03	8.85E-08	3.89E-12	1.22E-08	1.01E-07

TABLE D.9
SUMMARY OF OUTDOOR WORKER RISK FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen ?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{iw}	H ⁺	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	5.56E-06	0.0000187	-	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

Chemical		Concentration (mg/kg)	Ingestion Noncarcinogenic CDI	Inhalation Noncarcinogenic CDI	Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Antimony		5.62E+00	4.33E-06	3.57E-10	-	1.55E-06	1.28E-07	-
Benzo(a)pyrene		3.59E-02	2.77E-08	2.28E-12	1.50E-08	9.88E-09	8.15E-10	5.35E-09
Lead		2.75E+02	2.12E-04	1.74E-08	-	7.55E-05	6.23E-06	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		1.08E-02	-	-	1.08E-02	-	-	-	-
Benzo(a)pyrene		-	-	-	-	7.21E-08	8.96E-13	3.90E-08	1.11E-07
Lead		-	-	-	-	6.42E-07	7.48E-11	-	6.42E-07
*Total Risk/HI		1.08E-02	-	-	1.08E-02	7.14E-07	7.57E-11	3.90E-08	7.53E-07

TABLE D.10
SUMMARY OF UTILITY WORKER RISK FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen ?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{iw}	H ⁺	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	5.56E-06	0.0000187	-	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

Chemical		Concentration (mg/kg)	Ingestion Noncarcinogenic CDI	Inhalation Noncarcinogenic CDI	Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Antimony		5.62E+00	1.27E-06	3.18E-11	-	4.54E-07	1.13E-08	-
Benzo(a)pyrene		3.59E-02	8.11E-09	2.03E-13	3.33E-09	2.90E-09	7.24E-11	1.19E-09
Lead		2.75E+02	6.20E-05	1.55E-09	-	2.22E-05	5.54E-07	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		3.18E-03	-	-	3.18E-03	-	-	-	-
Benzo(a)pyrene		-	-	-	-	2.12E-08	7.97E-14	8.68E-09	2.98E-08
Lead		-	-	-	-	1.88E-07	6.65E-12	-	1.88E-07
*Total Risk/HI		3.18E-03	-	-	3.18E-03	2.10E-07	6.73E-12	8.68E-09	2.18E-07

TABLE D.11
SUMMARY OF CONSTRUCTION WORKER RISK FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen ?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (µg/m ³) ⁻¹	IUR Reference	ABS _{gi}	ABS _{derm}	D _{ia}	D _{iw}	H ⁺	K _d	Volatilization Factor (m ³ /kg)	Particulate Emission Factor (m ³ /kg)	Soil Saturation Concentration (mg/kg)
Antimony	No	No	0.0004	IRIS	-		-		-		0.15	-	-	-	-	45	-	3.23E+09	-
Benzo(a)pyrene	Yes	No	-		-		7.3	IRIS	0.0011	CALEPA	1	0.13	0.0476	5.56E-06	0.0000187	-	-	3.23E+09	-
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	-	-	-	-	900	-	3.23E+09	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

Chemical		Concentration (mg/kg)	Ingestion Noncarcinogenic CDI	Inhalation Noncarcinogenic CDI	Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Antimony		5.62E+00	1.27E-06	3.18E-11	-	1.81E-08	4.54E-10	-
Benzo(a)pyrene		3.59E-02	8.11E-09	2.03E-13	3.33E-09	1.16E-10	2.90E-12	4.75E-11
Lead		2.75E+02	6.20E-05	1.55E-09	-	8.86E-07	2.22E-08	-

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Antimony		3.18E-03	-	-	3.18E-03	-	-	-	-
Benzo(a)pyrene		-	-	-	-	8.46E-10	3.19E-15	3.47E-10	1.19E-09
Lead		-	-	-	-	7.53E-09	2.66E-13	-	7.53E-09
*Total Risk/HI		3.18E-03	-	-	3.18E-03	8.38E-09	2.69E-13	3.47E-10	8.73E-09

TABLE D.12

**SUMMARY OF TRESPASSER RISK FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>ABS_{derm}</i>	<i>K_d</i>	<i>Soil Saturation Concentration (mg/kg)</i>
Antimony	No	No	0.0004	IRIS	-		-	45	-
Benzo(a)anthracene	Yes	No	-		0.73	Surroga	0.13	-	-
Benzo(a)pyrene	Yes	No	-		7.3	IRIS	0.13	-	-
Benzo(b)fluoranthene	Yes	No	-		0.73	Surroga	0.13	-	-
Benzo(g,h,i)perylene	No	No	-		-		0.13	-	-
Benzo(k)fluoranthene	Yes	No	-		0.073	Surroga	0.13	-	-
Copper	No	No	0.04	HEAST	-		-	35	-
Dibenz(a,h)anthracene	Yes	No	-		7.3	Surroga	0.13	-	-
Indeno(1,2,3-cd)pyrene	Yes	No	-		0.73	Surroga	0.13	-	-
Lead	No	No	-		0.0085	CALEPA	-	900	-
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		0.13	4.956	-
TPH (C10-C28) DRO	No	Yes	0.01	PPRTV C	-		-	1.592	6.24
Zinc	No	No	0.3	IRIS	-		-	62	-

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Concentration (mg/kg)</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Antimony	4.69E+00	-	-
Benzo(a)anthracene	3.01E+01	3.28E-06	1.41E-06
Benzo(a)pyrene	4.28E+01	4.67E-06	2.00E-06
Benzo(b)fluoranthene	3.23E+01	3.52E-06	1.51E-06
Benzo(g,h,i)perylene	1.91E+01	2.08E-06	2.97E-07
Benzo(k)fluoranthene	1.67E+01	1.82E-06	7.80E-07
Copper	2.50E+02	-	-
Dibenz(a,h)anthracene	3.09E+00	3.37E-07	1.44E-07
Indeno(1,2,3-cd)pyrene	2.09E+01	2.28E-06	9.77E-07
Lead	6.00E+02	-	-
Methylnaphthalene, 2-	7.78E-01	8.48E-08	1.21E-08
TPH (C10-C28) DRO	3.94E+03	-	-
Zinc	2.70E+03	-	-

TABLE D.12

SUMMARY OF TRESPASSER RISK FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Dermal HQ</i>	<i>Total HI</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Antimony		-	0.00E+00	-	-
Benzo(a)anthracene		-	-	1.03E-06	1.03E-06
Benzo(a)pyrene		-	-	1.46E-05	1.46E-05
Benzo(b)fluoranthene		-	-	1.10E-06	1.10E-06
Benzo(g,h,i)perylene		-	-	-	-
Benzo(k)fluoranthene		-	-	5.70E-08	5.70E-08
Copper		-	0.00E+00	-	-
Dibenz(a,h)anthracene		-	-	1.05E-06	1.05E-06
Indeno(1,2,3-cd)pyrene		-	-	7.13E-07	7.13E-07
Lead		-	-	-	0.00E+00
Methylnaphthalene, 2-		2.12E-05	2.12E-05	-	-
TPH (C10-C28) DRO		-	0.00E+00	-	0.00E+00
Zinc		-	0.00E+00	-	-
*Total Risk/HI		2.12E-05	2.12E-05	1.86E-05	1.86E-05

TABLE D.13

SUMMARY OF TRESPASSER RISK FOR SURFACE WATER
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>RAGSe GIABS (unitless)</i>	<i>Kp</i>	<i>FA</i>	<i>EPD</i>
Manganese	No	No	0.024	SURROGA	-		0.04	0.001	1	1

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Concentration (mg/L)</i>	<i>Concentration (ug/L)</i>	<i>Ingestion Noncarcinogenic CDI</i>	<i>Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Manganese	7.02E-02	7.02E+01	6.97E-06	1.14E-05	3.89E-06	1.62E-06

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>	<i>Ingestion HQ</i>	<i>Dermal HQ</i>	<i>Total HI</i>	<i>Ingestion Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Manganese	2.90E-04	1.18E-02	1.21E-02	-	-	-
*Total Risk/HI	2.90E-04	1.18E-02	1.21E-02	-	-	-

Appendix E

Site-Wide Groundwater Risk Tables

Appendix E

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TABLE E.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	VOCs												
75-34-3	1,1-Dichloroethane	0.21	J	7.8		µg/L	MW-26 (10/31/11)	6/78	1 - 5	7.8	2.7	C	ASC
75-35-4	1,1-Dichloroethene	0.13	J	0.49	J	µg/L	MW-26 (10/31/11)	3/78	1 - 5	0.49	7	N	BSC
95-63-6	1,2,4-Trimethylbenzene	0.14	J	2800	E	µg/L	VAS-3 (08/08/12)	25/38	1	2800	1.5	N	ASC
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	1.6	J	1.8	J	µg/L	MW36S (09/18/13)	1/78	1 - 5	1.8	0.0075	C	LDF
95-50-1	1,2-Dichlorobenzene	0.21	J	4.6		µg/L	VAS-1 (08/08/12)	11/78	1 - 5	4.6	30	N	BSC
107-06-2	1,2-Dichloroethane	0.3	J	31		µg/L	MW-36D (10/23/12)	17/78	1 - 5	31	0.17	C	ASC
78-87-5	1,2-Dichloropropane	0.099	J	0.19	J	µg/L	VAS-10 (09/11/12)	3/78	1 - 5	0.19	0.44	C	BSC
541-73-1	1,3-Dichlorobenzene	0.29	J	0.65	J	µg/L	VAS-1 (08/08/12)	4/78	1 - 5	0.65	30 (5)	N	BSC
106-46-7	1,4-Dichlorobenzene	0.26	J	1.2		µg/L	VAS-1 (08/08/12)	5/78	1 - 5	1.2	0.48	C	ASC
78-93-3	2-Butanone (MEK)	2.5	J	79		µg/L	MW36S (09/18/13)	19/31	5 - 25	79	560	N	BSC
591-78-6	2-Hexanone	1.4	J	19	J	µg/L	MW36S (09/18/13)	7/78	5 - 25	19	3.8	N	ASC
108-10-1	4-Methyl-2-pentanone (MIBK)	1.2	J	16		µg/L	MW-36S (10/22/12)	6/78	5 - 25	16	120	N	BSC
67-64-1	Acetone	14	J	280	J	µg/L	VAS-1 (08/08/12)	10/21	5 - 25	280	1400	N	BSC
71-43-2	Benzene	0.12	J	860		µg/L	MW36S (09/18/13)	56/78	1	860	0.45	C	ASC
75-15-0	Carbon disulfide	0.15	J	4.3		µg/L	MW-105 (11/02/11)	11/78	1 - 5	4.3	81	N	BSC
56-23-5	Carbon tetrachloride	0.074	J	13		µg/L	VAS-10 (09/11/12)	6/78	1 - 5	13	0.45	C	ASC
108-90-7	Chlorobenzene	0.13	J	0.44	J	µg/L	VAS-1 (08/08/12)	5/78	1 - 5	0.44	7.8	N	BSC
67-66-3	Chloroform (Trichloromethane)	0.15	J	24		µg/L	VAS-10 (09/11/12)	11/78	1 - 5	24	0.22	C	ASC
156-59-2	cis-1,2-Dichloroethene	0.32	J	9.2		µg/L	MW-29 (11/01/11)	9/78	1 - 5	9.2	3.6	N	ASC
110-82-7	Cyclohexane	0.44	J	700		µg/L	VAS-3 (08/08/12)	46/78	1	700	1300	N	BSC
100-41-4	Ethylbenzene	0.11	J	2400		µg/L	VAS-3 (08/08/12)	46/78	1	2400	1.5	C	ASC
98-82-8	Isopropyl benzene	0.097	J	130		µg/L	VAS-3 (08/08/12)	46/78	1	130	45	N	ASC
108-87-2	Methyl cyclohexane	0.3	J	360		µg/L	VAS-3 (08/08/12)	45/78	1	360	1300 (6)	N	BSC
1634-04-4	Methyl tert butyl ether (MTBE)	0.17	J	3.2		µg/L	MW-26 (10/31/11)	18/78	1 - 5	3.2	10	C	BSC
100-42-5	Styrene	0.15	J	72		µg/L	VAS-3 (08/08/12)	23/78	1 - 5	72	100	N	BSC
127-18-4	Tetrachloroethene	0.13	J	8.9		µg/L	BH10-11 (09/16/11)	16/78	1 - 5	8.9	1	N	ASC
108-88-3	Toluene	0.17	J	6100		µg/L	VAS-3 (08/08/12)	47/78	1	6100	110	N	ASC
79-01-6	Trichloroethene	0.16	J	9.5		µg/L	VAS-10 (09/11/12)	14/78	1 - 5	9.5	0.28	C	ASC
75-01-4	Vinyl chloride	23		42		µg/L	MW-29 (11/01/11)	3/78	1 - 5	42	0.019	C	LDF
1330-20-7	Xylenes (total)	0.48	J	13000		µg/L	VAS-3 (08/08/12)	47/78	3	13000	19	N	ASC
	SVOCs												
105-67-9	2,4-Dimethylphenol	5	J	5	J	µg/L	MW-36S (10/22/12)	1/30	10 - 12	5	36	N	BSC
91-57-6	2-Methylnaphthalene	3.6	J	180		µg/L	MW36S (09/18/13)	3/30	10 - 12	180	3.6	N	ASC
95-48-7	2-Methylphenol	3.2	J	3.2	J	µg/L	MW-36S (10/22/12)	1/30	10 - 12	3.2	93	N	BSC
106-44-5	4-Methylphenol	2.4	J	4.9	J	µg/L	MW-36S (10/22/12)	3/30	10 - 12	4.9	190	N	BSC
98-86-2	Acetophenone	28		28		µg/L	MW36S (09/18/13)	1/30	10 - 12	28	190	N	BSC
56-55-3	Benzo(a)anthracene	0.024	J	0.024	J	µg/L	MW-105 (11/02/11)	1/30	0.05 - 1	0.024	0.034	C	BSC
208-08-9	Benzo(k)fluoranthene	1		1		µg/L	MW-36S (10/22/12)	1/30	1 - 1.2	1	0.34	C	LDF
92-52-4	Biphenyl (1,1-Biphenyl)	8.6	J	11		µg/L	MW36S (09/18/13)	2/30	10 - 12	11	0.083	N	ASC
53-70-3	Dibenz(a,h)anthracene	0.3	J	0.3	J	µg/L	MW-36S (10/22/12)	1/30	1 - 1.2	0.3	0.0034	C	LDF
132-64-9	Dibenzofuran	3	J	3.8	J	µg/L	MW36S (09/18/13)	2/30	10 - 12	3.8	0.79	N	ASC
84-66-2	Diethyl phthalate	4.3	J	4.3	J	µg/L	MW30 (09/18/13)	1/30	10 - 12	4.3	1500	N	BSC

TABLE E.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
	<u>SVOCs (cont.'d)</u>												
86-73-7	Fluorene	3.3	J	4	J	µg/L	MW36S (09/18/13)	2/30	10 - 12	4	29	N	BSC
193-39-5	Indeno(1,2,3-cd)pyrene	0.58	J	0.58	J	µg/L	MW-36S (10/22/12)	1/30	1 - 1.2	0.58	0.034	C	LDF
91-20-3	Naphthalene	4.8	J	270		µg/L	MW-36S (10/22/12)	6/30	10 - 12	270	0.17	C	ASC
87-86-5	Pentachlorophenol	0.2		0.2		µg/L	MW-24 (10/31/11)	1/30	0.2 - 31	0.2	0.04	C	LDF
85-01-8	Phenanthrene	3.3	J	3.4	J	µg/L	MW36S (09/18/13)	1/30	10 - 12	3.4	12	N	BSC
108-95-2	Phenol	1.5	J	10		µg/L	MW-10S (11/02/11)	3/30	10 - 12	10	580	N	BSC
	<u>Metals</u>												
7429-90-5	Aluminum	103	J	35300		µg/L	BH11-11 (09/16/11)	22/23	200	35300	2000	N	ASC
7440-38-2	Arsenic	3.9	J	7.9		µg/L	MW-28 (11/02/11)	9/23	5	7.9	0.052	C	ASC
7440-39-3	Barium	70.1	J	1390		µg/L	MW-29 (11/01/11)	23/23	--	1390	380	N	ASC
7440-41-7	Beryllium	0.95	J	1.9	J	µg/L	MW-32 (11/02/11)	2/23	2	1.9	2.5	N	BSC
7440-70-2	Calcium	11200		207000		µg/L	MW-26 (10/31/11)	23/23	--	207000	--		NTX; NUT
7440-47-3	Chromium	4.6	J	59		µg/L	BH11-11 (09/16/11)	8/23	10	59	2200	N	BSC
7440-48-4	Cobalt	3.1	J	139		µg/L	MW-36S (10/22/12)	15/23	50	139	0.6	N	ASC
7440-50-8	Copper	9.2	J	25		µg/L	BH11-11 (09/16/11)	3/23	25	25	80	N	BSC
7439-89-6	Iron	83	J	78400		µg/L	MW-29 (11/01/11)	21/23	150	78400	1400	N	ASC
7439-92-1	Lead	2.9	J	14.3		µg/L	BH11-11 (09/16/11)	5/24	5 - 12.2	14.3	5	C	ASC
7439-95-4	Magnesium	102	J	138000		µg/L	MW-29 (11/01/11)	22/23	5000	138000	--		NTX; NUT
7439-96-5	Manganese	5.8	J	30400		µg/L	MW-30 (11/01/11)	21/23	15	30400	43	N	ASC
7440-02-0	Nickel	3.9	J	36.6	J	µg/L	BH11-11 (09/16/11)	19/23	40	36.6	39	N	BSC
7440-09-7	Potassium	2020	J	14100		µg/L	BH11-11 (09/16/11)	23/23	--	14100	--		NTX; NUT
7440-22-4	Silver	1.1	J	7	J	µg/L	MW-36S (10/22/12)	4/23	10	7	9.4	N	BSC
7440-23-5	Sodium	10200		248000		µg/L	MW-29 (11/01/11)	23/23	--	248000	--		NTX; NUT
7440-28-0	Thallium	27.4	J	27.4	J	µg/L	MW-36S (10/22/12)	1/23	10 - 30	27.4	0.02	N	LDF
7440-62-6	Vanadium	2.2	J	53.5		µg/L	BH11-11 (09/16/11)	17/23	50	53.5	8.6	N	ASC
7440-66-6	Zinc	6.1	J	101		µg/L	MW-28 (11/02/11)	17/23	30	101	600	N	BSC
	<u>Dissolved Metals</u>												
7429-90-5	Aluminum	98.2	J	362		µg/L	BH11-11 (09/16/12)	5/23	200	362	2000	N	BSC
7440-38-2	Arsenic	3.9	J	5.7		µg/L	MW-10S (10/11/12)	4/23	5	5.7	0.052	C	ASC
7440-39-3	Barium	48.7	J	1030		µg/L	MW-29 (11/01/11)	23/23	--	1030	380	N	ASC
7440-70-2	Calcium	9310		208000		µg/L	MW-26 (10/31/11)	23/23	--	208000	--		NTX; NUT
7440-47-3	Chromium	10.1		10.1		µg/L	BH36-11 (09/16/11)	1/23	10	10.1	2200	N	BSC
7440-48-4	Cobalt	5.7	J	124		µg/L	MW-36S (10/22/12)	12/23	50	124	0.6	N	ASC
7440-50-8	Copper	3.8	J	3.8	J	µg/L	BH11-11 (09/16/12)	1/23	25	3.8	80	N	BSC
7439-89-6	Iron	61.5	J	47500		µg/L	MW-29 (11/01/11)	12/23	150	47500	1400	N	ASC
7439-92-1	Lead	4.1	J	5.7		µg/L	BH36-11 (09/16/11)	2/24	5	5.7	5	C	ASC
7439-95-4	Magnesium	156	J	144000		µg/L	MW-29 (11/01/11)	22/23	5000	144000	--		NTX; NUT
7439-96-5	Manganese	23.5		29100		µg/L	MW-36S (10/22/12)	19/23	15	29100	43	N	ASC
7439-97-6	Mercury	0.53		0.53		µg/L	MW-27 (10/18/12)	1/23	0.2	0.53	0.063	N	LDF
7440-02-0	Nickel	4	J	28.9	J	µg/L	MW-27 (11/01/11)	16/23	40	28.9	39	N	BSC

TABLE E.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for Contaminant Deletion or Selection (4)
7440-09-7	<u>Dissolved Metals (cont.'d)</u>	845	J	11400		µg/L	MW-24 (10/31/11)	23/23	--	11400	--		NTX; NUT
7782-49-2	Potassium	4.9	J	13.1		µg/L	MW-29 (10/18/12)	5/23	10 - 30	13.1	10	N	ASC
7440-22-4	Selenium	1.7	J	6.6	J	µg/L	MW-36S (10/22/12)	3/23	10	6.6	9.4	N	BSC
7440-23-5	Silver	11800		261000		µg/L	MW-29 (11/01/11)	23/23	--	261000	--		NTX; NUT
7440-62-6	Sodium	4.5	J	13.3	J	µg/L	MW-105 (11/02/12)	6/23	50	13.3	8.6	N	ASC
7440-66-6	Vanadium	7.8	J	88.5		µg/L	MW-28 (11/02/11)	11/23	30	88.5	600	N	BSC
	<u>PCBs</u>												
11096-82-5	Aroclor-1260 (PCB-1260)	2.4		3.5		µg/L	BH11-11 (09/16/11)	2/19	0.51 - 0.67	3.5	0.039	C	ASC

Notes:

SVOCs Semi-volatile Organic Compounds

VOCs Volatile Organic Compounds

PCBs Polychlorinated Biphenyls

C Carcinogenic; analyte considered to be a carcinogen.

N Non-Carcinogenic; analyte considered to be a non-carcinogen.

-- Not Available

J Result is an estimated value.

E Exceeds calibration range.

(1) Minimum/maximum detected concentration.

(2) Based on data collected from sampling locations: BH10-11, BH11-11, BH36-11, MW27, MW28, MW29, MW30, MW31, MW35, MW36D, MW36S, MW37, MW109, MW111, MW-14, MW-22, MW-23, MW-24, MW-25, MW-26, MW-27, MW-28, MW-29, MW-30, MW-31, MW-32, MW-35, MW-36D, MW-36S, MW-37, MW-100, MW-101, MW-105, MW-110, VAS-1, VAS-2, VAS-3, VAS-4, VAS-5, VAS-6, VAS-7, VAS-8, VAS-9, VAS-10.

(3) DNREC-SIRS Screening Level Table - Groundwater, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.

(4) Rationale Codes Selection Reason Maximum detected above Screening Criterion (ASC)

Deletion Reason Maximum detected below Screening Criterion (BSC)

No Toxicity Data (NTX)

Essential Nutrient (NUT)

Low Detection Frequency (LDF); less than 5 percent

(5) No screening criterion available for this analyte, substituted 1,2-dichlorobenzene screening criterion.

(6) No screening criterion available for this analyte, substituted cyclohexane screening criterion.

TABLE E.2

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
VOCs									
1,1-Dichloroethane	µg/L	3.48E-01	(b)	7.80E+00	E	µg/L	5.58E-01	95% KM (BCA) UCL	(4)
1,2,4-Trimethylbenzene	µg/L	2.21E+02	(c)	2.80E+03		µg/L	5.32E+02	95% Adjusted Gamma KM-UCL	(4)
1,2-Dichloroethane	µg/L	2.45E+00	(d)	3.10E+01		µg/L	3.57E+00	95% KM (Percentile Bootstrap) UCL	(4)
1,4-Dichlorobenzene	µg/L	4.54E-01	(d)	1.20E+00	J	µg/L	6.43E-01	95% KM (t) UCL	(4)
2-Hexanone	µg/L	2.61E+00	(d)	1.90E+01		µg/L	3.35E+00	95% KM (Percentile Bootstrap) UCL	(4)
Benzene	µg/L	1.25E+02	(a)	8.60E+02		µg/L	2.85E+02	97.5% KM (Chebyshev) UCL	(4)
Carbon tetrachloride	µg/L	5.39E-01	(d)	1.30E+01		µg/L	1.16E+00	95% KM (Percentile Bootstrap) UCL	(4)
Chloroform (Trichloromethane)	µg/L	1.38E+00	(d)	2.40E+01		µg/L	2.38E+00	95% KM (Percentile Bootstrap) UCL	(4)
cis-1,2-Dichloroethene	µg/L	7.79E-01	(c)	9.20E+00		µg/L	1.04E+00	95% KM (t) UCL	(4)
Ethylbenzene	µg/L	1.39E+02	(b)	2.40E+03		µg/L	4.08E+02	97.5% KM (Chebyshev) UCL	(4)
Isopropyl benzene	µg/L	1.28E+01	(a)	1.30E+02		µg/L	2.86E+01	97.5% KM (Chebyshev) UCL	(4)
Tetrachloroethene	µg/L	6.02E-01	(b)	8.90E+00		µg/L	8.49E-01	95% KM (Percentile Bootstrap) UCL	(4)
Toluene	µg/L	2.84E+02	(b)	6.10E+03		µg/L	9.90E+02	97.5% KM (Chebyshev) UCL	(4)
Trichloroethene	µg/L	7.88E-01	(b)	9.50E+00		µg/L	1.13E+00	95% KM (BCA) UCL	(4)
Xylenes (total)	µg/L	5.86E+02	(a)	1.30E+04		µg/L	2.08E+03	97.5% KM (Chebyshev) UCL	(4)
SVOCs									
2-Methylnaphthalene	µg/L	1.35E+01	(d)	1.80E+02	J	µg/L	2.78E+01	95% KM (t) UCL	(4)
Biphenyl (1,1-Biphenyl)	µg/L	8.70E+00	(a)	1.10E+01		µg/L	8.94E+00	95% KM (t) UCL	(4)
Dibenzofuran	µg/L	3.35E+00	(a)	3.80E+00		µg/L	3.95E+00	95% KM (t) UCL	(4)
Naphthalene	µg/L	2.41E+01	(c)	2.70E+02		µg/L	6.89E+01	95% Adjusted Gamma KM-UCL	(4)
Metals									
Aluminum	µg/L	5.07E+03	(b)	3.53E+04		µg/L	1.29E+04	95% Chebyshev (Mean, Sd) UCL	(4)
Arsenic	µg/L	4.77E+00	(d)	7.90E+00		µg/L	5.27E+00	95% KM (Percentile Bootstrap) UCL	(4)
Barium	µg/L	3.37E+02	(c)	1.39E+03		µg/L	4.70E+02	95% Adjusted Gamma UCL	(4)
Cobalt	µg/L	3.73E+01	(c)	1.39E+02		µg/L	5.69E+01	95% Adjusted Gamma KM-UCL	(4)
Iron	µg/L	1.85E+04	(c)	7.84E+04		µg/L	4.19E+04	95% KM (Chebyshev) UCL	(4)
Lead	µg/L	4.69E+00	(d)	1.43E+01		µg/L	6.16E+00	95% KM (t) UCL	(4)
Manganese	µg/L	5.09E+03	(c)	3.04E+04		µg/L	1.39E+04	95% KM (Chebyshev) UCL	(4)
Selenium	µg/L	7.03E+00	(d)	1.31E+01		µg/L	7.99E+00	95% KM (Percentile Bootstrap) UCL	(4)
Vanadium	µg/L	1.56E+01	(c)	5.35E+01		µg/L	2.27E+01	95% Adjusted Gamma KM-UCL	(4)
PCBs									
Aroclor-1260 (PCB-1260)	µg/L	7.67E-01	(a)	3.50E+00		µg/L	1.20E+00	95% KM (t) UCL	(4)

Notes:

VOCs - Volatile Organic Compounds

SVOCs - Semi-volatile Organic Compounds

PCBs - Polychlorinated Biphenyls

J - Result is an estimated value.

E - Exceeds calibration range.

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% KM (Chebyshev) UCL = 95% UCL based upon Kaplan-Meier Estimates using the Chebyshev Inequality

95% Chebyshev (Mean, Sd) UCL = 95% Chebyshev UCL of mean and standard deviation using the Chebyshev Inequality

95% KM (BCA) UCL = 95% UCL based on the Bias-corrected accelerated (BCA) Bootstrap method

95% Adjusted Gamma UCL = adjusted gamma UCL using chi-square

95% Adjusted Gamma KM-UCL = adjusted gamma UCL based upon Kaplan-Meier Estimates for non-detects using chi-square

95% KM (Percentile Bootstrap) UCL = 95% UCL based upon Kaplan-Meier Estimates using the Percentile Bootstrap Method.

97.5% KM (Chebyshev) UCL = 97.5% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

TABLE E.3

VALUES USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER - FUTURE UTILITY WORKER
SITE WIDE
FORMER WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Utility Worker
Receptor Age: Adult

<i>Exposure Route</i>	<i>Parameter Code</i>	<i>Parameter Definition</i>	<i>Units</i>	<i>RME Value</i>	<i>RME Rationale/ Reference</i>	<i>Intake Equation/ Model Name</i>
Ingestion	CW	Chemical Concentration in Groundwater	mg/L	(1)	(1)	Chronic Daily Intake (CDI) (mg/kg-day) = CW x IR x ET x EF x ED x 1/BW x 1/AT
	IR	Ingestion Rate	L/hour	0.02	Virginia DEQ, 2014	
	ET	Exposure Time	hours/day	8	RAIS, 2014	
	EF	Exposure Frequency	days/year	20	RAIS, 2014 (2)	
	ED	Exposure Duration	years	25	RAIS, 2014 (3)	
	BW	Body Weight	kg	80	RAIS, 2014	
	AT-C	Averaging Time (cancer)	days	25,550	RAIS, 2014	
	AT-N	Averaging Time (non-cancer)	days	9,125	RAIS, 2014	
Dermal	CW	Chemical Concentration in Groundwater	mg/L	(1)	(1)	CDI (mg/kg-day) = DAevent x SA x EF x EV x ED x 1/BW x 1/AT
	SA	Skin Surface Area Available for Contact	cm ²	3,470	RAIS, 2014	
	CF	Conversion Factor	L/cm ³	0.001	--	DAevent (mg/cm ² -event) - Inorganics (RAIS, 2014) = PC x ET x CW x CF
	EV	Event Frequency	events/day	1	RAIS, 2014	
	ET	Exposure Time	hours/event	8	RAIS, 2014	DAevent (mg/cm ² -event) - Organics (RAIS, 2014) = ET <= t* = 2 x FA x PC x CW x CF x SQRT(6 x t _{event} x ET / PI) ET > t* = FA x PC x CW x CF x (ET/(1+B)+2 x t _{event} x ((1+3B+3B ²)/(1+B) ²)) t* = 2.4 x t _{event}
	EF	Exposure Frequency	days/year	20	RAIS, 2014 (2)	
	ED	Exposure Duration	years	25	RAIS, 2014 (3)	
	BW	Body Weight	kg	80	RAIS, 2014	
	AT-C	Averaging Time (cancer)	days	25,550	RAIS, 2014	
	AT-N	Averaging Time (non-cancer)	days	9,125	RAIS, 2014	
	FA	Fraction Absorbed	unitless	chemical-specific	RAIS, 2014	
	PC	Permeability Constant	cm/hour	chemical-specific	RAIS, 2014	
	t _{event}	Lag Time per event	hr/event	chemical-specific	RAIS, 2014	
	B	Constant	dimensionless	chemical-specific	RAIS, 2014	
Inhalation	CW	Chemical Concentration in Groundwater	mg/L	(1)	(1)	Exposure Concentration (EC) (mg/m ³) = CW x FT x EF x ED x VF x 1/AT
	FT	Fraction Time Exposed	unitless	8/24	RAIS, 2014	
	EF	Exposure Frequency	days/year	20	RAIS, 2014 (2)	
	ED	Exposure Duration	years	25	RAIS, 2014 (3)	
	AT-C	Averaging Time (cancer)	days	25,550	RAIS, 2014	
	AT-N	Averaging Time (non-cancer)	days	9,125	RAIS, 2014	
	VF	Volatilization Factor	L/m ³	chemical-specific	(4)	

Notes:

- (1) For Site Wide groundwater concentrations, refer to Table E.2.
(2) The exposure frequency of 20 days/year as presented for the excavation worker exposure in the RAIS Calculator was implemented for this receptor.
(3) The exposure duration of 25 years as presented for the outdoor worker exposure in the RAIS Calculator was implemented for this receptor.
(4) Calculated following the methodology presented in USEPA (1999).

References:

RAIS, 2014: The Risk Assessment Information System (<http://rais.ornl.gov/#>), last revision date October 2014.
Virginia DEQ, 2014: Virginia DEQ Waste Management, Voluntary Remediation Program Risk Assessment Guidance, May 2014.

TABLE E.4

VALUES USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER - FUTURE CONSTRUCTION WORKER

SITE WIDE

FORMER WILMINGTON ASSEMBLY PLANT

WILMINGTON, DELAWARE

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CW	Chemical Concentration in Groundwater	mg/L	(1)	(1)	Chronic Daily Intake (CDI) (mg/kg-day) = CW x IR x ET x EF x ED x 1/BW x 1/AT
	IR	Ingestion Rate	L/hour	0.02	Virginia DEQ, 2014	
	ET	Exposure Time	hours/day	8	RAIS, 2014	
	EF	Exposure Frequency	days/year	20	RAIS, 2014	
	ED	Exposure Duration	years	1	RAIS, 2014	
	BW	Body Weight	kg	80	RAIS, 2014	
	AT-C	Averaging Time (cancer)	days	25,550	RAIS, 2014	
	AT-N	Averaging Time (non-cancer)	days	365	RAIS, 2014	
Dermal	CW	Chemical Concentration in Groundwater	mg/L	(1)	(1)	CDI (mg/kg-day) = DAevent x SA x EF x EV x ED x 1/BW x 1/AT
	SA	Skin Surface Area Available for Contact	cm ²	3,470	RAIS, 2014	
	CF	Conversion Factor	L/cm ³	0.001	--	DAevent (mg/cm ² -event) - Inorganics (RAIS, 2014) = PC x ET x CW x CF
	EV	Event Frequency	events/day	1	RAIS, 2014	
	ET	Exposure Time	hours/event	8	RAIS, 2014	DAevent (mg/cm ² -event) - Organics (RAIS, 2014) = ET <= t* = 2 x FA x PC x CW x CF x SQRT(6 x t _{event} x ET / PI)
	EF	Exposure Frequency	days/year	20	RAIS, 2014	
	ED	Exposure Duration	years	1	RAIS, 2014	ET > t* = FA x PC x CW x CF x (ET/(1+B)+2 x t _{event} x ((1+3B+3B ²)/(1+B) ²))
	BW	Body Weight	kg	80	RAIS, 2014	
	AT-C	Averaging Time (cancer)	days	25,550	RAIS, 2014	t* = 2.4 x t _{event}
	AT-N	Averaging Time (non-cancer)	days	365	RAIS, 2014	
	FA	Fraction Absorbed	unitless	chemical-specific	RAIS, 2014	
	PC	Permeability Constant	cm/hour	chemical-specific	RAIS, 2014	
	t _{event}	Lag Time per event	hr/event	chemical-specific	RAIS, 2014	
	B	Constant	dimensionless	chemical-specific	RAIS, 2014	
Inhalation	CW	Chemical Concentration in Groundwater	mg/L	(1)	(1)	Exposure Concentration (EC) (mg/m ³) = CW x FT x EF x ED x VF x 1/AT
	FT	Fraction Time Exposed	unitless	8/24	RAIS, 2014	
	EF	Exposure Frequency	days/year	20	RAIS, 2014	
	ED	Exposure Duration	years	1	RAIS, 2014	
	AT-C	Averaging Time (cancer)	days	25,550	RAIS, 2014	
	AT-N	Averaging Time (non-cancer)	days	365	RAIS, 2014	
	VF	Volatilization Factor	L/m ³	chemical-specific	(2)	

Notes:

- (1) For Site Wide groundwater concentrations, refer to Table E.2.
(2) Calculated following the methodology presented in USEPA (1999).

References:

RAIS, 2014: The Risk Assessment Information System (<http://rais.ornl.gov/#>), last revision date October 2014.
Virginia DEQ, 2014: Virginia DEQ Waste Management, Voluntary Remediation Program Risk Assessment Guidance, May 2014.

TABLE E.5

**DERIVATION OF GROUNDWATER DAevent FOR WORKERS
SITE WIDE
FORMER WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

$$\begin{aligned} \text{DAevent (cm/event) - Organics} &= \text{ET} \leq t^* = \\ &2 \times \text{FA} \times \text{PC} \times \text{SQRT}(6 \times t_{\text{event}} \times \text{ET} / \text{PI}) \\ \text{ET} > t^* &= \\ \text{FA} \times \text{PC} \times (\text{ET} / (1+B) + 2 \times t_{\text{event}} \times ((1+3B+3B^2) / (1+B)^2)) \\ t^* &= 2.4 \times t_{\text{event}} \end{aligned}$$

$$\text{DAevent (cm/event) - Inorganics} = \text{PC} \times \text{ET}$$

<i>Chemical of Potential Concern (COPC)</i>	<i>PC cm/hr</i>	<i>Ref</i>	<i>FA unitless</i>	<i>Ref</i>	<i>MW g/mole</i>	<i>Ref</i>	<i>t_{event} hr/event</i>	<i>D_{sc} cm²/hr</i>	<i>b unitless</i>	<i>c unitless</i>	<i>t* hr</i>	<i>ET hr/event</i>	<i>B dimensionless</i>	<i>DAevent cm/event</i>
<u>VOCs</u>														
1,1-Dichloroethane	6.75E-03	RAIS, 2014	1	USEPA, 2004	9.90E+01	RAIS, 2014	3.76E-01	4.42E-07	3.19E-01	3.51E-01	0.90	8.0E+00	2.58E-02	5.79E-02
1,2,4-Trimethylbenzene	8.57E-02	RAIS, 2014	1	USEPA, 2004	1.20E+02	RAIS, 2014	4.93E-01	3.37E-07	5.73E-01	6.06E-01	1.18	8.0E+00	3.61E-01	6.17E-01
1,2-Dichloroethane	4.20E-03	RAIS, 2014	1	USEPA, 2004	9.90E+01	RAIS, 2014	3.76E-01	4.42E-07	3.13E-01	3.44E-01	0.90	8.0E+00	1.61E-02	3.63E-02
1,4-Dichlorobenzene	4.53E-02	RAIS, 2014	1	USEPA, 2004	1.47E+02	RAIS, 2014	6.99E-01	2.38E-07	4.48E-01	4.86E-01	1.68	8.0E+00	2.11E-01	3.75E-01
2-Hexanone	3.55E-03	RAIS, 2014	1	USEPA, 2004	1.00E+02	RAIS, 2014	3.81E-01	4.37E-07	3.12E-01	3.42E-01	0.91	8.0E+00	1.37E-02	3.08E-02
Benzene	1.49E-02	RAIS, 2014	1	USEPA, 2004	7.81E+01	RAIS, 2014	2.87E-01	5.79E-07	3.35E-01	3.68E-01	0.69	8.0E+00	5.06E-02	1.22E-01
Carbon tetrachloride	1.63E-02	RAIS, 2014	1	USEPA, 2004	1.54E+02	RAIS, 2014	7.65E-01	2.18E-07	3.52E-01	3.87E-01	1.84	8.0E+00	7.78E-02	1.48E-01
Chloroform (Trichloromethane)	6.83E-03	RAIS, 2014	1	USEPA, 2004	1.19E+02	RAIS, 2014	4.87E-01	3.42E-07	3.21E-01	3.53E-01	1.17	8.0E+00	2.87E-02	6.00E-02
cis-1,2-Dichloroethene	1.10E-02	RAIS, 2014	1	USEPA, 2004	9.69E+01	RAIS, 2014	3.66E-01	4.54E-07	3.29E-01	3.62E-01	0.88	8.0E+00	4.16E-02	9.29E-02
Ethylbenzene	4.93E-02	RAIS, 2014	1	USEPA, 2004	1.06E+02	RAIS, 2014	4.12E-01	4.04E-07	4.35E-01	4.74E-01	0.99	8.0E+00	1.95E-01	3.78E-01
Isopropyl benzene	8.97E-02	RAIS, 2014	1	USEPA, 2004	1.20E+02	RAIS, 2014	4.93E-01	3.37E-07	5.89E-01	6.20E-01	1.18	8.0E+00	3.78E-01	6.40E-01
Tetrachloroethene	3.34E-02	RAIS, 2014	1	USEPA, 2004	1.66E+02	RAIS, 2014	8.93E-01	1.86E-07	4.13E-01	4.52E-01	2.14	8.0E+00	1.66E-01	2.99E-01
Toluene	3.11E-02	RAIS, 2014	1	USEPA, 2004	9.21E+01	RAIS, 2014	3.44E-01	4.83E-07	3.77E-01	4.14E-01	0.83	8.0E+00	1.15E-01	2.47E-01
Trichloroethene	1.16E-02	RAIS, 2014	1	USEPA, 2004	1.31E+02	RAIS, 2014	5.69E-01	2.93E-07	3.35E-01	3.68E-01	1.36	8.0E+00	5.11E-02	1.02E-01
Xylenes (total)	5.00E-02	RAIS, 2014	1	USEPA, 2004	1.06E+02	RAIS, 2014	4.12E-01	4.04E-07	4.37E-01	4.76E-01	0.99	8.0E+00	1.98E-01	3.83E-01
<u>SVOCs</u>														
2-Methylnaphthalene	9.17E-02	RAIS, 2014	1	USEPA, 2004	1.42E+02	RAIS, 2014	6.55E-01	2.54E-07	6.29E-01	6.55E-01	1.57	8.0E+00	4.20E-01	6.83E-01
Biphenyl (1,1-Biphenyl)	9.43E-02	RAIS, 2014	1	USEPA, 2004	1.54E+02	RAIS, 2014	7.65E-01	2.18E-07	6.59E-01	6.80E-01	1.84	8.0E+00	4.50E-01	7.23E-01
Dibenzofuran	9.75E-02	RAIS, 2014	1	USEPA, 2004	1.68E+02	RAIS, 2014	9.16E-01	1.82E-07	6.96E-01	7.10E-01	2.20	8.0E+00	4.86E-01	7.81E-01
Naphthalene	4.66E-02	RAIS, 2014	1	USEPA, 2004	1.28E+02	RAIS, 2014	5.47E-01	3.04E-07	4.41E-01	4.80E-01	1.31	8.0E+00	2.03E-01	3.71E-01

TABLE E.5

**DERIVATION OF GROUNDWATER DAevent FOR WORKERS
SITE WIDE
FORMER WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

$$\begin{aligned} \text{DAevent (cm/event) - Organics} &= \text{ET} \leq t^* = \\ &2 \times \text{FA} \times \text{PC} \times \sqrt{6 \times t_{\text{event}} \times \text{ET} / \text{PI}} \\ \text{ET} > t^* &= \\ \text{FA} \times \text{PC} \times (\text{ET} / (1+B) + 2 \times t_{\text{event}} \times ((1+3B+3B^2)/(1+B)^2)) \\ t^* &\approx 2.4 \times t_{\text{event}} \end{aligned}$$

$$\text{DAevent (cm/event) - Inorganics} = \text{PC} \times \text{ET}$$

<i>Chemical of Potential Concern (COPC)</i>	<i>PC cm/hr</i>	<i>Ref</i>	<i>FA unitless</i>	<i>Ref</i>	<i>MW g/mole</i>	<i>Ref</i>	<i>t_{event} hr/event</i>	<i>D_{sc} cm²/hr</i>	<i>b unitless</i>	<i>c unitless</i>	<i>t* hr</i>	<i>ET hr/event</i>	<i>B dimensionless</i>	<i>DAevent cm/event</i>
<u>Metals</u>														
Aluminum	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
Arsenic	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
Barium	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
Cobalt	4.00E-04	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	3.20E-03
Iron	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
Lead	1.00E-04	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-04
Manganese	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
Selenium	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
Vanadium	1.00E-03	RAIS, 2014	--	--	--	--	--	--	--	--	--	8.0E+00	--	8.00E-03
<u>PCBs</u>														
Aroclor-1260 (PCB-1260)	9.86E-01	RAIS, 2014	1	USEPA, 2004	3.95E+02	RAIS, 2014	1.71E+01	9.73E-09	3.88E+01	7.58E+00	76.73	8.0E+00	7.54E+00	3.19E+01

References:

RAIS, 2014: The Risk Assessment Information System (<http://rais.ornl.gov/#>), last revision date October 2014.

USEPA, 2004: RAGs Volume 1, Human Health Evaluation Manual, Part E: Supplemental Guidance for Dermal Risk Assessment, EPA/540/R/99/005, July 2004.

Notes:

VOCs - Volatile Organic Compounds

SVOCs - Semi-volatile Organic Compounds

PCBs - Polychlorinated Biphenyls

TABLE E.6

DERIVATION OF VOLATILIZATION FACTOR (VF) FOR GROUNDWATER - WORKERS INHALATION EXPOSURE
SITE WIDE
FORMER WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

<i>Chemical of Potential Concern (COPC)</i>	<i>Molecular Weight, MW_i (1) (g/mol)</i>	<i>Henry's Law Constant, H_i (1) (atm-m³/mol)</i>	<i>Liquid Phase Coefficient, k_{IL} (2) (cm/s)</i>	<i>Gas Phase Coefficient, k_{IG} (3) (cm/s)</i>	<i>Overall Mass Transfer Coefficient, K_i (4) (cm/s)</i>	<i>Volatilization Factor, VF (5) (L/m³)</i>
VOCs						
1,1-Dichloroethane	9.90E+01	5.61E-03	1.14E-03	4.71E-01	1.13E-03	1.67E-01
1,2,4-Trimethylbenzene	1.20E+02	6.15E-03	1.03E-03	4.41E-01	1.02E-03	1.52E-01
1,2-Dichloroethane	9.90E+01	1.18E-03	1.14E-03	4.71E-01	1.08E-03	1.60E-01
1,4-Dichlorobenzene	1.47E+02	2.40E-03	9.34E-04	4.12E-01	9.13E-04	1.35E-01
2-Hexanone	1.00E+02	9.29E-05	1.13E-03	4.69E-01	6.92E-04	1.03E-01
Benzene	7.81E+01	5.54E-03	1.28E-03	5.10E-01	1.27E-03	1.88E-01
Carbon tetrachloride	1.54E+02	2.76E-02	9.12E-04	4.06E-01	9.10E-04	1.35E-01
Chloroform (Trichloromethane)	1.19E+02	3.66E-03	1.04E-03	4.43E-01	1.02E-03	1.51E-01
cis-1,2-Dichloroethene	9.69E+01	4.07E-03	1.15E-03	4.74E-01	1.13E-03	1.68E-01
Ethylbenzene	1.06E+02	7.85E-03	1.10E-03	4.60E-01	1.09E-03	1.62E-01
Isopropyl benzene	1.20E+02	1.15E-02	1.03E-03	4.41E-01	1.03E-03	1.52E-01
Tetrachloroethene	1.66E+02	1.77E-02	8.79E-04	3.96E-01	8.76E-04	1.30E-01
Toluene	9.21E+01	6.61E-03	1.18E-03	4.82E-01	1.17E-03	1.73E-01
Trichloroethene	1.31E+02	9.83E-03	9.89E-04	4.29E-01	9.83E-04	1.46E-01
Xylenes (total)	1.06E+02	5.17E-03	1.10E-03	4.60E-01	1.09E-03	1.61E-01
SVOCs						
2-Methylnaphthalene	1.42E+02	5.17E-04	9.50E-04	4.17E-01	8.58E-04	1.27E-01
Biphenyl (1,1-Biphenyl)	1.54E+02	3.07E-04	9.12E-04	4.06E-01	7.74E-04	1.15E-01
Dibenzofuran	1.68E+02	2.12E-04	8.73E-04	3.94E-01	6.96E-04	1.03E-01
Naphthalene	1.28E+02	4.39E-04	1.00E-03	4.32E-01	8.86E-04	1.31E-01

Temperature, T (K):	298.15
Ideal Gas Constant, R (atm-m ³ /mole-K):	0.000082
Area of Trench, A (m ²):	10
Volume of Trench, V (m ³):	30
Depth of the trench, D, (m):	3
Width of the trench, W, (m):	1
Length of the trench, L, (m):	10
Wind speed 10 m above the water surface, u (m/s):	0.45
Air changes per hour, ACH (hr ⁻¹):	162

mixing factor (deviation from complete mixing in real conditions, k [unitless]):	0.5
Fraction of trench floor through which contaminant can enter, F (unitless):	1
Molecular weight of Oxygen, MW _{O₂} (g/mol)	16
liquid-phase mass transfer coefficient for oxygen at 25°C, k _L O ₂ (cm/s).	0.002
Conversion Factor, CF ₁ (cm ² /m ²);	10000
Conversion Factor, CF ₂ (L/cm ³);	0.001
Conversion Factor, CF ₃ (sec/hr);	3600

Notes:

(1) The Risk Assessment Information System (RAIS), last revision date October 2014 (<http://rais.ornl.gov/#>).

(2) Calculated using the following equation:

$$k_{IL} = \left(\frac{MW_{O_2}}{MW_i} \right)^{0.5} \left(\frac{T}{298} \right) (k_{L, O_2})$$

(3) Calculated using the following equation:

$$k_{IG} = \left(\frac{MW_{H_2O}}{MW_i} \right)^{0.335} \left(\frac{T}{298} \right)^{1.005} (k_{IG, H_2O})$$

(4) Calculated using the following equation:

$$\frac{1}{K_i} = \frac{1}{k_{IL}} + \frac{RT}{H_i k_{IG}}$$

(5) Calculated using the following equation:

$$VF_i = \frac{(K_i \times A \times F \times CF_1 \times CF_2 \times CF_3)}{(k \times ACH \times V)}$$

VOCs Volatile Organic Compounds

SVOCs Semi-volatile Organic Compounds

TABLE E.7

**SUMMARY OF RESIDENT RISK FOR INDOOR AIR
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Benzene	No	Yes	0.0000078	IRIS	0.03	IRIS
Biphenyl, 1,1'-	No	Yes	-		0.0004	PPRTV C
Carbon Tetrachloride	No	Yes	0.000006	IRIS	0.1	IRIS
Chloroform	No	Yes	0.000023	IRIS	0.0977	ATSDR F
Dibenzofuran	No	Yes	-		-	
Dichlorobenzene, 1,4-	No	Yes	0.000011	CALEPA	0.8	IRIS
Dichloroethane, 1,1-	No	Yes	0.0000016	CALEPA	0.5	HEAST
Dichloroethane, 1,2-	No	Yes	0.000026	IRIS	0.007	PPRTV C
Dichloroethylene, 1,2-cis-	No	Yes	-		-	
Ethylbenzene	No	Yes	0.0000025	CALEPA	1	IRIS
Hexanone, 2-	No	Yes	-		0.03	IRIS
Isopropyl benzene	No	Yes	-		0.4	IRIS
Methylnaphthalene, 2-	No	Yes	-		-	
Naphthalene	No	Yes	0.000034	CALEPA	0.003	IRIS
Tetrachloroethylene	No	Yes	0.00000026	IRIS	0.04	IRIS
Toluene	No	Yes	-		5	IRIS
Trichloroethylene	Yes	Yes	0.0000041	IRIS	0.002	IRIS
Trimethylbenzene, 1,2,4-	No	Yes	-		0.007	PPRTV C
Xylenes	No	Yes	-		0.1	IRIS

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Groundwater Concentration ($\mu\text{g}/\text{L}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Benzene	2.85E+02	2.21E+01	2.12E-02	7.87E+00
Biphenyl, 1,1'-	8.94E+00	1.78E-02	1.71E-05	6.34E-03
Carbon Tetrachloride	1.16E+00	4.59E-01	4.40E-04	1.63E-01
Chloroform	2.38E+00	1.41E-01	1.35E-04	5.02E-02
Dibenzofuran	3.95E+00	5.28E-06	5.06E-09	1.88E-06
Dichlorobenzene, 1,4-	6.43E-01	1.50E-02	1.44E-05	5.34E-03
Dichloroethane, 1,1-	5.58E-01	4.07E-02	3.90E-05	1.45E-02
Dichloroethane, 1,2-	3.57E+00	5.39E-02	5.17E-05	1.92E-02
Dichloroethylene, 1,2-cis-	1.04E+00	5.40E-02	5.18E-05	1.92E-02
Ethylbenzene	4.08E+02	3.52E+01	3.38E-02	1.25E+01
Hexanone, 2-	3.35E+00	4.17E-03	4.00E-06	1.49E-03
Isopropyl benzene	2.86E+01	3.53E+00	3.38E-03	1.26E+00
Methylnaphthalene, 2-	2.78E+01	9.15E-02	8.77E-05	3.26E-02
Naphthalene	6.89E+01	2.79E-01	2.68E-04	9.94E-02
Tetrachloroethylene	8.49E-01	1.73E-01	1.66E-04	6.16E-02
Toluene	9.90E+02	8.51E+01	8.16E-02	3.03E+01
Trichloroethylene	1.13E+00	1.46E-01	1.40E-04	1.44E-01
Trimethylbenzene, 1,2,4-	5.32E+02	2.80E+01	2.68E-02	9.97E+00
Xylenes	2.08E+03	1.27E+02	1.22E-01	4.52E+01

TABLE E.7

**SUMMARY OF RESIDENT RISK FOR INDOOR AIR
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Benzene		7.06E-01	6.14E-05
Biphenyl, 1,1'-		4.27E-02	-
Carbon Tetrachloride		4.40E-03	9.81E-07
Chloroform		1.38E-03	1.16E-06
Dibenzofuran		-	-
Dichlorobenzene, 1,4-		1.80E-05	5.88E-08
Dichloroethane, 1,1-		7.81E-05	2.32E-08
Dichloroethane, 1,2-		7.38E-03	4.99E-07
Dichloroethylene, 1,2-cis-		-	-
Ethylbenzene		3.38E-02	3.13E-05
Hexanone, 2-		1.33E-04	-
Isopropyl benzene		8.46E-03	-
Methylnaphthalene, 2-		-	-
Naphthalene		8.92E-02	3.38E-06
Tetrachloroethylene		4.15E-03	1.60E-08
Toluene		1.63E-02	-
Trichloroethylene		7.00E-02	5.90E-07
Trimethylbenzene, 1,2,4-		3.84E+00	-
Xylenes		1.22E+00	-
*Total Risk/HI		6.04E+00	9.94E-05

TABLE E.8

**SUMMARY OF INDOOR WORKER RISK FOR INDOOR AIR
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen?</i>	<i>VOC?</i>	<i>Inhalation Unit Risk ($\mu\text{g}/\text{m}^3$)⁻¹</i>	<i>IUR Reference</i>	<i>Chronic RfC (mg/m^3)</i>	<i>RfC Reference</i>
Benzene	No	Yes	0.0000078	IRIS	0.03	IRIS
Biphenyl, 1,1'-	No	Yes	-		0.0004	PPRTV C
Carbon Tetrachloride	No	Yes	0.000006	IRIS	0.1	IRIS
Chloroform	No	Yes	0.000023	IRIS	0.0977	ATSDR F
Dibenzofuran	No	Yes	-		-	
Dichlorobenzene, 1,4-	No	Yes	0.000011	CALEPA	0.8	IRIS
Dichloroethane, 1,1-	No	Yes	0.0000016	CALEPA	0.5	HEAST
Dichloroethane, 1,2-	No	Yes	0.000026	IRIS	0.007	PPRTV C
Dichloroethylene, 1,2-cis-	No	Yes	-		-	
Ethylbenzene	No	Yes	0.0000025	CALEPA	1	IRIS
Hexanone, 2-	No	Yes	-		0.03	IRIS
Isopropyl benzene	No	Yes	-		0.4	IRIS
Methylnaphthalene, 2-	No	Yes	-		-	
Naphthalene	No	Yes	0.000034	CALEPA	0.003	IRIS
Tetrachloroethylene	No	Yes	0.00000026	IRIS	0.04	IRIS
Toluene	No	Yes	-		5	IRIS
Trichloroethylene	Yes	Yes	0.0000041	IRIS	0.002	IRIS
Trimethylbenzene, 1,2,4-	No	Yes	-		0.007	PPRTV C
Xylenes	No	Yes	-		0.1	IRIS

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>	<i>Groundwater Concentration ($\mu\text{g}/\text{L}$)</i>	<i>Indoor Air Concentration ($\mu\text{g}/\text{m}^3$)</i>	<i>Inhalation Indoor Air Noncarcinogenic CDI</i>	<i>Inhalation Indoor Air Carcinogenic CDI</i>
Benzene	2.85E+02	1.81E+01	4.13E-03	1.48E+00
Biphenyl, 1,1'-	8.94E+00	1.28E-02	2.92E-06	1.04E-03
Carbon Tetrachloride	1.16E+00	3.70E-01	8.45E-05	3.02E-02
Chloroform	2.38E+00	1.19E-01	2.72E-05	9.70E-03
Dibenzofuran	3.95E+00	2.98E-06	6.80E-10	2.43E-07
Dichlorobenzene, 1,4-	6.43E-01	1.19E-02	2.72E-06	9.70E-04
Dichloroethane, 1,1-	5.58E-01	3.26E-02	7.44E-06	2.66E-03
Dichloroethane, 1,2-	3.57E+00	4.54E-02	1.04E-05	3.70E-03
Dichloroethylene, 1,2-cis-	1.04E+00	4.31E-02	9.84E-06	3.51E-03
Ethylbenzene	4.08E+02	2.82E+01	6.44E-03	2.30E+00
Hexanone, 2-	3.35E+00	3.22E-03	7.35E-07	2.63E-04
Isopropyl benzene	2.86E+01	2.78E+00	6.35E-04	2.27E-01
Methylnaphthalene, 2-	2.78E+01	6.89E-02	1.57E-05	5.62E-03
Naphthalene	6.89E+01	2.14E-01	4.89E-05	1.74E-02
Tetrachloroethylene	8.49E-01	1.38E-01	3.15E-05	1.13E-02
Toluene	9.90E+02	6.97E+01	1.59E-02	5.68E+00
Trichloroethylene	1.13E+00	1.18E-01	2.69E-05	9.62E-03
Trimethylbenzene, 1,2,4-	5.32E+02	2.18E+01	4.98E-03	1.78E+00
Xylenes	2.08E+03	1.04E+02	2.37E-02	8.48E+00

TABLE E.8

**SUMMARY OF INDOOR WORKER RISK FOR INDOOR AIR
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Inhalation Indoor Air HQ</i>	<i>Inhalation Indoor Air Risk</i>
Benzene		1.38E-01	1.15E-05
Biphenyl, 1,1'-		7.31E-03	-
Carbon Tetrachloride		8.45E-04	1.81E-07
Chloroform		2.78E-04	2.23E-07
Dibenzofuran		-	-
Dichlorobenzene, 1,4-		3.40E-06	1.07E-08
Dichloroethane, 1,1-		1.49E-05	4.25E-09
Dichloroethane, 1,2-		1.48E-03	9.62E-08
Dichloroethylene, 1,2-cis-		-	-
Ethylbenzene		6.44E-03	5.75E-06
Hexanone, 2-		2.45E-05	-
Isopropyl benzene		1.59E-03	-
Methylnaphthalene, 2-		-	-
Naphthalene		1.63E-02	5.93E-07
Tetrachloroethylene		7.88E-04	2.93E-09
Toluene		3.18E-03	-
Trichloroethylene		1.35E-02	3.94E-08
Trimethylbenzene, 1,2,4-		7.11E-01	-
Xylenes		2.37E-01	-
*Total Risk/HI		1.14E+00	1.84E-05

TABLE E.9
SUMMARY OF RESIDENT RISK FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

Chemical	Mutagen ?	VOC?	Chronic RfD (mg/kg-day)	RfD Reference	Chronic RfC (mg/m ³)	RfC Reference	Ingestion SF (mg/kg-day) ⁻¹	SFO Reference	Inhalation Unit Risk (ug/m ³) ⁻¹	IUR Reference	RAGSe GIABS (unitless)	Kp (cm/hour)	FA	In EPD?
Aluminum	No	No	1	PPRTV C	0.005	PPRTV C	-		-		1	0.001	1	Yes
Aroclor-1260 (PCB-1260)	No	No	-		-		2	SURROGA	0.000571	SURROGA	1	0.986	0	No
Arsenic	No	No	0.0003	IRIS	0.000015	CALEPA	1.5	IRIS	0.0043	IRIS	1	0.001	1	Yes
Barium	No	No	0.2	IRIS	0.0005	HEAST	-		-		0.07	0.001	1	Yes
Benzene	No	Yes	0.004	IRIS	0.03	IRIS	0.055	IRIS	0.0000078	IRIS	1	0.0149	1	Yes
Biphenyl (1,1-Biphenyl)	No	Yes	0.5	IRIS	0.0004	PPRTV C	0.008	IRIS	-		1	0.0943	1	Yes
Carbon tetrachloride	No	Yes	0.004	IRIS	0.1	IRIS	0.07	IRIS	0.000006	IRIS	1	0.0163	1	Yes
Chloroform (Trichloromethane)	No	Yes	0.01	IRIS	0.0977	ATSDR F	0.031	CALEPA	0.000023	IRIS	1	0.00683	1	Yes
Cobalt	No	No	0.0003	PPRTV C	0.000006	PPRTV C	-		0.009	PPRTV C	1	0.0004	1	Yes
Dibenzofuran	No	Yes	0.001	PPRTV C	-		-		-		1	0.0975	1	Yes
Dichlorobenzene, 1,4-	No	Yes	0.07	ATSDR F	0.8	IRIS	0.0054	CALEPA	0.000011	CALEPA	1	0.0453	1	Yes
Dichloroethane, 1,1-	No	Yes	0.2	PPRTV C	0.5	HEAST	0.0057	CALEPA	0.0000016	CALEPA	1	0.00675	1	Yes
Dichloroethane, 1,2-	No	Yes	0.006	PPRTV C	0.007	PPRTV C	0.091	IRIS	0.000026	IRIS	1	0.0042	1	Yes
Dichloroethene, cis-1,2-	No	Yes	0.002	IRIS	-		-		-		1	0.011	1	Yes
Ethylbenzene	No	Yes	0.1	IRIS	1	IRIS	0.011	CALEPA	0.0000025	CALEPA	1	0.0493	1	Yes
Hexanone, 2-	No	Yes	0.005	IRIS	0.03	IRIS	-		-		1	0.00355	1	Yes
Iron	No	No	0.7	PPRTV C	-		-		-		1	0.001	1	Yes
Isopropyl benzene	No	Yes	0.1	IRIS	0.4	IRIS	-		-		1	0.0897	1	Yes
Lead	No	No	-		-		0.0085	CALEPA	0.000012	CALEPA	1	0.0001	1	Yes
Manganese	No	No	0.024	SURROGA	0.00005	IRIS	-		-		0.04	0.001	1	Yes
Methylnaphthalene, 2-	No	Yes	0.004	IRIS	-		-		-		1	0.0917	1	Yes
Naphthalene	No	Yes	0.02	IRIS	0.003	IRIS	-		0.000034	CALEPA	1	0.0466	1	Yes
Selenium	No	No	0.005	IRIS	0.02	CALEPA	-		-		1	0.001	1	Yes
Tetrachloroethene	No	Yes	0.006	IRIS	0.04	IRIS	0.0021	IRIS	0.00000026	IRIS	1	0.0334	1	Yes
Toluene	No	Yes	0.08	IRIS	5	IRIS	-		-		1	0.0311	1	Yes
Trichloroethene	Yes	Yes	0.0005	IRIS	0.002	IRIS	0.046	IRIS	0.0000041	IRIS	1	0.0116	1	Yes
Trimethylbenzene, 1,2,4-	No	Yes	0.05	PPRTV A	0.007	PPRTV C	-		-		1	0.0857	1	Yes
Vanadium	No	No	0.00504	SURROGA	0.0001	ATSDR F	-		-		0.026	0.001	1	Yes
Xylenes (total)	No	Yes	0.2	IRIS	0.1	IRIS	-		-		1	0.05	1	Yes

TABLE E.9
SUMMARY OF RESIDENT RISK FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CHRONIC DAILY INTAKES (CDI)															
Chemical		Concentration (mg/L)	Original Concentration (µg/L)	Child Ingestion Noncarcinogenic CDI	Child Inhalation Noncarcinogenic CDI	Child Dermal Noncarcinogenic CDI	Adult Ingestion Noncarcinogenic CDI	Adult Inhalation Noncarcinogenic CDI	Adult Dermal Noncarcinogenic CDI	Adjusted Ingestion Noncarcinogenic CDI	Adjusted Inhalation Noncarcinogenic CDI	Adjusted Dermal Noncarcinogenic CDI	Ingestion Carcinogenic CDI	Inhalation Carcinogenic CDI	Dermal Carcinogenic CDI
Aluminum		1.29E+01	1.29E+04	6.43E-01	6.18E+00	2.84E-03	3.87E-01	6.18E+00	2.29E-03	4.46E-01	6.18E+00	2.48E-03	1.66E-01	2.30E+03	9.22E-04
Aroclor-1260 (PCB-1260)		1.20E-03	1.20E+00	5.98E-05	5.75E-04	-	3.60E-05	5.75E-04	-	4.15E-05	5.75E-04	-	1.54E-05	2.14E-01	-
Arsenic		5.27E-03	5.27E+00	2.63E-04	2.53E-03	1.16E-06	1.58E-04	2.53E-03	9.37E-07	1.82E-04	2.53E-03	1.01E-06	6.76E-05	9.38E-01	3.77E-07
Barium		4.70E-01	4.70E+02	2.34E-02	2.25E-01	1.03E-04	1.41E-02	2.25E-01	8.36E-05	1.62E-02	2.25E-01	9.04E-05	6.03E-03	8.37E+01	3.36E-05
Benzene		2.85E-01	2.85E+02	1.42E-02	1.37E-01	1.89E-03	8.54E-03	1.37E-01	1.36E-03	9.85E-03	1.37E-01	1.48E-03	3.66E-03	5.08E+01	5.50E-04
Biphenyl (1,1-Biphenyl)		8.94E-03	8.94E+00	4.46E-04	4.29E-03	6.12E-04	2.68E-04	4.29E-03	4.31E-04	3.09E-04	4.29E-03	4.80E-04	1.15E-04	1.59E+00	1.78E-04
Carbon tetrachloride		1.16E-03	1.16E+00	5.78E-05	5.56E-04	1.37E-05	3.48E-05	5.56E-04	9.64E-06	4.01E-05	5.56E-04	1.07E-05	1.49E-05	2.07E-01	3.99E-06
Chloroform (Trichloromethane)		2.38E-03	2.38E+00	1.19E-04	1.14E-03	9.43E-06	7.13E-05	1.14E-03	6.64E-06	8.22E-05	1.14E-03	7.39E-06	3.05E-05	4.24E-01	2.74E-06
Cobalt		5.69E-02	5.69E+01	2.84E-03	2.73E-02	5.01E-06	1.71E-03	2.73E-02	4.05E-06	1.97E-03	2.73E-02	4.38E-06	7.30E-04	1.01E+01	1.63E-06
Dibenzofuran		3.95E-03	3.95E+00	1.97E-04	1.89E-03	3.06E-04	1.18E-04	1.89E-03	2.16E-04	1.37E-04	1.89E-03	2.40E-04	5.07E-05	7.03E-01	8.91E-05
Dichlorobenzene, 1,4-		6.43E-04	6.43E-01	3.21E-05	3.08E-04	2.02E-05	1.93E-05	3.08E-04	1.42E-05	2.22E-05	3.08E-04	1.58E-05	8.25E-06	1.15E-01	5.88E-06
Dichloroethane, 1,1-		5.58E-04	5.58E-01	2.78E-05	2.68E-04	1.91E-06	1.67E-05	2.68E-04	1.35E-06	1.93E-05	2.68E-04	1.50E-06	7.16E-06	9.94E-02	5.58E-07
Dichloroethane, 1,2-		3.57E-03	3.57E+00	1.78E-04	1.71E-03	7.62E-06	1.07E-04	1.71E-03	5.37E-06	1.23E-04	1.71E-03	5.98E-06	4.58E-05	6.36E-01	2.22E-06
Dichloroethene, cis-1,2-		1.04E-03	1.04E+00	5.19E-05	4.99E-04	5.74E-06	3.12E-05	4.99E-04	4.04E-06	3.59E-05	4.99E-04	4.50E-06	1.33E-05	1.85E-01	1.67E-06
Ethylbenzene		4.08E-01	4.08E+02	2.03E-02	1.96E-01	1.07E-02	1.22E-02	1.96E-01	7.55E-03	1.41E-02	1.96E-01	8.40E-03	5.24E-03	7.27E+01	3.12E-03
Hexanone, 2-		3.35E-03	3.35E+00	1.67E-04	1.61E-03	6.09E-06	1.00E-04	1.61E-03	4.29E-06	1.16E-04	1.61E-03	4.78E-06	4.30E-05	5.97E-01	1.77E-06
Iron		4.19E+01	4.19E+04	2.09E+00	2.01E+01	9.23E-03	1.26E+00	2.01E+01	7.45E-03	1.45E+00	2.01E+01	8.06E-03	5.38E-01	7.46E+03	2.99E-03
Isopropyl benzene		2.86E-02	2.86E+01	1.43E-03	1.37E-02	1.50E-03	8.57E-04	1.37E-02	1.05E-03	9.88E-04	1.37E-02	1.17E-03	3.67E-04	5.09E+00	4.35E-04
Lead		6.16E-03	6.16E+00	3.07E-04	2.95E-03	1.36E-07	1.85E-04	2.95E-03	1.10E-07	2.13E-04	2.95E-03	1.19E-07	7.91E-05	1.10E+00	4.40E-08
Manganese		1.39E+01	1.39E+04	6.93E-01	6.66E+00	3.06E-03	4.17E-01	6.66E+00	2.47E-03	4.80E-01	6.66E+00	2.67E-03	1.78E-01	2.48E+03	9.94E-04
Methylnaphthalene, 2-		2.78E-02	2.78E+01	1.39E-03	1.33E-02	1.71E-03	8.33E-04	1.33E-02	1.21E-03	9.61E-04	1.33E-02	1.34E-03	3.57E-04	4.95E+00	4.99E-04
Naphthalene		6.89E-02	6.89E+01	3.44E-03	3.30E-02	1.97E-03	2.06E-03	3.30E-02	1.39E-03	2.38E-03	3.30E-02	1.54E-03	8.84E-04	1.23E+01	5.74E-04
Selenium		7.99E-03	7.99E+00	3.98E-04	3.83E-03	1.76E-06	2.39E-04	3.83E-03	1.42E-06	2.76E-04	3.83E-03	1.54E-06	1.03E-04	1.42E+00	5.71E-07
Tetrachloroethene		8.49E-04	8.49E-01	4.23E-05	4.07E-04	2.22E-05	2.54E-05	4.07E-04	1.56E-05	2.93E-05	4.07E-04	1.74E-05	1.09E-05	1.51E-01	6.46E-06
Toluene		9.90E-01	9.90E+02	4.94E-02	4.75E-01	1.50E-02	2.97E-02	4.75E-01	1.06E-02	3.42E-02	4.75E-01	1.17E-02	1.27E-02	1.76E+02	4.36E-03
Trichloroethene		1.13E-03	1.13E+00	5.63E-05	5.42E-04	8.21E-06	3.39E-05	5.42E-04	5.79E-06	3.90E-05	5.42E-04	6.44E-06	4.51E-05	5.57E-01	7.40E-06
Trimethylbenzene, 1,2,4-		5.32E-01	5.32E+02	2.65E-02	2.55E-01	2.66E-02	1.59E-02	2.55E-01	1.87E-02	1.84E-02	2.55E-01	2.08E-02	6.83E-03	9.47E+01	7.74E-03
Vanadium		2.27E-02	2.27E+01	1.13E-03	1.09E-02	5.00E-06	6.80E-04	1.09E-02	4.04E-06	7.84E-04	1.09E-02	4.37E-06	2.91E-04	4.04E+00	1.62E-06
Xylenes (total)		2.08E+00	2.08E+03	1.04E-01	9.97E-01	5.54E-02	6.23E-02	9.97E-01	3.90E-02	7.19E-02	9.97E-01	4.34E-02	2.67E-02	3.70E+02	1.61E-02

TABLE E.9
SUMMARY OF RESIDENT RISK FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

SUMMARY OF CALCULATED RISKS AND HAZARDS

Chemical		Child Ingestion HQ	Child Inhalation HQ	Child Dermal HQ	Child Total HI	Adult Ingestion HQ	Adult Inhalation HQ	Adult Dermal HQ	Adult Total HI	Adjusted Ingestion HQ	Adjusted Inhalation HQ	Adjusted Dermal HQ	Adjusted Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Risk
Aluminum		6.43E-01	-	2.84E-03	6.46E-01	3.87E-01	-	2.29E-03	3.89E-01	4.46E-01	-	2.48E-03	4.48E-01	-	-	-	-
Aroclor-1260 (PCB-1260)		-	-	-	-	-	-	-	-	-	-	-	-	3.08E-05	-	-	3.08E-05
Arsenic		8.76E-01	-	3.87E-03	8.80E-01	5.26E-01	-	3.12E-03	5.30E-01	6.07E-01	-	3.38E-03	6.10E-01	1.01E-04	-	5.65E-07	1.02E-04
Barium		1.17E-01	-	7.39E-03	1.25E-01	7.04E-02	-	5.97E-03	7.64E-02	8.12E-02	-	6.46E-03	8.77E-02	-	-	-	-
Benzene		3.55E+00	4.55E+00	4.72E-01	8.58E+00	2.14E+00	4.55E+00	3.41E-01	7.03E+00	2.46E+00	4.55E+00	3.70E-01	7.39E+00	2.01E-04	3.96E-04	3.02E-05	6.27E-04
Biphenyl (1,1-Biphenyl)		8.92E-04	1.07E+01	1.22E-03	1.07E+01	5.36E-04	1.07E+01	8.62E-04	1.07E+01	6.18E-04	1.07E+01	9.60E-04	1.07E+01	9.18E-07	-	1.43E-06	2.34E-06
Carbon tetrachloride		1.45E-02	5.56E-03	3.42E-03	2.34E-02	8.69E-03	5.56E-03	2.41E-03	1.67E-02	1.00E-02	5.56E-03	2.68E-03	1.83E-02	1.04E-06	1.24E-06	2.79E-07	2.56E-06
Chloroform (Trichloromethane)		1.19E-02	1.17E-02	9.43E-04	2.45E-02	7.13E-03	1.17E-02	6.64E-04	1.95E-02	8.22E-03	1.17E-02	7.39E-04	2.06E-02	9.47E-07	9.75E-06	8.51E-08	1.08E-05
Cobalt		9.46E+00	-	1.67E-02	9.47E+00	5.68E+00	-	1.35E-02	5.70E+00	6.55E+00	-	1.46E-02	6.57E+00	-	-	-	-
Dibenzofuran		1.97E-01	-	3.06E-01	5.03E-01	1.18E-01	-	2.16E-01	3.34E-01	1.37E-01	-	2.40E-01	3.76E-01	-	-	-	-
Dichlorobenzene, 1,4-		4.58E-04	3.85E-04	2.88E-04	1.13E-03	2.75E-04	3.85E-04	2.03E-04	8.64E-04	3.17E-04	3.85E-04	2.26E-04	9.29E-04	4.46E-08	1.26E-06	3.17E-08	1.34E-06
Dichloroethane, 1,1-		1.39E-04	5.35E-04	9.57E-06	6.84E-04	8.36E-05	5.35E-04	6.74E-06	6.25E-04	9.64E-05	5.35E-04	7.51E-06	6.39E-04	4.08E-08	1.59E-07	3.18E-09	2.03E-07
Dichloroethane, 1,2-		2.97E-02	2.45E-01	1.27E-03	2.75E-01	1.78E-02	2.45E-01	8.95E-04	2.63E-01	2.06E-02	2.45E-01	9.96E-04	2.66E-01	4.17E-06	1.65E-05	2.02E-07	2.09E-05
Dichloroethene, cis-1,2-		2.59E-02	-	2.87E-03	2.88E-02	1.56E-02	-	2.02E-03	1.76E-02	1.80E-02	-	2.25E-03	2.02E-02	-	-	-	-
Ethylbenzene		2.03E-01	1.96E-01	1.07E-01	5.06E-01	1.22E-01	1.96E-01	7.55E-02	3.93E-01	1.41E-01	1.96E-01	8.40E-02	4.21E-01	5.76E-05	1.82E-04	3.43E-05	2.74E-04
Hexanone, 2-		3.34E-02	5.35E-02	1.22E-03	8.82E-02	2.01E-02	5.35E-02	8.58E-04	7.45E-02	2.32E-02	5.35E-02	9.55E-04	7.76E-02	-	-	-	-
Iron		2.98E+00	-	1.32E-02	3.00E+00	1.79E+00	-	1.06E-02	1.80E+00	2.07E+00	-	1.15E-02	2.08E+00	-	-	-	-
Isopropyl benzene		1.43E-02	3.43E-02	1.50E-02	6.35E-02	8.57E-03	3.43E-02	1.05E-02	5.34E-02	9.88E-03	3.43E-02	1.17E-02	5.59E-02	-	-	-	-
Lead		-	-	-	-	-	-	-	-	-	-	-	-	6.72E-07	-	3.74E-10	6.72E-07
Manganese		2.89E+01	-	3.19E+00	3.21E+01	1.74E+01	-	2.58E+00	1.99E+01	2.00E+01	-	2.79E+00	2.28E+01	-	-	-	-
Methylnaphthalene, 2-		3.47E-01	-	4.28E-01	7.75E-01	2.08E-01	-	3.02E-01	5.10E-01	2.40E-01	-	3.36E-01	5.76E-01	-	-	-	-
Naphthalene		1.72E-01	1.10E+01	9.85E-02	1.13E+01	1.03E-01	1.10E+01	6.94E-02	1.12E+01	1.19E-01	1.10E+01	7.72E-02	1.12E+01	-	4.17E-04	-	4.17E-04
Selenium		7.97E-02	-	3.52E-04	8.00E-02	4.79E-02	-	2.84E-04	4.82E-02	5.52E-02	-	3.08E-04	5.55E-02	-	-	-	-
Tetrachloroethene		7.06E-03	1.02E-02	3.70E-03	2.09E-02	4.24E-03	1.02E-02	2.60E-03	1.70E-02	4.89E-03	1.02E-02	2.90E-03	1.80E-02	2.29E-08	3.93E-08	1.36E-08	7.58E-08
Toluene		6.17E-01	9.49E-02	1.87E-01	8.99E-01	3.71E-01	9.49E-02	1.32E-01	5.98E-01	4.28E-01	9.49E-02	1.47E-01	6.69E-01	-	-	-	-
Trichloroethene		1.13E-01	2.71E-01	1.64E-02	4.00E-01	6.77E-02	2.71E-01	1.16E-02	3.50E-01	7.81E-02	2.71E-01	1.29E-02	3.62E-01	2.07E-06	2.28E-06	3.40E-07	4.70E-06
Trimethylbenzene, 1,2,4-		5.31E-01	3.64E+01	5.31E-01	3.75E+01	3.19E-01	3.64E+01	3.74E-01	3.71E+01	3.68E-01	3.64E+01	4.17E-01	3.72E+01	-	-	-	-
Vanadium		2.25E-01	-	3.81E-02	2.63E-01	1.35E-01	-	3.08E-02	1.66E-01	1.56E-01	-	3.33E-02	1.89E-01	-	-	-	-
Xylenes (total)		5.19E-01	9.97E+00	2.77E-01	1.08E+01	3.12E-01	9.97E+00	1.95E-01	1.05E+01	3.59E-01	9.97E+00	2.17E-01	1.05E+01	-	-	-	-
*Total Risk/HI		4.97E+01	7.36E+01	5.72E+00	1.29E+02	2.98E+01	7.36E+01	4.38E+00	1.08E+02	3.44E+01	7.36E+01	4.78E+00	1.13E+02	4.01E-04	1.03E-03	6.75E-05	1.49E-03

TABLE E.10

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS FOR FUTURE UTILITY WORKER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Receptor Population: Utility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk (1)		Cancer Risk	Intake/Exposure Concentration		RfD/RfC (1)		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site Wide	Ingestion	Aluminum	1.29E+04	µg/L	5.04E-04	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.41E-03	mg/kg-d	1.00E+00	mg/kg-d	1.41E-03
				Aroclor-1260 (PCB-1260)	1.20E+00	µg/L	4.70E-08	mg/kg-d	2.00E+00	(mg/kg-d) ⁻¹	9.39E-08	1.32E-07	mg/kg-d	--	mg/kg-d	NC
				Arsenic	5.27E+00	µg/L	2.06E-07	mg/kg-d	1.50E+00	(mg/kg-d) ⁻¹	3.09E-07	5.78E-07	mg/kg-d	3.00E-04	mg/kg-d	1.93E-03
				Barium	4.70E+02	µg/L	1.84E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	5.15E-05	mg/kg-d	2.00E-01	mg/kg-d	2.58E-04
				Benzene	2.85E+02	µg/L	1.12E-05	mg/kg-d	5.50E-02	(mg/kg-d) ⁻¹	6.14E-07	3.12E-05	mg/kg-d	4.00E-03	mg/kg-d	7.81E-03
				Biphenyl (1,1-Biphenyl)	8.94E+00	µg/L	3.50E-07	mg/kg-d	8.00E-03	(mg/kg-d) ⁻¹	2.80E-09	9.79E-07	mg/kg-d	5.00E-01	mg/kg-d	1.96E-06
				Carbon tetrachloride	1.16E+00	µg/L	4.53E-08	mg/kg-d	7.00E-02	(mg/kg-d) ⁻¹	3.17E-09	1.27E-07	mg/kg-d	4.00E-03	mg/kg-d	3.17E-05
				Chloroform (Trichloromethane)	2.38E+00	µg/L	9.33E-08	mg/kg-d	3.10E-02	(mg/kg-d) ⁻¹	2.89E-09	2.61E-07	mg/kg-d	1.00E-02	mg/kg-d	2.61E-05
				Cobalt	5.69E+01	µg/L	2.23E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	6.24E-06	mg/kg-d	3.00E-04	mg/kg-d	2.08E-02
				Dibenzofuran	3.95E+00	µg/L	1.54E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.32E-07	mg/kg-d	1.00E-03	mg/kg-d	4.32E-04
				Dichlorobenzene, 1,4-	6.43E-01	µg/L	2.52E-08	mg/kg-d	5.40E-03	(mg/kg-d) ⁻¹	1.36E-10	7.05E-08	mg/kg-d	7.00E-02	mg/kg-d	1.01E-06
				Dichloroethane, 1,1-	5.58E-01	µg/L	2.18E-08	mg/kg-d	5.70E-03	(mg/kg-d) ⁻¹	1.24E-10	6.12E-08	mg/kg-d	2.00E-01	mg/kg-d	3.06E-07
				Dichloroethane, 1,2-	3.57E+00	µg/L	1.40E-07	mg/kg-d	9.10E-02	(mg/kg-d) ⁻¹	1.27E-08	3.91E-07	mg/kg-d	6.00E-03	mg/kg-d	6.52E-05
				Dichloroethene, cis-1,2-	1.04E+00	µg/L	4.07E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.14E-07	mg/kg-d	2.00E-03	mg/kg-d	5.70E-05
				Ethylbenzene	4.08E+02	µg/L	1.60E-05	mg/kg-d	1.10E-02	(mg/kg-d) ⁻¹	1.75E-07	4.47E-05	mg/kg-d	1.00E-01	mg/kg-d	4.47E-04
				Hexanone, 2-	3.35E+00	µg/L	1.31E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	3.67E-07	mg/kg-d	5.00E-03	mg/kg-d	7.33E-05
				Iron	4.19E+04	µg/L	1.64E-03	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.59E-03	mg/kg-d	7.00E-01	mg/kg-d	6.55E-03
				Isopropyl benzene	2.86E+01	µg/L	1.12E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	3.14E-06	mg/kg-d	1.00E-01	mg/kg-d	3.14E-05
				Lead	6.16E+00	µg/L	2.41E-07	mg/kg-d	8.50E-03	(mg/kg-d) ⁻¹	2.05E-09	6.75E-07	mg/kg-d	--	mg/kg-d	NC
				Manganese	1.39E+04	µg/L	5.44E-04	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.52E-03	mg/kg-d	2.40E-02	mg/kg-d	6.35E-02
				Methylnaphthalene, 2-	2.78E+01	µg/L	1.09E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	3.05E-06	mg/kg-d	4.00E-03	mg/kg-d	7.62E-04
				Naphthalene	6.89E+01	µg/L	2.70E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.55E-06	mg/kg-d	2.00E-02	mg/kg-d	3.77E-04
				Selenium	7.99E+00	µg/L	3.13E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	8.76E-07	mg/kg-d	5.00E-03	mg/kg-d	1.75E-04
				Tetrachloroethene	8.49E-01	µg/L	3.32E-08	mg/kg-d	2.10E-03	(mg/kg-d) ⁻¹	6.98E-11	9.30E-08	mg/kg-d	6.00E-03	mg/kg-d	1.55E-05
				Toluene	9.90E+02	µg/L	3.88E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.09E-04	mg/kg-d	8.00E-02	mg/kg-d	1.36E-03
				Trichloroethene	1.13E+00	µg/L	4.42E-08	mg/kg-d	4.60E-02	(mg/kg-d) ⁻¹	2.03E-09	1.24E-07	mg/kg-d	5.00E-04	mg/kg-d	2.47E-04
				Trimethylbenzene, 1,2,4-	5.32E+02	µg/L	2.08E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	5.83E-05	mg/kg-d	5.00E-02	mg/kg-d	1.17E-03
				Vanadium	2.27E+01	µg/L	8.89E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.49E-06	mg/kg-d	5.04E-03	mg/kg-d	4.94E-04
				Xylenes (total)	2.08E+03	µg/L	8.14E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.28E-04	mg/kg-d	2.00E-01	mg/kg-d	1.14E-03
							Exp. Route Total							1.22E-06		

TABLE E.10

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS FOR FUTURE UTILITY WORKER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Receptor Population: Utility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk (1)		Cancer Risk	Intake/Exposure Concentration		RfD/RfC (1)		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site Wide	Dermal	Aluminum	1.29E+04	µg/L	8.75E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.45E-04	mg/kg-d	1.00E+00	mg/kg-d	2.45E-04
				Aroclor-1260 (PCB-1260)	1.20E+00	µg/L	3.25E-05	mg/kg-d	2.00E+00	(mg/kg-d) ⁻¹	6.49E-05	9.09E-05	mg/kg-d	--	mg/kg-d	NC
				Arsenic	5.27E+00	µg/L	3.58E-08	mg/kg-d	1.50E+00	(mg/kg-d) ⁻¹	5.37E-08	1.00E-07	mg/kg-d	3.00E-04	mg/kg-d	3.34E-04
				Barium	4.70E+02	µg/L	3.19E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	8.94E-06	mg/kg-d	2.00E-01	mg/kg-d	4.47E-05
				Benzene	2.85E+02	µg/L	2.96E-05	mg/kg-d	5.50E-02	(mg/kg-d) ⁻¹	1.63E-06	8.30E-05	mg/kg-d	4.00E-03	mg/kg-d	2.07E-02
				Biphenyl (1,1-Biphenyl)	8.94E+00	µg/L	5.49E-06	mg/kg-d	8.00E-03	(mg/kg-d) ⁻¹	4.39E-08	1.54E-05	mg/kg-d	5.00E-01	mg/kg-d	3.07E-05
				Carbon tetrachloride	1.16E+00	µg/L	1.45E-07	mg/kg-d	7.00E-02	(mg/kg-d) ⁻¹	1.02E-08	4.07E-07	mg/kg-d	4.00E-03	mg/kg-d	1.02E-04
				Chloroform (Trichloromethane)	2.38E+00	µg/L	1.21E-07	mg/kg-d	3.10E-02	(mg/kg-d) ⁻¹	3.76E-09	3.40E-07	mg/kg-d	1.00E-02	mg/kg-d	3.40E-05
				Cobalt	5.69E+01	µg/L	1.55E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.33E-07	mg/kg-d	3.00E-04	mg/kg-d	1.44E-03
				Dibenzofuran	3.95E+00	µg/L	2.62E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.32E-06	mg/kg-d	1.00E-03	mg/kg-d	7.32E-03
				Dichlorobenzene, 1,4-	6.43E-01	µg/L	2.05E-07	mg/kg-d	5.40E-03	(mg/kg-d) ⁻¹	1.11E-09	5.74E-07	mg/kg-d	7.00E-02	mg/kg-d	8.20E-06
				Dichloroethane, 1,1-	5.58E-01	µg/L	2.74E-08	mg/kg-d	5.70E-03	(mg/kg-d) ⁻¹	1.56E-10	7.67E-08	mg/kg-d	2.00E-01	mg/kg-d	3.84E-07
				Dichloroethane, 1,2-	3.57E+00	µg/L	1.10E-07	mg/kg-d	9.10E-02	(mg/kg-d) ⁻¹	1.00E-08	3.08E-07	mg/kg-d	6.00E-03	mg/kg-d	5.13E-05
				Dichloroethene, cis-1,2-	1.04E+00	µg/L	8.20E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.30E-07	mg/kg-d	2.00E-03	mg/kg-d	1.15E-04
				Ethylbenzene	4.08E+02	µg/L	1.31E-04	mg/kg-d	1.10E-02	(mg/kg-d) ⁻¹	1.44E-06	3.66E-04	mg/kg-d	1.00E-01	mg/kg-d	3.66E-03
				Hexanone, 2-	3.35E+00	µg/L	8.74E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.45E-07	mg/kg-d	5.00E-03	mg/kg-d	4.89E-05
				Iron	4.19E+04	µg/L	2.84E-04	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.96E-04	mg/kg-d	7.00E-01	mg/kg-d	1.14E-03
				Isopropyl benzene	2.86E+01	µg/L	1.56E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.35E-05	mg/kg-d	1.00E-01	mg/kg-d	4.35E-04
				Lead	6.16E+00	µg/L	4.18E-09	mg/kg-d	8.50E-03	(mg/kg-d) ⁻¹	3.55E-11	1.17E-08	mg/kg-d	--	mg/kg-d	NC
				Manganese	1.39E+04	µg/L	9.44E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.64E-04	mg/kg-d	2.40E-02	mg/kg-d	1.10E-02
				Methylnaphthalene, 2-	2.78E+01	µg/L	1.61E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.51E-05	mg/kg-d	4.00E-03	mg/kg-d	1.13E-02
				Naphthalene	6.89E+01	µg/L	2.17E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	6.07E-05	mg/kg-d	2.00E-02	mg/kg-d	3.04E-03
				Selenium	7.99E+00	µg/L	5.43E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.52E-07	mg/kg-d	5.00E-03	mg/kg-d	3.04E-05
				Tetrachloroethene	8.49E-01	µg/L	2.15E-07	mg/kg-d	2.10E-03	(mg/kg-d) ⁻¹	4.52E-10	6.02E-07	mg/kg-d	6.00E-03	mg/kg-d	1.00E-04
				Toluene	9.90E+02	µg/L	2.08E-04	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	5.81E-04	mg/kg-d	8.00E-02	mg/kg-d	7.27E-03
				Trichloroethene	1.13E+00	µg/L	9.79E-08	mg/kg-d	4.60E-02	(mg/kg-d) ⁻¹	4.50E-09	2.74E-07	mg/kg-d	5.00E-04	mg/kg-d	5.48E-04
				Trimethylbenzene, 1,2,4-	5.32E+02	µg/L	2.78E-04	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.79E-04	mg/kg-d	5.00E-02	mg/kg-d	1.56E-02
				Vanadium	2.27E+01	µg/L	1.54E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.32E-07	mg/kg-d	5.04E-03	mg/kg-d	8.57E-05
				Xylenes (total)	2.08E+03	µg/L	6.76E-04	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.89E-03	mg/kg-d	2.00E-01	mg/kg-d	9.47E-03
			Exp. Route Total								6.81E-05					9.42E-02
		Exposure Point Total									6.94E-05					2.03E-01
	Exposure Medium Total										6.94E-05					2.03E-01

TABLE E.10

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS FOR FUTURE UTILITY WORKER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
 Receptor Population: Utility Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk (1)		Cancer Risk	Intake/Exposure Concentration		RfD/RfC (1)		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Groundwater	Ambient Air	Site Wide	Inhalation	Aluminum	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	5.00E-03	mg/m ³	NC			
				Aroclor-1260 (PCB-1260)	NA	µg/L	NC	mg/m ³	5.71E-01	(mg/m ³) ⁻¹	NC	NC	mg/m ³	--	mg/m ³	NC			
				Arsenic	NA	µg/L	NC	mg/m ³	4.30E+00	(mg/m ³) ⁻¹	NC	NC	mg/m ³	1.50E-05	mg/m ³	NC			
				Barium	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	5.00E-04	mg/m ³	NC			
				Benzene	2.85E+02	µg/L	3.49E-04	mg/m ³	7.80E-03	(mg/m ³) ⁻¹	2.72E-06	9.77E-04	mg/m ³	3.00E-02	mg/m ³	3.26E-02			
				Biphenyl (1,1-Biphenyl)	8.94E+00	µg/L	6.68E-06	mg/m ³	--	(mg/m ³) ⁻¹	NC	1.87E-05	mg/m ³	4.00E-04	mg/m ³	4.68E-02			
				Carbon tetrachloride	1.16E+00	µg/L	1.02E-06	mg/m ³	6.00E-03	(mg/m ³) ⁻¹	6.11E-09	2.85E-06	mg/m ³	1.00E-01	mg/m ³	2.85E-05			
				Chloroform (Trichloromethane)	2.38E+00	µg/L	2.35E-06	mg/m ³	2.30E-02	(mg/m ³) ⁻¹	5.41E-08	6.59E-06	mg/m ³	9.77E-02	mg/m ³	6.74E-05			
				Cobalt	NA	µg/L	NC	mg/m ³	9.00E+00	(mg/m ³) ⁻¹	NC	NC	mg/m ³	6.00E-06	mg/m ³	NC			
				Dibenzofuran	3.95E+00	µg/L	2.65E-06	mg/m ³	--	(mg/m ³) ⁻¹	NC	7.43E-06	mg/m ³	--	mg/m ³	NC			
				Dichlorobenzene, 1,4-	6.43E-01	µg/L	5.67E-07	mg/m ³	1.10E-02	(mg/m ³) ⁻¹	6.24E-09	1.59E-06	mg/m ³	8.00E-01	mg/m ³	1.98E-06			
				Dichloroethane, 1,1-	5.58E-01	µg/L	6.07E-07	mg/m ³	1.60E-03	(mg/m ³) ⁻¹	9.71E-10	1.70E-06	mg/m ³	5.00E-01	mg/m ³	3.40E-06			
				Dichloroethane, 1,2-	3.57E+00	µg/L	3.74E-06	mg/m ³	2.60E-02	(mg/m ³) ⁻¹	9.72E-08	1.05E-05	mg/m ³	7.00E-03	mg/m ³	1.50E-03			
				Dichloroethene, cis-1,2-	1.04E+00	µg/L	1.14E-06	mg/m ³	--	(mg/m ³) ⁻¹	NC	3.19E-06	mg/m ³	--	mg/m ³	NC			
				Ethylbenzene	4.08E+02	µg/L	4.30E-04	mg/m ³	2.50E-03	(mg/m ³) ⁻¹	1.07E-06	1.20E-03	mg/m ³	1.00E+00	mg/m ³	1.20E-03			
				Hexanone, 2-	3.35E+00	µg/L	2.24E-06	mg/m ³	--	(mg/m ³) ⁻¹	NC	6.27E-06	mg/m ³	3.00E-02	mg/m ³	2.09E-04			
				Iron	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	--	mg/m ³	NC			
				Isopropyl benzene	2.86E+01	µg/L	2.84E-05	mg/m ³	--	(mg/m ³) ⁻¹	NC	7.96E-05	mg/m ³	4.00E-01	mg/m ³	1.99E-04			
				Lead	NA	µg/L	NC	mg/m ³	1.20E-02	(mg/m ³) ⁻¹	NC	NC	mg/m ³	--	mg/m ³	NC			
				Manganese	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	5.00E-05	mg/m ³	NC			
				Methylnaphthalene, 2-	2.78E+01	µg/L	2.30E-05	mg/m ³	--	(mg/m ³) ⁻¹	NC	6.45E-05	mg/m ³	--	mg/m ³	NC			
				Naphthalene	6.89E+01	µg/L	5.90E-05	mg/m ³	3.40E-02	(mg/m ³) ⁻¹	2.01E-06	1.65E-04	mg/m ³	3.00E-03	mg/m ³	5.51E-02			
				Selenium	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	2.00E-02	mg/m ³	NC			
				Tetrachloroethene	8.49E-01	µg/L	7.19E-07	mg/m ³	2.60E-04	(mg/m ³) ⁻¹	1.87E-10	2.01E-06	mg/m ³	4.00E-02	mg/m ³	5.03E-05			
				Toluene	9.90E+02	µg/L	1.12E-03	mg/m ³	--	(mg/m ³) ⁻¹	NC	3.13E-03	mg/m ³	5.00E+00	mg/m ³	6.26E-04			
				Trichloroethene	1.13E+00	µg/L	1.07E-06	mg/m ³	4.10E-03	(mg/m ³) ⁻¹	4.40E-09	3.00E-06	mg/m ³	2.00E-03	mg/m ³	1.50E-03			
				Trimethylbenzene, 1,2,4-	5.32E+02	µg/L	5.26E-04	mg/m ³	--	(mg/m ³) ⁻¹	NC	1.47E-03	mg/m ³	7.00E-03	mg/m ³	2.10E-01			
				Vanadium	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	1.00E-04	mg/m ³	NC			
				Xylenes (total)	2.08E+03	µg/L	2.19E-03	mg/m ³	--	(mg/m ³) ⁻¹	NC	6.12E-03	mg/m ³	1.00E-01	mg/m ³	6.12E-02			
							Exp. Route Total								5.97E-06				4.11E-01
							Exposure Point Total								5.97E-06				4.11E-01
							Exposure Medium Total								5.97E-06				4.11E-01
Medium Total											7.53E-05					6.15E-01			
TOTAL OF RECEPTOR RISKS ACROSS ALL MEDIA											7.53E-05	TOTAL OF RECEPTOR HAZARDS ACROSS ALL MEDIA				6.15E-01			

Notes:

NA = Not Applicable

NC = Not Calculated

(1) Toxicity data taken from Risk Assessment Information System (RAIS, 2014), refer to Table E.9.

TABLE E.11

**SUMMARY OF FUTURE UTILITY WORKER RISKS AND HAZARDS FOR CHEMICALS OF POTENTIAL CONCERN
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

Scenario Timeframe: Future
Receptor Population: Utility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemicals of Potential Concern	Carcinogenic Risk (Refer to Table E.10)				Non-Carcinogenic Hazard Quotient (Refer to Table E.10)			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site Wide	Aluminum	NC	NC	NC	NC	1.41E-03	NC	2.45E-04	1.66E-03
			Aroclor-1260 (PCB-1260)	9.39E-08	NC	6.49E-05	6.50E-05	NC	NC	NC	NC
			Arsenic	3.09E-07	NC	5.37E-08	3.63E-07	1.93E-03	NC	3.34E-04	2.26E-03
			Barium	NC	NC	NC	NC	2.58E-04	NC	4.47E-05	3.02E-04
			Benzene	6.14E-07	2.72E-06	1.63E-06	4.97E-06	7.81E-03	3.26E-02	2.07E-02	6.11E-02
			Biphenyl (1,1-Biphenyl)	2.80E-09	NC	4.39E-08	4.67E-08	1.96E-06	4.68E-02	3.07E-05	4.68E-02
			Carbon tetrachloride	3.17E-09	6.11E-09	1.02E-08	1.95E-08	3.17E-05	2.85E-05	1.02E-04	1.62E-04
			Chloroform (Trichloromethane)	2.89E-09	5.41E-08	3.76E-09	6.08E-08	2.61E-05	6.74E-05	3.40E-05	1.28E-04
			Cobalt	NC	NC	NC	NC	2.08E-02	NC	1.44E-03	2.22E-02
			Dibenzofuran	NC	NC	NC	NC	4.32E-04	NC	7.32E-03	7.76E-03
			Dichlorobenzene, 1,4-	1.36E-10	6.24E-09	1.11E-09	7.48E-09	1.01E-06	1.98E-06	8.20E-06	1.12E-05
			Dichloroethane, 1,1-	1.24E-10	9.71E-10	1.56E-10	1.25E-09	3.06E-07	3.40E-06	3.84E-07	4.09E-06
			Dichloroethane, 1,2-	1.27E-08	9.72E-08	1.00E-08	1.20E-07	6.52E-05	1.50E-03	5.13E-05	1.61E-03
			Dichloroethene, cis-1,2-	NC	NC	NC	NC	5.70E-05	NC	1.15E-04	1.72E-04
			Ethylbenzene	1.75E-07	1.07E-06	1.44E-06	2.69E-06	4.47E-04	1.20E-03	3.66E-03	5.32E-03
			Hexanone, 2-	NC	NC	NC	NC	7.33E-05	2.09E-04	4.89E-05	3.31E-04
			Iron	NC	NC	NC	NC	6.55E-03	NC	1.14E-03	7.69E-03
			Isopropyl benzene	NC	NC	NC	NC	3.14E-05	1.99E-04	4.35E-04	6.66E-04
			Lead	2.05E-09	NC	3.55E-11	2.08E-09	NC	NC	NC	NC
			Manganese	NC	NC	NC	NC	6.35E-02	NC	1.10E-02	7.45E-02
			Methylnaphthalene, 2-	NC	NC	NC	NC	7.62E-04	NC	1.13E-02	1.20E-02
			Naphthalene	NC	2.01E-06	NC	2.01E-06	3.77E-04	5.51E-02	3.04E-03	5.85E-02
			Selenium	NC	NC	NC	NC	1.75E-04	NC	3.04E-05	2.06E-04
			Tetrachloroethene	6.98E-11	1.87E-10	4.52E-10	7.08E-10	1.55E-05	5.03E-05	1.00E-04	1.66E-04
			Toluene	NC	NC	NC	NC	1.36E-03	6.26E-04	7.27E-03	9.25E-03
			Trichloroethene	2.03E-09	4.40E-09	4.50E-09	1.09E-08	2.47E-04	1.50E-03	5.48E-04	2.30E-03
			Trimethylbenzene, 1,2,4-	NC	NC	NC	NC	1.17E-03	2.10E-01	1.56E-02	2.27E-01
			Vanadium	NC	NC	NC	NC	4.94E-04	NC	8.57E-05	5.80E-04
			Xylenes (total)	NC	NC	NC	NC	1.14E-03	6.12E-02	9.47E-03	7.18E-02
			Chemical Total	1.22E-06	5.97E-06	6.81E-05	7.53E-05	1.09E-01	4.11E-01	9.42E-02	6.15E-01
		Exposure Point Total					7.53E-05				6.15E-01
	Exposure Medium Total						7.53E-05				6.15E-01
Medium Total							7.53E-05				6.15E-01
TOTAL OF RECEPTOR RISKS ACROSS ALL MEDIA							7.53E-05	TOTAL OF RECEPTOR HAZARDS ACROSS ALL MEDIA			6.15E-01

Note:

NC = Not Calculated

TABLE E.12

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS FOR FUTURE CONSTRUCTION WORKER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk (1)		Cancer Risk	Intake/Exposure Concentration		RfD/RfC (1)		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site Wide	Ingestion	Aluminum	1.29E+04	µg/L	2.02E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.41E-03	mg/kg-d	1.00E+00	mg/kg-d	1.41E-03
				Aroclor-1260 (PCB-1260)	1.20E+00	µg/L	1.88E-09	mg/kg-d	2.00E+00	(mg/kg-d) ⁻¹	3.76E-09	1.32E-07	mg/kg-d	--	mg/kg-d	NC
				Arsenic	5.27E+00	µg/L	8.25E-09	mg/kg-d	1.50E+00	(mg/kg-d) ⁻¹	1.24E-08	5.78E-07	mg/kg-d	3.00E-04	mg/kg-d	1.93E-03
				Barium	4.70E+02	µg/L	7.36E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	5.15E-05	mg/kg-d	2.00E-01	mg/kg-d	2.58E-04
				Benzene	2.85E+02	µg/L	4.46E-07	mg/kg-d	5.50E-02	(mg/kg-d) ⁻¹	2.45E-08	3.12E-05	mg/kg-d	4.00E-03	mg/kg-d	7.81E-03
				Biphenyl (1,1-Biphenyl)	8.94E+00	µg/L	1.40E-08	mg/kg-d	8.00E-03	(mg/kg-d) ⁻¹	1.12E-10	9.79E-07	mg/kg-d	5.00E-01	mg/kg-d	1.96E-06
				Carbon tetrachloride	1.16E+00	µg/L	1.81E-09	mg/kg-d	7.00E-02	(mg/kg-d) ⁻¹	1.27E-10	1.27E-07	mg/kg-d	4.00E-03	mg/kg-d	3.17E-05
				Chloroform (Trichloromethane)	2.38E+00	µg/L	3.73E-09	mg/kg-d	3.10E-02	(mg/kg-d) ⁻¹	1.16E-10	2.61E-07	mg/kg-d	1.00E-02	mg/kg-d	2.61E-05
				Cobalt	5.69E+01	µg/L	8.91E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	6.24E-06	mg/kg-d	3.00E-04	mg/kg-d	2.08E-02
				Dibenzofuran	3.95E+00	µg/L	6.18E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.32E-07	mg/kg-d	1.00E-03	mg/kg-d	4.32E-04
				Dichlorobenzene, 1,4-	6.43E-01	µg/L	1.01E-09	mg/kg-d	5.40E-03	(mg/kg-d) ⁻¹	5.44E-12	7.05E-08	mg/kg-d	7.00E-02	mg/kg-d	1.01E-06
				Dichloroethane, 1,1-	5.58E-01	µg/L	8.74E-10	mg/kg-d	5.70E-03	(mg/kg-d) ⁻¹	4.98E-12	6.12E-08	mg/kg-d	2.00E-01	mg/kg-d	3.06E-07
				Dichloroethane, 1,2-	3.57E+00	µg/L	5.59E-09	mg/kg-d	9.10E-02	(mg/kg-d) ⁻¹	5.09E-10	3.91E-07	mg/kg-d	6.00E-03	mg/kg-d	6.52E-05
				Dichloroethene, cis-1,2-	1.04E+00	µg/L	1.63E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.14E-07	mg/kg-d	2.00E-03	mg/kg-d	5.70E-05
				Ethylbenzene	4.08E+02	µg/L	6.38E-07	mg/kg-d	1.10E-02	(mg/kg-d) ⁻¹	7.02E-09	4.47E-05	mg/kg-d	1.00E-01	mg/kg-d	4.47E-04
				Hexanone, 2-	3.35E+00	µg/L	5.24E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	3.67E-07	mg/kg-d	5.00E-03	mg/kg-d	7.33E-05
				Iron	4.19E+04	µg/L	6.55E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.59E-03	mg/kg-d	7.00E-01	mg/kg-d	6.55E-03
				Isopropyl benzene	2.86E+01	µg/L	4.48E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	3.14E-06	mg/kg-d	1.00E-01	mg/kg-d	3.14E-05
				Lead	6.16E+00	µg/L	9.64E-09	mg/kg-d	8.50E-03	(mg/kg-d) ⁻¹	8.19E-11	6.75E-07	mg/kg-d	--	mg/kg-d	NC
				Manganese	1.39E+04	µg/L	2.18E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.52E-03	mg/kg-d	2.40E-02	mg/kg-d	6.35E-02
				Methylnaphthalene, 2-	2.78E+01	µg/L	4.35E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	3.05E-06	mg/kg-d	4.00E-03	mg/kg-d	7.62E-04
				Naphthalene	6.89E+01	µg/L	1.08E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.55E-06	mg/kg-d	2.00E-02	mg/kg-d	3.77E-04
				Selenium	7.99E+00	µg/L	1.25E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	8.76E-07	mg/kg-d	5.00E-03	mg/kg-d	1.75E-04
				Tetrachloroethene	8.49E-01	µg/L	1.33E-09	mg/kg-d	2.10E-03	(mg/kg-d) ⁻¹	2.79E-12	9.30E-08	mg/kg-d	6.00E-03	mg/kg-d	1.55E-05
				Toluene	9.90E+02	µg/L	1.55E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.09E-04	mg/kg-d	8.00E-02	mg/kg-d	1.36E-03
				Trichloroethene	1.13E+00	µg/L	1.77E-09	mg/kg-d	4.60E-02	(mg/kg-d) ⁻¹	8.13E-11	1.24E-07	mg/kg-d	5.00E-04	mg/kg-d	2.47E-04
				Trimethylbenzene, 1,2,4-	5.32E+02	µg/L	8.32E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	5.83E-05	mg/kg-d	5.00E-02	mg/kg-d	1.17E-03
				Vanadium	2.27E+01	µg/L	3.56E-08	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.49E-06	mg/kg-d	5.04E-03	mg/kg-d	4.94E-04
				Xylenes (total)	2.08E+03	µg/L	3.26E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.28E-04	mg/kg-d	2.00E-01	mg/kg-d	1.14E-03
							Exp. Route Total							4.87E-08		

TABLE E.12

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS FOR FUTURE CONSTRUCTION WORKER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk (1)		Cancer Risk	Intake/Exposure Concentration		RfD/RfC (1)		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Site Wide	Dermal	Aluminum	1.29E+04	µg/L	3.50E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.45E-04	mg/kg-d	1.00E+00	mg/kg-d	2.45E-04
				Aroclor-1260 (PCB-1260)	1.20E+00	µg/L	1.30E-06	mg/kg-d	2.00E+00	(mg/kg-d) ⁻¹	2.60E-06	9.09E-05	mg/kg-d	--	mg/kg-d	NC
				Arsenic	5.27E+00	µg/L	1.43E-09	mg/kg-d	1.50E+00	(mg/kg-d) ⁻¹	2.15E-09	1.00E-07	mg/kg-d	3.00E-04	mg/kg-d	3.34E-04
				Barium	4.70E+02	µg/L	1.28E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	8.94E-06	mg/kg-d	2.00E-01	mg/kg-d	4.47E-05
				Benzene	2.85E+02	µg/L	1.19E-06	mg/kg-d	5.50E-02	(mg/kg-d) ⁻¹	6.52E-08	8.30E-05	mg/kg-d	4.00E-03	mg/kg-d	2.07E-02
				Biphenyl (1,1-Biphenyl)	8.94E+00	µg/L	2.19E-07	mg/kg-d	8.00E-03	(mg/kg-d) ⁻¹	1.76E-09	1.54E-05	mg/kg-d	5.00E-01	mg/kg-d	3.07E-05
				Carbon tetrachloride	1.16E+00	µg/L	5.81E-09	mg/kg-d	7.00E-02	(mg/kg-d) ⁻¹	4.07E-10	4.07E-07	mg/kg-d	4.00E-03	mg/kg-d	1.02E-04
				Chloroform (Trichloromethane)	2.38E+00	µg/L	4.85E-09	mg/kg-d	3.10E-02	(mg/kg-d) ⁻¹	1.50E-10	3.40E-07	mg/kg-d	1.00E-02	mg/kg-d	3.40E-05
				Cobalt	5.69E+01	µg/L	6.19E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.33E-07	mg/kg-d	3.00E-04	mg/kg-d	1.44E-03
				Dibenzofuran	3.95E+00	µg/L	1.05E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.32E-06	mg/kg-d	1.00E-03	mg/kg-d	7.32E-03
				Dichlorobenzene, 1,4-	6.43E-01	µg/L	8.20E-09	mg/kg-d	5.40E-03	(mg/kg-d) ⁻¹	4.43E-11	5.74E-07	mg/kg-d	7.00E-02	mg/kg-d	8.20E-06
				Dichloroethane, 1,1-	5.58E-01	µg/L	1.10E-09	mg/kg-d	5.70E-03	(mg/kg-d) ⁻¹	6.25E-12	7.67E-08	mg/kg-d	2.00E-01	mg/kg-d	3.84E-07
				Dichloroethane, 1,2-	3.57E+00	µg/L	4.40E-09	mg/kg-d	9.10E-02	(mg/kg-d) ⁻¹	4.00E-10	3.08E-07	mg/kg-d	6.00E-03	mg/kg-d	5.13E-05
				Dichloroethene, cis-1,2-	1.04E+00	µg/L	3.28E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.30E-07	mg/kg-d	2.00E-03	mg/kg-d	1.15E-04
				Ethylbenzene	4.08E+02	µg/L	5.24E-06	mg/kg-d	1.10E-02	(mg/kg-d) ⁻¹	5.76E-08	3.66E-04	mg/kg-d	1.00E-01	mg/kg-d	3.66E-03
				Hexanone, 2-	3.35E+00	µg/L	3.49E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.45E-07	mg/kg-d	5.00E-03	mg/kg-d	4.89E-05
				Iron	4.19E+04	µg/L	1.14E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.96E-04	mg/kg-d	7.00E-01	mg/kg-d	1.14E-03
				Isopropyl benzene	2.86E+01	µg/L	6.22E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.35E-05	mg/kg-d	1.00E-01	mg/kg-d	4.35E-04
				Lead	6.16E+00	µg/L	1.67E-10	mg/kg-d	8.50E-03	(mg/kg-d) ⁻¹	1.42E-12	1.17E-08	mg/kg-d	--	mg/kg-d	NC
				Manganese	1.39E+04	µg/L	3.78E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	2.64E-04	mg/kg-d	2.40E-02	mg/kg-d	1.10E-02
				Methylnaphthalene, 2-	2.78E+01	µg/L	6.45E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.51E-05	mg/kg-d	4.00E-03	mg/kg-d	1.13E-02
				Naphthalene	6.89E+01	µg/L	8.68E-07	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	6.07E-05	mg/kg-d	2.00E-02	mg/kg-d	3.04E-03
				Selenium	7.99E+00	µg/L	2.17E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.52E-07	mg/kg-d	5.00E-03	mg/kg-d	3.04E-05
				Tetrachloroethene	8.49E-01	µg/L	8.61E-09	mg/kg-d	2.10E-03	(mg/kg-d) ⁻¹	1.81E-11	6.02E-07	mg/kg-d	6.00E-03	mg/kg-d	1.00E-04
				Toluene	9.90E+02	µg/L	8.31E-06	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	5.81E-04	mg/kg-d	8.00E-02	mg/kg-d	7.27E-03
				Trichloroethene	1.13E+00	µg/L	3.92E-09	mg/kg-d	4.60E-02	(mg/kg-d) ⁻¹	1.80E-10	2.74E-07	mg/kg-d	5.00E-04	mg/kg-d	5.48E-04
				Trimethylbenzene, 1,2,4-	5.32E+02	µg/L	1.11E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	7.79E-04	mg/kg-d	5.00E-02	mg/kg-d	1.56E-02
				Vanadium	2.27E+01	µg/L	6.17E-09	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	4.32E-07	mg/kg-d	5.04E-03	mg/kg-d	8.57E-05
				Xylenes (total)	2.08E+03	µg/L	2.70E-05	mg/kg-d	--	(mg/kg-d) ⁻¹	NC	1.89E-03	mg/kg-d	2.00E-01	mg/kg-d	9.47E-03
			Exp. Route Total								2.73E-06					9.42E-02
		Exposure Point Total									2.77E-06					2.03E-01
	Exposure Medium Total										2.77E-06					2.03E-01

TABLE E.12

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS FOR FUTURE CONSTRUCTION WORKER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk (1)		Cancer Risk	Intake/Exposure Concentration		RfD/RfC (1)		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Groundwater	Ambient Air	Site Wide	Inhalation	Aluminum	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	5.00E-03	mg/m ³	NC	
				Aroclor-1260 (PCB-1260)	NA	µg/L	NC	mg/m ³	5.71E-01	(mg/m ³) ⁻¹	NC	NC	mg/m ³	--	mg/m ³	NC	
				Arsenic	NA	µg/L	NC	mg/m ³	4.30E+00	(mg/m ³) ⁻¹	NC	NC	mg/m ³	1.50E-05	mg/m ³	NC	
				Barium	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	5.00E-04	mg/m ³	NC	
				Benzene	2.85E+02	µg/L	1.40E-05	mg/m ³	7.80E-03	(mg/m ³) ⁻¹	1.09E-07	9.77E-04	mg/m ³	3.00E-02	mg/m ³	3.26E-02	
				Biphenyl (1,1-Biphenyl)	8.94E+00	µg/L	2.67E-07	mg/m ³	--	(mg/m ³) ⁻¹	NC	1.87E-05	mg/m ³	4.00E-04	mg/m ³	4.68E-02	
				Carbon tetrachloride	1.16E+00	µg/L	4.07E-08	mg/m ³	6.00E-03	(mg/m ³) ⁻¹	2.44E-10	2.85E-06	mg/m ³	1.00E-01	mg/m ³	2.85E-05	
				Chloroform (Trichloromethane)	2.38E+00	µg/L	9.41E-08	mg/m ³	2.30E-02	(mg/m ³) ⁻¹	2.16E-09	6.59E-06	mg/m ³	9.77E-02	mg/m ³	6.74E-05	
				Cobalt	NA	µg/L	NC	mg/m ³	9.00E+00	(mg/m ³) ⁻¹	NC	NC	mg/m ³	6.00E-06	mg/m ³	NC	
				Dibenzofuran	3.95E+00	µg/L	1.06E-07	mg/m ³	--	(mg/m ³) ⁻¹	NC	7.43E-06	mg/m ³	--	mg/m ³	NC	
				Dichlorobenzene, 1,4-	6.43E-01	µg/L	2.27E-08	mg/m ³	1.10E-02	(mg/m ³) ⁻¹	2.50E-10	1.59E-06	mg/m ³	8.00E-01	mg/m ³	1.98E-06	
				Dichloroethane, 1,1-	5.58E-01	µg/L	2.43E-08	mg/m ³	1.60E-03	(mg/m ³) ⁻¹	3.89E-11	1.70E-06	mg/m ³	5.00E-01	mg/m ³	3.40E-06	
				Dichloroethane, 1,2-	3.57E+00	µg/L	1.50E-07	mg/m ³	2.60E-02	(mg/m ³) ⁻¹	3.89E-09	1.05E-05	mg/m ³	7.00E-03	mg/m ³	1.50E-03	
				Dichloroethene, cis-1,2-	1.04E+00	µg/L	4.56E-08	mg/m ³	--	(mg/m ³) ⁻¹	NC	3.19E-06	mg/m ³	--	mg/m ³	NC	
				Ethylbenzene	4.08E+02	µg/L	1.72E-05	mg/m ³	2.50E-03	(mg/m ³) ⁻¹	4.30E-08	1.20E-03	mg/m ³	1.00E+00	mg/m ³	1.20E-03	
				Hexanone, 2-	3.35E+00	µg/L	8.96E-08	mg/m ³	--	(mg/m ³) ⁻¹	NC	6.27E-06	mg/m ³	3.00E-02	mg/m ³	2.09E-04	
				Iron	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	--	mg/m ³	NC	
				Isopropyl benzene	2.86E+01	µg/L	1.14E-06	mg/m ³	--	(mg/m ³) ⁻¹	NC	7.96E-05	mg/m ³	4.00E-01	mg/m ³	1.99E-04	
				Lead	NA	µg/L	NC	mg/m ³	1.20E-02	(mg/m ³) ⁻¹	NC	NC	mg/m ³	--	mg/m ³	NC	
				Manganese	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	5.00E-05	mg/m ³	NC	
				Methylnaphthalene, 2-	2.78E+01	µg/L	9.22E-07	mg/m ³	--	(mg/m ³) ⁻¹	NC	6.45E-05	mg/m ³	--	mg/m ³	NC	
				Naphthalene	6.89E+01	µg/L	2.36E-06	mg/m ³	3.40E-02	(mg/m ³) ⁻¹	8.02E-08	1.65E-04	mg/m ³	3.00E-03	mg/m ³	5.51E-02	
				Selenium	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	2.00E-02	mg/m ³	NC	
				Tetrachloroethene	8.49E-01	µg/L	2.87E-08	mg/m ³	2.60E-04	(mg/m ³) ⁻¹	7.47E-12	2.01E-06	mg/m ³	4.00E-02	mg/m ³	5.03E-05	
				Toluene	9.90E+02	µg/L	4.47E-05	mg/m ³	--	(mg/m ³) ⁻¹	NC	3.13E-03	mg/m ³	5.00E+00	mg/m ³	6.26E-04	
				Trichloroethene	1.13E+00	µg/L	4.29E-08	mg/m ³	4.10E-03	(mg/m ³) ⁻¹	1.76E-10	3.00E-06	mg/m ³	2.00E-03	mg/m ³	1.50E-03	
				Trimethylbenzene, 1,2,4-	5.32E+02	µg/L	2.10E-05	mg/m ³	--	(mg/m ³) ⁻¹	NC	1.47E-03	mg/m ³	7.00E-03	mg/m ³	2.10E-01	
				Vanadium	NA	µg/L	NC	mg/m ³	--	(mg/m ³) ⁻¹	NC	NC	mg/m ³	1.00E-04	mg/m ³	NC	
				Xylenes (total)	2.08E+03	µg/L	8.74E-05	mg/m ³	--	(mg/m ³) ⁻¹	NC	6.12E-03	mg/m ³	1.00E-01	mg/m ³	6.12E-02	
							Exp. Route Total								2.39E-07		
					Exposure Point Total								2.39E-07				4.11E-01
				Exposure Medium Total								2.39E-07				4.11E-01	
Medium Total											3.01E-06				6.15E-01		
TOTAL OF RECEPTOR RISKS ACROSS ALL MEDIA											3.01E-06	TOTAL OF RECEPTOR HAZARDS ACROSS ALL MEDIA			6.15E-01		

Notes:

NA = Not Applicable

NC = Not Calculated

(1) Toxicity data taken from Risk Assessment Information System (RAIS, 2014), refer to Table E.9.

TABLE E.13

SUMMARY OF FUTURE CONSTRUCTION WORKER RISKS AND HAZARDS FOR CHEMICALS OF POTENTIAL CONCERN
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemicals of Potential Concern	Carcinogenic Risk (Refer to Table E.12)				Non-Carcinogenic Hazard Quotient (Refer to Table E.12)			
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Site Wide	Aluminum	NC	NC	NC	NC	1.41E-03	NC	2.45E-04	1.66E-03
			Aroclor-1260 (PCB-1260)	3.76E-09	NC	2.60E-06	2.60E-06	NC	NC	NC	NC
			Arsenic	1.24E-08	NC	2.15E-09	1.45E-08	1.93E-03	NC	3.34E-04	2.26E-03
			Barium	NC	NC	NC	NC	2.58E-04	NC	4.47E-05	3.02E-04
			Benzene	2.45E-08	1.09E-07	6.52E-08	1.99E-07	7.81E-03	3.26E-02	2.07E-02	6.11E-02
			Biphenyl (1,1-Biphenyl)	1.12E-10	NC	1.76E-09	1.87E-09	1.96E-06	4.68E-02	3.07E-05	4.68E-02
			Carbon tetrachloride	1.27E-10	2.44E-10	4.07E-10	7.78E-10	3.17E-05	2.85E-05	1.02E-04	1.62E-04
			Chloroform (Trichloromethane)	1.16E-10	2.16E-09	1.50E-10	2.43E-09	2.61E-05	6.74E-05	3.40E-05	1.28E-04
			Cobalt	NC	NC	NC	NC	2.08E-02	NC	1.44E-03	2.22E-02
			Dibenzofuran	NC	NC	NC	NC	4.32E-04	NC	7.32E-03	7.76E-03
			Dichlorobenzene, 1,4-	5.44E-12	2.50E-10	4.43E-11	2.99E-10	1.01E-06	1.98E-06	8.20E-06	1.12E-05
			Dichloroethane, 1,1-	4.98E-12	3.89E-11	6.25E-12	5.01E-11	3.06E-07	3.40E-06	3.84E-07	4.09E-06
			Dichloroethane, 1,2-	5.09E-10	3.89E-09	4.00E-10	4.80E-09	6.52E-05	1.50E-03	5.13E-05	1.61E-03
			Dichloroethene, cis-1,2-	NC	NC	NC	NC	5.70E-05	NC	1.15E-04	1.72E-04
			Ethylbenzene	7.02E-09	4.30E-08	5.76E-08	1.08E-07	4.47E-04	1.20E-03	3.66E-03	5.32E-03
			Hexanone, 2-	NC	NC	NC	NC	7.33E-05	2.09E-04	4.89E-05	3.31E-04
			Iron	NC	NC	NC	NC	6.55E-03	NC	1.14E-03	7.69E-03
			Isopropyl benzene	NC	NC	NC	NC	3.14E-05	1.99E-04	4.35E-04	6.66E-04
			Lead	8.19E-11	NC	1.42E-12	8.33E-11	NC	NC	NC	NC
			Manganese	NC	NC	NC	NC	6.35E-02	NC	1.10E-02	7.45E-02
			Methylnaphthalene, 2-	NC	NC	NC	NC	7.62E-04	NC	1.13E-02	1.20E-02
			Naphthalene	NC	8.02E-08	NC	8.02E-08	3.77E-04	5.51E-02	3.04E-03	5.85E-02
			Selenium	NC	NC	NC	NC	1.75E-04	NC	3.04E-05	2.06E-04
			Tetrachloroethene	2.79E-12	7.47E-12	1.81E-11	2.83E-11	1.55E-05	5.03E-05	1.00E-04	1.66E-04
			Toluene	NC	NC	NC	NC	1.36E-03	6.26E-04	7.27E-03	9.25E-03
			Trichloroethene	8.13E-11	1.76E-10	1.80E-10	4.37E-10	2.47E-04	1.50E-03	5.48E-04	2.30E-03
			Trimethylbenzene, 1,2,4-	NC	NC	NC	NC	1.17E-03	2.10E-01	1.56E-02	2.27E-01
			Vanadium	NC	NC	NC	NC	4.94E-04	NC	8.57E-05	5.80E-04
			Xylenes (total)	NC	NC	NC	NC	1.14E-03	6.12E-02	9.47E-03	7.18E-02
			Chemical Total	4.87E-08	2.39E-07	2.73E-06	3.01E-06	1.09E-01	4.11E-01	9.42E-02	6.15E-01
		Exposure Point Total					3.01E-06				6.15E-01
	Exposure Medium Total						3.01E-06				6.15E-01
Medium Total							3.01E-06				6.15E-01
TOTAL OF RECEPTOR RISKS ACROSS ALL MEDIA							3.01E-06	TOTAL OF RECEPTOR HAZARDS ACROSS ALL MEDIA			6.15E-01

Note:

NC = Not Calculated

Appendix F

Off-Site Groundwater Risk Tables

TABLE F.1

**OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

CAS Number	Chemical	Minimum Concentration (1,2)	Minimum Qualifier	Maximum Concentration (1,2)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits (2)	Concentration Used for Screening (2)	Screening Toxicity Value (3)	COPC Flag	Rationale for (4) Contaminant Deletion or Selection	
	<u>VOCs</u>													
95-63-6	1,2,4-Trimethylbenzene	480		790		µg/L	DA-MW42 (09/18/13)	3/24	1	790	1.5	N	X	ASC
78-93-3	2-Butanone (MEK)	7.2		16		µg/L	DA-MW42 (09/18/13)	5/44	5 - 10	16	560	N		BSC
591-78-6	2-Hexanone	1.7	J	1.7	J	µg/L	VAS-12 (10/17/12)	1/44	5 - 25	1.7	3.8	N		BSC
108-10-1	4-Methyl-2-pentanone (MIBK)	1.4	J	1.8	J	µg/L	MW-40 (10/22/12)	2/44	5 - 25	1.8	120	N		BSC
67-64-1	Acetone	31		34		µg/L	VAS-13 (10/17/12)	2/44	5 - 28	34	1400	N		BSC
71-43-2	Benzene	0.79	J	6.4		µg/L	DA-MW47 (09/17/13)	5/44	1 - 5	6.4	0.45	C	X	ASC
75-15-0	Carbon disulfide	0.19	J	0.19	J	µg/L	DA-MW41 (06/28/13)	1/44	1 - 5	0.19	81	N		BSC
67-66-3	Chloroform (Trichloromethane)	0.097	J	2.7		µg/L	DA-MW40 (06/28/13)	11/44	1 - 5	2.7	0.22	C	X	ASC
110-82-7	Cyclohexane	0.98	J	390		µg/L	DA-MW42 (03/26/13)	11/44	1	390	1300	N		BSC
100-41-4	Ethylbenzene	0.11	J	750		µg/L	DA-MW42 (03/26/13)	14/44	1	750	1.5	C	X	ASC
98-82-8	Isopropyl benzene	0.23	J	54		µg/L	DA-MW42 (03/26/13)	12/44	1	54	45	N	X	ASC
108-87-2	Methyl cyclohexane	0.19	J	370		µg/L	VAS-14 (10/18/12)	15/44	1	370	1300 (5)	N		BSC
1634-04-4	Methyl tert butyl ether (MTBE)	0.14	J	12		µg/L	DA-MW46 (06/27/13)	13/44	1 - 5	12	10	C	X	ASC
100-42-5	Styrene	2.3		21		µg/L	DA-MW42 (03/26/13)	5/44	1 - 5	21	100	N		BSC
108-88-3	Toluene	0.2	J	330		µg/L	DA-MW42 (03/26/13)	14/44	1	330	110	N	X	ASC
79-01-6	Trichloroethene	0.12	J	0.39	J	µg/L	DA-MW44 (03/26/13)	2/44	1 - 5	0.39	0.28	C		LDF
1330-20-7	Xylenes (total)	0.15	J	1300		µg/L	DA-MW41 (03/26/13, 09/18/13)	13/44	3	1300	19	N	X	ASC
	<u>SVOCs</u>													
91-57-6	2-Methylnaphthalene	7.6	J	29		µg/L	DA-MW42 (09/18/13)	9/44	10 - 11	29	3.6	N	X	ASC
106-44-5	4-Methylphenol	2.1	J	5.8	J	µg/L	MW-41 (10/22/12)	2/44	10 - 11	5.8	190	N		BSC
98-86-2	Acetophenone	9.3	J	9.3	J	µg/L	VAS-13 (10/17/12)	1/44	10 - 11	9.3	190	N		BSC
84-66-2	Diethyl phthalate	140		140		µg/L	DA-MW40 (09/18/13)	1/44	10 - 11	140	1500	N		BSC
91-20-3	Naphthalene	3	J	220		µg/L	DA-MW42 (09/18/13)	10/44	10 - 11	220	0.17	C	X	ASC

Notes:

- VOCs Volatile Organic Compounds
SVOCs Semi-volatile Organic Compounds
C Carcinogenic; analyte considered to be a carcinogen.
N Non-Carcinogenic; analyte considered to be a non-carcinogen.
-- Not Available
J Result is an estimated value.

- (1) Minimum/maximum detected concentration.
(2) Based on data collected from sampling locations: DA-MW38, DA-MW39, DA-MW40, DA-MW41, DA-MW42, DA-MW43, DA-MW44, DA-MW45R, DA-MW46, DA-MW47, MW-38, MW-39, MW-40, MW-41, VAS-11, VAS-12, VAS-13, VAS-14.
(3) DNREC-SIRS Screening Level Table - Groundwater, Department of Natural Resources and Environmental Control, Division of Waste and Hazardous Substance, Site Investigation & Restoration Section, Delaware DNREC, October 2014.
(4) Rationale Codes
Selection Reason Maximum detected above Screening Criterion (ASC)
Deletion Reason Maximum detected below Screening Criterion (BSC)
Low Detection Frequency (LDF); less than 5 percent
(5) No screening criterion available for this analyte, substituted cyclohexane screening criterion.

TABLE F.2

EXPOSURE POINT CONCENTRATION (EPC) SUMMARY FOR CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Chemical of Potential Concern (COPC)	Units	Mean (1)	Data Distribution (2)	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic (3)	Medium EPC Rationale
<u>VOCs</u>									
1,2,4-Trimethylbenzene	µg/L	8.21E+01	(d)	7.90E+02		µg/L	1.75E+02	95% KM (t) UCL	(4)
Benzene	µg/L	1.06E+00	(b)	6.40E+00		µg/L	1.32E+00	95% KM (Percentile Bootstrap) UCL	(4)
Chloroform (Trichloromethane)	µg/L	4.07E-01	(c)	2.70E+00		µg/L	5.73E-01	95% Adjusted Gamma KM-UCL	(4)
Ethylbenzene	µg/L	5.74E+01	(c)	7.50E+02		µg/L	1.44E+02	95% Adjusted Gamma KM-UCL	(4)
Isopropyl benzene	µg/L	5.48E+00	(d)	5.40E+01		µg/L	8.49E+00	95% KM (t) UCL	(4)
Methyl tert butyl ether (MTBE)	µg/L	7.15E-01	(b)	1.20E+01		µg/L	1.28E+00	95% KM (BCA) UCL	(4)
Toluene	µg/L	2.32E+01	(a)	3.30E+02		µg/L	1.37E+02	99% KM (Chebyshev) UCL	(4)
Xylenes (total)	µg/L	1.21E+02	(c)	1.30E+03		µg/L	2.82E+02	95% Adjusted Gamma KM-UCL	(4)
<u>SVOCs</u>									
2-Methylnaphthalene	µg/L	1.03E+01	(d)	2.90E+01		µg/L	1.19E+01	95% KM (Percentile Bootstrap) UCL	(4)
Naphthalene	µg/L	2.24E+01	(d)	2.20E+02		µg/L	3.63E+01	95% KM (Percentile Bootstrap) UCL	(4)

Notes:

VOCs - Volatile Organic Compounds

SVOCs - Semi-volatile Organic Compounds

J - Result is an estimated value.

(1) The Kaplan-Meier estimation method for non-detects was used, as per USEPA (2013).

(2) Data Distribution (Note: data distribution calculated by ProUCL are based on detected values only):

(a) Data set is neither normally, gamma or lognormally distributed.

(b) Data set is lognormally distributed.

(c) Data set is gamma distributed.

(d) Data set is normally distributed.

(3) Statistics (Note: 95% UCL values are calculated using ProUCL software, Version 5.0):

95% KM (t) UCL = UCL based upon Kaplan-Meier Estimates for non-detects using Student's t-Distribution Critical Value

95% KM (BCA) UCL = 95% UCL based on the Bias-corrected accelerated (BCA) Bootstrap method

95% Adjusted Gamma KM-UCL = adjusted gamma UCL based upon Kaplan-Meier Estimates for non-detects using chi-square

95% KM (Percentile Bootstrap) UCL = 95% UCL based upon Kaplan-Meier Estimates using the Percentile Bootstrap Method.

99% KM (Chebyshev) UCL = 99% UCL based upon Kaplan-Meier Estimates for non-detects using the Chebyshev Inequality

(4) ProUCL recommended value is used as the EPC value. In the event of more than one recommended EPC value, the higher EPC value is used.

TABLE F.3

SUMMARY OF RESIDENT RISK FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

CHEMICAL-SPECIFIC PROPERTIES AND TOXICITY DATA

<i>Chemical</i>	<i>Mutagen ?</i>	<i>VOC?</i>	<i>Chronic RfD (mg/kg-day)</i>	<i>RfD Reference</i>	<i>Chronic RfC (mg/m³)</i>	<i>RfC Reference</i>	<i>Ingestion SF (mg/kg-day)⁻¹</i>	<i>SFO Reference</i>	<i>Inhalation Unit Risk (ug/m³)⁻¹</i>	<i>IUR Reference</i>	<i>RAGSe GIABS (unitless)</i>	<i>Kp (cm/hour)</i>	<i>FA</i>	<i>In EPD?</i>
Benzene	No	Yes	4.00E-03	IRIS	3.00E-02	IRIS	5.50E-02	IRIS	7.80E-06	IRIS	1	0.0149	1	Yes
Chloroform (Trichloromethane)	No	Yes	1.00E-02	IRIS	9.77E-02	ATSDR F	3.10E-02	CALEPA	2.30E-05	IRIS	1	0.00683	1	Yes
Ethylbenzene	No	Yes	1.00E-01	IRIS	1.00E+00	IRIS	1.10E-02	CALEPA	2.50E-06	CALEPA	1	0.0493	1	Yes
Isopropyl benzene	No	Yes	1.00E-01	IRIS	4.00E-01	IRIS	-		-		1	0.0897	1	Yes
Methyl tert butyl ether (MTBE)	No	Yes	-		3.00E+00	IRIS	1.80E-03	CALEPA	2.60E-07	CALEPA	1	0.00211	1	Yes
Methylnaphthalene, 2-	No	Yes	4.00E-03	IRIS	-		-		-		1	0.0917	1	Yes
Naphthalene	No	Yes	2.00E-02	IRIS	3.00E-03	IRIS	-		3.40E-05	CALEPA	1	0.0466	1	Yes
Toluene	No	Yes	8.00E-02	IRIS	5.00E+00	IRIS	-		-		1	0.0311	1	Yes
Trimethylbenzene, 1,2,4-	No	Yes	5.00E-02	PPRTV A	7.00E-03	PPRTV C	-		-		1	0.0857	1	Yes
Xylenes (total)	No	Yes	2.00E-01	IRIS	1.00E-01	IRIS	-		-		1	0.05	1	Yes

SUMMARY OF CHRONIC DAILY INTAKES (CDI)

<i>Chemical</i>		<i>Concentration (mg/L)</i>	<i>Original Concentration (ug/L)</i>	<i>Child Ingestion Noncarcinogenic CDI</i>	<i>Child Inhalation Noncarcinogenic CDI</i>	<i>Child Dermal Noncarcinogenic CDI</i>	<i>Adult Ingestion Noncarcinogenic CDI</i>	<i>Adult Inhalation Noncarcinogenic CDI</i>	<i>Adult Dermal Noncarcinogenic CDI</i>	<i>Adjusted Ingestion Noncarcinogenic CDI</i>	<i>Adjusted Inhalation Noncarcinogenic CDI</i>	<i>Adjusted Dermal Noncarcinogenic CDI</i>	<i>Ingestion Carcinogenic CDI</i>	<i>Inhalation Carcinogenic CDI</i>	<i>Dermal Carcinogenic CDI</i>
Benzene		1.32E-03	1.32E+00	6.58E-05	6.33E-04	8.74E-06	3.96E-05	6.33E-04	6.31E-06	4.56E-05	6.33E-04	6.85E-06	1.69E-05	2.35E-01	2.55E-06
Chloroform (Trichloromethane)		5.73E-04	5.73E-01	2.86E-05	2.75E-04	2.27E-06	1.72E-05	2.75E-04	1.60E-06	1.98E-05	2.75E-04	1.78E-06	7.35E-06	1.02E-01	6.61E-07
Ethylbenzene		1.44E-01	1.44E+02	7.18E-03	6.90E-02	3.78E-03	4.32E-03	6.90E-02	2.66E-03	4.98E-03	6.90E-02	2.96E-03	1.85E-03	2.56E+01	1.10E-03
Isopropyl benzene		8.49E-03	8.49E+00	4.23E-04	4.07E-03	4.44E-04	2.54E-04	4.07E-03	3.13E-04	2.93E-04	4.07E-03	3.48E-04	1.09E-04	1.51E+00	1.29E-04
Methyl tert butyl ether (MTBE)		1.28E-03	1.28E+00	6.38E-05	6.14E-04	1.28E-06	3.84E-05	6.14E-04	9.02E-07	4.42E-05	6.14E-04	1.00E-06	1.64E-05	2.28E-01	3.73E-07
Methylnaphthalene, 2-		1.19E-02	1.19E+01	5.93E-04	5.71E-03	7.33E-04	3.57E-04	5.71E-03	5.16E-04	4.11E-04	5.71E-03	5.75E-04	1.53E-04	2.12E+00	2.13E-04
Naphthalene		3.63E-02	3.63E+01	1.81E-03	1.74E-02	1.04E-03	1.09E-03	1.74E-02	7.31E-04	1.25E-03	1.74E-02	8.14E-04	4.66E-04	6.46E+00	3.02E-04
Toluene		1.37E-01	1.37E+02	6.83E-03	6.57E-02	2.07E-03	4.11E-03	6.57E-02	1.46E-03	4.73E-03	6.57E-02	1.63E-03	1.76E-03	2.44E+01	6.04E-04
Trimethylbenzene, 1,2,4-		1.75E-01	1.75E+02	8.73E-03	8.39E-02	8.74E-03	5.24E-03	8.39E-02	6.16E-03	6.05E-03	8.39E-02	6.85E-03	2.25E-03	3.12E+01	2.55E-03
Xylenes (total)		2.82E-01	2.82E+02	1.41E-02	1.35E-01	7.51E-03	8.45E-03	1.35E-01	5.29E-03	9.75E-03	1.35E-01	5.89E-03	3.62E-03	5.02E+01	2.19E-03

SUMMARY OF CALCULATED RISKS AND HAZARDS

<i>Chemical</i>		<i>Child Ingestion HQ</i>	<i>Child Inhalation HQ</i>	<i>Child Dermal HQ</i>	<i>Child Total HI</i>	<i>Adult Ingestion HQ</i>	<i>Adult Inhalation HQ</i>	<i>Adult Dermal HQ</i>	<i>Adult Total HI</i>	<i>Adjusted Ingestion HQ</i>	<i>Adjusted Inhalation HQ</i>	<i>Adjusted Dermal HQ</i>	<i>Adjusted Total HI</i>	<i>Ingestion Risk</i>	<i>Inhalation Risk</i>	<i>Dermal Risk</i>	<i>Total Risk</i>
Benzene		1.65E-02	2.11E-02	2.18E-03	3.97E-02	9.89E-03	2.11E-02	1.58E-03	3.26E-02	1.14E-02	2.11E-02	1.71E-03	3.42E-02	9.32E-07	1.83E-06	1.40E-07	2.91E-06
Chloroform (Trichloromethane)		2.86E-03	2.81E-03	2.27E-04	5.90E-03	1.72E-03	2.81E-03	1.60E-04	4.69E-03	1.98E-03	2.81E-03	1.78E-04	4.97E-03	2.28E-07	2.35E-06	2.05E-08	2.60E-06
Ethylbenzene		7.18E-02	6.90E-02	3.78E-02	1.79E-01	4.32E-02	6.90E-02	2.66E-02	1.39E-01	4.98E-02	6.90E-02	2.96E-02	1.48E-01	2.03E-05	6.41E-05	1.21E-05	9.66E-05
Isopropyl benzene		4.23E-03	1.02E-02	4.44E-03	1.88E-02	2.54E-03	1.02E-02	3.13E-03	1.58E-02	2.93E-03	1.02E-02	3.48E-03	1.66E-02	-	-	-	-
Methyl tert butyl ether (MTBE)		-	2.05E-04	-	2.05E-04	-	2.05E-04	-	2.05E-04	-	2.05E-04	-	2.05E-04	2.96E-08	5.93E-08	6.71E-10	8.95E-08
Methylnaphthalene, 2-		1.48E-01	-	1.83E-01	3.32E-01	8.91E-02	-	1.29E-01	2.18E-01	1.03E-01	-	1.44E-01	2.46E-01	-	-	-	-
Naphthalene		9.05E-02	5.80E+00	5.19E-02	5.94E+00	5.44E-02	5.80E+00	3.66E-02	5.89E+00	6.27E-02	5.80E+00	4.07E-02	5.90E+00	-	2.20E-04	-	2.20E-04
Toluene		8.54E-02	1.31E-02	2.59E-02	1.24E-01	5.13E-02	1.31E-02	1.83E-02	8.27E-02	5.92E-02	1.31E-02	2.03E-02	9.26E-02	-	-	-	-
Trimethylbenzene, 1,2,4-		1.75E-01	1.20E+01	1.75E-01	1.23E+01	1.05E-01	1.20E+01	1.23E-01	1.22E+01	1.21E-01	1.20E+01	1.37E-01	1.22E+01	-	-	-	-
Xylenes (total)		7.03E-02	1.35E+00	3.75E-02	1.46E+00	4.23E-02	1.35E+00	2.64E-02	1.42E+00	4.87E-02	1.35E+00	2.94E-02	1.43E+00	-	-	-	-
*Total Risk/HI		6.64E-01	1.93E+01	5.18E-01	2.04E+01	3.99E-01	1.93E+01	3.65E-01	2.00E+01	4.60E-01	1.93E+01	4.06E-01	2.01E+01	2.15E-05	2.88E-04	1.23E-05	3.22E-04

Appendix F

List of Tables

Table F.1	Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
Table F.2	Exposure Point Concentration (EPC) Summary for Chemicals of Potential Concern in Groundwater
Table F.3	Summary of Resident Risk for Groundwater

Appendix G

ProUCL Output Sheets

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Benzo(a)pyrene

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	4
		Number of Missing Observations	3
Number of Detects	2	Number of Non-Detects	4
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.012	Minimum Non-Detect	0.036
Maximum Detect	0.43	Maximum Non-Detect	0.0405
Variance Detects	0.0874	Percent Non-Detects	66.67%
Mean Detects	0.221	SD Detects	0.296
Median Detects	0.221	CV Detects	1.337
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-2.633	SD of Logged Detects	2.531

Warning: Data set has only 2 Detected Values.

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

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

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

Mean	0.0817	Standard Error of Mean	0.0899
SD	0.156	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.263	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.23	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.351	95% KM Chebyshev UCL	0.474
97.5% KM Chebyshev UCL	0.643	99% KM Chebyshev UCL	0.977

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.556	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.397	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2.224	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.275	nu hat (KM)	3.298
		Adjusted Level of Significance (β)	0.0122
Approximate Chi Square Value (3.30, α)	0.466	Adjusted Chi Square Value (3.30, β)	0.212
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.578	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.269

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Benzo(a)pyrene (cont.'d)**Lognormal GOF Test on Detected Observations Only****Not Enough Data to Perform GOF Test****Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.0847	Mean in Log Scale	-3.854
SD in Original Scale	0.17	SD in Log Scale	1.679
95% t UCL (assumes normality of ROS data)	0.224	95% Percentile Bootstrap UCL	0.221
95% BCA Bootstrap UCL	0.229	95% Bootstrap t UCL	2.88
95% H-UCL (Log ROS)	11.71		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.086
SD in Original Scale	0.169
95% t UCL (Assumes normality)	0.225

DL/2 Log-Transformed

Mean in Log Scale	-3.536
SD in Log Scale	1.331
95% H-Stat UCL	1.634

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Data do not follow a Discernible Distribution at 5% Significance Level****Suggested UCL to Use**99% KM (Chebyshev) UCL 0.977**Warning: Recommended UCL exceeds the maximum observation**

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

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

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

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

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Antimony

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	5
Number of Detects	1	Number of Missing Observations	2
Number of Distinct Detects	1	Number of Non-Detects	6
		Number of Distinct Non-Detects	4

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!

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Arsenic

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Number of Detects	6	Number of Non-Detects	1
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	1.35	Minimum Non-Detect	0.99
Maximum Detect	4.3	Maximum Non-Detect	0.99
Variance Detects	1.335	Percent Non-Detects	14.29%
Mean Detects	2.583	SD Detects	1.155
Median Detects	2.45	CV Detects	0.447
Skewness Detects	0.481	Kurtosis Detects	-1
Mean of Logged Detects	0.862	SD of Logged Detects	0.464

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.936	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.17	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

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

Mean	2.356	Standard Error of Mean	0.466
SD	1.124	95% KM (BCA) UCL	3.07
95% KM (t) UCL	3.26	95% KM (Percentile Bootstrap) UCL	3.064
95% KM (z) UCL	3.121	95% KM Bootstrap t UCL	3.506
90% KM Chebyshev UCL	3.752	95% KM Chebyshev UCL	4.385
97.5% KM Chebyshev UCL	5.263	99% KM Chebyshev UCL	6.988

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.263	Anderson-Darling GOF Test
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.205	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	5.898	k star (bias corrected MLE)	3.06
Theta hat (MLE)	0.438	Theta star (bias corrected MLE)	0.844
nu hat (MLE)	70.77	nu star (bias corrected)	36.72
MLE Mean (bias corrected)	2.583	MLE Sd (bias corrected)	1.477

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.39	nu hat (KM)	61.46
Approximate Chi Square Value (61.46, α)	44.43	Adjusted Chi Square Value (61.46, β)	40.09
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	3.259	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.611

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:13:37 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.23	Mean	2.247
Maximum	4.3	Median	2.3
SD	1.38	CV	0.614
k hat (MLE)	1.931	k star (bias corrected MLE)	1.199
Theta hat (MLE)	1.164	Theta star (bias corrected MLE)	1.874
nu hat (MLE)	27.04	nu star (bias corrected)	16.78
MLE Mean (bias corrected)	2.247	MLE Sd (bias corrected)	2.052
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (16.78, α)	8.518	Adjusted Chi Square Value (16.78, β)	6.817
95% Gamma Approximate UCL (use when $n \geq 50$)	4.428	95% Gamma Adjusted UCL (use when $n < 50$)	5.532

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.936
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.188
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.319	Mean in Log Scale	0.694
SD in Original Scale	1.265	SD in Log Scale	0.613
95% t UCL (assumes normality of ROS data)	3.248	95% Percentile Bootstrap UCL	3.057
95% BCA Bootstrap UCL	3.121	95% Bootstrap t UCL	3.471
95% H-UCL (Log ROS)	4.748		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.737	95% H-UCL (KM -Log)	3.891
KM SD (logged)	0.497	95% Critical H Value (KM-Log)	2.457
KM Standard Error of Mean (logged)	0.206		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	2.285
SD in Original Scale	1.317
95% t UCL (Assumes normality)	3.252

DL/2 Log-Transformed

Mean in Log Scale	0.638
SD in Log Scale	0.727
95% H-Stat UCL	5.959

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 3.26

95% KM (Percentile Bootstrap) UCL 3.064

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

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

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

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

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt**General Statistics**

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Minimum	1.4	Mean	4.343
Maximum	6.8	Median	4.4
SD	1.939	Std. Error of Mean	0.733
Coefficient of Variation	0.446	Skewness	-0.323

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.963
5% Shapiro Wilk Critical Value	0.803
Lilliefors Test Statistic	0.187
5% Lilliefors Critical Value	0.335

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution**95% Normal UCL**

95% Student's-t UCL **5.767**

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	5.453
95% Modified-t UCL (Johnson-1978)	5.752

Gamma GOF Test

A-D Test Statistic	0.294
5% A-D Critical Value	0.71
K-S Test Statistic	0.206
5% K-S Critical Value	0.313

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.574	k star (bias corrected MLE)	2.709
Theta hat (MLE)	0.949	Theta star (bias corrected MLE)	1.603
nu hat (MLE)	64.04	nu star (bias corrected)	37.93
MLE Mean (bias corrected)	4.343	MLE Sd (bias corrected)	2.638
		Approximate Chi Square Value (0.05)	24.83
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	21.68

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.635	95% Adjusted Gamma UCL (use when n<50)	7.597

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.906
5% Shapiro Wilk Critical Value	0.803
Lilliefors Test Statistic	0.184
5% Lilliefors Critical Value	0.335

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.336	Mean of logged Data	1.355
Maximum of Logged Data	1.917	SD of logged Data	0.557

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt (cont.'d)**Assuming Lognormal Distribution**

95% H-UCL	8.137	90% Chebyshev (MVUE) UCL	7.224
95% Chebyshev (MVUE) UCL	8.494	97.5% Chebyshev (MVUE) UCL	10.26
99% Chebyshev (MVUE) UCL	13.72		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5.548	95% Jackknife UCL	5.767
95% Standard Bootstrap UCL	5.432	95% Bootstrap-t UCL	5.699
95% Hall's Bootstrap UCL	5.352	95% Percentile Bootstrap UCL	5.457
95% BCA Bootstrap UCL	5.414		
90% Chebyshev(Mean, Sd) UCL	6.541	95% Chebyshev(Mean, Sd) UCL	7.537
97.5% Chebyshev(Mean, Sd) UCL	8.92	99% Chebyshev(Mean, Sd) UCL	11.63

Suggested UCL to Use

95% Student's-t UCL 5.767

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:13:37 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Minimum	4.2	Mean	76.64
Maximum	467	Median	8.6
SD	172.3	Std. Error of Mean	65.11
Coefficient of Variation	2.248	Skewness	2.636

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.489		
5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.479		
5% Lilliefors Critical Value	0.335	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL			
95% Student's-t UCL	203.2	95% Adjusted-CLT UCL (Chen-1995)	253.1
		95% Modified-t UCL (Johnson-1978)	214

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.248		
5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.403		
5% K-S Critical Value	0.33	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics		Anderson-Darling Gamma GOF Test	
k hat (MLE)	0.429		
Theta hat (MLE)	178.8		
nu hat (MLE)	6.001		
MLE Mean (bias corrected)	76.64		
Adjusted Level of Significance	0.0158		
		k star (bias corrected MLE)	0.34
		Theta star (bias corrected MLE)	225.3
		nu star (bias corrected)	4.763
		MLE Sd (bias corrected)	131.4
		Approximate Chi Square Value (0.05)	1.044
		Adjusted Chi Square Value	0.615

Assuming Gamma Distribution		95% Adjusted Gamma UCL (use when n<50)	
95% Approximate Gamma UCL (use when n>=50))	349.6		

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.786		
5% Shapiro Wilk Critical Value	0.803	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.274		
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Lead (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	1.435	Mean of logged Data	2.821
Maximum of Logged Data	6.146	SD of logged Data	1.584

Assuming Lognormal Distribution			
95% H-UCL	1993	90% Chebyshev (MVUE) UCL	120.4
95% Chebyshev (MVUE) UCL	155.1	97.5% Chebyshev (MVUE) UCL	203.1
99% Chebyshev (MVUE) UCL	297.6		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	183.7	95% Jackknife UCL	203.2
95% Standard Bootstrap UCL	174.6	95% Bootstrap-t UCL	2478
95% Hall's Bootstrap UCL	1967	95% Percentile Bootstrap UCL	205.7
95% BCA Bootstrap UCL	210.6		
90% Chebyshev(Mean, Sd) UCL	272	95% Chebyshev(Mean, Sd) UCL	360.5
97.5% Chebyshev(Mean, Sd) UCL	483.3	99% Chebyshev(Mean, Sd) UCL	724.5

Suggested UCL to Use
 95% Hall's Bootstrap UCL 1967

Recommended UCL exceeds the maximum observation

In Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Manganese

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Minimum	74	Mean	144.1
Maximum	202	Median	141.6
SD	38.16	Std. Error of Mean	14.42
Coefficient of Variation	0.265	Skewness	-0.591

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.885		
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.315		
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL			
95% Student's-t UCL	172.1	95% Adjusted-CLT UCL (Chen-1995)	164.4
		95% Modified-t UCL (Johnson-1978)	171.6

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.684		
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.35		
5% K-S Critical Value	0.312	Data Not Gamma Distributed at 5% Significance Level	

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

Gamma Statistics			
k hat (MLE)	13.92	k star (bias corrected MLE)	8.05
Theta hat (MLE)	10.35	Theta star (bias corrected MLE)	17.9
nu hat (MLE)	194.9	nu star (bias corrected)	112.7
MLE Mean (bias corrected)	144.1	MLE Sd (bias corrected)	50.78
		Approximate Chi Square Value (0.05)	89.19
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	82.88

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	182.1	95% Adjusted Gamma UCL (use when n<50)	195.9

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:13:37 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese (cont.'d)

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.812	Data appear Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.803	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.367	Data Not Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.335		
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.304	Mean of logged Data	4.934
Maximum of Logged Data	5.308	SD of logged Data	0.308
Assuming Lognormal Distribution			
95% H-UCL	192.7	90% Chebyshev (MVUE) UCL	195.3
95% Chebyshev (MVUE) UCL	218.2	97.5% Chebyshev (MVUE) UCL	250.1
99% Chebyshev (MVUE) UCL	312.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	167.8	95% Jackknife UCL	172.1
95% Standard Bootstrap UCL	166.1	95% Bootstrap-t UCL	169.3
95% Hall's Bootstrap UCL	169	95% Percentile Bootstrap UCL	165.5
95% BCA Bootstrap UCL	162.5		
90% Chebyshev(Mean, Sd) UCL	187.3	95% Chebyshev(Mean, Sd) UCL	206.9
97.5% Chebyshev(Mean, Sd) UCL	234.2	99% Chebyshev(Mean, Sd) UCL	287.6
Suggested UCL to Use			
95% Student's-t UCL	172.1		

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

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Mercury

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Number of Detects	2	Number of Non-Detects	5
Number of Distinct Detects	2	Number of Distinct Non-Detects	5
Minimum Detect	0.057	Minimum Non-Detect	0.032
Maximum Detect	0.071	Maximum Non-Detect	0.038
Variance Detects	9.8000E-5	Percent Non-Detects	71.43%
Mean Detects	0.064	SD Detects	0.0099
Median Detects	0.064	CV Detects	0.155
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-2.755	SD of Logged Detects	0.155

Warning: Data set has only 2 Detected Values.

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

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

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

Mean	0.0411	Standard Error of Mean	0.00798
SD	0.0149	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0567	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0543	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0651	95% KM Chebyshev UCL	0.0759
97.5% KM Chebyshev UCL	0.091	99% KM Chebyshev UCL	0.121

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	83.26	k star (bias corrected MLE)	N/A
Theta hat (MLE)	7.6870E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	333	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	7.591	nu hat (KM)	106.3
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (106.28, α)	83.49	Adjusted Chi Square Value (106.28, β)	77.4
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0524	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0565

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Mercury (cont.'d)**Lognormal GOF Test on Detected Observations Only****Not Enough Data to Perform GOF Test****Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.04	Mean in Log Scale	-3.283
SD in Original Scale	0.0169	SD in Log Scale	0.367
95% t UCL (assumes normality of ROS data)	0.0524	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.0564		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.031
SD in Original Scale	0.0229
95% t UCL (Assumes normality)	0.0478

DL/2 Log-Transformed

Mean in Log Scale	-3.668
SD in Log Scale	0.629
95% H-Stat UCL	0.0629

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Data do not follow a Discernible Distribution at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL 0.0567

95% KM (% Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Nickel

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	2
Minimum	2.3	Mean	7.564
Maximum	11.95	Median	6.8
SD	3.297	Std. Error of Mean	1.246
Coefficient of Variation	0.436	Skewness	-0.288

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.961		
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.189		
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL			
95% Student's-t UCL	9.986	95% Adjusted-CLT UCL (Chen-1995)	9.469
		95% Modified-t UCL (Johnson-1978)	9.963

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.341		
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.206		
5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Anderson-Darling Gamma GOF Test	
k hat (MLE)	4.704		
Theta hat (MLE)	1.608		
nu hat (MLE)	65.86		
MLE Mean (bias corrected)	7.564		
Adjusted Level of Significance	0.0158		

Assuming Gamma Distribution		95% UCLs (Adjusted for Skewness)	
95% Approximate Gamma UCL (use when n>=50))	11.48	95% Adjusted Gamma UCL (use when n<50)	13.12

TABLE G.1

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:13:37 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Nickel (cont.'d)

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.882	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.833	Mean of logged Data	1.913
Maximum of Logged Data	2.481	SD of logged Data	0.555
Assuming Lognormal Distribution			
95% H-UCL	14.16	90% Chebyshev (MVUE) UCL	12.59
95% Chebyshev (MVUE) UCL	14.8	97.5% Chebyshev (MVUE) UCL	17.87
99% Chebyshev (MVUE) UCL	23.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.614	95% Jackknife UCL	9.986
95% Standard Bootstrap UCL	9.463	95% Bootstrap-t UCL	9.802
95% Hall's Bootstrap UCL	9.599	95% Percentile Bootstrap UCL	9.443
95% BCA Bootstrap UCL	9.279		
90% Chebyshev(Mean, Sd) UCL	11.3	95% Chebyshev(Mean, Sd) UCL	13
7.5% Chebyshev(Mean, Sd) UCL	15.35	99% Chebyshev(Mean, Sd) UCL	19.96
Suggested UCL to Use			
95% Student's-t UCL	9.986		

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

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	7
		Number of Missing Observations	4
Number of Detects	3	Number of Non-Detects	6
Number of Distinct Detects	3	Number of Distinct Non-Detects	4
Minimum Detect	0.012	Minimum Non-Detect	0.036
Maximum Detect	0.43	Maximum Non-Detect	0.0405
Variance Detects	0.0565	Percent Non-Detects	66.67%
Mean Detects	0.156	SD Detects	0.238
Median Detects	0.025	CV Detects	1.527
Skewness Detects	1.726	Kurtosis Detects	N/A
Mean of Logged Detects	-2.985	SD of Logged Detects	1.89

Warning: Data set has only 3 Detected Values.

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

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.773	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.375	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

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

Mean	0.0642	Standard Error of Mean	0.053
SD	0.129	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.163	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.151	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.223	95% KM Chebyshev UCL	0.295
97.5% KM Chebyshev UCL	0.395	99% KM Chebyshev UCL	0.592

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.555	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.28	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3.333	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.246	nu hat (KM)	4.429
Approximate Chi Square Value (4.43, α)	0.898	Adjusted Level of Significance (β)	0.0231
		Adjusted Chi Square Value (4.43, β)	0.615

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options			
Date/Time of Computation	12/8/2014 10:46:35 AM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.317	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.463

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene (cont.'d)**Lognormal GOF Test on Detected Observations Only**

Shapiro Wilk Test Statistic	0.896	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.312	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.0666	Mean in Log Scale	-3.653
SD in Original Scale	0.137	SD in Log Scale	1.188
95% t UCL (assumes normality of ROS data)	0.151	95% Percentile Bootstrap UCL	0.155
95% BCA Bootstrap UCL	0.204	95% Bootstrap t UCL	1.335
95% H-UCL (Log ROS)	0.245		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.699	95% H-UCL (KM -Log)	0.157
KM SD (logged)	1.067	95% Critical H Value (KM-Log)	3.39
KM Standard Error of Mean (logged)	0.5		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.0644
SD in Original Scale	0.137
95% t UCL (Assumes normality)	0.149

DL/2 Log-Transformed

Mean in Log Scale	-3.645
SD in Log Scale	1.068
95% H-Stat UCL	0.166

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**

95% KM (t) UCL	0.163	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:46:35 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Antimony

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	5
		Number of Missing Observations	2
Number of Detects	1	Number of Non-Detects	10
Number of Distinct Detects	1	Number of Distinct Non-Detects	4

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!

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic**General Statistics**

Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	2
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	8	Number of Distinct Non-Detects	2
Minimum Detect	1.35	Minimum Non-Detect	0.99
Maximum Detect	4.3	Maximum Non-Detect	1.1
Variance Detects	0.918	Percent Non-Detects	18.18%
Mean Detects	2.578	SD Detects	0.958
Median Detects	2.6	CV Detects	0.372
Skewness Detects	0.428	Kurtosis Detects	-0.229
Mean of Logged Detects	0.883	SD of Logged Detects	0.388

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.961
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.146
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	2.289	Standard Error of Mean	0.327
SD	1.021	95% KM (BCA) UCL	2.868
95% KM (t) UCL	2.881	95% KM (Percentile Bootstrap) UCL	2.813
95% KM (z) UCL	2.826	95% KM Bootstrap t UCL	2.924
90% KM Chebyshev UCL	3.269	95% KM Chebyshev UCL	3.712
97.5% KM Chebyshev UCL	4.328	99% KM Chebyshev UCL	5.538

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.204
5% A-D Critical Value	0.722
K-S Test Statistic	0.134
5% K-S Critical Value	0.28

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	7.927	k star (bias corrected MLE)	5.359
Theta hat (MLE)	0.325	Theta star (bias corrected MLE)	0.481
nu hat (MLE)	142.7	nu star (bias corrected)	96.46
MLE Mean (bias corrected)	2.578	MLE Sd (bias corrected)	1.114

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.027	nu hat (KM)	110.6
Approximate Chi Square Value (110.59, α)	87.32	Adjusted Chi Square Value (110.59, β)	83.95
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	2.899	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.015

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.653	Mean	2.228
Maximum	4.3	Median	2.3
SD	1.158	CV	0.52
k hat (MLE)	3.354	k star (bias corrected MLE)	2.5
Theta hat (MLE)	0.664	Theta star (bias corrected MLE)	0.891
nu hat (MLE)	73.78	nu star (bias corrected)	54.99
MLE Mean (bias corrected)	2.228	MLE Sd (bias corrected)	1.409
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (54.99, α)	38.95	Adjusted Chi Square Value (54.99, β)	36.76
95% Gamma Approximate UCL (use when $n \geq 50$)	3.145	95% Gamma Adjusted UCL (use when $n < 50$)	3.333

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.13	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.283	Mean in Log Scale	0.714
SD in Original Scale	1.079	SD in Log Scale	0.511
95% t UCL (assumes normality of ROS data)	2.873	95% Percentile Bootstrap UCL	2.81
95% BCA Bootstrap UCL	2.8	95% Bootstrap t UCL	2.92
95% H-UCL (Log ROS)	3.313		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.72	95% H-UCL (KM -Log)	3.184
KM SD (logged)	0.477	95% Critical H Value (KM-Log)	2.147
KM Standard Error of Mean (logged)	0.153		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.204	Mean in Log Scale	0.604
SD in Original Scale	1.194	SD in Log Scale	0.711
95% t UCL (Assumes normality)	2.857	95% H-Stat UCL	4.115

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.881	95% KM (Percentile Bootstrap) UCL	2.813

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

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

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options	
Date/Time of Computation	12/8/2014 10:46:35 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cobalt

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	2
Minimum	1.3	Mean	4.173
Maximum	6.8	Median	4.4
SD	1.903	Std. Error of Mean	0.574
Coefficient of Variation	0.456	Skewness	-0.277
Normal GOF Test			
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.153	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.212	95% Adjusted-CLT UCL (Chen-1995)	5.065
		95% Modified-t UCL (Johnson-1978)	5.205
Gamma GOF Test			
A-D Test Statistic	0.45	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.159	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.256	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.076	k star (bias corrected MLE)	3.025
Theta hat (MLE)	1.024	Theta star (bias corrected MLE)	1.38
nu hat (MLE)	89.66	nu star (bias corrected)	66.54
MLE Mean (bias corrected)	4.173	MLE Sd (bias corrected)	2.399
		Approximate Chi Square Value (0.05)	48.77
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	46.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.693	95% Adjusted Gamma UCL (use when n<50)	5.997
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:46:35 AM
 From File Worksheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	0.262	Mean of logged Data	1.301
Maximum of Logged Data	1.917	SD of logged Data	0.576

Assuming Lognormal Distribution			
95% H-UCL	6.567	90% Chebyshev (MVUE) UCL	6.543
95% Chebyshev (MVUE) UCL	7.576	97.5% Chebyshev (MVUE) UCL	9.01
99% Chebyshev (MVUE) UCL	11.83		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	5.116	95% Jackknife UCL	5.212
95% Standard Bootstrap UCL	5.085	95% Bootstrap-t UCL	5.144
95% Hall's Bootstrap UCL	5.019	95% Percentile Bootstrap UCL	5.109
95% BCA Bootstrap UCL	5.055		
90% Chebyshev(Mean, Sd) UCL	5.894	95% Chebyshev(Mean, Sd) UCL	6.673
97.5% Chebyshev(Mean, Sd) UCL	7.755	99% Chebyshev(Mean, Sd) UCL	9.881

Suggested UCL to Use
 95% Student's-t UCL 5.212

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

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	2
Minimum	4.2	Mean	62.6
Maximum	467	Median	8.6
SD	138.5	Std. Error of Mean	41.76
Coefficient of Variation	2.212	Skewness	2.993
Normal GOF Test			
Shapiro Wilk Test Statistic	0.485	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.43	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	138.3	95% Adjusted-CLT UCL (Chen-1995)	171.6
		95% Modified-t UCL (Johnson-1978)	144.6
Gamma GOF Test			
A-D Test Statistic	1.503	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.785	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.35	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.27	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.478	k star (bias corrected MLE)	0.409
Theta hat (MLE)	130.8	Theta star (bias corrected MLE)	153.2
nu hat (MLE)	10.53	nu star (bias corrected)	8.988
MLE Mean (bias corrected)	62.6	MLE Sd (bias corrected)	97.94
		Approximate Chi Square Value (0.05)	3.32
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	2.783
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	169.5	95% Adjusted Gamma UCL (use when n<50)	202.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.827	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.435	Mean of logged Data	2.8
Maximum of Logged Data	6.146	SD of logged Data	1.472

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead (cont.'d)

Assuming Lognormal Distribution

95% H-UCL	308.7	90% Chebyshev (MVUE) UCL	100.1
95% Chebyshev (MVUE) UCL	126.8	97.5% Chebyshev (MVUE) UCL	163.8
99% Chebyshev (MVUE) UCL	236.6		

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

95% CLT UCL	131.3	95% Jackknife UCL	138.3
95% Standard Bootstrap UCL	128.5	95% Bootstrap-t UCL	1193
95% Hall's Bootstrap UCL	593.7	95% Percentile Bootstrap UCL	143.9
95% BCA Bootstrap UCL	185.1		
90% Chebyshev(Mean, Sd) UCL	187.9	95% Chebyshev(Mean, Sd) UCL	244.6
97.5% Chebyshev(Mean, Sd) UCL	323.4	99% Chebyshev(Mean, Sd) UCL	478.1

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 244.6

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese**General Statistics**

Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	2
Minimum	20	Mean	122.8
Maximum	202	Median	141
SD	51.09	Std. Error of Mean	15.41
Coefficient of Variation	0.416	Skewness	-0.692

Normal GOF Test

Shapiro Wilk Test Statistic 0.923
5% Shapiro Wilk Critical Value 0.85
Lilliefors Test Statistic 0.268
5% Lilliefors Critical Value 0.267

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level**Assuming Normal Distribution****95% Normal UCL**

95% Student's-t UCL 150.7

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 144.7
95% Modified-t UCL (Johnson-1978) 150.2

Gamma GOF Test

A-D Test Statistic 0.88
5% A-D Critical Value 0.733
K-S Test Statistic 0.303
5% K-S Critical Value 0.257

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics**

k hat (MLE)	3.851	k star (bias corrected MLE)	2.862
Theta hat (MLE)	31.89	Theta star (bias corrected MLE)	42.92
nu hat (MLE)	84.73	nu star (bias corrected)	62.96
MLE Mean (bias corrected)	122.8	MLE Sd (bias corrected)	72.61
		Approximate Chi Square Value (0.05)	45.7
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	43.32

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)) 169.2

95% Adjusted Gamma UCL (use when n<50) 178.5

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.764
5% Shapiro Wilk Critical Value 0.85
Lilliefors Test Statistic 0.297
5% Lilliefors Critical Value 0.267

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese (cont.'d)**Lognormal Statistics**

Minimum of Logged Data	2.996	Mean of logged Data	4.675
Maximum of Logged Data	5.308	SD of logged Data	0.644

Assuming Lognormal Distribution

95% H-UCL	214.4	90% Chebyshev (MVUE) UCL	206.9
95% Chebyshev (MVUE) UCL	242.1	97.5% Chebyshev (MVUE) UCL	290.9
99% Chebyshev (MVUE) UCL	386.9		

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

95% CLT UCL	148.2	95% Jackknife UCL	150.7
95% Standard Bootstrap UCL	146.8	95% Bootstrap-t UCL	147.9
95% Hall's Bootstrap UCL	144.9	95% Percentile Bootstrap UCL	147.4
95% BCA Bootstrap UCL	145.5		
90% Chebyshev(Mean, Sd) UCL	169	95% Chebyshev(Mean, Sd) UCL	190
97.5% Chebyshev(Mean, Sd) UCL	219	99% Chebyshev(Mean, Sd) UCL	276.1

Suggested UCL to Use95% Student's-t UCL 150.7

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

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Mercury

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	8
		Number of Missing Observations	2
Number of Detects	3	Number of Non-Detects	8
Number of Distinct Detects	3	Number of Distinct Non-Detects	5
Minimum Detect	0.039	Minimum Non-Detect	0.032
Maximum Detect	0.071	Maximum Non-Detect	0.038
Variance Detects	2.5733E-4	Percent Non-Detects	72.73%
Mean Detects	0.0557	SD Detects	0.016
Median Detects	0.057	CV Detects	0.288
Skewness Detects	-0.371	Kurtosis Detects	N/A
Mean of Logged Detects	-2.918	SD of Logged Detects	0.303

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.995	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.2	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

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

Mean	0.0385	Standard Error of Mean	0.00464
SD	0.0126	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0469	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0461	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0524	95% KM Chebyshev UCL	0.0587
97.5% KM Chebyshev UCL	0.0674	99% KM Chebyshev UCL	0.0846

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	17.05	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00327	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	102.3	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	9.366	nu hat (KM)	206.1
Approximate Chi Square Value (206.05, α)	173.8	Adjusted Level of Significance (β)	0.0278
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0456	Adjusted Chi Square Value (206.05, β)	169
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0469

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Mercury (cont.'d)**Lognormal GOF Test on Detected Observations Only**

Shapiro Wilk Test Statistic	0.977	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.236	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.0261	Mean in Log Scale	-3.878
SD in Original Scale	0.0206	SD in Log Scale	0.675
95% t UCL (assumes normality of ROS data)	0.0373	95% Percentile Bootstrap UCL	0.0367
95% BCA Bootstrap UCL	0.0388	95% Bootstrap t UCL	0.0488
95% H-UCL (Log ROS)	0.0436		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.299	95% H-UCL (KM -Log)	0.045
KM SD (logged)	0.267	95% Critical H Value (KM-Log)	1.918
KM Standard Error of Mean (logged)	0.0985		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.0283
SD in Original Scale	0.019
95% t UCL (Assumes normality)	0.0387

DL/2 Log-Transformed

Mean in Log Scale	-3.715
SD in Log Scale	0.532
95% H-Stat UCL	0.0407

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL 0.0469

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 10:46:35 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Nickel

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	2
Minimum	2.3	Mean	9.532
Maximum	31.8	Median	7.1
SD	7.948	Std. Error of Mean	2.396
Coefficient of Variation	0.834	Skewness	2.511
Normal GOF Test			
Shapiro Wilk Test Statistic	0.705	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.29	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13.88	95% Adjusted-CLT UCL (Chen-1995)	15.41
		95% Modified-t UCL (Johnson-1978)	14.18
Gamma GOF Test			
A-D Test Statistic	0.489	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.197	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.351	k star (bias corrected MLE)	1.771
Theta hat (MLE)	4.054	Theta star (bias corrected MLE)	5.383
nu hat (MLE)	51.73	nu star (bias corrected)	38.96
MLE Mean (bias corrected)	9.532	MLE Sd (bias corrected)	7.163
		Approximate Chi Square Value (0.05)	25.66
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	23.91
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	14.47	95% Adjusted Gamma UCL (use when n<50)	15.53
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.952	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.163	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.2

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU3
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 10:46:35 AM
 From File Worksheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Nickel (cont.'d)

Lognormal Statistics

Minimum of Logged Data	0.833	Mean of logged Data	2.027
Maximum of Logged Data	3.459	SD of logged Data	0.685

Assuming Lognormal Distribution

95% H-UCL	16.3	90% Chebyshev (MVUE) UCL	15.37
95% Chebyshev (MVUE) UCL	18.09	97.5% Chebyshev (MVUE) UCL	21.87
99% Chebyshev (MVUE) UCL	29.29		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	13.47	95% Jackknife UCL	13.88
95% Standard Bootstrap UCL	13.25	95% Bootstrap-t UCL	18.98
95% Hall's Bootstrap UCL	30.83	95% Percentile Bootstrap UCL	13.72
95% BCA Bootstrap UCL	15.94		
90% Chebyshev(Mean, Sd) UCL	16.72	95% Chebyshev(Mean, Sd) UCL	19.98
97.5% Chebyshev(Mean, Sd) UCL	24.5	99% Chebyshev(Mean, Sd) UCL	33.38

Suggested UCL to Use

95% Adjusted Gamma UCL 15.53

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

TABLE G.3

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 12:45:16 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt

General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	3.2	Mean	3.45
Maximum	3.7	Median	3.45

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Cobalt was not processed!

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

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

Manganese

General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	0
Minimum	124	Mean	159.5
Maximum	195	Median	159.5

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Manganese was not processed!

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

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

TABLE G.4

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 12:46:19 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Methylnaphthalene

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.15	Minimum Non-Detect	0.35
Maximum Detect	1.7	Maximum Non-Detect	0.36
Variance Detects	1.201	Percent Non-Detects	60%
Mean Detects	0.925	SD Detects	1.096
Median Detects	0.925	CV Detects	1.185
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.683	SD of Logged Detects	1.717

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

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

Mean	0.46	Standard Error of Mean	0.392
SD	0.62	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.296	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.105	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.636	95% KM Chebyshev UCL	2.169
97.5% KM Chebyshev UCL	2.909	99% KM Chebyshev UCL	4.362

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

Gamma Statistics on Detected Data Only

k hat (MLE)	0.958	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.965	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3.834	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.55	nu hat (KM)	5.505
Approximate Chi Square Value (5.50, α)	1.392	Adjusted Level of Significance (β)	0.0086
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.819	Adjusted Chi Square Value (5.50, β)	0.68
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.726

TABLE G.4

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 12:46:19 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

2-Methylnaphthalene (cont.'d)**Lognormal GOF Test on Detected Observations Only****Not Enough Data to Perform GOF Test****Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.468	Mean in Log Scale	-1.422
SD in Original Scale	0.692	SD in Log Scale	1.161
95% t UCL (assumes normality of ROS data)	1.127	95% Percentile Bootstrap UCL	1.067
95% BCA Bootstrap UCL	1.088	95% Bootstrap t UCL	7.017
95% H-UCL (Log ROS)	12.25		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.477
SD in Original Scale	0.684
95% t UCL (Assumes normality)	1.129

DL/2 Log-Transformed

Mean in Log Scale	-1.308
SD in Log Scale	1.031
95% H-Stat UCL	6.161

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Data do not follow a Discernible Distribution at 5% Significance Level****Suggested UCL to Use**97.5% KM (Chebyshev) UCL 2.909**Warning: Recommended UCL exceeds the maximum observation**

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

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

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

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

TABLE G.4

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU4
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 12:46:19 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt

General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	3
Minimum	3.2	Mean	3.45
Maximum	3.7	Median	3.45

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Cobalt was not processed!

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

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

Manganese

General Statistics			
Total Number of Observations	2	Number of Distinct Observations	2
		Number of Missing Observations	3
Minimum	124	Mean	159.5
Maximum	195	Median	159.5

Warning: This data set only has 2 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Manganese was not processed!

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

1,4-Dichlorobenzene

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	1	Number of Missing Observations	6
Number of Distinct Detects	1	Number of Non-Detects	4
		Number of Distinct Non-Detects	4

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 1,4-Dichlorobenzene was not processed!

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Ethylbenzene

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	6
Number of Detects	2	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.26	Minimum Non-Detect	0.082
Maximum Detect	22	Maximum Non-Detect	0.1
Variance Detects	236.3	Percent Non-Detects	60%
Mean Detects	11.13	SD Detects	15.37
Median Detects	11.13	CV Detects	1.381
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.872	SD of Logged Detects	3.138

Warning: Data set has only 2 Detected Values.

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

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
 Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

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

Mean	4.501	Standard Error of Mean	5.534
SD	8.75	95% KM (BCA) UCL	N/A
95% KM (t) UCL	16.3	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	13.6	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	21.1	95% KM Chebyshev UCL	28.62
97.5% KM Chebyshev UCL	39.06	99% KM Chebyshev UCL	59.56

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.424	k star (bias corrected MLE)	N/A
Theta hat (MLE)	26.25	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.696	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.265	nu hat (KM)	2.647
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (2.65, α)	0.276	Adjusted Chi Square Value (2.65, β)	0.105
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	43.18	95% Gamma Adjusted KM-UCL (use when $n < 50$)	113.5

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Ethylbenzene (cont.'d)**Lognormal GOF Test on Detected Observations Only****Not Enough Data to Perform GOF Test****Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	4.452	Mean in Log Scale	-6.722
SD in Original Scale	9.81	SD in Log Scale	7.108
95% t UCL (assumes normality of ROS data)	13.81	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	7.468E+58		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	4.479
SD in Original Scale	9.795
95% t UCL (Assumes normality)	13.82

DL/2 Log-Transformed

Mean in Log Scale	-1.516
SD in Log Scale	2.687
95% H-Stat UCL	1.657E+8

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Data do not follow a Discernible Distribution at 5% Significance Level****Suggested UCL to Use**99% KM (Chebyshev) UCL 59.56**Warning: Recommended UCL exceeds the maximum observation**

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Xylenes (total)

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	6
Number of Detects	3	Number of Non-Detects	2
Number of Distinct Detects	3	Number of Distinct Non-Detects	2
Minimum Detect	0.059	Minimum Non-Detect	0.25
Maximum Detect	100	Maximum Non-Detect	0.26
Variance Detects	3269	Percent Non-Detects	40%
Mean Detects	33.99	SD Detects	57.18
Median Detects	1.9	CV Detects	1.682
Skewness Detects	1.73	Kurtosis Detects	N/A
Mean of Logged Detects	0.806	SD of Logged Detects	3.72

Warning: Data set has only 3 Detected Values.

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

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.764	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.379	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

Mean	20.42	Standard Error of Mean	21.8
SD	39.8	95% KM (BCA) UCL	N/A
95% KM (t) UCL	66.89	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	56.27	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	85.81	95% KM Chebyshev UCL	115.4
97.5% KM Chebyshev UCL	156.5	99% KM Chebyshev UCL	237.3

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.26	k star (bias corrected MLE)	N/A
Theta hat (MLE)	131	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.557	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Xylenes (total) (cont.'d)**Gamma Kaplan-Meier (KM) Statistics**

k hat (KM)	0.263	nu hat (KM)	2.631
Approximate Chi Square Value (2.63, α)	0.272	Adjusted Level of Significance (β)	0.0086
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	197.4	Adjusted Chi Square Value (2.63, β)	0.104
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	518

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	20.41	Mean in Log Scale	-0.78
SD in Original Scale	44.5	SD in Log Scale	3.411
95% t UCL (assumes normality of ROS data)	62.83	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	8.671E+13		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.649	95% H-UCL (KM -Log)	2.614E+10
KM SD (logged)	2.951	95% Critical H Value (KM-Log)	13.74
KM Standard Error of Mean (logged)	1.616		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	20.44
SD in Original Scale	44.48
95% t UCL (Assumes normality)	62.85

DL/2 Log-Transformed

Mean in Log Scale	-0.341
SD in Log Scale	3.063
95% H-Stat UCL	2.379E+11

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Approximate Normal Distributed at 5% Significance Level****Suggested UCL to Use**

95% KM (t) UCL	66.89	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

2-Methylnaphthalene

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	1	Number of Missing Observations	5
Number of Distinct Detects	1	Number of Non-Detects	5
		Number of Distinct Non-Detects	4

**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 2-Methylnaphthalene was not processed!

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:36:50 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	5
Number of Detects	4	Number of Non-Detects	2
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	0.019	Minimum Non-Detect	0.035
Maximum Detect	0.2	Maximum Non-Detect	0.87
Variance Detects	0.0062	Percent Non-Detects	33.33%
Mean Detects	0.089	SD Detects	0.0788
Median Detects	0.0685	CV Detects	0.885
Skewness Detects	1.329	Kurtosis Detects	1.899
Mean of Logged Detects	-2.749	SD of Logged Detects	0.983

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.27	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

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

Mean	0.075	Standard Error of Mean	0.0347
SD	0.0671	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.145	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.132	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.179	95% KM Chebyshev UCL	0.226
97.5% KM Chebyshev UCL	0.291	99% KM Chebyshev UCL	0.42

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.205	Anderson-Darling GOF Test	
5% A-D Critical Value	0.662	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.176	Kolmogrov-Smirnov GOF	
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.665	k star (bias corrected MLE)	0.583
Theta hat (MLE)	0.0535	Theta star (bias corrected MLE)	0.153
nu hat (MLE)	13.32	nu star (bias corrected)	4.663
MLE Mean (bias corrected)	0.089	MLE Sd (bias corrected)	0.117

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.249	nu hat (KM)	14.98
Approximate Chi Square Value (14.98, α)	7.25	Adjusted Chi Square Value (14.98, β)	5.425
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.155	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.207

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:36:50 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.0705
Maximum	0.2	Median	0.0545
SD	0.069	CV	0.979
k hat (MLE)	1.318	k star (bias corrected MLE)	0.77
Theta hat (MLE)	0.0535	Theta star (bias corrected MLE)	0.0916
nu hat (MLE)	15.81	nu star (bias corrected)	9.238
MLE Mean (bias corrected)	0.0705	MLE Sd (bias corrected)	0.0803
		Adjusted Level of Significance (β)	0.0122
Approximate Chi Square Value (9.24, α)	3.472	Adjusted Chi Square Value (9.24, β)	2.323
95% Gamma Approximate UCL (use when $n \geq 50$)	0.188	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.998
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.166
5% Lilliefors Critical Value	0.443

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0705	Mean in Log Scale	-3.007
SD in Original Scale	0.0681	SD in Log Scale	0.92
95% t UCL (assumes normality of ROS data)	0.127	95% Percentile Bootstrap UCL	0.12
95% BCA Bootstrap UCL	0.131	95% Bootstrap t UCL	0.207
95% H-UCL (Log ROS)	0.366		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.992	95% H-UCL (KM -Log)	0.347
KM SD (logged)	0.903	95% Critical H Value (KM-Log)	3.779
KM Standard Error of Mean (logged)	0.466		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.135
SD in Original Scale	0.162
95% t UCL (Assumes normality)	0.268

DL/2 Log-Transformed

Mean in Log Scale	-2.645
SD in Log Scale	1.28
95% H-Stat UCL	2.969

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.145

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Naphthalene

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	1	Number of Missing Observations	5
Number of Distinct Detects	1	Number of Non-Detects	5
		Number of Distinct Non-Detects	4

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 Naphthalene was not processed!

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:36:50 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Antimony

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	12
		Number of Missing Observations	3
Number of Detects	8	Number of Non-Detects	6
Number of Distinct Detects	8	Number of Distinct Non-Detects	4
Minimum Detect	1.7	Minimum Non-Detect	2.1
Maximum Detect	656	Maximum Non-Detect	3.6
Variance Detects	75745	Percent Non-Detects	42.86%
Mean Detects	204.5	SD Detects	275.2
Median Detects	65.3	CV Detects	1.346
Skewness Detects	1.247	Kurtosis Detects	-0.308
Mean of Logged Detects	4.044	SD of Logged Detects	2.049

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.73	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.282	Lilliefors GOF Test
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

Mean	117.6	Standard Error of Mean	62.56
SD	219	95% KM (BCA) UCL	216.5
95% KM (t) UCL	228.3	95% KM (Percentile Bootstrap) UCL	217
95% KM (z) UCL	220.5	95% KM Bootstrap t UCL	493.3
90% KM Chebyshev UCL	305.2	95% KM Chebyshev UCL	390.2
97.5% KM Chebyshev UCL	508.2	99% KM Chebyshev UCL	740

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.306	Anderson-Darling GOF Test
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.169	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.309	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.498	k star (bias corrected MLE)	0.395
Theta hat (MLE)	410.5	Theta star (bias corrected MLE)	518.1
nu hat (MLE)	7.968	nu star (bias corrected)	6.313
MLE Mean (bias corrected)	204.5	MLE Sd (bias corrected)	325.5

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.288	nu hat (KM)	8.072
Approximate Chi Square Value (8.07, α)	2.777	Adjusted Chi Square Value (8.07, β)	2.381
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	341.7	95% Gamma Adjusted KM-UCL (use when $n < 50$)	398.5

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Antimony (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	116.8
Maximum	656	Median	7.5
SD	227.6	CV	1.948
k hat (MLE)	0.17	k star (bias corrected MLE)	0.182
Theta hat (MLE)	685.3	Theta star (bias corrected MLE)	643.4
nu hat (MLE)	4.774	nu star (bias corrected)	5.084
MLE Mean (bias corrected)	116.8	MLE Sd (bias corrected)	274.2
		Adjusted Level of Significance (β)	0.0312
Approximate Chi Square Value (5.08, α)	1.191	Adjusted Chi Square Value (5.08, β)	0.963
95% Gamma Approximate UCL (use when $n \geq 50$)	498.6	95% Gamma Adjusted UCL (use when $n < 50$)	616.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.951
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.128
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	117.5	Mean in Log Scale	2.43
SD in Original Scale	227.2	SD in Log Scale	2.49
95% t UCL (assumes normality of ROS data)	225.1	95% Percentile Bootstrap UCL	213.4
95% BCA Bootstrap UCL	259.5	95% Bootstrap t UCL	496.1
95% H-UCL (Log ROS)	12719		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.538	95% H-UCL (KM -Log)	4315
KM SD (logged)	2.263	95% Critical H Value (KM-Log)	5.21
KM Standard Error of Mean (logged)	0.647		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	117.4
SD in Original Scale	227.3
95% t UCL (Assumes normality)	224.9

DL/2 Log-Transformed

Mean in Log Scale	2.389
SD in Log Scale	2.492
95% H-Stat UCL	12335

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	228.3	95% KM (Percentile Bootstrap) UCL	217

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Arsenic

General Statistics			
Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	1
Minimum	1.9	Mean	17.16
Maximum	92.1	Median	5.25
SD	25.38	Std. Error of Mean	6.344
Coefficient of Variation	1.479	Skewness	2.205
Normal GOF Test			
Shapiro Wilk Test Statistic	0.635	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.328	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.222	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	28.28	95% Adjusted-CLT UCL (Chen-1995)	31.33
		95% Modified-t UCL (Johnson-1978)	28.87
Gamma GOF Test			
A-D Test Statistic	1.383	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.772	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.258	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.223	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.799	k star (bias corrected MLE)	0.691
Theta hat (MLE)	21.48	Theta star (bias corrected MLE)	24.85
nu hat (MLE)	25.56	nu star (bias corrected)	22.1
MLE Mean (bias corrected)	17.16	MLE Sd (bias corrected)	20.65
		Approximate Chi Square Value (0.05)	12.42
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	11.59
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	30.55	95% Adjusted Gamma UCL (use when n<50)	32.72
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.888	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.222	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.642	Mean of logged Data	2.1
Maximum of Logged Data	4.523	SD of logged Data	1.16

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Arsenic (cont.'d)**Assuming Lognormal Distribution**

95% H-UCL	38.78	90% Chebyshev (MVUE) UCL	29.63
95% Chebyshev (MVUE) UCL	36.25	97.5% Chebyshev (MVUE) UCL	45.44
99% Chebyshev (MVUE) UCL	63.49		

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

95% CLT UCL	27.6	95% Jackknife UCL	28.28
95% Standard Bootstrap UCL	27.3	95% Bootstrap-t UCL	40.54
95% Hall's Bootstrap UCL	28.37	95% Percentile Bootstrap UCL	27.88
95% BCA Bootstrap UCL	31.27		
90% Chebyshev(Mean, Sd) UCL	36.19	95% Chebyshev(Mean, Sd) UCL	44.82
97.5% Chebyshev(Mean, Sd) UCL	56.78	99% Chebyshev(Mean, Sd) UCL	80.29

Suggested UCL to Use95% Chebyshev (Mean, Sd) UCL **44.82**

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Barium

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	54.9	Mean	3006
Maximum	16400	Median	309
SD	4901	Std. Error of Mean	1310
Coefficient of Variation	1.63	Skewness	2.017
Normal GOF Test			
Shapiro Wilk Test Statistic	0.671	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.301	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5326	95% Adjusted-CLT UCL (Chen-1995)	5915
		95% Modified-t UCL (Johnson-1978)	5443
Gamma GOF Test			
A-D Test Statistic	0.893	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.803	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.263	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.243	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.449	k star (bias corrected MLE)	0.4
Theta hat (MLE)	6696	Theta star (bias corrected MLE)	7508
nu hat (MLE)	12.57	nu star (bias corrected)	11.21
MLE Mean (bias corrected)	3006	MLE Sd (bias corrected)	4751
		Approximate Chi Square Value (0.05)	4.711
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	4.166
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7152	95% Adjusted Gamma UCL (use when n<50)	8088
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Barium (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	4.006	Mean of logged Data	6.569
Maximum of Logged Data	9.705	SD of logged Data	1.866

Assuming Lognormal Distribution			
95% H-UCL	39792	90% Chebyshev (MVUE) UCL	8409
95% Chebyshev (MVUE) UCL	10805	97.5% Chebyshev (MVUE) UCL	14130
99% Chebyshev (MVUE) UCL	20662		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	5160	95% Jackknife UCL	5326
95% Standard Bootstrap UCL	5096	95% Bootstrap-t UCL	7759
95% Hall's Bootstrap UCL	6180	95% Percentile Bootstrap UCL	5242
95% BCA Bootstrap UCL	5885		
90% Chebyshev(Mean, Sd) UCL	6935	95% Chebyshev(Mean, Sd) UCL	8715
97.5% Chebyshev(Mean, Sd) UCL	11186	99% Chebyshev(Mean, Sd) UCL	16039

Suggested UCL to Use
 99% Chebyshev (Mean, Sd) UCL 16039

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:36:50 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cadmium

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	3
Number of Detects	12	Number of Non-Detects	2
Number of Distinct Detects	12	Number of Distinct Non-Detects	2
Minimum Detect	0.24	Minimum Non-Detect	1.1
Maximum Detect	586	Maximum Non-Detect	1.2
Variance Detects	27668	Percent Non-Detects	14.29%
Mean Detects	64.37	SD Detects	166.3
Median Detects	6	CV Detects	2.584
Skewness Detects	3.318	Kurtosis Detects	11.23
Mean of Logged Detects	1.712	SD of Logged Detects	2.435

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.438
5% Shapiro Wilk Critical Value	0.859
Lilliefors Test Statistic	0.385
5% Lilliefors Critical Value	0.256

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	55.25	Standard Error of Mean	41.63
SD	149.1	95% KM (BCA) UCL	136.1
95% KM (t) UCL	129	95% KM (Percentile Bootstrap) UCL	134.5
95% KM (z) UCL	123.7	95% KM Bootstrap t UCL	487.4
90% KM Chebyshev UCL	180.1	95% KM Chebyshev UCL	236.7
97.5% KM Chebyshev UCL	315.2	99% KM Chebyshev UCL	469.4

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.853
5% A-D Critical Value	0.832
K-S Test Statistic	0.212
5% K-S Critical Value	0.266

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.284
Theta hat (MLE)	226.9
nu hat (MLE)	6.81
MLE Mean (bias corrected)	64.37

k star (bias corrected MLE)	0.268
Theta star (bias corrected MLE)	239.9
nu star (bias corrected)	6.441
MLE Sd (bias corrected)	124.3

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.137
Approximate Chi Square Value (3.84, α)	0.661
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	321.3

nu hat (KM)	3.843
Adjusted Chi Square Value (3.84, β)	0.511
95% Gamma Adjusted KM-UCL (use when $n < 50$)	415.2

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:36:50 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cadmium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	55.17
Maximum	586	Median	2.45
SD	154.8	CV	2.805
k hat (MLE)	0.226	k star (bias corrected MLE)	0.225
Theta hat (MLE)	244.6	Theta star (bias corrected MLE)	245.4
nu hat (MLE)	6.317	nu star (bias corrected)	6.296
MLE Mean (bias corrected)	55.17	MLE Sd (bias corrected)	116.4
		Adjusted Level of Significance (β)	0.0312
Approximate Chi Square Value (6.30, α)	1.793	Adjusted Chi Square Value (6.30, β)	1.494
95% Gamma Approximate UCL (use when $n \geq 50$)	193.7	95% Gamma Adjusted UCL (use when $n < 50$)	232.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.163	Lilliefors GOF Test
5% Lilliefors Critical Value	0.256	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	55.25	Mean in Log Scale	1.376
SD in Original Scale	154.8	SD in Log Scale	2.399
95% t UCL (assumes normality of ROS data)	128.5	95% Percentile Bootstrap UCL	133.6
95% BCA Bootstrap UCL	180.3	95% Bootstrap t UCL	488.9
95% H-UCL (Log ROS)	2709		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.365	95% H-UCL (KM -Log)	1831
KM SD (logged)	2.326	95% Critical H Value (KM-Log)	5.338
KM Standard Error of Mean (logged)	0.651		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	55.26
SD in Original Scale	154.8
95% t UCL (Assumes normality)	128.5

DL/2 Log-Transformed

Mean in Log Scale	1.388
SD in Log Scale	2.386
95% H-Stat UCL	2570

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	236.7	95% GROS Adjusted Gamma UCL	232.6
95% Adjusted Gamma KM-UCL	415.2		

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:36:50 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chromium

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Number of Detects	13	Number of Non-Detects	1
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	11.2	Minimum Non-Detect	18
Maximum Detect	248	Maximum Non-Detect	18
Variance Detects	4170	Percent Non-Detects	7.143%
Mean Detects	53.26	SD Detects	64.58
Median Detects	32.1	CV Detects	1.212
Skewness Detects	2.628	Kurtosis Detects	7.615
Mean of Logged Detects	3.529	SD of Logged Detects	0.917

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.655
5% Shapiro Wilk Critical Value	0.866
Lilliefors Test Statistic	0.324
5% Lilliefors Critical Value	0.246

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	50.41	Standard Error of Mean	16.88
SD	60.67	95% KM (BCA) UCL	85.11
95% KM (t) UCL	80.29	95% KM (Percentile Bootstrap) UCL	80.46
95% KM (z) UCL	78.17	95% KM Bootstrap t UCL	118.6
90% KM Chebyshev UCL	101	95% KM Chebyshev UCL	124
97.5% KM Chebyshev UCL	155.8	99% KM Chebyshev UCL	218.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.654
5% A-D Critical Value	0.754
K-S Test Statistic	0.228
5% K-S Critical Value	0.242

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.262	k star (bias corrected MLE)	1.022
Theta hat (MLE)	42.22	Theta star (bias corrected MLE)	52.13
nu hat (MLE)	32.8	nu star (bias corrected)	26.57
MLE Mean (bias corrected)	53.26	MLE Sd (bias corrected)	52.69

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.69	nu hat (KM)	19.33
Approximate Chi Square Value (19.33, α)	10.36	Adjusted Chi Square Value (19.33, β)	9.495
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	94.06	95% Gamma Adjusted KM-UCL (use when $n < 50$)	102.6

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Chromium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	49.46
Maximum	248	Median	28.9
SD	63.66	CV	1.287
k hat (MLE)	0.642	k star (bias corrected MLE)	0.552
Theta hat (MLE)	77.04	Theta star (bias corrected MLE)	89.59
nu hat (MLE)	17.98	nu star (bias corrected)	15.46
MLE Mean (bias corrected)	49.46	MLE Sd (bias corrected)	66.56
		Adjusted Level of Significance (β)	0.0312
Approximate Chi Square Value (15.46, α)	7.581	Adjusted Chi Square Value (15.46, β)	6.86
95% Gamma Approximate UCL (use when $n \geq 50$)	100.8	95% Gamma Adjusted UCL (use when $n < 50$)	111.4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.157	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	50.36	Mean in Log Scale	3.458
SD in Original Scale	62.99	SD in Log Scale	0.92
95% t UCL (assumes normality of ROS data)	80.17	95% Percentile Bootstrap UCL	79.55
95% BCA Bootstrap UCL	96	95% Bootstrap t UCL	117.5
95% H-UCL (Log ROS)	95.65		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.461	95% H-UCL (KM -Log)	89.17
KM SD (logged)	0.884	95% Critical H Value (KM-Log)	2.606
KM Standard Error of Mean (logged)	0.246		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	50.1
SD in Original Scale	63.16
95% t UCL (Assumes normality)	80

DL/2 Log-Transformed

Mean in Log Scale	3.434
SD in Log Scale	0.95
95% H-Stat UCL	99.45

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	124	95% GROS Adjusted Gamma UCL	111.4
95% Adjusted Gamma KM-UCL	102.6		

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	3
Minimum	1.5	Mean	5.864
Maximum	10	Median	5.65
SD	2.22	Std. Error of Mean	0.593
Coefficient of Variation	0.379	Skewness	0.04
Normal GOF Test			
Shapiro Wilk Test Statistic	0.982	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.119	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.915	95% Adjusted-CLT UCL (Chen-1995)	6.847
		95% Modified-t UCL (Johnson-1978)	6.916
Gamma GOF Test			
A-D Test Statistic	0.346	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.984	k star (bias corrected MLE)	4.749
Theta hat (MLE)	0.98	Theta star (bias corrected MLE)	1.235
nu hat (MLE)	167.5	nu star (bias corrected)	133
MLE Mean (bias corrected)	5.864	MLE Sd (bias corrected)	2.691
		Approximate Chi Square Value (0.05)	107.3
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	104.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.265	95% Adjusted Gamma UCL (use when n<50)	7.478
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.884	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.207	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.683
Maximum of Logged Data	2.303	SD of logged Data	0.472

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Cobalt (cont.'d)**Assuming Lognormal Distribution**

95% H-UCL	7.822	90% Chebyshev (MVUE) UCL	8.276
95% Chebyshev (MVUE) UCL	9.323	97.5% Chebyshev (MVUE) UCL	10.78
99% Chebyshev (MVUE) UCL	13.63		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6.84	95% Jackknife UCL	6.915
95% Standard Bootstrap UCL	6.801	95% Bootstrap-t UCL	6.917
95% Hall's Bootstrap UCL	7.029	95% Percentile Bootstrap UCL	6.829
95% BCA Bootstrap UCL	6.807		
90% Chebyshev(Mean, Sd) UCL	7.645	95% Chebyshev(Mean, Sd) UCL	8.451
97.5% Chebyshev(Mean, Sd) UCL	9.57	99% Chebyshev(Mean, Sd) UCL	11.77

Suggested UCL to Use

95% Student's-t UCL 6.915

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Copper

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	2.9	Mean	66.49
Maximum	271	Median	22.85
SD	90.87	Std. Error of Mean	24.29
Coefficient of Variation	1.367	Skewness	1.546
Normal GOF Test			
Shapiro Wilk Test Statistic	0.696	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.348	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	109.5	95% Adjusted-CLT UCL (Chen-1995)	117.2
		95% Modified-t UCL (Johnson-1978)	111.2
Gamma GOF Test			
A-D Test Statistic	0.675	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.778	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.239	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.67	k star (bias corrected MLE)	0.574
Theta hat (MLE)	99.17	Theta star (bias corrected MLE)	115.8
nu hat (MLE)	18.77	nu star (bias corrected)	16.08
MLE Mean (bias corrected)	66.49	MLE Sd (bias corrected)	87.73
		Approximate Chi Square Value (0.05)	8.02
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	7.276
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	133.3	95% Adjusted Gamma UCL (use when n<50)	147
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.134	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.065	Mean of logged Data	3.29
Maximum of Logged Data	5.602	SD of logged Data	1.445

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Copper (cont.'d)**Assuming Lognormal Distribution**

95% H-UCL	320.9	90% Chebyshev (MVUE) UCL	154.3
95% Chebyshev (MVUE) UCL	193.8	97.5% Chebyshev (MVUE) UCL	248.7
99% Chebyshev (MVUE) UCL	356.5		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	106.4	95% Jackknife UCL	109.5
95% Standard Bootstrap UCL	104.9	95% Bootstrap-t UCL	125.8
95% Hall's Bootstrap UCL	98.58	95% Percentile Bootstrap UCL	106.6
95% BCA Bootstrap UCL	114.6		
90% Chebyshev(Mean, Sd) UCL	139.3	95% Chebyshev(Mean, Sd) UCL	172.3
97.5% Chebyshev(Mean, Sd) UCL	218.2	99% Chebyshev(Mean, Sd) UCL	308.1

Suggested UCL to Use

95% Adjusted Gamma UCL 147

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Iron

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	7470	Mean	25512
Maximum	82400	Median	17750
SD	19419	Std. Error of Mean	5190
Coefficient of Variation	0.761	Skewness	2.17
Normal GOF Test			
Shapiro Wilk Test Statistic	0.766	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.229	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	34703	95% Adjusted-CLT UCL (Chen-1995)	37266
		95% Modified-t UCL (Johnson-1978)	35205
Gamma GOF Test			
A-D Test Statistic	0.476	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.202	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.231	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.654	k star (bias corrected MLE)	2.133
Theta hat (MLE)	9614	Theta star (bias corrected MLE)	11963
nu hat (MLE)	74.3	nu star (bias corrected)	59.71
MLE Mean (bias corrected)	25512	MLE Sd (bias corrected)	17470
		Approximate Chi Square Value (0.05)	42.94
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	41.06
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	35474	95% Adjusted Gamma UCL (use when n<50)	37100
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.967	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.919	Mean of logged Data	9.947
Maximum of Logged Data	11.32	SD of logged Data	0.626

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Iron (cont.'d)

Assuming Lognormal Distribution

95% H-UCL 37548	90% Chebyshev (MVUE) UCL 38089
95% Chebyshev (MVUE) UCL 44015	97.5% Chebyshev (MVUE) UCL 52241
99% Chebyshev (MVUE) UCL 68399	

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 34049	95% Jackknife UCL 34703
95% Standard Bootstrap UCL 33618	95% Bootstrap-t UCL 42006
95% Hall's Bootstrap UCL 71238	95% Percentile Bootstrap UCL 34639
95% BCA Bootstrap UCL 37114	
90% Chebyshev(Mean, Sd) UCL 41082	95% Chebyshev(Mean, Sd) UCL 48135
97.5% Chebyshev(Mean, Sd) UCL 57924	99% Chebyshev(Mean, Sd) UCL 77152

Suggested UCL to Use

95% Student's-t UCL 34703

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	10.9	Mean	3150
Maximum	13700	Median	660
SD	5037	Std. Error of Mean	1346
Coefficient of Variation	1.599	Skewness	1.535
Normal GOF Test			
Shapiro Wilk Test Statistic	0.652	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.36	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5534	95% Adjusted-CLT UCL (Chen-1995)	5954
		95% Modified-t UCL (Johnson-1978)	5626
Gamma GOF Test			
A-D Test Statistic	0.601	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.823	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.212	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.246	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.344	k star (bias corrected MLE)	0.318
Theta hat (MLE)	9146	Theta star (bias corrected MLE)	9898
nu hat (MLE)	9.644	nu star (bias corrected)	8.911
MLE Mean (bias corrected)	3150	MLE Sd (bias corrected)	5584
		Approximate Chi Square Value (0.05)	3.273
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	2.835
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	8576	95% Adjusted Gamma UCL (use when n<50)	9899
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.147	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.389	Mean of logged Data	6.098
Maximum of Logged Data	9.525	SD of logged Data	2.498

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Lead (cont.'d)

Assuming Lognormal Distribution

95% H-UCL 515172	90% Chebyshev (MVUE) UCL 17238
95% Chebyshev (MVUE) UCL 22597	97.5% Chebyshev (MVUE) UCL 30036
99% Chebyshev (MVUE) UCL 44648	

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 5364	95% Jackknife UCL 5534
95% Standard Bootstrap UCL 5282	95% Bootstrap-t UCL 6783
95% Hall's Bootstrap UCL 4835	95% Percentile Bootstrap UCL 5384
95% BCA Bootstrap UCL 5810	
90% Chebyshev(Mean, Sd) UCL 7188	95% Chebyshev(Mean, Sd) UCL 9018
97.5% Chebyshev(Mean, Sd) UCL 11557	99% Chebyshev(Mean, Sd) UCL 16544

Suggested UCL to Use

95% Adjusted Gamma UCL 9899

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Manganese

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	23.6	Mean	287
Maximum	655	Median	288.5
SD	196.5	Std. Error of Mean	52.53
Coefficient of Variation	0.685	Skewness	0.332

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.95		
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.143	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	378.4
95% Student's-t UCL	380	95% Modified-t UCL (Johnson-1978)	380.8

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.422		
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.186	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.233	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1.595	k star (bias corrected MLE)	1.301
Theta hat (MLE)	179.9	Theta star (bias corrected MLE)	220.6
nu hat (MLE)	44.66	nu star (bias corrected)	36.42
MLE Mean (bias corrected)	287	MLE Sd (bias corrected)	251.6
		Approximate Chi Square Value (0.05)	23.61
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	22.25

Assuming Gamma Distribution		95% Adjusted Gamma UCL (use when n<50)	
95% Approximate Gamma UCL (use when n>=50))	442.8		469.9

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.898		
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Manganese (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	3.161	Mean of logged Data	5.314
Maximum of Logged Data	6.485	SD of logged Data	1.002

Assuming Lognormal Distribution			
95% H-UCL	729.4	90% Chebyshev (MVUE) UCL	598
95% Chebyshev (MVUE) UCL	724.2	97.5% Chebyshev (MVUE) UCL	899.4
99% Chebyshev (MVUE) UCL	1243		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	373.4	95% Jackknife UCL	380
95% Standard Bootstrap UCL	371.8	95% Bootstrap-t UCL	386.2
95% Hall's Bootstrap UCL	380.4	95% Percentile Bootstrap UCL	368.7
95% BCA Bootstrap UCL	374.4		
90% Chebyshev(Mean, Sd) UCL	444.6	95% Chebyshev(Mean, Sd) UCL	516
97.5% Chebyshev(Mean, Sd) UCL	615	99% Chebyshev(Mean, Sd) UCL	809.7

Suggested UCL to Use
 95% Student's-t UCL 380

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Mercury

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
		Number of Missing Observations	5
Minimum	0.045	Mean	0.0963
Maximum	0.27	Median	0.0675
SD	0.0666	Std. Error of Mean	0.0192
Coefficient of Variation	0.692	Skewness	1.804

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.779	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.859	Lilliefors GOF Test	
Lilliefors Test Statistic	0.248	Data appear Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.256		

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	0.139
95% Student's-t UCL	0.131	95% Modified-t UCL (Johnson-1978)	0.132

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.739	Kolmogrov-Smirnoff Gamma GOF Test	
K-S Test Statistic	0.23	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.247		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.041	k star (bias corrected MLE)	2.337
Theta hat (MLE)	0.0316	Theta star (bias corrected MLE)	0.0412
nu hat (MLE)	72.99	nu star (bias corrected)	56.08
MLE Mean (bias corrected)	0.0963	MLE Sd (bias corrected)	0.063
		Approximate Chi Square Value (0.05)	39.87
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	37.79

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.135	95% Adjusted Gamma UCL (use when n<50)	0.143

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.887	Data appear Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.859	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.2	Data appear Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.256		

Data appear Lognormal at 5% Significance Level

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Mercury (cont.'d)**Lognormal Statistics**

Minimum of Logged Data	-3.101	Mean of logged Data	-2.514
Maximum of Logged Data	-1.309	SD of logged Data	0.585

Assuming Lognormal Distribution

95% H-UCL	0.143	90% Chebyshev (MVUE) UCL	0.144
95% Chebyshev (MVUE) UCL	0.166	97.5% Chebyshev (MVUE) UCL	0.197
99% Chebyshev (MVUE) UCL	0.258		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.128	95% Jackknife UCL	0.131
95% Standard Bootstrap UCL	0.127	95% Bootstrap-t UCL	0.156
95% Hall's Bootstrap UCL	0.159	95% Percentile Bootstrap UCL	0.13
95% BCA Bootstrap UCL	0.134		
90% Chebyshev(Mean, Sd) UCL	0.154	95% Chebyshev(Mean, Sd) UCL	0.18
97.5% Chebyshev(Mean, Sd) UCL	0.216	99% Chebyshev(Mean, Sd) UCL	0.288

Suggested UCL to Use

95% Student's-t UCL 0.131

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Nickel

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	3.1	Mean	21.2
Maximum	76.2	Median	12
SD	22.1	Std. Error of Mean	5.906
Coefficient of Variation	1.042	Skewness	1.772
Normal GOF Test			
Shapiro Wilk Test Statistic	0.729	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.343	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	31.66	95% Adjusted-CLT UCL (Chen-1995)	33.9
		95% Modified-t UCL (Johnson-1978)	32.13
Gamma GOF Test			
A-D Test Statistic	0.768	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.245	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.233	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.392	k star (bias corrected MLE)	1.141
Theta hat (MLE)	15.23	Theta star (bias corrected MLE)	18.58
nu hat (MLE)	38.97	nu star (bias corrected)	31.95
MLE Mean (bias corrected)	21.2	MLE Sd (bias corrected)	19.85
		Approximate Chi Square Value (0.05)	20.04
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	18.79
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	33.81	95% Adjusted Gamma UCL (use when n<50)	36.05
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.181	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Nickel (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	1.131	Mean of logged Data	2.654
Maximum of Logged Data	4.333	SD of logged Data	0.894
Assuming Lognormal Distribution			
95% H-UCL	40.59	90% Chebyshev (MVUE) UCL	36.12
95% Chebyshev (MVUE) UCL	43.24	97.5% Chebyshev (MVUE) UCL	53.11
99% Chebyshev (MVUE) UCL	72.52		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	30.91	95% Jackknife UCL	31.66
95% Standard Bootstrap UCL	30.71	95% Bootstrap-t UCL	40.83
95% Hall's Bootstrap UCL	34.72	95% Percentile Bootstrap UCL	31.04
95% BCA Bootstrap UCL	33.91		
90% Chebyshev(Mean, Sd) UCL	38.92	95% Chebyshev(Mean, Sd) UCL	46.94
97.5% Chebyshev(Mean, Sd) UCL	58.08	99% Chebyshev(Mean, Sd) UCL	79.96
Suggested UCL to Use			
95% H-UCL	40.59		

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
 H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
 It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
 Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Selenium

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	8
		Number of Missing Observations	3
Number of Detects	4	Number of Non-Detects	10
Number of Distinct Detects	4	Number of Distinct Non-Detects	4
Minimum Detect	2.9	Minimum Non-Detect	2.1
Maximum Detect	110	Maximum Non-Detect	2.5
Variance Detects	2555	Percent Non-Detects	71.43%
Mean Detects	34.55	SD Detects	50.54
Median Detects	12.65	CV Detects	1.463
Skewness Detects	1.942	Kurtosis Detects	3.815
Mean of Logged Detects	2.702	SD of Logged Detects	1.506

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.721
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.401
5% Lilliefors Critical Value	0.443

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	11.37	Standard Error of Mean	8.521
SD	27.61	95% KM (BCA) UCL	N/A
95% KM (t) UCL	26.46	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	25.39	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	36.93	95% KM Chebyshev UCL	48.51
97.5% KM Chebyshev UCL	64.58	99% KM Chebyshev UCL	96.15

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.4
5% A-D Critical Value	0.672
K-S Test Statistic	0.333
5% K-S Critical Value	0.406

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.717	k star (bias corrected MLE)	0.346
Theta hat (MLE)	48.2	Theta star (bias corrected MLE)	99.89
nu hat (MLE)	5.735	nu star (bias corrected)	2.767
MLE Mean (bias corrected)	34.55	MLE Sd (bias corrected)	58.75

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.17	nu hat (KM)	4.75
Approximate Chi Square Value (4.75, α)	1.038	Adjusted Chi Square Value (4.75, β)	0.831
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	52.02	95% Gamma Adjusted KM-UCL (use when $n < 50$)	65.01

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Selenium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	9.879
Maximum	110	Median	0.01
SD	29.18	CV	2.954
k hat (MLE)	0.159	k star (bias corrected MLE)	0.172
Theta hat (MLE)	62.3	Theta star (bias corrected MLE)	57.36
nu hat (MLE)	4.44	nu star (bias corrected)	4.822
MLE Mean (bias corrected)	9.879	MLE Sd (bias corrected)	23.8
Approximate Chi Square Value (4.82, α)	1.071	Adjusted Level of Significance (R)	0.0212
95% Gamma Approximate UCL (use when $n \geq 50$)	44.48	Adjusted Chi Square Value (4.82, β)	0.859
		95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.25	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	9.933	Mean in Log Scale	-1.744
SD in Original Scale	29.16	SD in Log Scale	3.345
95% t UCL (assumes normality of ROS data)	23.74	95% Percentile Bootstrap UCL	24.97
95% BCA Bootstrap UCL	33.99	95% Bootstrap t UCL	102.6
95% H-UCL (Log ROS)	48133		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.302	95% H-UCL (KM -Log)	17.76
KM SD (logged)	1.127	95% Critical H Value (KM-Log)	3.007
KM Standard Error of Mean (logged)	0.348		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	10.68
SD in Original Scale	28.9
95% t UCL (Assumes normality)	24.35

DL/2 Log-Transformed

Mean in Log Scale	0.855
SD in Log Scale	1.413
95% H-Stat UCL	25.38

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	26.46	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Vanadium

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	3
Minimum	17.9	Mean	26
Maximum	40.3	Median	26.05
SD	5.316	Std. Error of Mean	1.421
Coefficient of Variation	0.204	Skewness	1.356

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.892		
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	28.89
95% Student's-t UCL	28.52	95% Modified-t UCL (Johnson-1978)	28.6

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.415		
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.228	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	28.29	k star (bias corrected MLE)	22.28
Theta hat (MLE)	0.919	Theta star (bias corrected MLE)	1.167
nu hat (MLE)	792.2	nu star (bias corrected)	623.8
MLE Mean (bias corrected)	26	MLE Sd (bias corrected)	5.509
		Approximate Chi Square Value (0.05)	566.8
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	559.6

Assuming Gamma Distribution		95% Adjusted Gamma UCL (use when n<50)	
95% Approximate Gamma UCL (use when n>=50))	28.61		28.98

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.95		
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.18	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Vanadium (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	2.885	Mean of logged Data	3.24
Maximum of Logged Data	3.696	SD of logged Data	0.193

Assuming Lognormal Distribution			
95% H-UCL	28.66	90% Chebyshev (MVUE) UCL	30.01
95% Chebyshev (MVUE) UCL	31.84	97.5% Chebyshev (MVUE) UCL	34.37
99% Chebyshev (MVUE) UCL	39.35		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	28.34	95% Jackknife UCL	28.52
95% Standard Bootstrap UCL	28.27	95% Bootstrap-t UCL	29.26
95% Hall's Bootstrap UCL	32.06	95% Percentile Bootstrap UCL	28.42
95% BCA Bootstrap UCL	28.82		
90% Chebyshev(Mean, Sd) UCL	30.26	95% Chebyshev(Mean, Sd) UCL	32.19
97.5% Chebyshev(Mean, Sd) UCL	34.87	99% Chebyshev(Mean, Sd) UCL	40.14

Suggested UCL to Use
 95% Student's-t UCL 28.52

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

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Zinc

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	3
Minimum	12.7	Mean	2781
Maximum	16900	Median	165.5
SD	5157	Std. Error of Mean	1378
Coefficient of Variation	1.855	Skewness	2.075
Normal GOF Test			
Shapiro Wilk Test Statistic	0.617	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.363	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5221	95% Adjusted-CLT UCL (Chen-1995)	5864
		95% Modified-t UCL (Johnson-1978)	5349
Gamma GOF Test			
A-D Test Statistic	0.835	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.829	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.255	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.247	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.318	k star (bias corrected MLE)	0.297
Theta hat (MLE)	8757	Theta star (bias corrected MLE)	9359
nu hat (MLE)	8.891	nu star (bias corrected)	8.319
MLE Mean (bias corrected)	2781	MLE Sd (bias corrected)	5101
		Approximate Chi Square Value (0.05)	2.921
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	2.513
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7919	95% Adjusted Gamma UCL (use when n<50)	9204
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.18	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.5

**SUMMARY OF ProUCL OUTPUT FOR SURFACE SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:36:50 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Zinc (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	2.542	Mean of logged Data	5.779
Maximum of Logged Data	9.735	SD of logged Data	2.396
Assuming Lognormal Distribution			
95% H-UCL	217929	90% Chebyshev (MVUE) UCL	10289
95% Chebyshev (MVUE) UCL	13456	97.5% Chebyshev (MVUE) UCL	17851
99% Chebyshev (MVUE) UCL	26485		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5048	95% Jackknife UCL	5221
95% Standard Bootstrap UCL	4917	95% Bootstrap-t UCL	7726
95% Hall's Bootstrap UCL	5331	95% Percentile Bootstrap UCL	5126
95% BCA Bootstrap UCL	5717		
90% Chebyshev(Mean, Sd) UCL	6915	95% Chebyshev(Mean, Sd) UCL	8788
97.5% Chebyshev(Mean, Sd) UCL	11388	99% Chebyshev(Mean, Sd) UCL	16494
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	16494		

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

1,4-Dichlorobenzene

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	8
Number of Detects	1	Number of Missing Observations	6
Number of Distinct Detects	1	Number of Non-Detects	8
		Number of Distinct Non-Detects	7

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 1,4-Dichlorobenzene was not processed!

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Ethylbenzene

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	6
Number of Detects	2	Number of Non-Detects	7
Number of Distinct Detects	2	Number of Distinct Non-Detects	6
Minimum Detect	0.26	Minimum Non-Detect	0.082
Maximum Detect	22	Maximum Non-Detect	0.11
Variance Detects	236.3	Percent Non-Detects	77.78%
Mean Detects	11.13	SD Detects	15.37
Median Detects	11.13	CV Detects	1.381
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.872	SD of Logged Detects	3.138

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

**Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test**

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

Mean	2.537	Standard Error of Mean	3.244
SD	6.881	95% KM (BCA) UCL	N/A
95% KM (t) UCL	8.569	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	7.873	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	12.27	95% KM Chebyshev UCL	16.68
97.5% KM Chebyshev UCL	22.8	99% KM Chebyshev UCL	34.81

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

Gamma Statistics on Detected Data Only

k hat (MLE)	0.424	k star (bias corrected MLE)	N/A
Theta hat (MLE)	26.25	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.696	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.136	nu hat (KM)	2.447
		Adjusted Level of Significance (β)	0.0231
Approximate Chi Square Value (2.45, α)	0.229	Adjusted Chi Square Value (2.45, β)	0.148
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	27.07	95% Gamma Adjusted KM-UCL (use when $n < 50$)	41.96

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Ethylbenzene (cont.'d)**Lognormal GOF Test on Detected Observations Only****Not Enough Data to Perform GOF Test****Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	2.473	Mean in Log Scale	-12.3
SD in Original Scale	7.323	SD in Log Scale	7.787
95% t UCL (assumes normality of ROS data)	7.012	95% Percentile Bootstrap UCL	7.333
95% BCA Bootstrap UCL	9.778	95% Bootstrap t UCL	13097739
95% H-UCL (Log ROS)	1.920E+33		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	2.51
SD in Original Scale	7.309
95% t UCL (Assumes normality)	7.04

DL/2 Log-Transformed

Mean in Log Scale	-2.193
SD in Log Scale	2.064
95% H-Stat UCL	68.26

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Data do not follow a Discernible Distribution at 5% Significance Level****Suggested UCL to Use**99% KM (Chebyshev) UCL 34.81**Warning: Recommended UCL exceeds the maximum observation**

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Xylenes (total)

General Statistics			
Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	6
Number of Detects	3	Number of Non-Detects	6
Number of Distinct Detects	3	Number of Distinct Non-Detects	5
Minimum Detect	0.059	Minimum Non-Detect	0.25
Maximum Detect	100	Maximum Non-Detect	0.34
Variance Detects	3269	Percent Non-Detects	66.67%
Mean Detects	33.99	SD Detects	57.18
Median Detects	1.9	CV Detects	1.682
Skewness Detects	1.73	Kurtosis Detects	N/A
Mean of Logged Detects	0.806	SD of Logged Detects	3.72

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0**

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.764	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.379	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

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

Mean	11.37	Standard Error of Mean	12.8
SD	31.34	95% KM (BCA) UCL	N/A
95% KM (t) UCL	35.16	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	32.41	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	49.75	95% KM Chebyshev UCL	67.14
97.5% KM Chebyshev UCL	91.27	99% KM Chebyshev UCL	138.7

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.26	k star (bias corrected MLE)	N/A
Theta hat (MLE)	131	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.557	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Xylenes (total) (cont.'d)**Gamma Kaplan-Meier (KM) Statistics**

k hat (KM)	0.132	nu hat (KM)	2.368
Approximate Chi Square Value (2.37, α)	0.213	Adjusted Level of Significance (β)	0.0231
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	126.5	Adjusted Chi Square Value (2.37, β)	0.139
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	193.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	11.37	Mean in Log Scale	-1.844
SD in Original Scale	33.24	SD in Log Scale	2.804
95% t UCL (assumes normality of ROS data)	31.97	95% Percentile Bootstrap UCL	33.39
95% BCA Bootstrap UCL	44.49	95% Bootstrap t UCL	8571
95% H-UCL (Log ROS)	18853		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.618	95% H-UCL (KM -Log)	1581
KM SD (logged)	2.452	95% Critical H Value (KM-Log)	6.895
KM Standard Error of Mean (logged)	1.001		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	11.42
SD in Original Scale	33.22
95% t UCL (Assumes normality)	32.01

DL/2 Log-Transformed

Mean in Log Scale	-1.046
SD in Log Scale	2.323
95% H-Stat UCL	1137

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Approximate Normal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL **35.16**

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

2-Methylnaphthalene

General Statistics			
Total Number of Observations	10	Number of Distinct Observations	7
Number of Detects	1	Number of Missing Observations	5
Number of Distinct Detects	1	Number of Non-Detects	9
		Number of Distinct Non-Detects	6

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 2-Methylnaphthalene was not processed!

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene

General Statistics			
Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	5
Number of Detects	4	Number of Non-Detects	6
Number of Distinct Detects	4	Number of Distinct Non-Detects	5
Minimum Detect	0.019	Minimum Non-Detect	0.035
Maximum Detect	0.2	Maximum Non-Detect	0.87
Variance Detects	0.0062	Percent Non-Detects	60%
Mean Detects	0.089	SD Detects	0.0788
Median Detects	0.0685	CV Detects	0.885
Skewness Detects	1.329	Kurtosis Detects	1.899
Mean of Logged Detects	-2.749	SD of Logged Detects	0.983

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.907
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.27
5% Lilliefors Critical Value	0.443

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.0501	Standard Error of Mean	0.022
SD	0.0572	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0905	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0864	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.116	95% KM Chebyshev UCL	0.146
97.5% KM Chebyshev UCL	0.188	99% KM Chebyshev UCL	0.269

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.205
5% A-D Critical Value	0.662
K-S Test Statistic	0.176
5% K-S Critical Value	0.399

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.665	k star (bias corrected MLE)	0.583
Theta hat (MLE)	0.0535	Theta star (bias corrected MLE)	0.153
nu hat (MLE)	13.32	nu star (bias corrected)	4.663
MLE Mean (bias corrected)	0.089	MLE Sd (bias corrected)	0.117

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.766	nu hat (KM)	15.32
Approximate Chi Square Value (15.32, α)	7.488	Adjusted Chi Square Value (15.32, β)	6.559
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.103	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.117

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.0432
Maximum	0.2	Median	0.0162
SD	0.0603	CV	1.394
k hat (MLE)	0.953	k star (bias corrected MLE)	0.734
Theta hat (MLE)	0.0454	Theta star (bias corrected MLE)	0.0589
nu hat (MLE)	19.06	nu star (bias corrected)	14.67
MLE Mean (bias corrected)	0.0432	MLE Sd (bias corrected)	0.0505
		Adjusted Level of Significance (β)	0.0267
Approximate Chi Square Value (14.67, α)	7.035	Adjusted Chi Square Value (14.67, β)	6.139
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0902	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.998
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.166
5% Lilliefors Critical Value	0.443

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0471	Mean in Log Scale	-3.501
SD in Original Scale	0.0582	SD in Log Scale	0.895
95% t UCL (assumes normality of ROS data)	0.0808	95% Percentile Bootstrap UCL	0.0807
95% BCA Bootstrap UCL	0.0976	95% Bootstrap t UCL	0.169
95% H-UCL (Log ROS)	0.107		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.423	95% H-UCL (KM -Log)	0.0985
KM SD (logged)	0.828	95% Critical H Value (KM-Log)	2.763
KM Standard Error of Mean (logged)	0.319		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.0888
SD in Original Scale	0.134
95% t UCL (Assumes normality)	0.167

DL/2 Log-Transformed

Mean in Log Scale	-3.157
SD in Log Scale	1.161
95% H-Stat UCL	0.316

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0905

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Naphthalene

General Statistics			
Total Number of Observations	10	Number of Distinct Observations	7
Number of Detects	1	Number of Missing Observations	5
Number of Distinct Detects	1	Number of Non-Detects	9
		Number of Distinct Non-Detects	6

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 Naphthalene was not processed!

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Antimony

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	16
		Number of Missing Observations	5
Number of Detects	10	Number of Non-Detects	15
Number of Distinct Detects	9	Number of Distinct Non-Detects	7
Minimum Detect	1.5	Minimum Non-Detect	2.1
Maximum Detect	656	Maximum Non-Detect	3.6
Variance Detects	66228	Percent Non-Detects	60%
Mean Detects	163.9	SD Detects	257.3
Median Detects	27.6	CV Detects	1.57
Skewness Detects	1.573	Kurtosis Detects	0.918
Mean of Logged Detects	3.329	SD of Logged Detects	2.354

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.669
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.308
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	66.53	Standard Error of Mean	36.61
SD	173.7	95% KM (BCA) UCL	125.2
95% KM (t) UCL	129.2	95% KM (Percentile Bootstrap) UCL	129.6
95% KM (z) UCL	126.8	95% KM Bootstrap t UCL	305.4
90% KM Chebyshev UCL	176.4	95% KM Chebyshev UCL	226.1
97.5% KM Chebyshev UCL	295.2	99% KM Chebyshev UCL	430.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.468
5% A-D Critical Value	0.8
K-S Test Statistic	0.164
5% K-S Critical Value	0.285

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.376
Theta hat (MLE)	436.4
nu hat (MLE)	7.511
MLE Mean (bias corrected)	163.9

k star (bias corrected MLE)	0.33
Theta star (bias corrected MLE)	497.3
nu star (bias corrected)	6.591
MLE Sd (bias corrected)	285.5

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.147
Approximate Chi Square Value (7.34, α)	2.358
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	207

nu hat (KM)	7.338
Adjusted Chi Square Value (7.34, β)	2.17
95% Gamma Adjusted KM-UCL (use when $n < 50$)	225

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Antimony (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	65.56
Maximum	656	Median	0.01
SD	177.6	CV	2.709
k hat (MLE)	0.138	k star (bias corrected MLE)	0.149
Theta hat (MLE)	473.4	Theta star (bias corrected MLE)	441.4
nu hat (MLE)	6.924	nu star (bias corrected)	7.426
MLE Mean (bias corrected)	65.56	MLE Sd (bias corrected)	170.1
		Adjusted Level of Significance (β)	0.0395
Approximate Chi Square Value (7.43, α)	2.407	Adjusted Chi Square Value (7.43, β)	2.217
95% Gamma Approximate UCL (use when $n \geq 50$)	202.2	95% Gamma Adjusted UCL (use when $n < 50$)	219.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.904
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.183
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	67.09	Mean in Log Scale	1.647
SD in Original Scale	177	SD in Log Scale	2.152
95% t UCL (assumes normality of ROS data)	127.7	95% Percentile Bootstrap UCL	133.2
95% BCA Bootstrap UCL	156.5	95% Bootstrap t UCL	310.4
95% H-UCL (Log ROS)	336.7		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.625	95% H-UCL (KM -Log)	179.4
KM SD (logged)	1.983	95% Critical H Value (KM-Log)	3.949
KM Standard Error of Mean (logged)	0.419		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	66.27
SD in Original Scale	177.3
95% t UCL (Assumes normality)	127

DL/2 Log-Transformed

Mean in Log Scale	1.433
SD in Log Scale	2.141
95% H-Stat UCL	260.7

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	129.2	95% GROS Adjusted Gamma UCL	219.6
95% Adjusted Gamma KM-UCL	225		

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic

General Statistics			
Total Number of Observations	29	Number of Distinct Observations	29
		Number of Missing Observations	1
Number of Detects	28	Number of Non-Detects	1
Number of Distinct Detects	28	Number of Distinct Non-Detects	1
Minimum Detect	1.55	Minimum Non-Detect	1.2
Maximum Detect	92.1	Maximum Non-Detect	1.2
Variance Detects	402.8	Percent Non-Detects	3.448%
Mean Detects	11.67	SD Detects	20.07
Median Detects	4.75	CV Detects	1.72
Skewness Detects	3.1	Kurtosis Detects	9.929
Mean of Logged Detects	1.749	SD of Logged Detects	1.042

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.519
5% Shapiro Wilk Critical Value	0.924
Lilliefors Test Statistic	0.347
5% Lilliefors Critical Value	0.167

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	11.31	Standard Error of Mean	3.68
SD	19.46	95% KM (BCA) UCL	17.58
95% KM (t) UCL	17.57	95% KM (Percentile Bootstrap) UCL	17.59
95% KM (z) UCL	17.36	95% KM Bootstrap t UCL	23.77
90% KM Chebyshev UCL	22.35	95% KM Chebyshev UCL	27.35
97.5% KM Chebyshev UCL	34.29	99% KM Chebyshev UCL	47.93

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.558
5% A-D Critical Value	0.781
K-S Test Statistic	0.261
5% K-S Critical Value	0.171

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.833	k star (bias corrected MLE)	0.768
Theta hat (MLE)	14.01	Theta star (bias corrected MLE)	15.2
nu hat (MLE)	46.66	nu star (bias corrected)	43
MLE Mean (bias corrected)	11.67	MLE Sd (bias corrected)	13.32

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.338	nu hat (KM)	19.59
Approximate Chi Square Value (19.59, α)	10.55	Adjusted Chi Square Value (19.59, β)	10.16
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	21	95% Gamma Adjusted KM-UCL (use when $n < 50$)	21.82

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	11.27
Maximum	92.1	Median	4.7
SD	19.83	CV	1.759
k hat (MLE)	0.68	k star (bias corrected MLE)	0.633
Theta hat (MLE)	16.57	Theta star (bias corrected MLE)	17.82
nu hat (MLE)	39.43	nu star (bias corrected)	36.69
MLE Mean (bias corrected)	11.27	MLE Sd (bias corrected)	14.17
		Adjusted Level of Significance (β)	0.0407
Approximate Chi Square Value (36.69, α)	23.82	Adjusted Chi Square Value (36.69, β)	23.2
95% Gamma Approximate UCL (use when $n \geq 50$)	17.35	95% Gamma Adjusted UCL (use when $n < 50$)	17.82

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.889
5% Shapiro Wilk Critical Value	0.924
Lilliefors Test Statistic	0.164
5% Lilliefors Critical Value	0.167

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	11.28	Mean in Log Scale	1.662
SD in Original Scale	19.82	SD in Log Scale	1.125
95% t UCL (assumes normality of ROS data)	17.55	95% Percentile Bootstrap UCL	17.57
95% BCA Bootstrap UCL	19.77	95% Bootstrap t UCL	24.25
95% H-UCL (Log ROS)	17.33		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.695	95% H-UCL (KM -Log)	15.47
KM SD (logged)	1.045	95% Critical H Value (KM-Log)	2.523
KM Standard Error of Mean (logged)	0.198		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	11.29
SD in Original Scale	19.82
95% t UCL (Assumes normality)	17.55

DL/2 Log-Transformed

Mean in Log Scale	1.671
SD in Log Scale	1.106
95% H-Stat UCL	16.86

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 34.29

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Barium

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Minimum	44.6	Mean	1732
Maximum	16400	Median	163
SD	3894	Std. Error of Mean	778.8
Coefficient of Variation	2.248	Skewness	2.931
Normal GOF Test			
Shapiro Wilk Test Statistic	0.501	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.395	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3065	95% Adjusted-CLT UCL (Chen-1995)	3501
		95% Modified-t UCL (Johnson-1978)	3141
Gamma GOF Test			
A-D Test Statistic	3.04	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.835	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.326	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.188	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.375	k star (bias corrected MLE)	0.357
Theta hat (MLE)	4617	Theta star (bias corrected MLE)	4854
nu hat (MLE)	18.76	nu star (bias corrected)	17.84
MLE Mean (bias corrected)	1732	MLE Sd (bias corrected)	2900
		Approximate Chi Square Value (0.05)	9.279
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	8.858
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3332	95% Adjusted Gamma UCL (use when n<50)	3490
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.84	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.236	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.798	Mean of logged Data	5.685
Maximum of Logged Data	9.705	SD of logged Data	1.747

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Barium (cont.'d)

Assuming Lognormal Distribution

95% H-UCL	4854	
95% Chebyshev (MVUE) UCL	3481	90% Chebyshev (MVUE) UCL 2765
99% Chebyshev (MVUE) UCL	6424	97.5% Chebyshev (MVUE) UCL 4474

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3013	95% Jackknife UCL 3065
95% Standard Bootstrap UCL	2981	95% Bootstrap-t UCL 4572
95% Hall's Bootstrap UCL	3785	95% Percentile Bootstrap UCL 3128
95% BCA Bootstrap UCL	3578	
90% Chebyshev(Mean, Sd) UCL	4069	95% Chebyshev(Mean, Sd) UCL 5127
97.5% Chebyshev(Mean, Sd) UCL	6596	99% Chebyshev(Mean, Sd) UCL 9481

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 5127

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cadmium

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	21
		Number of Missing Observations	5
Number of Detects	18	Number of Non-Detects	7
Number of Distinct Detects	17	Number of Distinct Non-Detects	5
Minimum Detect	0.24	Minimum Non-Detect	1
Maximum Detect	586	Maximum Non-Detect	1.3
Variance Detects	18865	Percent Non-Detects	28%
Mean Detects	43.05	SD Detects	137.4
Median Detects	0.71	CV Detects	3.19
Skewness Detects	4.064	Kurtosis Detects	16.87
Mean of Logged Detects	0.829	SD of Logged Detects	2.353

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.348
5% Shapiro Wilk Critical Value	0.897
Lilliefors Test Statistic	0.4
5% Lilliefors Critical Value	0.209

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	31.13	Standard Error of Mean	23.64
SD	114.9	95% KM (BCA) UCL	76.55
95% KM (t) UCL	71.57	95% KM (Percentile Bootstrap) UCL	75.92
95% KM (z) UCL	70.01	95% KM Bootstrap t UCL	281
90% KM Chebyshev UCL	102	95% KM Chebyshev UCL	134.2
97.5% KM Chebyshev UCL	178.8	99% KM Chebyshev UCL	266.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.201
5% A-D Critical Value	0.869
K-S Test Statistic	0.291
5% K-S Critical Value	0.224

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.243
Theta hat (MLE)	177
nu hat (MLE)	8.756
MLE Mean (bias corrected)	43.05

k star (bias corrected MLE)	0.24
Theta star (bias corrected MLE)	179.6
nu star (bias corrected)	8.63
MLE Sd (bias corrected)	87.93

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0735	nu hat (KM)	3.673
Approximate Chi Square Value (3.67, α)	0.597	Adjusted Chi Square Value (3.67, β)	0.522
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	191.6	95% Gamma Adjusted KM-UCL (use when $n < 50$)	218.9

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cadmium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	31
Maximum	586	Median	0.45
SD	117.3	CV	3.783
k hat (MLE)	0.181	k star (bias corrected MLE)	0.186
Theta hat (MLE)	171.2	Theta star (bias corrected MLE)	166.6
nu hat (MLE)	9.055	nu star (bias corrected)	9.301
MLE Mean (bias corrected)	31	MLE Sd (bias corrected)	71.88
		Adjusted Level of Significance (β)	0.0395
Approximate Chi Square Value (9.30, α)	3.51	Adjusted Chi Square Value (9.30, β)	3.271
95% Gamma Approximate UCL (use when $n \geq 50$)	82.15	95% Gamma Adjusted UCL (use when $n < 50$)	88.16

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.849
5% Shapiro Wilk Critical Value	0.897
Lilliefors Test Statistic	0.234
5% Lilliefors Critical Value	0.209

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	31.19	Mean in Log Scale	0.45
SD in Original Scale	117.2	SD in Log Scale	2.097
95% t UCL (assumes normality of ROS data)	71.3	95% Percentile Bootstrap UCL	77.71
95% BCA Bootstrap UCL	103.3	95% Bootstrap t UCL	286.1
95% H-UCL (Log ROS)	83		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	31.16
SD in Original Scale	117.2
95% t UCL (Assumes normality)	71.27

DL/2 Log-Transformed

Mean in Log Scale	0.441
SD in Log Scale	2.08
95% H-Stat UCL	77.39

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

99% KM (Chebyshev) UCL

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chromium

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Number of Detects	24	Number of Non-Detects	1
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	8.3	Minimum Non-Detect	18
Maximum Detect	248	Maximum Non-Detect	18
Variance Detects	2369	Percent Non-Detects	4%
Mean Detects	42.18	SD Detects	48.67
Median Detects	28.3	CV Detects	1.154
Skewness Detects	3.621	Kurtosis Detects	14.81
Mean of Logged Detects	3.424	SD of Logged Detects	0.733

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.556
5% Shapiro Wilk Critical Value	0.916
Lilliefors Test Statistic	0.343
5% Lilliefors Critical Value	0.181

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	40.99	Standard Error of Mean	9.613
SD	47.05	95% KM (BCA) UCL	59.12
95% KM (t) UCL	57.43	95% KM (Percentile Bootstrap) UCL	58.44
95% KM (z) UCL	56.8	95% KM Bootstrap t UCL	81.08
90% KM Chebyshev UCL	69.83	95% KM Chebyshev UCL	82.89
97.5% KM Chebyshev UCL	101	99% KM Chebyshev UCL	136.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.257
5% A-D Critical Value	0.759
K-S Test Statistic	0.23
5% K-S Critical Value	0.181

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.718
Theta hat (MLE)	24.55
nu hat (MLE)	82.47
MLE Mean (bias corrected)	42.18

k star (bias corrected MLE)	1.531
Theta star (bias corrected MLE)	27.55
nu star (bias corrected)	73.5
MLE Sd (bias corrected)	34.09

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.759
Approximate Chi Square Value (37.94, α)	24.84
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	62.61

nu hat (KM)	37.94
Adjusted Chi Square Value (37.94, β)	24.11
95% Gamma Adjusted KM-UCL (use when $n < 50$)	64.49

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chromium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	40.5
Maximum	248	Median	27.5
SD	48.39	CV	1.195
k hat (MLE)	0.968	k star (bias corrected MLE)	0.878
Theta hat (MLE)	41.84	Theta star (bias corrected MLE)	46.11
nu hat (MLE)	48.39	nu star (bias corrected)	43.92
MLE Mean (bias corrected)	40.5	MLE Sd (bias corrected)	43.21
		Adjusted Level of Significance (β)	0.0395
Approximate Chi Square Value (43.92, α)	29.72	Adjusted Chi Square Value (43.92, β)	28.92
95% Gamma Approximate UCL (use when $n \geq 50$)	59.84	95% Gamma Adjusted UCL (use when $n < 50$)	61.49

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.939
5% Shapiro Wilk Critical Value	0.916
Lilliefors Test Statistic	0.164
5% Lilliefors Critical Value	0.181

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	40.97	Mean in Log Scale	3.386
SD in Original Scale	48.03	SD in Log Scale	0.742
95% t UCL (assumes normality of ROS data)	57.41	95% Percentile Bootstrap UCL	58.16
95% BCA Bootstrap UCL	66.36	95% Bootstrap t UCL	80.84
95% H-UCL (Log ROS)	54.22		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.386	95% H-UCL (KM -Log)	53.21
KM SD (logged)	0.728	95% Critical H Value (KM-Log)	2.174
KM Standard Error of Mean (logged)	0.149		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	40.86
SD in Original Scale	48.11
95% t UCL (Assumes normality)	57.32

DL/2 Log-Transformed

Mean in Log Scale	3.375
SD in Log Scale	0.759
95% H-Stat UCL	54.82

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 82.89

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cobalt

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	22
		Number of Missing Observations	5
Number of Detects	24	Number of Non-Detects	1
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	1.3	Minimum Non-Detect	6.3
Maximum Detect	65.9	Maximum Non-Detect	6.3
Variance Detects	159.8	Percent Non-Detects	4%
Mean Detects	7.702	SD Detects	12.64
Median Detects	5.1	CV Detects	1.641
Skewness Detects	4.595	Kurtosis Detects	21.93
Mean of Logged Detects	1.616	SD of Logged Detects	0.785

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.384	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.38	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	7.549	Standard Error of Mean	2.484
SD	12.15	95% KM (BCA) UCL	12.6
95% KM (t) UCL	11.8	95% KM (Percentile Bootstrap) UCL	12.46
95% KM (z) UCL	11.63	95% KM Bootstrap t UCL	23.81
90% KM Chebyshev UCL	15	95% KM Chebyshev UCL	18.38
97.5% KM Chebyshev UCL	23.06	99% KM Chebyshev UCL	32.26

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.881	Anderson-Darling GOF Test	
5% A-D Critical Value	0.765	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.224	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.182	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.318	k star (bias corrected MLE)	1.181
Theta hat (MLE)	5.845	Theta star (bias corrected MLE)	6.523
nu hat (MLE)	63.25	nu star (bias corrected)	56.68
MLE Mean (bias corrected)	7.702	MLE Sd (bias corrected)	7.088

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.386	nu hat (KM)	19.29
Approximate Chi Square Value (19.29, α)	10.33	Adjusted Chi Square Value (19.29, β)	9.883
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	14.1	95% Gamma Adjusted KM-UCL (use when $n < 50$)	14.73

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cobalt (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	1.3	Mean	7.48
Maximum	65.9	Median	5
SD	12.43	CV	1.661
k hat (MLE)	1.305	k star (bias corrected MLE)	1.175
Theta hat (MLE)	5.733	Theta star (bias corrected MLE)	6.367
nu hat (MLE)	65.23	nu star (bias corrected)	58.74
MLE Mean (bias corrected)	7.48	MLE Sd (bias corrected)	6.901
		Adjusted Level of Significance (β)	0.0395
Approximate Chi Square Value (58.74, α)	42.12	Adjusted Chi Square Value (58.74, β)	41.16
95% Gamma Approximate UCL (use when $n \geq 50$)	10.43	95% Gamma Adjusted UCL (use when $n < 50$)	10.68

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.894
5% Shapiro Wilk Critical Value	0.916
Lilliefors Test Statistic	0.143
5% Lilliefors Critical Value	0.181

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	7.537	Mean in Log Scale	1.603
SD in Original Scale	12.4	SD in Log Scale	0.772
95% t UCL (assumes normality of ROS data)	11.78	95% Percentile Bootstrap UCL	12.27
95% BCA Bootstrap UCL	14.79	95% Bootstrap t UCL	24.57
95% H-UCL (Log ROS)	9.495		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.602	95% H-UCL (KM -Log)	9.367
KM SD (logged)	0.763	95% Critical H Value (KM-Log)	2.213
KM Standard Error of Mean (logged)	0.157		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	7.52
SD in Original Scale	12.41
95% t UCL (Assumes normality)	11.77

DL/2 Log-Transformed

Mean in Log Scale	1.598
SD in Log Scale	0.775
95% H-Stat UCL	9.482

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Approximate Lognormal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (Chebyshev) UCL 18.38

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Copper

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Minimum	2.9	Mean	41.46
Maximum	271	Median	10.7
SD	72.86	Std. Error of Mean	14.57
Coefficient of Variation	1.758	Skewness	2.44
Normal GOF Test			
Shapiro Wilk Test Statistic	0.54	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.346	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	66.39	95% Adjusted-CLT UCL (Chen-1995)	73.02
		95% Modified-t UCL (Johnson-1978)	67.57
Gamma GOF Test			
A-D Test Statistic	2.526	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.791	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.261	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.182	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.666	k star (bias corrected MLE)	0.613
Theta hat (MLE)	62.22	Theta star (bias corrected MLE)	67.63
nu hat (MLE)	33.31	nu star (bias corrected)	30.65
MLE Mean (bias corrected)	41.46	MLE Sd (bias corrected)	52.95
		Approximate Chi Square Value (0.05)	19
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	18.38
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	66.86	95% Adjusted Gamma UCL (use when n<50)	69.14
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.88	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.175	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Copper (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	1.065	Mean of logged Data	2.811
Maximum of Logged Data	5.602	SD of logged Data	1.221

Assuming Lognormal Distribution			
95% H-UCL	70.26	90% Chebyshev (MVUE) UCL	62.33
95% Chebyshev (MVUE) UCL	75.43	97.5% Chebyshev (MVUE) UCL	93.62
99% Chebyshev (MVUE) UCL	129.3		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	65.42	95% Jackknife UCL	66.39
95% Standard Bootstrap UCL	64.63	95% Bootstrap-t UCL	78.74
95% Hall's Bootstrap UCL	62.04	95% Percentile Bootstrap UCL	68.7
95% BCA Bootstrap UCL	71.67		
90% Chebyshev(Mean, Sd) UCL	85.17	95% Chebyshev(Mean, Sd) UCL	105
97.5% Chebyshev(Mean, Sd) UCL	132.5	99% Chebyshev(Mean, Sd) UCL	186.4

Suggested UCL to Use
 95% Chebyshev (Mean, Sd) UCL 105

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Iron

General Statistics

Total Number of Observations	25	Number of Distinct Observations	24
		Number of Missing Observations	5
Minimum	5210	Mean	23260
Maximum	82400	Median	17900
SD	16021	Std. Error of Mean	3204
Coefficient of Variation	0.689	Skewness	2.22

Normal GOF Test

Shapiro Wilk Test Statistic	0.808
5% Shapiro Wilk Critical Value	0.918
Lilliefors Test Statistic	0.157
5% Lilliefors Critical Value	0.177

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level**Assuming Normal Distribution****95% Normal UCL**95% Student's-t UCL 28742**95% UCLs (Adjusted for Skewness)**

95% Adjusted-CLT UCL (Chen-1995) 30051

95% Modified-t UCL (Johnson-1978) 28979

Gamma GOF Test

A-D Test Statistic	0.27
5% A-D Critical Value	0.752
K-S Test Statistic	0.106
5% K-S Critical Value	0.176

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics**

k hat (MLE)	2.805
Theta hat (MLE)	8293
nu hat (MLE)	140.2
MLE Mean (bias corrected)	23260
Adjusted Level of Significance	0.0395

k star (bias corrected MLE)	2.495
Theta star (bias corrected MLE)	9323
nu star (bias corrected)	124.7
MLE Sd (bias corrected)	14726
Approximate Chi Square Value (0.05)	99.95
Adjusted Chi Square Value	98.44

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)) 29031

95% Adjusted Gamma UCL (use when n<50) 29477

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979
5% Shapiro Wilk Critical Value	0.918
Lilliefors Test Statistic	0.0885
5% Lilliefors Critical Value	0.177

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Iron (cont.'d)

Lognormal Statistics

Minimum of Logged Data	8.558	Mean of logged Data	9.866
Maximum of Logged Data	11.32	SD of logged Data	0.631

Assuming Lognormal Distribution

95% H-UCL	30696	90% Chebyshev (MVUE) UCL	32637
95% Chebyshev (MVUE) UCL	36876	97.5% Chebyshev (MVUE) UCL	42761
99% Chebyshev (MVUE) UCL	54319		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	28531	95% Jackknife UCL	28742
95% Standard Bootstrap UCL	28479	95% Bootstrap-t UCL	31340
95% Hall's Bootstrap UCL	51012	95% Percentile Bootstrap UCL	28866
95% BCA Bootstrap UCL	29976		
90% Chebyshev(Mean, Sd) UCL	32873	95% Chebyshev(Mean, Sd) UCL	37227
97.5% Chebyshev(Mean, Sd) UCL	43270	99% Chebyshev(Mean, Sd) UCL	55141

Suggested UCL to Use

95% Student's-t UCL 28742

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Minimum	4.4	Mean	1771
Maximum	13700	Median	29.05
SD	4033	Std. Error of Mean	806.5
Coefficient of Variation	2.277	Skewness	2.436
Normal GOF Test			
Shapiro Wilk Test Statistic	0.492	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.373	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3151	95% Adjusted-CLT UCL (Chen-1995)	3518
		95% Modified-t UCL (Johnson-1978)	3217
Gamma GOF Test			
A-D Test Statistic	2.52	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.878	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.276	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.192	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.245	k star (bias corrected MLE)	0.242
Theta hat (MLE)	7233	Theta star (bias corrected MLE)	7314
nu hat (MLE)	12.24	nu star (bias corrected)	12.11
MLE Mean (bias corrected)	1771	MLE Sd (bias corrected)	3599
		Approximate Chi Square Value (0.05)	5.299
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	4.993
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4048	95% Adjusted Gamma UCL (use when n<50)	4295
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.225	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead (cont.'d)

Lognormal Statistics

Minimum of Logged Data	1.482	Mean of logged Data	4.569
Maximum of Logged Data	9.525	SD of logged Data	2.582

Assuming Lognormal Distribution

95% H-UCL	36535	90% Chebyshev (MVUE) UCL	5266
95% Chebyshev (MVUE) UCL	6863	97.5% Chebyshev (MVUE) UCL	9080
99% Chebyshev (MVUE) UCL	13434		

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

95% CLT UCL	3098	95% Jackknife UCL	3151
95% Standard Bootstrap UCL	3042	95% Bootstrap-t UCL	3992
95% Hall's Bootstrap UCL	2846	95% Percentile Bootstrap UCL	3196
95% BCA Bootstrap UCL	3556		
90% Chebyshev(Mean, Sd) UCL	4191	95% Chebyshev(Mean, Sd) UCL	5287
97.5% Chebyshev(Mean, Sd) UCL	6808	99% Chebyshev(Mean, Sd) UCL	9796

Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL 9796

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Minimum	23.6	Mean	276
Maximum	1950	Median	122
SD	394.3	Std. Error of Mean	78.87
Coefficient of Variation	1.429	Skewness	3.43
Normal GOF Test			
Shapiro Wilk Test Statistic	0.601	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.261	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	410.9	95% Adjusted-CLT UCL (Chen-1995)	463.5
		95% Modified-t UCL (Johnson-1978)	420
Gamma GOF Test			
A-D Test Statistic	0.764	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.777	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.18	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.895	k star (bias corrected MLE)	0.814
Theta hat (MLE)	308.3	Theta star (bias corrected MLE)	338.9
nu hat (MLE)	44.76	nu star (bias corrected)	40.72
MLE Mean (bias corrected)	276	MLE Sd (bias corrected)	305.8
		Approximate Chi Square Value (0.05)	27.1
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	26.34
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	414.8	95% Adjusted Gamma UCL (use when n<50)	426.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.952	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Manganese (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	3.161	Mean of logged Data	4.967
Maximum of Logged Data	7.576	SD of logged Data	1.158

Assuming Lognormal Distribution			
95% H-UCL	531.9	90% Chebyshev (MVUE) UCL	488
95% Chebyshev (MVUE) UCL	587.1	97.5% Chebyshev (MVUE) UCL	724.6
99% Chebyshev (MVUE) UCL	994.7		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	405.7	95% Jackknife UCL	410.9
95% Standard Bootstrap UCL	401.2	95% Bootstrap-t UCL	545.7
95% Hall's Bootstrap UCL	932.3	95% Percentile Bootstrap UCL	411.7
95% BCA Bootstrap UCL	481.4		
90% Chebyshev(Mean, Sd) UCL	512.6	95% Chebyshev(Mean, Sd) UCL	619.8
97.5% Chebyshev(Mean, Sd) UCL	768.5	99% Chebyshev(Mean, Sd) UCL	1061

Suggested UCL to Use
 95% Adjusted Gamma UCL 426.7

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Mercury

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	20
		Number of Missing Observations	8
Number of Detects	18	Number of Non-Detects	4
Number of Distinct Detects	16	Number of Distinct Non-Detects	4
Minimum Detect	0.029	Minimum Non-Detect	0.036
Maximum Detect	0.27	Maximum Non-Detect	0.041
Variance Detects	0.00366	Percent Non-Detects	18.18%
Mean Detects	0.0789	SD Detects	0.0605
Median Detects	0.052	CV Detects	0.766
Skewness Detects	2.11	Kurtosis Detects	5.157
Mean of Logged Detects	-2.743	SD of Logged Detects	0.619

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.757
5% Shapiro Wilk Critical Value	0.897
Lilliefors Test Statistic	0.238
5% Lilliefors Critical Value	0.209

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.0704	Standard Error of Mean	0.0123
SD	0.0562	95% KM (BCA) UCL	0.0916
95% KM (t) UCL	0.0916	95% KM (Percentile Bootstrap) UCL	0.0918
95% KM (z) UCL	0.0907	95% KM Bootstrap t UCL	0.105
90% KM Chebyshev UCL	0.107	95% KM Chebyshev UCL	0.124
97.5% KM Chebyshev UCL	0.147	99% KM Chebyshev UCL	0.193

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.762
5% A-D Critical Value	0.748
K-S Test Statistic	0.207
5% K-S Critical Value	0.206

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	2.612	k star (bias corrected MLE)	2.214
Theta hat (MLE)	0.0302	Theta star (bias corrected MLE)	0.0356
nu hat (MLE)	94.05	nu star (bias corrected)	79.71
MLE Mean (bias corrected)	0.0789	MLE Sd (bias corrected)	0.053

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.573	nu hat (KM)	69.2
Approximate Chi Square Value (69.20, α)	51.05	Adjusted Chi Square Value (69.20, β)	49.88
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0955	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0977

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Mercury (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.0666
Maximum	0.27	Median	0.046
SD	0.0607	CV	0.911
k hat (MLE)	1.556	k star (bias corrected MLE)	1.374
Theta hat (MLE)	0.0428	Theta star (bias corrected MLE)	0.0484
nu hat (MLE)	68.47	nu star (bias corrected)	60.47
MLE Mean (bias corrected)	0.0666	MLE Sd (bias corrected)	0.0568
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (60.47, α)	43.58	Adjusted Chi Square Value (60.47, β)	42.51
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0924	95% Gamma Adjusted UCL (use when $n < 50$)	0.0947

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.93
5% Shapiro Wilk Critical Value	0.897
Lilliefors Test Statistic	0.179
5% Lilliefors Critical Value	0.209

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0697	Mean in Log Scale	-2.893
SD in Original Scale	0.058	SD in Log Scale	0.645
95% t UCL (assumes normality of ROS data)	0.091	95% Percentile Bootstrap UCL	0.0921
95% BCA Bootstrap UCL	0.0967	95% Bootstrap t UCL	0.104
95% H-UCL (Log ROS)	0.0923		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.87	95% H-UCL (KM -Log)	0.0902
KM SD (logged)	0.608	95% Critical H Value (KM-Log)	2.103
KM Standard Error of Mean (logged)	0.134		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.0681
SD in Original Scale	0.0593
95% t UCL (Assumes normality)	0.0898

DL/2 Log-Transformed

Mean in Log Scale	-2.961
SD in Log Scale	0.731
95% H-Stat UCL	0.0967

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.124

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Nickel

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Minimum	2.5	Mean	15.93
Maximum	76.2	Median	9.9
SD	17.79	Std. Error of Mean	3.559
Coefficient of Variation	1.117	Skewness	2.483
Normal GOF Test			
Shapiro Wilk Test Statistic	0.645	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.294	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.01	95% Adjusted-CLT UCL (Chen-1995)	23.67
		95% Modified-t UCL (Johnson-1978)	22.31
Gamma GOF Test			
A-D Test Statistic	1.447	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.219	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.178	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.481	k star (bias corrected MLE)	1.33
Theta hat (MLE)	10.75	Theta star (bias corrected MLE)	11.97
nu hat (MLE)	74.06	nu star (bias corrected)	66.51
MLE Mean (bias corrected)	15.93	MLE Sd (bias corrected)	13.81
		Approximate Chi Square Value (0.05)	48.74
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	47.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	21.73	95% Adjusted Gamma UCL (use when n<50)	22.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.165	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Nickel (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	0.916	Mean of logged Data	2.394
Maximum of Logged Data	4.333	SD of logged Data	0.815
Assuming Lognormal Distribution			
95% H-UCL	22.28	90% Chebyshev (MVUE) UCL	23.07
95% Chebyshev (MVUE) UCL	26.72	97.5% Chebyshev (MVUE) UCL	31.78
99% Chebyshev (MVUE) UCL	41.73		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	21.78	95% Jackknife UCL	22.01
95% Standard Bootstrap UCL	21.67	95% Bootstrap-t UCL	27.68
95% Hall's Bootstrap UCL	27.11	95% Percentile Bootstrap UCL	22.33
95% BCA Bootstrap UCL	23.9		
90% Chebyshev(Mean, Sd) UCL	26.6	95% Chebyshev(Mean, Sd) UCL	31.44
97.5% Chebyshev(Mean, Sd) UCL	38.15	99% Chebyshev(Mean, Sd) UCL	51.33
Suggested UCL to Use			
95% H-UCL	22.28		

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
 H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
 It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
 Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Selenium

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	11
		Number of Missing Observations	5
Number of Detects	4	Number of Non-Detects	21
Number of Distinct Detects	4	Number of Distinct Non-Detects	7
Minimum Detect	2.9	Minimum Non-Detect	2.1
Maximum Detect	110	Maximum Non-Detect	2.6
Variance Detects	2555	Percent Non-Detects	84%
Mean Detects	34.55	SD Detects	50.54
Median Detects	12.65	CV Detects	1.463
Skewness Detects	1.942	Kurtosis Detects	3.815
Mean of Logged Detects	2.702	SD of Logged Detects	1.506

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.721
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.401
5% Lilliefors Critical Value	0.443

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	7.292	Standard Error of Mean	4.888
SD	21.17	95% KM (BCA) UCL	N/A
95% KM (t) UCL	15.66	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	15.33	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	21.96	95% KM Chebyshev UCL	28.6
97.5% KM Chebyshev UCL	37.82	99% KM Chebyshev UCL	55.93

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.4
5% A-D Critical Value	0.672
K-S Test Statistic	0.333
5% K-S Critical Value	0.406

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.717	k star (bias corrected MLE)	0.346
Theta hat (MLE)	48.2	Theta star (bias corrected MLE)	99.89
nu hat (MLE)	5.735	nu star (bias corrected)	2.767
MLE Mean (bias corrected)	34.55	MLE Sd (bias corrected)	58.75

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.119	nu hat (KM)	5.934
Approximate Chi Square Value (5.93, α)	1.606	Adjusted Chi Square Value (5.93, β)	1.458
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	26.94	95% Gamma Adjusted KM-UCL (use when $n < 50$)	29.67

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Selenium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	5.536
Maximum	110	Median	0.01
SD	22.05	CV	3.983
k hat (MLE)	0.149	k star (bias corrected MLE)	0.158
Theta hat (MLE)	37.06	Theta star (bias corrected MLE)	35.01
nu hat (MLE)	7.47	nu star (bias corrected)	7.907
MLE Mean (bias corrected)	5.536	MLE Sd (bias corrected)	13.92
		Adjusted Level of Significance (β)	0.0395
Approximate Chi Square Value (7.91, α)	2.681	Adjusted Chi Square Value (7.91, β)	2.478
95% Gamma Approximate UCL (use when $n \geq 50$)	16.33	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.25
5% Lilliefors Critical Value	0.443

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.556	Mean in Log Scale	-4.059
SD in Original Scale	22.05	SD in Log Scale	3.781
95% t UCL (assumes normality of ROS data)	13.1	95% Percentile Bootstrap UCL	14.05
95% BCA Bootstrap UCL	18.63	95% Bootstrap t UCL	59.83
95% H-UCL (Log ROS)	4879		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.056	95% H-UCL (KM -Log)	6.534
KM SD (logged)	0.888	95% Critical H Value (KM-Log)	2.357
KM Standard Error of Mean (logged)	0.205		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	6.493
SD in Original Scale	21.81
95% t UCL (Assumes normality)	13.95

DL/2 Log-Transformed

Mean in Log Scale	0.547
SD in Log Scale	1.099
95% H-Stat UCL	5.697

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 15.66

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Vanadium

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	24
		Number of Missing Observations	5
Minimum	15.5	Mean	31.17
Maximum	61.5	Median	26.9
SD	11.89	Std. Error of Mean	2.377
Coefficient of Variation	0.381	Skewness	1.103
Normal GOF Test			
Shapiro Wilk Test Statistic	0.89	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35.23	95% Adjusted-CLT UCL (Chen-1995)	35.64
		95% Modified-t UCL (Johnson-1978)	35.32
Gamma GOF Test			
A-D Test Statistic	0.644	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.175	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.175	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.134	k star (bias corrected MLE)	7.185
Theta hat (MLE)	3.832	Theta star (bias corrected MLE)	4.338
nu hat (MLE)	406.7	nu star (bias corrected)	359.2
MLE Mean (bias corrected)	31.17	MLE Sd (bias corrected)	11.63
		Approximate Chi Square Value (0.05)	316.3
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	313.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	35.4	95% Adjusted Gamma UCL (use when n<50)	35.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.154	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Vanadium (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	2.741	Mean of logged Data	3.377
Maximum of Logged Data	4.119	SD of logged Data	0.354

Assuming Lognormal Distribution			
95% H-UCL	35.63	90% Chebyshev (MVUE) UCL	37.83
95% Chebyshev (MVUE) UCL	40.89	97.5% Chebyshev (MVUE) UCL	45.13
99% Chebyshev (MVUE) UCL	53.47		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	35.08	95% Jackknife UCL	35.23
95% Standard Bootstrap UCL	34.97	95% Bootstrap-t UCL	35.91
95% Hall's Bootstrap UCL	35.65	95% Percentile Bootstrap UCL	35.12
95% BCA Bootstrap UCL	35.45		
90% Chebyshev(Mean, Sd) UCL	38.3	95% Chebyshev(Mean, Sd) UCL	41.53
97.5% Chebyshev(Mean, Sd) UCL	46.01	99% Chebyshev(Mean, Sd) UCL	54.82

Suggested UCL to Use
 95% Adjusted Gamma UCL 35.7

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

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 12/8/2014 2:38:37 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Zinc

General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	5
Minimum	12.7	Mean	1570
Maximum	16900	Median	39.7
SD	4043	Std. Error of Mean	808.6
Coefficient of Variation	2.575	Skewness	3.022
Normal GOF Test			
Shapiro Wilk Test Statistic	0.451	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.396	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2954	95% Adjusted-CLT UCL (Chen-1995)	3423
		95% Modified-t UCL (Johnson-1978)	3035
Gamma GOF Test			
A-D Test Statistic	3.639	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.868	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.334	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.191	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.266	k star (bias corrected MLE)	0.261
Theta hat (MLE)	5904	Theta star (bias corrected MLE)	6023
nu hat (MLE)	13.3	nu star (bias corrected)	13.04
MLE Mean (bias corrected)	1570	MLE Sd (bias corrected)	3075
		Approximate Chi Square Value (0.05)	5.917
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	5.592
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3459	95% Adjusted Gamma UCL (use when n<50)	3661
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.797	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.251	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.177	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

TABLE G.6

**SUMMARY OF ProUCL OUTPUT FOR SOIL
OU5
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 12/8/2014 2:38:37 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Zinc (cont.'d)

Lognormal Statistics			
Minimum of Logged Data	2.542	Mean of logged Data	4.715
Maximum of Logged Data	9.735	SD of logged Data	2.154

Assuming Lognormal Distribution			
95% H-UCL	7283	90% Chebyshev (MVUE) UCL	2372
95% Chebyshev (MVUE) UCL	3046	97.5% Chebyshev (MVUE) UCL	3982
99% Chebyshev (MVUE) UCL	5821		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	2900	95% Jackknife UCL	2954
95% Standard Bootstrap UCL	2877	95% Bootstrap-t UCL	4516
95% Hall's Bootstrap UCL	3116	95% Percentile Bootstrap UCL	2992
95% BCA Bootstrap UCL	3736		
90% Chebyshev(Mean, Sd) UCL	3996	95% Chebyshev(Mean, Sd) UCL	5095
97.5% Chebyshev(Mean, Sd) UCL	6620	99% Chebyshev(Mean, Sd) UCL	9616

Suggested UCL to Use
 97.5% Chebyshev (Mean, Sd) UCL 6620

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

TABLE G.7

SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

User Selected Options
Date/Time of Computation 2/2/2015 10:23
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)Pyrene**General Statistics**

Total Number of Observations	16	Number of Distinct Observations	14
Number of Detects	12	Number of Non-Detects	4
Number of Distinct Detects	11	Number of Distinct Non-Detects	3
Minimum Detect	0.005	Minimum Non-Detect	0.038
Maximum Detect	0.1	Maximum Non-Detect	0.047
Variance Detects	7.7452E-4	Percent Non-Detects	25%
Mean Detects	0.0272	SD Detects	0.0278
Median Detects	0.0135	CV Detects	1.023
Skewness Detects	1.879	Kurtosis Detects	3.646
Mean of Logged Detects	-3.995	SD of Logged Detects	0.89

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.743
5% Shapiro Wilk Critical Value	0.859
Lilliefors Test Statistic	0.336
5% Lilliefors Critical Value	0.256

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.0235	Standard Error of Mean	0.00638
SD	0.0242	95% KM (BCA) UCL	0.0359
95% KM (t) UCL	0.0347	95% KM (Percentile Bootstrap) UCL	0.0344
95% KM (z) UCL	0.034	95% KM Bootstrap t UCL	0.0422
90% KM Chebyshev UCL	0.0427	95% KM Chebyshev UCL	0.0513
97.5% KM Chebyshev UCL	0.0634	99% KM Chebyshev UCL	0.087

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.788
5% A-D Critical Value	0.747
K-S Test Statistic	0.305
5% K-S Critical Value	0.25

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.424	k star (bias corrected MLE)	1.124
Theta hat (MLE)	0.0191	Theta star (bias corrected MLE)	0.0242
nu hat (MLE)	34.18	nu star (bias corrected)	26.97
MLE Mean (bias corrected)	0.0272	MLE Sd (bias corrected)	0.0257

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.944	nu hat (KM)	30.21
Approximate Chi Square Value (30.21, α)	18.66	Adjusted Chi Square Value (30.21, β)	17.63
95% Gamma Approximate KM-UCL (use when n>=50)	0.0381	95% Gamma Adjusted KM-UCL (use when n<50)	0.0403

TABLE G.7

SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

User Selected Options
Date/Time of Computation 2/2/2015 10:23
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)Pyrene (cont'd)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.005	Mean	0.0237
Maximum	0.1	Median	0.0135
SD	0.0247	CV	1.045
k hat (MLE)	1.601	k star (bias corrected MLE)	1.343
Theta hat (MLE)	0.0148	Theta star (bias corrected MLE)	0.0176
nu hat (MLE)	51.24	nu star (bias corrected)	42.96
MLE Mean (bias corrected)	0.0237	MLE Sd (bias corrected)	0.0204
		Adjusted Level of Significance (β)	0.0335
Approximate Chi Square Value (42.96, α)	28.93	Adjusted Chi Square Value (42.96, β)	27.63
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0351	95% Gamma Adjusted UCL (use when $n < 50$)	0.0368

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.258	Lilliefors GOF Test
5% Lilliefors Critical Value	0.256	Detected Data Not Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0236	Mean in Log Scale	-4.094
SD in Original Scale	0.0247	SD in Log Scale	0.792
95% t UCL (assumes normality of ROS data)	0.0344	95% Percentile Bootstrap UCL	0.034
95% BCA Bootstrap UCL	0.037	95% Bootstrap t UCL	0.0438
95% H-UCL (Log ROS)	0.0372		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.119	95% H-UCL (KM -Log)	0.0368
KM SD (logged)	0.798	95% Critical H Value (KM-Log)	2.41
KM Standard Error of Mean (logged)	0.218		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.0255
SD in Original Scale	0.0241
95% t UCL (Assumes normality)	0.036

DL/2 Log-Transformed

Mean in Log Scale	-3.972
SD in Log Scale	0.765
95% H-Stat UCL	0.0402

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL 0.0359

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

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

TABLE G.7

SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

User Selected Options	
Date/Time of Computation	2/2/2015 10:23
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

TABLE G.7

**SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 2/2/2015 10:23
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Antimony**General Statistics**

Total Number of Observations	10	Number of Distinct Observations	6
		Number of Missing Observations	5
Number of Detects	6	Number of Non-Detects	4
Number of Distinct Detects	5	Number of Distinct Non-Detects	2
Minimum Detect	1.9	Minimum Non-Detect	2.1
Maximum Detect	14	Maximum Non-Detect	2.4
Variance Detects	23.45	Percent Non-Detects	40%
Mean Detects	4.133	SD Detects	4.842
Median Detects	2.2	CV Detects	1.171
Skewness Detects	2.43	Kurtosis Detects	5.926
Mean of Logged Detects	1.074	SD of Logged Detects	0.777

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.548
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.458
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	3.253	Standard Error of Mean	1.244
SD	3.59	95% KM (BCA) UCL	5.655
95% KM (t) UCL	5.533	95% KM (Percentile Bootstrap) UCL	5.62
95% KM (z) UCL	5.299	95% KM Bootstrap t UCL	32.27
90% KM Chebyshev UCL	6.984	95% KM Chebyshev UCL	8.674
97.5% KM Chebyshev UCL	11.02	99% KM Chebyshev UCL	15.63

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.298
5% A-D Critical Value	0.707
K-S Test Statistic	0.439
5% K-S Critical Value	0.337

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.597
Theta hat (MLE)	2.588
nu hat (MLE)	19.17
MLE Mean (bias corrected)	4.133

k star (bias corrected MLE)	0.91
Theta star (bias corrected MLE)	4.543
nu star (bias corrected)	10.92
MLE Sd (bias corrected)	4.334

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.821
Approximate Chi Square Value (16.43, α)	8.265
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	6.467

nu hat (KM)	16.43
Adjusted Chi Square Value (16.43, β)	7.28
95% Gamma Adjusted KM-UCL (use when $n < 50$)	7.341

TABLE G.7

**SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 2/2/2015 10:23
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Antimony (cont'd)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	2.949
Maximum	14	Median	1.95
SD	3.962	CV	1.343
k hat (MLE)	0.76	k star (bias corrected MLE)	0.599
Theta hat (MLE)	3.88	Theta star (bias corrected MLE)	4.925
nu hat (MLE)	15.2	nu star (bias corrected)	11.98
MLE Mean (bias corrected)	2.949	MLE Sd (bias corrected)	3.811
		Adjusted Level of Significance (β)	0.0267
Approximate Chi Square Value (11.98, α)	5.211	Adjusted Chi Square Value (11.98, β)	4.46
95% Gamma Approximate UCL (use when $n \geq 50$)	6.777	95% Gamma Adjusted UCL (use when $n < 50$)	7.918

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.638	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.394	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.24	Mean in Log Scale	0.892
SD in Original Scale	3.799	SD in Log Scale	0.642
95% t UCL (assumes normality of ROS data)	5.442	95% Percentile Bootstrap UCL	5.59
95% BCA Bootstrap UCL	6.827	95% Bootstrap t UCL	19.42
95% H-UCL (Log ROS)	5.05		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	2.915
SD in Original Scale	3.937
95% t UCL (Assumes normality)	5.197

DL/2 Log-Transformed

Mean in Log Scale	0.678
SD in Log Scale	0.774
95% H-Stat UCL	5.285

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

95% KM (t) UCL	5.533	95% KM (% Bootstrap) UCL	5.62

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

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

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

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

TABLE G.7

**SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 2/2/2015 10:23
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	20.3	Mean	93.84
Maximum	709	Median	47.35
SD	165.8	Std. Error of Mean	41.44
Coefficient of Variation	1.766	Skewness	3.862
Normal GOF Test			
Shapiro Wilk Test Statistic	0.401	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.406	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.222	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	166.5	95% Adjusted-CLT UCL (Chen-1995)	204.8
		95% Modified-t UCL (Johnson-1978)	173.2
Gamma GOF Test			
A-D Test Statistic	1.96	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.3	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.221	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.115	k star (bias corrected MLE)	0.948
Theta hat (MLE)	84.14	Theta star (bias corrected MLE)	99.01
nu hat (MLE)	35.69	nu star (bias corrected)	30.33
MLE Mean (bias corrected)	93.84	MLE Sd (bias corrected)	96.39
		Approximate Chi Square Value (0.05)	18.75
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	17.72
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	151.8	95% Adjusted Gamma UCL (use when n<50)	160.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.826	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.196	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.222	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			

TABLE G.7

**SUMMARY OF PROUCL OUTPUT FOR SURFACE SOIL
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 2/2/2015 10:23
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead (cont'd)**Lognormal Statistics**

Minimum of Logged Data	3.011	Mean of logged Data	4.03
Maximum of Logged Data	6.564	SD of logged Data	0.823

Assuming Lognormal Distribution

95% H-UCL	132.7	90% Chebyshev (MVUE) UCL	127.8
95% Chebyshev (MVUE) UCL	150.9	97.5% Chebyshev (MVUE) UCL	183
99% Chebyshev (MVUE) UCL	245.9		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	162	95% Jackknife UCL	166.5
95% Standard Bootstrap UCL	158.7	95% Bootstrap-t UCL	495
95% Hall's Bootstrap UCL	470.1	95% Percentile Bootstrap UCL	173.4
95% BCA Bootstrap UCL	220.8		
90% Chebyshev(Mean, Sd) UCL	218.2	95% Chebyshev(Mean, Sd) UCL	274.5
97.5% Chebyshev(Mean, Sd) UCL	352.6	99% Chebyshev(Mean, Sd) UCL	506.1

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 274.5

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Methylnaphthalene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	9
Number of Detects	3	Number of Non-Detects	9
Number of Distinct Detects	3	Number of Distinct Non-Detects	6
Minimum Detect	0.59	Minimum Non-Detect	0.39
Maximum Detect	1.5	Maximum Non-Detect	0.49
Variance Detects	0.208	Percent Non-Detects	75%
Mean Detects	1.063	SD Detects	0.456
Median Detects	1.1	CV Detects	0.429
Skewness Detects	-0.359	Kurtosis Detects	N/A
Mean of Logged Detects	-0.00895	SD of Logged Detects	0.475

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.995	Detected Data appear Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.767	Lilliefors GOF Test	
Lilliefors Test Statistic	0.199	Detected Data appear Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.512		

Detected Data appear Normal at 5% Significance Level

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

Mean	0.558	Standard Error of Mean	0.122
SD	0.346	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.778	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.76	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.925	95% KM Chebyshev UCL	1.091
97.5% KM Chebyshev UCL	1.322	99% KM Chebyshev UCL	1.775

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	7.269	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.146	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	43.61	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.605	nu hat (KM)	62.51
Approximate Chi Square Value (62.51, α)	45.33	Adjusted Level of Significance (β)	0.029
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.77	Adjusted Chi Square Value (62.51, β)	43.1
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.81

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

2-Methylnaphthalene (cont.'d)**Lognormal GOF Test on Detected Observations Only**

Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.253	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.362	Mean in Log Scale	-1.604
SD in Original Scale	0.468	SD in Log Scale	1.051
95% t UCL (assumes normality of ROS data)	0.604	95% Percentile Bootstrap UCL	0.599
95% BCA Bootstrap UCL	0.649	95% Bootstrap t UCL	0.995
95% H-UCL (Log ROS)	0.905		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.708	95% H-UCL (KM -Log)	0.721
KM SD (logged)	0.448	95% Critical H Value (KM-Log)	2.079
KM Standard Error of Mean (logged)	0.158		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.424
SD in Original Scale	0.432
95% t UCL (Assumes normality)	0.648

DL/2 Log-Transformed

Mean in Log Scale	-1.171
SD in Log Scale	0.732
95% H-Stat UCL	0.699

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL 0.778

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)anthracene**General Statistics**

Total Number of Observations	12	Number of Distinct Observations	12
Number of Detects	10	Number of Non-Detects	2
Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	0.046	Minimum Non-Detect	0.04
Maximum Detect	47	Maximum Non-Detect	0.041
Variance Detects	257.1	Percent Non-Detects	16.67%
Mean Detects	9.345	SD Detects	16.03
Median Detects	0.39	CV Detects	1.716
Skewness Detects	1.773	Kurtosis Detects	2.648
Mean of Logged Detects	-0.168	SD of Logged Detects	2.619

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.665
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.392
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	7.794	Standard Error of Mean	4.355
SD	14.31	95% KM (BCA) UCL	15.72
95% KM (t) UCL	15.62	95% KM (Percentile Bootstrap) UCL	15.51
95% KM (z) UCL	14.96	95% KM Bootstrap t UCL	23.08
90% KM Chebyshev UCL	20.86	95% KM Chebyshev UCL	26.78
97.5% KM Chebyshev UCL	34.99	99% KM Chebyshev UCL	51.13

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.879
5% A-D Critical Value	0.818
K-S Test Statistic	0.271
5% K-S Critical Value	0.289

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.289	k star (bias corrected MLE)	0.269
Theta hat (MLE)	32.36	Theta star (bias corrected MLE)	34.76
nu hat (MLE)	5.776	nu star (bias corrected)	5.376
MLE Mean (bias corrected)	9.345	MLE Sd (bias corrected)	18.02

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.297	nu hat (KM)	7.117
Approximate Chi Square Value (7.12, α)	2.235	Adjusted Chi Square Value (7.12, β)	1.841
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	24.82	95% Gamma Adjusted KM-UCL (use when $n < 50$)	30.12

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)anthracene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	7.789
Maximum	47	Median	0.23
SD	14.95	CV	1.92
k hat (MLE)	0.241	k star (bias corrected MLE)	0.237
Theta hat (MLE)	32.28	Theta star (bias corrected MLE)	32.93
nu hat (MLE)	5.792	nu star (bias corrected)	5.677
MLE Mean (bias corrected)	7.789	MLE Sd (bias corrected)	16.01
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (5.68, α)	1.477	Adjusted Chi Square Value (5.68, β)	1.177
95% Gamma Approximate UCL (use when n>=50)	29.94	95% Gamma Adjusted UCL (use when n<50)	37.58

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.877
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.186
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.787	Mean in Log Scale	-1.193
SD in Original Scale	14.95	SD in Log Scale	3.368
95% t UCL (assumes normality of ROS data)	15.54	95% Percentile Bootstrap UCL	15.26
95% BCA Bootstrap UCL	17.61	95% Bootstrap t UCL	23.28
95% H-UCL (Log ROS)	304267		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.676	95% H-UCL (KM -Log)	1403
KM SD (logged)	2.537	95% Critical H Value (KM-Log)	6.15
KM Standard Error of Mean (logged)	0.772		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	7.791
SD in Original Scale	14.95
95% t UCL (Assumes normality)	15.54

DL/2 Log-Transformed

Mean in Log Scale	-0.79
SD in Log Scale	2.779
95% H-Stat UCL	5869

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	26.78	95% GROS Adjusted Gamma UCL	37.58
95% Adjusted Gamma KM-UCL	30.12		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
Number of Detects	11	Number of Non-Detects	1
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.042	Minimum Non-Detect	0.041
Maximum Detect	39	Maximum Non-Detect	0.041
Variance Detects	167.7	Percent Non-Detects	8.333%
Mean Detects	7.235	SD Detects	12.95
Median Detects	0.25	CV Detects	1.79
Skewness Detects	1.853	Kurtosis Detects	2.882
Mean of Logged Detects	-0.398	SD of Logged Detects	2.506

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.64
5% Shapiro Wilk Critical Value	0.85
Lilliefors Test Statistic	0.404
5% Lilliefors Critical Value	0.267

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	6.635	Standard Error of Mean	3.63
SD	11.99	95% KM (BCA) UCL	13.41
95% KM (t) UCL	13.15	95% KM (Percentile Bootstrap) UCL	12.67
95% KM (z) UCL	12.61	95% KM Bootstrap t UCL	19.52
90% KM Chebyshev UCL	17.52	95% KM Chebyshev UCL	22.46
97.5% KM Chebyshev UCL	29.3	99% KM Chebyshev UCL	42.75

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.038
5% A-D Critical Value	0.824
K-S Test Statistic	0.286
5% K-S Critical Value	0.276

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.292	k star (bias corrected MLE)	0.273
Theta hat (MLE)	24.82	Theta star (bias corrected MLE)	26.54
nu hat (MLE)	6.414	nu star (bias corrected)	5.998
MLE Mean (bias corrected)	7.235	MLE Sd (bias corrected)	13.86

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.306	nu hat (KM)	7.352
Approximate Chi Square Value (7.35, α)	2.366	Adjusted Chi Square Value (7.35, β)	1.957
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	20.62	95% Gamma Adjusted KM-UCL (use when $n < 50$)	24.92

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(a)pyrene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	6.633
Maximum	39	Median	0.23
SD	12.52	CV	1.888
k hat (MLE)	0.266	k star (bias corrected MLE)	0.255
Theta hat (MLE)	24.91	Theta star (bias corrected MLE)	25.98
nu hat (MLE)	6.391	nu star (bias corrected)	6.127
MLE Mean (bias corrected)	6.633	MLE Sd (bias corrected)	13.13
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (6.13, α)	1.705	Adjusted Chi Square Value (6.13, β)	1.375
95% Gamma Approximate UCL (use when $n \geq 50$)	23.83	95% Gamma Adjusted UCL (use when $n < 50$)	29.56

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.874
5% Shapiro Wilk Critical Value	0.85
Lilliefors Test Statistic	0.199
5% Lilliefors Critical Value	0.267

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.632	Mean in Log Scale	-0.898
SD in Original Scale	12.52	SD in Log Scale	2.953
95% t UCL (assumes normality of ROS data)	13.12	95% Percentile Bootstrap UCL	13.1
95% BCA Bootstrap UCL	15.06	95% Bootstrap t UCL	19.56
95% H-UCL (Log ROS)	17477		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.631	95% H-UCL (KM -Log)	708.2
KM SD (logged)	2.415	95% Critical H Value (KM-Log)	5.876
KM Standard Error of Mean (logged)	0.731		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	6.634
SD in Original Scale	12.52
95% t UCL (Assumes normality)	13.13

DL/2 Log-Transformed

Mean in Log Scale	-0.688
SD in Log Scale	2.593
95% H-Stat UCL	1957

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL 42.75

Warning: Recommended UCL exceeds the maximum observation

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(b)fluoranthene**General Statistics**

Total Number of Observations	12	Number of Distinct Observations	12
Number of Detects	10	Number of Non-Detects	2
Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	0.071	Minimum Non-Detect	0.04
Maximum Detect	50	Maximum Non-Detect	0.041
Variance Detects	297.8	Percent Non-Detects	16.67%
Mean Detects	10.12	SD Detects	17.26
Median Detects	0.525	CV Detects	1.705
Skewness Detects	1.742	Kurtosis Detects	2.361
Mean of Logged Detects	0.0437	SD of Logged Detects	2.525

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.671
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.387
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	8.444	Standard Error of Mean	4.69
SD	15.41	95% KM (BCA) UCL	16.52
95% KM (t) UCL	16.87	95% KM (Percentile Bootstrap) UCL	16.92
95% KM (z) UCL	16.16	95% KM Bootstrap t UCL	27.73
90% KM Chebyshev UCL	22.51	95% KM Chebyshev UCL	28.88
97.5% KM Chebyshev UCL	37.73	99% KM Chebyshev UCL	55.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.849
5% A-D Critical Value	0.813
K-S Test Statistic	0.253
5% K-S Critical Value	0.288

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.303	k star (bias corrected MLE)	0.279
Theta hat (MLE)	33.4	Theta star (bias corrected MLE)	36.31
nu hat (MLE)	6.062	nu star (bias corrected)	5.577
MLE Mean (bias corrected)	10.12	MLE Sd (bias corrected)	19.17

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.3	nu hat (KM)	7.204
Approximate Chi Square Value (7.20, α)	2.283	Adjusted Chi Square Value (7.20, β)	1.884
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	26.64	95% Gamma Adjusted KM-UCL (use when $n < 50$)	32.28

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(b)fluoranthene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	8.439
Maximum	50	Median	0.24
SD	16.1	CV	1.908
k hat (MLE)	0.248	k star (bias corrected MLE)	0.242
Theta hat (MLE)	33.99	Theta star (bias corrected MLE)	34.9
nu hat (MLE)	5.959	nu star (bias corrected)	5.803
MLE Mean (bias corrected)	8.439	MLE Sd (bias corrected)	17.16
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (5.80, α)	1.54	Adjusted Chi Square Value (5.80, β)	1.231
95% Gamma Approximate UCL (use when $n \geq 50$)	31.8	95% Gamma Adjusted UCL (use when $n < 50$)	39.78

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.873
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.199
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8.437	Mean in Log Scale	-0.945
SD in Original Scale	16.1	SD in Log Scale	3.247
95% t UCL (assumes normality of ROS data)	16.78	95% Percentile Bootstrap UCL	16.84
95% BCA Bootstrap UCL	19.38	95% Bootstrap t UCL	27.91
95% H-UCL (Log ROS)	149637		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.5	95% H-UCL (KM -Log)	1352
KM SD (logged)	2.502	95% Critical H Value (KM-Log)	6.071
KM Standard Error of Mean (logged)	0.761		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	8.44
SD in Original Scale	16.1
95% t UCL (Assumes normality)	16.79

DL/2 Log-Transformed

Mean in Log Scale	-0.614
SD in Log Scale	2.752
95% H-Stat UCL	5845

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	28.88	95% GROS Adjusted Gamma UCL	39.78
95% Adjusted Gamma KM-UCL	32.28		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(g,h,i)perylene**General Statistics**

Total Number of Observations	12	Number of Distinct Observations	12
Number of Detects	9	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.032	Minimum Non-Detect	0.4
Maximum Detect	29	Maximum Non-Detect	0.47
Variance Detects	118.4	Percent Non-Detects	25%
Mean Detects	7.087	SD Detects	10.88
Median Detects	0.37	CV Detects	1.535
Skewness Detects	1.328	Kurtosis Detects	0.509
Mean of Logged Detects	-0.28	SD of Logged Detects	2.649

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.716
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.376
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	5.35	Standard Error of Mean	2.872
SD	9.381	95% KM (BCA) UCL	10.04
95% KM (t) UCL	10.51	95% KM (Percentile Bootstrap) UCL	10.18
95% KM (z) UCL	10.07	95% KM Bootstrap t UCL	15.11
90% KM Chebyshev UCL	13.97	95% KM Chebyshev UCL	17.87
97.5% KM Chebyshev UCL	23.29	99% KM Chebyshev UCL	33.93

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.747
5% A-D Critical Value	0.806
K-S Test Statistic	0.243
5% K-S Critical Value	0.301

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.307	k star (bias corrected MLE)	0.279
Theta hat (MLE)	23.09	Theta star (bias corrected MLE)	25.43
nu hat (MLE)	5.525	nu star (bias corrected)	5.017
MLE Mean (bias corrected)	7.087	MLE Sd (bias corrected)	13.42

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.325	nu hat (KM)	7.805
Approximate Chi Square Value (7.80, α)	2.623	Adjusted Chi Square Value (7.80, β)	2.187
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	15.92	95% Gamma Adjusted KM-UCL (use when $n < 50$)	19.09

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(g,h,i)perylene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	5.318
Maximum	29	Median	0.105
SD	9.817	CV	1.846
k hat (MLE)	0.236	k star (bias corrected MLE)	0.233
Theta hat (MLE)	22.5	Theta star (bias corrected MLE)	22.84
nu hat (MLE)	5.673	nu star (bias corrected)	5.588
MLE Mean (bias corrected)	5.318	MLE Sd (bias corrected)	11.02
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (5.59, α)	1.433	Adjusted Chi Square Value (5.59, β)	1.139
95% Gamma Approximate UCL (use when $n \geq 50$)	20.74	95% Gamma Adjusted UCL (use when $n < 50$)	26.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.875
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.211
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.349	Mean in Log Scale	-0.711
SD in Original Scale	9.798	SD in Log Scale	2.39
95% t UCL (assumes normality of ROS data)	10.43	95% Percentile Bootstrap UCL	10.25
95% BCA Bootstrap UCL	11.33	95% Bootstrap t UCL	15.14
95% H-UCL (Log ROS)	566.5		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.788	95% H-UCL (KM -Log)	463.5
KM SD (logged)	2.368	95% Critical H Value (KM-Log)	5.773
KM Standard Error of Mean (logged)	0.741		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	5.369
SD in Original Scale	9.787
95% t UCL (Assumes normality)	10.44

DL/2 Log-Transformed

Mean in Log Scale	-0.597
SD in Log Scale	2.331
95% H-Stat UCL	454.4

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	17.87	95% GROS Adjusted Gamma UCL	26.1
95% Adjusted Gamma KM-UCL	19.09		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Benzo(k)fluoranthene**General Statistics**

Total Number of Observations	12	Number of Distinct Observations	12
Number of Detects	9	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.025	Minimum Non-Detect	0.039
Maximum Detect	26	Maximum Non-Detect	0.041
Variance Detects	84.69	Percent Non-Detects	25%
Mean Detects	5.689	SD Detects	9.203
Median Detects	0.29	CV Detects	1.618
Skewness Detects	1.658	Kurtosis Detects	2.174
Mean of Logged Detects	-0.487	SD of Logged Detects	2.615

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.702
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.368
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	4.273	Standard Error of Mean	2.42
SD	7.904	95% KM (BCA) UCL	8.609
95% KM (t) UCL	8.62	95% KM (Percentile Bootstrap) UCL	8.175
95% KM (z) UCL	8.254	95% KM Bootstrap t UCL	13.96
90% KM Chebyshev UCL	11.53	95% KM Chebyshev UCL	14.82
97.5% KM Chebyshev UCL	19.39	99% KM Chebyshev UCL	28.35

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.671
5% A-D Critical Value	0.806
K-S Test Statistic	0.247
5% K-S Critical Value	0.301

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.308	k star (bias corrected MLE)	0.28
Theta hat (MLE)	18.45	Theta star (bias corrected MLE)	20.34
nu hat (MLE)	5.551	nu star (bias corrected)	5.034
MLE Mean (bias corrected)	5.689	MLE Sd (bias corrected)	10.76

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.292	nu hat (KM)	7.015
Approximate Chi Square Value (7.01, α)	2.179	Adjusted Chi Square Value (7.01, β)	1.791
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	13.76	95% Gamma Adjusted KM-UCL (use when $n < 50$)	16.73

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzo(k)fluoranthene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	4.27
Maximum	26	Median	0.11
SD	8.258	CV	1.934
k hat (MLE)	0.241	k star (bias corrected MLE)	0.236
Theta hat (MLE)	17.73	Theta star (bias corrected MLE)	18.08
nu hat (MLE)	5.778	nu star (bias corrected)	5.667
MLE Mean (bias corrected)	4.27	MLE Sd (bias corrected)	8.786
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (5.67, α)	1.472	Adjusted Chi Square Value (5.67, β)	1.172
95% Gamma Approximate UCL (use when n>=50)	16.44	95% Gamma Adjusted UCL (use when n<50)	20.64

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.899
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.189
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.269	Mean in Log Scale	-1.601
SD in Original Scale	8.258	SD in Log Scale	3.005
95% t UCL (assumes normality of ROS data)	8.55	95% Percentile Bootstrap UCL	8.363
95% BCA Bootstrap UCL	9.69	95% Bootstrap t UCL	14.24
95% H-UCL (Log ROS)	12623		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.288	95% H-UCL (KM -Log)	804.4
KM SD (logged)	2.546	95% Critical H Value (KM-Log)	6.17
KM Standard Error of Mean (logged)	0.78		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	4.272
SD in Original Scale	8.256
95% t UCL (Assumes normality)	8.552

DL/2 Log-Transformed

Mean in Log Scale	-1.343
SD in Log Scale	2.716
95% H-Stat UCL	2223

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	14.82	95% GROS Adjusted Gamma UCL	20.64
95% Adjusted Gamma KM-UCL	16.73		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Dibenz(a,h)anthracene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	4
Number of Distinct Detects	7	Number of Distinct Non-Detects	4
Minimum Detect	0.012	Minimum Non-Detect	0.039
Maximum Detect	4.8	Maximum Non-Detect	0.047
Variance Detects	3.335	Percent Non-Detects	33.33%
Mean Detects	1.287	SD Detects	1.826
Median Detects	0.12	CV Detects	1.419
Skewness Detects	1.206	Kurtosis Detects	0.333
Mean of Logged Detects	-1.633	SD of Logged Detects	2.456

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.745
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.353
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.865	Standard Error of Mean	0.468
SD	1.517	95% KM (BCA) UCL	1.665
95% KM (t) UCL	1.706	95% KM (Percentile Bootstrap) UCL	1.649
95% KM (z) UCL	1.635	95% KM Bootstrap t UCL	2.18
90% KM Chebyshev UCL	2.269	95% KM Chebyshev UCL	2.906
97.5% KM Chebyshev UCL	3.789	99% KM Chebyshev UCL	5.524

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.68
5% A-D Critical Value	0.788
K-S Test Statistic	0.244
5% K-S Critical Value	0.315

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.356	k star (bias corrected MLE)	0.306
Theta hat (MLE)	3.618	Theta star (bias corrected MLE)	4.211
nu hat (MLE)	5.692	nu star (bias corrected)	4.891
MLE Mean (bias corrected)	1.287	MLE Sd (bias corrected)	2.328

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.325	nu hat (KM)	7.791
Approximate Chi Square Value (7.79, α)	2.614	Adjusted Chi Square Value (7.79, β)	2.18
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	2.576	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.09

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Dibenz(a,h)anthracene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.861
Maximum	4.8	Median	0.023
SD	1.587	CV	1.842
k hat (MLE)	0.282	k star (bias corrected MLE)	0.267
Theta hat (MLE)	3.059	Theta star (bias corrected MLE)	3.23
nu hat (MLE)	6.758	nu star (bias corrected)	6.401
MLE Mean (bias corrected)	0.861	MLE Sd (bias corrected)	1.668
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (6.40, α)	1.848	Adjusted Chi Square Value (6.40, β)	1.5
95% Gamma Approximate UCL (use when $n \geq 50$)	2.983	95% Gamma Adjusted UCL (use when $n < 50$)	3.676

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.864
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.229
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.864	Mean in Log Scale	-2.409
SD in Original Scale	1.585	SD in Log Scale	2.27
95% t UCL (assumes normality of ROS data)	1.686	95% Percentile Bootstrap UCL	1.657
95% BCA Bootstrap UCL	1.877	95% Bootstrap t UCL	2.193
95% H-UCL (Log ROS)	52.98		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.422	95% H-UCL (KM -Log)	34.18
KM SD (logged)	2.191	95% Critical H Value (KM-Log)	5.38
KM Standard Error of Mean (logged)	0.682		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.865
SD in Original Scale	1.585
95% t UCL (Assumes normality)	1.687

DL/2 Log-Transformed

Mean in Log Scale	-2.379
SD in Log Scale	2.248
95% H-Stat UCL	48.5

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	1.665	95% GROS Adjusted Gamma UCL	3.676
95% Adjusted Gamma KM-UCL	3.09		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Indeno(1,2,3-cd)pyrene

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.023	Minimum Non-Detect	0.04
Maximum Detect	33	Maximum Non-Detect	0.041
Variance Detects	124.2	Percent Non-Detects	16.67%
Mean Detects	6.506	SD Detects	11.14
Median Detects	0.26	CV Detects	1.713
Skewness Detects	1.819	Kurtosis Detects	2.933
Mean of Logged Detects	-0.59	SD of Logged Detects	2.721

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.662
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.38
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	5.426	Standard Error of Mean	3.027
SD	9.948	95% KM (BCA) UCL	10.78
95% KM (t) UCL	10.86	95% KM (Percentile Bootstrap) UCL	10.58
95% KM (z) UCL	10.41	95% KM Bootstrap t UCL	15.19
90% KM Chebyshev UCL	14.51	95% KM Chebyshev UCL	18.62
97.5% KM Chebyshev UCL	24.33	99% KM Chebyshev UCL	35.55

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.809
5% A-D Critical Value	0.821
K-S Test Statistic	0.249
5% K-S Critical Value	0.289

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.283	k star (bias corrected MLE)	0.265
Theta hat (MLE)	23.01	Theta star (bias corrected MLE)	24.59
nu hat (MLE)	5.654	nu star (bias corrected)	5.291
MLE Mean (bias corrected)	6.506	MLE Sd (bias corrected)	12.65

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.298	nu hat (KM)	7.14
Approximate Chi Square Value (7.14, α)	2.248	Adjusted Chi Square Value (7.14, β)	1.853
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	17.24	95% Gamma Adjusted KM-UCL (use when $n < 50$)	20.91

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Indeno(1,2,3-cd)pyrene (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	5.423
Maximum	33	Median	0.115
SD	10.39	CV	1.916
k hat (MLE)	0.242	k star (bias corrected MLE)	0.237
Theta hat (MLE)	22.41	Theta star (bias corrected MLE)	22.87
nu hat (MLE)	5.809	nu star (bias corrected)	5.69
MLE Mean (bias corrected)	5.423	MLE Sd (bias corrected)	11.14
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (5.69, α)	1.484	Adjusted Chi Square Value (5.69, β)	1.182
95% Gamma Approximate UCL (use when $n \geq 50$)	20.8	95% Gamma Adjusted UCL (use when $n < 50$)	26.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.887	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.213	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.424	Mean in Log Scale	-1.202
SD in Original Scale	10.39	SD in Log Scale	2.846
95% t UCL (assumes normality of ROS data)	10.81	95% Percentile Bootstrap UCL	10.74
95% BCA Bootstrap UCL	12.41	95% Bootstrap t UCL	15.23
95% H-UCL (Log ROS)	6129		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.093	95% H-UCL (KM -Log)	1466
KM SD (logged)	2.612	95% Critical H Value (KM-Log)	6.316
KM Standard Error of Mean (logged)	0.795		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	5.425
SD in Original Scale	10.39
95% t UCL (Assumes normality)	10.81

DL/2 Log-Transformed

Mean in Log Scale	-1.142
SD in Log Scale	2.778
95% H-Stat UCL	4097

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	18.62	95% GROS Adjusted Gamma UCL	26.1
95% Adjusted Gamma KM-UCL	20.91		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Antimony**General Statistics**

Total Number of Observations	12	Number of Distinct Observations	8
Number of Detects	3	Number of Non-Detects	9
Number of Distinct Detects	3	Number of Distinct Non-Detects	5
Minimum Detect	1.5	Minimum Non-Detect	2.2
Maximum Detect	10.5	Maximum Non-Detect	2.7
Variance Detects	21.86	Percent Non-Detects	75%
Mean Detects	6.733	SD Detects	4.676
Median Detects	8.2	CV Detects	0.694
Skewness Detects	-1.273	Kurtosis Detects	N/A
Mean of Logged Detects	1.62	SD of Logged Detects	1.059

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.926
5% Shapiro Wilk Critical Value	0.767
Lilliefors Test Statistic	0.29
5% Lilliefors Critical Value	0.512

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

Mean	2.808	Standard Error of Mean	1.048
SD	2.963	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.69	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.531	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	5.951	95% KM Chebyshev UCL	7.375
97.5% KM Chebyshev UCL	9.35	99% KM Chebyshev UCL	13.23

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.893	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.556	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.36	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.898	nu hat (KM)	21.56
Approximate Chi Square Value (21.56, α)	12.01	Adjusted Level of Significance (β)	0.029
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	5.042	Adjusted Chi Square Value (21.56, β)	10.94
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	5.537

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Antimony (cont.'d)**Lognormal GOF Test on Detected Observations Only**

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.343	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	2.903	Mean in Log Scale	0.711
SD in Original Scale	3.104	SD in Log Scale	0.797
95% t UCL (assumes normality of ROS data)	4.512	95% Percentile Bootstrap UCL	4.419
95% BCA Bootstrap UCL	4.908	95% Bootstrap t UCL	9.89
95% H-UCL (Log ROS)	5.185		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.709	95% H-UCL (KM -Log)	4.183
KM SD (logged)	0.681	95% Critical H Value (KM-Log)	2.386
KM Standard Error of Mean (logged)	0.241		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	2.571
SD in Original Scale	3.206
95% t UCL (Assumes normality)	4.233

DL/2 Log-Transformed

Mean in Log Scale	0.53
SD in Log Scale	0.8
95% H-Stat UCL	4.346

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL 4.69

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Copper**General Statistics**

Total Number of Observations	12	Number of Distinct Observations	12
Number of Detects	8	Number of Non-Detects	4
Number of Distinct Detects	8	Number of Distinct Non-Detects	4
Minimum Detect	3.6	Minimum Non-Detect	5.4
Maximum Detect	394	Maximum Non-Detect	7.1
Variance Detects	21281	Percent Non-Detects	33.33%
Mean Detects	96.31	SD Detects	145.9
Median Detects	18.2	CV Detects	1.515
Skewness Detects	1.644	Kurtosis Detects	1.662
Mean of Logged Detects	3.357	SD of Logged Detects	1.735

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.705
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.327
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	65.64	Standard Error of Mean	36.9
SD	119.6	95% KM (BCA) UCL	126.3
95% KM (t) UCL	131.9	95% KM (Percentile Bootstrap) UCL	123.6
95% KM (z) UCL	126.3	95% KM Bootstrap t UCL	402.5
90% KM Chebyshev UCL	176.3	95% KM Chebyshev UCL	226.5
97.5% KM Chebyshev UCL	296.1	99% KM Chebyshev UCL	432.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.555
5% A-D Critical Value	0.761
K-S Test Statistic	0.291
5% K-S Critical Value	0.309

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.521	k star (bias corrected MLE)	0.409
Theta hat (MLE)	184.8	Theta star (bias corrected MLE)	235.5
nu hat (MLE)	8.338	nu star (bias corrected)	6.545
MLE Mean (bias corrected)	96.31	MLE Sd (bias corrected)	150.6

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.301	nu hat (KM)	7.234
Approximate Chi Square Value (7.23, α)	2.3	Adjusted Chi Square Value (7.23, β)	1.899
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	206.5	95% Gamma Adjusted KM-UCL (use when $n < 50$)	250.1

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Copper (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	64.21
Maximum	394	Median	8
SD	125.7	CV	1.957
k hat (MLE)	0.211	k star (bias corrected MLE)	0.214
Theta hat (MLE)	304.4	Theta star (bias corrected MLE)	300.4
nu hat (MLE)	5.063	nu star (bias corrected)	5.13
MLE Mean (bias corrected)	64.21	MLE Sd (bias corrected)	138.9
		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (5.13, α)	1.213	Adjusted Chi Square Value (5.13, β)	0.95
95% Gamma Approximate UCL (use when $n \geq 50$)	271.6	95% Gamma Adjusted UCL (use when $n < 50$)	346.7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.923
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.218
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	65.29	Mean in Log Scale	2.629
SD in Original Scale	125.1	SD in Log Scale	1.752
95% t UCL (assumes normality of ROS data)	130.1	95% Percentile Bootstrap UCL	129.6
95% BCA Bootstrap UCL	155.2	95% Bootstrap t UCL	410.7
95% H-UCL (Log ROS)	666.8		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.719	95% H-UCL (KM -Log)	403.1
KM SD (logged)	1.605	95% Critical H Value (KM-Log)	4.115
KM Standard Error of Mean (logged)	0.498		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	65.25
SD in Original Scale	125.1
95% t UCL (Assumes normality)	130.1

DL/2 Log-Transformed

Mean in Log Scale	2.616
SD in Log Scale	1.766
95% H-Stat UCL	696.7

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	126.3	95% GROS Adjusted Gamma UCL	346.7
95% Adjusted Gamma KM-UCL	250.1		

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

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

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

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

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	2.2	Mean	94.98
Maximum	526	Median	12.8
SD	175.7	Std. Error of Mean	50.71
Coefficient of Variation	1.85	Skewness	2.053
Normal GOF Test			
Shapiro Wilk Test Statistic	0.587	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.389	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.256	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	186.1	95% Adjusted-CLT UCL (Chen-1995)	210.5
		95% Modified-t UCL (Johnson-1978)	191.1
Gamma GOF Test			
A-D Test Statistic	1.172	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.797	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.261	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.437	k star (bias corrected MLE)	0.383
Theta hat (MLE)	217.5	Theta star (bias corrected MLE)	247.9
nu hat (MLE)	10.48	nu star (bias corrected)	9.196
MLE Mean (bias corrected)	94.98	MLE Sd (bias corrected)	153.4
		Approximate Chi Square Value (0.05)	3.445
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	2.929
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	253.5	95% Adjusted Gamma UCL (use when n<50)	298.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.199	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.256	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.788	Mean of logged Data	3.068
Maximum of Logged Data	6.265	SD of logged Data	1.739

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Lead (cont.'d)

Assuming Lognormal Distribution

95% H-UCL	977.9	90% Chebyshev (MVUE) UCL	201.9
95% Chebyshev (MVUE) UCL	258.8	97.5% Chebyshev (MVUE) UCL	337.8
99% Chebyshev (MVUE) UCL	493		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	178.4	95% Jackknife UCL	186.1
95% Standard Bootstrap UCL	175.1	95% Bootstrap-t UCL	537
95% Hall's Bootstrap UCL	692	95% Percentile Bootstrap UCL	181.6
95% BCA Bootstrap UCL	209.1		
90% Chebyshev(Mean, Sd) UCL	247.1	95% Chebyshev(Mean, Sd) UCL	316
97.5% Chebyshev(Mean, Sd) UCL	411.7	99% Chebyshev(Mean, Sd) UCL	599.6

Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL 599.6

Recommended UCL exceeds the maximum observation

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Zinc

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	11.1	Mean	440.8
Maximum	2370	Median	41.45
SD	786.9	Std. Error of Mean	227.2
Coefficient of Variation	1.785	Skewness	1.909
Normal GOF Test			
Shapiro Wilk Test Statistic	0.624	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.387	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.256	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	848.7	95% Adjusted-CLT UCL (Chen-1995)	948.1
		95% Modified-t UCL (Johnson-1978)	869.6
Gamma GOF Test			
A-D Test Statistic	1.181	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.805	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.262	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.395	k star (bias corrected MLE)	0.352
Theta hat (MLE)	1116	Theta star (bias corrected MLE)	1253
nu hat (MLE)	9.476	nu star (bias corrected)	8.441
MLE Mean (bias corrected)	440.8	MLE Sd (bias corrected)	743.2
		Approximate Chi Square Value (0.05)	2.993
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	2.52
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1243	95% Adjusted Gamma UCL (use when n<50)	1477
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.194	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.256	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.407	Mean of logged Data	4.418
Maximum of Logged Data	7.771	SD of logged Data	1.906

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 11:44:43 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Zinc (cont.'d)

Assuming Lognormal Distribution

95% H-UCL	7862	90% Chebyshev (MVUE) UCL	1038
95% Chebyshev (MVUE) UCL	1340	97.5% Chebyshev (MVUE) UCL	1759
99% Chebyshev (MVUE) UCL	2583		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	814.4	95% Jackknife UCL	848.7
95% Standard Bootstrap UCL	799	95% Bootstrap-t UCL	1562
95% Hall's Bootstrap UCL	1055	95% Percentile Bootstrap UCL	827.6
95% BCA Bootstrap UCL	964.3		
90% Chebyshev(Mean, Sd) UCL	1122	95% Chebyshev(Mean, Sd) UCL	1431
97.5% Chebyshev(Mean, Sd) UCL	1859	99% Chebyshev(Mean, Sd) UCL	2701

Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL 2701

Recommended UCL exceeds the maximum observation

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.

For additional insight the user may want to consult a statistician.

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

TPH (C10-C28) DRO

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	6
Number of Detects	4	Number of Non-Detects	3
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	310	Minimum Non-Detect	33
Maximum Detect	7400	Maximum Non-Detect	42
Variance Detects	10764067	Percent Non-Detects	42.86%
Mean Detects	3000	SD Detects	3281
Median Detects	2145	CV Detects	1.094
Skewness Detects	1.012	Kurtosis Detects	-0.388
Mean of Logged Detects	7.343	SD of Logged Detects	1.46

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.89	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

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

Mean	1728	Standard Error of Mean	1135
SD	2602	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3935	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3596	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	5135	95% KM Chebyshev UCL	6678
97.5% KM Chebyshev UCL	8820	99% KM Chebyshev UCL	13026

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.294	Anderson-Darling GOF Test
5% A-D Critical Value	0.668	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.404	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	0.883	k star (bias corrected MLE)	0.387
Theta hat (MLE)	3397	Theta star (bias corrected MLE)	7743
nu hat (MLE)	7.065	nu star (bias corrected)	3.1
MLE Mean (bias corrected)	3000	MLE Sd (bias corrected)	4820

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.441	nu hat (KM)	6.179
Approximate Chi Square Value (6.18, α)	1.732	Adjusted Chi Square Value (6.18, β)	1.115
95% Gamma Approximate KM-UCL (use when n>=50)	6166	95% Gamma Adjusted KM-UCL (use when n<50)	9574

TABLE G.8

**SUMMARY OF ProUCL OUTPUT FOR SEDIMENT
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 11:44:43 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

TPH (C10-C28) DRO (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	1714
Maximum	7400	Median	310
SD	2820	CV	1.645
k hat (MLE)	0.147	k star (bias corrected MLE)	0.18
Theta hat (MLE)	11624	Theta star (bias corrected MLE)	9550
nu hat (MLE)	2.065	nu star (bias corrected)	2.513
MLE Mean (bias corrected)	1714	MLE Sd (bias corrected)	4046
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (2.51, α)	0.244	Adjusted Chi Square Value (2.51, β)	0.129
95% Gamma Approximate UCL (use when $n \geq 50$)	17649	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.219	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1725	Mean in Log Scale	5.494
SD in Original Scale	2813	SD in Log Scale	2.565
95% t UCL (assumes normality of ROS data)	3791	95% Percentile Bootstrap UCL	3733
95% BCA Bootstrap UCL	4234	95% Bootstrap t UCL	15778
95% H-UCL (Log ROS)	50080944		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	5.694	95% H-UCL (KM -Log)	1451643
KM SD (logged)	2.13	95% Critical H Value (KM-Log)	7.159
KM Standard Error of Mean (logged)	0.93		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	1723
SD in Original Scale	2814
95% t UCL (Assumes normality)	3790

DL/2 Log-Transformed

Mean in Log Scale	5.466
SD in Log Scale	2.559
95% H-Stat UCL	46450261

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3935	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.9

SUMMARY OF ProUCL OUTPUT FOR SURFACE WATER
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE

User Selected Options
Date/Time of Computation 11/21/2014 12:13:54 PM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	41.3	Mean	56.96
Maximum	76.7	Median	55.8
SD	13.89	Std. Error of Mean	6.212
Coefficient of Variation	0.244	Skewness	0.508

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.975		
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.154	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	68.69
95% Student's-t UCL	70.2	95% Modified-t UCL (Johnson-1978)	70.44

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.181		
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.174	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	21.36	k star (bias corrected MLE)	8.676
Theta hat (MLE)	2.667	Theta star (bias corrected MLE)	6.565
nu hat (MLE)	213.6	nu star (bias corrected)	86.76
MLE Mean (bias corrected)	56.96	MLE Sd (bias corrected)	19.34
Adjusted Level of Significance	0.0086	Approximate Chi Square Value (0.05)	66.29
		Adjusted Chi Square Value	58.51

Assuming Gamma Distribution		95% Adjusted Gamma UCL (use when n<50)	
95% Approximate Gamma UCL (use when n>=50)	74.55		84.46

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.988		
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.145	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

TABLE G.9

**SUMMARY OF ProUCL OUTPUT FOR SURFACE WATER
OU6
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 12:13:54 PM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Manganese (cont.'d)**Lognormal Statistics**

Minimum of Logged Data	3.721	Mean of logged Data	4.019
Maximum of Logged Data	4.34	SD of logged Data	0.243

Assuming Lognormal Distribution

95% H-UCL	75.55	90% Chebyshev (MVUE) UCL	75.45
95% Chebyshev (MVUE) UCL	83.83	97.5% Chebyshev (MVUE) UCL	95.46
99% Chebyshev (MVUE) UCL	118.3		

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

95% CLT UCL	67.18	95% Jackknife UCL	70.2
95% Standard Bootstrap UCL	65.87	95% Bootstrap-t UCL	73.49
95% Hall's Bootstrap UCL	76.04	95% Percentile Bootstrap UCL	66.66
95% BCA Bootstrap UCL	66.66		
90% Chebyshev(Mean, Sd) UCL	75.6	95% Chebyshev(Mean, Sd) UCL	84.04
97.5% Chebyshev(Mean, Sd) UCL	95.75	99% Chebyshev(Mean, Sd) UCL	118.8

Suggested UCL to Use95% Student's-t UCL 70.2

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,1-Dichloroethane

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	8
		Number of Missing Observations	5
Number of Detects	6	Number of Non-Detects	72
Number of Distinct Detects	5	Number of Distinct Non-Detects	3
Minimum Detect	0.21	Minimum Non-Detect	1
Maximum Detect	7.8	Maximum Non-Detect	5
Variance Detects	9.178	Percent Non-Detects	92.31%
Mean Detects	1.69	SD Detects	3.029
Median Detects	0.26	CV Detects	1.793
Skewness Detects	2.328	Kurtosis Detects	5.482
Mean of Logged Detects	-0.573	SD of Logged Detects	1.478

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.594
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.371
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.348	Standard Error of Mean	0.108
SD	0.861	95% KM (BCA) UCL	0.558
95% KM (t) UCL	0.529	95% KM (Percentile Bootstrap) UCL	0.554
95% KM (z) UCL	0.526	95% KM Bootstrap t UCL	1.176
90% KM Chebyshev UCL	0.673	95% KM Chebyshev UCL	0.82
97.5% KM Chebyshev UCL	1.024	99% KM Chebyshev UCL	1.426

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.933
5% A-D Critical Value	0.732
K-S Test Statistic	0.377
5% K-S Critical Value	0.347

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.568	k star (bias corrected MLE)	0.395
Theta hat (MLE)	2.978	Theta star (bias corrected MLE)	4.28
nu hat (MLE)	6.81	nu star (bias corrected)	4.738
MLE Mean (bias corrected)	1.69	MLE Sd (bias corrected)	2.689

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.164	nu hat (KM)	25.56
Approximate Chi Square Value (25.56, α)	15.04	Adjusted Chi Square Value (25.56, β)	14.89
95% Gamma Approximate KM-UCL (use when n>=50)	0.592	95% Gamma Adjusted KM-UCL (use when n<50)	0.598

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,1-Dichloroethane (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.514
Maximum	7.8	Median	0.0104
SD	1.076	CV	2.094
k hat (MLE)	0.346	k star (bias corrected MLE)	0.341
Theta hat (MLE)	1.487	Theta star (bias corrected MLE)	1.508
nu hat (MLE)	53.91	nu star (bias corrected)	53.17
MLE Mean (bias corrected)	0.514	MLE Sd (bias corrected)	0.88
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (53.17, α)	37.42	Adjusted Chi Square Value (53.17, β)	37.17
95% Gamma Approximate UCL (use when $n \geq 50$)	0.73	95% Gamma Adjusted UCL (use when $n < 50$)	0.735

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.758
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.34
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.467	Mean in Log Scale	-1.31
SD in Original Scale	0.905	SD in Log Scale	0.96
95% t UCL (assumes normality of ROS data)	0.637	95% Percentile Bootstrap UCL	0.663
95% BCA Bootstrap UCL	0.771	95% Bootstrap t UCL	0.897
95% H-UCL (Log ROS)	0.545		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.387	95% H-UCL (KM -Log)	0.307
KM SD (logged)	0.464	95% Critical H Value (KM-Log)	1.835
KM Standard Error of Mean (logged)	0.0898		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.733
SD in Original Scale	0.958
95% t UCL (Assumes normality)	0.913

DL/2 Log-Transformed

Mean in Log Scale	-0.563
SD in Log Scale	0.554
95% H-Stat UCL	0.748

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL 0.558

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,2,4-Trimethylbenzene

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	26
		Number of Missing Observations	33
Number of Detects	25	Number of Non-Detects	13
Number of Distinct Detects	25	Number of Distinct Non-Detects	1
Minimum Detect	0.14	Minimum Non-Detect	1
Maximum Detect	2800	Maximum Non-Detect	1
Variance Detects	459365	Percent Non-Detects	34.21%
Mean Detects	336.3	SD Detects	677.8
Median Detects	14	CV Detects	2.015
Skewness Detects	2.719	Kurtosis Detects	7.566
Mean of Logged Detects	2.745	SD of Logged Detects	3.336
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.572	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.315	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	221.4	Standard Error of Mean	93
SD	561.7	95% KM (BCA) UCL	407.7
95% KM (t) UCL	378.3	95% KM (Percentile Bootstrap) UCL	387.3
95% KM (z) UCL	374.4	95% KM Bootstrap t UCL	587.4
90% KM Chebyshev UCL	500.4	95% KM Chebyshev UCL	626.8
97.5% KM Chebyshev UCL	802.2	99% KM Chebyshev UCL	1147
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.842	Anderson-Darling GOF Test	
5% A-D Critical Value	0.884	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.182	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.192	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.234	k star (bias corrected MLE)	0.232
Theta hat (MLE)	1439	Theta star (bias corrected MLE)	1448
nu hat (MLE)	11.68	nu star (bias corrected)	11.61
MLE Mean (bias corrected)	336.3	MLE Sd (bias corrected)	697.8
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.155	nu hat (KM)	11.81
Approximate Chi Square Value (11.81, α)	5.1	Adjusted Chi Square Value (11.81, β)	4.917
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	512.6	95% Gamma Adjusted KM-UCL (use when $n < 50$)	531.6

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,2,4-Trimethylbenzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	221.3
Maximum	2800	Median	0.535
SD	569.3	CV	2.573
k hat (MLE)	0.149	k star (bias corrected MLE)	0.155
Theta hat (MLE)	1486	Theta star (bias corrected MLE)	1431
nu hat (MLE)	11.31	nu star (bias corrected)	11.75
MLE Mean (bias corrected)	221.3	MLE Sd (bias corrected)	562.7
		Adjusted Level of Significance (β)	0.0434
Approximate Chi Square Value (11.75, α)	5.065	Adjusted Chi Square Value (11.75, β)	4.883
95% Gamma Approximate UCL (use when $n \geq 50$)	513.5	95% Gamma Adjusted UCL (use when $n < 50$)	532.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.916
5% Shapiro Wilk Critical Value	0.918
Lilliefors Test Statistic	0.134
5% Lilliefors Critical Value	0.177

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	221.7	Mean in Log Scale	1.442
SD in Original Scale	569.2	SD in Log Scale	3.441
95% t UCL (assumes normality of ROS data)	377.4	95% Percentile Bootstrap UCL	388.7
95% BCA Bootstrap UCL	432.8	95% Bootstrap t UCL	580.5
95% H-UCL (Log ROS)	46366		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.391	95% H-UCL (KM -Log)	18061
KM SD (logged)	3.269	95% Critical H Value (KM-Log)	5.707
KM Standard Error of Mean (logged)	0.55		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	221.4
SD in Original Scale	569.2
95% t UCL (Assumes normality)	377.2

DL/2 Log-Transformed

Mean in Log Scale	1.569
SD in Log Scale	3.154
95% H-Stat UCL	12195

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	407.7	95% GROS Adjusted Gamma UCL	532.6
95% Adjusted Gamma KM-UCL	531.6		

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,2-Dichloroethane

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	20
		Number of Missing Observations	5
Number of Detects	17	Number of Non-Detects	61
Number of Distinct Detects	17	Number of Distinct Non-Detects	3
Minimum Detect	0.3	Minimum Non-Detect	1
Maximum Detect	31	Maximum Non-Detect	5
Variance Detects	95.39	Percent Non-Detects	78.21%
Mean Detects	8.707	SD Detects	9.767
Median Detects	4.3	CV Detects	1.122
Skewness Detects	1.409	Kurtosis Detects	0.979
Mean of Logged Detects	1.448	SD of Logged Detects	1.374

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.797
5% Shapiro Wilk Critical Value	0.892
Lilliefors Test Statistic	0.204
5% Lilliefors Critical Value	0.215

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	2.447	Standard Error of Mean	0.652
SD	5.527	95% KM (BCA) UCL	3.401
95% KM (t) UCL	3.533	95% KM (Percentile Bootstrap) UCL	3.572
95% KM (z) UCL	3.52	95% KM Bootstrap t UCL	4.183
90% KM Chebyshev UCL	4.404	95% KM Chebyshev UCL	5.291
97.5% KM Chebyshev UCL	6.521	99% KM Chebyshev UCL	8.938

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.26
5% A-D Critical Value	0.773
K-S Test Statistic	0.104
5% K-S Critical Value	0.217

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.825	k star (bias corrected MLE)	0.719
Theta hat (MLE)	10.55	Theta star (bias corrected MLE)	12.11
nu hat (MLE)	28.06	nu star (bias corrected)	24.44
MLE Mean (bias corrected)	8.707	MLE Sd (bias corrected)	10.27

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.196	nu hat (KM)	30.57
Approximate Chi Square Value (30.57, α)	18.94	Adjusted Chi Square Value (30.57, β)	18.77
95% Gamma Approximate KM-UCL (use when n>=50)	3.949	95% Gamma Adjusted KM-UCL (use when n<50)	3.985

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,2-Dichloroethane (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	2.23
Maximum	31	Median	0.01
SD	5.703	CV	2.557
k hat (MLE)	0.219	k star (bias corrected MLE)	0.219
Theta hat (MLE)	10.17	Theta star (bias corrected MLE)	10.17
nu hat (MLE)	34.2	nu star (bias corrected)	34.22
MLE Mean (bias corrected)	2.23	MLE Sd (bias corrected)	4.762
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (34.22, α)	21.84	Adjusted Chi Square Value (34.22, β)	21.65
95% Gamma Approximate UCL (use when $n \geq 50$)	3.494	95% Gamma Adjusted UCL (use when $n < 50$)	3.525

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.106	Lilliefors GOF Test
5% Lilliefors Critical Value	0.215	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.6	Mean in Log Scale	-0.154
SD in Original Scale	5.557	SD in Log Scale	1.442
95% t UCL (assumes normality of ROS data)	3.648	95% Percentile Bootstrap UCL	3.699
95% BCA Bootstrap UCL	4.031	95% Bootstrap t UCL	4.278
95% H-UCL (Log ROS)	3.808		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.0303	95% H-UCL (KM -Log)	2.301
KM SD (logged)	1.074	95% Critical H Value (KM-Log)	2.339
KM Standard Error of Mean (logged)	0.221		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.378	Mean in Log Scale	-0.147
SD in Original Scale	5.593	SD in Log Scale	1.102
95% t UCL (Assumes normality)	3.433	95% H-Stat UCL	2.135

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.533	95% KM (Percentile Bootstrap) UCL	3.572

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,4-Dichlorobenzene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	7
		Number of Missing Observations	5
Number of Detects	5	Number of Non-Detects	73
Number of Distinct Detects	4	Number of Distinct Non-Detects	3
Minimum Detect	0.275	Minimum Non-Detect	1
Maximum Detect	1.2	Maximum Non-Detect	5
Variance Detects	0.179	Percent Non-Detects	93.59%
Mean Detects	0.869	SD Detects	0.423
Median Detects	1.1	CV Detects	0.486
Skewness Detects	-0.836	Kurtosis Detects	-1.761
Mean of Logged Detects	-0.279	SD of Logged Detects	0.646
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.823	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.308	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.454	Standard Error of Mean	0.113
SD	0.208	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.643	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.641	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.794	95% KM Chebyshev UCL	0.948
97.5% KM Chebyshev UCL	1.162	99% KM Chebyshev UCL	1.583
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.579	Anderson-Darling GOF Test	
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.341	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	3.776	k star (bias corrected MLE)	1.644
Theta hat (MLE)	0.23	Theta star (bias corrected MLE)	0.529
nu hat (MLE)	37.76	nu star (bias corrected)	16.44
MLE Mean (bias corrected)	0.869	MLE Sd (bias corrected)	0.678
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	4.754	nu hat (KM)	741.7
Approximate Chi Square Value (741.69, α)	679.5	Adjusted Chi Square Value (741.69, β)	678.4
Approximate KM-UCL (use when $n \geq 50$)	0.495	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.496

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

1,4-Dichlorobenzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.0701	Mean	0.471
Maximum	1.2	Median	0.432
SD	0.248	CV	0.527
k hat (MLE)	3.548	k star (bias corrected MLE)	3.42
Theta hat (MLE)	0.133	Theta star (bias corrected MLE)	0.138
nu hat (MLE)	553.5	nu star (bias corrected)	533.5
MLE Mean (bias corrected)	0.471	MLE Sd (bias corrected)	0.255
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (533.54, α)	481	Adjusted Chi Square Value (533.54, β)	480
95% Gamma Approximate UCL (use when $n \geq 50$)	0.523	95% Gamma Adjusted UCL (use when $n < 50$)	0.524

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.804
5% Shapiro Wilk Critical Value	0.762
Lilliefors Test Statistic	0.319
5% Lilliefors Critical Value	0.396

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.451	Mean in Log Scale	-0.914
SD in Original Scale	0.23	SD in Log Scale	0.489
95% t UCL (assumes normality of ROS data)	0.494	95% Percentile Bootstrap UCL	0.494
95% BCA Bootstrap UCL	0.5	95% Bootstrap t UCL	0.499
95% H-UCL (Log ROS)	0.501		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.881	95% H-UCL (KM -Log)	0.493
KM SD (logged)	0.418	95% Critical H Value (KM-Log)	1.809
KM Standard Error of Mean (logged)	0.277		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.665
SD in Original Scale	0.507
95% t UCL (Assumes normality)	0.76

DL/2 Log-Transformed

Mean in Log Scale	-0.546
SD in Log Scale	0.438
95% H-Stat UCL	0.698

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Hexanone

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	10
		Number of Missing Observations	5
Number of Detects	7	Number of Non-Detects	71
Number of Distinct Detects	7	Number of Distinct Non-Detects	3
Minimum Detect	1.4	Minimum Non-Detect	5
Maximum Detect	19	Maximum Non-Detect	25
Variance Detects	50.69	Percent Non-Detects	91.03%
Mean Detects	7.029	SD Detects	7.12
Median Detects	2.8	CV Detects	1.013
Skewness Detects	1.122	Kurtosis Detects	-0.49
Mean of Logged Detects	1.493	SD of Logged Detects	1.03

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.791
5% Shapiro Wilk Critical Value	0.803
Lilliefors Test Statistic	0.295
5% Lilliefors Critical Value	0.335

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	2.607	Standard Error of Mean	0.407
SD	2.541	95% KM (BCA) UCL	3.351
95% KM (t) UCL	3.284	95% KM (Percentile Bootstrap) UCL	3.346
95% KM (z) UCL	3.276	95% KM Bootstrap t UCL	3.492
90% KM Chebyshev UCL	3.827	95% KM Chebyshev UCL	4.379
97.5% KM Chebyshev UCL	5.147	99% KM Chebyshev UCL	6.653

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.552
5% A-D Critical Value	0.725
K-S Test Statistic	0.286
5% K-S Critical Value	0.318

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.234
Theta hat (MLE)	5.695
nu hat (MLE)	17.28
MLE Mean (bias corrected)	7.029

k star (bias corrected MLE)	0.8
Theta star (bias corrected MLE)	8.78
nu star (bias corrected)	11.21
MLE Sd (bias corrected)	7.856

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.052	nu hat (KM)	164.2
Approximate Chi Square Value (164.17, α)	135.5	Adjusted Chi Square Value (164.17, β)	135.1
95% Gamma Approximate KM-UCL (use when n>=50)	3.157	95% Gamma Adjusted KM-UCL (use when n<50)	3.168

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Hexanone (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	2.815
Maximum	19	Median	1.903
SD	3.378	CV	1.2
k hat (MLE)	0.467	k star (bias corrected MLE)	0.458
Theta hat (MLE)	6.027	Theta star (bias corrected MLE)	6.151
nu hat (MLE)	72.86	nu star (bias corrected)	71.39
MLE Mean (bias corrected)	2.815	MLE Sd (bias corrected)	4.161
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (71.39, α)	52.94	Adjusted Chi Square Value (71.39, β)	52.64
95% Gamma Approximate UCL (use when $n \geq 50$)	3.796	95% Gamma Adjusted UCL (use when $n < 50$)	3.818

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.888
5% Shapiro Wilk Critical Value	0.803
Lilliefors Test Statistic	0.245
5% Lilliefors Critical Value	0.335

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.016	Mean in Log Scale	0.825
SD in Original Scale	2.847	SD in Log Scale	0.727
95% t UCL (assumes normality of ROS data)	3.553	95% Percentile Bootstrap UCL	3.609
95% BCA Bootstrap UCL	3.692	95% Bootstrap t UCL	3.821
95% H-UCL (Log ROS)	3.507		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.801	95% H-UCL (KM -Log)	2.697
KM SD (logged)	0.444	95% Critical H Value (KM-Log)	1.824
KM Standard Error of Mean (logged)	0.137		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	3.932
SD in Original Scale	3.198
95% t UCL (Assumes normality)	4.535

DL/2 Log-Transformed

Mean in Log Scale	1.193
SD in Log Scale	0.519
95% H-Stat UCL	4.214

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 3.284

95% KM (Percentile Bootstrap) UCL 3.346

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	51
		Number of Missing Observations	5
Number of Detects	56	Number of Non-Detects	22
Number of Distinct Detects	50	Number of Distinct Non-Detects	1
Minimum Detect	0.12	Minimum Non-Detect	1
Maximum Detect	850	Maximum Non-Detect	1
Variance Detects	62746	Percent Non-Detects	28.21%
Mean Detects	173.9	SD Detects	250.5
Median Detects	39	CV Detects	1.44
Skewness Detects	1.556	Kurtosis Detects	1.411
Mean of Logged Detects	3.044	SD of Logged Detects	2.834
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.715	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	9.193E-14	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.249	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.118	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	125	Standard Error of Mean	25.64
SD	224.4	95% KM (BCA) UCL	166.6
95% KM (t) UCL	167.6	95% KM (Percentile Bootstrap) UCL	168.6
95% KM (z) UCL	167.1	95% KM Bootstrap t UCL	172.6
90% KM Chebyshev UCL	201.9	95% KM Chebyshev UCL	236.7
97.5% KM Chebyshev UCL	285.1	99% KM Chebyshev UCL	380
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.028	Anderson-Darling GOF Test	
5% A-D Critical Value	0.858	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.137	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.129	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.322	k star (bias corrected MLE)	0.317
Theta hat (MLE)	539.6	Theta star (bias corrected MLE)	548.7
nu hat (MLE)	36.1	nu star (bias corrected)	35.5
MLE Mean (bias corrected)	173.9	MLE Sd (bias corrected)	308.9
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.31	nu hat (KM)	48.38
nate Chi Square Value (48.38, α)	33.42	Adjusted Chi Square Value (48.38, β)	33.18
mate KM-UCL (use when n>=50)	180.9	95% Gamma Adjusted KM-UCL (use when n<50)	182.2

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	124.9
Maximum	850	Median	2.65
SD	225.8	CV	1.808
k hat (MLE)	0.194	k star (bias corrected MLE)	0.195
Theta hat (MLE)	643.2	Theta star (bias corrected MLE)	639.6
nu hat (MLE)	30.3	nu star (bias corrected)	30.47
MLE Mean (bias corrected)	124.9	MLE Sd (bias corrected)	282.7
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (30.47, α)	18.86	Adjusted Chi Square Value (30.47, β)	18.69
95% Gamma Approximate UCL (use when $n \geq 50$)	201.8	95% Gamma Adjusted UCL (use when $n < 50$)	203.7

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic 0.124
5% Lilliefors Critical Value 0.118

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	125.1	Mean in Log Scale	1.912
SD in Original Scale	225.7	SD in Log Scale	3.124
95% t UCL (assumes normality of ROS data)	167.7	95% Percentile Bootstrap UCL	169.8
95% BCA Bootstrap UCL	174.7	95% Bootstrap t UCL	177.2
95% H-UCL (Log ROS)	5220		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale 125
SD in Original Scale 225.8
95% t UCL (Assumes normality) 167.6

DL/2 Log-Transformed

Mean in Log Scale 1.99
SD in Log Scale 2.933
95% H-Stat UCL 2591

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 285.1

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Carbon tetrachloride

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	9
		Number of Missing Observations	5
Number of Detects	6	Number of Non-Detects	72
Number of Distinct Detects	6	Number of Distinct Non-Detects	3
Minimum Detect	0.074	Minimum Non-Detect	1
Maximum Detect	13	Maximum Non-Detect	5
Variance Detects	34.45	Percent Non-Detects	92.31%
Mean Detects	4.599	SD Detects	5.869
Median Detects	1.67	CV Detects	1.276
Skewness Detects	0.883	Kurtosis Detects	-1.652
Mean of Logged Detects	0.111	SD of Logged Detects	2.207
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.779	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.539	Standard Error of Mean	0.244
SD	1.897	95% KM (BCA) UCL	1.201
95% KM (t) UCL	0.946	95% KM (Percentile Bootstrap) UCL	1.158
95% KM (z) UCL	0.941	95% KM Bootstrap t UCL	1.417
90% KM Chebyshev UCL	1.272	95% KM Chebyshev UCL	1.604
97.5% KM Chebyshev UCL	2.065	99% KM Chebyshev UCL	2.971
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.432	Anderson-Darling GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.262	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.35	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.455	k star (bias corrected MLE)	0.339
Theta hat (MLE)	10.1	Theta star (bias corrected MLE)	13.57
nu hat (MLE)	5.465	nu star (bias corrected)	4.066
MLE Mean (bias corrected)	4.599	MLE Sd (bias corrected)	7.901
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0807	nu hat (KM)	12.59
Approximate Chi Square Value (12.59, α)	5.62	Adjusted Chi Square Value (12.59, β)	5.532
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.208	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.227
Gamma (KM) may not be used when k hat (KM) is < 0.1			

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Carbon tetrachloride (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.982
Maximum	13	Median	0.01
SD	2.195	CV	2.235
k hat (MLE)	0.274	k star (bias corrected MLE)	0.272
Theta hat (MLE)	3.581	Theta star (bias corrected MLE)	3.607
nu hat (MLE)	42.78	nu star (bias corrected)	42.47
MLE Mean (bias corrected)	0.982	MLE Sd (bias corrected)	1.882
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (42.47, α)	28.53	Adjusted Chi Square Value (42.47, β)	28.31
95% Gamma Approximate UCL (use when $n \geq 50$)	1.462	95% Gamma Adjusted UCL (use when $n < 50$)	1.473

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.895
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.205
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.734	Mean in Log Scale	-1.643
SD in Original Scale	1.954	SD in Log Scale	1.604
95% t UCL (assumes normality of ROS data)	1.103	95% Percentile Bootstrap UCL	1.1
95% BCA Bootstrap UCL	1.263	95% Bootstrap t UCL	1.746
95% H-UCL (Log ROS)	1.197		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.65	95% H-UCL (KM -Log)	0.393
KM SD (logged)	0.969	95% Critical H Value (KM-Log)	2.233
KM Standard Error of Mean (logged)	0.391		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.956
SD in Original Scale	1.898
95% t UCL (Assumes normality)	1.314

DL/2 Log-Transformed

Mean in Log Scale	-0.51
SD in Log Scale	0.716
95% H-Stat UCL	0.913

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.946	95% KM (Percentile Bootstrap) UCL	1.158

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chloroform (Trichloromethane)

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	13
		Number of Missing Observations	5
Number of Detects	11	Number of Non-Detects	67
Number of Distinct Detects	11	Number of Distinct Non-Detects	3
Minimum Detect	0.15	Minimum Non-Detect	1
Maximum Detect	24	Maximum Non-Detect	5
Variance Detects	70.99	Percent Non-Detects	85.9%
Mean Detects	8.223	SD Detects	8.425
Median Detects	6.5	CV Detects	1.025
Skewness Detects	0.933	Kurtosis Detects	-0.398
Mean of Logged Detects	1.284	SD of Logged Detects	1.661

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.864
5% Shapiro Wilk Critical Value	0.85
Lilliefors Test Statistic	0.206
5% Lilliefors Critical Value	0.267

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	1.378	Standard Error of Mean	0.491
SD	4.1	95% KM (BCA) UCL	2.704
95% KM (t) UCL	2.195	95% KM (Percentile Bootstrap) UCL	2.383
95% KM (z) UCL	2.186	95% KM Bootstrap t UCL	2.648
90% KM Chebyshev UCL	2.851	95% KM Chebyshev UCL	3.519
97.5% KM Chebyshev UCL	4.445	99% KM Chebyshev UCL	6.265

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.216
5% A-D Critical Value	0.764
K-S Test Statistic	0.128
5% K-S Critical Value	0.265

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.73	k star (bias corrected MLE)	0.592
Theta hat (MLE)	11.26	Theta star (bias corrected MLE)	13.9
nu hat (MLE)	16.07	nu star (bias corrected)	13.02
MLE Mean (bias corrected)	8.223	MLE Sd (bias corrected)	10.69

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.113	nu hat (KM)	17.62
Approximate Chi Square Value (17.62, α)	9.115	Adjusted Chi Square Value (17.62, β)	8.999
95% Gamma Approximate KM-UCL (use when n>=50)	2.663	95% Gamma Adjusted KM-UCL (use when n<50)	2.697

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chloroform (Trichloromethane) (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	1.429
Maximum	24	Median	0.01
SD	4.192	CV	2.933
k hat (MLE)	0.209	k star (bias corrected MLE)	0.21
Theta hat (MLE)	6.828	Theta star (bias corrected MLE)	6.811
nu hat (MLE)	32.66	nu star (bias corrected)	32.74
MLE Mean (bias corrected)	1.429	MLE Sd (bias corrected)	3.12
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (32.74, α)	20.66	Adjusted Chi Square Value (32.74, β)	20.48
95% Gamma Approximate UCL (use when $n \geq 50$)	2.265	95% Gamma Adjusted UCL (use when $n < 50$)	2.285

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.922
5% Shapiro Wilk Critical Value	0.85
Lilliefors Test Statistic	0.184
5% Lilliefors Critical Value	0.267

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.531	Mean in Log Scale	-1.302
SD in Original Scale	4.114	SD in Log Scale	1.865
95% t UCL (assumes normality of ROS data)	2.307	95% Percentile Bootstrap UCL	2.327
95% BCA Bootstrap UCL	2.543	95% Bootstrap t UCL	2.977
95% H-UCL (Log ROS)	3.095		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.08	95% H-UCL (KM -Log)	0.974
KM SD (logged)	1.198	95% Critical H Value (KM-Log)	2.467
KM Standard Error of Mean (logged)	0.308		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	1.679
SD in Original Scale	4.061
95% t UCL (Assumes normality)	2.444

DL/2 Log-Transformed

Mean in Log Scale	-0.335
SD in Log Scale	0.949
95% H-Stat UCL	1.426

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.195	95% KM (Percentile Bootstrap) UCL	2.383

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

cis-1,2-Dichloroethene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	12
		Number of Missing Observations	5
Number of Detects	9	Number of Non-Detects	69
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.32	Minimum Non-Detect	1
Maximum Detect	9.05	Maximum Non-Detect	5
Variance Detects	7.605	Percent Non-Detects	88.46%
Mean Detects	1.92	SD Detects	2.758
Median Detects	0.92	CV Detects	1.436
Skewness Detects	2.684	Kurtosis Detects	7.477
Mean of Logged Detects	0.0977	SD of Logged Detects	1.004
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.594	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.367	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.779	Standard Error of Mean	0.157
SD	1.001	95% KM (BCA) UCL	1.036
95% KM (t) UCL	1.04	95% KM (Percentile Bootstrap) UCL	1.05
95% KM (z) UCL	1.037	95% KM Bootstrap t UCL	1.252
90% KM Chebyshev UCL	1.249	95% KM Chebyshev UCL	1.462
97.5% KM Chebyshev UCL	1.758	99% KM Chebyshev UCL	2.339
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.733	Anderson-Darling GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.291	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.287	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.036	k star (bias corrected MLE)	0.765
Theta hat (MLE)	1.853	Theta star (bias corrected MLE)	2.51
nu hat (MLE)	18.66	nu star (bias corrected)	13.77
MLE Mean (bias corrected)	1.92	MLE Sd (bias corrected)	2.195
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.605	nu hat (KM)	94.42
nate Chi Square Value (94.42, α)	73.01	Adjusted Chi Square Value (94.42, β)	72.65
mate KM-UCL (use when n>=50)	1.007	95% Gamma Adjusted KM-UCL (use when n<50)	1.012

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

cis-1,2-Dichloroethene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.661
Maximum	9.05	Median	0.275
SD	1.182	CV	1.788
k hat (MLE)	0.4	k star (bias corrected MLE)	0.393
Theta hat (MLE)	1.651	Theta star (bias corrected MLE)	1.68
nu hat (MLE)	62.43	nu star (bias corrected)	61.37
MLE Mean (bias corrected)	0.661	MLE Sd (bias corrected)	1.054
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (61.37, α)	44.35	Adjusted Chi Square Value (61.37, β)	44.08
95% Gamma Approximate UCL (use when $n \geq 50$)	0.914	95% Gamma Adjusted UCL (use when $n < 50$)	0.92

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.926
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.213
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.799	Mean in Log Scale	-0.523
SD in Original Scale	1.043	SD in Log Scale	0.704
95% t UCL (assumes normality of ROS data)	0.996	95% Percentile Bootstrap UCL	1.004
95% BCA Bootstrap UCL	1.124	95% Bootstrap t UCL	1.218
95% H-UCL (Log ROS)	0.891		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.467	95% H-UCL (KM -Log)	0.813
KM SD (logged)	0.539	95% Critical H Value (KM-Log)	1.882
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.805
SD in Original Scale	1.095
95% t UCL (Assumes normality)	1.011

DL/2 Log-Transformed

Mean in Log Scale	-0.481
SD in Log Scale	0.559
95% H-Stat UCL	0.816

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.04	95% GROS Approximate Gamma UCL	0.914
95% Approximate Gamma KM-UCL	1.007		

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Ethylbenzene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	44
		Number of Missing Observations	5
Number of Detects	46	Number of Non-Detects	32
Number of Distinct Detects	43	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	2400	Maximum Non-Detect	1
Variance Detects	222170	Percent Non-Detects	41.03%
Mean Detects	234.9	SD Detects	471.3
Median Detects	9.65	CV Detects	2.006
Skewness Detects	2.899	Kurtosis Detects	9.797
Mean of Logged Detects	2.53	SD of Logged Detects	3.093
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.582	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.323	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.131	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	138.7	Standard Error of Mean	43.06
SD	376.2	95% KM (BCA) UCL	212.3
95% KM (t) UCL	210.4	95% KM (Percentile Bootstrap) UCL	209.9
95% KM (z) UCL	209.5	95% KM Bootstrap t UCL	253.1
90% KM Chebyshev UCL	267.9	95% KM Chebyshev UCL	326.4
97.5% KM Chebyshev UCL	407.6	99% KM Chebyshev UCL	567.1
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.673	Anderson-Darling GOF Test	
5% A-D Critical Value	0.89	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.168	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.144	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.244	k star (bias corrected MLE)	0.242
Theta hat (MLE)	964.7	Theta star (bias corrected MLE)	970.3
nu hat (MLE)	22.4	nu star (bias corrected)	22.28
MLE Mean (bias corrected)	234.9	MLE Sd (bias corrected)	477.4
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.136	nu hat (KM)	21.21
Approximate Chi Square Value (21.21, α)	11.75	Adjusted Chi Square Value (21.21, β)	11.61
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	250.4	95% Gamma Adjusted KM-UCL (use when $n < 50$)	253.3

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Ethylbenzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	138.6
Maximum	2400	Median	0.325
SD	378.6	CV	2.733
k hat (MLE)	0.145	k star (bias corrected MLE)	0.148
Theta hat (MLE)	955.8	Theta star (bias corrected MLE)	936.6
nu hat (MLE)	22.61	nu star (bias corrected)	23.08
MLE Mean (bias corrected)	138.6	MLE Sd (bias corrected)	360.2
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (23.08, α)	13.15	Adjusted Chi Square Value (23.08, β)	13.01
95% Gamma Approximate UCL (use when $n \geq 50$)	243.2	95% Gamma Adjusted UCL (use when $n < 50$)	245.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925
5% Shapiro Wilk Critical Value	0.945
Lilliefors Test Statistic	0.122
5% Lilliefors Critical Value	0.131

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	138.9	Mean in Log Scale	0.973
SD in Original Scale	378.5	SD in Log Scale	3.274
95% t UCL (assumes normality of ROS data)	210.3	95% Percentile Bootstrap UCL	216
95% BCA Bootstrap UCL	235.2	95% Bootstrap t UCL	249.2
95% H-UCL (Log ROS)	3873		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.968	95% H-UCL (KM -Log)	1412
KM SD (logged)	3.037	95% Critical H Value (KM-Log)	4.839
KM Standard Error of Mean (logged)	0.36		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	138.8
SD in Original Scale	378.6
95% t UCL (Assumes normality)	210.1

DL/2 Log-Transformed

Mean in Log Scale	1.208
SD in Log Scale	2.853
95% H-Stat UCL	868.7

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 407.6

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Isopropyl benzene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	41
		Number of Missing Observations	5
Number of Detects	46	Number of Non-Detects	32
Number of Distinct Detects	40	Number of Distinct Non-Detects	1
Minimum Detect	0.097	Minimum Non-Detect	1
Maximum Detect	130	Maximum Non-Detect	1
Variance Detects	672.2	Percent Non-Detects	41.03%
Mean Detects	21.28	SD Detects	25.93
Median Detects	18	CV Detects	1.218
Skewness Detects	2.52	Kurtosis Detects	8.351
Mean of Logged Detects	1.952	SD of Logged Detects	1.94
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.723	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.207	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.131	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	12.75	Standard Error of Mean	2.54
SD	22.19	95% KM (BCA) UCL	17.64
95% KM (t) UCL	16.98	95% KM (Percentile Bootstrap) UCL	17
95% KM (z) UCL	16.93	95% KM Bootstrap t UCL	18.69
90% KM Chebyshev UCL	20.38	95% KM Chebyshev UCL	23.83
97.5% KM Chebyshev UCL	28.62	99% KM Chebyshev UCL	38.03
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.575	Anderson-Darling GOF Test	
5% A-D Critical Value	0.808	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.16	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.137	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.564	k star (bias corrected MLE)	0.542
Theta hat (MLE)	37.73	Theta star (bias corrected MLE)	39.28
nu hat (MLE)	51.89	nu star (bias corrected)	49.84
MLE Mean (bias corrected)	21.28	MLE Sd (bias corrected)	28.91
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.33	nu hat (KM)	51.55
nate Chi Square Value (51.55, α)	36.06	Adjusted Chi Square Value (51.55, β)	35.81
nate KM-UCL (use when $n \geq 50$)	18.23	95% Gamma Adjusted KM-UCL (use when $n < 50$)	18.36

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Isopropyl benzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	12.77
Maximum	130	Median	1.117
SD	22.34	CV	1.749
k hat (MLE)	0.254	k star (bias corrected MLE)	0.253
Theta hat (MLE)	50.3	Theta star (bias corrected MLE)	50.54
nu hat (MLE)	39.6	nu star (bias corrected)	39.41
MLE Mean (bias corrected)	12.77	MLE Sd (bias corrected)	25.41
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (39.41, α)	26.03	Adjusted Chi Square Value (39.41, β)	25.83
95% Gamma Approximate UCL (use when $n \geq 50$)	19.33	95% Gamma Adjusted UCL (use when $n < 50$)	19.49

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.874
5% Shapiro Wilk Critical Value	0.945
Lilliefors Test Statistic	0.205
5% Lilliefors Critical Value	0.131

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	12.94	Mean in Log Scale	0.899
SD in Original Scale	22.24	SD in Log Scale	2.108
95% t UCL (assumes normality of ROS data)	17.13	95% Percentile Bootstrap UCL	17.33
95% BCA Bootstrap UCL	18.06	95% Bootstrap t UCL	18.82
95% H-UCL (Log ROS)	53.46		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	12.76
SD in Original Scale	22.33
95% t UCL (Assumes normality)	16.97

DL/2 Log-Transformed

Mean in Log Scale	0.867
SD in Log Scale	1.979
95% H-Stat UCL	36.32

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 28.62

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Tetrachloroethene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	17
		Number of Missing Observations	5
Number of Detects	16	Number of Non-Detects	62
Number of Distinct Detects	15	Number of Distinct Non-Detects	3
Minimum Detect	0.13	Minimum Non-Detect	1
Maximum Detect	8.9	Maximum Non-Detect	5
Variance Detects	4.458	Percent Non-Detects	79.49%
Mean Detects	1.045	SD Detects	2.111
Median Detects	0.615	CV Detects	2.02
Skewness Detects	3.893	Kurtosis Detects	15.39
Mean of Logged Detects	-0.633	SD of Logged Detects	0.982
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.387	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.446	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.602	Standard Error of Mean	0.128
SD	0.977	95% KM (BCA) UCL	0.831
95% KM (t) UCL	0.816	95% KM (Percentile Bootstrap) UCL	0.849
95% KM (z) UCL	0.813	95% KM Bootstrap t UCL	0.976
90% KM Chebyshev UCL	0.987	95% KM Chebyshev UCL	1.161
97.5% KM Chebyshev UCL	1.403	99% KM Chebyshev UCL	1.878
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.798	Anderson-Darling GOF Test	
5% A-D Critical Value	0.769	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.222	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.867	k star (bias corrected MLE)	0.746
Theta hat (MLE)	1.205	Theta star (bias corrected MLE)	1.4
nu hat (MLE)	27.75	nu star (bias corrected)	23.88
MLE Mean (bias corrected)	1.045	MLE Sd (bias corrected)	1.21
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.38	nu hat (KM)	59.3
Approximate Chi Square Value (59.30, α)	42.6	Adjusted Chi Square Value (59.30, β)	42.33
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.838	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.844

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Tetrachloroethene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.7
Maximum	8.9	Median	0.371
SD	1.173	CV	1.675
k hat (MLE)	0.478	k star (bias corrected MLE)	0.469
Theta hat (MLE)	1.464	Theta star (bias corrected MLE)	1.494
nu hat (MLE)	74.64	nu star (bias corrected)	73.1
MLE Mean (bias corrected)	0.7	MLE Sd (bias corrected)	1.023
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (73.10, α)	54.41	Adjusted Chi Square Value (73.10, β)	54.11
95% Gamma Approximate UCL (use when $n \geq 50$)	0.941	95% Gamma Adjusted UCL (use when $n < 50$)	0.946

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.868
5% Shapiro Wilk Critical Value	0.887
Lilliefors Test Statistic	0.197
5% Lilliefors Critical Value	0.222

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.634	Mean in Log Scale	-0.824
SD in Original Scale	1.01	SD in Log Scale	0.772
95% t UCL (assumes normality of ROS data)	0.824	95% Percentile Bootstrap UCL	0.852
95% BCA Bootstrap UCL	0.975	95% Bootstrap t UCL	1.1
95% H-UCL (Log ROS)	0.707		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.828	95% H-UCL (KM -Log)	0.656
KM SD (logged)	0.703	95% Critical H Value (KM-Log)	1.986
KM Standard Error of Mean (logged)	0.17		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.753
SD in Original Scale	1.064
95% t UCL (Assumes normality)	0.953

DL/2 Log-Transformed

Mean in Log Scale	-0.56
SD in Log Scale	0.593
95% H-Stat UCL	0.775

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.816

95% KM (Percentile Bootstrap) UCL 0.849

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Toluene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	44
		Number of Missing Observations	5
Number of Detects	45	Number of Non-Detects	33
Number of Distinct Detects	43	Number of Distinct Non-Detects	3
Minimum Detect	0.17	Minimum Non-Detect	0.17
Maximum Detect	6100	Maximum Non-Detect	3.4
Variance Detects	1622597	Percent Non-Detects	42.31%
Mean Detects	492.6	SD Detects	1274
Median Detects	7.2	CV Detects	2.586
Skewness Detects	3.612	Kurtosis Detects	13.42
Mean of Logged Detects	2.621	SD of Logged Detects	3.176
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.447	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.35	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.132	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	284.3	Standard Error of Mean	113
SD	987.1	95% KM (BCA) UCL	482
95% KM (t) UCL	472.5	95% KM (Percentile Bootstrap) UCL	488
95% KM (z) UCL	470.3	95% KM Bootstrap t UCL	714.1
90% KM Chebyshev UCL	623.5	95% KM Chebyshev UCL	777.1
97.5% KM Chebyshev UCL	990.2	99% KM Chebyshev UCL	1409
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.867	Anderson-Darling GOF Test	
5% A-D Critical Value	0.909	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.231	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.146	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.205	k star (bias corrected MLE)	0.206
Theta hat (MLE)	2405	Theta star (bias corrected MLE)	2391
nu hat (MLE)	18.44	nu star (bias corrected)	18.54
MLE Mean (bias corrected)	492.6	MLE Sd (bias corrected)	1085
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.083	nu hat (KM)	12.94
Approximate Chi Square Value (12.94, α)	5.855	Adjusted Chi Square Value (12.94, β)	5.765
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	628.6	95% Gamma Adjusted KM-UCL (use when $n < 50$)	638.4
Gamma (KM) may not be used when k hat (KM) is < 0.1			

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Toluene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	284.2
Maximum	6100	Median	0.305
SD	993.6	CV	3.496
k hat (MLE)	0.129	k star (bias corrected MLE)	0.133
Theta hat (MLE)	2203	Theta star (bias corrected MLE)	2143
nu hat (MLE)	20.13	nu star (bias corrected)	20.69
MLE Mean (bias corrected)	284.2	MLE Sd (bias corrected)	780.4
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (20.69, α)	11.36	Adjusted Chi Square Value (20.69, β)	11.23
95% Gamma Approximate UCL (use when $n \geq 50$)	517.6	95% Gamma Adjusted UCL (use when $n < 50$)	523.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.916
5% Shapiro Wilk Critical Value	0.945
Lilliefors Test Statistic	0.122
5% Lilliefors Critical Value	0.132

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	284.4	Mean in Log Scale	0.655
SD in Original Scale	993.5	SD in Log Scale	3.642
95% t UCL (assumes normality of ROS data)	471.7	95% Percentile Bootstrap UCL	466.7
95% BCA Bootstrap UCL	581.7	95% Bootstrap t UCL	727.9
95% H-UCL (Log ROS)	15518		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.029	95% H-UCL (KM -Log)	1532
KM SD (logged)	3.042	95% Critical H Value (KM-Log)	4.846
KM Standard Error of Mean (logged)	0.355		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	284.4
SD in Original Scale	993.5
95% t UCL (Assumes normality)	471.7

DL/2 Log-Transformed

Mean in Log Scale	1.212
SD in Log Scale	2.927
95% H-Stat UCL	1163

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 990.2

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Trichloroethene

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	17
		Number of Missing Observations	5
Number of Detects	14	Number of Non-Detects	64
Number of Distinct Detects	14	Number of Distinct Non-Detects	3
Minimum Detect	0.16	Minimum Non-Detect	1
Maximum Detect	9.5	Maximum Non-Detect	5
Variance Detects	10.64	Percent Non-Detects	82.05%
Mean Detects	2.373	SD Detects	3.262
Median Detects	0.698	CV Detects	1.375
Skewness Detects	1.536	Kurtosis Detects	1.061
Mean of Logged Detects	-0.0581	SD of Logged Detects	1.419
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.705	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.32	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.788	Standard Error of Mean	0.196
SD	1.543	95% KM (BCA) UCL	1.129
95% KM (t) UCL	1.113	95% KM (Percentile Bootstrap) UCL	1.144
95% KM (z) UCL	1.109	95% KM Bootstrap t UCL	1.256
90% KM Chebyshev UCL	1.375	95% KM Chebyshev UCL	1.641
97.5% KM Chebyshev UCL	2.01	99% KM Chebyshev UCL	2.735
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.905	Anderson-Darling GOF Test	
5% A-D Critical Value	0.779	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.239	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.661	k star (bias corrected MLE)	0.567
Theta hat (MLE)	3.59	Theta star (bias corrected MLE)	4.186
nu hat (MLE)	18.5	nu star (bias corrected)	15.87
MLE Mean (bias corrected)	2.373	MLE Sd (bias corrected)	3.151
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.26	nu hat (KM)	40.63
Approximate Chi Square Value (40.63, α)	27.02	Adjusted Chi Square Value (40.63, β)	26.81
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.184	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.193

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Trichloroethene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.95
Maximum	9.5	Median	0.273
SD	1.719	CV	1.81
k hat (MLE)	0.357	k star (bias corrected MLE)	0.352
Theta hat (MLE)	2.658	Theta star (bias corrected MLE)	2.697
nu hat (MLE)	55.76	nu star (bias corrected)	54.94
MLE Mean (bias corrected)	0.95	MLE Sd (bias corrected)	1.601
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (54.94, α)	38.91	Adjusted Chi Square Value (54.94, β)	38.66
95% Gamma Approximate UCL (use when $n \geq 50$)	1.341	95% Gamma Adjusted UCL (use when $n < 50$)	1.35

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.174
5% Lilliefors Critical Value	0.237

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.916	Mean in Log Scale	-0.763
SD in Original Scale	1.58	SD in Log Scale	1.097
95% t UCL (assumes normality of ROS data)	1.214	95% Percentile Bootstrap UCL	1.21
95% BCA Bootstrap UCL	1.32	95% Bootstrap t UCL	1.452
95% H-UCL (Log ROS)	1.144		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.814	95% H-UCL (KM -Log)	0.779
KM SD (logged)	0.848	95% Critical H Value (KM-Log)	2.123
KM Standard Error of Mean (logged)	0.195		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.977
SD in Original Scale	1.571
95% t UCL (Assumes normality)	1.273

DL/2 Log-Transformed

Mean in Log Scale	-0.458
SD in Log Scale	0.733
95% H-Stat UCL	0.979

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL 1.129

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Xylenes (total)

General Statistics			
Total Number of Observations	78	Number of Distinct Observations	42
		Number of Missing Observations	5
Number of Detects	47	Number of Non-Detects	31
Number of Distinct Detects	41	Number of Distinct Non-Detects	1
Minimum Detect	0.48	Minimum Non-Detect	3
Maximum Detect	13000	Maximum Non-Detect	3
Variance Detects	7033592	Percent Non-Detects	39.74%
Mean Detects	971	SD Detects	2652
Median Detects	7.9	CV Detects	2.731
Skewness Detects	3.558	Kurtosis Detects	12.85
Mean of Logged Detects	3.131	SD of Logged Detects	3.097
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.431	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.946	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.368	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.129	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	585.6	Standard Error of Mean	239.3
SD	2091	95% KM (BCA) UCL	1003
95% KM (t) UCL	984.1	95% KM (Percentile Bootstrap) UCL	1020
95% KM (z) UCL	979.3	95% KM Bootstrap t UCL	1486
90% KM Chebyshev UCL	1304	95% KM Chebyshev UCL	1629
97.5% KM Chebyshev UCL	2080	99% KM Chebyshev UCL	2967
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.832	Anderson-Darling GOF Test	
5% A-D Critical Value	0.915	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.226	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.144	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.197	k star (bias corrected MLE)	0.199
Theta hat (MLE)	4932	Theta star (bias corrected MLE)	4892
nu hat (MLE)	18.51	nu star (bias corrected)	18.66
MLE Mean (bias corrected)	971	MLE Sd (bias corrected)	2179
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0784	nu hat (KM)	12.23
Approximate Chi Square Value (12.23, α)	5.38	Adjusted Chi Square Value (12.23, β)	5.294
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1331	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1353
Gamma (KM) may not be used when k hat (KM) is < 0.1			

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Xylenes (total) (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	585.1
Maximum	13000	Median	1.1
SD	2105	CV	3.597
k hat (MLE)	0.125	k star (bias corrected MLE)	0.129
Theta hat (MLE)	4685	Theta star (bias corrected MLE)	4549
nu hat (MLE)	19.48	nu star (bias corrected)	20.07
MLE Mean (bias corrected)	585.1	MLE Sd (bias corrected)	1631
		Adjusted Level of Significance (β)	0.0469
Approximate Chi Square Value (20.07, α)	10.9	Adjusted Chi Square Value (20.07, β)	10.77
95% Gamma Approximate UCL (use when $n \geq 50$)	1077	95% Gamma Adjusted UCL (use when $n < 50$)	1090

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic 0.891
5% Shapiro Wilk Critical Value 0.946
Lilliefors Test Statistic 0.147
5% Lilliefors Critical Value 0.129

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	586.2	Mean in Log Scale	1.844
SD in Original Scale	2105	SD in Log Scale	3.107
95% t UCL (assumes normality of ROS data)	982.9	95% Percentile Bootstrap UCL	1007
95% BCA Bootstrap UCL	1140	95% Bootstrap t UCL	1413
95% H-UCL (Log ROS)	4524		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale 585.7
SD in Original Scale 2105
95% t UCL (Assumes normality) 982.5

DL/2 Log-Transformed

Mean in Log Scale 2.048
SD in Log Scale 2.745
95% H-Stat UCL 1341

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 2080

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Methylnaphthalene

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	6
		Number of Missing Observations	10
Number of Detects	3	Number of Non-Detects	27
Number of Distinct Detects	3	Number of Distinct Non-Detects	3
Minimum Detect	3.6	Minimum Non-Detect	10
Maximum Detect	175	Maximum Non-Detect	12
Variance Detects	7897	Percent Non-Detects	90%
Mean Detects	102.9	SD Detects	88.86
Median Detects	130	CV Detects	0.864
Skewness Detects	-1.246	Kurtosis Detects	N/A
Mean of Logged Detects	3.771	SD of Logged Detects	2.162

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.93
5% Shapiro Wilk Critical Value 0.767
Lilliefors Test Statistic 0.287
5% Lilliefors Critical Value 0.512

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level
Lilliefors GOF Test
Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

Mean	13.53	Standard Error of Mean	8.406
SD	37.59	95% KM (BCA) UCL	N/A
95% KM (t) UCL	27.81	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	27.35	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	38.75	95% KM Chebyshev UCL	50.17
97.5% KM Chebyshev UCL	66.02	99% KM Chebyshev UCL	97.17

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.701	k star (bias corrected MLE)	N/A
Theta hat (MLE)	146.8	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4.204	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.129	nu hat (KM)	7.768
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (7.77, α)	2.601	Adjusted Chi Square Value (7.77, β)	2.432
95% Gamma Approximate KM-UCL (use when n>=50)	40.39	95% Gamma Adjusted KM-UCL (use when n<50)	43.21

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Methylnaphthalene (cont.'d)**Lognormal GOF Test on Detected Observations Only**

Shapiro Wilk Test Statistic	0.807	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.361	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	17.85	Mean in Log Scale	1.489
SD in Original Scale	38.69	SD in Log Scale	1.71
95% t UCL (assumes normality of ROS data)	29.86	95% Percentile Bootstrap UCL	30.93
95% BCA Bootstrap UCL	34.61	95% Bootstrap t UCL	57.85
95% H-UCL (Log ROS)	57.79		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.53	95% H-UCL (KM -Log)	10.8
KM SD (logged)	0.933	95% Critical H Value (KM-Log)	2.394
KM Standard Error of Mean (logged)	0.209		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	14.84
SD in Original Scale	37.89
95% t UCL (Assumes normality)	26.59

DL/2 Log-Transformed

Mean in Log Scale	1.835
SD in Log Scale	0.869
95% H-Stat UCL	13.28

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL **27.81**

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Biphenyl (1,1-Biphenyl)

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	5
		Number of Missing Observations	10
Number of Detects	2	Number of Non-Detects	28
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	8.6	Minimum Non-Detect	10
Maximum Detect	11.5	Maximum Non-Detect	12
Variance Detects	4.205	Percent Non-Detects	93.33%
Mean Detects	10.05	SD Detects	2.051
Median Detects	10.05	CV Detects	0.204
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	2.297	SD of Logged Detects	0.205

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

**Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test**

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

Mean	8.7	Standard Error of Mean	0.139
SD	0.529	95% KM (BCA) UCL	N/A
95% KM (t) UCL	8.936	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	8.929	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	9.117	95% KM Chebyshev UCL	9.306
97.5% KM Chebyshev UCL	9.568	99% KM Chebyshev UCL	10.08

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

Gamma Statistics on Detected Data Only

k hat (MLE)	47.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.211	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	190.8	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	270.3	nu hat (KM)	16219
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (N/A, α)	15924	Adjusted Chi Square Value (N/A, β)	15907
95% Gamma Approximate KM-UCL (use when n>=50)	8.861	95% Gamma Adjusted KM-UCL (use when n<50)	8.871

**Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test**

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Biphenyl (1,1-Biphenyl) (cont.'d)**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	8.722	Mean in Log Scale	2.159
SD in Original Scale	1.056	SD in Log Scale	0.12
95% t UCL (assumes normality of ROS data)	9.049	95% Percentile Bootstrap UCL	9.041
95% BCA Bootstrap UCL	9.031	95% Bootstrap t UCL	9.069
95% H-UCL (Log ROS)	9.062		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	5.387
SD in Original Scale	1.339
95% t UCL (Assumes normality)	5.802

DL/2 Log-Transformed

Mean in Log Scale	1.665
SD in Log Scale	0.18
95% H-Stat UCL	5.692

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

95% KM (t) UCL 8.936

95% KM (% Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Dibenzofuran

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	5
		Number of Missing Observations	10
Number of Detects	2	Number of Non-Detects	28
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	3	Minimum Non-Detect	10
Maximum Detect	3.7	Maximum Non-Detect	12
Variance Detects	0.245	Percent Non-Detects	93.33%
Mean Detects	3.35	SD Detects	0.495
Median Detects	3.35	CV Detects	0.148
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.203	SD of Logged Detects	0.148

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

**Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test**

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

Mean	3.35	Standard Error of Mean	0.35
SD	0.35	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.945	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.926	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.4	95% KM Chebyshev UCL	4.876
97.5% KM Chebyshev UCL	5.536	99% KM Chebyshev UCL	6.832

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

Gamma Statistics on Detected Data Only

k hat (MLE)	91.28	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0367	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	365.1	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	91.61	nu hat (KM)	5497
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (N/A, α)	5325	Adjusted Chi Square Value (N/A, β)	5316
95% Gamma Approximate KM-UCL (use when n>=50)	3.458	95% Gamma Adjusted KM-UCL (use when n<50)	3.464

**Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test**

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Dibenzofuran (cont.'d)**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	3.401	Mean in Log Scale	1.203
SD in Original Scale	0.709	SD in Log Scale	0.207
95% t UCL (assumes normality of ROS data)	3.621	95% Percentile Bootstrap UCL	3.615
95% BCA Bootstrap UCL	3.616	95% Bootstrap t UCL	3.642
95% H-UCL (Log ROS)	3.642		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	4.94
SD in Original Scale	0.485
95% t UCL (Assumes normality)	5.091

DL/2 Log-Transformed

Mean in Log Scale	1.592
SD in Log Scale	0.115
95% H-Stat UCL	5.129

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

95% KM (t) UCL 3.945

95% KM (% Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

Warning: Recommended UCL exceeds the maximum observation

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Naphthalene

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	9
		Number of Missing Observations	10
Number of Detects	6	Number of Non-Detects	24
Number of Distinct Detects	6	Number of Distinct Non-Detects	3
Minimum Detect	4.8	Minimum Non-Detect	10
Maximum Detect	270	Maximum Non-Detect	12
Variance Detects	15733	Percent Non-Detects	80%
Mean Detects	93.73	SD Detects	125.4
Median Detects	19.5	CV Detects	1.338
Skewness Detects	0.983	Kurtosis Detects	-1.726
Mean of Logged Detects	3.453	SD of Logged Detects	1.702

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.708
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.383
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	24.09	Standard Error of Mean	12.45
SD	61.95	95% KM (BCA) UCL	49.33
95% KM (t) UCL	45.24	95% KM (Percentile Bootstrap) UCL	43.87
95% KM (z) UCL	44.56	95% KM Bootstrap t UCL	203.3
90% KM Chebyshev UCL	61.43	95% KM Chebyshev UCL	78.35
97.5% KM Chebyshev UCL	101.8	99% KM Chebyshev UCL	147.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.647
5% A-D Critical Value	0.732
K-S Test Statistic	0.327
5% K-S Critical Value	0.347

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.572
Theta hat (MLE)	163.8
nu hat (MLE)	6.867
MLE Mean (bias corrected)	93.73

k star (bias corrected MLE)	0.397
Theta star (bias corrected MLE)	235.9
nu star (bias corrected)	4.767
MLE Sd (bias corrected)	148.7

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.151
Approximate Chi Square Value (9.07, α)	3.369
95% Gamma Approximate KM-UCL (use when n>=50)	64.84

nu hat (KM)	9.07
Adjusted Chi Square Value (9.07, β)	3.171
95% Gamma Adjusted KM-UCL (use when n<50)	68.89

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Naphthalene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	24.45
Maximum	270	Median	0.01
SD	64.49	CV	2.638
k hat (MLE)	0.163	k star (bias corrected MLE)	0.168
Theta hat (MLE)	150.4	Theta star (bias corrected MLE)	145.1
nu hat (MLE)	9.751	nu star (bias corrected)	10.11
MLE Mean (bias corrected)	24.45	MLE Sd (bias corrected)	59.55
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (10.11, α)	4.01	Adjusted Chi Square Value (10.11, β)	3.791
95% Gamma Approximate UCL (use when $n \geq 50$)	61.62	95% Gamma Adjusted UCL (use when $n < 50$)	65.2

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.87
5% Shapiro Wilk Critical Value	0.788
Lilliefors Test Statistic	0.251
5% Lilliefors Critical Value	0.362

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	25.36	Mean in Log Scale	1.992
SD in Original Scale	63.02	SD in Log Scale	1.414
95% t UCL (assumes normality of ROS data)	44.91	95% Percentile Bootstrap UCL	43.83
95% BCA Bootstrap UCL	56.33	95% Bootstrap t UCL	163.8
95% H-UCL (Log ROS)	44.28		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.176	95% H-UCL (KM -Log)	22.2
KM SD (logged)	0.978	95% Critical H Value (KM-Log)	2.451
KM Standard Error of Mean (logged)	0.27		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	22.8
SD in Original Scale	63.35
95% t UCL (Assumes normality)	42.45

DL/2 Log-Transformed

Mean in Log Scale	1.987
SD in Log Scale	1.028
95% H-Stat UCL	19.99

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	45.24	95% GROS Adjusted Gamma UCL	65.2
95% Adjusted Gamma KM-UCL	68.89		

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Aluminum

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	23
		Number of Missing Observations	18
Minimum	103	Mean	5065
Maximum	35300	Median	1495
SD	8606	Std. Error of Mean	1794
Coefficient of Variation	1.699	Skewness	2.571
Normal GOF Test			
Shapiro Wilk Test Statistic	0.616	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.303	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.185	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8147	95% Adjusted-CLT UCL (Chen-1995)	9045
		95% Modified-t UCL (Johnson-1978)	8307
Gamma GOF Test			
A-D Test Statistic	0.934	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.801	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.192	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.191	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.54	k star (bias corrected MLE)	0.498
Theta hat (MLE)	9386	Theta star (bias corrected MLE)	10166
nu hat (MLE)	24.83	nu star (bias corrected)	22.92
MLE Mean (bias corrected)	5065	MLE Sd (bias corrected)	7176
		Approximate Chi Square Value (0.05)	13.03
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	12.49
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8910	95% Adjusted Gamma UCL (use when n<50)	9295
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.149	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.185	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.635	Mean of logged Data	7.367
Maximum of Logged Data	10.47	SD of logged Data	1.598

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Aluminum (cont.'d)**Assuming Lognormal Distribution**

95% H-UCL 18085
95% Chebyshev (MVUE) UCL 14185
99% Chebyshev (MVUE) UCL 25864

90% Chebyshev (MVUE) UCL 11347
97.5% Chebyshev (MVUE) UCL 18125

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

95% CLT UCL 8017
95% Standard Bootstrap UCL 7927
95% Hall's Bootstrap UCL 11510
95% BCA Bootstrap UCL 9048
90% Chebyshev(Mean, Sd) UCL 10449
97.5% Chebyshev(Mean, Sd) UCL 16272

95% Jackknife UCL 8147
95% Bootstrap-t UCL 10753
95% Percentile Bootstrap UCL 8281

95% Chebyshev(Mean, Sd) UCL 12887
99% Chebyshev(Mean, Sd) UCL 22920

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 12887

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	10
		Number of Missing Observations	18
Number of Detects	9	Number of Non-Detects	14
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	3.9	Minimum Non-Detect	5
Maximum Detect	7.9	Maximum Non-Detect	5
Variance Detects	1.786	Percent Non-Detects	60.87%
Mean Detects	5.511	SD Detects	1.336
Median Detects	5.7	CV Detects	0.243
Skewness Detects	0.433	Kurtosis Detects	-0.523
Mean of Logged Detects	1.681	SD of Logged Detects	0.242

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.13	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	4.774	Standard Error of Mean	0.27
SD	1.032	95% KM (BCA) UCL	5.265
95% KM (t) UCL	5.237	95% KM (Percentile Bootstrap) UCL	5.27
95% KM (z) UCL	5.218	95% KM Bootstrap t UCL	5.327
90% KM Chebyshev UCL	5.584	95% KM Chebyshev UCL	5.95
97.5% KM Chebyshev UCL	6.46	99% KM Chebyshev UCL	7.46

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.248	Anderson-Darling GOF Test
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	19.38	k star (bias corrected MLE)	12.99
Theta hat (MLE)	0.284	Theta star (bias corrected MLE)	0.424
nu hat (MLE)	348.8	nu star (bias corrected)	233.9
MLE Mean (bias corrected)	5.511	MLE Sd (bias corrected)	1.529

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	21.4	nu hat (KM)	984.4
Approximate Chi Square Value (984.39, α)	912.6	Adjusted Chi Square Value (984.39, β)	907.6
95% Gamma Approximate KM-UCL (use when n>=50)	5.15	95% Gamma Adjusted KM-UCL (use when n<50)	5.178

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Arsenic (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	2.813	Mean	4.75
Maximum	7.9	Median	4.555
SD	1.191	CV	0.251
k hat (MLE)	17.52	k star (bias corrected MLE)	15.26
Theta hat (MLE)	0.271	Theta star (bias corrected MLE)	0.311
nu hat (MLE)	805.7	nu star (bias corrected)	702
MLE Mean (bias corrected)	4.75	MLE Sd (bias corrected)	1.216
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (701.98, α)	641.5	Adjusted Chi Square Value (701.98, β)	637.3
95% Gamma Approximate UCL (use when $n \geq 50$)	5.198	95% Gamma Adjusted UCL (use when $n < 50$)	5.232

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.952
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.153
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.783	Mean in Log Scale	1.54
SD in Original Scale	1.138	SD in Log Scale	0.226
95% t UCL (assumes normality of ROS data)	5.191	95% Percentile Bootstrap UCL	5.197
95% BCA Bootstrap UCL	5.215	95% Bootstrap t UCL	5.257
95% H-UCL (Log ROS)	5.213		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.543	95% H-UCL (KM -Log)	5.127
KM SD (logged)	0.194	95% Critical H Value (KM-Log)	1.76
KM Standard Error of Mean (logged)	0.054		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	3.678
SD in Original Scale	1.705
95% t UCL (Assumes normality)	4.289

DL/2 Log-Transformed

Mean in Log Scale	1.215
SD in Log Scale	0.408
95% H-Stat UCL	4.324

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 5.237

95% KM (Percentile Bootstrap) UCL 5.27

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Barium

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	23
		Number of Missing Observations	18
Minimum	70.1	Mean	336.9
Maximum	1320	Median	259
SD	317	Std. Error of Mean	66.1
Coefficient of Variation	0.941	Skewness	1.892
Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.764	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.914	Lilliefors GOF Test	
Lilliefors Test Statistic	0.221	Data Not Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.185		
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	450.4	95% Adjusted-CLT UCL (Chen-1995)	473.5
		95% Modified-t UCL (Johnson-1978)	454.8
Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.715	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.759	Kolmogrov-Smirnoff Gamma GOF Test	
K-S Test Statistic	0.161	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.185		
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.636	k star (bias corrected MLE)	1.452
Theta hat (MLE)	206	Theta star (bias corrected MLE)	232.1
nu hat (MLE)	75.25	nu star (bias corrected)	66.77
MLE Mean (bias corrected)	336.9	MLE Sd (bias corrected)	279.7
		Approximate Chi Square Value (0.05)	48.97
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	47.86
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	459.4	95% Adjusted Gamma UCL (use when n<50)	470
Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.957	Data appear Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.914	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.137	Data appear Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.185		
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.25	Mean of logged Data	5.484
Maximum of Logged Data	7.185	SD of logged Data	0.811

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Barium (cont.'d)**Assuming Lognormal Distribution**

95% H-UCL	497.3	90% Chebyshev (MVUE) UCL	510.8
95% Chebyshev (MVUE) UCL	593.3	97.5% Chebyshev (MVUE) UCL	707.9
99% Chebyshev (MVUE) UCL	932.9		

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

95% CLT UCL	445.7	95% Jackknife UCL	450.4
95% Standard Bootstrap UCL	443.4	95% Bootstrap-t UCL	494.4
95% Hall's Bootstrap UCL	485.4	95% Percentile Bootstrap UCL	448.4
95% BCA Bootstrap UCL	465.9		
90% Chebyshev(Mean, Sd) UCL	535.2	95% Chebyshev(Mean, Sd) UCL	625.1
97.5% Chebyshev(Mean, Sd) UCL	749.7	99% Chebyshev(Mean, Sd) UCL	994.6

Suggested UCL to Use95% Adjusted Gamma UCL 470

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cobalt

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	15
		Number of Missing Observations	18
Number of Detects	15	Number of Non-Detects	8
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	3.1	Minimum Non-Detect	50
Maximum Detect	139	Maximum Non-Detect	50
Variance Detects	2065	Percent Non-Detects	34.78%
Mean Detects	47.67	SD Detects	45.44
Median Detects	25.7	CV Detects	0.953
Skewness Detects	1.231	Kurtosis Detects	0.255
Mean of Logged Detects	3.409	SD of Logged Detects	1.054
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.229	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	37.27	Standard Error of Mean	8.415
SD	38.48	95% KM (BCA) UCL	51.49
95% KM (t) UCL	51.72	95% KM (Percentile Bootstrap) UCL	50.46
95% KM (z) UCL	51.11	95% KM Bootstrap t UCL	57.49
90% KM Chebyshev UCL	62.52	95% KM Chebyshev UCL	73.95
97.5% KM Chebyshev UCL	89.82	99% KM Chebyshev UCL	121
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.394	Anderson-Darling GOF Test	
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.176	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.227	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.238	k star (bias corrected MLE)	1.035
Theta hat (MLE)	38.52	Theta star (bias corrected MLE)	46.08
nu hat (MLE)	37.13	nu star (bias corrected)	31.04
MLE Mean (bias corrected)	47.67	MLE Sd (bias corrected)	46.87
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.938	nu hat (KM)	43.15
Approximate Chi Square Value (43.15, α)	29.09	Adjusted Chi Square Value (43.15, β)	28.25
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	55.29	95% Gamma Adjusted KM-UCL (use when $n < 50$)	56.93

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Cobalt (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	37.34
Maximum	139	Median	22.4
SD	40.04	CV	1.072
k hat (MLE)	0.744	k star (bias corrected MLE)	0.676
Theta hat (MLE)	50.15	Theta star (bias corrected MLE)	55.2
nu hat (MLE)	34.25	nu star (bias corrected)	31.11
MLE Mean (bias corrected)	37.34	MLE Sd (bias corrected)	45.4
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (31.11, α)	19.37	Adjusted Chi Square Value (31.11, β)	18.7
95% Gamma Approximate UCL (use when $n \geq 50$)	59.97	95% Gamma Adjusted UCL (use when $n < 50$)	62.13

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.959
5% Shapiro Wilk Critical Value	0.881
Lilliefors Test Statistic	0.113
5% Lilliefors Critical Value	0.229

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	37.4	Mean in Log Scale	3.172
SD in Original Scale	39.46	SD in Log Scale	0.977
95% t UCL (assumes normality of ROS data)	51.53	95% Percentile Bootstrap UCL	51.38
95% BCA Bootstrap UCL	54.71	95% Bootstrap t UCL	56.89
95% H-UCL (Log ROS)	64.59		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.169	95% H-UCL (KM -Log)	63.2
KM SD (logged)	0.966	95% Critical H Value (KM-Log)	2.481
KM Standard Error of Mean (logged)	0.238		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	39.79
SD in Original Scale	37.9
95% t UCL (Assumes normality)	53.36

DL/2 Log-Transformed

Mean in Log Scale	3.343
SD in Log Scale	0.846
95% H-Stat UCL	61.66

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Gamma Distributed at 5% Significance Level****Suggested UCL to Use**

95% KM (Percentile Bootstrap) UCL	50.46	95% GROS Adjusted Gamma UCL	62.13
95% Adjusted Gamma KM-UCL	56.93		

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Iron

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	18
Number of Detects	22	Number of Non-Detects	1
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	83	Minimum Non-Detect	150
Maximum Detect	78200	Maximum Non-Detect	150
Variance Detects	6.734E+8	Percent Non-Detects	4.348%
Mean Detects	19340	SD Detects	25950
Median Detects	6885	CV Detects	1.342
Skewness Detects	1.351	Kurtosis Detects	0.571
Mean of Logged Detects	8.42	SD of Logged Detects	2.15
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.748	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.289	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.189	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	18502	Standard Error of Mean	5358
SD	25105	95% KM (BCA) UCL	27187
95% KM (t) UCL	27703	95% KM (Percentile Bootstrap) UCL	27555
95% KM (z) UCL	27315	95% KM Bootstrap t UCL	30563
90% KM Chebyshev UCL	34576	95% KM Chebyshev UCL	41857
97.5% KM Chebyshev UCL	51962	99% KM Chebyshev UCL	71812
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.451	Anderson-Darling GOF Test	
5% A-D Critical Value	0.816	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.111	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.446	k star (bias corrected MLE)	0.416
Theta hat (MLE)	43358	Theta star (bias corrected MLE)	46543
nu hat (MLE)	19.63	nu star (bias corrected)	18.28
MLE Mean (bias corrected)	19340	MLE Sd (bias corrected)	30002
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.543	nu hat (KM)	24.99
Approximate Chi Square Value (24.99, α)	14.6	Adjusted Chi Square Value (24.99, β)	14.03
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	31662	95% Gamma Adjusted KM-UCL (use when $n < 50$)	32960

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Iron (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	18499
Maximum	78200	Median	4350
SD	25672	CV	1.388
k hat (MLE)	0.342	k star (bias corrected MLE)	0.327
Theta hat (MLE)	54043	Theta star (bias corrected MLE)	56635
nu hat (MLE)	15.75	nu star (bias corrected)	15.03
MLE Mean (bias corrected)	18499	MLE Sd (bias corrected)	32368
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (15.03, α)	7.279	Adjusted Chi Square Value (15.03, β)	6.89
95% Gamma Approximate UCL (use when $n \geq 50$)	38184	95% Gamma Adjusted UCL (use when $n < 50$)	40341

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic 0.941
5% Shapiro Wilk Critical Value 0.911
Lilliefors Test Statistic 0.133
5% Lilliefors Critical Value 0.189

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	18501	Mean in Log Scale	8.232
SD in Original Scale	25670	SD in Log Scale	2.286
95% t UCL (assumes normality of ROS data)	27692	95% Percentile Bootstrap UCL	27515
95% BCA Bootstrap UCL	28632	95% Bootstrap t UCL	30919
95% H-UCL (Log ROS)	466827		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	8.246	95% H-UCL (KM -Log)	349113
KM SD (logged)	2.21	95% Critical H Value (KM-Log)	4.403
KM Standard Error of Mean (logged)	0.472		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale 18502
SD in Original Scale 25669
95% t UCL (Assumes normality) 27693

DL/2 Log-Transformed

Mean in Log Scale 8.242
SD in Log Scale 2.268
95% H-Stat UCL 437436

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Gamma Distributed at 5% Significance Level****Suggested UCL to Use**

95% KM (Chebyshev) UCL 41857
95% Adjusted Gamma KM-UCL 32960

95% GROS Adjusted Gamma UCL 40341

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead

General Statistics			
Total Number of Observations	24	Number of Distinct Observations	7
		Number of Missing Observations	18
Number of Detects	5	Number of Non-Detects	19
Number of Distinct Detects	5	Number of Distinct Non-Detects	2
Minimum Detect	2.9	Minimum Non-Detect	5
Maximum Detect	14.3	Maximum Non-Detect	12.2
Variance Detects	19.07	Percent Non-Detects	79.17%
Mean Detects	7.8	SD Detects	4.366
Median Detects	8.4	CV Detects	0.56
Skewness Detects	0.654	Kurtosis Detects	0.402
Mean of Logged Detects	1.915	SD of Logged Detects	0.612
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.227	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	4.691	Standard Error of Mean	0.855
SD	2.552	95% KM (BCA) UCL	6.32
95% KM (t) UCL	6.155	95% KM (Percentile Bootstrap) UCL	6.089
95% KM (z) UCL	6.096	95% KM Bootstrap t UCL	6.46
90% KM Chebyshev UCL	7.255	95% KM Chebyshev UCL	8.416
97.5% KM Chebyshev UCL	10.03	99% KM Chebyshev UCL	13.19
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.247	Anderson-Darling GOF Test	
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.225	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	3.745	k star (bias corrected MLE)	1.631
Theta hat (MLE)	2.083	Theta star (bias corrected MLE)	4.781
nu hat (MLE)	37.45	nu star (bias corrected)	16.31
MLE Mean (bias corrected)	7.8	MLE Sd (bias corrected)	6.107
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	3.377	nu hat (KM)	162.1
Approximate Chi Square Value (162.11, α)	133.7	Adjusted Chi Square Value (162.11, β)	131.9
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	5.688	95% Gamma Adjusted KM-UCL (use when $n < 50$)	5.767

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Lead (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.123	Mean	4.484
Maximum	14.3	Median	3.913
SD	3.112	CV	0.694
k hat (MLE)	1.782	k star (bias corrected MLE)	1.587
Theta hat (MLE)	2.516	Theta star (bias corrected MLE)	2.825
nu hat (MLE)	85.56	nu star (bias corrected)	76.2
MLE Mean (bias corrected)	4.484	MLE Sd (bias corrected)	3.559
		Adjusted Level of Significance (β)	0.0392
Approximate Chi Square Value (76.20, α)	57.09	Adjusted Chi Square Value (76.20, β)	55.93
95% Gamma Approximate UCL (use when $n \geq 50$)	5.985	95% Gamma Adjusted UCL (use when $n < 50$)	6.109

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962
5% Shapiro Wilk Critical Value	0.762
Lilliefors Test Statistic	0.236
5% Lilliefors Critical Value	0.396

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	4.693	Mean in Log Scale	1.408
SD in Original Scale	2.794	SD in Log Scale	0.524
95% t UCL (assumes normality of ROS data)	5.671	95% Percentile Bootstrap UCL	5.655
95% BCA Bootstrap UCL	6.033	95% Bootstrap t UCL	6.05
95% H-UCL (Log ROS)	5.837		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.444	95% H-UCL (KM -Log)	5.457
KM SD (logged)	0.416	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.191		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	3.754
SD in Original Scale	2.889
95% t UCL (Assumes normality)	4.765

DL/2 Log-Transformed

Mean in Log Scale	1.161
SD in Log Scale	0.504
95% H-Stat UCL	4.467

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**

95% KM (t) UCL	6.155	95% KM (Percentile Bootstrap) UCL	6.089

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	22
		Number of Missing Observations	18
Number of Detects	21	Number of Non-Detects	2
Number of Distinct Detects	21	Number of Distinct Non-Detects	1
Minimum Detect	5.8	Minimum Non-Detect	15
Maximum Detect	30400	Maximum Non-Detect	15
Variance Detects	1.001E+8	Percent Non-Detects	8.696%
Mean Detects	5577	SD Detects	10003
Median Detects	1360	CV Detects	1.794
Skewness Detects	2.081	Kurtosis Detects	2.83
Mean of Logged Detects	7.055	SD of Logged Detects	2.142
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.564	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.358	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.193	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	5093	Standard Error of Mean	2021
SD	9459	95% KM (BCA) UCL	8706
95% KM (t) UCL	8563	95% KM (Percentile Bootstrap) UCL	8710
95% KM (z) UCL	8417	95% KM Bootstrap t UCL	10033
90% KM Chebyshev UCL	11156	95% KM Chebyshev UCL	13903
97.5% KM Chebyshev UCL	17715	99% KM Chebyshev UCL	25203
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.839	Anderson-Darling GOF Test	
5% A-D Critical Value	0.822	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.185	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.202	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.416	k star (bias corrected MLE)	0.388
Theta hat (MLE)	13406	Theta star (bias corrected MLE)	14362
nu hat (MLE)	17.47	nu star (bias corrected)	16.31
MLE Mean (bias corrected)	5577	MLE Sd (bias corrected)	8950
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.29	nu hat (KM)	13.33
Approximate Chi Square Value (13.33, α)	6.117	Adjusted Chi Square Value (13.33, β)	5.765
95% Gamma Approximate KM-UCL (use when n>=50)	11100	95% Gamma Adjusted KM-UCL (use when n<50)	11778

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Manganese (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	5092
Maximum	30400	Median	1290
SD	9672	CV	1.899
k hat (MLE)	0.28	k star (bias corrected MLE)	0.272
Theta hat (MLE)	18213	Theta star (bias corrected MLE)	18714
nu hat (MLE)	12.86	nu star (bias corrected)	12.52
MLE Mean (bias corrected)	5092	MLE Sd (bias corrected)	9762
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (12.52, α)	5.57	Adjusted Chi Square Value (12.52, β)	5.236
95% Gamma Approximate UCL (use when $n \geq 50$)	11444	95% Gamma Adjusted UCL (use when $n < 50$)	12173

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic 0.949
5% Shapiro Wilk Critical Value 0.908
Lilliefors Test Statistic 0.135
5% Lilliefors Critical Value 0.193

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5094	Mean in Log Scale	6.685
SD in Original Scale	9671	SD in Log Scale	2.385
95% t UCL (assumes normality of ROS data)	8557	95% Percentile Bootstrap UCL	8500
95% BCA Bootstrap UCL	9432	95% Bootstrap t UCL	10242
95% H-UCL (Log ROS)	150111		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	6.594	95% H-UCL (KM -Log)	219845
KM SD (logged)	2.493	95% Critical H Value (KM-Log)	4.887
KM Standard Error of Mean (logged)	0.533		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale 5093
SD in Original Scale 9672
95% t UCL (Assumes normality) 8556

DL/2 Log-Transformed

Mean in Log Scale 6.616
SD in Log Scale 2.506
95% H-Stat UCL 237620

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 13903
95% Adjusted Gamma KM-UCL 11778

95% GROS Adjusted Gamma UCL 12173

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Selenium

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	6
		Number of Missing Observations	18
Number of Detects	8	Number of Non-Detects	15
Number of Distinct Detects	5	Number of Distinct Non-Detects	2
Minimum Detect	4.9	Minimum Non-Detect	10
Maximum Detect	13.1	Maximum Non-Detect	30
Variance Detects	7.44	Percent Non-Detects	65.22%
Mean Detects	8.463	SD Detects	2.728
Median Detects	8.3	CV Detects	0.322
Skewness Detects	0.422	Kurtosis Detects	-0.692
Mean of Logged Detects	2.089	SD of Logged Detects	0.327

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.902
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.253
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	7.031	Standard Error of Mean	0.544
SD	2.016	95% KM (BCA) UCL	7.995
95% KM (t) UCL	7.965	95% KM (Percentile Bootstrap) UCL	7.99
95% KM (z) UCL	7.926	95% KM Bootstrap t UCL	8.022
90% KM Chebyshev UCL	8.663	95% KM Chebyshev UCL	9.402
97.5% KM Chebyshev UCL	10.43	99% KM Chebyshev UCL	12.44

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.508
5% A-D Critical Value	0.715
K-S Test Statistic	0.254
5% K-S Critical Value	0.294

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	10.99
Theta hat (MLE)	0.77
nu hat (MLE)	175.8
MLE Mean (bias corrected)	8.463

k star (bias corrected MLE)	6.95
Theta star (bias corrected MLE)	1.218
nu star (bias corrected)	111.2
MLE Sd (bias corrected)	3.21

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	12.16	nu hat (KM)	559.5
Approximate Chi Square Value (559.47, α)	505.6	Adjusted Chi Square Value (559.47, β)	501.9
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	7.78	95% Gamma Adjusted KM-UCL (use when $n < 50$)	7.837

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Selenium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	3.573	Mean	7.06
Maximum	13.1	Median	6.6
SD	2.212	CV	0.313
k hat (MLE)	11.32	k star (bias corrected MLE)	9.869
Theta hat (MLE)	0.624	Theta star (bias corrected MLE)	0.715
nu hat (MLE)	520.5	nu star (bias corrected)	454
MLE Mean (bias corrected)	7.06	MLE Sd (bias corrected)	2.247
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (453.97, α)	405.6	Adjusted Chi Square Value (453.97, β)	402.3
95% Gamma Approximate UCL (use when n>=50)	7.902	95% Gamma Adjusted UCL (use when n<50)	7.967

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.913
5% Shapiro Wilk Critical Value	0.818
Lilliefors Test Statistic	0.243
5% Lilliefors Critical Value	0.313

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.089	Mean in Log Scale	1.92
SD in Original Scale	2.121	SD in Log Scale	0.281
95% t UCL (assumes normality of ROS data)	7.848	95% Percentile Bootstrap UCL	7.825
95% BCA Bootstrap UCL	7.914	95% Bootstrap t UCL	8.003
95% H-UCL (Log ROS)	7.906		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.916	95% H-UCL (KM -Log)	7.727
KM SD (logged)	0.253	95% Critical H Value (KM-Log)	1.793
KM Standard Error of Mean (logged)	0.0762		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	7.074
SD in Original Scale	3.365
95% t UCL (Assumes normality)	8.279

DL/2 Log-Transformed

Mean in Log Scale	1.872
SD in Log Scale	0.394
95% H-Stat UCL	8.235

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	7.965	95% KM (Percentile Bootstrap) UCL	7.99

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Vanadium

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	18
		Number of Missing Observations	18
Number of Detects	17	Number of Non-Detects	6
Number of Distinct Detects	17	Number of Distinct Non-Detects	1
Minimum Detect	2.2	Minimum Non-Detect	50
Maximum Detect	53.5	Maximum Non-Detect	50
Variance Detects	241.4	Percent Non-Detects	26.09%
Mean Detects	16.24	SD Detects	15.54
Median Detects	8.8	CV Detects	0.957
Skewness Detects	1.317	Kurtosis Detects	0.768
Mean of Logged Detects	2.365	SD of Logged Detects	0.959

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.815
5% Shapiro Wilk Critical Value	0.892
Lilliefors Test Statistic	0.26
5% Lilliefors Critical Value	0.215

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	15.63	Standard Error of Mean	3.475
SD	14.42	95% KM (BCA) UCL	21.63
95% KM (t) UCL	21.6	95% KM (Percentile Bootstrap) UCL	21.38
95% KM (z) UCL	21.35	95% KM Bootstrap t UCL	23.73
90% KM Chebyshev UCL	26.06	95% KM Chebyshev UCL	30.78
97.5% KM Chebyshev UCL	37.33	99% KM Chebyshev UCL	50.21

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.501
5% A-D Critical Value	0.759
K-S Test Statistic	0.167
5% K-S Critical Value	0.214

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.326
Theta hat (MLE)	12.25
nu hat (MLE)	45.08
MLE Mean (bias corrected)	16.24

k star (bias corrected MLE)	1.131
Theta star (bias corrected MLE)	14.36
nu star (bias corrected)	38.46
MLE Sd (bias corrected)	15.27

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.176
Approximate Chi Square Value (54.08, α)	38.19
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	22.14

nu hat (KM)	54.08
Adjusted Chi Square Value (54.08, β)	37.22
95% Gamma Adjusted KM-UCL (use when $n < 50$)	22.72

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Vanadium (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	2.179	Mean	15.39
Maximum	53.5	Median	9.198
SD	14.08	CV	0.915
k hat (MLE)	1.414	k star (bias corrected MLE)	1.258
Theta hat (MLE)	10.88	Theta star (bias corrected MLE)	12.23
nu hat (MLE)	65.04	nu star (bias corrected)	57.89
MLE Mean (bias corrected)	15.39	MLE Sd (bias corrected)	13.72
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (57.89, α)	41.4	Adjusted Chi Square Value (57.89, β)	40.39
95% Gamma Approximate UCL (use when $n \geq 50$)	21.51	95% Gamma Adjusted UCL (use when $n < 50$)	22.05

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962
5% Shapiro Wilk Critical Value	0.892
Lilliefors Test Statistic	0.11
5% Lilliefors Critical Value	0.215

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	15.07	Mean in Log Scale	2.335
SD in Original Scale	13.96	SD in Log Scale	0.891
95% t UCL (assumes normality of ROS data)	20.06	95% Percentile Bootstrap UCL	19.94
95% BCA Bootstrap UCL	21.1	95% Bootstrap t UCL	22.06
95% H-UCL (Log ROS)	24.18		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.339	95% H-UCL (KM -Log)	25.24
KM SD (logged)	0.915	95% Critical H Value (KM-Log)	2.417
KM Standard Error of Mean (logged)	0.226		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	18.53
SD in Original Scale	13.82
95% t UCL (Assumes normality)	23.47

DL/2 Log-Transformed

Mean in Log Scale	2.588
SD in Log Scale	0.903
95% H-Stat UCL	31.77

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Percentile Bootstrap) UCL	21.38	95% GROS Adjusted Gamma UCL	22.05
95% Adjusted Gamma KM-UCL	22.72		

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

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

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

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

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File Worksheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Aroclor-1260 (PCB-1260)

General Statistics			
Total Number of Observations	19	Number of Distinct Observations	7
		Number of Missing Observations	24
Number of Detects	2	Number of Non-Detects	17
Number of Distinct Detects	2	Number of Distinct Non-Detects	5
Minimum Detect	2.4	Minimum Non-Detect	0.51
Maximum Detect	3.5	Maximum Non-Detect	0.67
Variance Detects	0.605	Percent Non-Detects	89.47%
Mean Detects	2.95	SD Detects	0.778
Median Detects	2.95	CV Detects	0.264
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.064	SD of Logged Detects	0.267

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

**Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test**

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

Mean	0.767	Standard Error of Mean	0.25
SD	0.77	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.2	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.178	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.516	95% KM Chebyshev UCL	1.855
97.5% KM Chebyshev UCL	2.327	99% KM Chebyshev UCL	3.252

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

Gamma Statistics on Detected Data Only

k hat (MLE)	28.43	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.104	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	113.7	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.992	nu hat (KM)	37.71
		Adjusted Level of Significance (β)	0.0369
Approximate Chi Square Value (37.71, α)	24.65	Adjusted Chi Square Value (37.71, β)	23.73
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.173	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.219

**Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test**

TABLE G.10

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
SITE WIDE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 9:21:26 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Aroclor-1260 (PCB-1260) (cont.'d)**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.735	Mean in Log Scale	-0.749
SD in Original Scale	0.858	SD in Log Scale	0.923
95% t UCL (assumes normality of ROS data)	1.076	95% Percentile Bootstrap UCL	1.089
95% BCA Bootstrap UCL	1.155	95% Bootstrap t UCL	1.527
95% H-UCL (Log ROS)	1.248		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.548
SD in Original Scale	0.866
95% t UCL (Assumes normality)	0.892

DL/2 Log-Transformed

Mean in Log Scale	-1.079
SD in Log Scale	0.761
95% H-Stat UCL	0.685

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

Nonparametric Distribution Free UCL Statistics

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

Suggested UCL to Use

95% KM (t) UCL

95% KM (% Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

1,2,4-Trimethylbenzene

General Statistics			
Total Number of Observations	24	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	21
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	575	Minimum Non-Detect	1
Maximum Detect	770	Maximum Non-Detect	1
Variance Detects	11025	Percent Non-Detects	87.5%
Mean Detects	650	SD Detects	105
Median Detects	605	CV Detects	0.162
Skewness Detects	1.574	Kurtosis Detects	N/A
Mean of Logged Detects	6.469	SD of Logged Detects	0.156

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.333	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

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

Mean	82.12	Standard Error of Mean	54.19
SD	216.8	95% KM (BCA) UCL	N/A
95% KM (t) UCL	175	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	171.3	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	244.7	95% KM Chebyshev UCL	318.3
97.5% KM Chebyshev UCL	420.6	99% KM Chebyshev UCL	621.3

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	60.34	k star (bias corrected MLE)	N/A
Theta hat (MLE)	10.77	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	362	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.144	nu hat (KM)	6.89
Approximate Chi Square Value (6.89, α)	2.11	Adjusted Level of Significance (β)	0.0392
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	268.1	Adjusted Chi Square Value (6.89, β)	1.929
		95% Gamma Adjusted KM-UCL (use when $n < 50$)	293.3

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

1,2,4-Trimethylbenzene (cont.'d)**Lognormal GOF Test on Detected Observations Only**

Shapiro Wilk Test Statistic	0.876	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.325	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	308.8	Mean in Log Scale	5.606
SD in Original Scale	165.4	SD in Log Scale	0.513
95% t UCL (assumes normality of ROS data)	366.6	95% Percentile Bootstrap UCL	366.5
95% BCA Bootstrap UCL	369	95% Bootstrap t UCL	379.3
95% H-UCL (Log ROS)	384.1		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.809	95% H-UCL (KM -Log)	152.6
KM SD (logged)	2.14	95% Critical H Value (KM-Log)	4.325
KM Standard Error of Mean (logged)	0.535		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	81.69
SD in Original Scale	221.6
95% t UCL (Assumes normality)	159.2

DL/2 Log-Transformed

Mean in Log Scale	0.202
SD in Log Scale	2.42
95% H-Stat UCL	258.6

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Detected Data appear Normal Distributed at 5% Significance Level****Suggested UCL to Use**95% KM (t) UCL 175

95% KM (Percentile Bootstrap) UCL N/A

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzene

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	8
Number of Detects	5	Number of Non-Detects	39
Number of Distinct Detects	5	Number of Distinct Non-Detects	3
Minimum Detect	0.85	Minimum Non-Detect	1
Maximum Detect	6.4	Maximum Non-Detect	3.5
Variance Detects	5.616	Percent Non-Detects	88.64%
Mean Detects	2.184	SD Detects	2.37
Median Detects	1.2	CV Detects	1.085
Skewness Detects	2.176	Kurtosis Detects	4.779
Mean of Logged Detects	0.45	SD of Logged Detects	0.815

Normal GOF Test on Detects Only		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.648		
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.414	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

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

Mean	1.056	Standard Error of Mean	0.145
SD	0.823	95% KM (BCA) UCL	1.32
95% KM (t) UCL	1.3	95% KM (Percentile Bootstrap) UCL	1.322
95% KM (z) UCL	1.295	95% KM Bootstrap t UCL	1.982
90% KM Chebyshev UCL	1.492	95% KM Chebyshev UCL	1.689
97.5% KM Chebyshev UCL	1.963	99% KM Chebyshev UCL	2.501

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.78	Anderson-Darling GOF Test	
5% A-D Critical Value	0.686	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.374	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.361	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only

k hat (MLE)	1.658	k star (bias corrected MLE)	0.797
Theta hat (MLE)	1.317	Theta star (bias corrected MLE)	2.742
nu hat (MLE)	16.58	nu star (bias corrected)	7.965
MLE Mean (bias corrected)	2.184	MLE Sd (bias corrected)	2.447

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.645	nu hat (KM)	144.8
Approximate Chi Square Value (144.79, α)	118	Adjusted Chi Square Value (144.79, β)	117.2
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.296	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.305

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Benzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.758
Maximum	6.4	Median	0.445
SD	1.069	CV	1.411
k hat (MLE)	0.505	k star (bias corrected MLE)	0.486
Theta hat (MLE)	1.501	Theta star (bias corrected MLE)	1.56
nu hat (MLE)	44.43	nu star (bias corrected)	42.73
MLE Mean (bias corrected)	0.758	MLE Sd (bias corrected)	1.087
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (42.73, α)	28.74	Adjusted Chi Square Value (42.73, β)	28.35
95% Gamma Approximate UCL (use when $n \geq 50$)	1.126	95% Gamma Adjusted UCL (use when $n < 50$)	1.142

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.788
5% Shapiro Wilk Critical Value	0.762
Lilliefors Test Statistic	0.322
5% Lilliefors Critical Value	0.396

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.033	Mean in Log Scale	-0.135
SD in Original Scale	0.904	SD in Log Scale	0.524
95% t UCL (assumes normality of ROS data)	1.262	95% Percentile Bootstrap UCL	1.274
95% BCA Bootstrap UCL	1.417	95% Bootstrap t UCL	1.532
95% H-UCL (Log ROS)	1.169		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.0335	95% H-UCL (KM -Log)	1.102
KM SD (logged)	0.308	95% Critical H Value (KM-Log)	1.782
KM Standard Error of Mean (logged)	0.0703		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.727
SD in Original Scale	0.916
95% t UCL (Assumes normality)	0.959

DL/2 Log-Transformed

Mean in Log Scale	-0.523
SD in Log Scale	0.476
95% H-Stat UCL	0.761

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.3	95% KM (Percentile Bootstrap) UCL	1.322

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chloroform (Trichloromethane)

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	15
Number of Detects	11	Number of Non-Detects	33
Number of Distinct Detects	10	Number of Distinct Non-Detects	5
Minimum Detect	0.097	Minimum Non-Detect	1
Maximum Detect	2.7	Maximum Non-Detect	3.5
Variance Detects	0.725	Percent Non-Detects	75%
Mean Detects	0.817	SD Detects	0.852
Median Detects	0.4	CV Detects	1.042
Skewness Detects	1.247	Kurtosis Detects	0.757
Mean of Logged Detects	-0.733	SD of Logged Detects	1.104

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.794
5% Shapiro Wilk Critical Value	0.85
Lilliefors Test Statistic	0.324
5% Lilliefors Critical Value	0.267

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.407	Standard Error of Mean	0.0881
SD	0.496	95% KM (BCA) UCL	0.553
95% KM (t) UCL	0.555	95% KM (Percentile Bootstrap) UCL	0.554
95% KM (z) UCL	0.552	95% KM Bootstrap t UCL	0.608
90% KM Chebyshev UCL	0.671	95% KM Chebyshev UCL	0.791
97.5% KM Chebyshev UCL	0.957	99% KM Chebyshev UCL	1.284

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.664
5% A-D Critical Value	0.75
K-S Test Statistic	0.263
5% K-S Critical Value	0.262

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.078	k star (bias corrected MLE)	0.845
Theta hat (MLE)	0.758	Theta star (bias corrected MLE)	0.967
nu hat (MLE)	23.72	nu star (bias corrected)	18.59
MLE Mean (bias corrected)	0.817	MLE Sd (bias corrected)	0.889

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.673	nu hat (KM)	59.18
Approximate Chi Square Value (59.18, α)	42.49	Adjusted Chi Square Value (59.18, β)	42.01
95% Gamma Approximate KM-UCL (use when n>=50)	0.567	95% Gamma Adjusted KM-UCL (use when n<50)	0.573

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Chloroform (Trichloromethane) (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.436
Maximum	2.7	Median	0.261
SD	0.534	CV	1.224
k hat (MLE)	0.714	k star (bias corrected MLE)	0.68
Theta hat (MLE)	0.611	Theta star (bias corrected MLE)	0.641
nu hat (MLE)	62.82	nu star (bias corrected)	59.87
MLE Mean (bias corrected)	0.436	MLE Sd (bias corrected)	0.529
		Adjusted Level of Significance (B)	0.0445
Approximate Chi Square Value (59.87, α)	43.08	Adjusted Chi Square Value (59.87, β)	42.59
95% Gamma Approximate UCL (use when $n \geq 50$)	0.606	95% Gamma Adjusted UCL (use when $n < 50$)	0.613

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.202	Lilliefors GOF Test
5% Lilliefors Critical Value	0.267	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.436	Mean in Log Scale	-1.235
SD in Original Scale	0.499	SD in Log Scale	0.87
95% t UCL (assumes normality of ROS data)	0.562	95% Percentile Bootstrap UCL	0.567
95% BCA Bootstrap UCL	0.599	95% Bootstrap t UCL	0.66
95% H-UCL (Log ROS)	0.571		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.268	95% H-UCL (KM -Log)	0.477
KM SD (logged)	0.754	95% Critical H Value (KM-Log)	2.117
KM Standard Error of Mean (logged)	0.196		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.649
SD in Original Scale	0.489
95% t UCL (Assumes normality)	0.773

DL/2 Log-Transformed

Mean in Log Scale	-0.622
SD in Log Scale	0.601
95% H-Stat UCL	0.771

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.555	95% GROS Adjusted Gamma UCL	0.613
95% Adjusted Gamma KM-UCL	0.573		

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Ethylbenzene

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	15
Number of Detects	14	Number of Non-Detects	30
Number of Distinct Detects	14	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	1
Maximum Detect	705	Maximum Non-Detect	1
Variance Detects	66914	Percent Non-Detects	68.18%
Mean Detects	179.6	SD Detects	258.7
Median Detects	7.975	CV Detects	1.44
Skewness Detects	1.109	Kurtosis Detects	-0.484
Mean of Logged Detects	2.347	SD of Logged Detects	3.409

Normal GOF Test on Detects Only		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.716	Detected Data Not Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.874	Lilliefors GOF Test	
Lilliefors Test Statistic	0.314	Detected Data Not Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.237		

Detected Data Not Normal at 5% Significance Level

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

Mean	57.43	Standard Error of Mean	25.58
SD	163.5	95% KM (BCA) UCL	101.2
95% KM (t) UCL	100.4	95% KM (Percentile Bootstrap) UCL	99.79
95% KM (z) UCL	99.51	95% KM Bootstrap t UCL	129
90% KM Chebyshev UCL	134.2	95% KM Chebyshev UCL	168.9
97.5% KM Chebyshev UCL	217.2	99% KM Chebyshev UCL	312

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.773	Anderson-Darling GOF Test	
5% A-D Critical Value	0.856	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.184	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.25	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.25	k star (bias corrected MLE)	0.244
Theta hat (MLE)	719.1	Theta star (bias corrected MLE)	736.5
nu hat (MLE)	6.995	nu star (bias corrected)	6.829
MLE Mean (bias corrected)	179.6	MLE Sd (bias corrected)	363.7

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.123	nu hat (KM)	10.85
Approximate Chi Square Value (10.85, α)	4.482	Adjusted Chi Square Value (10.85, β)	4.344
95% Gamma Approximate KM-UCL (use when n>=50)	139.1	95% Gamma Adjusted KM-UCL (use when n<50)	143.5

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Ethylbenzene (cont.)d**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	60.05
Maximum	705	Median	0.01
SD	164.8	CV	2.745
k hat (MLE)	0.135	k star (bias corrected MLE)	0.141
Theta hat (MLE)	444.6	Theta star (bias corrected MLE)	425.9
nu hat (MLE)	11.89	nu star (bias corrected)	12.41
MLE Mean (bias corrected)	60.05	MLE Sd (bias corrected)	159.9
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (12.41, α)	5.498	Adjusted Chi Square Value (12.41, β)	5.341
95% Gamma Approximate UCL (use when $n \geq 50$)	135.5	95% Gamma Adjusted UCL (use when $n < 50$)	139.5

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.879
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.184
5% Lilliefors Critical Value	0.237

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	58.16	Mean in Log Scale	-0.198
SD in Original Scale	165.2	SD in Log Scale	3.249
95% t UCL (assumes normality of ROS data)	100	95% Percentile Bootstrap UCL	99.39
95% BCA Bootstrap UCL	114.1	95% Bootstrap t UCL	129.7
95% H-UCL (Log ROS)	2528		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.166	95% H-UCL (KM -Log)	176
KM SD (logged)	2.638	95% Critical H Value (KM-Log)	4.62
KM Standard Error of Mean (logged)	0.518		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	57.5
SD in Original Scale	165.4
95% t UCL (Assumes normality)	99.41

DL/2 Log-Transformed

Mean in Log Scale	0.274
SD in Log Scale	2.359
95% H-Stat UCL	96.4

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	100.4	95% GROS Adjusted Gamma UCL	139.5
95% Adjusted Gamma KM-UCL	143.5		

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Isopropyl benzene

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	13
Number of Detects	12	Number of Non-Detects	32
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.23	Minimum Non-Detect	1
Maximum Detect	46.5	Maximum Non-Detect	1
Variance Detects	234.3	Percent Non-Detects	72.73%
Mean Detects	19.21	SD Detects	15.31
Median Detects	18.5	CV Detects	0.797
Skewness Detects	0.246	Kurtosis Detects	-0.95
Mean of Logged Detects	2.052	SD of Logged Detects	2.008

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.935
5% Shapiro Wilk Critical Value	0.859
Lilliefors Test Statistic	0.141
5% Lilliefors Critical Value	0.256

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	5.478	Standard Error of Mean	1.791
SD	11.37	95% KM (BCA) UCL	8.884
95% KM (t) UCL	8.49	95% KM (Percentile Bootstrap) UCL	8.471
95% KM (z) UCL	8.425	95% KM Bootstrap t UCL	9.44
90% KM Chebyshev UCL	10.85	95% KM Chebyshev UCL	13.29
97.5% KM Chebyshev UCL	16.66	99% KM Chebyshev UCL	23.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.971
5% A-D Critical Value	0.772
K-S Test Statistic	0.252
5% K-S Critical Value	0.256

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.673	k star (bias corrected MLE)	0.56
Theta hat (MLE)	28.54	Theta star (bias corrected MLE)	34.28
nu hat (MLE)	16.15	nu star (bias corrected)	13.45
MLE Mean (bias corrected)	19.21	MLE Sd (bias corrected)	25.66

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.232	nu hat (KM)	20.43
Approximate Chi Square Value (20.43, α)	11.17	Adjusted Chi Square Value (20.43, β)	10.94
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	10.02	95% Gamma Adjusted KM-UCL (use when $n < 50$)	10.23

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Isopropyl benzene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	6.813
Maximum	46.5	Median	0.645
SD	11.27	CV	1.655
k hat (MLE)	0.249	k star (bias corrected MLE)	0.247
Theta hat (MLE)	27.4	Theta star (bias corrected MLE)	27.6
nu hat (MLE)	21.89	nu star (bias corrected)	21.73
MLE Mean (bias corrected)	6.813	MLE Sd (bias corrected)	13.71
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (21.73, α)	12.13	Adjusted Chi Square Value (21.73, β)	11.89
95% Gamma Approximate UCL (use when $n \geq 50$)	12.2	95% Gamma Adjusted UCL (use when $n < 50$)	12.45

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.753
5% Shapiro Wilk Critical Value	0.859
Lilliefors Test Statistic	0.318
5% Lilliefors Critical Value	0.256

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.016	Mean in Log Scale	-0.076
SD in Original Scale	11.31	SD in Log Scale	2.167
95% t UCL (assumes normality of ROS data)	8.883	95% Percentile Bootstrap UCL	8.889
95% BCA Bootstrap UCL	9.296	95% Bootstrap t UCL	10.35
95% H-UCL (Log ROS)	35.33		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	5.602
SD in Original Scale	11.44
95% t UCL (Assumes normality)	8.502

DL/2 Log-Transformed

Mean in Log Scale	0.0556
SD in Log Scale	1.6
95% H-Stat UCL	8.138

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	8.49	95% KM (Percentile Bootstrap) UCL	8.471

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Methyl tert butyl ether (MTBE)

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	16
Number of Detects	14	Number of Non-Detects	30
Number of Distinct Detects	12	Number of Distinct Non-Detects	5
Minimum Detect	0.14	Minimum Non-Detect	1
Maximum Detect	12	Maximum Non-Detect	3.5
Variance Detects	10.33	Percent Non-Detects	68.18%
Mean Detects	1.511	SD Detects	3.214
Median Detects	0.34	CV Detects	2.128
Skewness Detects	3.131	Kurtosis Detects	10.15
Mean of Logged Detects	-0.732	SD of Logged Detects	1.351

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.484
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.42
5% Lilliefors Critical Value	0.237

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	0.715	Standard Error of Mean	0.294
SD	1.84	95% KM (BCA) UCL	1.281
95% KM (t) UCL	1.209	95% KM (Percentile Bootstrap) UCL	1.214
95% KM (z) UCL	1.198	95% KM Bootstrap t UCL	2.332
90% KM Chebyshev UCL	1.596	95% KM Chebyshev UCL	1.996
97.5% KM Chebyshev UCL	2.55	99% KM Chebyshev UCL	3.639

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.628
5% A-D Critical Value	0.789
K-S Test Statistic	0.286
5% K-S Critical Value	0.241

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.547	k star (bias corrected MLE)	0.478
Theta hat (MLE)	2.76	Theta star (bias corrected MLE)	3.163
nu hat (MLE)	15.32	nu star (bias corrected)	13.37
MLE Mean (bias corrected)	1.511	MLE Sd (bias corrected)	2.186

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.151	nu hat (KM)	13.27
Approximate Chi Square Value (13.27, α)	6.076	Adjusted Chi Square Value (13.27, β)	5.911
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.561	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.605

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Methyl tert butyl ether (MTBE) (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	0.815
Maximum	12	Median	0.15
SD	1.959	CV	2.403
k hat (MLE)	0.342	k star (bias corrected MLE)	0.334
Theta hat (MLE)	2.384	Theta star (bias corrected MLE)	2.442
nu hat (MLE)	30.1	nu star (bias corrected)	29.38
MLE Mean (bias corrected)	0.815	MLE Sd (bias corrected)	1.411
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (29.38, α)	18.01	Adjusted Chi Square Value (29.38, β)	17.71
95% Gamma Approximate UCL (use when $n \geq 50$)	1.33	95% Gamma Adjusted UCL (use when $n < 50$)	1.353

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.843
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.181
5% Lilliefors Critical Value	0.237

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.76	Mean in Log Scale	-1.07
SD in Original Scale	1.863	SD in Log Scale	1.061
95% t UCL (assumes normality of ROS data)	1.233	95% Percentile Bootstrap UCL	1.271
95% BCA Bootstrap UCL	1.597	95% Bootstrap t UCL	3.033
95% H-UCL (Log ROS)	0.893		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.111	95% H-UCL (KM -Log)	0.715
KM SD (logged)	0.942	95% Critical H Value (KM-Log)	2.304
KM Standard Error of Mean (logged)	0.217		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	0.892
SD in Original Scale	1.835
95% t UCL (Assumes normality)	1.357

DL/2 Log-Transformed

Mean in Log Scale	-0.625
SD in Log Scale	0.793
95% H-Stat UCL	0.952

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL 1.281

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Toluene

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	15
Number of Detects	14	Number of Non-Detects	30
Number of Distinct Detects	14	Number of Distinct Non-Detects	1
Minimum Detect	0.2	Minimum Non-Detect	1
Maximum Detect	325	Maximum Non-Detect	1
Variance Detects	14303	Percent Non-Detects	68.18%
Mean Detects	72.02	SD Detects	119.6
Median Detects	1.125	CV Detects	1.661
Skewness Detects	1.249	Kurtosis Detects	-0.163
Mean of Logged Detects	1.17	SD of Logged Detects	2.943

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.639
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.435
5% Lilliefors Critical Value	0.237

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	23.16	Standard Error of Mean	11.43
SD	73.08	95% KM (BCA) UCL	42.57
95% KM (t) UCL	42.38	95% KM (Percentile Bootstrap) UCL	43.04
95% KM (z) UCL	41.96	95% KM Bootstrap t UCL	56.39
90% KM Chebyshev UCL	57.46	95% KM Chebyshev UCL	72.99
97.5% KM Chebyshev UCL	94.56	99% KM Chebyshev UCL	136.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.913
5% A-D Critical Value	0.865
K-S Test Statistic	0.369
5% K-S Critical Value	0.251

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.231	k star (bias corrected MLE)	0.229
Theta hat (MLE)	311.2	Theta star (bias corrected MLE)	313.8
nu hat (MLE)	6.481	nu star (bias corrected)	6.425
MLE Mean (bias corrected)	72.02	MLE Sd (bias corrected)	150.3

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.1	nu hat (KM)	8.839
Approximate Chi Square Value (8.84, α)	3.23	Adjusted Chi Square Value (8.84, β)	3.115
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	63.38	95% Gamma Adjusted KM-UCL (use when $n < 50$)	65.71

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Toluene (cont.'d)

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	25.65
Maximum	325	Median	0.01
SD	73.65	CV	2.872
k hat (MLE)	0.152	k star (bias corrected MLE)	0.157
Theta hat (MLE)	168.3	Theta star (bias corrected MLE)	163.2
nu hat (MLE)	13.41	nu star (bias corrected)	13.83
MLE Mean (bias corrected)	25.65	MLE Sd (bias corrected)	64.7
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (13.83, α)	6.455	Adjusted Chi Square Value (13.83, β)	6.284
95% Gamma Approximate UCL (use when $n \geq 50$)	54.95	95% Gamma Adjusted UCL (use when $n < 50$)	56.45

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.768
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.272
5% Lilliefors Critical Value	0.237

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	23.71	Mean in Log Scale	-0.292
SD in Original Scale	73.76	SD in Log Scale	2.411
95% t UCL (assumes normality of ROS data)	42.4	95% Percentile Bootstrap UCL	43
95% BCA Bootstrap UCL	49.06	95% Bootstrap t UCL	57.58
95% H-UCL (Log ROS)	65.88		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	23.26
SD in Original Scale	73.89
95% t UCL (Assumes normality)	41.98

DL/2 Log-Transformed

Mean in Log Scale	-0.1
SD in Log Scale	1.841
95% H-Stat UCL	12.97

DL/2 is not a recommended method, provided for comparisons and historical reasons**Nonparametric Distribution Free UCL Statistics****Data do not follow a Discernible Distribution at 5% Significance Level****Suggested UCL to Use**99% KM (Chebyshev) UCL

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Xylenes (total)

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	14
Number of Detects	13	Number of Non-Detects	31
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	0.15	Minimum Non-Detect	3
Maximum Detect	1300	Maximum Non-Detect	3
Variance Detects	253932	Percent Non-Detects	70.45%
Mean Detects	409.7	SD Detects	503.9
Median Detects	65	CV Detects	1.23
Skewness Detects	0.769	Kurtosis Detects	-1.143
Mean of Logged Detects	3.549	SD of Logged Detects	3.449

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.786
5% Shapiro Wilk Critical Value	0.866
Lilliefors Test Statistic	0.291
5% Lilliefors Critical Value	0.246

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	121.4	Standard Error of Mean	50.63
SD	322.7	95% KM (BCA) UCL	205.2
95% KM (t) UCL	206.5	95% KM (Percentile Bootstrap) UCL	204
95% KM (z) UCL	204.7	95% KM Bootstrap t UCL	245.7
90% KM Chebyshev UCL	273.3	95% KM Chebyshev UCL	342.1
97.5% KM Chebyshev UCL	437.6	99% KM Chebyshev UCL	625.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.658
5% A-D Critical Value	0.837
K-S Test Statistic	0.195
5% K-S Critical Value	0.257

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.282	k star (bias corrected MLE)	0.268
Theta hat (MLE)	1451	Theta star (bias corrected MLE)	1526
nu hat (MLE)	7.34	nu star (bias corrected)	6.98
MLE Mean (bias corrected)	409.7	MLE Sd (bias corrected)	790.7

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.142	nu hat (KM)	12.45
Approximate Chi Square Value (12.45, α)	5.528	Adjusted Chi Square Value (12.45, β)	5.371
95% Gamma Approximate KM-UCL (use when n>=50)	273.5	95% Gamma Adjusted KM-UCL (use when n<50)	281.5

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Xylenes (total) (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	130.2
Maximum	1300	Median	0.01
SD	324.4	CV	2.492
k hat (MLE)	0.131	k star (bias corrected MLE)	0.137
Theta hat (MLE)	994	Theta star (bias corrected MLE)	948.9
nu hat (MLE)	11.53	nu star (bias corrected)	12.07
MLE Mean (bias corrected)	130.2	MLE Sd (bias corrected)	351.5
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (12.07, α)	5.275	Adjusted Chi Square Value (12.07, β)	5.123
95% Gamma Approximate UCL (use when $n \geq 50$)	298	95% Gamma Adjusted UCL (use when $n < 50$)	306.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.191	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	123.4	Mean in Log Scale	0.513
SD in Original Scale	325.6	SD in Log Scale	3.462
95% t UCL (assumes normality of ROS data)	205.9	95% Percentile Bootstrap UCL	214
95% BCA Bootstrap UCL	228.3	95% Bootstrap t UCL	261.1
95% H-UCL (Log ROS)	14980		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.418	95% H-UCL (KM -Log)	528
KM SD (logged)	2.765	95% Critical H Value (KM-Log)	4.813
KM Standard Error of Mean (logged)	0.501		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	122.1
SD in Original Scale	326.1
95% t UCL (Assumes normality)	204.7

DL/2 Log-Transformed

Mean in Log Scale	1.334
SD in Log Scale	2.329
95% H-Stat UCL	250

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	206.5	95% GROS Adjusted Gamma UCL	306.8
95% Adjusted Gamma KM-UCL	281.5		

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

2-Methylnaphthalene

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	35
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	7.9	Minimum Non-Detect	10
Maximum Detect	28.5	Maximum Non-Detect	11
Variance Detects	40.16	Percent Non-Detects	79.55%
Mean Detects	16.74	SD Detects	6.337
Median Detects	16	CV Detects	0.378
Skewness Detects	0.414	Kurtosis Detects	0.257
Mean of Logged Detects	2.749	SD of Logged Detects	0.404

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.97
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.115
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	10.27	Standard Error of Mean	0.811
SD	4.299	95% KM (BCA) UCL	12.19
95% KM (t) UCL	11.63	95% KM (Percentile Bootstrap) UCL	11.88
95% KM (z) UCL	11.6	95% KM Bootstrap t UCL	11.99
90% KM Chebyshev UCL	12.7	95% KM Chebyshev UCL	13.8
97.5% KM Chebyshev UCL	15.33	99% KM Chebyshev UCL	18.33

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.201
5% A-D Critical Value	0.722
K-S Test Statistic	0.141
5% K-S Critical Value	0.28

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	7.453	k star (bias corrected MLE)	5.043
Theta hat (MLE)	2.247	Theta star (bias corrected MLE)	3.321
nu hat (MLE)	134.2	nu star (bias corrected)	90.77
MLE Mean (bias corrected)	16.74	MLE Sd (bias corrected)	7.457

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.702	nu hat (KM)	501.7
Approximate Chi Square Value (501.75, α)	450.8	Adjusted Chi Square Value (501.75, β)	449.2
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	11.43	95% Gamma Adjusted KM-UCL (use when $n < 50$)	11.47

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

2-Methylnaphthalene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	9.299
Maximum	28.5	Median	8.601
SD	5.881	CV	0.632
k hat (MLE)	1.584	k star (bias corrected MLE)	1.491
Theta hat (MLE)	5.871	Theta star (bias corrected MLE)	6.237
nu hat (MLE)	139.4	nu star (bias corrected)	131.2
MLE Mean (bias corrected)	9.299	MLE Sd (bias corrected)	7.615
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (131.21, α)	105.7	Adjusted Chi Square Value (131.21, β)	105
95% Gamma Approximate UCL (use when $n \geq 50$)	11.54	95% Gamma Adjusted UCL (use when $n < 50$)	11.62

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.961
5% Shapiro Wilk Critical Value	0.829
Lilliefors Test Statistic	0.17
5% Lilliefors Critical Value	0.295

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	10.26	Mean in Log Scale	2.229
SD in Original Scale	4.969	SD in Log Scale	0.442
95% t UCL (assumes normality of ROS data)	11.52	95% Percentile Bootstrap UCL	11.54
95% BCA Bootstrap UCL	11.66	95% Bootstrap t UCL	11.77
95% H-UCL (Log ROS)	11.62		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.271	95% H-UCL (KM -Log)	11.04
KM SD (logged)	0.306	95% Critical H Value (KM-Log)	1.781
KM Standard Error of Mean (logged)	0.07		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	7.448
SD in Original Scale	5.498
95% t UCL (Assumes normality)	8.841

DL/2 Log-Transformed

Mean in Log Scale	1.851
SD in Log Scale	0.493
95% H-Stat UCL	8.296

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 11.63

95% KM (Percentile Bootstrap) UCL **11.88**

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

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

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

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

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
Date/Time of Computation 11/21/2014 10:45:25 AM
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Naphthalene

General Statistics			
Total Number of Observations	44	Number of Distinct Observations	12
Number of Detects	10	Number of Non-Detects	34
Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	3	Minimum Non-Detect	10
Maximum Detect	205	Maximum Non-Detect	11
Variance Detects	5928	Percent Non-Detects	77.27%
Mean Detects	85.93	SD Detects	77
Median Detects	69.5	CV Detects	0.896
Skewness Detects	0.346	Kurtosis Detects	-1.663
Mean of Logged Detects	3.722	SD of Logged Detects	1.571

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.887
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.182
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

Mean	22.35	Standard Error of Mean	7.798
SD	49.01	95% KM (BCA) UCL	38.64
95% KM (t) UCL	35.46	95% KM (Percentile Bootstrap) UCL	36.34
95% KM (z) UCL	35.18	95% KM Bootstrap t UCL	39.98
90% KM Chebyshev UCL	45.74	95% KM Chebyshev UCL	56.34
97.5% KM Chebyshev UCL	71.05	99% KM Chebyshev UCL	99.94

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.423
5% A-D Critical Value	0.755
K-S Test Statistic	0.189
5% K-S Critical Value	0.275

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogrov-Smirnoff GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	0.81	k star (bias corrected MLE)	0.634
Theta hat (MLE)	106.1	Theta star (bias corrected MLE)	135.6
nu hat (MLE)	16.2	nu star (bias corrected)	12.67
MLE Mean (bias corrected)	85.93	MLE Sd (bias corrected)	107.9

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.208	nu hat (KM)	18.3
Approximate Chi Square Value (18.30, α)	9.609	Adjusted Chi Square Value (18.30, β)	9.395
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	42.57	95% Gamma Adjusted KM-UCL (use when $n < 50$)	43.54

TABLE G.11

**SUMMARY OF ProUCL OUTPUT FOR GROUNDWATER
OFF-SITE
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

User Selected Options
 Date/Time of Computation 11/21/2014 10:45:25 AM
 From File WorkSheet.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Naphthalene (cont.'d)**Gamma ROS Statistics using Imputed Non-Detects**

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

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

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

Minimum	0.01	Mean	23.77
Maximum	205	Median	0.01
SD	50.05	CV	2.106
k hat (MLE)	0.172	k star (bias corrected MLE)	0.176
Theta hat (MLE)	138	Theta star (bias corrected MLE)	135.3
nu hat (MLE)	15.16	nu star (bias corrected)	15.46
MLE Mean (bias corrected)	23.77	MLE Sd (bias corrected)	56.71
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (15.46, α)	7.581	Adjusted Chi Square Value (15.46, β)	7.394
95% Gamma Approximate UCL (use when $n \geq 50$)	48.47	95% Gamma Adjusted UCL (use when $n < 50$)	49.7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.877
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.181
5% Lilliefors Critical Value	0.28

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	24.21	Mean in Log Scale	1.722
SD in Original Scale	49.19	SD in Log Scale	1.75
95% t UCL (assumes normality of ROS data)	36.68	95% Percentile Bootstrap UCL	37.21
95% BCA Bootstrap UCL	39.97	95% Bootstrap t UCL	43.97
95% H-UCL (Log ROS)	62.77		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.834	95% H-UCL (KM -Log)	22.97
KM SD (logged)	1.256	95% Critical H Value (KM-Log)	2.669
KM Standard Error of Mean (logged)	0.226		

DL/2 Statistics**DL/2 Normal**

Mean in Original Scale	23.44
SD in Original Scale	49.15
95% t UCL (Assumes normality)	35.9

DL/2 Log-Transformed

Mean in Log Scale	2.098
SD in Log Scale	1.145
95% H-Stat UCL	24.43

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 35.46

95% KM (Percentile Bootstrap) UCL 36.34

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

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

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

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

Appendix G

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Appendix H

Indoor Air Modeling

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Section 1.0 Introduction

This Appendix presents the estimation of indoor air exposure point concentrations (EPCs) for volatile chemicals of potential concern (COPCs) at the Former Wilmington Assembly Plant in Wilmington, Delaware (Site). The indoor air EPCs are applied in the Human Health Risk Assessment (HHRA) to assess potential health risks/hazards posed by the indoor air inhalation exposure pathway. For the purpose of the HHRA, the Site has been divided into six Operable Units (OUs) identified as OU-1 to OU-6. The Site is expected to remain industrial/commercial, and therefore, the indoor air inhalation exposure pathway is considered for an indoor worker conducting activities within an enclosed building in each OU. An unrestricted land use scenario (i.e., residential) was also assessed in the HHRA.

The EPCs were estimated using the Johnson and Ettinger (1991) model (J&E Model) as implemented by the United States Environmental Protection Agency (USEPA) (USEPA, 2004). The predicted concentrations were developed following the approach applied by the USEPA in their document entitled, *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (USEPA, 2002).

The methodology for developing the estimated soil and groundwater to indoor air EPCs is presented in Section 2.0. The input parameters applied to develop the EPCs are presented in Section 3.0. All references cited in this Appendix are listed in Section 4.0.

Section 2.0 Methodology

The derivation of the Site-specific soil vapor attenuation factor for the groundwater to indoor air pathway was conducted through the application of the J&E Model for groundwater incorporated into a Microsoft Excel spreadsheet by the USEPA (USEPA, 2004; "GW-ADV-Feb04.xls, Version 3.1"). The Site-specific compound, vadose zone soil, and building properties applied in the derivation of the soil vapor attenuation factor, and thus the estimation of indoor air EPCs, are presented in Section 3.0.

The Site-specific compound, vadose zone soil, and building properties applied in the derivation of the soil vapor attenuation factor, and thus the estimation of indoor air EPCs are presented in Section 3.0.

Section 3.0 Estimated Indoor Air EPCs

Site-specific compound, vadose zone soil, and building properties were applied in the estimation of indoor air EPCs using the J&E Model. The compound-specific inputs applied in the J&E Model are described in Section 3.1. The details of the vadose zone conditions at the Site are presented in Section 3.2. The details of the building properties applied in the estimation of the indoor air EPCs are described in Section 3.3. The estimation of the indoor air EPCs is presented in Section 3.4.

3.1 Compound Properties

The compound properties applied in the estimation of the indoor air EPCs consist of a Henry's Law constant, a water diffusion coefficient, and an air diffusion coefficient, which were obtained from USEPA (2004). For 2-hexanone and xylenes, the Henry's Law constant, water diffusion coefficient, and air diffusion coefficient were obtained from RAIS (2014). The Henry's Law constant and air diffusion coefficient were corrected to a vadose zone temperature of 14 degrees Celsius. This temperature represents the average groundwater temperature for Delaware as indicated in USEPA (2004).

3.2 Vadose Zone Conditions

The indoor air EPCs (from soil and groundwater) for the Site were estimated using the J&E Model with conservative default vadose zone soil properties, consistent with USEPA (2004). Based on the investigative activities that have been conducted, the Site is underlain by coarse-textured soils (fill layer and sand layer) from ground surface to about 30 feet below ground surface (ftBGS). Therefore, the vadose zone at the Site is assumed to be comprised of a sand soil type.

3.2.1 Soil to Indoor Air

- Distance below grade to top of soil contamination, L_t :

For the resident soil to indoor air pathway, a distance of 200.1 cm was applied, based on the assumption that impacted soils occur directly beneath (within 0.1 cm) the basement.

For the industrial/commercial worker soil to indoor air pathway, a distance of 15.1 cm was applied, based on the assumption that impacted soils occur directly beneath (within 0.1 cm) the foundation slab.

Soil Strata A – Sand Soil Type

- Dry bulk density, ρ_{db} :

A dry bulk density value of 1.66 g/cm^3 was applied, based on the default dry bulk density for a sand soil type, as indicated in USEPA (2004).

- Porosity, ϵ_T :

A porosity value of 0.375 was applied, based on the default porosity for a sand soil type, as indicated in USEPA (2004).

- Moisture-filled porosity, ϵ_m :

A moisture-filled porosity value of 0.054 was applied, based on the default moisture-filled porosity for a sand soil type, as indicated in USEPA (2004).

- Fraction of organic carbon content in Soil, f_{oc} :

A value of 0.002 was applied, consistent with the default fraction of organic carbon indicated in USEPA (2004).

- Thickness of Soil Stratum A, h_A :

For the resident soil to indoor air pathway, a thickness of 200.1 cm was applied, based on the assumption that impacted soils occur directly beneath the basement.

For the industrial/commercial worker soil to indoor air pathway, a distance of 15.1 cm was applied, based on the assumption that impacted soils occur directly beneath the foundation slab.

3.2.2 Groundwater to Indoor Air

- Depth below grade to the water table, L_{WT} :

For on-Site groundwater, a depth of 357 cm was applied, based on the average depth to on-Site groundwater.

For off-Site groundwater, a depth of 438 cm was applied, based on the average depth to off-Site groundwater.

Soil Strata A – Sand Soil Type

- Dry bulk density, ρ_{db} :

A dry bulk density value of 1.66 g/cm^3 was applied, based on the default dry bulk density for a sand soil type, as indicated in USEPA (2004).

- Porosity, ϵ_T :

A porosity value of 0.375 was applied, based on the default porosity for a sand soil type, as indicated in USEPA (2004).

- Moisture-filled porosity, ϵ_m :

A moisture-filled porosity value of 0.054 was applied, based on the default moisture-filled porosity for a sand soil type, as indicated in USEPA (2004).

- Thickness of Soil Stratum A, h_A :

For on-Site groundwater, a thickness of 357 cm was applied, based on the depth below grade to the water table.

For off-Site groundwater, a thickness of 438 cm was applied, based on the depth below grade to the water table.

3.3 Building Properties

The building properties applied in the development of the indoor air EPCs for the Site consisted of the following:

- Enclosed space floor length, L_B :

An enclosed floor space length of 1,000 cm was applied, based on the default building dimensions indicated in USEPA (2004).

- Enclosed space floor width, W_B :

An enclosed floor space width of 1,000 cm was applied, based on the default building dimensions indicated in USEPA (2004).

- Enclosed space height, H_B :

For the residential building, an enclosed space height of 366 cm was applied, based on the default building mixing height for a basement scenario indicated in USEPA (2004).

For the industrial/commercial building, an enclosed space height of 244 cm was applied, based on the default building mixing height for a slab-on-grade scenario indicated in USEPA (2004).

- Building indoor air exchange rate, ER :

A building indoor air exchange rate value of 0.5 building volumes per hour was applied, consistent with the typical or mean indoor air exchange rate indicated in USEPA (2004).

- Floor-wall seam crack width, w :

A floor-wall seam crack width value of 0.1 cm was applied consistent with the default floor-wall seam crack width, as indicated in USEPA (2004).

- Vadose zone/building pressure differential, ΔP :
A pressure differential value of 4 Pa was applied consistent with the typical or mean building depressurization indicated in USEPA (2004).
- Foundation thickness, L_{crack} :
A foundation thickness of 10 cm was applied, consistent with the default building foundation slab thickness indicated in USEPA (2004).
- Depth below grade to bottom of enclosed space floor, L_f :
For the residential building, a depth below grade to the bottom of enclosed space floor of 200 cm was applied, consistent with the depth to base of foundation for a basement scenario indicated in USEPA (2004).

For the industrial/commercial building, a depth below grade to the bottom of enclosed space floor of 15 cm was applied, consistent with depth to base of foundation for a slab-on-grade scenario indicated in USEPA (2004).
- Average vapor flow rate into building, Q_{soil} :
A vapor flow rate into the building of 5 liters per minute was applied, consistent with the default average vapor flow rate into a building, as indicated in USEPA (2004).

3.4 Estimated Indoor Air EPC Results

The J&E Model outputs (DATENTER, CHEMPROPS, and INTERCALCs) for each COPC in each medium are provided in the following tables:

Table H.1	OU-3 Soil to Indoor Air – Residential
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Section 4.0 References

1. Johnson, P.C. and R.A. Ettinger, 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings, *Environmental Science and Technology*, 25(8), pp. 1445-1452.
2. RAIS, 2014. Risk Assessment Information System, Chemical Specific Parameters.
3. USEPA, 1996. Soil Screening Guidance: Technical Background Document. EPA Report No. EPA/540/R-95/128, Office of Emergency and Remedial Response, Washington, DC, May.
4. USEPA, 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings, Office of Emergency and Remedial Response, Washington, DC, February 22.

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J&E Model Outputs

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TABLE H.1

**J&E MODEL OUTPUT FOR OU3 SOIL (RESIDENTIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>SoilConc</i> ($\mu\text{g/kg}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (<i>unitless</i>)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
7439976		Mercury (elemental)	4.69E+01	3.99E-03	2.90E-02	6.30E-06	5.20E+01	1.04E+06	1.64E-03	2.50E-01

TABLE H.2

**J&E MODEL OUTPUT FOR OU3 SOIL (INDUSTRIAL/COMMERCIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>SoilConc</i> ($\mu\text{g/kg}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (<i>unitless</i>)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
7439976		Mercury (elemental)	4.69E+01	3.99E-03	2.90E-02	6.30E-06	5.20E+01	1.04E+06	2.45E-03	3.74E-01

TABLE H.3

**J&E MODEL OUTPUT FOR OU4 SOIL (RESIDENTIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>SoilConc</i> ($\mu\text{g/kg}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (unitless)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
91576		2-Methylnaphthalene	2.91E+03	1.81E-04	4.93E-02	7.75E-06	2.81E+03	1.39E+05	1.64E-03	6.49E+00

TABLE H.4

**J&E MODEL OUTPUT FOR OU4 SOIL (INDUSTRIAL/COMMERCIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>SoilConc</i> ($\mu\text{g/kg}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (<i>unitless</i>)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
91576		2-Methylnaphthalene	2.91E+03	1.81E-04	4.93E-02	7.75E-06	2.81E+03	1.39E+05	2.46E-03	9.72E+00

TABLE H.5

**J&E MODEL OUTPUT FOR OU5 SOIL (RESIDENTIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>SoilConc</i> ($\mu\text{g/kg}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (unitless)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
106467		1,4-Dichlorobenzene	5.10E+03	1.16E-03	6.52E-02	7.90E-06	6.17E+02	1.01E+05	1.64E-03	3.22E+02
100414		Ethylbenzene	3.48E+04	4.09E-03	7.09E-02	7.80E-06	3.63E+02	1.34E+05	1.64E-03	1.25E+04
1330207		Xylenes	3.52E+04	2.65E-03	8.01E-02	9.90E-06	3.83E+02	8.69E+04	1.64E-03	7.90E+03
91576		2-Methylnaphthalene	4.20E+03	1.81E-04	4.93E-02	7.75E-06	2.81E+03	1.39E+05	1.64E-03	9.36E+00
91203		Naphthalene	2.20E+04	2.10E-04	5.58E-02	7.50E-06	2.00E+03	1.25E+05	1.64E-03	7.95E+01
7439976		Mercury (elemental)	1.24E+02	3.99E-03	2.90E-02	6.30E-06	5.20E+01	1.04E+06	1.64E-03	6.60E-01

TABLE H.6

**J&E MODEL OUTPUT FOR OU5 SOIL (INDUSTRIAL/COMMERCIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>SoilConc</i> ($\mu\text{g/kg}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (unitless)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
106467		1,4-Dichlorobenzene	5.10E+03	1.16E-03	6.52E-02	7.90E-06	6.17E+02	1.01E+05	2.46E-03	4.84E+02
100414		Ethylbenzene	3.48E+04	4.09E-03	7.09E-02	7.80E-06	3.63E+02	1.34E+05	2.46E-03	1.87E+04
1330207		Xylenes	3.52E+04	2.65E-03	8.01E-02	9.90E-06	3.83E+02	8.69E+04	2.46E-03	1.18E+04
91576		2-Methylnaphthalene	4.20E+03	1.81E-04	4.93E-02	7.75E-06	2.81E+03	1.39E+05	2.46E-03	1.40E+01
91203		Naphthalene	2.20E+04	2.10E-04	5.58E-02	7.50E-06	2.00E+03	1.25E+05	2.46E-03	1.19E+02
7439976		Mercury (elemental)	1.24E+02	3.99E-03	2.90E-02	6.30E-06	5.20E+01	1.04E+06	2.45E-03	9.89E-01

TABLE H.7

**J&E MODEL OUTPUT FOR SITE WIDE GROUNDWATER (RESIDENTIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>GWConc</i> ($\mu\text{g/L}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (unitless)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
75343		1,1-Dichloroethane	5.58E-01	3.47E-03	7.01E-02	1.05E-05	3.16E+01	5.06E+03	4.96E-04	4.07E-02
95636		1,2,4-Trimethylbenzene	5.32E+02	2.89E-03	5.73E-02	7.92E-06	1.35E+03	5.70E+01	4.29E-04	2.80E+01
107062		1,2-Dichloroethane	3.57E+00	5.64E-04	9.83E-02	9.90E-06	1.74E+01	8.52E+03	6.30E-04	5.39E-02
106467		1,4-Dichlorobenzene	6.43E-01	1.16E-03	6.52E-02	7.90E-06	6.17E+02	7.90E+01	4.75E-04	1.50E-02
591786		2-Hexanone	3.35E+00	4.81E-05	6.65E-02	8.44E-06	1.50E+01	1.72E+04	6.11E-04	4.17E-03
71432		Benzene	2.85E+02	3.28E-03	8.32E-02	9.80E-06	5.89E+01	1.79E+03	5.56E-04	2.21E+01
56235		Carbon tetrachloride	1.16E+00	1.83E-02	7.37E-02	8.80E-06	1.74E+02	7.93E+02	5.10E-04	4.59E-01
67663		Chloroform	2.38E+00	2.25E-03	9.83E-02	1.00E-05	3.98E+01	7.92E+03	6.19E-04	1.41E-01
156592		cis-1,2-Dichloroethylene	1.04E+00	2.47E-03	6.96E-02	1.13E-05	3.55E+01	3.50E+03	4.94E-04	5.40E-02
100414		Ethylbenzene	4.08E+02	4.09E-03	7.09E-02	7.80E-06	3.63E+02	1.69E+02	4.98E-04	3.52E+01
98828		Cumene	2.86E+01	6.47E-03	6.14E-02	7.10E-06	4.89E+02	6.13E+01	4.49E-04	3.53E+00
127184		Tetrachloroethylene	8.49E-01	9.92E-03	6.81E-02	8.20E-06	1.55E+02	2.00E+02	4.83E-04	1.73E-01
108883		Toluene	9.90E+02	3.67E-03	8.22E-02	8.60E-06	1.82E+02	5.26E+02	5.51E-04	8.51E+01
79016		Trichloroethylene	1.13E+00	5.93E-03	7.47E-02	9.10E-06	1.66E+02	1.47E+03	5.16E-04	1.46E-01
1330207		Xylenes	2.08E+03	2.65E-03	8.01E-02	9.90E-06	3.82E+02	1.06E+02	5.43E-04	1.27E+02
91576		2-Methylnaphthalene	2.78E+01	1.81E-04	4.93E-02	7.75E-06	2.81E+03	2.46E+01	4.27E-04	9.15E-02
92524		Biphenyl	8.94E+00	1.21E-04	3.82E-02	8.15E-06	4.38E+03	7.45E+00	3.87E-04	1.78E-02
132649		Dibenzofuran	3.95E+00	4.42E-08	2.25E-02	6.00E-06	5.15E+03	3.10E+00	7.13E-04	5.28E-06
91203		Naphthalene	6.89E+01	2.10E-04	5.58E-02	7.50E-06	2.00E+03	3.10E+01	4.55E-04	2.79E-01

TABLE H.8

**J&E MODEL OUTPUT FOR SITE WIDE GROUNDWATER (INDUSTRIAL/COMMERCIAL BUILDING)
FORMER GM WILMINGTON ASSEMBLY PLANT
WILMINGTON, DELAWARE**

<i>CASRN</i>	<i>ChemCLASS</i>	<i>CHEMNAME</i>	<i>GWConc</i> ($\mu\text{g/L}$)	<i>Henry's</i> <i>Law</i> <i>Constant</i> <i>at</i> <i>gw temp.</i> ($\text{atm m}^3/\text{mol}$)	<i>Air</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>gw temp.</i> (cm^2/s)	<i>Water</i> <i>Diffusion</i> <i>Coefficient</i> <i>at</i> <i>25 C</i> (cm^2/s)	<i>Koc</i> (mL/g)	<i>Soil</i> <i>saturation</i> <i>conc.,</i> <i>Csat</i> (mg/kg)	<i>Infinite</i> <i>source</i> <i>indoor</i> <i>attenuation</i> <i>coefficient,</i> <i>a</i> (unitless)	<i>Vapor Intrusion</i> <i>Infinite</i> <i>source</i> <i>bldg.</i> <i>conc.,</i> <i>C_{building}</i> ($\mu\text{g/m}^3$)
75343		1,1-Dichloroethane	5.58E-01	3.47E-03	7.01E-02	1.05E-05	3.16E+01	5.06E+03	3.96E-04	3.26E-02
95636		1,2,4-Trimethylbenzene	5.32E+02	2.89E-03	5.73E-02	7.92E-06	1.35E+03	5.70E+01	3.34E-04	2.18E+01
107062		1,2-Dichloroethane	3.57E+00	5.64E-04	9.83E-02	9.90E-06	1.74E+01	8.52E+03	5.30E-04	4.54E-02
106467		1,4-Dichlorobenzene	6.43E-01	1.16E-03	6.52E-02	7.90E-06	6.17E+02	7.90E+01	3.76E-04	1.19E-02
591786		2-Hexanone	3.35E+00	4.81E-05	6.65E-02	8.44E-06	1.50E+01	1.72E+04	4.72E-04	3.22E-03
71432		Benzene	2.85E+02	3.28E-03	8.32E-02	9.80E-06	5.89E+01	1.79E+03	4.56E-04	1.81E+01
56235		Carbon tetrachloride	1.16E+00	1.83E-02	7.37E-02	8.80E-06	1.74E+02	7.93E+02	4.11E-04	3.70E-01
67663		Chloroform	2.38E+00	2.25E-03	9.83E-02	1.00E-05	3.98E+01	7.92E+03	5.22E-04	1.19E-01
156592		cis-1,2-Dichloroethylene	1.04E+00	2.47E-03	6.96E-02	1.13E-05	3.55E+01	3.50E+03	3.95E-04	4.31E-02
100414		Ethylbenzene	4.08E+02	4.09E-03	7.09E-02	7.80E-06	3.63E+02	1.69E+02	3.99E-04	2.82E+01
98828		Cumene	2.86E+01	6.47E-03	6.14E-02	7.10E-06	4.89E+02	6.13E+01	3.53E-04	2.78E+00
127184		Tetrachloroethylene	8.49E-01	9.92E-03	6.81E-02	8.20E-06	1.55E+02	2.00E+02	3.85E-04	1.38E-01
108883		Toluene	9.90E+02	3.67E-03	8.22E-02	8.60E-06	1.82E+02	5.26E+02	4.51E-04	6.97E+01
79016		Trichloroethylene	1.13E+00	5.93E-03	7.47E-02	9.10E-06	1.66E+02	1.47E+03	4.17E-04	1.18E-01
1330207		Xylenes	2.08E+03	2.65E-03	8.01E-02	9.90E-06	3.82E+02	1.06E+02	4.43E-04	1.04E+02
91576		2-Methylnaphthalene	2.78E+01	1.81E-04	4.93E-02	7.75E-06	2.81E+03	2.46E+01	3.22E-04	6.89E-02
92524		Biphenyl	8.94E+00	1.21E-04	3.82E-02	8.15E-06	4.38E+03	7.45E+00	2.78E-04	1.28E-02
132649		Dibenzofuran	3.95E+00	4.42E-08	2.25E-02	6.00E-06	5.15E+03	3.10E+00	4.02E-04	2.98E-06
91203		Naphthalene	6.89E+01	2.10E-04	5.58E-02	7.50E-06	2.00E+03	3.10E+01	3.50E-04	2.14E-01