N60478.AR.001214
NWS EARLE
5090.3a

FINAL HUMAN HEALTH RISK ASSESSMENT SITE 9 LANDFILL SOUTHEAST OF "P" BARRICADES WITH TRANSMITTAL NWS EARLE NJ
2/6/2013
TETRA TECH

TETRA TECH

PHIL-25098

February 6, 2013

Project Number 02091

Naval Facilities Engineering Command Mid-Atlantic
Northeast IPT
9742 Maryland Avenue
Norfolk, Virginia 23511-3095

Attn: Mr. Roberto Pagtalunan

Reference: CLEAN Contract No. N62470-08-D-1001
Contract Task Order (CTO) No. WE15

Subject: Submission of Final Human Health Risk Assessment
Site 9, Landfill Southeast of "P" Barricades
Naval Weapons Station (NWS) Earle
Colts Neck, New Jersey

Dear Mr. Pagtalunan:

Enclosed is one (1) copy of the Final Human Health Risk Assessment for Site 9, Landfill Southeast of "P" Barricades. The Human Health Risk Assessment has been revised in accordance with Tetra Tech, Inc.'s (Tetra Tech) proposed responses to EPA comments dated September 12, 2012, and a follow-up discussion between the Navy, EPA, and Tetra Tech held on December 18, 2012.

As requested by the Navy, copies of these documents are also being forwarded under cover of this letter to Ms. Jessica Mollin at EPA Region 2 and Ms. Erica Bergman at NJDEP. Both hard copy and electronic (CD) formats of the documents are being provided to each recipient.

We appreciate the opportunity to provide these services to the Navy. Please contact me if you have any questions or require additional copies.

Sincerely,

Mary M. Mang

Mary M. Mang
Project Manager

MMM/pg

Enclosure

c: Scott Fleming (NWS Earle) (1 copy)
Jessica Mollin (EPA Region II) (2 copies)
Erica Bergman (NJDEP) (2 copies)
Garth Glenn (Tetra Tech) (no enclosure)
John Trepanowski (Tetra Tech) (no enclosure)
NIRIS RDM (1 copy)
File

Tetra Tech, Inc.
234 Mall Boulevard, Suite 260, King of Prussia, PA 19406-2954
Tel 610.491.9688 Fax 610.491.9645 www.tetratech.com

Human Health Risk Assessment

for

Site 9
Landfill Southeast of "P" Barricades

Naval Weapons Station Earle
Colts Neck, New Jersey

Naval Facilities Engineering Command
Mid-Atlantic

Contract Number N62470-08-D-1001
Contract Task Order WE15

February 2013

TETRA TECH

HUMAN HEALTH RISK ASSESSMENT

for

SITE 9, LANDFILL SOUTHEAST OF "P" BARRICADES

NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Mid-Atlantic
9742 Maryland Avenue
Norfolk, Virginia 23511-3095

Submitted by:
Tetra Tech, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NO. N62470-08-D-1001
CONTRACT TASK ORDER WE15

FEBRUARY 2013

TABLE OF CONTENTS

SECTION			PAGE
1.0	**INTRODUCTION**		**1**
2.0	**DATA EVALUATION**		**1**
	2.1	Data Quality Evaluation	2
	2.2	Selection of Chemicals of Potential Concern (COPCs)	6
3.0	**EXPOSURE POINT CONCENTRATIONS**		**7**
4.0	**EXPOSURE ASSESSMENT**		**8**
	4.1	Potential Exposure Pathways	8
	4.2	Reasonable Maximum and Central Tendency Exposure	11
	4.3	Receptors and Routes of Exposure	11
	4.4	Exposure Estimates	12
5.0	**TOXICITY ASSESSMENT**		**14**
	5.1	Reference Doses	15
	5.2	Cancer Slope Factors (SFs)	16
	5.3	Inhalation Toxicity	17
	5.4	EPA Weight of Evidence	17
	5.5	Adjustment of Dose-Response Parameters for Dermal Exposure	18
	5.6	Toxicity Criteria for Chromium	19
6.0	**RISK CHARACTERIZATION**		**19**
	6.1	Noncarcinogenic Hazards	19
	6.2	Carcinogenic Risks	20
	6.3	Comparison of Cancer Risk Estimates and Noncancer HIs to Reference Criteria	20
	6.4	Noncancer Hazards	22
	6.5	Cancer Risks	22
7.0	**UNCERTAINTY ANALYSIS**		**22**
	7.1	Uncertainties Associated with Locations and Numbers of Samples Collected	23
	7.2	Uncertainties Regarding Comparing Site and Background Concentrations	24
	7.3	Uncertainties Regarding the Estimation of the EPC	26
	7.4	Uncertainties in Laboratory Data Quality	28
	7.5	Uncertainties Associated with Receptor Exposure Scenarios	28
	7.6	Uncertainties Associated with Exposure Modeling	29
	7.7	Uncertainties Associated with Dermal Exposure to Soil	30
	7.8	Uncertainties Associated With Toxicity Assessment	31
	7.9	Uncertainties Associated with Risk Characterization	32
	7.10	Uncertainties Associated with Risk Contributions from Background Conditions	32
8.0	**RISK ASSESSMENT SUMMARY AND CONCLUSIONS**		**33**
	8.1	Conclusions	33
REFERENCES			**R-1**

TABLE OF CONTENTS (Continued)

FIGURES

NUMBER		PAGE
2-1	TEST PIT SAMPLE LOCATIONS	3
2-2	SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS	4
4-1	CONCEPTUAL SITE MODEL	10

ATTACHMENTS

ATTACHMENT 1 - DATA USEABILITY WORKSHEETS

ATTACHMENT 2 - EPA RAGS D Tables

RAGS D Table 1s
1.0 Selection of Exposure Pathways

RAGS D Table 2s
2.1 Occurrence, Distribution, and Selection of COPCs – Exposure to Soil, Including All COPCs Above Screening Levels

RAGS D Table 3s
3.1 Exposure Point Concentration Summary – Exposure to Site 9 Soil, Including COPCs Similar to Background

RAGS D Table 4s
4.1.RME Values for Daily Intake - Child Resident Contact with Site 9 Soil (Ingestion/Dermal)
4.1a.RME Values for Daily Intake - Child Resident Contact with Site 9 Soil (Inhalation)
4.2.RME Values for Daily Intake - Adult Resident Contact with Site 9 Soil (Ingestion/Dermal)
4.2a.RME Values for Daily Intake - Adult Resident Contact with Site 9 Soil (Inhalation)
4.3 RME Values for Daily Intake - Industrial Worker Contact with Site 9 Soil (Ingestion/Dermal)
4.3a RME Values for Daily Intake - Industrial Worker Contact with Site 9 Soil (Inhalation)
4.4 RME Values for Daily Intake - Construction Worker Contact with Site 9 Soil (Ingestion/Dermal)
4.4a RME Values for Daily Intake - Construction Worker Contact with Site 9 Soil (Inhalation)
4.5.RME Values for Daily Intake - Recreational Adult Contact with Site 9 Soil (Ingestion/Dermal)
4.5a.RME Values for Daily Intake - Recreational Adult Contact with Site 9 Soil (Inhalation)

RAGS D Table 5s
5.1 Non-Cancer Toxicity Data - Oral/Dermal
5.2 Non-Cancer Toxicity Data - Inhalation

RAGS D Table 6s
6.1 Cancer Toxicity Data - Oral/Dermal
6.2 Cancer Toxicity Data - Inhalation

RAGS D Table 7s
7.1.RME Cancer Risks and Non-Cancer Hazards - Child Resident, Including All COPCs
7.2.RME Cancer Risks and Non-Cancer Hazards - Adult Resident, Including All COPCs
7.3.RME Cancer Risks and Non-Cancer Hazards - Lifetime Resident, Including All COPCs
7.4.RME Cancer Risks and Non-Cancer Hazards - Industrial Worker, Including All COPCs
7.5.RME Cancer Risks and Non-Cancer Hazards - Construction Worker, Including All COPCs
7.6.RME Cancer Risks and Non-Cancer Hazards - Recreational User, Including All COPCs

TABLE OF CONTENTS (Continued)

RAGS D Table 9s

9.1.RME Summary of Receptor Risks and Hazards - Child Resident, Including All COPCs
9.2.RME Summary of Receptor Risks and Hazards - Adult Resident, Including All COPCs
9.3.RME Summary of Receptor Risks and Hazards - Lifetime Resident, Including All COPCs
9.4.RME Summary of Receptor Risks and Hazards - Industrial Worker, Including All COPCs
9.5.RME Summary of Receptor Risks and Hazards - Construction Worker, Including All COPCs
9.6.RME Summary of Receptor Risks and Hazards– Recreational User, Including All COPCs

RAGS D Table 10s

10.1.RME Risk Assessment Summary - Child Resident
10.2.RME Risk Assessment Summary - Adult Resident
10.3.RME Risk Assessment Summary - Lifetime Resident
10.4.RME Risk Assessment Summary - Industrial Worker
10.5.RME Risk Assessment Summary - Construction Worker
10.6.RME Risk Assessment Summary – Recreational User

ATTACHMENT 3 - ANALYTICAL RESULTS FOR SOIL

Table HH-1 Summary of Detected Analytical Results for Soil

ATTACHMENT 4 - COMPARISON OF SOIL DATA TO BACKGROUND

Table HH-2 Statistical Comparison of Concentrations in Site 9 Soil to Background
Table HH-3 Background Threshold Values (BTVs) ProUCL Output
Table HH-4 Soil UCL Support Documentation
Table HH-5 Comparison of Site 9 Concentrations to NJDEP Soil Background Levels

ATTACHMENT 5 - RAGS D TABLES EXCLUDING COPCS SIMILAR TO BACKGROUND

RAGS D Table 2s – BACKGROUND ELIMINATED

2.1.bkg Occurrence, Distribution, and Selection of COPCs – Exposure to Soil, Background Eliminated

RAGS D Table 7 s – BACKGROUND ELIMINATED

7.1.bkg.RME Cancer Risks and Non-Cancer Hazards - Child Resident, Background Eliminated
7.2.bkg.RME Cancer Risks and Non-Cancer Hazards - Adult Resident, Background Eliminated
7.3.bkg.RME Cancer Risks and Non-Cancer Hazards - Lifetime Resident, Background Eliminated
7.4.bkg.RME Cancer Risks and Non-Cancer Hazards - Industrial Worker, Background Eliminated
7.5.bkg.RME Cancer Risks and Non-Cancer Hazards - Construction Worker, Background Eliminated
7.6.bkg.RME Cancer Risks and Non-Cancer Hazards - Recreational User, Background Eliminated

RAGS D Table 9 s – BACKGROUND ELIMINATED

9.1.bkg.RME Summary of Receptor Risks and Hazards - Child Resident, Background Eliminated
9.2.bkg.RME Summary of Receptor Risks and Hazards - Adult Resident, Background Eliminated
9.3.bkg.RME Summary of Receptor Risks and Hazards - Lifetime Resident, Background Eliminated
9.4.bkg.RME Summary of Receptor Risks and Hazards - Industrial Worker, Background Eliminated
9.5.bkg.RME Summary of Receptor Risks and Hazards - Construction Worker, Background Eliminated
9.6.bkg.RME Summary of Receptor Risks and Hazards– Recreational User, Background Eliminated

HUMAN HEALTH RISK ASSESSMENT
SITE 9, LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

1.0 INTRODUCTION

The general scope of the human health risk assessment (HHRA) for NWS Earle Site 9 was to estimate potential cancer risks and noncancer hazards from current or future exposures to soil by potential human receptors. Since Site 9 is part of an active military base and is located in a restricted access and unused wooded area, current receptor exposures are limited to recreational persons, such as base personnel, who may request access during hunting season. Although land use at NWS Earle Site 9 is expected to remain the same in the future, in the event that land use were to change, hypothetical exposure scenarios that have been identified could involve exposure to future residents, industrial workers, or construction workers. The risk assessment considers the analytical results for constituents detected in environmental media, identifies substances that possess toxic or carcinogenic properties which are present above threshold concentrations that could produce adverse effects after releases from environmental media, and quantitatively estimates the possible human health risks based on plausible pathways of exposure for individuals that may frequent the site and surrounding areas.

Risk assessment tables have been prepared following the format adopted by EPA Risk Assessment Guidance for Superfund (RAGS), Volume I, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (EPA, 2001). The results of the HHRA are presented in the following seven sections:

- Data evaluation
- Estimation of exposure point concentrations
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty analysis
- Risk Assessment Summary and Conclusions

2.0 DATA EVALUATION

The following discussion summarizes the data quality evaluation process and the selection of substances of significance for assessing human health risks.

2.1 Data Quality Evaluation

Data quality objectives for the studies conducted at Site 9 and details regarding the sampling and analytical programs were presented in the NWS Earle Remedial Investigation (RI) Work Plan and Quality Assurance Project Plan (QAPP) (Halliburton NUS, 1995), the NWS Earle Remedial Investigation (RI) report (Brown & Root Environmental, 1996), the 1992 Site Investigation (SI) Study (Weston, 1994), and the Feasibility Study for Site 9, Landfill Southeast of "P" Barricades (Tetra Tech, 2011). A summary of the site history, field observations, and an outline of the sampling investigation is presented below to facilitate data evaluation and the interpretation of the exposure assessment.

The Landfill Southeast of "P" Barricades is an isolated 3-acre site located in the Waterfront area. From 1967 to 1972, the Navy used this area for the disposal of dunnage lumber and construction debris from base operations. Dunnage is lumber that is used to secure and space a ship's cargo during transport. Lumber was stacked, burned (using a petroleum ignition source), and then covered with soil. Pine species reforestation was completed several years ago in the area.

Previous investigations included a 1992 SI Study. As reported in the SI report (Weston, 1994), the location and extent of Site 9 was identified by evaluating apparent soil disturbance, consideration of the approximate age of the reforestation, and from review of several aerial photographs that were taken sequentially during the period of operation. As part of the SI field investigation, on May 15, 1992, six test pits were excavated to final depths ranging from 7 to 10 feet below ground surface (bgs). The goals of the test pit investigation were to define the general limits of the former site operations (i.e., burning, covering) and to locate depth intervals for sampling where there were indications of disposal, such that there could be a greater chance of encountering potential impacts to subsurface soils. Sample locations of all test pits are shown in the attached Figure 2-1. Soil samples were obtained from the test pits at the following depths:

- TP9-01: 4-7 ft bgs
- TP9-02: 6-10 ft bgs
- TP9-03: 6-9 ft bgs
- TP9-04: 3-5 ft bgs
- TP9-05: 3-6 ft bgs
- TP9-06: 5-8 ft bgs

112G02091\0830\112G2091GM01-1.DWG 02/27/12 MKB

N

DIRT ROAD

DIRT ROAD

DIRT ROAD

DIRT ROAD

WAGNER CREEK

PF01B

TP9-07

TP9-08

TP9-06

TP9-04

TP9-05

TP9-02

SITE 9

TP9-03

STONE FOUNDATION

DIRT ROAD

DIRT ROAD

EPIC BOUNDARY

PF01A

TP9-01

INTERMITTENT STREAM

DIRT ROAD

DIRT ROAD

PF01C

LEGEND

- EPIC BOUNDARY REFERENCE: EPIC 03/13/74 PHOTO
- TEST PIT LOCATION, RI 1996
- TEST PIT LOCATION, SI 1994
- WETLANDS DELINEATION SOURCE: US FISH & WILDLIFE SERVICE NATIONAL WETLAND INVENTORY
- WOODLAND AREA
- PINE TREE AREA
- WETLANDS
- STREAM SOURCE: USGS TOPOGRAPHIC QUAD
- INTERMITTENT STREAM/DRAINAGE

0 200 400

SCALE IN FEET

TETRA TECH

TEST PIT LOCATIONS
SITE 9 – LANDFILL SOUTHEAST OF "P" BARRICADES
NAVAL WEAPONS STATION
COLTS NECK, NEW JERSEY

FILE	SCALE
112G2091GM01-1	AS NOTED
FIGURE NUMBER	REV / DATE
FIGURE 2-1	0 / 02/27/12

Test pit excavations performed during the 1992 SI revealed very few waste materials. The materials that were found were limited to one piece of cement, trace brick fragments, and a single 4 by 4 piece of timber. In addition, several pieces of metal scrap (steel sheeting, metal bands) and timber (wood beams) were found on the ground surface.

During the 1995 RI, the northern extent of Site 9 was further delineated by excavating two more test pits. No waste or debris was encountered in either of the two test pits, and excavated soil did not reveal elevated readings with a photoionization detector (PID). Since these test pits were found not to reveal any evidence of disposal or soil disturbance, no soil samples were collected during the RI field investigation.

The soil sampling focus at Site 9 was limited to subsurface soil due to the lack of visible impacts to surface soil as noted during the test pit field investigations (1992 and 1995). As a result, the exposure evaluation performed for this risk assessment assumes that disturbance of subsurface soil would have to occur in order to allow human contact with soil that was sampled and analyzed. Surface soil is not considered to represent a source of significant current exposure to human receptors in the risk assessment as no observations of soil disturbance or waste disposal were identified during either the SI or RI field investigations.

The RI field investigation included sampling of surface water and sediment from a nearby tributary and stream to determine if groundwater was impacting surface water. Three surface water/sediment sample pairs were collected from a drainage ditch south of the site as part of the Wagner Creek watershed sampling program. Sample locations of all surface water and sediment samples are shown in relation to the locations of surface water bodies in the attached Figure 2-2. Based on consideration of the relatively flat topography at the site, none of the soil sampling locations in the test pit areas are in close enough proximity to suggest possible transport of contaminants via surficial runoff towards the Wagner Creek watershed tributary, which is located approximately 300 feet south of the site. Surface water and sediment data were evaluated against ecological criteria in the 1996 RI report.

For the human health risk assessment, data quality evaluation included a review of the validated analytical data for soil to determine any problems with detection limit adequacy, rejected data, blank qualified data, and bias or imprecision. Data quality problems are summarized on the attached Data Useability Worksheets prepared for the 1992 soil sampling data (Attachment 1). Based on data validation qualifiers, blank qualified data were not considered acceptable for use in the risk assessment, while estimated values were accepted for use, but may be associated with caveats in the HHRA uncertainty analysis. No significant data validation issues (e.g., rejected data) were identified in the data evaluation that would prevent the overall use of the analytical data sets for the HHRA. Table HH-1 summarizes the

112G02091\0830\112G2091GM01-2.DWG 02/27/12 MKB

N

WSSW20/WSSD20

WAGNER CREEK

DIRT ROAD

PF01B

SITE 9

STONE FOUNDATION

EPIC BOUNDARY

PF01A

WSSW17/WSSD17

INTERMITTENT STREAM

WSSW19/WSSD19

PF01C

WSSW18/WSSD18

0 200 400

SCALE IN FEET

LEGEND

- EPIC BOUNDARY REFERENCE: EPIC 03/13/74 PHOTO
- SURFACE WATER AND SEDIMENT SAMPLE
- WETLANDS DELINEATION SOURCE: US FISH & WILDLIFE SERVICE NATIONAL WETLAND INVENTORY
- WOODLAND AREA
- PINE TREE AREA
- WETLANDS
- STREAM SOURCE: USGS TOPOGRAPHIC QUAD
- INTERMITTENT STREAM/DRAINAGE

TETRA TECH

SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS
SITE 9 – LANDFILL SOUTHEAST OF "P" BARRICADES
NAVAL WEAPONS STATION
COLTS NECK, NEW JERSEY

FILE	SCALE
112G2091GM01-2	AS NOTED
FIGURE NUMBER	REV / DATE
FIGURE 2-2	0 / 02/27/12

detected soil analytical data. Samples were analyzed for full Target Compound List (TCL) organics, Target Analyte List (TAL) inorganics, and Total Petroleum Hydrocarbons (TPH).

It is noted that the organic quantitation limits and inorganic detection limits in the most recent versions of the low/medium Contract Laboratory Program (CLP) analytical protocols (SOM01.2 and ISM01.2) are generally within a factor of two compared to the Contract Required Quantitation Limits (CRQLs) for the analytical methods from the 1992 SI. In the SI, nominal values for Volatile Organic Compound (VOC) CRQLs were 10 ug/kg, Semivolatile Organic Compound (SVOC) CRQLs 330 ug/kg (830 ug/kg for low response compounds), pesticide CRQLs 1.7 or 3.3 ug/kg (except for methoxychlor and toxaphene), and polychlorinated biphenyl (PCB) CRQLs 33 ug/kg. In contrast, the current CLP Statement of Work (SOW) SOM01.2 specifies nominal values for VOC CRQLs of 5 ug/kg (10 for ketones), SVOC CRQLs of 170 ug/kg (330 for low response compounds), pesticide CRQLs of 1.7 or 3.3 ug/kg (except for methoxychlor and toxaphene), and PCB CRQLs of 33 ug/kg.

The SI report's sample detection limits were based on instrument detection limits (IDLs) as adjusted for sample weight and moisture. The IDLs were required to be less than or equal to the Contract Required Detection Limits (CRDLs) specified in the CLP routine analytical services SOW. Recently, the CLP's inorganic CRDLs have been lowered by a factor of two for several metals. However, since IDLs are lower than CRDLs by a considerable margin, the inorganic sample detection limits would be acceptable when compared to the current CLP SOW.

2.2 Selection of Chemicals of Potential Concern (COPCs)

Risk-based screening of Site 9 soil concentrations was used to select chemicals of potential concern (COPCs). EPA's latest Regional Screening Levels (RSLs) for residential soil (EPA, 2012a), which are based on a composite of ingestion, dermal contact, and inhalation exposure assumptions, were used to identify candidate COPCs for the assessment of incidental soil ingestion, soil dermal contact, and inhalation of particulate emissions from soil. Before risk-based screening was conducted, RSLs that were based on noncancer effects were first multiplied by an adjustment factor of 0.1 to account for possible additivity of noncancer effects from different substances. Cancer RSLs were based on a target risk level of 1×10^{-6}. For chromium, the RSL was based on a conservative assumption of hexavalent chromium because of lack of chromium speciation analysis data. Note that arsenic and chromium are known human carcinogens and so were automatically retained as COPCs in accordance with EPA Region 2 recommendations. Note also that chemical-specific considerations were applied to evaluate whether chemicals that do not have published RSL criteria should be selected as COPCs. In particular, essential nutrients were not considered as COPCs, specifically calcium, chloride, magnesium, potassium, and sodium.

As shown in the attached RAGS D Table 2.1, the maximum detected levels of aluminum, chromium, arsenic, and iron exceeded their respective RSLs in Site 9 soil. These four metals were detected in 6 out of 6 soil samples. Aluminum concentrations exceeded the adjusted residential soil RSL in 2 out of 6 test pit samples (TP9-02 and TP9-06). Arsenic, chromium, and iron exceeded RSLs in all 6 soil samples.

Background concentrations did not factor into the decision process for selecting COPCs documented in this section. Instead, background soil concentrations are evaluated at the end of the risk assessment (see Section 6 - Risk Characterization and Section 7 - Uncertainty Analysis). (Note that Attachment 4 presents a statistical background analysis that shows arsenic, chromium, and iron are similar to background levels, and Attachment 5 distinguishes potentially site-related risks from risks related to background conditions.)

3.0 EXPOSURE POINT CONCENTRATIONS

The exposure point concentration (EPC) represents an estimated chemical concentration to which a receptor is assumed to be continuously exposed while in contact with an environmental medium. The 95 percent upper confidence limit (UCL) on the mean of the data was considered the input concentration for a chemical used to estimate site-associated risks.

Statistical calculations of the 95 percent UCL were performed following current risk assessment guidance (EPA 2002a, 2006, 2010a, 2010b) and included a decision scheme to select the optimal UCL method based on several considerations: the number of detected and nondetected data points; the estimated shape of the probability distribution of chemical concentration data (normal, lognormal, gamma, or nonparametric) as determined by distributional fit tests; the estimated standard deviation of the log-transformed data; and the estimated gamma distribution shape parameter (k), which is related to skewness. The software program, ProUCL version 4.1.00 (EPA, 2010a) was used for all calculations. For full data sets without any nondetect sample results, the statistical UCL considers a choice between 15 computational algorithms, including 5 parametric methods and 10 nonparametric methods. The nonparametric methods do not depend upon any assumptions about the data distributions. The five parametric UCL computation methods were student's t-UCL, approximate gamma UCL using chi-square approximation, adjusted gamma UCL (adjusted for level significance), Land's H-UCL, and Chebyshev inequality-based UCL [using minimum variance unbiased estimators (MVUEs) of parameters of a lognormal distribution]. The 10 nonparametric methods were the central limit theorem (CLT)-based UCL, modified-t statistic (adjusted for skewness)-based UCL, adjusted-CLT (adjusted for skewness)-based UCL, Chebyshev inequality-based UCL (using sample mean and sample standard deviation), jackknife method-based UCL, UCL based upon standard bootstrap, UCL based upon percentile bootstrap, UCL

based upon bias-corrected accelerated (BCA) bootstrap, UCL based upon bootstrap t, and UCL based upon Hall's bootstrap.

The calculated EPCs for aluminum, arsenic, chromium, and iron are shown in the attached RAGS D Table 3.1. For each substance, the assumption of a normal distributional shape of the data could not be rejected based on statistical tests. Therefore, the selected UCLs were all based upon the student's t-distribution. As discussed in Section 7, there is considerable uncertainty in estimating UCLs based on only 6 samples in a sample data set, which reduces the confidence in the accuracy of EPCs. Note that, for each COPC, the statistical UCL was slightly greater than the maximum detected concentration, but within a range of 10% to 30% larger.

Note that the EPCs for inhalation exposure were based on COPC data expressed in soil concentration units, so that soil concentration UCL values could be input into a mathematical model to estimate airborne particulate emissions concentrations. Supporting documentation for UCL estimates, including the statistical estimates of distributional shape, mean, variance, and other parameters associated with UCL computation are included in the ProUCL output documentation presented in Table HH-4.

4.0 EXPOSURE ASSESSMENT

The exposure assessment identifies categories of potential human health exposure based upon a characterization of the site setting, potential receptors consistent with current and possible future land use, and possible exposure pathways for each environmental medium of concern. A complete exposure pathway has three components: a source, a route of transport, and an exposure point for receptors. The risk assessment focuses on quantifying estimated risks for the plausible current or future receptors that may be exposed to COPCs originating from the site.

4.1 Potential Exposure Pathways

In Figure 4-1, a conceptual site model (CSM) is presented as a flow chart which traces the possible migration pathways leading from the source media, lists the potential migration processes, and indicates the possible routes of exposure where potentially contaminated media may come into contact with human receptors associated with demographic groups such as local residents, recreational persons, or on-site workers. Hypothetical receptor exposure pathways that were considered in the CSM include future residential tap water use of potable groundwater, construction worker contact with exposed groundwater or subsurface soil during excavation work, residential and industrial worker contact with disturbed soil that may be redistributed at the ground surface after construction and re-landscaping, and recreational contact with surface water and sediment. The determination of which receptor exposure scenarios were relevant

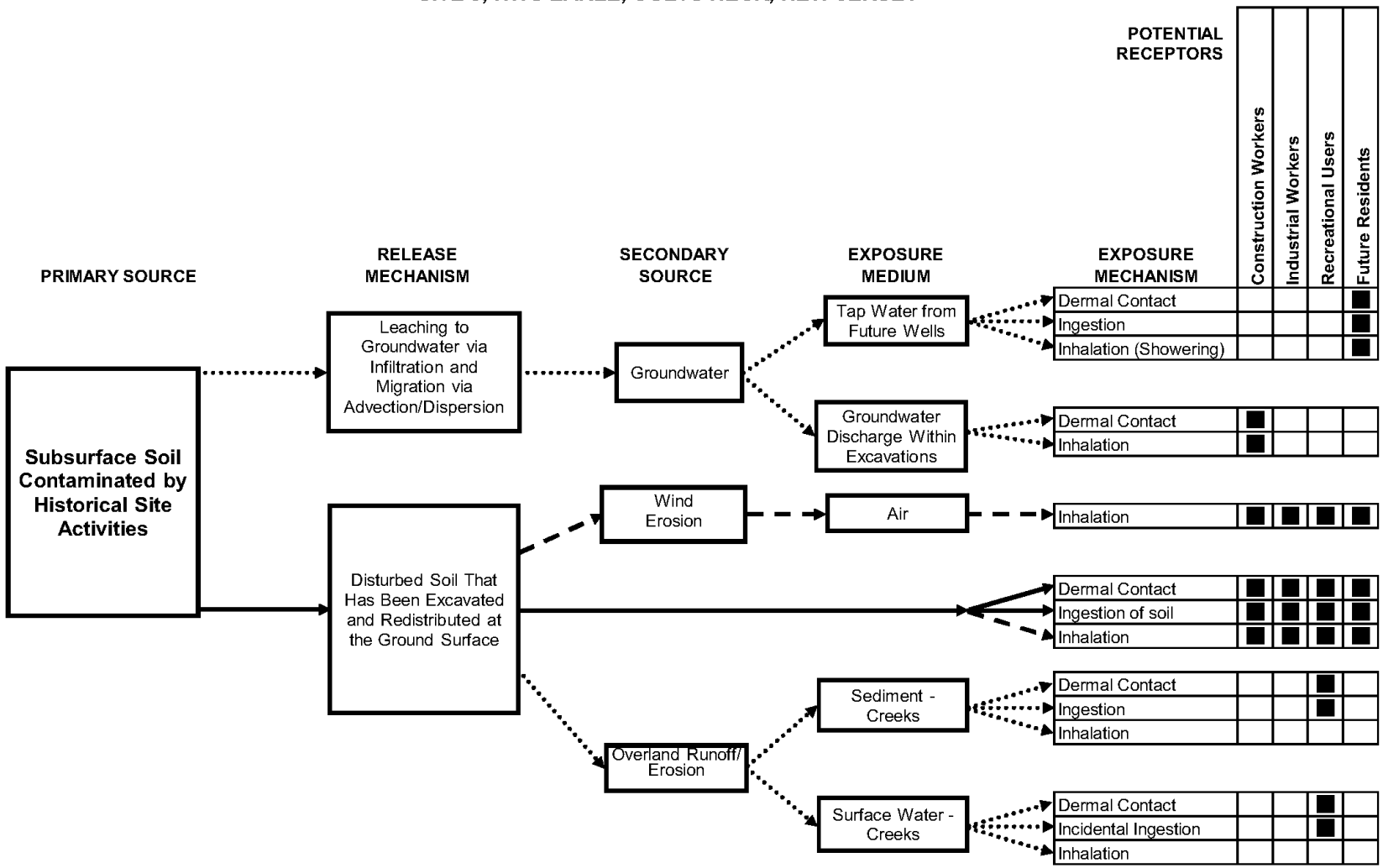
to estimating human health risks, along with the rationale for including or excluding each receptor activity pattern or route of exposure in the risk assessment, are listed in the attached RAGS D Table 1. Since Site 9 is part of an active military base and located in a restricted access unused wooded area, the current receptor exposure scenario only includes recreational hunters. Although military ownership along with this land use scenario is expected to remain the same in the future, in the event that land use were to change, other plausible exposure scenarios could involve exposure to residents, industrial workers, or construction workers.

In Table 1, note that inhalation of COPCs in airborne particulates associated with dust emissions from soil was considered for metal COPCs; however, there were no volatile COPCs detected that might evaporate from soil. Since no evidence of soil contamination was identified at the ground surface during the field investigation, all soil samples were collected from subsurface intervals from test pits. Therefore, there is not a complete pathway to allow current exposure to COPCs found in subsurface soil, and future exposures would only occur if construction activities, utility work, or landscaping were to disturb subsurface soils and mix or redistribute soil at the ground surface.

Table 1 also lists the receptors that could be hypothetically exposed to surface water and sediment. However, this pathway was not evaluated in the HHRA because the nearest surface water bodies are not in close proximity to the site. Therefore, creeks or other surface water bodies would be unlikely to be affected by surficial runoff from the site due to the lack of waste materials present on the surface and the distance to the closest water bodies.

Table 1 shows the receptors that could be hypothetically exposed to groundwater. However, the groundwater pathway was not quantitatively evaluated in the HHRA because there are no current wells located on-site or in close proximity to the site. In addition, there were no requirements to trigger a groundwater investigation. Furthermore, soil material uncovered during the test pit investigations did not reveal any obvious contaminant sources or signs of residual contamination.

FIGURE 4-1
CONCEPTUAL SITE MODEL - HUMAN HEALTH RISK ASSESSMENT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY



4.2 Reasonable Maximum and Central Tendency Exposure

Two types of exposure estimates may be presented in a human health risk assessment: Reasonable Maximum Exposure (RME) is an exposure scenario that is expected to represent a high end, but not usually worst-case, exposure in a given medium of concern. In contrast, Central Tendency Exposure (CTE) is considered to be an estimate of the average or mid-range of exposures that may occur. Different activity pattern variables (days per year exposed, quantity of soil ingested, etc.) were assumed under RME versus CTE receptor exposure estimates. CTE analysis is performed only if the overall cumulative cancer risks are above 1×10^{-4} or the noncancer hazard indices (HIs) based on the same target organ are above 1.0, which did not occur for any of the receptors or media evaluated at the site. Both risk estimates are provided to risk managers, who frequently use RME risks for making decisions.

4.3 Receptors and Routes of Exposure

- Future Recreational User - This receptor is an active duty serviceman stationed at NWS Earle or an adult member of a serviceman's immediate family who hunts for deer at Site 9 during the New Jersey regulated bow and firearm deer hunting season with permission from appropriate NWS Earle base authorities. This receptor is potentially exposed to contact with surface soil (assuming that subsurface soils have been disturbed by excavation and redistributed at the ground surface) via ingestion, dermal absorption, and inhalation of fugitive dust emitted from soil. The RME exposure duration was assumed to span 8 years (equivalent to two tours of duty), with an annual exposure frequency of three months per year (fall and winter hunting seasons) that includes one weekend day plus two shorter weekday hunting sessions every week.

- Future Residential Child - This receptor is a child (ages 1 to 6) who resides at a hypothetical future residence located on-site or adjacent to the site. This receptor is potentially exposed to contact with soil via ingestion, dermal absorption, and inhalation of fugitive dust emitted from soil. Note that exposure to disturbed soil would be anticipated to occur only if subsurface soil were to be excavated and redistributed at the ground surface.

- Future Residential Adult - This receptor is an adult (24-year exposure duration) who resides at a hypothetical future residence located on-site or adjacent to the site. This receptor is potentially exposed to contact with soil via ingestion, dermal absorption, and inhalation of fugitive dust emitted from soil. Note that exposure to disturbed soil would be anticipated to occur only if subsurface soil were to be excavated and redistributed at the ground surface.

- Future Lifetime Resident - Lifetime exposure is a combination of the exposure scenarios for an adult and a child in order to estimate the cumulative lifetime cancer risk under residential land use scenarios. The lifetime cancer risk was estimated by adding the cancer risk for a 24-year adult exposure to the cancer risk for a 6-year child exposure. Note that lifetime residential exposure is based on the upper range of time resided at one location for a civilian and not necessarily military population. This was considered the more conservative approach to account for any future land use.

- Future Industrial Worker - This receptor is an occupational worker or maintenance worker who has contact with soil while engaged in grounds keeping or other forms of outdoor work that might be applicable if future industrial land development were to occur at Site 9. This receptor is potentially exposed to COPCs in disturbed soil (comprised of a combination of surface soil and subsurface soil) via ingestion, dermal absorption, and inhalation of fugitive dust emitted from soil.

- Future Construction Worker - This receptor is a construction worker who comes into contact with subsurface soil during excavation work or while working in a utility trench. The receptor is potentially exposed to COPCs in disturbed soil (comprised of a combination of surface soil and subsurface soil) via ingestion, dermal absorption, and inhalation of fugitive dust emitted from soil.

4.4 Exposure Estimates

The exposure estimation methods and models applied to evaluate cancer risks and noncancer hazards were in accordance with EPA guidance (EPA, 1986, 1989, 1992a, 1992b, 1993a, 1996b, 1996c, 1997a, 2002b, 2004, and 2009).

Noncarcinogenic hazards were assessed by estimating a total annual exposure, then converting the dose to an average daily intake. When compared to toxicity benchmarks, daily intake represents the rate of exposure and does not suggest incrementally increasing degrees of cumulative toxicity according to years of exposure duration. The intake incorporates terms describing the exposure time and/or frequency that represent the number of hours per day and the number of days per year that exposure occurs. The sum of exposures over one year was divided by 365 days of "averaging time" in order to convert the annual exposure to an average daily intake. Noncarcinogenic hazards for some exposure routes were generally greater for children than for adults because of differences in body weight and intake.

Carcinogenic risks, on the other hand, were estimated as an incremental lifetime risk and, therefore, incorporate terms to sum the exposures over an expected exposure duration (years of exposure), and then divide by the total days in a typical lifetime (70 years). The carcinogenic exposure model accounts for the probability of developing cancer increasing with every additional year of cumulative exposure.

Averaging times for air pathway exposures were reported in units of hours, which differs from the units for averaging time, days, that were applied to direct contact (ingestion and dermal) exposure equations. As recommended on page 3 of RAGS Part F inhalation guidance, whenever air pathway exposure is less than 24 hours per day, the exposure time (ET) should be stated in hours per day and the averaging time expressed in units of hours (EPA, 2009).

RME input parameters and equations used to calculate daily intake of COPCs from soil exposure are shown in Tables 4.1.RME through 4.5.RME. CTE parameters and equations are shown for receptors requiring this type of exposure evaluation in Tables 4.1.CTE and 4.2.CTE. The following pathway-specific assumptions and estimation methods for COPC exposures should be noted:

- Incidental ingestion of soil: For the RME exposure scenario, residential soil contact was assumed to involve daily ingestion of 100 milligrams (mg) of soil per day for an adult and 200 mg of soil per day for a child, over a timeframe of 350 days per year. RME industrial worker soil contact was assumed to involve daily ingestion of 100 mg per day over a period of 250 days per year. RME construction worker soil contact was assumed to involve daily ingestion of 330 mg per day over a period of 130 days per year (approximately 6 months full time work). RME recreational user soil contact was assumed to involve daily ingestion of 100 mg per day over a period of 39 days per year. The equations used to estimate the daily dose from incidental ingestion of soil and the sources cited for the assumed ingestion rates are shown in RAGS D Tables 4.1 through 4.5.
- Dermal absorption of COPCs in soil: Skin surface areas available for dermal contact were based on values presented in dermal guidance (EPA, 2004). Soil-to-skin adherence factors were assumed to be 0.2 mg/cm^2/event for a child resident, 0.07 mg/cm^2/event for an adult resident, and 0.2 mg/cm^2/event for an industrial worker, construction worker, and recreational user. Activity-specific exposure assumptions are listed in footnotes to RAGS D Tables 4.1 through 4.5. Chemical-specific soil dermal adherence factors (ABSDER) were evaluated based on EPA guidance (EPA, 2004). Since no ABSDER value has been published by EPA for aluminum, no accurate estimates of this factor could be derived. Therefore, potential dermal absorption of aluminum found in soil is discussed qualitatively in the Section 7, Uncertainty Analysis. The equations used to estimate daily dose from dermal contact with soil and the sources cited for the assumed input parameters are shown in RAGS D Tables 4.1 through 4.5.
- Inhalation of fugitive dusts emitted from soil: Exposure time for particulate dust inhalation was assumed to be 12 hours per day of outdoor inhalation for residents, 8 hours per workday for industrial and construction workers, and 3 hours per day for recreational users. The site-specific particulate emission factor (PEF) associated with modeling inhalation of fugitive dust was derived based on information presented in EPA's Soil Screening Guidance (EPA, 2002b, 1996b, and 1996c), Cowherd, 1984, and site-specific information. The PEF was calculated as follows:

$$PEF(m^3/kg) = \frac{Q/C \times 3600 s/h}{E_{10}}$$

where:

PEF	=	3.082 x 10^9 m^3/kg	= Particulate emission factor for Site 9
Q/C	=	64.16 (g/m^2-s)/(kg/m^3)	= Inverse of the ratio of the geometric mean air conc. to the emission flux at the center of Site 9, source size 3 acres, Q/C for Philadelphia climate zone (EPA, 2002b)
E_{10}	=	0.036 x (1-V) x $(U_m/Ut)^3$ x F(x)	= Particulates less than 10 microns (PM_{10}) average annual emission flux (g/m^2-hr)
V	=	0.8	= Fraction of vegetative cover (grass or vegetated area)
U_m	=	4.56 m/sec	= Mean Annual Windspeed at 7 m (Newark, NJ) (Table 4-1, Cowherd)
U_t	=	11.319 m/s	= Threshold value of windspeed at 7 m (equation, below)
F(x)	=	0.159	= Function where x = 0.886 x Ut/U_m; Since X > 2, use $F(x)=0.18*(8x^3+12x)*\exp(-x^2)$ (Appendix B, Cowherd)
Ut	=	U* x (1/0.4) x ln (z/z_0)	

where:

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

A	=	14.0111	= Air dispersion constant in climate zone model (EPA, 2002b)
B	=	19.6154	= Air dispersion constant in climate zone model (EPA, 2002b)
C	=	225.3397	= Air dispersion constant in climate zone model (EPA, 2002b)
A_{site}	=	3 acres	= Approximate area of Site 9
Ut	=	11.319 m/s	= Wind speed at height z for Site 9
z	=	700 cm	= Height above surface (Cowherd)
z_0	=	0.5 cm	= Roughness height where annual windspeed was measured: assume unobstructed terrain for weather station (Figure 3-6, Cowherd)
U*	=	0.625 m/s	= Threshold friction velocity for assumed particle size 0.5 mm (Figure 3-4, Cowherd), corrected x 1.25 (EPA, 1996b)

5.0 TOXICITY ASSESSMENT

The toxicity assessment identifies the potential health hazards associated with exposure to a COPC. Literature references establish that the selected COPC has the potential to cause carcinogenic and/or noncarcinogenic health effects in humans. Dose-response relationships and the potential for exposure must be evaluated before the risks to receptors can be determined. Dose-response relationships

correlate the magnitude of the intake with the probability of toxic effects. As discussed below, dose-response values [reference doses (RfDs) and slope factors (SFs)] have been developed by EPA and other sources. Oral and inhalation RfDs and SFs were obtained from the following primary recommended sources (ATSDR, 2010, EPA, 1997b, 2012a, 2012b, 2012c, and 2012d):

- Integrated Risk Information System (IRIS) (Online Database) (EPA, 2012b).
- EPA Provisional Peer Reviewed Toxicity Values (PPRTVs) (EPA, 2012d) - The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical specific basis when requested by EPA's Superfund program.
- Other Toxicity Values - These sources may include but are not limited to the Agency for Toxic Substances and Disease Registry (ATSDR, 2010) Minimal Risk Levels (MRLs), the Annual Health Effects Assessment Summary Tables (HEAST) (EPA, 1997b), and California EPA (EPA, 2012c).

Although RfDs and SFs can be found in several toxicological sources, EPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated and values presented have been verified by the agency's consensus peer review process.

5.1 Reference Doses

The RfD is developed by EPA for chronic and/or subchronic human exposure to hazardous chemicals and is based solely on the noncarcinogenic effects of chemical substances. The RfD is defined as an estimate of a daily oral exposure for a given duration to the human population (including susceptible subgroups) that is likely to be without an appreciable risk of adverse health effects over a lifetime. It is derived from laboratory or epidemiological studies and based on a Benchmark Dose Lower-Confidence Limit (BMDL), a No Observed Effects Level (NOAEL), a Lowest Observed Effects Level (LOAEL), or another suitable point of departure, with uncertainty/variability factors applied to reflect limitations of the data used. The RfD may be evaluated for varying timeframes based on the available information. Subchronic RfDs are specifically developed to be protective for a portion of a lifetime exposure to a compound (as a Superfund program guideline, short term). Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (as a Superfund program guideline, long term). The RfD is usually expressed as a dose (mg) per unit body weight (kg) per unit time (day).

Uncertainty factors are generally applied as multiples of 10 to represent specific areas of uncertainty in the available data. A factor of 10 is used to account for variations in the general population (to protect sensitive subpopulations), when test results from animals are extrapolated to humans (to account for interspecies variability), when a NOAEL derived from a subchronic study (instead of a chronic study) is

used to develop the RfD, and when a LOAEL is used instead of a NOAEL. In addition, EPA reserves the use of a modifying factor of up to 10 for professional judgment of uncertainties in the database not already accounted for. The default value of the modifying factor is 1.

The RfD incorporates the surety of the evidence for chronic human health effects. Even if applicable human data exist, the RfD (as diminished by the uncertainty factor) is designed to maintain a margin of safety so that chronic human health effects are not underestimated. Thus, the average daily dose is compared to the RfD and a determination is made whether the goal of protection of a Hazard Index (HI) equal to 1 is exceeded.

Noncancer hazards are considered to be associated with particular target organs or critical effects, but are not additive across multiple chemicals except when the same target organ is affected. Target organ data have been extracted from the Integrated Risk Information System (EPA, 2012b), Health Effect Assessment Summary Tables (HEAST; EPA, 1997b), or other applicable sources. Only the target organs that are affected in the applicable study in which the RfD was derived have been included in RAGS D Tables 5.1 and 5.2. Table 5.1 lists the oral RfDs, primary target organs, uncertainty/modifying factors, and sources for the selected COPC. Table 5.2 lists the Inhalation reference concentrations (RfCs) (mg/m^3), primary target organs, uncertainty/modifying factors, and sources for the selected COPCs.

5.2 Cancer Slope Factors (SFs)

SFs are applicable for estimating the lifetime probability (assumed 70-year lifespan) of human receptors developing cancer as a result of exposure to known or potential carcinogens. SFs generally represent an upper bound on the average risk in a population or the risk for a randomly selected individual but not the risk for a highly susceptible individual or group (EPA, 2005a). The slope factor is generally reported in units of 1/(mg/kg/day), and for most substances is derived through an assumed low-dosage linear relationship extrapolated from high to low dose responses, typically based on animal studies. The value used in reporting the slope factor is the upper 95 percent confidence limit.

Available oral and dermal SFs, weight of evidence, and sources for the selected COPC are provided in Table 6.1. Inhalation Unit Risks (IURs), weight of evidence, and toxicity data sources for the selected COPCs are provided in Table 6.2. Note that arsenic and chromium are Class A carcinogens, while aluminum and iron have not been classified by EPA regarding their carcinogenicity.

5.3 Inhalation Toxicity

The intake equations presented in RAGS, Part A (EPA, 1989, Exhibit 6-16) are no longer recommended by EPA to be used when evaluating risk from the inhalation pathway. Instead, the revised equations from RAGS, Part F (EPA, 2009) are recommended. The net impact of this change is to use inhalation unit risks (IURs) instead of inhalation slope factors for cancer risk, and reference concentrations (RfCs) instead of inhalation RfDs for noncancer hazards. In addition, on RAGS D Table 7s, receptor inhalation risks are estimated using chemical intakes expressed as a time-averaged concentration, so that body weight and inhalation rate are not directly input into risk calculations. Since the soil exposure scenarios were less than 24 hours per day, the scenario-specific exposure time (ET) in hours per day was used in the equations and the averaging time was expressed in units of hours.

5.4 EPA Weight of Evidence

A weight-of-evidence approach is used to classify the likelihood that a substance is a carcinogen. This qualitative information is important to consider when using SFs to estimate potential risk. Each substance is assigned a weight-of-evidence for carcinogenicity. EPA has recently revised their weight-of-evidence classifications. The updated categories are listed below (EPA, 2005a):

WEIGHT OF EVIDENCE CATEGORY	DEFINITION
Carcinogenic to Humans	There is strong evidence of human carcinogenicity
Likely to be Carcinogenic to Humans	The weight-of-evidence is adequate to demonstrate carcinogenic potential to humans, but does not reach the weight of evidence for the classification of "Carcinogenic to Humans"
Suggestive Evidence of Carcinogenic Potential	The weight of evidence is suggestive of carcinogenicity; a concern for potential carcinogenic effects in humans is raised, but the data are judged not sufficient for a stronger conclusion
Inadequate Information to Assess Carcinogenic Potential	Available data are judged inadequate for applying one of the other classifications
Not Likely to be Carcinogenic to Humans	The available data are considered robust enough for deciding that there is no basis for human health hazard

Weight-of-evidence classifications have not yet been updated for many substances. In these instances, it is appropriate to still list the old weight-of-evidence classifications (EPA, 1986). The older weight-of-evidence categories were used on RAGS D Table 6.1 and 6.2, and are listed as follows:

- Group A - Human Carcinogen (Sufficient evidence from epidemiological studies to support a causal association between exposure and cancer).

- Group B1 - Probable Human Carcinogen (Limited evidence of carcinogenicity in humans from epidemiological studies; sufficient evidence in animals).
- Group B2 - Probable Human Carcinogen (Sufficient evidence of carcinogenicity in animals and no or inadequate evidence in humans).
- Group C - Possible Human Carcinogen (Limited evidence of carcinogenicity in animals).
- Group D - Not Classified (Inadequate evidence of carcinogenicity in animals).
- Group E - No Evidence of Carcinogenicity (No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiological and animal studies).

5.5 Adjustment of Dose-Response Parameters for Dermal Exposure

Risks associated with dermal exposures were evaluated using toxicity values that are specific to absorbed dermal doses. Most oral toxicity values are based on administered doses rather than absorbed doses. Therefore, in accordance with EPA guidance (2004), the toxicity values based on administered doses were adjusted before they were used for evaluating absorbed doses. Consistent with RAGS Part E (Section 4, page 4-2), oral adjustment factors are not applied when the GI absorption from the critical study exceeds 50%.

Dermal RfDs and SFs were obtained from oral RfDs and SFs via the following relationships:

$$RfD_{Adjusted} = RfD_{Oral} \times GI_{Oral}$$

$$SF_{Adjusted} = SF_{Oral} / GI_{Oral}$$

where:

GI_{Oral} = Gastrointestinal (GI) Absorption Efficiency (EPA, 2004)
RfD_{Oral} = Oral Reference Dose (EPA, 2012b; EPA, 2012c; EPA, 1997b; or EPA, 2012d)
SF_{Oral} = Oral Slope Factor (EPA, 2012b; EPA, 2012c; EPA, 1997b; or EPA, 2012d)

Dermally adjusted RfDs and SFs for the selected COPCs are presented in Tables 5.1 and 6.1, respectively. The applicable chemical-specific dermal absorption factors for soil are shown on Table 6.1. Note that soil dermal adherence factors are not available for aluminum, chromium, and iron. Dermal guidance (EPA, 2004) does not recommend using default soil dermal absorption factors for metals where chemical-specific data are not available.

5.6 Toxicity Criteria for Chromium

Because speciation data (i.e., trivalent versus hexavalent) was not available, the toxicity criteria for hexavalent chromium (Cr+6) were applicable for soil in this risk assessment. Hexavalent chromium is considered to be more toxic than trivalent chromium; therefore, this assumption is conservative in nature.

EPA has categorized hexavalent chromium as a mutagen having enhanced carcinogenic potency during early life periods of exposure (EPA, 2012b; McCarroll, 2010). Based upon EPA guidance (EPA, 2005b), cancer slope factors for hexavalent chromium should be multiplied by a factor of 10 for those periods of exposure occurring between 0 and 2 years of age, and by a factor of 3 for periods of exposure occurring between 2 and 16 years of age. A multiplier of 1 (no correction) applies to chromium cancer slope factors that are outside of these critical age ranges. A receptor-specific age dependent adjustment factor (ADAF) is calculated and multiplied by the daily intake and the slope factor for chromium as shown below:

Receptor	Medium	RME/CTE	ADAF for Chromium
Residential Child	Soil	RME	5.33 = [(10 x 2 yrs) + (3 x 4 yrs)] / (2 + 4 yrs)
Residential Adult **	Soil	RME	1.83 = [(3 x 10 yrs) + (1 x 14 yrs)] / (10+14 yrs)
Industrial worker	Soil	RME	1.0 (adult age 18 years or older)
Construction worker	Soil	RME	1.0 (adult age 18 years or older)
Recreational User	Soil	RME	1.0 (adult age 18 years or older)

** Note that for mutagens, the labeled "residential adult" receptor assumes exposures across a combined age range of 6 to 16 (10 years) plus ages 16 to 30 (14 years).

6.0 RISK CHARACTERIZATION

This section presents estimates of carcinogenic risks and noncarcinogenic hazards for all applicable human receptors that may be exposed to COPCs present in various environmental media and at each site-related area of interest. The risk characterization quantitatively evaluates the potential for adverse health effects from exposure to COPC concentrations in environmental media by integrating information developed during the toxicity and exposure assessments.

6.1 Noncarcinogenic Hazards

Noncarcinogenic substances were evaluated for noncancer hazards, which are technically not risks since a probability of health effects is not developed for noncarcinogens. Noncarcinogenic hazards were assessed using the concept of hazard quotients (HQs) and HIs. The HQ is defined as the ratio of the estimated intake and the RfD for a selected chemical of concern, as shown on the following page:

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

HIs are generated by summing individual HQs for COPCs. If the value of the total HI exceeds unity (1.0), the potential for noncarcinogenic health hazards associated with exposure to a particular chemical mixture cannot be ruled out (EPA, 1986). In that case, a review of the target organ(s) affected by each chemical should be performed, which indicates the most sensitive toxic endpoints used to develop the associated RfDs for each substance. A target organ-specific HI can be calculated for the receptor by summing the HQs for similar target organs. Since HIs for different organs are not truly additive, if each target organ-specific HI is less than 1, then adverse effects are not anticipated. The HI is not defined as a mathematical prediction of the severity of toxic effects; it is simply a numerical indicator of exceedance of the oral reference dose. Above an HI of 1, toxic effects would not necessarily occur but can no longer be ruled out. EPA's goal of protection for noncancer hazards is an HI less than or equal to 1.

6.2 Carcinogenic Risks

Incremental cancer risk (ICR) estimates can be generated for each exposure pathway using the estimated intakes and published SFs, as follows:

$$Risk = Intake \times SF$$

The risk determined using these equations is defined as a unitless expression of an individual's increased likelihood of developing cancer over a lifetime as a result of a specific period and amount of exposure to carcinogenic chemicals. An ICR of 1×10^{-6} indicates that the exposed receptor has a one in one million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of 1,000,000 persons. The calculated cancer risks should be recognized as upper-limit estimates. SFs are defined as the upper 95 percent confidence limit of a dose-response curve generally derived from animal studies.

6.3 Comparison of Cancer Risk Estimates and Noncancer HIs to Reference Criteria

In order to interpret the quantitative cancer risks and noncancer HI estimates and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates are compared to typical reference criteria. COPCs exhibiting a HQ above 1, or otherwise contributing to a noncancer HI greater than 1 on the basis of a single target organ or effect, are potential candidates for remedial decision-

making. However, remediation decisions are not made strictly based on HIs but are often further modified by other regulatory requirements such as chemical-specific clean-up goals.

In the National Oil and Hazardous Substances Pollution Contingency Plan developed for Superfund sites, EPA has defined the range of 1×10^{-4} to 1×10^{-6} as the ICR target range such that, when the sum of cancer risks for all COPCs in a given medium is greater than 1×10^{-4}, this generally indicates that EPA will require consideration of remediation options (EPA, 1990, 1992d). ICRs below 1×10^{-4} normally do not require remediation of remedial efforts for a given medium. Whenever the overall ICR for a medium is greater than 1×10^{-4}, individual chemicals are selected which contributed significantly to overall risk, typically those chemicals with an individual ICR greater than 1×10^{-6}.

Receptor cancer risks and noncancer hazards were presented for each receptor in the form of RAGS D Table 7s, RAGS D Table 9s, and RAGS D Table 10s. In each risk table where HQs were reported as N/A, the HQs were not calculable because no RfD has been established. Cancer risks that are reported as "N/A" generally indicate that the chemical is not carcinogenic or that an SF has not yet been developed.

Site-specific noncarcinogenic and carcinogenic risks were estimated for potential receptors at the site and are discussed below. If the RME HI were to exceed 1.0 for any target organ group or the RME cumulative cancer risk were to exceed 1×10^{-4}, then the CTE cancer risks or noncancer hazards would have to be calculated for the receptor. For each receptor, RAGS D Table 7s present the chemical-specific EPC, estimated noncancer daily intake, the associated noncancer toxicity value (RfD and RfC), and the noncancer HQ. RAGS D Table 7s also present the cancer dose, associated cancer toxicity values (SF and IUR), and estimated cancer risk. Associated target organs for noncancer toxicity effects and the cumulative HI affecting each target organ are presented in RAGS D Table 9s. A summary of cancer risks and noncancer hazards is presented only for substances that are important contributors to unacceptable risk in RAGS D Table 10s.

The RAGS D Table 7s and Table 9s in Attachment 2 present the estimated risks to receptors from exposure to all soil COPCs, even those where site concentrations were similar to background levels (i.e., arsenic, chromium, and iron). For more information on how background analysis affects risks, Attachment 4 presents several background comparison tables and Attachment 5 presents an alternate set of risk tables to distinguish site-related risks from risks related to background conditions.

6.4 Noncancer Hazards

Noncancer hazards were estimated for potential exposures to child and adult residents, industrial workers, construction workers, and recreational users, as shown in Tables 9.1, 9.2, 9.4, 9.5, and 9.6, respectively. For the residential child, the estimated RME HI exceeded 1.0 for exposure to soil. When HIs were grouped according to target organ, no target organ-specific HIs exceeded 1.0, which indicates that adverse noncancer hazards are not expected from exposures to soil. RME HIs were less than 1.0 for the residential adult, industrial worker, construction worker, and recreational user.

6.5 Cancer Risks

Cancer risks were evaluated for potential future soil exposures to child, adult, and lifetime residents, and for industrial workers, construction workers, and recreational users, as shown in Tables 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6, respectively. The associated ICRs were estimated for exposures to soil COPCs for the residential child (ICR of 8.4×10^{-5}), residential adult (ICR of 1.8×10^{-5}), lifetime resident (ICR of 1.0×10^{-4}), industrial worker (ICR of 1.0×10^{-5}), construction worker (ICR of less than 1×10^{-6}), and the recreational user (ICR of less than 1×10^{-6}). The estimated carcinogenic risk for the future lifetime resident was at the upper end of EPA's target acceptable risk range of 1×10^{-4} to 1×10^{-6}.

The COPCs that contributed to cancer risks were arsenic and chromium, which are Class A carcinogens that were detected at concentrations similar to background based on statistical tests. Note that the arsenic maximum site concentration of 13.2 mg/kg and the UCL of 10.3 mg/kg were both less than the NJDEP residential direct contact soil cleanup standard of 19 mg/kg, which is based on natural background levels for arsenic in New Jersey soils (NJDEP, 2012). For more information on background analysis of risks, Attachment 4 presents a statistical background comparison and Attachment 5 presents an alternate set of tables to distinguish site-related risks from risks related to background conditions.

7.0 UNCERTAINTY ANALYSIS

This section discusses the general and site-specific uncertainties associated with the estimated risks, exposure models, and assumptions utilized in the HHRA. The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the risk assessment. As discussed in EPA (1989), the risk measures used in risk assessments are not fully probabilistic estimates of risk but rather are conditional estimates based on a considerable number of assumptions about exposure and toxicity. There are uncertainties associated with each aspect of risk assessment, from environmental data collection through risk characterization.

7.1 Uncertainties Associated with Locations and Numbers of Samples Collected

The areal extent of soil sampling (including the number collected and location of the sampling points) can affect whether sampling results reflect actual site conditions and include areas thought to contain the most significant contamination or exposure problems. To evaluate this type of uncertainty, background information on the site and field sampling strategy should be examined. According to previous investigation reports (Weston, 1994), a site reconnaissance was conducted along with a review of the historical aerial photographs. As reported in the SI report, the location and extent of Site 9 was identified by evaluating apparent soil disturbance, consideration of the approximate age of the reforestation, and from review of several aerial photographs that were taken sequentially during the period of operation. Six test pits were excavated to a maximum depth of 10 feet below ground surface (bgs), and samples were collected from horizons considered to be representative of potentially impacted soils. Test pit excavations revealed waste materials limited to one piece of cement, trace brick fragments, and a single 4 by 4 piece of timber. In addition, a few pieces of metal scrap (steel sheeting, metal bands) and timber (wood beams) were found on the ground surface at Site 9. During 1995 and 1996, Brown and Root Environmental, on behalf of the Navy, conducted an expanded delineation involving two more areas of test pits to confirm the northern extent of the fill. No waste or debris was encountered in either test pit, and excavated soil did not reveal elevated readings when screened with a photoionization detector (PID).

The soil sampling focus at Site 9 was limited to subsurface soil due to the lack of visible impacts to surface soil noted during excavation of test pits. As a result, the exposure evaluation performed for this risk assessment assumes that disturbance of subsurface soil would have to occur in order to allow human contact with soil that was sampled and analyzed. Based upon these observations, surface soil is not considered to represent a source of significant current exposure to human receptors in the risk assessment. Therefore, the test pit samples collected are representative of the subsurface.

The soil sampling focus was biased towards identifying locations and depths where evidence of disposal was encountered and soil impacts were considered more probable. As a result, the soil data set is not necessarily representative of a truly unbiased mixture of impacted and unimpacted sample locations and depths across the whole site. This approach accomplishes the objective of estimating an upper range for potential human health risks from future soil exposure, and is useable information because the findings of the risk assessment suggest that there are no unacceptable risks from potentially site-related COPCs.

A second source of uncertainty is associated with a small sample data set. Only six soil samples were collected in the area. Although sampling was focused to identify areas where soil impacts are more probable, the fact that only six samples were collected contributes to sampling uncertainty. In addition,

there is likely to be a quantitative impact on the accuracy of the derived 95% UCL estimates. Uncertainties related to statistical calculations of UCLs are discussed in Section 7.3.

7.2 Uncertainties Regarding Comparing Site and Background Concentrations

NJDEP soil background levels were examined and compared to Site 9 soil concentrations. Attachment 4, Table HH-5 compares Site 9 soil concentrations for detected metals to NJDEP urban coastal plain soils. Based on this comparison, concentrations of aluminum, arsenic, and chromium in all Site 9 soil samples were less than the 90th percentile of background soil concentrations. Iron concentrations exceeded the 90th percentile of background soil concentrations in 5 out of 6 soil samples, but iron was not a risk driver.

Statistical background comparison tests were performed and evaluated for those COPC metals that were found to exceed RSLs, aluminum, arsenic, chromium, and iron. The statistical methods utilized for background data comparisons were based upon two sample hypothesis tests (which compare the pooled site data to the pooled background data) and statistical comparisons of individual site samples to background threshold values (BTVs), which are derived as 95 percent upper prediction limits (UPLs) or other statistical quantities that are predicted to encompass the upper range of the background population. These tests demonstrated that Site 9 soil concentrations of arsenic, chromium, and iron did not exceed background concentrations, based on the basewide background soil samples collected for the NWS Earle 1996 RI report. In Attachment 5, modified risk tables are presented which omit COPCs within the range of background, and reveal no site-related COPCs associated with either cancer risks or unacceptable non-cancer hazards from soil exposure.

For the statistical hypothesis tests used to compare site and background soils, the site data set consisted of 6 subsurface soil samples collected at varying depths (listed in Section 2.1) from test pits constructed at Site 9. The background data set was comprised of 8 soil samples that were collected as part of the 1996 NWS Earle RI's background soil investigation (B&RE, 1996). Specific information regarding background sampling activities and locations are presented in Chapter 31 of the 1996 RI report. All background locations were located within the property boundaries of NWS Earle and access to the base is restricted. Background locations were carefully selected to be distant from and upgradient of any Navy industrial-type activities. All background soil borings displayed 0 parts per million (PPM) HNU readings and no evidence of stains or odors at any depth. Background soils were obtained from the following locations, where one surface soil and one subsurface soil sample were obtained from each location:

- Background sample location BG-1 is situated in the northeastern portion of the Mainside Area of NWS Earle, within a wooded area southeast of Macedonia Road. This location is upgradient of the

station and several thousand feet from an industrial-type area of the station. One sample was collected at 0-6 inches and one at 5-7 feet bgs.

- Background sample location BG-2 is situated within a wooded area of the NWS Earle Mainside Area, on the north side of Hominy Hills (east of Route 34), approximately 1 mile southwest of the intersection of Guadalcanal Road and Asbury Avenue. One sample was collected at 0-6 inches and one at 5-7 feet bgs.
- Background sample location BG-3 is situated at the Waterfront area of the station, approximately 1000 feet northwest of High Point Chapel and south of IRP Site 7. This location is upgradient and generally upwind of all industrial-type operations at the Waterfront portion of the station. One sample was collected at 0-6 inches and one at 5-7 feet bgs. The sample location area was within a wooded area that eventually backs up to private residential properties.
- Background sample location BG-4 is situated approximately 250 feet east of Site 15 within a mowed grass-covered area at the Waterfront Area of NWS Earle. This location was selected in order to provide data on background conditions near the shoreline. One sample was collected at 0-6 inches and one at 5-7 feet bgs.

Parametric two-sample tests were applied that assume the data follow a normal distribution, while nonparametric tests do not require the assumption of normal data. All two sample statistical tests were run using a decision-making probability level (P-level) of 0.05, which means that, in situations where the test conclusion states that site-related results are greater than background, the chance of the test yielding a false conclusion caused by random variations in the data set is five percent or less.

Since several types of two sample tests were used simultaneously, the overall conclusion (whether site results are greater than background) was assumed to be “yes” if any one of the quantitative tests concluded that site data are elevated above background. Given the possibility that no conclusion might be able to be reached for any of the quantitative tests (e.g., if the assumptions necessary to run each of the various tests were not valid), a statistical test of frequency of detection was also available – the z-test or Fisher’s exact test. However, it turned out that this test was not needed or applicable. Further information regarding each statistical test is presented below:

- The means of the two data sets were compared if both site and background matched a normal distribution (see the right-hand columns of Table HH-2 for distributional analysis test results). If the site and background data exhibit equal standard deviations (based upon Bartlett's test for equal variances), then the student’s t-test was applied; otherwise, Satterthwaite’s t-test was performed to see if the site mean is greater than the background mean. The t-test was used because all site and background data consisted of positive detects and matched a normal distribution at a 5 percent level of significance.

- Nonparametric statistical tests, which do not require underlying assumptions regarding equal data distributions, were also applied in each case. The Wilcoxon rank sum test was used to determine whether the site and background data are from populations with identical medians and rank distributions. The test involves combining the two data sets, ranking results from smallest to largest, and evaluating whether the two sites have a similar distribution of data within the range of low to high ranks. A normal approximation was not used due to insufficient data points; therefore, an exact computation of probabilities was used instead.

- The quantile test (EPA, 1992c, 1996a) is sometimes considered as a type of hot spot test. This test combines the site and background data into one set and determines whether the major portion of a subset of the largest detected results is comprised chiefly of site data rather than an equal mixture of site and background. In this procedure, the probability is calculated that k or more samples from the largest r data points in the combined data set are comprised of site data, assuming that the site and background populations are equally distributed. In the event that there is less than a five percent chance that this could happen if the populations are indeed the same, then the test concludes that there could be a hot spot comprised of samples exhibiting the highest ranked concentrations from the area of interest.

  Only in the event that none of the above quantitative statistical tests yielded a definite “yes” or “no” decision, a test of proportions was available to determine if the percentage of positively detected results is greater in the site data versus the background data. However, the test was not applicable because the four analytes in question all had identical 100 percent frequencies of detection.

- To compare individual sample results to an upper limit associated with the range of background data, BTVs were calculated for background soils. Based on an assessment of the distributional shape of background data - either normal, gamma, or an indiscernible distributional shape - an appropriate calculation method was used. The EPA program ProUCL was applied to estimate several types of BTVs. In all cases, normal distribution assumptions were verified for an appropriate parametric BTV, and the maximum sample concentration was then tabulated against the BTV.

7.3 Uncertainties Regarding the Estimation of the EPC

Other uncertainties exist regarding estimation of an analyte concentration for input into the quantitative risk assessment. The calculated EPC is generally regarded as a conservative estimate since it is based on the 95 percent UCL on the arithmetic mean (based on a normal, lognormal, gamma, or nonparametric

data distribution). As discussed in Section 3.0, ProUCL was employed to select the optimal type of 95 percent UCL for any given COPC in the data set. The goal of this decision scheme was to consider the individual characteristics of each data set, particularly the distributional shape, and pick the most representative UCL calculation that is expected to have a high confidence (at least 95 percent chance) of being greater than the population's true mean. This approach lowers the chances of underestimation of the upper range of human health risks that could be associated with future exposure to soil.

The ability (power) of distributional analysis tests to be able to correctly identify genuine differences between the shape of a sample population versus a reference normal, lognormal, or gamma population is reduced when too few samples are collected or when very few detected sample results exist. If an incorrect distributional assumption is made, this could lead to an over- or underestimate of the upper 95 percent concentration, which in turn would create some additional uncertainty as to whether the calculated risk is a reasonable approximation of high end exposure.

There are statistical uncertainties related to the use of very few (in this case only 6) samples for deriving a 95% UCL that is based on statistical models that fit the appropriate distributional shape of the data. The true distributional shape of the sample population for a COPC can be more accurately estimated if additional samples (e.g., at least 8 to 10) are included in the sample data set. ProUCL's decision scheme flow chart recommends at least 8 to 10 detected results to estimate a reliable UCL. In all cases, the log standard deviation was very small (less than 0.5), which is in the range where ProUCL recommends use of the t-distribution. In calculating a UCL, small data set size is compensated through the use of a wider statistical confidence interval associated with a larger value of the t-statistic, which is designed to ensure the calculated UCL has at least 95% probability of being greater than the population's true mean.

The RAGS D Table 3s illustrate that the calculated UCLs were slightly smaller than, but within a few percent of the maximum concentrations for each COPC. For aluminum, the maximum concentration exceeded the statistical UCL by 4.7%; for iron, 7.4%; chromium, 14.7%; and arsenic, 28.2%. For these COPCs, use of the statistical UCL as the EPC for calculating risks yielded estimates that were fairly close to the upper range of actual soil concentrations in each data set.

The ProUCL support documentation contains several notes stating that, "even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions." However, given that all of the COPC data sets matched a normal distributional shape and contained only positive values, this warning was not applicable because bootstrap calculations were not required for computing the t-distribution statistics to generate a 95% UCL.

Other uncertainties related to the EPC, such as bias in the selection of representative sampling locations, are addressed in Section 7.1.

7.4 Uncertainties in Laboratory Data Quality

Validated laboratory data were used to calculate EPCs. Established data validation procedures were applied to define analytical uncertainties in terms of qualifying data affected by QC problems as inaccurate or imprecise (J-qualified data) and to identify sample results that are at concentrations similar to the range (within 5 or 10 times) of the associated blank concentration (B-qualified data). Note that there were no data points that were qualified as rejected or unuseable (R-qualified data) in the data sets used for this risk assessment. This data qualification treatment does not eliminate all uncertainty but focuses attention on potential areas of concern regarding accuracy, precision, representativeness, and data gaps. The data quality worksheets prepared for Site 9 contain an evaluation of the analytical data quality and discuss the comparison of the analytical protocols and detection limits employed at the time of sampling (1992) versus current low/medium CLP methods.

7.5 Uncertainties Associated with Receptor Exposure Scenarios

The likelihood of the occurrence of the defined exposure scenarios is a source of uncertainty. The future anticipated land use near the site is expected to remain as a military base, but with a potential for future industrial or construction activities. However, hypothetical future residents were also evaluated so as to provide a comprehensive assessment of potential future risks from exposure, which would apply only in the event that future land use does not involve the current land use restrictions.

Note that potential exposures to recreational receptors were assumed to apply only to an adult recreational hunter who engages in both bow hunting and firearm hunting. Currently, hunting is restricted to state-regulated time intervals during deer season and requires the permission of base authorities. Hunting is allowed only for servicemen, with the possible accompaniment of a family member. If future land ownership were to change, then it is possible that different activity patterns could be applicable to recreational users, so a different period of time might apply to recreational exposures under different land use assumptions.

A full time industrial worker might be exposed at the site on a year-round basis, while a construction worker might be exposed only for a temporary duration of 3 to 6 months. A civilian industrial worker engaged in grounds keeping or another outdoor activity could be exposed for up to 25 years, although this length of time is considerably greater than the one or two tours of duty typical for servicemen. Relative to an industrial worker, a construction worker was assumed to be exposed to a higher daily

incidental soil ingestion rate (330 mg/day soil ingestion rate versus 100 mg/day). However, since the industrial worker is considered to be exposed for 25 years over a long term period of employment, the cumulative soil intake via ingestion for evaluating cancer effects would be much greater than the short term soil intake for a construction worker. In contrast, the potential for noncancer effects might be slightly higher for a construction worker versus an industrial worker, since noncancer hazards are not estimated in the same cumulative manner.

The soil sampling focus at Site 9 was limited to subsurface soil due to the lack of visible impacts to surface soil noted during excavation of test pits. Surface soil was not sampled and is not considered to represent a source of significant COPC exposure to human receptors in the risk assessment. As a result, the exposure evaluation performed for this risk assessment assumes that disturbance of subsurface soil would have to occur in order to allow human contact with soil representative of that which was sampled and analyzed. Therefore, there is uncertainty as to whether any future receptors will be exposed to subsurface soil, since subsurface soils would first have to be disturbed by excavation or landscaping and redistributed at the ground surface to enable exposure via incidental ingestion, dermal absorption, and inhalation of fugitive dust emissions.

7.6 Uncertainties Associated with Exposure Modeling

There are limitations to using various models and equations to estimate exposure doses or contaminant concentrations. For example, the use of modeled air concentrations (i.e., generated fugitive dust concentrations and generated volatile emissions) in place of measured air concentrations may not be indicative of actual site conditions during exposure. The fugitive dust model described in Section 4.4 was based upon EPA's Soil Screening Guidance (EPA, 2002b, 1996b, and 1996c), Cowherd, 1984, and site-specific information. The applied air dispersion model from EPA's Soil Screening Guidance utilizes the ISC3 dispersion model to estimate the maximum annual average on-site air concentration for several national sites previously modeled for the 1996 SSG, from which the closest geographic match was selected for modeling emissions at Site 9. Although this generic approach may not be highly accurate for individual site conditions, the overall model is believed to be conservative for most anticipated situations.

Exposure to fugitive dust conservatively assumes that potential receptors will be exposed to the same concentration indoors as outdoors (a very conservative assumption), that soils within an area have unlimited erosion potential, that emissions can be estimated from mean annual wind speed and vegetative cover, and that dispersion concentrations can be estimated from source area and region-wide meteorological factors. For receptors exposed to fugitive dust emissions, it was assumed that future conditions would approximate current conditions in terms of a high relative fraction of vegetative cover. If future vegetative cover is different in a residential area, then dust exposures could be lower or higher than

estimated by the model. However, the impact of this error would not be significant because a worst-case (no vegetative cover) scenario would only increase exposures calculated by the model by a factor of 5, while inhalation exposures at typical sites fall in a range several orders of magnitude below levels of concern.

Exposure assumptions can add uncertainty into the risk assessment process based on input values selected for each exposure route. For example, not all people weigh 70 kilograms, incidentally ingest 100 mg of soil per day, and live at the same residence for 30 years. The rationale for each assumption was provided in each table of input parameters. Receptor characteristics, such as age and body weight, were based on published values. Conservative values (based on reasonable maximum exposure data or professional judgment) were used in combination with average values.

7.7 Uncertainties Associated with Dermal Exposure to Soil

The model for dermal exposure to soil assumes that only a very thin, constant thickness layer of soil is available for contaminant transfer to the stratum corneum and that a constant amount of contaminant, proportional to the soil concentration, will be absorbed per unit area of skin and per exposure event. However, adherence to skin varies with such factors as particle size, soil type, and organic carbon content. As estimated by EPA (2004), the absorbed dermal dose could vary substantially from the model estimates, even assuming that activity patterns lead to the exposure duration applied in the experimental trials used to develop absorption factors.

Because of the lack of reliable data regarding dermal absorption factors, EPA has not developed chemical-specific soil absorption factors for most substances, except a select few for which well-documented absorption studies are available (arsenic, for example). Dermal guidance (EPA, 2004) does not recommend that risk assessors assume generic soil absorption factors for metals lacking specific absorption studies in the literature. In the case of aluminum, the lack of an available dermal absorption factor would not be expected to result in overlooking any significant noncancer hazard. The estimated oral intake of aluminum in Site 9 soil was close to an order of magnitude below the threshold of concern for the ingestion pathway. The Toxicological Profile for Aluminum (ATSDR, 2008) states that dermal absorption studies were not located for animals, and a review of one study revealed that only 0.012% of applied aluminum in deodorant products was estimated to be absorbed through human skin.

The uncertainties associated with the lack of available dermal absorption factors for chromium and iron in soil are not of critical concern to the Site 9 risk assessment because these two metals were detected at concentrations that did not statistically exceed background levels.

7.8 Uncertainties Associated With Toxicity Assessment

There is uncertainty associated with the RfDs and SFs. The uncertainty results from the extrapolation of animal data to humans, the extrapolation of carcinogenic effects from the laboratory high-dose to the environmental low-dose scenarios, and interspecies and intraspecies variations in toxicological endpoints caused by chemical exposure. The use of EPA RfD values is generally considered to be conservative because the doses are based on no-effect or lowest-observed-effect levels and then further reduced with uncertainty factors. EPA incorporates uncertainty factors into the derived RfDs and SFs based on the attributes of toxicological studies, so that uncertainty factors are chemical-specific and can range from 1 to 3,000. Uncertainty factors for RfDs, RfCs, SFs, and IURs used in this risk assessment are presented on RAGS D Tables 5.1, 5.2, 6.1, and 6.2.

The uncertainty associated with dermal exposure is high because of the derivation of the dermal slope factor and reference dose. The dermal toxicity factors are based on default oral absorption factors. This can result in an overestimation of the toxicity factors.

As discussed in Section 4.1, established RfDs have an inherent amount of uncertainty. Uncertainty factors for RfDs, RfCs, SFs, and IURs used in this risk assessment are presented on Tables 5.1, 5.2, 6.1, and 6.2.

For chromium, no speciation data were available, so a conservative assumption was applied by assuming that hexavalent chromium was present in soil. There is a large difference in toxicological properties for hexavalent chromium and trivalent chromium. Trivalent chromium is not carcinogenic and is considered a very low toxicity inorganic substance and a trace level micronutrient. In contrast, hexavalent chromium is considered carcinogenic (see RAGS D Table 6 for associated cancer oral SF and IUR) and is associated with notable noncarcinogenic toxicity (see RAGS D Table 5 for associated oral RfD and inhalation RfC). The inhalation toxicity for chromium depends on the form of chromium. Documentation of the chromium RfC on IRIS (EPA, 2012b) indicates that “the effects were observed in chrome platers who were exposed to chromic acid mists near the plating baths. Environmental exposures would most likely occur through contact with hexavalent chromium dusts, and exposures to chromic acid mists in the environment are considered to be unlikely.” However, it should be noted that uncertainties in the speciation of chromium in soil and the potential form of any airborne chromium released from soil at the site are not major concerns for this risk assessment because soil concentrations were similar to background concentrations.

The cancer risk estimates for hexavalent chromium were calculated using age-dependent adjustment factors (ADAFs) that account for enhanced carcinogenicity during early life exposure. The carcinogenic potency for inhalation of hexavalent chromium is based on the published value in EPA’s Integrated Unit

Risk System (IRIS, EPA, 2012b) and is derived from study data that were obtained under an assumption that one-seventh of inhaled chromium is represented by the hexavalent species, with the balance contributed from trivalent chromium. In addition, it should be noted that the current hexavalent chromium RSL incorporates a multiplier of 7 to account for 100 percent hexavalent chromium present in measured chromium in soil and also an adjustment for ADAFs.

Arsenic is currently undergoing re-evaluation through the EPA IRIS program. However, the toxicity factors for arsenic are based upon extensive epidemiological evidence and this substance has been associated with a variety of cancers in epidemiological studies. It should be noted that uncertainties in the toxicity of arsenic are not a major concern for this risk assessment because soil concentrations were demonstrated to be similar to background concentrations.

Inhalation risks are uncertain for several reasons. Inhalation risks are subject to modeling uncertainty with regards to accuracy of predictions for inter-media transfer from air to the lungs. In addition, EPA RAGS Part F guidance (EPA, 2009) was applied that utilizes the inhalation unit risk (IUR) for carcinogenic risk and reference concentration (RfC) for noncancer hazards, and which does not directly adjust for the effect of receptor-specific differences in breathing rate and body weight in calculating risk. This approach is generally expected to be more accurate compared to the older approach which estimated chemical toxicities relative to unit air volume inhaled and per kg body weight. However, the approach may or may not be more accurate for some substances, depending on the chemical-specific mechanism of action.

7.9 Uncertainties Associated with Risk Characterization

ICRs and HIs are summed for all potential COPCs and for all applicable routes of exposure. Summing the risks implies that no antagonistic or synergistic effects exist between chemicals. It also assumes that similar mechanisms of action and metabolism are prevalent. Therefore, the use of an additive approach may either underestimate or overestimate risks, depending on the chemical-specific interactions, which cannot necessarily be predicted from single-chemical studies. The direction of the bias associated with non-additive chemical interactions cannot be defined, although the approach is based on current guidance and risk assessment methodology.

7.10 Uncertainties Associated with Risk Contributions from Background Conditions

There could be effects on potential human health risks from naturally occurring substances alone or in combination with effects from site-related COPCs. Attachments 4 and 5 provide a comparison of site versus background concentrations for COPCs and list the risks associated with just those substances detected at levels exceeding background, as opposed to risks from exposure to all substances, which are

tabulated in Attachment 2. Three substances, arsenic, chromium, and iron, were detected above RSLs but were within background ranges, whereas aluminum was the only COPC found at levels greater than background. The second set of risk tables in Attachment 5 allows risk managers to assess the level of risks contributed only by potentially site-related substances, since substances found at concentrations similar to background would not need to be considered for further action to control risks related to the site during development of remedies.

8.0 RISK ASSESSMENT SUMMARY AND CONCLUSIONS

The HHRA for Site 9 was performed to evaluate risks to current or future human receptors potentially exposed to soil. The results of each step of the risk assessment process were documented using RAGS Part D Table 1s to present the exposure pathways considered, Table 2s to present the outcome of risk based screening to select COPCs, Table 3s to present the results of statistical calculations of the UCL on the mean concentration estimated for the selected COPC, Table 4s to document the receptor activity patterns and exposure model input values used to estimate daily intakes for COPC exposure, Table 5s and Table 6s to present the current published/peer reviewed toxicity values applied to estimate risks, and Table 7s to present the cancer risks and non-cancer hazards estimated for each exposure pathway.

Quantitative estimates of cancer and noncancer risks for COPCs were presented on RAGS D Table 9s. RAGS D Table 10s summarized whether or not there were any risk drivers; that is, identifying if any COPC contributes significantly to unacceptable levels of cumulative cancer risk from all substances or noncancer hazards totaled separately for each target organ.

In summary, the Site 9 HHRA identified four substances as soil COPCs - aluminum, arsenic, chromium, and iron. Cancer risk estimates and the potential for noncancer hazards were evaluated for future hypothetical residents, industrial workers, construction workers, and future recreational users. Adverse noncancer effects were not estimated to be associated with potential soil exposures to any receptor. Carcinogenic risks were evaluated for potential exposures to arsenic and chromium in soil, and the cumulative cancer risk levels were estimated to fall within EPA's target acceptable risk range for all receptors. Note that, out of the four COPCs, only aluminum was present at levels that were shown to be statistically greater than background.

8.1 Conclusions

In conclusion, the findings of the HHRA performed for Site 9 at NWS Earle indicate that unacceptable human health risks are not expected to occur for any substances for future child, adult, or lifetime residents, future industrial workers, future construction workers, or future recreational users exposed to soils at the site.

REFERENCES

ATSDR (Agency for Toxic Substances and Disease Registry), 2007. A Toxicological Profile for Arsenic. Atlanta, Georgia. May.

ATSDR, 2008. A Toxicological Profile for Aluminum. Atlanta, Georgia. September.

ATSDR, 2010. Minimal Risk Levels (MRLs). From ATSDR's internet website: http://www.atsdr.cdc.gov/mrls.html.

B&RE (Brown and Root Environmental), 1996. Remedial Investigation Report for Naval Weapons Station Earle, Colts Neck, New Jersey. Wayne, Pennsylvania. July.

Brownlee, K.A., 1965. Statistical Theory and Methodology in Science and Engineering. John Wiley and Sons, Inc. New York, New York.

Cowherd, C., G.E. Muleski, P.J. Englehart, and D.A. Gillette. 1984. Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. Midwest Research Institute, Kansas City, MO.

EPA (United States Environmental Protection Agency), 1986. Guidelines for the Health Risk Assessment of Chemical Mixtures. Federal Register, Vol. 51, No. 185, p. 34014 et seq. September 24.

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

EPA, 1990. National Oil and Hazardous Substances Pollution Contingency Plan. 40 CRF Part 300, Vol. 55, no. 46. March 8.

EPA, 1991. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors. Interim Final. Office of Emergency and Remedial Response. Washington, DC. OSWER 9285.6-03.

EPA, 1992a. Guidelines for Exposure Assessment. Exposure Assessment Group. Office of Health and Environmental Assessment. In Federal Register, Vol. 57, No. 104, p. 22888. Friday, May 29.

EPA, 1992b. Guidance on Risk Characterization for Risk Managers and Risk Assessors. Memorandum from F. Henry Habicht on February 28, 1992. Office of the Administrator. Washington, DC.

REFERENCES (Continued)

EPA, 1992c. Statistical Methods for Evaluating the Attainment of Cleanup Standards. Volume 3: Reference-Based Standards for Soils and Solid Media. Office of Policy, Planning, and Evaluation. Washington, DC. EPA/230-R-94-004. December.

EPA, 1992d. National Oil and Hazardous Substances Pollution Contingency Plan. Office of Emergency and Remedial Response. Washington, DC. EPA/540-z-00-001. OSWER Directive 9200.2-14. January.

EPA, 1993a. Superfund's Standard Default Exposure Factors for Central Tendency and Reasonable Maximum Exposure. Draft.

EPA, 1993b. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/R-93/089. Environmental Criteria and Assessment Office. July

EPA, 1996a. Guidance for Data Quality Assessment. Pre- Publication Copy. Final. EPA QA/G-9. Quality Assurance Division. Washington, DC. February.

EPA, 1996b. Soil Screening Guidance: User's Guide. Office of Emergency and Remedial Response. EPA 540/R-96/018. Washington, DC. April.

EPA, 1996c. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. EPA/540/R-95/128. Washington, DC. May.

EPA, 1997a. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/P-95/002Fa - August 1997. Office of Research and Development.

EPA, 1997b. Health Effects Assessment Summary Tables (HEAST). EPA/540/R-95-036. Office of Solid Waste and Emergency Response. May.

EPA, 2001. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments). December.

EPA, 2002a. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response. OSWER Directive 9285.6-10. December.

EPA, 2002b. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24, December.

EPA, 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. EPA/540/R/99/005, Office of Emergency and Remedial Response, Washington, D.C., July.

EPA, 2005a. Guidelines for Carcinogen Risk Assessment. Risk Assessment Forum, Washington, D.C. EPA/630/P-03/001F. March.

EPA, 2005b. Supplemental guidance for assessing cancer susceptibility from early-life exposure to carcinogens. Risk Assessment Forum, Washington, DC. From website: http://www.epa.gov/ncea/raf.

EPA, 2006. On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations. EPA/600/R-06/022. Office of Research and Development. March.

EPA, 2009. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. EPA 540-R-070-002. Office of Emergency and Remedial Response. Washington, DC. January.

EPA, 2010a. ProUCL 4.1.00 User Guide. EPA/600/R-07/041. Office of Research and Development. May.

EPA, 2010b. ProUCL Version 4.1.00 Technical Guide. EPA/600/R-07/041. Office of Research and Development. May.

EPA, 2010c. Toxicological Review of Hexavalent Chromium In Support of Information on the Integrated Risk Information System (IRIS). EPA/635/R-10/004A. Office of Research and Development. September.

EPA, 2012a. EPA Risk-Based Concentration Table. Region 3 Human Health Risk Assessment internet website at: http://www.epa.gov/reg3hwmd/risk/human/index.htm. November.

EPA, 2012b. Integrated Risk Information System (IRIS). Online database, internet website: http://www.epa.gov/iris/subst/index.html. April.

REFERENCES (Continued)

EPA, 2012c. California Environmental Protection Agency (Cal EPA) toxicity values. From California EPA's internet website: http://www.oehha.ca.gov/risk/chemicalDB/index.asp.

EPA, 2012d. Provisional Peer Reviewed Toxicity Values (PPRTVs) Database. Office of Superfund Remediation and Technology Innovation. Distributed through National Center for Environmental Assessment, Cincinnati, OH.

Gehan, E.A., 1965. A Generalized Wilcoxon Test for Comparing Arbitrarily Singly-Censored Samples. Biometrika. Volume 52, pp. 203-223.

Halliburton NUS, 1995. NWS Earle Remedial Investigation Work Plan and Quality Assurance Project Plan.

McCarroll, N, et al, 2010. An Evaluation of the Mode of Action Framework for Mutagenic Carcinogens Case Study II: Chromium (VI). Environmental and Molecular Mutagenesis, Vol. 51, No. 2, pp 89-111. March.

NFEC, 2002. Guidance for Environmental Background Analysis. Volume I: Soil. Washington, D.C. NFESC UG-2049-ENV. April.

NJDEP (New Jersey Department of Environmental Protection), 2012. N.J.A.C. 7:26D Remediation Standards. Amended May 7, 2012.

Singh, Anita, A.K. Singh, M. Engelhardt, and J. Nocerino. "On the Computation of the Upper Confidence Limit of the Mean of Contaminant Data Distributions." Submitted for Publication, 1999.

Tetra Tech, Inc. (Tetra Tech), 2011. Feasibility Study for Site 9, Landfill Southeast of "P" Barricades (Draft). January.

Weston, 1994. Installation Restoration Program Site Investigation for 16 Sites at NWS Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. January.

Attachment 1

Data Useability Worksheets

Site 9 Human Health Risk Assessment

DATA USEABILITY WORKSHEET
Site: NWS Earle, Site 9
Medium: Soil

Activity	Comment
Field Sampling	
Discuss sampling problems and field conditions that affect data useability.	There were no apparent problems that would affect data useability.
Are samples representative of receptor exposure for this medium (e.g. sample depth, grab vs composite, filtered vs unfiltered, low flow, etc.)?	Yes. Soil sample results may be representative of future receptor exposure in the event that subsurface soil at the site is disturbed, excavated, and redistributed at the ground surface. Test pits were dug in the areas identified from historical photographs and site observations where land disturbance was indicated.
Assess the effect of field QC results on data useability.	The 1994 Site Investigation Report for NWS Earle stated field QA/QC samples represented approximately 10% of overall total field samples across multiple sites and included trip blanks and equipment blanks. Data validation was performed and did not reveal any blank contamination impacts on any organic analysis results. Low levels of certain metals (less than CRDLs) were qualified due to blank contamination. No field duplicates were collected at Site 9, which affects the ability to measure field precision for soil sampling.
Summarize the effect of field sampling issues on the risk assessment, if applicable.	There were no field sampling issues identified that should affect the risk assessment.
Analytical Techniques	
Were the analytical methods appropriate for quantitative risk assessment?	Yes. Samples were analyzed for organic compounds following Contract Laboratory Program (CLP) routine analytical methods. Inorganic analyses were also performed according to CLP routine analysis methods.
Were detection limits adequate?	Yes. The method detection and quantitation limits achieved the CLP method's required detection limits at the time, which are similar to the detection limits in place currently for routine soil analysis.
Summarize the effect of analytical technique issues on the risk assessment, if applicable.	There were no analytical technique issues that should affect the risk assessment.

DATA USEABILITY WORKSHEET (continued)
Site: NWS Earle, Site 9
Medium: Soil

Activity	Comment
Data Quality Objectives	
Precision - How were duplicates handled?	Laboratory duplicates and matrix spikes/matrix spike duplicates were analyzed as required by the methods. Data validation guidance was followed to evaluate laboratory precision. Field duplicates were collected for a representative portion of NWS Earle Sites sampled during the same timeframe for this group of 1992 IR investigations, but apparently no field duplicates were obtained for Site 9 due to a limited total number (6) of field samples collected.
Accuracy - How were split samples handled?	No split samples were collected.
Representativeness - Indicate any problems associated with data representativeness (e.g., trip blank or rinsate blank contamination, chain of custody problems, etc.).	Analytes qualified with a "B" for blank contamination were not considered in the risk assessment. Only low levels of certain metals were affected.
Completeness - Indicate any problems associated with data completeness (e.g., incorrect sample analysis, incomplete sample records, problems with field procedures, etc.).	No problems were associated with data completeness.
Comparability - Indicate any problems associated with data comparability.	No problems were expected with data comparability due to the use of routine CLP methods of analysis.
Were the DQOs specified in the QAPP satisfied?	The DQOs specified in the QAPP were followed with respect to the distribution of field QA/QC samples and with respect to proper field QA/QC procedures, such as decontamination and sample handling.
Summarize the effect of DQO issues on the risk assessment, if applicable.	There were no DQO issues identified that should affect the risk assessment.

DATA USEABILITY WORKSHEET (continued)
Site: NWS Earle, Site 9
Medium: Soil

Activity	Comment
Data Validation and Interpretation	
What are the data validation requirements?	Data validation requirements were specified in the QAPP and required validation to confirm that the laboratory met the method QC requirements and that field QC samples and laboratory QC samples were qualified according to national functional guidelines.
What method or guidance was used to validate the data?	Laboratory data were validated in accordance with the QAPP requirements that refer to CLP QC requirements and national functional guidelines for data validation.
Was the data validation method consistent with guidance? Discuss any discrepancies.	The only validation issue identified was the use of the "B" qualifier for blank contamination instead of the "U" qualifier. However, examination of data does not suggest that this would result in bias in the estimated exposure point concentrations (EPCs) for any COPCs, since all COPCs that exceeded screening levels were not impacted by any blank contamination.
Were all data qualifiers defined? Discuss those which were not.	Data qualifiers were defined in the footnotes to the analytical results tables. The "P" qualifier was not defined in the 1994 IR report, but was converted to a "J" because it indicates a pesticide result associated with a two column percent difference exceeding 25%.
Which qualifiers represent useable data?	Usable data were represented with an equals sign ("="), or with a "J" qualifier in the original 1994 IR report.
Which qualifiers represent unuseable data?	No data were rejected (qualified "R"). Data qualified for blank contamination "B" were not used in the risk assessment.
How are tentatively identified compounds handled?	Tentatively identified compounds (TICs) were not presented or discussed in the 1994 investigation report.
Summarize the effect of data validation and interpretation issues on the risk assessment, if applicable.	There were no other significant issues in data interpretation or data validation.
Additional notes:	No other problems were noted.

Note: The purpose of this Worksheet is to succinctly summarize the data useability analysis and conclusions. Reference specific pages in the Remedial Investigation and/or the Risk Assessment text to further expand on the information presented here.

Attachment 2

EPA RAGS D Tables

Site 9 Human Health Risk Assessment

RAGS D Table 1s

Site 9 Human Health Risk Assessment

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale
Future	Soil	Soil	Contact with Site 9 Soil	Industrial Worker	Adult	Ingestion	Quant	Land is currently wooded, but future industrial use is conceivable.
		Soil	Contact with Site 9 Soil	Industrial Worker	Adult	Dermal	Quant	Land is currently wooded, but future industrial use is conceivable.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Industrial Worker	Adult	Inhalation	Quant	Land is currently wooded, but future industrial use is conceivable.
Current/Future	Soil	Soil	Contact with Site 9 Soil	Recreational Person	Adult	Ingestion	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Soil	Contact with Site 9 Soil	Recreational Person	Adult	Dermal	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Recreational Person	Adult	Inhalation	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Soil	Contact with Site 9 Soil	Recreational Person	Child	Ingestion	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Soil	Contact with Site 9 Soil	Recreational Person	Child	Dermal	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Recreational Person	Child	Inhalation	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Soil	Contact with Site 9 Soil	Recreational Person	Child/Adult**	Ingestion	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Soil	Contact with Site 9 Soil	Recreational Person	Child/Adult**	Dermal	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Recreational Person	Child/Adult**	Inhalation	Quant	Seasonal hunting is currently allowed for activity duty servicemen and guest family members.
Future	Soil	Soil	Contact with Site 9 Soil	Resident	Adult	Ingestion	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Soil	Contact with Site 9 Soil	Resident	Adult	Dermal	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Resident	Adult	Inhalation	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Soil	Contact with Site 9 Soil	Resident	Child	Ingestion	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Soil	Contact with Site 9 Soil	Resident	Child	Dermal	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Resident	Child	Inhalation	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Soil	Contact with Site 9 Soil	Resident	Child/Adult**	Ingestion	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Soil	Contact with Site 9 Soil	Resident	Child/Adult**	Dermal	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Resident	Child/Adult**	Inhalation	Quant	Land use is expected to remain as a military base. Future residential use not predicted but is possible.
Future	Soil	Soil	Contact with Site 9 Soil	Construction Worker	Adult	Ingestion	Quant	Land is currently wooded, but future construction is conceivable.
		Soil	Contact with Site 9 Soil	Construction Worker	Adult	Dermal	Quant	Land is currently wooded, but future construction is conceivable.
		Particulates	Particulate Dust Inhalation from Site 9 Soil	Construction Worker	Adult	Inhalation	Quant	Land is currently wooded, but future construction is conceivable.
Future	Sediment	Sediment	Contact with Sediment During Wading	Recreational Person	Child	Ingestion	None	Nearby creeks are located outside the reach of potential influence from the site
		Sediment	Contact with Sediment During Wading	Recreational Person	Child	Dermal	None	Nearby creeks are located outside the reach of potential influence from the site
		Particulates	Particulate Dust Inhalation from Sediment During Wading	Recreational Person	Child	Inhalation	None	Sediments typically wet, which inhibits release of inhalable particulates.
		Sediment	Contact with Sediment During Wading	Recreational Person	Adult	Ingestion	None	Nearby creeks are located outside the reach of potential influence from the site
		Sediment	Contact with Sediment During Wading	Recreational Person	Adult	Dermal	None	Nearby creeks are located outside the reach of potential influence from the site
		Particulates	Particulate Dust Inhalation from Sediment During Wading	Recreational Person	Adult	Inhalation	None	Sediments typically wet, which inhibits release of inhalable particulates.
		Sediment	Contact with Sediment During Wading	Recreational Person	Child/Adult**	Ingestion	None	Nearby creeks are located outside the reach of potential influence from the site
		Sediment	Contact with Sediment During Wading	Recreational Person	Child/Adult**	Dermal	None	Nearby creeks are located outside the reach of potential influence from the site
		Particulates	Particulate Dust Inhalation from Sediment During Wading	Recreational Person	Child/Adult**	Inhalation	None	Sediments typically wet, which inhibits release of inhalable particulates.
Future	Surface Water	Surface Water	Contact with Surface Water During Wading	Recreational Person	Child	Ingestion	None	Nearby creeks are located outside the reach of potential influence from the site
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Child	Dermal	None	Nearby creeks are located outside the reach of potential influence from the site
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Child	Inhalation	None	Ambient inhalation exposure expected to be insignificant due to no detected VOCs.
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Adult	Ingestion	None	Nearby creeks are located outside the reach of potential influence from the site
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Adult	Dermal	None	Nearby creeks are located outside the reach of potential influence from the site
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Adult	Inhalation	None	Ambient inhalation exposure expected to be insignificant due to no detected VOCs.
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Child/Adult**	Ingestion	None	Nearby creeks are located outside the reach of potential influence from the site
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Child/Adult**	Dermal	None	Nearby creeks are located outside the reach of potential influence from the site
		Surface Water	Contact with Surface Water During Wading	Recreational Person	Child/Adult**	Inhalation	None	Ambient inhalation exposure expected to be insignificant due to no detected VOCs.
Future	Groundwater	Groundwater	Contact with Groundwater During Construction Activities	Construction Worker	Adult	Ingestion	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Contact with Groundwater During Construction Activities	Construction Worker	Adult	Dermal	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Vapors	Inhalation of Groundwater Vapors During Construction Activities	Construction Worker	Adult	Inhalation	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Tap Water Contact with Groundwater	Resident	Adult	Ingestion	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Tap Water Contact with Groundwater	Resident	Adult	Dermal	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Vapors	Inhalation of Groundwater Vapors During Showering	Resident	Adult	Inhalation	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Tap Water Contact with Groundwater	Resident	Child	Ingestion	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Tap Water Contact with Groundwater	Resident	Child	Dermal	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Vapors	Inhalation of Groundwater Vapors During Bathing	Resident	Child	Inhalation	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Tap Water Contact with Groundwater	Resident	Child/Adult**	Ingestion	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Groundwater	Tap Water Contact with Groundwater	Resident	Child/Adult**	Dermal	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)
		Vapors	Inhalation of Groundwater Vapors During Showering	Resident	Child/Adult**	Inhalation	None	No wells in close proximity of site. No notable organics levels in soil (VOCs or petroleum hydrocarbons)

**Child/Adult represents cumulative (lifetime) exposure only applied to cancer risk.
"Soil" represents surface and subsurface soils that are mixed as a result of construction or landscaping activities. Subsurface soil samples from test pits comprise the soil data set used in the risk assessment. See Section 2.1, Data Evaluation for further discussion of soil sampling depths.
Only future exposures were assumed because: (1) the only measured contamination was found in subsurface soil, which would have to be disturbed via excavation/landscaping to allow exposure, (2) the site is a military base where land use is limited to recreational hunting, and (3) there are no wells in proximity of the site.

RAGS D Table 2s

Site 9 Human Health Risk Assessment

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - EXPOSURE TO SOIL, INCLUDING COPCS SIMILAR TO BACKGROUND
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point(s)	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits (2)	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Contaminant Selection or Deletion (6,7)
Contact with Soil	7429-90-5	**Aluminum**	2320	9220	mg/kg	TP9-06	6/6	N/A	9220	See Attachment 4	7700 N			**Y**	**ASL**
	7440-38-2	**Arsenic**	6	13.2	mg/kg	TP9-03	6/6	N/A	13.2	See Attachment 4	0.39 C			**Y****	**ASL**
	7440-47-3	**Chromium**	10.9	25.8	mg/kg	TP9-06	6/6	N/A	25.8	See Attachment 4	0.29 C			**Y****	**ASL**
	7440-50-8	Copper	6.3	6.3	mg/kg	TP9-05	1/1	N/A	6.3	See Attachment 4	310 N			N	BSL
	57-12-5	Cyanide	1.57	1.57	mg/kg	TP9-06	1/6	1.07-1.31	1.57	See Attachment 4	22 N			N	BSL
	7439-89-6	**Iron**	8580	36300	mg/kg	TP9-02	6/6	N/A	36300	See Attachment 4	5500 N			**Y**	**ASL**
	7439-92-1	Lead	5.5	17.4	mg/kg	TP9-05	6/6	N/A	17.4	See Attachment 4	400 N			N	BSL
	7439-95-4	Magnesium	1100	1520	mg/kg	TP9-06	2/2	N/A	1520	See Attachment 4	N			N	NUT
	7439-96-5	Manganese	24.4	168	mg/kg	TP9-05	6/6	N/A	168	See Attachment 4	180 N			N	BSL
	7440-09-7	Potassium	1420	4120	mg/kg	TP9-06	5/6	209-209	4120	See Attachment 4	N			N	NUT
	7440-22-4	Silver	2.5	2.7	mg/kg	TP9-02	2/5	1.87-2.01	2.7	See Attachment 4	39 N			N	BSL
	7440-62-2	Vanadium	11	23.2	mg/kg	TP9-01	3/3	N/A	23.2	See Attachment 4	39 N			N	BSL
	7440-66-6	Zinc	5.3	60.3	mg/kg	TP9-04	6/6	N/A	60.3	See Attachment 4	2300 N			N	BSL
	72-54-8	4,4'-DDD	0.41 J	0.41 J	ug/kg	TP9-05	1/6	3.8-4.3	0.41	--	2000 C			N	BSL
	72-55-9	4,4'-DDE	0.41 J	1.2 J	ug/kg	TP9-05	2/6	3.8-4.3	1.2	--	1400 C			N	BSL
	50-29-3	4,4'-DDT	0.41 J	0.82 J	ug/kg	TP9-04	2/6	3.8-4.3	0.82	--	1700 C			N	BSL
	72-43-5	Methoxychlor	93	93	ug/kg	TP9-04	1/6	19-22	93	--	31000 N			N	BSL
	117-81-7	Bis(2-ethylhexyl) Phthalate	26 J	35 J	ug/kg	TP9-02	3/6	390-440	35	--	35000 C			N	BSL
	84-74-2	Di-n-butyl Phthalate	21 J	37 J	ug/kg	TP9-02	6/6	N/A	37	--	610000 N			N	BSL
	67-66-3	Chloroform	1 J	1 J	ug/kg	TP9-01	2/6	11-13	1	--	290 C			N	BSL

Footnotes:

** - Arsenic and chromium are classified as known human carcinogens and must be retained as COPCs according to EPA Region 2 risk assessment guidance.
1 - Data qualifiers are defined in the Definitions section of the footnotes to this table.
2 - Values presented are sample-specific quantitation limits or sample-specific instrument detection limits.
3 - The maximum detected concentration is used for screening purposes.
4 - In these RAGS D tables, no substances were eliminated as COPCs based on background. Background comparisons are addressed in Attachments 4 & 5.
5 - The EPA Regional Screening Levels (RSLs) for residential soil exposure are presented. The noncarcinogenic values (annotated "N") are divided by 10. to correspond to a target hazard quotient of 0.1, or an incremental cancer risk of 1.0E-06 for carcinogens (annotated "C") (USEPA , November 2012).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level (without regard to whether levels exceed background).

Samples Compared:

TP9-01	TP9-03	TP9-05
TP9-02	TP9-04	TP9-06

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
N/A = Not Applicable or Not Available
COPC = Chemical of Potential Concern
C = Carcinogen
N = Non-Carcinogenic
J = Estimated Value

(7) Rationale Codes:

For Selection as a COPC:
ASL = Above Screening Level
For Elimination as a COPC:
BSL = Below Screening Level
NUT = Nutrient

RAGS D Table 3s

Site 9 Human Health Risk Assessment

TABLE 3.1
EXPOSURE POINT CONCENTRATION SUMMARY - CONTACT WITH SITE 9 SOIL, INCLUDING COPCS SIMILAR TO BACKGROUND
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Site 9 Soil	Aluminum	mg/kg	6.72E+03	8.81E+03	9220	8.81E+03	mg/kg	95% Student's-t UCL	Normal; All n
	Arsenic	mg/kg	8.12E+00	1.03E+01	13.2	1.03E+01	mg/kg	95% Student's-t UCL	Normal; All n
	Chromium	mg/kg	1.84E+01	2.25E+01	25.8	2.25E+01	mg/kg	95% Student's-t UCL	Normal; All n
	Iron	mg/kg	2.58E+04	3.38E+04	36300	3.38E+04	mg/kg	95% Student's-t UCL	Normal; All n

RAGS D Table 4s

Site 9 Human Health Risk Assessment

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - CHILD* RESIDENT CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child*	Site 9	CS	Chemical concentration in Soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991, 1997	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(a)	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 2004	
				BW	Body Weight	15	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child*	Site 9	CS	Chemical concentration in Soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 2004	
				BW	Body Weight	15	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

"Soil" represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

*In this table, the "child" receptor covers only ages 0 to 6 years. The higher age group categories (ages 6 to 16 and ages 16 to 30) are presented as a consolidated age group for estimating exposures in a table labeled as an "adult" receptor.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 1997. Exposure Factors Handbook. Update to Exposure Factors Handbook. EPA/600/8-89/043 - May 1989. Office of Research and Development.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.1a.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - CHILD* RESIDENT CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child*	Particulate Dust Inhalation from Site 9 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/PEF x CF1) x ET x EF x ED / AT
				PEF	Particulate Emission Factor from Soil	3.082E+09**	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	12	hours/day	(a)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	52560	hours	USEPA, 2009	
Inhalation	Resident	Child*	Inhalation of Ambient air VOCs from Site 9 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/VF x CF1) x ET x EF x ED / AT
				VF	Volatilization Factor from Soil	chemical specific	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	12	hours/day	(a)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	52560	hours	USEPA, 2009	

"Soil" represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

*In this table, the "child" receptor covers only ages 0 to 6 years. The higher age group categories (ages 6 to 16 and ages 16 to 30) are presented as a consolidated age group for estimating exposures in a table labeled as an "adult" receptor.

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. (Application of guidance to PEF and VF calculation is presented in text.)

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2009: Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA 540-R-070-002. (Note RAGS Part F specifies inhalation averaging time should be in hours rather than days.)

(a). Professional Judgment. 12 Hours per day of outdoor exposure based on entire day spent at residence.

**A PEF value of 3.082E+09 is used for Site 9, based on a source size of 3 acres and wind conditions based on regional meterological data as explained in the text.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT* RESIDENT CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult*	Site 9	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1989, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	$\frac{CS \times IRS \times CF3 \times FI \times EF \times ED}{BW \times AT}$
				FI	Fraction Ingested	1	unitless	(a)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult*	Site 9	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	$\frac{CS \times CF3 \times SA \times SSAF \times DABS \times EF \times ED}{BW \times AT}$
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

"Soil" represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

*In this table, age group categories (ages 6 to 16 and ages 16 to 30) are treated as a consolidated age group for assessing exposures and are labeled as an "adult" receptor.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

(a). Professional Judgment. Fraction ingested is 100% from source.

TABLE 4.2a.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT* RESIDENT CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult*	Particulate Dust Inhalation from Site 9 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/PEF x CF1) x ET x EF x ED / AT
				PEF	Particulate Emission Factor from Soil	3.082E+09**	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	12	hours/day	(a)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	210240	hours	USEPA, 2009	
Inhalation	Resident	Adult*	Inhalation of Ambient air VOCs from Site 9 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/VF x CF1) x ET x EF x ED / AT
				VF	Volatilization Factor from Soil	chemical specific	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	12	hours/day	(a)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	210240	hours	USEPA, 2009	

"Soil" represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

*In this table, age group categories (ages 6 to 16 and ages 16 to 30) are treated as a consolidated age group for assessing exposures and are labeled as an "adult" receptor.

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. (Application of guidance to PEF and VF calculation is presented in text.)

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2009: Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA 540-R-070-002. (Note RAGS Part F specifies inhalation averaging time should be in hours rather than days.)

(a). Professional Judgment. 12 Hours per day of outdoor exposure based on entire day spent at residence.

**A PEF value of 3.082E+09 is used for Site 9, based on a source size of 3 acres and wind conditions based on regional meterological data as explained in the text.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT INDUSTRIAL WORKER CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Worker	Adult	Site 9	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IR-S x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(a)	BW x AT
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
Dermal	Industrial Worker	Adult	Site 9	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	3,300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	

"Soil" Represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

(a). Professional Judgment. Fraction ingested is 100% from source.

TABLE 4.3a.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT INDUSTRIAL WORKER CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Worker	Adult	Particulate Dust Inhalation from Site 9 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/PEF x CF1) x ET x EF x ED / AT
				PEF	Particulate Emission Factor from Soil	3.082E+09**	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	8	hours/day	(a)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	219000	hours	USEPA, 2009	
Inhalation	Industrial Worker	Adult	Inhalation of Ambient air VOCs from Site 9 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/VF x CF1) x ET x EF x ED / AT
				VF	Volatilization Factor from Soil	chemical specific	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	8	hours/day	(a)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	219000	hours	USEPA, 2009	

"Soil" Represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. (Application of guidance to PEF and VF calculation is presented in text.)

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2009: Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA 540-R-070-002. (Note RAGS Part F specifies inhalation averaging time should be in hours rather than days.)

(a). Professional Judgment. Assumes full time outdoor worker.

**A PEF value of 3.082E+09 is used for Site 9, based on a source size of 3 acres and wind conditions based on regional meterological data as explained in the text.

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - CONSTRUCTION WORKER CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Worker	Adult	Site 3	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	$\frac{CS \times IR\text{-}S \times CF3 \times FI \times EF \times ED}{BW \times AT}$
				FI	Fraction Ingested	1	unitless	(a)	
				EF	Exposure Frequency	130	days/year	(b)	
				ED	Exposure Duration	1	years	(b)	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Worker	Adult	Site 3	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	3,300	cm2	USEPA, 2004	$\frac{CS \times CF3 \times SA \times SSAF \times DABS \times EF \times ED}{BW \times AT}$
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	130	days/year	(b)	
				ED	Exposure Duration	1	years	(b)	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

"Soil" Represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Professional Judgment. 6 months exposure is 26 weeks per year, 5 days per week, for one year exposure duration.

TABLE 4.4a.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - CONSTRUCTION WORKER CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Particulate Dust Inhalation from Site 3 Soil*	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/PEF x CF1) x ET x EF x ED / AT
				PEF	Particulate Emission Factor from Soil	3.082E+09**	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	8	hours/day	(a)	
				EF	Exposure Frequency	130	days/year	(b)	
				ED	Exposure Duration	1	years	(b)	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	8760	hours	USEPA, 2009	
Inhalation	Construction Worker	Adult	nhalation of Ambient air VOCs from Site 3 Soil	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/VF x CF1) x ET x EF x ED / AT
				VF	Volatilization Factor from Soil	chemical specific	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	8	hours/day	(a)	
				EF	Exposure Frequency	130	days/year	(b)	
				ED	Exposure Duration	1	years	(b)	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	8760	hours	USEPA, 2009	

"Soil" Represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. (Application of guidance to PEF and VF calculation is presented in text.)

USEPA, 2009: Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA 540-R-070-002. (Note RAGS Part F specifies inhalation averaging time should be in hours rather than days.)

(a). Professional Judgment. Fraction ingested is 100% from source.

(b). Professional Judgment. 6 months exposure is 26 weeks per year, 5 days per week, for one year exposure duration.

**A PEF value of 3.082E+09 is used for Site 9, based on a source size of 3 acres and wind conditions based on regional meterological data as explained in the text.

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT RECREATIONAL PERSON CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational Person	Adult	Site 3	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	Prof. Judgement (a)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	$\frac{CS \times IRS \times CF3 \times FI \times EF \times ED}{BW \times AT}$
				FI	Fraction Ingested	1	unitless	(b)	
				EF	Exposure Frequency	39	days/year	(c)	
				ED	Exposure Duration	8	years	(d)	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,920	days	USEPA, 1989	
Dermal	Recreational Person	Adult	Site 3	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	3,300	cm2	USEPA, 2004	$\frac{CS \times CF3 \times SA \times SSAF \times DABS \times EF \times ED}{BW \times AT}$
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EF	Exposure Frequency	39	days/year	(c)	
				ED	Exposure Duration	8	years	(d)	
				BW	Body Weight	70	kg	USEPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,920	days	USEPA, 1989	

"Soil" Represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

(a). Professional Judgment. Daily ingestion rate assumed to be the same as the default value used for an outdoor industrial worker (USEPA, 2002b).

(b). Professional Judgment. Fraction ingested is 100% from source.

(c). Professional Judgment. Assumes an annual exposure frequency of 13 weeks or three months per year (fall and winter hunting seasons) that includes one weekend day plus two shorter weekday hunting sessions every week.

(d). Professional Judgment. Assumes an exposure duration equivalent to 8 years or 2 tours of duty for an active serviceman.

TABLE 4.5a.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT RECREATIONAL PERSON CONTACT WITH SITE 9 SOIL

REASONABLE MAXIMUM EXPOSURE

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational Person	Adult	Particulate Dust Inhalation from Site 3 Soil*	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/PEF x CF1) x ET x EF x ED / AT
				PEF	Particulate Emission Factor from Soil	3.082E+09**	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	3	hours/day	(a)	
				EF	Exposure Frequency	39	days/year	(b)	
				ED	Exposure Duration	8	years	(c)	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	70080	hours	USEPA, 2009	
Inhalation	Recreational Person	Adult	hhalation of Ambient air VOCs from Site 3 Soi	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	EC (mg/m3) = (CS/VF x CF1) x ET x EF x ED / AT
				VF	Volatilization Factor from Soil	chemical specific	m3/kg	USEPA, 2002b	(Exposure Concentration equivalent to continuous exposure over averaging period)
				CF1	Conversion Factor 1	0.001	mg/ug	--	
				ET	Exposure Time	3	hours/day	(a)	
				EF	Exposure Frequency	39	days/year	(b)	
				ED	Exposure Duration	8	years	(c)	
				AT-C	Averaging Time (Cancer)	613200	hours	USEPA, 2009	
				AT-N	Averaging Time (Non-Cancer)	70080	hours	USEPA, 2009	

"Soil" Represents surface and subsurface soils that are mixed as a result of construction or landscaping activities.

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24. (Application of guidance to PEF and VF calculation is presented in text.)

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2009: Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual. (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA 540-R-070-002. (Note RAGS Part F specifies inhalation averaging time should be in hours rather than days.)

(a). Professional Judgment. 3 Hours per day of outdoor exposure based on deer hunting activities during approved hunting season.

(b). Professional Judgment. Assumes an annual exposure frequency of 13 weeks or three months per year (fall and winter hunting seasons) that includes one weekend day plus two shorter weekday hunting sessions every week.

(c). Professional Judgment. Assumes an exposure duration equivalent to 8 years or 2 tours of duty for an active serviceman.

**A PEF value of 3.082E+09 is used for Site 9, based on a source size of 3 acres and wind conditions based on regional meterological data as explained in the text.

RAGS D Table 5s

Site 9 Human Health Risk Assessment

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s) (3)	Date(s)
Aluminum	Chronic	1.00E+00	mg/kg-day	1.00E+00	1.00E+00	mg/kg-day	CNS (Developmental)	100	PPRTV	12/19/2012
Arsenic	Chronic	3.00E-04	mg/kg-day	1.00E+00	3.00E-04	mg/kg-day	Skin/Vascular	3	IRIS	12/19/2012
Chromium	Chronic	3.00E-03	mg/kg-day	2.50E-02	7.50E-05	mg/kg-day		900	IRIS	12/19/2012
Iron	Chronic	7.00E-01	mg/kg-day	1.00E+00	7.00E-01	mg/kg-day	Liver/Blood/GI Tract	1	PPRTV	12/19/2012

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.

3 - IRIS - Integrated Risk Information System (EPA, 2011)

PPRTV - Provisional Peer Reviewed Toxicity Values

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s) (2)	Dates
Aluminum	Chronic	5.00E-03	mg/m3	N/A	N/A	CNS	300	PPRTV	12/19/2012
Arsenic	Chronic	1.50E-05	mg/m3	N/A	N/A	Developmental/Vascular/CNS		Cal EPA	12/19/2012
Chromium	Chronic	1.00E-04	mg/m3	N/A	N/A	Lung/Nasal	300	IRIS	12/19/2012
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

1 - RAGS Part F (EPA, 2009) requires use of the inhalation RfC, so the extrapolated inhalation RfD is obsolete (RFDi = RfC *20m3/day / 70 kg)

2 - IRIS - Integrated Risk Information System (EPA, 2011)

Cal EPA - California Environmental Protection Agency Toxicity Value

PPRTV - Provisional Peer Reviewed Toxicity Values

RAGS D Table 6s

Site 9 Human Health Risk Assessment

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal(1)	Absorbed Cancer Slope Factor for Dermal(2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF		Soil Dermal Adherence Factor (ABSDER)
	Value	Units		Value	Units		Source(s) (3)	Date(s)	
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA (4)
Arsenic	1.50E+00	1/(mg/kg-day)	1.00E+00	1.50E+00	1/(mg/kg-day)	A	IRIS	12/19/2012	0.03
Chromium*	5.00E-01	1/(mg/kg-day)	2.50E-02	2.00E+01	1/(mg/kg-day)	A	NJDEP	10/16/2009	NA (4)
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA (4)

N/A = Not Applicable

* - An asterisk indicates a mutagenic chemical for which ADAFs need to be applied to adjust cancer potency slope factors. ADAFs for chromium for the residential child and adult are listed in Section 5.6 of the risk assessment

1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.

3 - IRIS - Integrated Risk Information System (EPA, 2011)
NJDEP - New Jersey Department of Environmental Protection

EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of noncarcinogenicity.

4 - Soil dermal adherence factors are not available for aluminum, chromium, and iron. Dermal guidance (EPA, 2004) doesn't advise using default soil dermal absorption factors for metals where chemical-specific data are unavailable

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation CSF	
	Value	Units	Value	Units		Sources(s) (2)	Date(s)
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Arsenic	4.30E-03	1/(ug/m3)	N/A	N/A	A	IRIS	12/19/2012
Chromium	1.20E-02	1/(ug/m3)	N/A	N/A	A	IRIS	12/19/2012
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable

* - An asterisk indicates a mutagenic chemical for which ADAFs need to be applied to adjust cancer slo

ADAFs for chromium for the residential child and adult are listed in Section 5.6 of the risk assessment

1 - RAGS Part F (EPA, 2009) requires use of the inhalation unit risk (IUR),
so the extrapolated Inhalation CSF is obsolete (CSFi = IUR * 70 kg / 20m3/day)

2 - IRIS - Integrated Risk Information System (EPA, 2011)

EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans .

C - Possible human carcinogen.

D - Not classifiable as a human carcinogen.

E - Evidence of noncarcinogenicity.

RAGS D Table 7s

Site 9 Human Health Risk Assessment

TABLE 7 (RAGS D 7.1.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child*

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	9.65E-03	mg/kg-day	--	1/(mg/kg-day)	--	1.13E-01	mg/kg-day	1.00E+00	mg/kg-day	1.13E-01
				Arsenic	1.03E+01	mg/kg	1.13E-05	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.69E-05	1.32E-04	mg/kg-day	3.00E-04	mg/kg-day	4.39E-01
				Chromium	2.25E+01	mg/kg	2.47E-05	mg/kg-day	5.00E-01	1/(mg/kg-day)	6.58E-05	2.88E-04	mg/kg-day	3.00E-03	mg/kg-day	9.59E-02
				Iron	3.38E+04	mg/kg	3.70E-02	mg/kg-day	--	1/(mg/kg-day)	--	4.32E-01	mg/kg-day	7.00E-01	mg/kg-day	6.17E-01
			Exp. Route Total								8.27E-05					1.26E+00
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
				Arsenic	1.03E+01	mg/kg	9.48E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.42E-06	1.11E-05	mg/kg-day	3.00E-04	mg/kg-day	3.69E-02
				Chromium	2.25E+01	mg/kg	NA	mg/kg-day	2.00E+01	1/(mg/kg-day)	NA	NA	mg/kg-day	7.50E-05	mg/kg-day	NA
				Iron	3.38E+04	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	7.00E-01	mg/kg-day	NA
			Exp. Route Total								1.42E-06					3.69E-02
		Exposure Point Total									8.41E-05					1.30E+00
	Exposure Medium Total										8.41E-05					1.30E+00
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	1.17E-07	mg/m3	--	1/(mg/m3)	--	1.37E-06	mg/m3	5.00E-03	mg/m3	2.74E-04
				Arsenic	1.03E+01	mg/kg	1.37E-10	mg/m3	4.30E+00	1/(mg/m3)	5.91E-10	1.60E-09	mg/m3	1.50E-05	mg/m3	1.07E-04
				Chromium	2.25E+01	mg/kg	3.00E-10	mg/m3	1.20E+01	1/(mg/m3)	1.92E-08	3.50E-09	mg/m3	1.00E-04	mg/m3	3.50E-05
				Iron	3.38E+04	mg/kg	4.51E-07	mg/m3	--	1/(mg/m3)	--	5.26E-06	mg/m3	--	mg/m3	--
			Exp. Route Total								1.98E-08					4.16E-04
		Exposure Point Total									1.98E-08					4.16E-04
	Exposure Medium Total										1.98E-08					4.16E-04
Medium Total											8.41E-05					1.30E+00
											Total of Receptor Risks Across All Media	8.41E-05				Total of Receptor Hazards Across All Media	1.30E+00

***In this table, risks for the "child" receptor cover ages 0 to 6 years. For mutagens, cancer risks for higher age group categories (ages 6 to 16 and ages 16 to 30) are presented in a table labeled as an "adult" receptor.**

TABLE 7 (RAGS D 7.2.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - ADULT* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult*

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	4.14E-03	mg/kg-day	--	1/(mg/kg-day)	--	1.21E-02	mg/kg-day	1.00E+00	mg/kg-day	1.21E-02
				Arsenic	1.03E+01	mg/kg	4.84E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	7.26E-06	1.41E-05	mg/kg-day	3.00E-04	mg/kg-day	4.70E-02
				Chromium	2.25E+01	mg/kg	1.06E-05	mg/kg-day	5.00E-01	1/(mg/kg-day)	9.69E-06	3.08E-05	mg/kg-day	3.00E-03	mg/kg-day	1.03E-02
				Iron	3.38E+04	mg/kg	1.59E-02	mg/kg-day	--	1/(mg/kg-day)	--	4.63E-02	mg/kg-day	7.00E-01	mg/kg-day	6.61E-02
			Exp. Route Total								1.69E-05					1.36E-01
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
				Arsenic	1.03E+01	mg/kg	5.79E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	8.69E-07	1.69E-06	mg/kg-day	3.00E-04	mg/kg-day	5.63E-03
				Chromium	2.25E+01	mg/kg	NA	mg/kg-day	2.00E+01	1/(mg/kg-day)	NA	NA	mg/kg-day	7.50E-05	mg/kg-day	NA
				Iron	3.38E+04	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	7.00E-01	mg/kg-day	NA
			Exp. Route Total								8.69E-07					5.63E-03
		Exposure Point Total									1.78E-05					1.41E-01
	Exposure Medium Total										1.78E-05					1.41E-01
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.70E-07	mg/m3	--	1/(mg/m3)	--	1.37E-06	mg/m3	5.00E-03	mg/m3	2.74E-04
				Arsenic	1.03E+01	mg/kg	5.49E-10	mg/m3	4.30E+00	1/(mg/m3)	2.36E-09	1.60E-09	mg/m3	1.50E-05	mg/m3	1.07E-04
				Chromium	2.25E+01	mg/kg	1.20E-09	mg/m3	1.20E+01	1/(mg/m3)	2.64E-08	3.50E-09	mg/m3	1.00E-04	mg/m3	3.50E-05
				Iron	3.38E+04	mg/kg	1.80E-06	mg/m3	--	1/(mg/m3)	--	5.26E-06	mg/m3	--	mg/m3	--
			Exp. Route Total								2.88E-08					4.16E-04
		Exposure Point Total									2.88E-08					4.16E-04
	Exposure Medium Total										2.88E-08					4.16E-04
Medium Total											1.78E-05					1.42E-01
											Total of Receptor Risks Across All Media	1.78E-05		Total of Receptor Hazards Across All Media		1.42E-01

***For mutagens, the labeled "adult" receptor assumes exposures across a combined age range of 6 to 16 (10 years) plus ages 16 to 30 (14 years).**

TABLE 7 (RAGS D 7.3.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - LIFETIME* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult*

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	4.14E-03	mg/kg-day	--	1/(mg/kg-day)	--					N/A
				Arsenic	1.03E+01	mg/kg	1.61E-05	mg/kg-day	1.50E+00	1/(mg/kg-day)	2.42E-05					N/A
				Chromium	2.25E+01	mg/kg	3.52E-05	mg/kg-day	5.00E-01	1/(mg/kg-day)	7.54E-05					N/A
				Iron	3.38E+04	mg/kg	1.59E-02	mg/kg-day	--	1/(mg/kg-day)	--					N/A
			Exp. Route Total								9.96E-05					--
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--					N/A
				Arsenic	1.03E+01	mg/kg	1.53E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	2.29E-06					N/A
				Chromium	2.25E+01	mg/kg	NA	mg/kg-day	2.00E+01	1/(mg/kg-day)	--					N/A
				Iron	3.38E+04	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--					N/A
			Exp. Route Total								2.29E-06					--
		Exposure Point Total									1.02E-04					--
	Exposure Medium Total										1.02E-04					--
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.70E-07	mg/m3	--	1/(mg/m3)	--					N/A
				Arsenic	1.03E+01	mg/kg	6.87E-10	mg/m3	4.30E+00	1/(mg/m3)	2.95E-09					N/A
				Chromium	2.25E+01	mg/kg	1.50E-09	mg/m3	1.20E+01	1/(mg/m3)	4.56E-08					N/A
				Iron	3.38E+04	mg/kg	1.80E-06	mg/m3	--	1/(mg/m3)	--					N/A
			Exp. Route Total								4.86E-08					--
		Exposure Point Total									4.86E-08					--
	Exposure Medium Total										4.86E-08					--
Medium Total											1.02E-04					--
											Total of Receptor Risks Across All Media	1.02E-04		Total of Receptor Hazards Across All Media		--

***Lifetime receptor exposures represent the sum of ages 0 to 6 (referred to as "child" exposure) plus ages 6 to 30 (referred to as "adult" exposure).**

TABLE 7 (RAGS D 7.4.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - INDUSTRIAL WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	3.08E-03	mg/kg-day	--	1/(mg/kg-day)	--	8.62E-03	mg/kg-day	1.00E+00	mg/kg-day	8.62E-03
				Arsenic	1.03E+01	mg/kg	3.60E-06	mg/kg-day	1.50E+00	1/(mg/kg-day)	5.40E-06	1.01E-05	mg/kg-day	3.00E-04	mg/kg-day	3.36E-02
				Chromium	2.25E+01	mg/kg	7.86E-06	mg/kg-day	5.00E-01	1/(mg/kg-day)	3.93E-06	2.20E-05	mg/kg-day	3.00E-03	mg/kg-day	7.34E-03
				Iron	3.38E+04	mg/kg	1.18E-02	mg/kg-day	--	1/(mg/kg-day)	--	3.31E-02	mg/kg-day	7.00E-01	mg/kg-day	4.72E-02
			Exp. Route Total								9.33E-06					9.68E-02
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
				Arsenic	1.03E+01	mg/kg	7.13E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	1.07E-06	2.00E-06	mg/kg-day	3.00E-04	mg/kg-day	6.65E-03
				Chromium	2.25E+01	mg/kg	NA	mg/kg-day	2.00E+01	1/(mg/kg-day)	NA	NA	mg/kg-day	7.50E-05	mg/kg-day	NA
				Iron	3.38E+04	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	7.00E-01	mg/kg-day	NA
			Exp. Route Total								1.07E-06					6.65E-03
		Exposure Point Total									1.04E-05					1.03E-01
	Exposure Medium Total										1.04E-05					1.03E-01
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	2.33E-07	mg/m3	--	1/(mg/m3)	--	6.53E-07	mg/m3	5.00E-03	mg/m3	1.31E-04
				Arsenic	1.03E+01	mg/kg	2.73E-10	mg/m3	4.30E+00	1/(mg/m3)	1.17E-09	7.63E-10	mg/m3	1.50E-05	mg/m3	5.09E-05
				Chromium	2.25E+01	mg/kg	5.95E-10	mg/m3	1.20E+01	1/(mg/m3)	7.14E-09	1.67E-09	mg/m3	1.00E-04	mg/m3	1.67E-05
				Iron	3.38E+04	mg/kg	8.94E-07	mg/m3	--	1/(mg/m3)	--	2.50E-06	mg/m3	--	mg/m3	--
			Exp. Route Total								8.32E-09					1.98E-04
		Exposure Point Total									8.32E-09					1.98E-04
	Exposure Medium Total										8.32E-09					1.98E-04
Medium Total											1.04E-05					1.04E-01
											Total of Receptor Risks Across All Media	1.04E-05				Total of Receptor Hazards Across All Media	1.04E-01

TABLE 7 (RAGS D 7.5.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CONSTRUCTION WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	2.11E-04	mg/kg-day	--	1/(mg/kg-day)	--	1.48E-02	mg/kg-day	1.00E+00	mg/kg-day	1.48E-02
				Arsenic	1.03E+01	mg/kg	2.47E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	3.71E-07	1.73E-05	mg/kg-day	3.00E-04	mg/kg-day	5.76E-02
				Chromium	2.25E+01	mg/kg	5.40E-07	mg/kg-day	5.00E-01	1/(mg/kg-day)	2.70E-07	3.78E-05	mg/kg-day	3.00E-03	mg/kg-day	1.26E-02
				Iron	3.38E+04	mg/kg	8.11E-04	mg/kg-day	--	1/(mg/kg-day)	--	5.68E-02	mg/kg-day	7.00E-01	mg/kg-day	8.11E-02
			Exp. Route Total								6.40E-07					1.66E-01
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
				Arsenic	1.03E+01	mg/kg	1.48E-08	mg/kg-day	1.50E+00	1/(mg/kg-day)	2.22E-08	1.04E-06	mg/kg-day	3.00E-04	mg/kg-day	3.46E-03
				Chromium	2.25E+01	mg/kg	NA	mg/kg-day	2.00E+01	1/(mg/kg-day)	NA	NA	mg/kg-day	7.50E-05	mg/kg-day	NA
				Iron	3.38E+04	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	7.00E-01	mg/kg-day	NA
			Exp. Route Total								2.22E-08					3.46E-03
		Exposure Point Total									6.63E-07					1.70E-01
	Exposure Medium Total										6.63E-07					1.70E-01
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.85E-09	mg/m3	--	1/(mg/m3)	--	3.39E-07	mg/m3	5.00E-03	mg/m3	6.79E-05
				Arsenic	1.03E+01	mg/kg	5.67E-12	mg/m3	4.30E+00	1/(mg/m3)	2.44E-11	3.97E-10	mg/m3	1.50E-05	mg/m3	2.65E-05
				Chromium	2.25E+01	mg/kg	1.24E-11	mg/m3	1.20E+01	1/(mg/m3)	1.49E-10	8.67E-10	mg/m3	1.00E-04	mg/m3	8.67E-06
				Iron	3.38E+04	mg/kg	1.86E-08	mg/m3	--	1/(mg/m3)	--	1.30E-06	mg/m3	--	mg/m3	--
			Exp. Route Total								1.73E-10					1.03E-04
		Exposure Point Total									1.73E-10					1.03E-04
	Exposure Medium Total										1.73E-10					1.03E-04
Medium Total											6.63E-07					1.70E-01
Total of Receptor Risks Across All Media											6.63E-07	Total of Receptor Hazards Across All Media				1.70E-01

TABLE 7 (RAGS D 7.6.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RECREATIONAL USER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	1.54E-04	mg/kg-day	--	1/(mg/kg-day)	--	1.34E-03	mg/kg-day	1.00E+00	mg/kg-day	1.34E-03
				Arsenic	1.03E+01	mg/kg	1.80E-07	mg/kg-day	1.50E+00	1/(mg/kg-day)	2.70E-07	1.57E-06	mg/kg-day	3.00E-04	mg/kg-day	5.24E-03
				Chromium	2.25E+01	mg/kg	3.93E-07	mg/kg-day	5.00E-01	1/(mg/kg-day)	1.96E-07	3.43E-06	mg/kg-day	3.00E-03	mg/kg-day	1.14E-03
				Iron	3.38E+04	mg/kg	5.90E-04	mg/kg-day	--	1/(mg/kg-day)	--	5.16E-03	mg/kg-day	7.00E-01	mg/kg-day	7.37E-03
			Exp. Route Total								4.66E-07					1.51E-02
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
				Arsenic	1.03E+01	mg/kg	3.56E-08	mg/kg-day	1.50E+00	1/(mg/kg-day)	5.34E-08	3.11E-07	mg/kg-day	3.00E-04	mg/kg-day	1.04E-03
				Chromium	2.25E+01	mg/kg	NA	mg/kg-day	2.00E+01	1/(mg/kg-day)	NA	NA	mg/kg-day	7.50E-05	mg/kg-day	NA
				Iron	3.38E+04	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	7.00E-01	mg/kg-day	NA
			Exp. Route Total								5.34E-08					1.04E-03
		Exposure Point Total									5.19E-07					1.61E-02
	Exposure Medium Total										5.19E-07					1.61E-02
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.36E-09	mg/m3	--	1/(mg/m3)	--	3.82E-08	mg/m3	5.00E-03	mg/m3	7.64E-06
				Arsenic	1.03E+01	mg/kg	5.10E-12	mg/m3	4.30E+00	1/(mg/m3)	2.19E-11	4.46E-11	mg/m3	1.50E-05	mg/m3	2.98E-06
				Chromium	2.25E+01	mg/kg	1.11E-11	mg/m3	1.20E+01	1/(mg/m3)	1.34E-10	9.75E-11	mg/m3	1.00E-04	mg/m3	9.75E-07
				Iron	3.38E+04	mg/kg	1.67E-08	mg/m3	--	1/(mg/m3)	--	1.46E-07	mg/m3	--	mg/m3	--
			Exp. Route Total								1.56E-10					1.16E-05
		Exposure Point Total									1.56E-10					1.16E-05
	Exposure Medium Total										1.56E-10					1.16E-05
Medium Total											5.19E-07					1.61E-02
											Total of Receptor Risks Across All Media					
											5.19E-07					1.61E-02
												Total of Receptor Hazards Across All Media				

RAGS D Table 9s

Site 9 Human Health Risk Assessment

TABLE 9 (RAGS D 9.1.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CHILD** RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child**

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.13E-01	--	NA	1.13E-01
			Arsenic*	1.69E-05	--	1.42E-06	--	1.84E-05	Skin/Vascular	4.39E-01	--	3.69E-02	4.76E-01
			Chromium*	6.58E-05	--	NA	--	6.58E-05		9.59E-02	--	NA	9.59E-02
			Iron*	--	--	--	--	--	Liver/Blood/GI Tract	6.17E-01	--	NA	6.17E-01
			(Total)	8.27E-05	--	1.42E-06		8.41E-05		1.26E+00	--	3.69E-02	1.30E+00
		Exposure Point Total						8.41E-05					1.30E+00
	Exposure Medium Total							8.41E-05					1.30E+00
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			Aluminum	--	--	--	--	--	CNS	--	2.74E-04	--	2.74E-04
			Arsenic*	--	5.91E-10	--	--	5.91E-10	Developmental/Vascular/CNS	--	1.07E-04	--	1.07E-04
			Chromium*	--	1.92E-08	--	--	1.92E-08	Lung/Nasal	--	3.50E-05	--	3.50E-05
			Iron*	--	--	--	--	--	N/A	--	--	--	--
			(Total)	--	1.98E-08	--		1.98E-08		--	4.16E-04	--	4.16E-04
		Exposure Point Total						1.98E-08					4.16E-04
	Exposure Medium Total							1.98E-08					4.16E-04
Soil Total								8.41E-05					1.30E+00
Receptor Total								8.41E-05					1.30E+00

Total Risk Across All Media: 8.41E-05

Total Hazard Index Across All Media: 1.30E+00

* Indicates that concentrations of this substance were not demonstrated to exceed background based on statistical tests.

Total Blood HI =	6.17E-01
Total CNS HI =	1.13E-01
Total CNS (Developmental) HI =	1.13E-01
Total Developmental HI =	1.13E-01
Total GI Tract HI =	6.17E-01
Total Liver HI =	6.17E-01
Total Lung HI =	3.50E-05
Total Nasal HI =	3.50E-05
Total Skin HI =	4.76E-01
Total Vascular HI =	4.76E-01

****In this table, risks for the "child" receptor cover ages 0 to 6 years. For mutagens, cancer risks for higher age group categories (ages 6 to 16 and ages 16 to 30) are presented in a table labeled as an "adult" receptor.**

TABLE 9 (RAGS D 9.2.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT** RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult**

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.21E-02	--	NA	1.21E-02
			Arsenic*	7.26E-06	--	8.69E-07	--	8.12E-06	Skin/Vascular	4.70E-02	--	5.63E-03	5.27E-02
			Chromium*	9.69E-06	--	NA	--	9.69E-06		1.03E-02	--	NA	1.03E-02
			Iron*	--	--	--	--	--	Liver/Blood/GI Tract	6.61E-02	--	NA	6.61E-02
			(Total)	1.69E-05	--	8.69E-07		1.78E-05		1.36E-01	--	5.63E-03	1.41E-01
		Exposure Point Total						1.78E-05					1.41E-01
	Exposure Medium Total							1.78E-05					1.41E-01
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			Aluminum	--	--	--	--	--	CNS	--	2.74E-04	--	2.74E-04
			Arsenic*	--	2.36E-09	--	--	2.36E-09	Developmental/Vascular/CNS	--	1.07E-04	--	1.07E-04
			Chromium*	--	2.64E-08	--	--	2.64E-08	Lung/Nasal	--	3.50E-05	--	3.50E-05
			Iron*	--	--	--	--	--	N/A	--	--	--	--
			(Total)	--	2.88E-08	--		2.88E-08		--	4.16E-04	--	4.16E-04
		Exposure Point Total						2.88E-08					4.16E-04
	Exposure Medium Total							2.88E-08					4.16E-04
Soil Total								1.78E-05					1.41E-01
Receptor Total								1.78E-05					1.41E-01

Total Risk Across All Media: 1.78E-05

Total Hazard Index Across All Media: 1.41E-01

* Indicates that concentrations of this substance were not demonstrated to exceed background based on statistical tests.

Total Blood HI =	6.61E-02
Total CNS HI =	1.24E-02
Total CNS (Developmental) HI =	1.21E-02
Total Developmental HI =	1.22E-02
Total GI Tract HI =	6.61E-02
Total Liver HI =	6.61E-02
Total Lung HI =	3.50E-05
Total Nasal HI =	3.50E-05
Total Skin HI =	5.27E-02
Total Vascular HI =	5.28E-02

****For mutagens, the labeled "adult" receptor assumes exposures across a combined age range of 6 to 16 (10 years) plus ages 16 to 30 (14 years).**

TABLE 9 (RAGS D 9.3.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - LIFETIME** RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult**

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	N/A	N/A	--	N/A	--
			Arsenic*	2.42E-05	--	2.29E-06	--	2.65E-05	N/A	N/A	--	N/A	--
			Chromium*	7.54E-05	--	--	--	7.54E-05	N/A	N/A	--	N/A	--
			Iron*	--	--	--	--	--	N/A	N/A	--	N/A	--
			(Total)	9.96E-05	--	2.29E-06		1.02E-04		--	--	--	--
		Exposure Point Total						1.02E-04					--
	Exposure Medium Total							1.02E-04					--
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			Aluminum	--	--	--	--	--	N/A	--	N/A	--	--
			Arsenic*	--	2.95E-09	--	--	2.95E-09	N/A	--	N/A	--	--
			Chromium*	--	4.56E-08	--	--	4.56E-08	N/A	--	N/A	--	--
			Iron*	--	--	--	--	--	N/A	--	N/A	--	--
			(Total)	--	4.86E-08	--		4.86E-08		--	--	--	--
		Exposure Point Total						4.86E-08					--
	Exposure Medium Total							4.86E-08					--
Soil Total								1.02E-04					--
Receptor Total								1.02E-04					--

Total Risk Across All Media 1.02E-04

Total Hazard Index Across All Media --

* Indicates that concentrations of this substance were not demonstrated to exceed background based on statistical tests.

****Lifetime receptor exposures represent the sum of ages 0 to 6 (referred to as "child" exposure) plus ages 6 to 30 (referred to as "adult" exposure).**

TABLE 9 (RAGS D 9.4.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - INDUSTRIAL WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	8.62E-03	--	NA	8.62E-03
			Arsenic*	5.40E-06	--	1.07E-06	--	6.47E-06	Skin/Vascular	3.36E-02	--	6.65E-03	4.02E-02
			Chromium*	3.93E-06	--	NA	--	3.93E-06		7.34E-03	--	NA	7.34E-03
			Iron*	--	--	--	--	--	Liver/Blood/GI Tract	4.72E-02	--	NA	4.72E-02
			(Total)	9.33E-06	--	1.07E-06		1.04E-05		9.68E-02	--	6.65E-03	1.03E-01
		Exposure Point Total						1.04E-05					1.03E-01
	Exposure Medium Total							1.04E-05					1.03E-01
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	1.31E-04	--	1.31E-04
			Arsenic*	--	1.17E-09	--	--	1.17E-09	Developmental/Vascular/CNS	--	5.09E-05	--	5.09E-05
			Chromium*	--	7.14E-09	--	--	7.14E-09	Lung/Nasal	--	1.67E-05	--	1.67E-05
			Iron*	--	--	--	--	--	N/A	--	--	--	--
			(Total)	--	8.32E-09	--		8.32E-09		--	1.98E-04	--	1.98E-04
		Exposure Point Total						8.32E-09					1.98E-04
	Exposure Medium Total							8.32E-09					1.98E-04
Soil Total								1.04E-05					1.03E-01
Receptor Total								1.04E-05					1.03E-01

Total Risk Across All Media: 1.04E-05

Total Hazard Index Across All Media: 1.03E-01

* Indicates that concentrations of this substance were not demonstrated to exceed background based on statistical tests.

Total Blood HI =	4.72E-02
Total CNS HI =	8.80E-03
Total CNS (Developmental) HI =	8.62E-03
Total Developmental HI =	8.67E-03
Total GI Tract HI =	4.72E-02
Total Liver HI =	4.72E-02
Total Lung HI =	1.67E-05
Total Nasal HI =	1.67E-05
Total Skin HI =	4.02E-02
Total Vascular HI =	4.03E-02

TABLE 9 (RAGS D 9.5.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CONSTRUCTION WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.48E-02	--	NA	1.48E-02
			Arsenic*	3.71E-07	--	2.22E-08	--	3.93E-07	Skin/Vascular	5.76E-02	--	3.46E-03	6.11E-02
			Chromium*	2.70E-07	--	NA	--	2.70E-07		1.26E-02	--	NA	1.26E-02
			Iron*	--	--	--	--	--	Liver/Blood/GI Tract	8.11E-02	--	NA	8.11E-02
			(Total)	6.40E-07	--	2.22E-08		6.63E-07		1.66E-01	--	3.46E-03	1.70E-01
		Exposure Point Total						6.63E-07					1.70E-01
	Exposure Medium Total							6.63E-07					1.70E-01
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	6.79E-05	--	6.79E-05
			Arsenic*	--	2.44E-11	--	--	2.44E-11	Developmental/Vascular/CNS	--	2.65E-05	--	2.65E-05
			Chromium*	--	1.49E-10	--	--	1.49E-10	Lung/Nasal	--	8.67E-06	--	8.67E-06
			Iron*	--	--	--	--	--	N/A	--	--	--	--
			(Total)	--	1.73E-10	--		1.73E-10		--	1.03E-04	--	1.03E-04
		Exposure Point Total						1.73E-10					1.03E-04
	Exposure Medium Total							1.73E-10					1.03E-04
Soil Total								6.63E-07					1.70E-01
Receptor Total								6.63E-07					1.70E-01

Total Risk Across All Media: 6.63E-07

Total Hazard Index Across All Media: 1.70E-01

* Indicates that concentrations of this substance were not demonstrated to exceed background based on statistical tests.

Total Blood HI =	8.11E-02
Total CNS HI =	1.49E-02
Total CNS (Developmental) HI =	1.48E-02
Total Developmental HI =	1.48E-02
Total GI Tract HI =	8.11E-02
Total Liver HI =	8.11E-02
Total Lung HI =	8.67E-06
Total Nasal HI =	8.67E-06
Total Skin HI =	6.11E-02
Total Vascular HI =	6.11E-02

TABLE 9 (RAGS D 9.6.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - RECREATIONAL USER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, INCLUDING ALL COPCS GREATER THAN SCREENING LEVELS
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.34E-03	--	NA	1.34E-03
			Arsenic*	2.70E-07	--	5.34E-08	--	3.23E-07	Skin/Vascular	5.24E-03	--	1.04E-03	6.28E-03
			Chromium*	1.96E-07	--	NA	--	1.96E-07		1.14E-03	--	NA	1.14E-03
			Iron*	--	--	--	--	--	Liver/Blood/GI Tract	7.37E-03	--	NA	7.37E-03
			(Total)	4.66E-07	--	5.34E-08		5.19E-07		1.51E-02	--	1.04E-03	1.61E-02
		Exposure Point Total						5.19E-07					1.61E-02
	Exposure Medium Total							5.19E-07					1.61E-02
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			Aluminum	--	--	--	--	--	CNS	--	7.64E-06	--	7.64E-06
			Arsenic*	--	2.19E-11	--	--	2.19E-11	Developmental/Vascular/CNS	--	2.98E-06	--	2.98E-06
			Chromium*	--	1.34E-10	--	--	1.34E-10	Lung/Nasal	--	9.75E-07	--	9.75E-07
			Iron*	--	--	--	--	--	N/A	--	--	--	--
			(Total)	--	1.56E-10	--		1.56E-10		--	1.16E-05	--	1.16E-05
		Exposure Point Total						1.56E-10					1.16E-05
	Exposure Medium Total							1.56E-10					1.16E-05
Soil Total								5.19E-07					1.61E-02
Receptor Total								5.19E-07					1.61E-02

Total Risk Across All Media: 5.19E-07

Total Hazard Index Across All Media: 1.61E-02

* Indicates that concentrations of this substance were not demonstrated to exceed background based on statistical tests.

Total Blood HI =	7.37E-03
Total CNS HI =	1.36E-03
Total CNS (Developmental) HI =	1.34E-03
Total Developmental HI =	1.35E-03
Total GI Tract HI =	7.37E-03
Total Liver HI =	7.37E-03
Total Lung HI =	9.75E-07
Total Nasal HI =	9.75E-07
Total Skin HI =	6.28E-03
Total Vascular HI =	6.28E-03

RAGS D Table 10s

Site 9 Human Health Risk Assessment

TABLE 9 (RAGS D 10.1.RME)
RISK ASSESSMENT SUMMARY - CHILD* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child*

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total ##	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total **
Soil	Soil	Contact With Site 9 Soil											
			(Total)	0.00E+00	--	0.00E+00		0.00E+00		0.00E+00	--	0.00E+00	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			(Total)	--	0.00E+00	--		0.00E+00		--		--	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
Soil Total								0.00E+00					0.00E+00
Receptor Total								0.00E+00					0.00E+00

Total Risk Across All Media ## 0.00E+00

Total Hazard Index Across All Media ** 0.00E+00

All carcinogenic chemicals are omitted and total cancer risks for an exposure medium are listed as "0.0E+0" if the associated total cancer risk from all COPCs for this receptor and the lifetime receptor are <= 1.0E-04.
If cumulative cancer risk (individual receptor or lifetime receptor) for an exposure medium exceeds 1.0E-04, then all COPCs are listed that individually contribute at least 1.0E-06 cancer risk to this receptor or to the lifetime receptor.

** All chemicals associated with noncarcinogenic toxicity are omitted and total noncancer hazard indices (HIs) for an exposure medium are listed as "0.0E+0" if all target organ-specific HIs <=1 and all HQs <= 1.0 for this receptor.
If a noncancer target organic HI exceeds 1.0 or if any HQ exceeds 1.0, then all COPCs are shown that individually contribute an HQ of at least 0.2 to the target organ HI that exceeds 1.0 or to an HQ that exceeds 1.0.

***In this table, risks for the "child" receptor cover ages 0 to 6 years. For mutagens, cancer risks for higher age group categories (ages 6 to 16 and ages 16 to 30) are presented in a table labeled as an "adult" receptor.**

TABLE 9 (RAGS D 10.2.RME)
RISK ASSESSMENT SUMMARY - ADULT* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult*

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total ##	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total **
Soil	Soil	Contact With Site 9 Soil											
			(Total)	0.00E+00	--	0.00E+00		0.00E+00		0.00E+00	--	0.00E+00	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			(Total)	--	0.00E+00	--		0.00E+00		--	0.00E+00	--	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
Soil Total								0.00E+00					0.00E+00
Receptor Total								0.00E+00					0.00E+00

Total Risk Across All Media ## 0.00E+00

Total Hazard Index Across All Media ** 0.00E+00

All carcinogenic chemicals are omitted and total cancer risks for an exposure medium are listed as "0.0E+0" if the associated total cancer risk from all COPCs for this receptor and the lifetime receptor are <= 1.0E-04.
If cumulative cancer risk (individual receptor or lifetime receptor) for an exposure medium exceeds 1.0E-04, then all COPCs are listed that individually contribute at least 1.0E-06 cancer risk to this receptor or to the lifetime receptor.

** All chemicals associated with noncarcinogenic toxicity are omitted and total noncancer hazard indices (HIs) for an exposure medium are listed as "0.0E+0" if all target organ-specific HIs <=1 and all HQs <= 1.0 for this receptor.
If a noncancer target organic HI exceeds 1.0 or if any HQ exceeds 1.0, then all COPCs are shown that individually contribute an HQ of at least 0.2 to the target organ HI that exceeds 1.0 or to an HQ that exceeds 1.0.

***For mutagens, the labeled "adult" receptor assumes exposures across a combined age range of 6 to 16 (10 years) plus ages 16 to 30 (14 years).**

TABLE 9 (RAGS D 10.3.RME)
RISK ASSESSMENT SUMMARY - LIFETIME* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult*

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total ##	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil											
			(Total)	0.00E+00	--	0.00E+00		0.00E+00			--	--	--
		Exposure Point Total						0.00E+00					--
	Exposure Medium Total							0.00E+00					--
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			(Total)	--	0.00E+00	--		0.00E+00		--	--	--	--
		Exposure Point Total						0.00E+00					--
	Exposure Medium Total							0.00E+00					--
Soil Total								0.00E+00					--
Receptor Total								0.00E+00					--

Total Risk Across All Media ## 0.00E+00

Total Hazard Index Across All Media --

All carcinogenic chemicals are omitted and total cancer risks for an exposure medium are listed as "0.0E+0" if the associated total cancer risk from all COPCs for this receptor and the lifetime receptor are <= 1.0E-04.
If cumulative cancer risk (individual receptor or lifetime receptor) for an exposure medium exceeds 1.0E-04, then all COPCs are listed that individually contribute at least 1.0E-06 cancer risk to this receptor or to the lifetime receptor.

***Lifetime receptor exposures represent the sum of ages 0 to 6 (referred to as "child" exposure) plus ages 6 to 30 (referred to as "adult" exposure).**

TABLE 10 (RAGS D 10.4.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - INDUSTRIAL WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total ##	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total **
Soil	Soil	Contact With Site 9 Soil											
			(Total)	0.00E+00	--	0.00E+00		0.00E+00		0.00E+00	--	0.00E+00	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			(Total)	--	0.00E+00	--		0.00E+00		--	0.00E+00	--	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
Soil Total								0.00E+00					0.00E+00
Receptor Total								0.00E+00					0.00E+00

Total Risk Across All Media ## 0.00E+00

Total Hazard Index Across All Media ** 0.00E+00

All carcinogenic chemicals are omitted and total cancer risks for an exposure medium are listed as "0.0E+0" if the associated total cancer risk from all COPCs for this receptor and the lifetime receptor are <= 1.0E-04.
If cumulative cancer risk (individual receptor or lifetime receptor) for an exposure medium exceeds 1.0E-04, then all COPCs are listed that individually contribute at least 1.0E-06 cancer risk to this receptor or to the lifetime receptor.

** All chemicals associated with noncarcinogenic toxicity are omitted and total noncancer hazard indices (HIs) for an exposure medium are listed as "0.0E+0" if all target organ-specific HIs <=1 and all HQs <= 1.0 for this receptor.
If a noncancer target organic HI exceeds 1.0 or if any HQ exceeds 1.0, then all COPCs are shown that individually contribute an HQ of at least 0.2 to the target organ HI that exceeds 1.0 or to an HQ that exceeds 1.0.

TABLE 10 (RAGS D 10.5.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CONSTRUCTION WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total ##	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total **
Soil	Soil	Contact With Site 9 Soil											
			(Total)	0.00E+00	--	0.00E+00		0.00E+00		0.00E+00	--	0.00E+00	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			(Total)	--	0.00E+00	--		0.00E+00		--	0.00E+00	--	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
Soil Total								0.00E+00					0.00E+00
Receptor Total								0.00E+00					0.00E+00

Total Risk Across All Media ## 0.00E+00

Total Hazard Index Across All Media ** 0.00E+00

All carcinogenic chemicals are omitted and total cancer risks for an exposure medium are listed as "0.0E+0" if the associated total cancer risk from all COPCs for this receptor and the lifetime receptor are <= 1.0E-04.
If cumulative cancer risk (individual receptor or lifetime receptor) for an exposure medium exceeds 1.0E-04, then all COPCs are listed that individually contribute at least 1.0E-06 cancer risk to this receptor or to the lifetime receptor.

** All chemicals associated with noncarcinogenic toxicity are omitted and total noncancer hazard indices (HIs) for an exposure medium are listed as "0.0E+0" if all target organ-specific HIs <=1 and all HQs <= 1.0 for this receptor.
If a noncancer target organic HI exceeds 1.0 or if any HQ exceeds 1.0, then all COPCs are shown that individually contribute an HQ of at least 0.2 to the target organ HI that exceeds 1.0 or to an HQ that exceeds 1.0.

TABLE 10 (RAGS D 10.6.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - RECREATIONAL USER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total ##	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total **
Soil	Soil	Contact With Site 9 Soil											
			(Total)	0.00E+00	--	0.00E+00		0.00E+00		0.00E+00	--	0.00E+00	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
	Particulates	Particulate Dust Inhalation from Site 9 Soil											
			(Total)	--	0.00E+00	--		0.00E+00		--	0.00E+00	--	0.00E+00
		Exposure Point Total						0.00E+00					0.00E+00
	Exposure Medium Total							0.00E+00					0.00E+00
Soil Total								0.00E+00					0.00E+00
Receptor Total								0.00E+00					0.00E+00

Total Risk Across All Media ## 0.00E+00

Total Hazard Index Across All Media ** 0.00E+00

All carcinogenic chemicals are omitted and total cancer risks for an exposure medium are listed as "0.0E+0" if the associated total cancer risk from all COPCs for this receptor and the lifetime receptor are <= 1.0E-04.
If cumulative cancer risk (individual receptor or lifetime receptor) for an exposure medium exceeds 1.0E-04, then all COPCs are listed that individually contribute at least 1.0E-06 cancer risk to this receptor or to the lifetime receptor.

** All chemicals associated with noncarcinogenic toxicity are omitted and total noncancer hazard indices (HIs) for an exposure medium are listed as "0.0E+0" if all target organ-specific HIs <=1 and all HQs <= 1.0 for this receptor.
If a noncancer target organic HI exceeds 1.0 or if any HQ exceeds 1.0, then all COPCs are shown that individually contribute an HQ of at least 0.2 to the target organ HI that exceeds 1.0 or to an HQ that exceeds 1.0.

Attachment 3 – Analytical Results for Soil

Table HH-1

Summary of Detected Analytical Results for Soil

Site 9 Human Health Risk Assessment

TABLE HH-1
SUMMARY OF DETECTED ANALYTICAL RESULTS FOR SOIL
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE ID:	TP9-01	TP9-02	TP9-03	TP9-04	TP9-05	TP9-06
INORGANICS (mg/kg)						
Aluminum	2320	9070	6090	7350	6280	9220
Arsenic	6	7.9	13.2	6.5	6.3	8.8
Barium	5 B	13.5 B	7.7 B	20.4 B	31.8 B	10.1 B
Beryllium	0.3 B	1.2 B	0.52 B	0.72 B	0.58 B	0.93 B
Calcium	110 B	242 B	141 B	750 B	799 B	89.5 B
Chromium	10.9	16.2	21	19.4	16.9	25.8
Cobalt	2.1 B	4.3 B	2.3 B	4.6 B	3.9 B	4 B
Copper	3 B	4.2 B	4.1 B	4.9 B	6.3	3.1 B
Cyanide	1.17 U	1.31 U	1.27 U	1.07 U	1.21 U	1.57
Iron	8580	36300	22300	33300	27600	26600
Lead	5.5	5.6	9.9	12.7	17.4	6.9
Magnesium	147 B	1210 B	911 B	1100	893 B	1520
Manganese	49.2	112	24.4	104	168	28.1
Potassium	209 U	1840	1970	2040	1420	4120
Silver	1.87 U	2.7	1.97 U	2.5	2.2 B	2.01 U
Sodium	42.6 B	52.8 B	47.8 B	50.5 B	36.5 B	51.3 B
Vanadium	23.2	5.7 B	20.8	11	11.7 B	11.5 B
Zinc	5.3	39.8	17.5	60.3	44.6	60.1
PESTICIDES/PCBS (ug/kg)						
4,4'-DDD	3.8 U	4.3 U	4.3 U	4.1 U	0.41 J	4.2 U
4,4'-DDE	3.8 U	4.3 U	4.3 U	0.41 J	1.2 J	4.2 U
4,4'-DDT	3.8 U	4.3 U	4.3 U	0.82 J	0.41 J	4.2 U
Methoxychlor	19 U	22 U	22 U	93	20 U	21 U
SEMIVOLATILES (ug/kg)						
Bis(2-ethylhexyl)phthalate	390 U	35 J	440 U	410 U	26 J	34 J
Di-n-butylphthalate	23 J	37 J	25 J	28 J	25 J	21 J
VOLATILES (ug/kg)						
Chloroform	1 J	1 J	13 U	11 U	12 U	13 U

Data Qualifiers:

B -- Positive result is considered to be an artifact of blank contamination, and should not be considered present.

J -- Value is considered estimated due to exceedance of quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).

U -- Value is a non-detected result as reported by the laboratory.

Attachment 4

Comparison of Soil Data to Background

Site 9 Human Health Risk Assessment

Table HH-2

Statistical Comparison of Site 9 Soil Concentrations to Background

Site 9 Human Health Risk Assessment

TABLE HH-2
STATISTICAL COMPARISON OF CONCENTRATIONS IN SITE 9 SOIL TO BACKGROUND
NWS EARLE, COLTS NECK, NEW JERSEY

Name of Test:		Detection Freq: Z or Fisher				95 % Background Threshold value (BTV) Test [1]							Quantile Test				Mann-Whitney/Gehan				Student's or Satterthwaite T-test					Bartlett's Test for Equal Standard Deviations						
Question Posed:		Site 9 sb Freq. > bkg. Freq.?				Site Max > UTL on Background ?##							Majority are Site 9 sb?				Ranks of Site 9 sb > bkg.?				Site 9 sb Mean > bkg. Mean ?					Site 9 sb Standard Deviation =bkg. Std.Dev.?						
Assumptions Valid:		#ND & Pos.>=5 or use Fisher				Data fit normal or gamma distrib., or nonparametric							# Site 9 sb (s) in Top r								#s>2,#b>2,>=85% Pos; both normal					#s>2,#b>2, Site 9 sb & bkg. both normally distributed						
Test Criterion:		P value <= 0.05 ?				Max >95% UTL (parametric). Or, Max >95% Quantile							P<=0.05 that #s>=k				P value <=0.05 ?				t-Value > t-Table					F-Value<=F-Table (Students T). If not, Satterthwaite						
Concentration > background?	Y/N	bkg. Freq.	Site 9 sb Freq.	P Value	YN	Back. Mean	Std.Dev. Back	t Value	N, Q, or Other***	Back. UTL	Site Max.	YN ##	r	k	P Value	YN	P Value	Test	Used	YN	bkg. Mean	Site 9 sb Mean	t Value	t Table	YN	bkg. Distrib.	Site 9 sb Distrib.	Std.Dev. bkg.	Std.Dev. Site 9 sb	F Value	F Table	YN
Aluminum	**Y**	8/8	6/6		NA	2690	1580	3.1880	N	7730	9220	**Y**	5	5	0.0030	**Y**	0.0023			**Y**	2690	6720	3.6737	1.7823	**Y**	normal	normal	1580	2530	1.2077	3.8639	**Y**
Arsenic	N	8/8	6/6		NA	6.64	5.21	3.1880	N	23.2	13.2	N	10	6	0.0699	N	0.3773			N	6.64	8.12	0.6274	1.7823	N	normal	normal	5.21	2.71	2.0181	3.8639	**Y**
Chromium	N	8/8	6/6		NA	27.4	22.9	3.1880	N	100	25.8	N	9	5	0.2378	N	0.5251			N	27.4	18.4	-1.0773	1.8946	N	normal	normal	22.9	5.02	8.5533	3.8639	N
Iron	N	8/8	6/6		NA	20400	19400	3.1880	N	82400	36300	N	8	5	0.1212	N	0.1412			N	20400	25800	0.6133	1.7823	N	normal	normal	19400	9790	2.2073	3.8639	**Y**

**** Site 9 concentrations in subsurface soil (sb) are compared to background soil.**

Interpretation of Z-Test or Fisher's Exact Test: If the "P-Value" is less than 0.05, then it can be concluded that the site data's detection frequency is greater than the background data detection frequency.
Interpretation of Quantile Test: If the "P-Value" is less than 0.05, then it can be concluded that the site data set has a distribution with more upper rank values relative to the background data set.
Since "k" samples from the top "r" ranks of the combined data set belonged to the site soil subgroup, this would be unlikely if the site and background data sets came from the same population.
Interpretation of Mann Whitney / Gehan Test: If the "P-Value" is less than 0.05, then it can be concluded that the site data set has a distribution with more values ranked greater than the ranks of background data, based on combining the data together and comparing the rank sums belonging to each group. This indicates the data belong to two populations having different medians.
Interpretation of Student's t- / Satterthwaite's t-Test: If the "t-Value" exceeds the lookup "t-Table" and both soil type distributions match a "normal" shape, then it can be concluded that the site data set belongs to a population having a greater mean relative to the mean of the background population.
Interpretation of Bartlett's Test: If the "F-Value" exceeds the lookup "F-Table" and both soil type distributions match a "normal" shape, then it can be concluded that the site and background data sets belong to two populations having different standard deviations. In this case, the Satterthwaite t-Test must be used rather than the Student's t-Test.

A statistical significance level (P value) of 0.05 is used for all tests that directly compare the Site 9 sb aggregate data group to bkg. soil. A two-sided significance level of 0.1 is used for Bartlett's test for equal variance.
For each test, a YES or NO decision is presented only if all assumptions are met. The overall decision (is Site 9 sb > bkg.) for each chemical appears at the left and is based on four criteria:
> Overall decision is YES if any one of the Mann-Whitney/Gehan, Quantile Test, or T-Test is YES, regardless of other test results.
> Overall decision is NO if at least one of Mann-Whitney/Gehan, Quantile Test, or T-Test is NO, and none of the aforementioned tests are YES.
> Overall decision is YES/NO if Z/Fisher Test is YES/NO, respectively, and other tests are NA. Z-test is treated as lowest priority since it relies on detection frequency, not magnitude of results.
> Overall decision is NA if all tests are NA. (Might occur if too few detections to be capable of detecting a statistically significant difference even if one exists.)
(1) -- Note that the Background Threshold Value (BTV) tests compare any individual sample from Site 9 to background. This test may produce false positives in larger site data sets.

NA* Low power because either N is small or very low frequency of detected values with detections close to the detection limits, which interferes with the power of statistical tests to detect a significant difference between groups.

# NDs or # Pos.	Number of non-detected (ND) or positive (Pos.) results in data set, not including rejected data or blank-qualified data.
# s or # b	Number of Site 9 sb (s) or bkg. (b) samples, not including rejected data or blank-qualified data.
s = b	Standard deviation of Site 9 sb results must not be different from the standard deviation of bkg. results.
P value	Probability or significance level is defined as the chance of a false positive. If P <= 0.05 then test determines Site 9 sb > bkg. with 95 % confidence.
N, Q, or other UTL***	UTL is based on a 95 % upper limit (using t-value) when data are normal (N). Otherwise, a gamma distribution 95% UPL or a nonparametric 95 % quantile (Q) is used if there are sufficient data points. UTL documentation is provided in the ProUCL statistical results in Table HH-3.
Gamma UPL	Wilson Hilferty (WH) approximate gamma UPL is used when data fits a gamma distribution and there are no nondetected results or a high percentage (greater than 85 to 90 percent) of detects
KM	Kaplan-Meier UPL estimate is preferred for cases involving a substantial percentage (e.g., greater than 10 to 15 percent) of nondetected results.
r,k	The Quantile test calculates the probability that k or more samples from the top r ranks of the combined Site 9 sb and bkg. data set are comprised of Site 9 sb data if both populations are in fact equal.

Table HH-3

Background Threshold Values ProUCL Output

Site 9 Human Health Risk Assessment

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

	General Background Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	C:\Earle\Site_9\Background_Comparison\EABGSB_ProUCLinput.wst		
Full Precision	ON		
Confidence Coefficient	95%		
Coverage	95%		
Different or Future K Values	1		
Number of Bootstrap Operations	2000		

Aluminum

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		

Raw Statistics		Log-Transformed Statistics	
Minimum	675	Minimum	6.5147127
Maximum	5310	Maximum	8.5773471
Second Largest	4520	Second Largest	8.4162673
First Quartile	1785	First Quartile	7.4868738
Median	2007.5	Median	7.6013585
Third Quartile	3710	Third Quartile	8.2114869
Mean	2685	Mean	7.7249502
SD	1583.6238	SD	0.6564789
Coefficient of Variation	0.589804		
Skewness	0.6834597		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9098369	Shapiro Wilk Test Statistic	0.932105
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	7732.009	95% UTL with 95% Coverage	18345.665
95% UPL (t)	5867.2984	95% UPL (t)	8468.827
90% Percentile (z)	4714.4955	90% Percentile (z)	5251.4621
95% Percentile (z)	5289.8293	95% Percentile (z)	6665.9114
99% Percentile (z)	6369.0598	99% Percentile (z)	10426.945

Gamma Distribution Test		Data Distribution Test	
k star	2.0142267	**Data appear Normal at 5% Significance Level**	
Theta Star	1333.0178		
MLE of Mean	2685		
MLE of Standard Deviation	1891.8649		
nu star	32.227628		
A-D Test Statistic	0.330462	**Nonparametric Statistics**	
5% A-D Critical Value	0.7212107	90% Percentile	4757

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

K-S Test Statistic	0.1915142	95% Percentile	5033.5
5% K-S Critical Value	0.2962133	99% Percentile	5254.7
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	5310
90% Percentile	5213.2567	95% Percentile Bootstrap UTL with 95% Coverage	5310
95% Percentile	6354.3834	95% BCA Bootstrap UTL with 95% Coverage	5310
99% Percentile	8884.3244	95% UPL	5310
		95% Chebyshev UPL	10006.584
95% WH Approx. Gamma UPL	6924.6576	Upper Threshold Limit Based upon IQR	6597.5
95% HW Approx. Gamma UPL	7193.1644		
95% WH Approx. Gamma UTL with 95% Coverage	11204.711		
95% HW Approx. Gamma UTL with 95% Coverage	12233.516		

Arsenic

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	1.35	Minimum	0.3001046
Maximum	14.4	Maximum	2.6672282
Second Largest	11.2	Second Largest	2.4159138
First Quartile	2	First Quartile	0.6891101
Median	5.9	Median	1.613422
Third Quartile	10.75	Third Quartile	2.3746189
Mean	6.64375	Mean	1.5304388
SD	5.2099793	SD	0.9707469
Coefficient of Variation	0.7841926		
Skewness	0.2914994		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8532838	Shapiro Wilk Test Statistic	0.8563736
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	23.247954	95% UTL with 95% Coverage	101.92213
95% UPL (t)	17.113224	95% UPL (t)	32.497351
90% Percentile (z)	13.320607	90% Percentile (z)	16.030625
95% Percentile (z)	15.213403	95% Percentile (z)	22.809459
99% Percentile (z)	18.763974	99% Percentile (z)	44.200396
Gamma Distribution Test		**Data Distribution Test**	
k star	1.0344149	**Data appear Normal at 5% Significance Level**	
Theta Star	6.4227131		

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

MLE of Mean	6.64375		
MLE of Standard Deviation	6.5322967		
nu star	16.550638		
A-D Test Statistic	0.6324232	**Nonparametric Statistics**	
5% A-D Critical Value	0.7282266	90% Percentile	12.16
K-S Test Statistic	0.2456407	95% Percentile	13.28
5% K-S Critical Value	0.2988374	99% Percentile	14.176
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	14.4
90% Percentile	15.170682	95% Percentile Bootstrap UTL with 95% Coverage	14.4
95% Percentile	19.666663	95% BCA Bootstrap UTL with 95% Coverage	14.4
99% Percentile	30.080362	95% UPL	14.4
		95% Chebyshev UPL	30.731102
95% WH Approx. Gamma UPL	22.802103	Upper Threshold Limit Based upon IQR	23.875
95% HW Approx. Gamma UPL	24.347989		
95% WH Approx. Gamma UTL with 95% Coverage	42.01952		
95% HW Approx. Gamma UTL with 95% Coverage	48.704806		

Chromium

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	4.7	Minimum	1.5475625
Maximum	59.5	Maximum	4.0859763
Second Largest	57.4	Second Largest	4.0500443
First Quartile	10.35	First Quartile	2.3254663
Median	16.5	Median	2.7853921
Third Quartile	48.325	Third Quartile	3.8724914
Mean	27.3625	Mean	2.942214
SD	22.895847	SD	0.9581622
Coefficient of Variation	0.8367601		
Skewness	0.6272942		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8288524	Shapiro Wilk Test Statistic	0.9208427
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	100.33157	95% UTL with 95% Coverage	401.76879
95% UPL (t)	73.371798	95% UPL (t)	130.01434
90% Percentile (z)	56.704709	90% Percentile (z)	64.725044

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

95% Percentile (z)	65.022817	95% Percentile (z)	91.675071
99% Percentile (z)	80.626206	99% Percentile (z)	176.13178
Gamma Distribution Test		**Data Distribution Test**	
k star	1.0255571	**Data appear Normal at 5% Significance Level**	
Theta Star	26.68062		
MLE of Mean	27.3625		
MLE of Standard Deviation	27.019409		
nu star	16.408914		
A-D Test Statistic	0.4329246	**Nonparametric Statistics**	
5% A-D Critical Value	0.7283527	90% Percentile	58.03
K-S Test Statistic	0.201007	95% Percentile	58.765
5% K-S Critical Value	0.2988782	99% Percentile	59.353
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	59.5
90% Percentile	62.613661	95% Percentile Bootstrap UTL with 95% Coverage	59.5
95% Percentile	81.243663	95% BCA Bootstrap UTL with 95% Coverage	59.5
99% Percentile	124.42179	95% UPL	59.5
		95% Chebyshev UPL	133.21711
95% WH Approx. Gamma UPL	93.899917	Upper Threshold Limit Based upon IQR	105.2875
95% HW Approx. Gamma UPL	99.5868		
95% WH Approx. Gamma UTL with 95% Coverage	173.33745		
95% HW Approx. Gamma UTL with 95% Coverage	199.13066		

Copper

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		
Raw Statistics		**Log-Transformed Statistics**	
Minimum	0.97	Minimum	-0.030459
Maximum	8.6	Maximum	2.1517622
Second Largest	8.4	Second Largest	2.1282317
First Quartile	1.95	First Quartile	0.6369234
Median	2.525	Median	0.926192
Third Quartile	8.25	Third Quartile	2.1101585
Mean	4.3275	Mean	1.147104
SD	3.4208468	SD	0.8808879
Coefficient of Variation	0.7904903		
Skewness	0.5415719		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.7704645	Shapiro Wilk Test Statistic	0.8643671
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	15.229739	95% UTL with 95% Coverage	52.169274
95% UPL (t)	11.201706	95% UPL (t)	18.490402
90% Percentile (z)	8.7114916	90% Percentile (z)	9.7377223
95% Percentile (z)	9.9542923	95% Percentile (z)	13.410468
99% Percentile (z)	12.28558	99% Percentile (z)	24.443288
Gamma Distribution Test		**Data Distribution Test**	
k star	1.158788	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	3.7345053		
MLE of Mean	4.3275		
MLE of Standard Deviation	4.0200836		
nu star	18.540608		
A-D Test Statistic	0.6784024	**Nonparametric Statistics**	
5% A-D Critical Value	0.7264555	90% Percentile	8.46
K-S Test Statistic	0.2700193	95% Percentile	8.53
5% K-S Critical Value	0.2982643	99% Percentile	8.586
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	8.6
90% Percentile	9.6083496	95% Percentile Bootstrap UTL with 95% Coverage	8.6
95% Percentile	12.311014	95% BCA Bootstrap UTL with 95% Coverage	8.6
99% Percentile	18.520686	95% UPL	8.6
		95% Chebyshev UPL	20.143137
95% WH Approx. Gamma UPL	14.054795	Upper Threshold Limit Based upon IQR	17.7
95% HW Approx. Gamma UPL	14.793474		
95% WH Approx. Gamma UTL with 95% Coverage	25.299254		
95% HW Approx. Gamma UTL with 95% Coverage	28.625758		

Iron

General Statistics			
Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		
Raw Statistics		**Log-Transformed Statistics**	
Minimum	3745	Minimum	8.2281769
Maximum	62500	Maximum	11.042922
Second Largest	28800	Second Largest	10.268131
First Quartile	8240	First Quartile	8.9614711
Median	14380	Median	9.519121
Third Quartile	26625	Third Quartile	10.188531
Mean	20435.625	Mean	9.5310502
SD	19439.976	SD	0.9780266
Coefficient of Variation	0.9512788		
Skewness	1.652721		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.			
Background Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8246353	Shapiro Wilk Test Statistic	0.9513914
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	82390.829	95% UTL with 95% Coverage	311147.09
95% UPL (t)	59500.336	95% UPL (t)	98360.902
90% Percentile (z)	45348.957	90% Percentile (z)	48264.026
95% Percentile (z)	52411.54	95% Percentile (z)	68855.188
99% Percentile (z)	65659.772	99% Percentile (z)	134091.86
Gamma Distribution Test		**Data Distribution Test**	
k star	0.9661882	**Data appear Normal at 5% Significance Level**	
Theta Star	21150.77		
MLE of Mean	20435.625		
MLE of Standard Deviation	20790.123		
nu star	15.459012		
A-D Test Statistic	0.2681583	**Nonparametric Statistics**	
5% A-D Critical Value	0.729658	90% Percentile	38910
K-S Test Statistic	0.1864025	95% Percentile	50705
5% K-S Critical Value	0.2993477	99% Percentile	60141
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	62500
90% Percentile	47454.97	95% Percentile Bootstrap UTL with 95% Coverage	62500
95% Percentile	61969.783	95% BCA Bootstrap UTL with 95% Coverage	62500
99% Percentile	95757.438	95% UPL	62500
		95% Chebyshev UPL	110312.67
95% WH Approx. Gamma UPL	71606.758	Upper Threshold Limit Based upon IQR	54202.5
95% HW Approx. Gamma UPL	75608.845		
95% WH Approx. Gamma UTL with 95% Coverage	133787.15		
95% HW Approx. Gamma UTL with 95% Coverage	153145.65		
Lead			
General Statistics			
Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		
Raw Statistics		**Log-Transformed Statistics**	
Minimum	1.4	Minimum	0.3364722
Maximum	39.4	Maximum	3.6737658
Second Largest	23.3	Second Largest	3.1484534
First Quartile	1.775	First Quartile	0.5734971
Median	6.8	Median	1.7826492
Third Quartile	17.9	Third Quartile	2.8712278
Mean	12.1625	Mean	1.827653
SD	13.593059	SD	1.3129103
Coefficient of Variation	1.1176205		
Skewness	1.3261208		

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8264553	Shapiro Wilk Test Statistic	0.8967155
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	55.483579	95% UTL with 95% Coverage	408.25755
95% UPL (t)	39.477807	95% UPL (t)	87.003785
90% Percentile (z)	29.582706	90% Percentile (z)	33.455469
95% Percentile (z)	34.521092	95% Percentile (z)	53.903657
99% Percentile (z)	43.784684	99% Percentile (z)	131.88616
Gamma Distribution Test		**Data Distribution Test**	
k star	0.6300499	**Data appear Normal at 5% Significance Level**	
Theta Star	19.304026		
MLE of Mean	12.1625		
MLE of Standard Deviation	15.322703		
nu star	10.080799		
A-D Test Statistic	0.4224889	**Nonparametric Statistics**	
5% A-D Critical Value	0.7403248	90% Percentile	28.13
K-S Test Statistic	0.2201778	95% Percentile	33.765
5% K-S Critical Value	0.3027626	99% Percentile	38.273
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	39.4
90% Percentile	31.284417	95% Percentile Bootstrap UTL with 95% Coverage	39.4
95% Percentile	43.000758	95% BCA Bootstrap UTL with 95% Coverage	39.4
99% Percentile	71.218307	95% UPL	39.4
		95% Chebyshev UPL	75.007432
95% WH Approx. Gamma UPL	52.465542	Upper Threshold Limit Based upon IQR	42.0875
95% HW Approx. Gamma UPL	57.018837		
95% WH Approx. Gamma UTL with 95% Coverage	108.24899		
95% HW Approx. Gamma UTL with 95% Coverage	131.76434		

Magnesium

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	18.5	Minimum	2.9177707
Maximum	619	Maximum	6.4281053
Second Largest	366	Second Largest	5.9026333
First Quartile	120.675	First Quartile	4.7581084

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Median	233.5	Median	5.4531248
Third Quartile	344.25	Third Quartile	5.8407205
Mean	252.025	Mean	5.1459142
SD	191.18515	SD	1.1108983
Coefficient of Variation	0.758596		
Skewness	0.855351		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9448395	Shapiro Wilk Test Statistic	0.9064594
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	861.33208	95% UTL with 95% Coverage	5921.5114
95% UPL (t)	636.21234	95% UPL (t)	1600.816
90% Percentile (z)	497.03863	90% Percentile (z)	713.07572
95% Percentile (z)	566.49659	95% Percentile (z)	1067.6116
99% Percentile (z)	696.78817	99% Percentile (z)	2276.1712
Gamma Distribution Test		**Data Distribution Test**	
k star	0.9879955	**Data appear Normal at 5% Significance Level**	
Theta Star	255.08719		
MLE of Mean	252.025		
MLE of Standard Deviation	253.55147		
nu star	15.807928		
A-D Test Statistic	0.2274108	**Nonparametric Statistics**	
5% A-D Critical Value	0.729164	90% Percentile	441.9
K-S Test Statistic	0.1958621	95% Percentile	530.45
5% K-S Critical Value	0.299169	99% Percentile	601.29
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	619
90% Percentile	582.03822	95% Percentile Bootstrap UTL with 95% Coverage	619
95% Percentile	758.23134	95% BCA Bootstrap UTL with 95% Coverage	619
99% Percentile	1167.7011	95% UPL	619
		95% Chebyshev UPL	1135.9333
95% WH Approx. Gamma UPL	877.94861	Upper Threshold Limit Based upon IQR	679.6125
95% HW Approx. Gamma UPL	966.22903		
95% WH Approx. Gamma UTL with 95% Coverage	1622.5196		
95% HW Approx. Gamma UTL with 95% Coverage	1960.8724		

Manganese

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Raw Statistics		Log-Transformed Statistics	
Minimum	2.6	Minimum	0.9555114
Maximum	214	Maximum	5.365976
Second Largest	55.9	Second Largest	4.0235644
First Quartile	4.4625	First Quartile	1.4860555
Median	19.6	Median	2.7356099
Third Quartile	51.55	Third Quartile	3.9414069
Mean	46.25625	Mean	2.8171603
SD	71.1302	SD	1.5912384
Coefficient of Variation	1.5377425		
Skewness	2.3429457		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.6677872	Shapiro Wilk Test Statistic	0.9209135
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	272.9482	95% UTL with 95% Coverage	2666.2739
95% UPL (t)	189.19267	95% UPL (t)	409.42774
90% Percentile (z)	137.41327	90% Percentile (z)	128.56241
95% Percentile (z)	163.25502	95% Percentile (z)	229.18159
99% Percentile (z)	211.72984	99% Percentile (z)	677.85575
Gamma Distribution Test		**Data Distribution Test**	
k star	0.4624301	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	100.02864		
MLE of Mean	46.25625		
MLE of Standard Deviation	68.021685		
nu star	7.3988811		
A-D Test Statistic	0.4513812	**Nonparametric Statistics**	
5% A-D Critical Value	0.755022	90% Percentile	103.33
K-S Test Statistic	0.2359731	95% Percentile	158.665
5% K-S Critical Value	0.3068887	99% Percentile	202.933
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	214
90% Percentile	127.14532	95% Percentile Bootstrap UTL with 95% Coverage	214
95% Percentile	182.68563	95% BCA Bootstrap UTL with 95% Coverage	214
99% Percentile	320.30471	95% UPL	214
		95% Chebyshev UPL	375.11325
95% WH Approx. Gamma UPL	225.79801	Upper Threshold Limit Based upon IQR	122.18125
95% HW Approx. Gamma UPL	245.40165		
95% WH Approx. Gamma UTL with 95% Coverage	504.20967		
95% HW Approx. Gamma UTL with 95% Coverage	627.80495		

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Potassium

General Statistics

Number of Valid Data	8	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	1
Tolerance Factor	3.187	Percent Non-Detects	12.50%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	95	Minimum Detected	4.5538769
Maximum Detected	792	Maximum Detected	6.6745614
Mean of Detected	449.71429	Mean of Detected	5.9631005
SD of Detected	210.48572	SD of Detected	0.6715528
Minimum Non-Detect	50.8	Minimum Non-Detect	3.9278964
Maximum Non-Detect	50.8	Maximum Non-Detect	3.9278964

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

Background Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.9556955	Shapiro Wilk Test Statistic	0.807849
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	396.675	Mean (Log Scale)	5.6220566
SD	245.92761	SD (Log Scale)	1.1476256
95% UTL 95% Coverage	1180.4463	95% UTL 95% Coverage	10716.496
95% UPL (t)	890.86752	95% UPL (t)	2774.4698
90% Percentile (z)	711.84391	90% Percentile (z)	1203.2698
95% Percentile (z)	801.18992	95% Percentile (z)	1825.7256
99% Percentile (z)	968.78817	99% Percentile (z)	3991.1434
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	385.13504	Mean in Original Scale	404.93077
SD	252.46118	SD in Original Scale	232.4211
95% UTL with 95% Coverage	1189.7288	95% UTL with 95% Coverage	4223.7487
		95% BCA UTL with 95% Coverage	792
		95% Bootstrap (%) UTL with 95% Coverage	792
95% UPL (t)	892.4568	95% UPL (t)	1636.4961
90% Percentile (z)	708.67705	90% Percentile (z)	910.63029
95% Percentile (z)	800.39672	95% Percentile (z)	1220.0925
99% Percentile (z)	972.44756	99% Percentile (z)	2112.1205

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.1491157	Data appear Normal at 5% Significance Level	
Theta Star	209.2555		
nu star	30.08762		
A-D Test Statistic	0.5225435	**Nonparametric Statistics**	

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

5% A-D Critical Value	0.7106965	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.2522213	Mean	405.375
5% K-S Critical Value	0.3132208	SD	216.77173
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	82.781073
		95% KM UTL with 95% Coverage	1096.2265
Assuming Gamma Distribution		95% KM Chebyshev UPL	1407.578
Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	840.97868
Mean	393.5	90% Percentile (z)	683.17915
Median	427.5	95% Percentile (z)	761.93277
SD	251.50632	99% Percentile (z)	909.66146
k star	0.2587134		
Theta star	1520.988	**Gamma ROS Limits with Extrapolated Data**	
Nu star	4.1394146	95% Wilson Hilferty (WH) Approx. Gamma UPL	1924.7924
95% Percentile of Chisquare (2k)	2.4789478	95% Hawkins Wixley (HW) Approx. Gamma UPL	2906.5371
		95% WH Approx. Gamma UTL with 95% Coverage	4028.5708
90% Percentile	1178.0526	95% HW Approx. Gamma UTL with 95% Coverage	7610.6414
95% Percentile	1885.225		
99% Percentile	3758.8245		

Note: DL/2 is not a recommended method.

Silver

General Statistics

Number of Valid Data	8	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	6

Warning: Data set has only 2 Detected Values.

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

No statistics will be produced!

Tolerance Factor	3.187	Percent Non-Detects	75.00%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.37	Minimum Detected	-0.994252
Maximum Detected	0.67	Maximum Detected	-0.400478
Mean of Detected	0.52	Mean of Detected	-0.697365
SD of Detected	0.212132	SD of Detected	0.4198621
Minimum Non-Detect	0.31	Minimum Non-Detect	-1.171183
Maximum Non-Detect	0.37	Maximum Non-Detect	-0.994252

Data with Multiple Detection Limits	**Single Detection Limit Scenario**	
Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect with Single DL	6
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected with Single DL	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	75.00%

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

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

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

Background Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.255625	Mean (Log Scale)	-1.516573
SD	0.1821976	SD (Log Scale)	0.5345148
95% UTL 95% Coverage	0.8362889	95% UTL 95% Coverage	1.2055384
95% UPL (t)	0.6217519	95% UPL (t)	0.6424522
90% Percentile (z)	0.4891207	90% Percentile (z)	0.4353677
95% Percentile (z)	0.5553135	95% Percentile (z)	0.528679
99% Percentile (z)	0.6794801	99% Percentile (z)	0.7610128
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		95% UTL 95% Coverage	N/A
		95% UPL (t)	N/A
		90% Percentile (z)	N/A
		95% Percentile (z)	N/A
		99% Percentile (z)	N/A
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.4075
5% K-S Critical Value	N/A	SD	0.0992157
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0496078
		95% KM UTL with 95% Coverage	0.7237004
Assuming Gamma Distribution		95% KM Chebyshev UPL	0.8662049
Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	0.6068743
Mean	N/A	90% Percentile (z)	0.53465
Median	N/A	95% Percentile (z)	0.5706953
SD	N/A	99% Percentile (z)	0.6383102
k star	N/A		
Theta star	N/A	**Gamma ROS Limits with Extrapolated Data**	
Nu star	N/A	95% Wilson Hilferty (WH) Approx. Gamma UPL	N/A
95% Percentile of Chisquare (2k)	N/A	95% Hawkins Wixley (HW) Approx. Gamma UPL	N/A
		95% WH Approx. Gamma UTL with 95% Coverage	N/A
90% Percentile	N/A	95% HW Approx. Gamma UTL with 95% Coverage	N/A
95% Percentile	N/A		
99% Percentile	N/A		

Note: DL/2 is not a recommended method.

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Vanadium

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Tolerance Factor	3.187		

Raw Statistics		**Log-Transformed Statistics**	
Minimum	11.05	Minimum	2.4024304
Maximum	64	Maximum	4.1588831
Second Largest	45	Second Largest	3.8066625
First Quartile	16.85	First Quartile	2.8179495
Median	32.6	Median	3.4794713
Third Quartile	42.75	Third Quartile	3.7549178
Mean	32.35625	Mean	3.3208481
SD	18.070446	SD	0.6222367
Coefficient of Variation	0.5584839		
Skewness	0.4981547		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Background Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9462932	Shapiro Wilk Test Statistic	0.9433741
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% UTL with 95% Coverage	89.946762	95% UTL with 95% Coverage	201.12297
95% UPL (t)	68.668885	95% UPL (t)	96.663445
90% Percentile (z)	55.514459	90% Percentile (z)	61.453239
95% Percentile (z)	62.079489	95% Percentile (z)	77.040898
99% Percentile (z)	74.394394	99% Percentile (z)	117.72921
Gamma Distribution Test		**Data Distribution Test**	
k star	2.1855085	**Data appear Normal at 5% Significance Level**	
Theta Star	14.804907		
MLE of Mean	32.35625		
MLE of Standard Deviation	21.886783		
nu star	34.968136		
A-D Test Statistic	0.2569364	**Nonparametric Statistics**	
5% A-D Critical Value	0.7204159	90% Percentile	50.7
K-S Test Statistic	0.1625469	95% Percentile	57.35
5% K-S Critical Value	0.2959474	99% Percentile	62.67
Data appear Gamma Distributed at 5% Significance Level			
Assuming Gamma Distribution		95% UTL with 95% Coverage	64
90% Percentile	61.638565	95% Percentile Bootstrap UTL with 95% Coverage	64
95% Percentile	74.643221	95% BCA Bootstrap UTL with 95% Coverage	64
99% Percentile	103.33667	95% UPL	64
		95% Chebyshev UPL	115.90153

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

95% WH Approx. Gamma UPL	81.044708	Upper Threshold Limit Based upon IQR	81.6
95% HW Approx. Gamma UPL	83.931008		
95% WH Approx. Gamma UTL with 95% Coverage	129.38111		
95% HW Approx. Gamma UTL with 95% Coverage	140.38974		

Zinc

General Statistics

Number of Valid Data	8	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	2
Tolerance Factor	3.187	Percent Non-Detects	25.00%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.665	Minimum Detected	-0.407968
Maximum Detected	50.7	Maximum Detected	3.9259259
Mean of Detected	20.3275	Mean of Detected	2.4292748
SD of Detected	17.615838	SD of Detected	1.5295385
Minimum Non-Detect	2	Minimum Non-Detect	0.6931472
Maximum Non-Detect	4	Maximum Non-Detect	1.3862944

Data with Multiple Detection Limits	**Single Detection Limit Scenario**	
Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect with Single DL	3
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected with Single DL	5
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	37.50%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

Background Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.9412169	Shapiro Wilk Test Statistic	0.8642267
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	15.620625	Mean (Log Scale)	1.9085995
SD	17.253574	SD (Log Scale)	1.6232301
95% UTL 95% Coverage	70.607767	95% UTL 95% Coverage	1190.1492
95% UPL (t)	50.291753	95% UPL (t)	176.00054
90% Percentile (z)	37.73197	90% Percentile (z)	53.992904
95% Percentile (z)	44.00023	95% Percentile (z)	97.375584
99% Percentile (z)	55.758441	99% Percentile (z)	294.35824
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	10.911182	Mean in Original Scale	15.510178
SD	22.090212	SD in Original Scale	17.355719
95% UTL with 95% Coverage	81.312687	95% UTL with 95% Coverage	1397.1637
		95% BCA UTL with 95% Coverage	50.7
		95% Bootstrap (%) UTL with 95% Coverage	50.7
95% UPL (t)	55.301552	95% UPL (t)	189.58105

TABLE HH-3
BACKGROUND THRESHOLD VALUES (BTVs) PROUCL OUTPUT
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

90% Percentile (z)	39.220927	90% Percentile (z)	55.146487
95% Percentile (z)	47.246347	95% Percentile (z)	102.1315
99% Percentile (z)	62.300699	99% Percentile (z)	324.49752
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.6068984	Data appear Normal at 5% Significance Level	
Theta Star	33.494076		
nu star	7.2827804		
A-D Test Statistic	0.2555424	**Nonparametric Statistics**	
5% A-D Critical Value	0.7152985	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.2102347	Mean	15.411875
5% K-S Critical Value	0.3409376	SD	16.32295
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	6.3218513
		95% KM UTL with 95% Coverage	67.433116
Assuming Gamma Distribution		95% KM Chebyshev UPL	90.877941
Gamma ROS Statistics with Extrapolated Data		95% KM UPL (t)	48.212909
Mean	15.245625	90% Percentile (z)	36.330577
Median	11.6	95% Percentile (z)	42.260738
SD	17.612494	99% Percentile (z)	53.384735
k star	0.1913177		
Theta star	79.687491	**Gamma ROS Limits with Extrapolated Data**	
Nu star	3.0610828	95% Wilson Hilferty (WH) Approx. Gamma UPL	101.13163
95% Percentile of Chisquare (2k)	1.9941135	95% Hawkins Wixley (HW) Approx. Gamma UPL	151.76627
		95% WH Approx. Gamma UTL with 95% Coverage	250.85638
90% Percentile	46.080477	95% HW Approx. Gamma UTL with 95% Coverage	492.67357
95% Percentile	79.452949		
99% Percentile	172.00974		
Note: DL/2 is not a recommended method.			

Table HH-4

Soil UCL Support Documentation

Site 9 Human Health Risk Assessment

TABLE HH-4
SOIL UCL SUPPORT DOCUMENTATION
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	C:\Earle\Site_9\UCLs\Earle_Site9_Soil_ProUCLinput.wst		
Full Precision	ON		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Aluminum			
General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	6
Raw Statistics		**Log-transformed Statistics**	
Minimum	2320	Minimum of Log Data	7.7493225
Maximum	9220	Maximum of Log Data	9.1291303
Mean	6721.6667	Mean of log Data	8.7255274
Median	6815	SD of log Data	0.5094324
SD	2534.5565		
Std. Error of Mean	1034.7284		
Coefficient of Variation	0.3770726		
Skewness	-1.047055		
Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!			
It is suggested to collect at least 8 to 10 observations using these statistical methods!			
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.			
Warning: There are only 6 Values in this data			
Note: It should be noted that even though bootstrap methods may be performed on this data set,			
the resulting calculations may not be reliable enough to draw conclusions			
The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.			
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8968547	Shapiro Wilk Test Statistic	0.7906458
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	8806.6944	95% H-UCL	12854.475
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13051.29
95% Adjusted-CLT UCL (Chen-1995)	7951.036	97.5% Chebyshev (MVUE) UCL	15734.479
95% Modified-t UCL (Johnson-1978)	8732.9772	99% Chebyshev (MVUE) UCL	21005.085
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.0469736	**Data appear Normal at 5% Significance Level**	
Theta Star	2206.0141		
MLE of Mean	6721.6667		
MLE of Standard Deviation	3850.7261		
nu star	36.563683		
Approximate Chi Square Value (.05)	23.722888	**Nonparametric Statistics**	
Adjusted Level of Significance	0.01222	95% CLT UCL	8423.6434
Adjusted Chi Square Value	20.072457	95% Jackknife UCL	8806.6944
		95% Standard Bootstrap UCL	8292.6155

TABLE HH-4
SOIL UCL SUPPORT DOCUMENTATION
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Anderson-Darling Test Statistic	0.5450826	95% Bootstrap-t UCL	8271.1009
Anderson-Darling 5% Critical Value	0.6980988	95% Hall's Bootstrap UCL	7983.7176
Kolmogorov-Smirnov Test Statistic	0.2950528	95% Percentile Bootstrap UCL	8151.6667
Kolmogorov-Smirnov 5% Critical Value	0.332736	95% BCA Bootstrap UCL	8056.6667
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	11231.943
		97.5% Chebyshev(Mean, Sd) UCL	13183.543
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	17017.084
95% Approximate Gamma UCL	10359.99		
95% Adjusted Gamma UCL	12244.086		
Potential UCL to Use		Use 95% Student's-t UCL	8806.6944

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

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

Arsenic

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	6

Raw Statistics		**Log-transformed Statistics**	
Minimum	6	Minimum of Log Data	1.7917595
Maximum	13.2	Maximum of Log Data	2.5802168
Mean	8.1166667	Mean of log Data	2.0543238
Median	7.2	SD of log Data	0.2963704
SD	2.7110269		
Std. Error of Mean	1.1067721		
Coefficient of Variation	0.3340074		
Skewness	1.6857026		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

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

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8095498	Shapiro Wilk Test Statistic	0.8693592
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	10.346866	95% H-UCL	10.940294

TABLE HH-4
SOIL UCL SUPPORT DOCUMENTATION
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	12.35715
95% Adjusted-CLT UCL (Chen-1995)	10.750994	97.5% Chebyshev (MVUE) UCL	14.203186
95% Modified-t UCL (Johnson-1978)	10.47381	99% Chebyshev (MVUE) UCL	17.829365
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	6.5071248	**Data appear Normal at 5% Significance Level**	
Theta Star	1.2473507		
MLE of Mean	8.1166667		
MLE of Standard Deviation	3.1818752		
nu star	78.085498		
Approximate Chi Square Value (.05)	58.728172	**Nonparametric Statistics**	
Adjusted Level of Significance	0.01222	95% CLT UCL	9.9371447
Adjusted Chi Square Value	52.706741	95% Jackknife UCL	10.346866
		95% Standard Bootstrap UCL	9.7713442
Anderson-Darling Test Statistic	0.4878778	95% Bootstrap-t UCL	12.258476
Anderson-Darling 5% Critical Value	0.6979838	95% Hall's Bootstrap UCL	17.065585
Kolmogorov-Smirnov Test Statistic	0.2489115	95% Percentile Bootstrap UCL	9.9666667
Kolmogorov-Smirnov 5% Critical Value	0.3322706	95% BCA Bootstrap UCL	10.466667
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	12.940974
		97.5% Chebyshev(Mean, Sd) UCL	15.028456
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	19.12891
95% Approximate Gamma UCL	10.791992		
95% Adjusted Gamma UCL	12.024913		
Potential UCL to Use		Use 95% Student's-t UCL	10.346866

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

Chromium

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	6

Raw Statistics		**Log-transformed Statistics**	
Minimum	10.9	Minimum of Log Data	2.3887628
Maximum	25.8	Maximum of Log Data	3.2503745
Mean	18.366667	Mean of log Data	2.8768763
Median	18.15	SD of log Data	0.2914003
SD	5.0170376		
Std. Error of Mean	2.048197		
Coefficient of Variation	0.2731599		
Skewness	0.0011583		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

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

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

TABLE HH-4
SOIL UCL SUPPORT DOCUMENTATION
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9874501	Shapiro Wilk Test Statistic	0.9617053
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	22.493883	95% H-UCL	24.717424
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	27.932186
95% Adjusted-CLT UCL (Chen-1995)	21.736686	97.5% Chebyshev (MVUE) UCL	32.058924
95% Modified-t UCL (Johnson-1978)	22.494044	99% Chebyshev (MVUE) UCL	40.165101
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	7.6204527	**Data appear Normal at 5% Significance Level**	
Theta Star	2.4101805		
MLE of Mean	18.366667		
MLE of Standard Deviation	6.6533437		
nu star	91.445433		
Approximate Chi Square Value (.05)	70.394533	**Nonparametric Statistics**	
Adjusted Level of Significance	0.01222	95% CLT UCL	21.735651
Adjusted Chi Square Value	63.754119	95% Jackknife UCL	22.493883
		95% Standard Bootstrap UCL	21.472083
Anderson-Darling Test Statistic	0.2101281	95% Bootstrap-t UCL	22.456464
Anderson-Darling 5% Critical Value	0.6977077	95% Hall's Bootstrap UCL	23.215454
Kolmogorov-Smirnov Test Statistic	0.1817946	95% Percentile Bootstrap UCL	21.45
Kolmogorov-Smirnov 5% Critical Value	0.3321036	95% BCA Bootstrap UCL	21.45
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	27.294551
		97.5% Chebyshev(Mean, Sd) UCL	31.157653
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	38.74597
95% Approximate Gamma UCL	23.859066		
95% Adjusted Gamma UCL	26.344145		
Potential UCL to Use		Use 95% Student's-t UCL	22.493883

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

Iron

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	6

Raw Statistics		**Log-transformed Statistics**	
Minimum	8580	Minimum of Log Data	9.0571892
Maximum	36300	Maximum of Log Data	10.499573
Mean	25780	Mean of log Data	10.066109
Median	27100	SD of log Data	0.5233928
SD	9789.3411		
Std. Error of Mean	3996.4818		
Coefficient of Variation	0.3797262		
Skewness	-1.130288		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

TABLE HH-4
SOIL UCL SUPPORT DOCUMENTATION
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

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

Warning: There are only 6 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9204412	Shapiro Wilk Test Statistic	0.79474
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	33833.104	95% H-UCL	50706.483
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	50813.144
95% Adjusted-CLT UCL (Chen-1995)	30383.15	97.5% Chebyshev (MVUE) UCL	61407.182
95% Modified-t UCL (Johnson-1978)	33525.749	99% Chebyshev (MVUE) UCL	82217.118
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.9316794	**Data appear Normal at 5% Significance Level**	
Theta Star	8793.5947		
MLE of Mean	25780		
MLE of Standard Deviation	15056.523		
nu star	35.180152		
Approximate Chi Square Value (.05)	22.609676	**Nonparametric Statistics**	
Adjusted Level of Significance	0.01222	95% CLT UCL	32353.628
Adjusted Chi Square Value	19.05698	95% Jackknife UCL	33833.104
		95% Standard Bootstrap UCL	31726.139
Anderson-Darling Test Statistic	0.536893	95% Bootstrap-t UCL	31974.149
Anderson-Darling 5% Critical Value	0.6980859	95% Hall's Bootstrap UCL	30759.362
Kolmogorov-Smirnov Test Statistic	0.2565038	95% Percentile Bootstrap UCL	31350
Kolmogorov-Smirnov 5% Critical Value	0.3327502	95% BCA Bootstrap UCL	30400
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	43200.26
		97.5% Chebyshev(Mean, Sd) UCL	50738.021
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	65544.492
95% Approximate Gamma UCL	40113.105		
95% Adjusted Gamma UCL	47591.19		
Potential UCL to Use		Use 95% Student's-t UCL	33833.104

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)

and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits

(e.g., Chen, Johnson, Lognormal, and Gamma) may not be

reliable. Chen's and Johnson's methods provide

adjustments for positvely skewed data sets.

Table HH-5

Comparison of Site 9 Soil

Concentrations to NJDEP Soil Background Levels

Site 9 Human Health Risk Assessment

TABLE HH-5
COMPARISON OF CONCENTRATIONS IN SITE 9 SOIL TO NJDEP SOIL BACKGROUND LEVELS
NWS EARLE, COLTS NECK, NEW JERSEY

SAMPLE LOCATION	TP9-01		TP9-02		TP9-03		TP9-04		TP9-05		TP9-06		NJDEP BACKGROUND LEVELS URBAN COASTAL PLAIN SOILS			
SAMPLE NOMENCLATURE (RI)	09-001-T007		09-002-T010		09-003-T001		09-004-T001		09-005-T001		09-006-T008					
SAMPLE DEPTH	4 - 7 feet bgs		6 -10 feet bgs		6 - 9 feet bgs		3 - 5 feet bgs		3 - 6 feet bgs		5 - 8 feet bgs		Frequency of Detection	Method Detection Limit	Median Concentration	90th Percentile Concentration
DATA SOURCE	SI		SI		SI		SI		SI		SI					
INORGANICS	**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**		**mg/kg**			**mg/kg**	**mg/kg**	**mg/kg**
aluminum	2,320		9,070		6,090		7,350		6,280		9,220		91 / 91	20	6,800	10,800
antimony	8.41	U	9.04	U	8.87	U	7.47	U	8.4	U	9.03	U	0 / 91	6	< Detection Limit	< Detection Limit
arsenic	6		7.9		13.2		6.5		6.3		8.8		82 / 91	1	5.2	13.6
barium	5	B	13.5	B	7.7	B	20.4	B	31.8	B	10.1	B	60 / 91	20	28.3	65.8
beryllium	0.3	B	1.2	B	0.52	B	0.72	B	0.58	B	0.93	B	15 / 91	0.5	< Detection Limit	0.68
cadmium	0.93	U	1.03	U	0.99	U	0.85	U	0.96	U	1.01	U	5 / 91	0.5	< Detection Limit	< Detection Limit
calcium	110	B	242	B	141	B	750	B	799	B	89.5	B	59 / 91	500	995	2000
chromium, total	10.9		16.2		21		19.4		16.9		25.8		91 / 91	1	11.8	34.7
cobalt	2.1	B	4.3	B	2.3	B	4.6	B	3.9	B	4	B	7 / 91	5	< Detection Limit	< Detection Limit
copper	3	B	4.2	B	4.1	B	4.9	B	6.3		3.1	B	82 / 91	2.5	9.3	33.3
iron	8,580		36,300		22,300		33,300		27,600		26,600		91 / 91	10	8,830	21,100
lead	5.5		5.6		9.9		12.7		17.4		6.9		82 / 91	10	37.6	144
magnesium	147	B	1,210	B	911	B	1,100		893	B	1,520		54 / 91	500	673	1,870
manganese	59.2		112		24.4		104		168		28.1		91 / 91	1.5	62.4	206
mercury	0.06	U	0.07	U	0.06	U	0.05	U	0.06	U	0.06	U	39 / 91	0.1	< Detection Limit	0.21
nickel	4.2	U	4.65	U	4.45	U	3.82	U	4.33	U	4.53	U	43 / 91	4	< Detection Limit	12.3
potassium	209	U	1,840		1,970		2,040		1,420		4,120		45 / 91	500	< Detection Limit	1,750
selenium	0.47	U	0.51	U	0.48	U	0.41	U	0.48	U	0.5	U	0 / 91	1	< Detection Limit	< Detection Limit
silver	1.87	U	2.7		1.97	U	2.5		2.2	B	2.01	U	3 / 91	1	< Detection Limit	< Detection Limit
sodium	42.6	B	52.8	B	47.8	B	50.5	B	36.5	B	51.3	B	0 / 91	500	< Detection Limit	< Detection Limit
thallium	0.47	U	0.51	U	0.48	U	0.41	U	0.48	U	0.5	U	2 / 91	1	< Detection Limit	< Detection Limit
vanadium	23.2		5.7	B	20.8		11		11.7	B	11.5	B	86 / 91	5	16	35.5
zinc	5.3		39.8		17.5		60.3		44.6		60.1		88 / 91	2	39.9	106

Notes:

NA	Not Sampled
J	Value is estimated because concentration is below the quantitation limit or because of exceedances of data validation quality control criteria.
JP	Value is estimated because concentration is below the quantitation limit or because of exceedances of data validation quality control criteria.
B	Analyte also detected in a the blank sample.
U	Compound or element was not detected. Value is the detection limit (inorganics) or quantitation limit (organics).

Sample Data Source:
Weston (Roy F. Weston, Inc.), 1994. Installation Restoration Program Site Investigation for 16 Sites at NWS Earle, Colts Neck, NJ. West Chester, PA. January.
NJDEP Background Data Source:
Sanders, Paul F, 2003. Ambient Levels of Metals in New Jersey Soils. Environmental Assessment and Risk Analysis Element Research Project Summary.
NJDEP Division of Science, Research, and Technology. May.

Attachment 5

RAGS D Tables Excluding COPCs Similar to Background

Site 9 Human Health Risk Assessment

RAGS D Table 2s – BACKGROUND ELIMINATED

Site 9 Human Health Risk Assessment

TABLE 2.1.bkg
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - EXPOSURE TO SOIL, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point(s)	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits (2)	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Contaminant Selection or Deletion (6,7)
Contact with Soil	7429-90-5	**Aluminum**	2320	9220	mg/kg	TP9-06	6/6	N/A	9220	See Attachment 4	7700 N			**Y**	**ASL**
	7440-38-2	Arsenic	6	13.2	mg/kg	TP9-03	6/6	N/A	13.2	See Attachment 4	0.39 C			N**	BKG
	7440-47-3	Chromium	10.9	25.8	mg/kg	TP9-06	6/6	N/A	25.8	See Attachment 4	0.29 C			N**	BKG
	7440-50-8	Copper	6.3	6.3	mg/kg	TP9-05	1/1	N/A	6.3	See Attachment 4	310 N			N	BSL, BKG
	57-12-5	Cyanide	1.57	1.57	mg/kg	TP9-06	1/6	1.07-1.31	1.57	See Attachment 4	22 N			N	BSL
	7439-89-6	Iron	8580	36300	mg/kg	TP9-02	6/6	N/A	36300	See Attachment 4	5500 N			N	BKG
	7439-92-1	Lead	5.5	17.4	mg/kg	TP9-05	6/6	N/A	17.4	See Attachment 4	400 N			N	BSL, BKG
	7439-95-4	Magnesium	1100	1520	mg/kg	TP9-06	2/2	N/A	1520	See Attachment 4	N			N	NUT
	7439-96-5	Manganese	24.4	168	mg/kg	TP9-05	6/6	N/A	168	See Attachment 4	180 N			N	BSL, BKG
	7440-09-7	Potassium	1420	4120	mg/kg	TP9-06	5/6	209-209	4120	See Attachment 4	N			N	NUT
	7440-22-4	Silver	2.5	2.7	mg/kg	TP9-02	2/5	1.87-2.01	2.7	See Attachment 4	39 N			N	BSL
	7440-62-2	Vanadium	11	23.2	mg/kg	TP9-01	3/3	N/A	23.2	See Attachment 4	39 N			N	BSL, BKG
	7440-66-6	Zinc	5.3	60.3	mg/kg	TP9-04	6/6	N/A	60.3	See Attachment 4	2300 N			N	BSL
	72-54-8	4,4'-DDD	0.41 J	0.41 J	ug/kg	TP9-05	1/6	3.8-4.3	0.41	--	2000 C			N	BSL
	72-55-9	4,4'-DDE	0.41 J	1.2 J	ug/kg	TP9-05	2/6	3.8-4.3	1.2	--	1400 C			N	BSL
	50-29-3	4,4'-DDT	0.41 J	0.82 J	ug/kg	TP9-04	2/6	3.8-4.3	0.82	--	1700 C			N	BSL
	72-43-5	Methoxychlor	93	93	ug/kg	TP9-04	1/6	19-22	93	--	31000 N			N	BSL
	117-81-7	Bis(2-ethylhexyl) Phthalate	26 J	35 J	ug/kg	TP9-02	3/6	390-440	35	--	35000 C			N	BSL
	84-74-2	Di-n-butyl Phthalate	21 J	37 J	ug/kg	TP9-02	6/6	N/A	37	--	610000 N			N	BSL
	67-66-3	Chloroform	1 J	1 J	ug/kg	TP9-01	2/6	11-13	1	--	290 C			N	BSL

Footnotes:

** - Arsenic and chromium are classified as known human carcinogens.
1 - Data qualifiers are defined in the Definitions section of the footnotes to this table.
2 - Values presented are sample-specific quantitation limits or sample-specific instrument detection limits.
3 - The maximum detected concentration is used for screening purposes.
4 - In this appendix, modified RAGS D tables have eliminated metal COPCs based on statistical two sample hypothesis tests presented in Attachment 4.
5 - The EPA Regional Screening Levels (RSLs) for residential soil exposure are presented. The noncarcinogenic values (annotated "N") are divided by 10. to correspond to a target hazard quotient of 0.1, or an incremental cancer risk of 1.0E-06 for carcinogens (annotated "C") (USEPA , November 2012).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is above background if it is a metal.

Samples Compared:

TP9-01	TP9-03	TP9-05
TP9-02	TP9-04	TP9-06

Definitions:

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
N/A = Not Applicable or Not Available
COPC = Chemical of Potential Concern
C = Carcinogen
N = Non-Carcinogenic
J = Estimated Value

(7) Rationale Codes:

For Selection as a COPC:
ASL = Above Screening Level
For Elimination as a COPC:
BSL = Below Screening Level
NUT = Nutrient
BKG = Concentrations do not exceed background based on statistical tests.

RAGS D Table 7s – BACKGROUND ELIMINATED

Site 9 Human Health Risk Assessment

TABLE 7 (RAGS D 7.1.bkg.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CHILD* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child*

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	9.65E-03	mg/kg-day	--	1/(mg/kg-day)	--	1.13E-01	mg/kg-day	1.00E+00	mg/kg-day	1.13E-01
			Exp. Route Total								--					1.13E-01
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
			Exp. Route Total								--					--
		Exposure Point Total									--					1.13E-01
	Exposure Medium Total										--					1.13E-01
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	1.17E-07	mg/m3	--	1/(mg/m3)	--	1.37E-06	mg/m3	5.00E-03	mg/m3	2.74E-04
			Exp. Route Total								--					2.74E-04
		Exposure Point Total									--					2.74E-04
	Exposure Medium Total										--					2.74E-04
Medium Total											--					1.13E-01
											Total of Receptor Risks Across All Media					Total of Receptor Hazards Across All Media	1.13E-01

***In this table, risks for the "child" receptor cover ages 0 to 6 years. For mutagens, cancer risks for higher age group categories (ages 6 to 16 and ages 16 to 30) are presented in a table labeled as an "adult" receptor.**

TABLE 7 (RAGS D 7.2.bkg.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - ADULT* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult*

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	4.14E-03	mg/kg-day	--	1/(mg/kg-day)	--	1.21E-02	mg/kg-day	1.00E+00	mg/kg-day	1.21E-02
			Exp. Route Total								--					1.21E-02
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
			Exp. Route Total								--					--
		Exposure Point Total									--					1.21E-02
	Exposure Medium Total										--					1.21E-02
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.70E-07	mg/m3	--	1/(mg/m3)	--	1.37E-06	mg/m3	5.00E-03	mg/m3	2.74E-04
			Exp. Route Total								--					2.74E-04
		Exposure Point Total									--					2.74E-04
	Exposure Medium Total										--					2.74E-04
Medium Total											--					1.23E-02
											Total of Receptor Risks Across All Media					Total of Receptor Hazards Across All Media
											--					1.23E-02

***For mutagens, the labeled "adult" receptor assumes exposures across a combined age range of 6 to 16 (10 years) plus ages 16 to 30 (14 years).**

TABLE 7 (RAGS D 7.3.bkg.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - LIFETIME* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult*

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	4.14E-03	mg/kg-day	--	1/(mg/kg-day)	--					N/A
			Exp. Route Total								--					--
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--					N/A
			Exp. Route Total								--					--
		Exposure Point Total									--					--
	Exposure Medium Total										--					--
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.70E-07	mg/m3	--	1/(mg/m3)	--					N/A
			Exp. Route Total								--					--
		Exposure Point Total									--					--
	Exposure Medium Total										--					--
Medium Total											--					--
											Total of Receptor Risks Across All Media	--			Total of Receptor Hazards Across All Media	--

***Lifetime receptor exposures represent the sum of ages 0 to 6 (referred to as "child" exposure) plus ages 6 to 30 (referred to as "adult" exposure).**

TABLE 7 (RAGS D 7.4.bkg.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - INDUSTRIAL WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	3.08E-03	mg/kg-day	--	1/(mg/kg-day)	--	8.62E-03	mg/kg-day	1.00E+00	mg/kg-day	8.62E-03
			Exp. Route Total								--					8.62E-03
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
			Exp. Route Total								--					--
		Exposure Point Total									--					8.62E-03
	Exposure Medium Total										--					8.62E-03
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	2.33E-07	mg/m3	--	1/(mg/m3)	--	6.53E-07	mg/m3	5.00E-03	mg/m3	1.31E-04
			Exp. Route Total								--					1.31E-04
		Exposure Point Total									--					1.31E-04
	Exposure Medium Total										--					1.31E-04
Medium Total											--					8.75E-03
											Total of Receptor Risks Across All Media	--				Total of Receptor Hazards Across All Media	8.75E-03

TABLE 7 (RAGS D 7.5.bkg.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - CONSTRUCTION WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	2.11E-04	mg/kg-day	--	1/(mg/kg-day)	--	1.48E-02	mg/kg-day	1.00E+00	mg/kg-day	1.48E-02
			Exp. Route Total								--					1.48E-02
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
			Exp. Route Total								--					--
		Exposure Point Total									--					1.48E-02
	Exposure Medium Total										--					1.48E-02
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.85E-09	mg/m3	--	1/(mg/m3)	--	3.39E-07	mg/m3	5.00E-03	mg/m3	6.79E-05
			Exp. Route Total								--					6.79E-05
		Exposure Point Total									--					6.79E-05
	Exposure Medium Total										--					6.79E-05
Medium Total											--					1.49E-02
											Total of Receptor Risks Across All Media --					Total of Receptor Hazards Across All Media 1.49E-02

TABLE 7 (RAGS D 7.6.bkg.RME)
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS - RECREATIONAL USER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Site 9 Contact with Soil	Ingestion	Aluminum	8.81E+03	mg/kg	1.54E-04	mg/kg-day	--	1/(mg/kg-day)	--	1.34E-03	mg/kg-day	1.00E+00	mg/kg-day	1.34E-03
			Exp. Route Total								--					1.34E-03
			Dermal	Aluminum	8.81E+03	mg/kg	NA	mg/kg-day	--	1/(mg/kg-day)	--	NA	mg/kg-day	1.00E+00	mg/kg-day	NA
			Exp. Route Total								--					--
		Exposure Point Total									--					1.34E-03
	Exposure Medium Total										--					1.34E-03
	Particulates	Site 9 Airborne Particulates, Emitted from Soil	Inhalation	Aluminum	8.81E+03	mg/kg	4.36E-09	mg/m3	--	1/(mg/m3)	--	3.82E-08	mg/m3	5.00E-03	mg/m3	7.64E-06
			Exp. Route Total								--					7.64E-06
		Exposure Point Total									--					7.64E-06
	Exposure Medium Total										--					7.64E-06
Medium Total											--					1.35E-03
											Total of Receptor Risks Across All Media --					Total of Receptor Hazards Across All Media 1.35E-03

RAGS D Table 9s – BACKGROUND ELIMINATED

Site 9 Human Health Risk Assessment

TABLE 9 (RAGS D 9.1.bkg.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CHILD* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child*

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.13E-01	--	NA	1.13E-01
			(Total)	--	--	--		--		1.13E-01	--	--	1.13E-01
		Exposure Point Total						--					1.13E-01
	Exposure Medium Total							--					1.13E-01
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	2.74E-04	--	2.74E-04
			(Total)	--	--	--		--		--	2.74E-04	--	2.74E-04
		Exposure Point Total						--					2.74E-04
	Exposure Medium Total							--					2.74E-04
Soil Total								--					1.13E-01
Receptor Total								--					1.13E-01

Total Risk Across All Media: --

Total Hazard Index Across All Media: 1.13E-01

Total CNS HI = 1.13E-01

Total CNS (Developmental) HI = 1.13E-01

***In this table, risks for the "child" receptor cover ages 0 to 6 years. For mutagens, cancer risks for higher age group categories (ages 6 to 16 and ages 16 to 30) are presented in a table labeled as an "adult" receptor.**

TABLE 9 (RAGS D 9.2.bkg.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - ADULT* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult*

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.21E-02	--	NA	1.21E-02
			(Total)	--	--	--		--		1.21E-02	--	--	1.21E-02
		Exposure Point Total						--					1.21E-02
	Exposure Medium Total							--					1.21E-02
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	2.74E-04	--	2.74E-04
			(Total)	--	--	--		--		--	2.74E-04	--	2.74E-04
		Exposure Point Total						--					2.74E-04
	Exposure Medium Total							--					2.74E-04
Soil Total								--					1.24E-02
Receptor Total								--					1.24E-02

Total Risk Across All Media: --

Total Hazard Index Across All Media: 1.24E-02

Total CNS HI = 1.23E-02
Total CNS (Developmental) HI = 1.21E-02

***For mutagens, the labeled "adult" receptor assumes exposures across a combined age range of 6 to 16 (10 years) plus ages 16 to 30 (14 years).**

TABLE 9 (RAGS D 9.3.bkg.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - LIFETIME* RESIDENT EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult*

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	N/A	N/A	--	N/A	--
			(Total)	--	--	--		--		--	--	--	--
		Exposure Point Total						--					--
	Exposure Medium Total							--					--
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	N/A	--	N/A	--	--
			(Total)	--	--	--		--		--	--	--	--
		Exposure Point Total						--					--
	Exposure Medium Total							--					--
Soil Total								--					--
Receptor Total								--					--

Total Risk Across All Media: --

Total Hazard Index Across All Media: --

***Lifetime receptor exposures represent the sum of ages 0 to 6 (referred to as "child" exposure) plus ages 6 to 30 (referred to as "adult" exposure).**

TABLE 9 (RAGS D 9.4.bkg.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - INDUSTRIAL WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	8.62E-03	--	NA	8.62E-03
			(Total)	--	--	--		--		8.62E-03	--	--	8.62E-03
		Exposure Point Total						--					8.62E-03
	Exposure Medium Total							--					8.62E-03
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	1.31E-04	--	1.31E-04
			(Total)	--	--	--		--		--	1.31E-04	--	1.31E-04
		Exposure Point Total						--					1.31E-04
	Exposure Medium Total							--					1.31E-04
Soil Total								--					8.75E-03
Receptor Total								--					8.75E-03

Total Risk Across All Media: --

Total Hazard Index Across All Media: 8.75E-03

Total CNS HI = 8.75E-03
Total CNS (Developmental) HI = 8.62E-03

TABLE 9 (RAGS D 9.5.bkg.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CONSTRUCTION WORKER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

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

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.48E-02	--	NA	1.48E-02
			(Total)	--	--	--		--		1.48E-02	--	--	1.48E-02
		Exposure Point Total						--					1.48E-02
	Exposure Medium Total							--					1.48E-02
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	6.79E-05	--	6.79E-05
			(Total)	--	--	--		--		--	6.79E-05	--	6.79E-05
		Exposure Point Total						--					6.79E-05
	Exposure Medium Total							--					6.79E-05
Soil Total								--					1.49E-02
Receptor Total								--					1.49E-02

Total Risk Across All Media: --

Total Hazard Index Across All Media: 1.49E-02

Total CNS HI = 1.49E-02
Total CNS (Developmental) HI = 1.48E-02

TABLE 9 (RAGS D 9.6.bkg.RME)
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - RECREATIONAL USER EXPOSURE TO SOIL
REASONABLE MAXIMUM EXPOSURE, BACKGROUND ELIMINATED
SITE 9, NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Receptor Population: Recreational User
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Contact With Site 9 Soil	Aluminum	--	--	--	--	--	CNS (Developmental)	1.34E-03	--	NA	1.34E-03
			(Total)	--	--	--		--		1.34E-03	--	--	1.34E-03
		Exposure Point Total						--					1.34E-03
	Exposure Medium Total							--					1.34E-03
	Particulates	Particulate Dust Inhalation from Site 9 Soil	Aluminum	--	--	--	--	--	CNS	--	7.64E-06	--	7.64E-06
			(Total)	--	--	--		--		--	7.64E-06	--	7.64E-06
		Exposure Point Total						--					7.64E-06
	Exposure Medium Total							--					7.64E-06
Soil Total								--					1.35E-03
Receptor Total								--					1.35E-03

Total Risk Across All Media: --

Total Hazard Index Across All Media: 1.35E-03

Total CNS HI = 1.35E-03
Total CNS (Developmental) HI = 1.34E-03