GEORGIA
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

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Georgia Risk Assessment Guidance

Date

Technical Guidance Document

Acknowledgement

The Georgia Environmental Protection Division (EPD) Land Protection Branch thanks the following for their contributions to the development of this guidance document through their participation in the Georgia Risk Assessment Guidance Technical Advisory Committee:

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- Beth Blalock, Gilbert Harrell Sumerford and Martin, PC
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Additional EPD management and staff provided technical review of this document.

Acronyms

Acronym	Meaning
AALM	All Ages Lead Model
ADAF	Age-dependent Adjustment Factor
ADD	Average Daily Dose
AF	Skin Adherence Factor
ALM	Adult Lead Methodology
ARAR	Applicable or Relevant and Appropriate Requirement
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
BERA	Baseline Ecological Risk Assessment
Bgs	Below ground surface
BRA	Baseline Risk Assessment
BTV	Background Threshold Values
BW	Body Weight
CalEPA	California EPA
CAS	Chemical Abstracts Service
cm	Centimeter
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DL	Detection Limit
DNR	Georgia Department of Natural Resources
DQO	Data Quality Objectives
ELCR	Excess Lifetime Cancer Risk
USEPA	United States Environmental Protection Agency
ED	Exposure Duration
EF	Exposure Frequency
EPC	Exposure Point Concentration
EPD	Georgia Environmental Protection Division
ERA	Ecological Risk Assessment
ERAGS	USEPA's Ecological Risk Assessment Guidance for Superfund
ESV	USEPA Region 4 Ecological Screening Value
ET	Exposure Time
FAQs	Frequently Asked Questions
FBQSTP	Field Branches Quality System and Technical Procedures

Acronym	**Meaning**
g	Gram
GBA	Georgia Brownfield Act
GC/MS	Gas Chromatography-Mass Spectometry
GRAG	Georgia Risk Assessment Guidance
GRBCA	Georgia Risk Based Corrective Action
H	Henry's Law Constant
HEAST	Health Effects Assessment Summary Table
HI	Hazard Index
HQ	Hazard Quotient
HSRA	Georgia Hazardous Site Response Act
IEUBK	Integrated Exposure Uptake Biokinetic Model
iPAC	USFWS Information for Planning and Consultation
IR	Intake or Ingestion Rate
IRIS	Integrated Risk Information System
ITRC	Interstate Technology Regulatory Council
IUR	Inhalation Unit Risk
IVBA	In vitro bioaccessibility
kg	kilogram
K_{oc}	Organic Carbon partition coefficient
L	Liter
LOAEL	Lowest Observed Adverse Effect Level
LSASD	United States Environmental Protection Agency Laboratory Services and Applied Science Division
MAX MDL	Maximum Method Detection Limit
MCL	USEPA Maximum Contaminant Level
MDC	Maximum Detected Concentration
MDL	Method Detection Limit
mg	Milligram
mL	Milliliter
mm Hg	Millimeter of Mercury
NJ	New Jersey
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
NTU	Nephelometric Turbidity Units
O.C.G.A.	Official Code of Georgia Annotated
OLEM	Office of Land and Emergency Management (USEPA)
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls

Acronym	**Meaning**
PCOPEC	Preliminary Chemical of Potential Ecological Concern
PFAS	Per- or Poly-fluorinated Alkyl Substances
PPRTV	USEPA Provisional Peer-Reviewed Toxicity Value
PRG	Preliminary Remediation Goal
ProUCL	USEPA ProUCL Statistical Software
QA	Quality Assurance
QL	Quantitation Limit
RA	Risk Assessment
RAGS	USEPA's Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System (ORNL)
RAP	Risk Assessment Program of Georgia EPD
RBA	Relative Bioavailability
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RG	Remedial Goal
RGO	Remedial Goal Option
RL	Reporting Limit
RME	Reasonable Maximum Exposure
RPF	Relative Potency Factor
RSL	USEPA Regional Screening Level
RSV	Refinement Screening Value
SA	Skin Surface Area
SESD	USEPA Region 4 Science and Ecosystem Support Division, now referred to as the USEPA Region 4 Laboratory Services and Applied Science Division (LSASD)
SF	Slope Factor
SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific Management Decision Points
SSG	USEPA's 1996 Soil Screening Guidance
SSL	Soil Screening Level
SW-846	Hazardous Waste Test Methods
SWMU	Solid Waste Management Unit
TCE	Trichloroethylene
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalence Quotient
THQ	Target Hazard Quotient
TOSHI	Target Organ Specific Hazard Index
TR	Target Risk
TRV	Toxicity Reference Value

Acronym	**Meaning**
UCL	Upper Confidence Limit on the mean
UEC	Universal Environmental Covenant
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Services
USGS	United States Geologic Survey
UST	Underground Storage Tank
UTL	Upper Tolerance Limit
VI	Vapor Intrusion
VOC	Volatile Organic Compound
VRP	Voluntary Remediation Program
WQC-HH	National Recommended Water Quality Criteria - Human Health for the consumption of Water + Organism
WQS	Georgia Water Quality Standard (also referred to as Georgia Instream Water Quality Standard)

Contents

1.0. Introduction, and Guidelines for Applicability and Use of this Guidance Document

Purpose

The purpose of this guidance is to help risk assessors develop human health and/or ecological risk assessments that are acceptable to the Georgia Environmental Protection Division (EPD).

Applicability

This guidance document is applicable to state regulated sites as follows:

- Both human health and ecological risk assessments conducted for Resource Conservation and Recovery Act (RCRA) and Georgia Hazardous Waste Management Act sites unless the guidance contradicts existing statutes and regulations.
- The ecological risk assessment guidance herein is applicable to sites regulated under RCRA, Georgia Hazardous Site Response Act (HSRA), Voluntary Remediation Program Act (VRPA), and Georgia Brownfield Act (GBA).

Use of this guidance and its limitations

- This document is not a statute or regulation. It serves as general guidance and does not supersede existing legal requirements.
- This guidance represents methodologies that have been vetted by EPD and the technical advisory committee. Performing a risk assessment according to this guidance should result in fewer questions and comments from EPD and may result in faster approval. It is not intended to preclude the use of other methodologies which may be appropriate, but these should be discussed with EPD in advance to ensure they meet the legal requirements.
- This document is generic in nature and may not be appropriate for all sites. Site-specific considerations may necessitate alternative approaches.
- The soil-to-groundwater and vapor intrusion exposure pathways should be evaluated in accordance with the EPD's 2019 *FAQs for Evaluating the Soil-to-Groundwater Pathway* and 2021 *Guidance for Evaluating the Vapor Intrusion Exposure Pathway*, respectively.
- Releases from USTs containing fuel-related products should be evaluated using the Georgia Risk Based Corrective Action Model (GRBCA).
- This document supersedes EPD's 1996 Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units (SWMU Guidance).
- This document supersedes any differences between it and USEPA Region 4's 2018 *Human Health Risk Assessment Supplemental Guidance* and *Ecological Risk Assessment Supplemental Guidance* documents.

Benefits and Recommendations

- Using the methods and recommendations in this document can streamline EPD's review of human health and ecological risk assessments.
- If considering alternative approaches or methodologies, please discuss them with EPD before implementation.

- This document is subject to future revisions based on feedback and new information.
- Trade names mentioned in this document do not constitute endorsement by EPD.
- Additional Resources are provided throughout the document in blue text boxes, and additional information or tips are provided in orange boxes. Links to the resource documents can also be found in a *References, Resources and Tools* document on EPD's website.

2.0. EPD's Overall Risk Assessment Approach

Risk assessment is not a one-size-fits-all process. Contaminants from releases can migrate from soil into groundwater, then to surface waters and even the indoor air of our homes or offices, affecting our wildlife and ecosystem along the way. The level of effort that is needed to conduct a risk assessment is dependent on site-specific factors such as the number and identity of the chemicals present, number and complexity of exposure pathways, and the precision that is needed to support an informed risk management decision (USEPA, 1989).

Thus far, EPD has provided risk assessment guidance in its *FAQs for Evaluating the Soil-to-Groundwater Pathway* (2019), *Area Averaging Approach to Soil Compliance for Direct Contact Exposure Scenarios* (2020) and *Guidance for Evaluating the Vapor Intrusion Exposure Pathway (2021)*. Please follow those guidance documents to evaluate the leaching and vapor intrusion pathways, or to use area averaging to develop Exposure Point Concentrations (EPCs).

This document provides guidance for evaluating the risks to human health from direct contact with impacted media and ecological risks at contaminated sites. In cases where risks to human health and the environment are currently evident, taking immediate action with EPD oversight to reduce risks is more important than documenting the need for such actions.

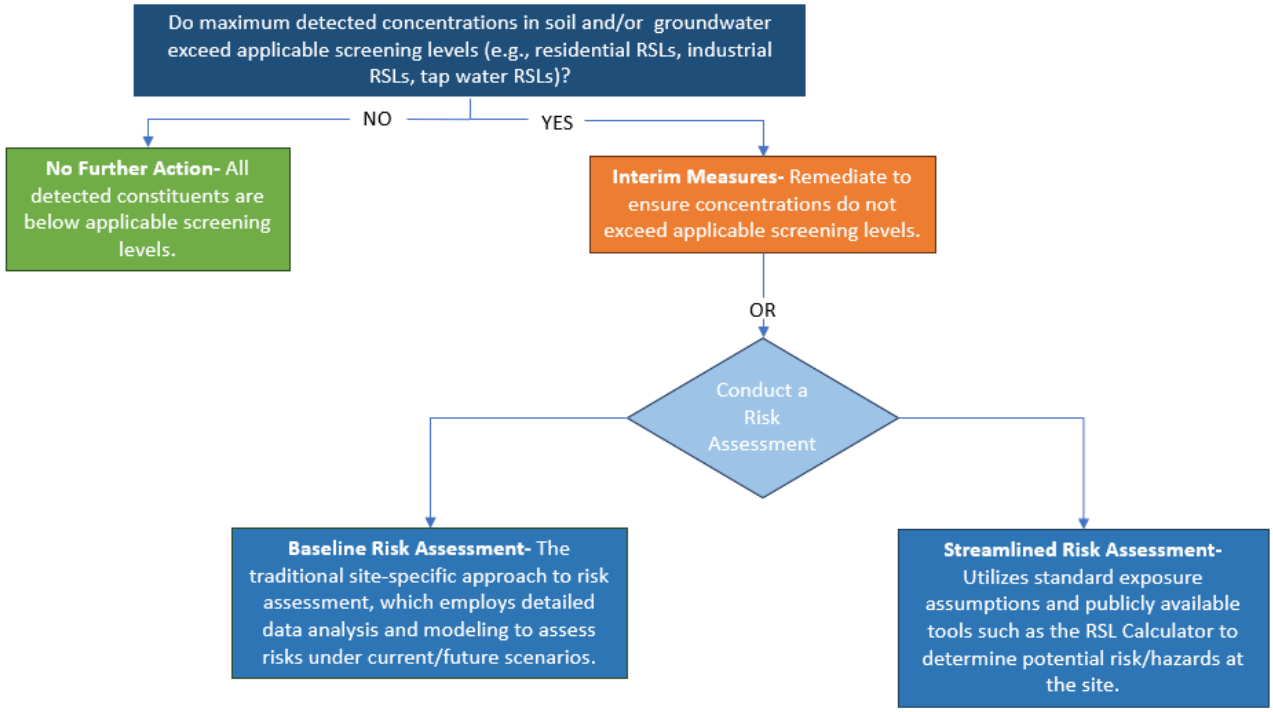
Risk and Hazard

In the GRAG, ***cancer risk*** refers to the theoretical calculations of increased cancer cases that might occur if people were exposed to specific chemical contaminants in the environment over an extended period. These estimates are specifically related to the chemical exposures from the environment and do not include risks from other factors such as family history, lifestyle or diet. The estimated risk is described as an Excess Lifetime Cancer Risk (ELCR), which indicates the additional number of cancer cases that could occur in a defined population exposed to a chemical over a lifetime. For instance, an ELCR of one in a million (1E-06) would mean there might be one additional cancer case in one million people exposed to the chemical over a lifetime. Importantly, these calculated excess cancer risks do not predict individual cancer outcomes nor do they reflect actual cancer cases within a population. The USEPA generally considers an ELCR between one in a million (1E-06) and one in ten thousand (1E-04) to be within an acceptable range. If multiple chemical contaminants are evaluated at a site, each chemical's risk is combined to determine a cumulative theoretical cancer risk.

In the GRAG**, n*on-cancer hazard*** refers to the potential for adverse health effects, other than cancer, resulting from exposure to a chemical contaminants at a site. This hazard is measured using a Hazard Quotient (HQ), which is the ratio of the chemical concentration in an environmental medium (e.g., soil, groundwater, air) to a chemical-specific reference dose or concentration, below which no adverse effects are expected. When exposure involves multiple chemicals, the individual HQs are summed to determine the Hazard Index (HI). A HQ or HI greater than 1 indicates a potential concern for noncancer health effects.

EPD proposes three options for preparing a human health risk assessment (See Figure 1 below for a flowchart showing where these options fit in the risk assessment process and Table 1 which provides the differences between baseline and streamlined risk assessments):

Figure 1: Risk Assessment Approach for Human Health Direct Contact



- **Interim Measures to USEPA Regional Screening Levels (RSLs):** This option is ideal for small releases such as a leaking drum or a small spill, especially when you only have a few pathways and/or few chemicals of potential concern. Cleaning up to RSLs is a preferred option if the release meets the following conditions:
    - Less than ten (10) chemicals
    - Non-residential land use
    - Contamination is limited to soils only. No other complete pathways (e.g., vapor intrusion (VI), soil migration to groundwater, ecological concerns).

  Interim corrective action measures should be based on the most current USEPA Regional Screening Levels (RSLs) set at a target cancer risk of 1E-05 and a hazard quotient of 1 for each individual contaminant. RSLs based on stricter criteria are also acceptable.

- **Streamlined Risk Assessment:** This option utilizes standard exposure assumptions and publicly available tools such as the RSL Calculator to determine risk and calculate cleanup levels based on human health, leaching, and direct contact considerations while factoring in Applicable or Relevant and Appropriate Requirements (ARARs). This option is ideal for less complex sites.

- **Baseline Risk Assessment:** This option is the traditional site-specific approach which employs detailed data analysis and modeling to assess risks under current conditions without considering potential corrective actions. Cleanup goals are derived based on this assessment and applicable regulatory requirements. A baseline risk assessment (BRA) can be conducted upon delineation of the site's contamination, after a streamlined risk assessment shows unacceptable risk, or redone after years of corrective action to determine whether corrective action has been satisfactorily completed at a site.

The following are the steps in conducting a risk assessment.

1. **Develop a Conceptual Site Model (CSM).** The first step in evaluating any site is to develop a CSM. Start by identifying the source of the contamination and the receiving environmental media. For instance, the source may be a leaking 55-gallon drums and the receiving environmental medium being surface soil. Second, map out the fate and transport of the contamination in the released media. For our example, migration of contamination might be to subsurface soil with leaching to groundwater, and possibly groundwater discharge to surface water. Third, determine exposure points and routes of exposure. For instance, a resident could be living near the contamination. The resident could be exposed through direct contact with contaminated soil or airborne dust, or, if the resident has a drinking water well or obtains their drinking water from surface water, the resident could be exposed by drinking contaminated water. If the contaminants are volatile, vapor intrusion from contaminated groundwater or soil could be an issue. A CSM should be a component of every risk assessment and should be updated as new information becomes available. See Section 3 for more information on the CSM.

2. **Evaluating Data for Inclusion into Risk Assessment.** It is ideal that risk assessors be involved early in the site investigation phase to understand the site and to determine what exposure pathways may be of interest to the assessment. The use of effective planning improves the useability of environmental data. All samples of environmental media (e.g., soil, groundwater, etc.) should be representative of the media being sampled; this is ensured by using standardized sampling methods and analytical protocols (USEPA, April 1992). Please see Section 4 of this document for more information on data collection guidelines and data useability.

3. **Organizing and Screening Data.** Once the data have been evaluated for useability, the data should be organized by medium. Once organized, contaminant concentrations in each environmental medium should be compared to risk-based screening levels to determine the chemicals of potential concern (COPCs). COPCs are those chemicals that will be evaluated in the risk assessment. If no COPCs are identified during the screening process for a certain medium, then no further investigation or cleanup is necessary for that medium (USEPA Region 4, March 2018). See Section 5 for more information on screening.

4. **COPC Risk Assessment.** Chemicals exceeding screening levels are considered COPCs and need further evaluation using one of the two types of risk assessments listed above (or for some sites, the site may be remediated to USEPA RSLs). If the calculated cumulative cancer risk and non-cancer hazard for a pathway (see the definition of pathway in the box to the right) exceeds the excess lifetime cancer risk (ELCR) of 1E-05 and/or hazard index (HI) of 1 for any receptor, Chemicals of Concern (COCs) should be selected, and corrective action may be required to reduce risks/hazard. See Sections 6 and 7 of this document for more guidance on conducting risk assessments (baseline risk assessment and streamlined risk assessment, respectively).

5. **Selection of Chemicals of Concern (COCs).** For each pathway that exceeds a cancer risk of 1E-05 and/or a hazard index (target organ specific or overall) of 1 for a receptor, the COC should be selected. COCs are the chemicals that contribute significantly to the overall risk for the pathway. See Section 6.4.1 for more information on selecting COCs.

6. **Ecological Risk Assessment.** Each site will also need to evaluate if there is a sufficient ecological habitat present on or off-site. If no habitat is present or may be impacted and this is confirmed by EPD, no further action is necessary for ecological risk. If an ecological habitat is present and may be impacted, sampling of the soils, sediments or surface water at the habitat is warranted. Analytical data will then be evaluated in a screening level ecological risk assessment (SLERA) and, if necessary, a baseline ecological risk assessment (BERA). See Section 8 for more information on ecological risk assessment.

7. **Calculation of Remedial Goals Options and Selection of final Remedial Goals(RGOs)..** For each pathway and receptor that exceed the risk/hazard threshold(s), risk-based human health direct contact and ecological remedial goals (if applicable) for COCs should be calculated. After evaluating other risks associated with the vapor intrusion and soil-to-groundwater (leaching) pathways at the site (if applicable), include all remedial goal options in a corrective action plan and select the goals that are protective of all receptors. See Section

A pathway in the context of this document is defined as direct contact (including inhalation, incidental ingestion, and dermal contact) with any of the following media:

1. Surface Soil
2. Subsurface Soil
3. Combined Soil
4. Groundwater
5. Surface Water
6. Sediment
7. Ambient Air
8. Indoor Air

The human food chain pathway includes human ingestion of vegetables, fruits, meat (deer, cows, fish, shellfish, etc.) and eggs. If the human food chain pathway is a potentially complete pathway at your site, please contact EPD to discuss.

9 of this document for guidance on the calculation of remedial goals options and the selection of remedial goals.

Table 1: Difference Between a Baseline Risk Assessment and Streamlined Risk Assessment

Criteria	Streamlined Risk Assessment	Baseline Risk Assessment
Guidance	Generally follows Section 7 of this guidance document. Uses standard exposure assumptions and publicly available tools to calculate risk.	Generally follows USEPA Region 4 Human Health Risk Assessment Supplemental Guidance and Section 6 of this guidance document.
Conceptual Site Model and Screening	See Section 3 (CSM) and Section 5 (Screening). Screening Template Tables or EPD's ScreenTool may be utilized to screen data.	
Exposure Assessment	Use the CSM to determine receptors, exposure points and pathways. Use standard exposure assumptions. Set the EPC as either the maximum detected concentration or the 95% Upper Confidence Limit or UCL on the mean of the environmental sampling data utilizing ProUCL software.	Use the CSM to determine receptors, exposure points and pathways. Use site-specific or standard exposure assumptions. Calculate an Exposure Point Concentration (EPC) utilizing either statistical evaluation (i.e., 95% UCL on the mean of the environmental sampling data utilizing ProUCL software) or area averaging[1].
Toxicity Assessment	Use toxicity values from the RSL calculator.	Use Toxicity Hierarchy in Section 6.3
Lead	Use applicable Lead RSLs as cleanup value.	The following models can be used to evaluate Lead and calculate cleanup values for Lead at your site: • Integrated Exposure Uptake Biokinetic Model or IEUBK • Adult Lead Methodology (ALM) • All Ages Lead Model or AALM
Risk Characterization	Use RSL or RAIS calculator to calculate risk and provide calculator printouts for risk calculations.	Use RSL or RAIS calculator or spreadsheet to calculate risk showing all calculations.

[1] Please see EPD's *Area Averaging Approach to Soil Compliance for Direct Contact Exposure Scenarios* (December 15, 2020) for guidance on area averaging.

3.0. The Conceptual Site Model

A well-developed Conceptual Site Model (CSM) lays the critical groundwork for an effective risk assessment. It serves as a dynamic roadmap that systematically outlines what we know and suspect about a site, ultimately driving the entire investigation and risk assessment process. The CSM facilitates a clear comprehension of potential contaminant sources, exposure pathways, and receptors. Risk assessors should consider site history and use, potential contaminant transport, characteristics of people who live, work, or conduct activities in or around the site, the physical setting, and contaminant characteristics to construct a detailed CSM. As more data is collected about the site, the CSM will need to be refined. A CSM informs the preparation of an investigation workplan so that the environmental sampling data collected are appropriate for the risk assessment (USEPA, July 2011).

The CSM is the working hypothesis, which is a "living" analysis updated as new information becomes available, that depicts the relationship between the chemical source areas, migration pathways, and receptors and exposure routes to identify the potentially complete exposure pathways at a site.

3.1. Understanding the CSM

Think of the CSM as a clear, evolving story of the site, not just a diagram or checklist. It answers fundamental questions, including:

- What are the sources of contamination? Pinpoint the origins of contaminants and the activities that may have led to their release.
- How do contaminants move? Track how contamination behaves – Does it spread through soil? Migrate through groundwater? Become airborne? Understanding these pathways is vital.
- Who or what might be exposed? Identify people, plants, and animals (receptors) who may come into contact with contaminants. Consider exposure routes - direct contact, eating contaminated food, breathing vapors, etc.
- What are the potential risks? Analyze the specific ways contaminants could harm the identified receptors. (ITRC, January 2015)

Resources

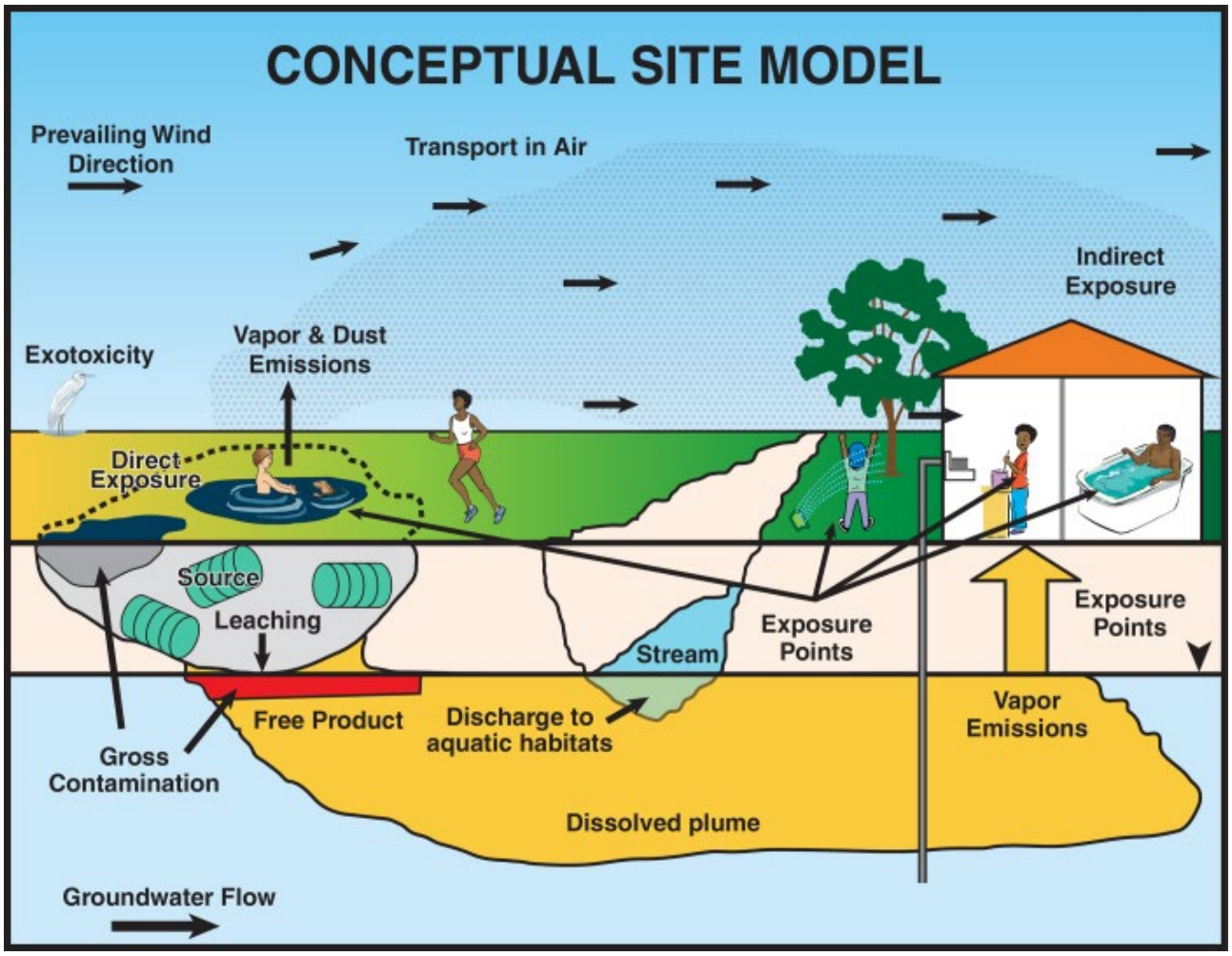
Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model, USEPA, EPA542-F-11-011, July 2021.

Decision Making at Contaminated Sites: Issues and Option in Human Health Risk Assessment, ITRC, Section 3.2, January 2015.

Soil Screening Guidance: User's Guide, USEPA, Publication 9355.4-23, Attachment A, July 1996.

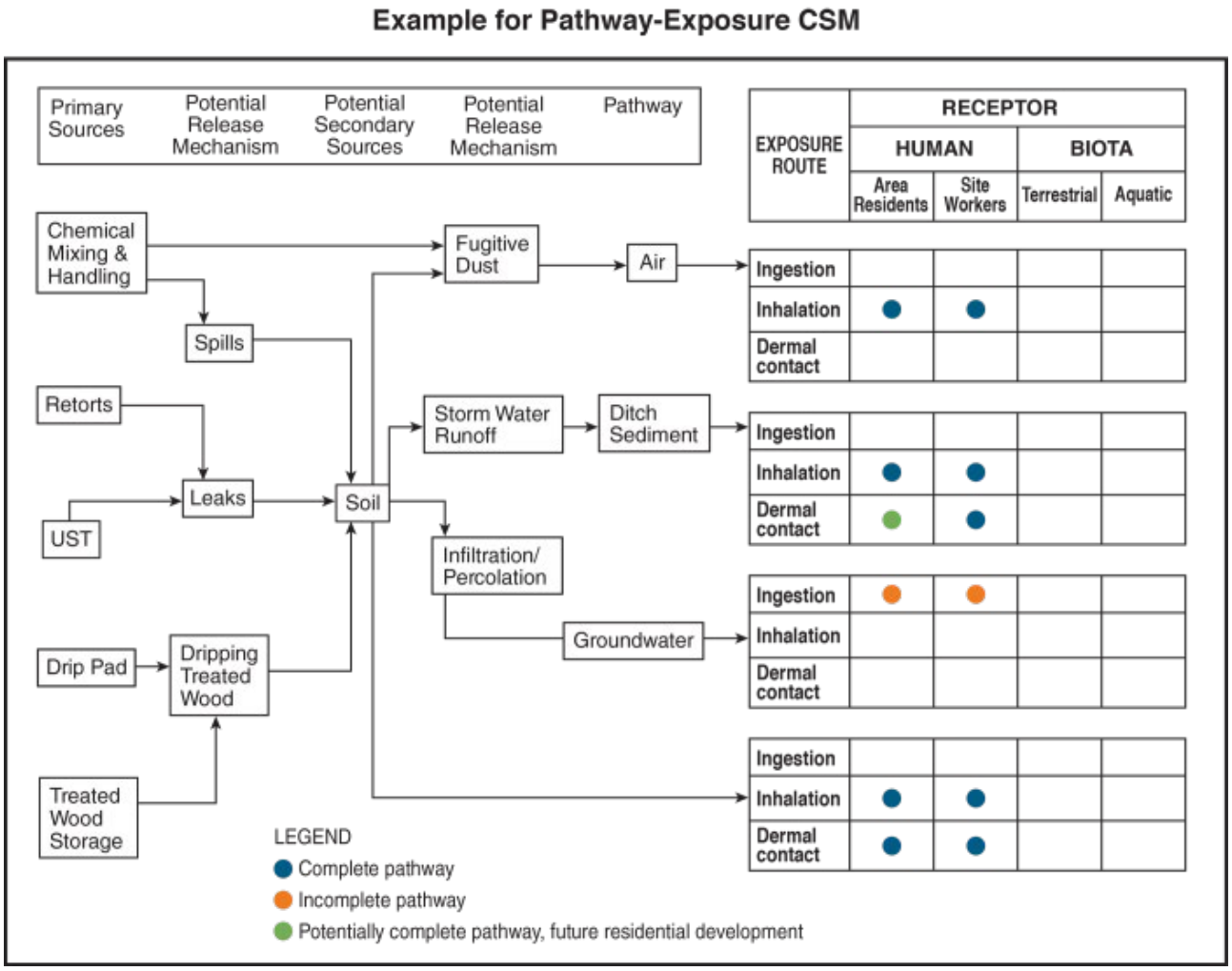
The USEPA's *Soil Screening Guidance User's Guide* (USEPA, 1996) presents Conceptual Site Model Summary Forms in Attachment A of that document, which are worksheets that may be useful to document site-specific information used in the development of the CSM. These worksheets do not need to be included in a risk assessment report but should be used as a checklist for what information should be included in the text of the CSM. However, the risk assessment report should include both a CSM diagram (See examples in Figure 2 and 3 below and in Exhibits A-2 and A-3 of Appendix A of the *Soil Screening Guidance: User's Guide* discussed above) and supporting text to discuss the elements used to identify the potentially complete exposure pathways. Where there are multiple zones, populations, or site sub-units, separate CSM diagrams may be required.

Figure 2: Conceptual Site Model Visual Depiction Example



Source: ITRC, *Decision Making at Contaminated Sites: Issues and Option in Human Health Risk Assessment*, Figure 3-2, January 2015. (ITRC, January 2015)

Figure 3:



Source: ITRC, *Decision Making at Contaminated Sites: Issues and Option in Human Health Risk Assessment*, Figure 3-3, January 2015. (ITRC, January 2015)

3.2. CSM as a Collaborative Tool

A CSM is best developed through teamwork. Stakeholders like risk assessors, site investigators, and ultimately regulators (e.g., the EPD) should be involved to ensure clarity and guide decision-making (USEPA, July 2011).

3.3. CSM and the EPD

By including these key elements in your CSM, you'll have the solid foundation the EPD needs to understand your site thoroughly:

- Thorough Source Identification: Pinpoint historical and current contamination sources on and around the site.

- Release Mechanisms: Explain how contaminants left their source – leaks, spills, intentional disposal, etc.

- Environmental Media Affected: Detail if the contamination affects soil, groundwater, surface water, and/or air.

- Potential Migration Pathways: Chart how contaminants could move in the future and where they might end up.

- Current and Future Land Use: Understand how the site is used now and planned uses – residential, commercial, etc.

- Receptors Clearly Defined: List people (workers, residents, children), animals, and sensitive environments within the area of concern. (New Jersey DEP, August 2019)

3.4. The CSM is not Static

A CSM is not a static document. As site investigation progresses and new data is uncovered, the CSM should be refined. Open communication between risk assessors and the EPD on CSM updates will ensure transparency and a smooth assessment process (USEPA, July 2011).

3.5 Exposure CSM

The portion of the CSM that will be the most beneficial to the risk assessment is the exposure CSM. The exposure CSM should start with the source of the contamination and through various release mechanisms, tracing the contamination's transport through environmental media to a contact point with the receptor. See Figure 3 for an example exposure CSM. Additional information on the ecological CSM is provided in Section 8. The exposure CSM should include the following:

- Source of release (spill, leaks, container, tanks, etc.)
- Receiving media (soil, surface water, air)
- Fate and transport pathways (soil to groundwater, groundwater to surface water, etc.)
- Primary, secondary and tertiary contact media, if applicable
- Exposure routes (ingestion, inhalation, and dermal contact)
- Receptor Populations
    - Industrial/Commercial Worker - indoor, outdoor, and/or composite
    - Construction Worker or Utility Worker
    - Agricultural-landscaper, groundskeeper
    - Recreational – adult and child

- Resident – adult and child
- Trespasser – adolescent
- Biota – terrestrial and/or aquatic

Table 2: Contaminated Environmental Media and Potential Receptors

This table includes the most common exposure pathways and receptors. Additional receptors may be applicable depending on site-specific land use.

Media	Resident (adult and child)	Industrial Worker	Construction Worker	Agricultural Worker	Trespasser	Recreator (adult and child)	Hunter	Angler
Surface Soil (0-1 ft bgs)	√	√	√	√	√	√	√	√
Subsurface Soil (1 ft bgs- 10 ft bgs)			√					
Groundwater	√	√	√(1)					
Surface Water						√		√
Sediment						√(2)		√(2)
Wild Game/Aquatic Life (food ingestion)							√	√
Groundwater to Surface Water (daylighting and hyporheic zone)						√		√

√ - Complete pathway

Feet below ground surface- ft bgs

(1) Potentially complete pathway for incidental ingestion of groundwater if groundwater table is less than 15 feet below surface level

(2) Potentially complete but quantitatively insignificant pathway

Table 3: Pathways to be Considered per Contaminated Environmental Media

Contaminated Environmental Media	Human Health Direct Contact	Vapor Intrusion	Soil to Groundwater	Ecological
Surface soil (0-1')	X	X[1]	X[2]	X[3]
Subsurface soil (1'-10')	X			
Groundwater	X	X		X[4]
Surface water	X			X
Sediment	X			X
Biota	X			X

X = applies to that pathway

1. Volatile organic compounds (VOC) contamination present in the soil can cause vapor intrusion. However, soil analytical data cannot be used to evaluate vapor intrusion; soil gas analytical data should be used to evaluate vapor intrusion from VOC contamination present in soil. Please see EPD's *Guidance for Evaluating the Vapor Intrusion Exposure Pathway* for more guidance on this pathway.
2. The soil-to-groundwater pathway should include an evaluation of the entire soil column to the top of the groundwater table, not just the top 10 feet of soil that is evaluated for human exposures. Please see EPD's Guidance *FAQs for Evaluating the Soil-to-Groundwater Pathway* for more guidance in evaluating this pathway.
3. The depth of soil to be considered should be based on the habitat and presence/species of burrowing animals. This exposure zone could range up to 6 feet below ground surface.
4. Ecological receptors may be exposed to groundwater at the point of discharge to a receiving water body.

4.0 Data Collection Guidelines and Evaluation Before the Risk Assessment

It is crucial that the data collection and evaluation activities at sites produce data of adequate and known quality for use in a risk assessment. As every site is different, data collection and sampling approaches for one site may not be suitable for another site. It is important to involve the EPD Risk Assessment Program (RAP) early in the process to assist with review of any sampling and analysis plans.

4.1 Environmental Sampling and Laboratory Analysis

The CSM should be utilized to develop a sampling plan using the Data Quality Objectives (DQO) Process. USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process*, explains the DQO Process and how it is used to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. The DQO Process consists of seven iterative steps:

- State the problem
- Identify the goal of the study
- Identify information inputs
- Define the boundary of the study
- Develop the analytic approach
- Specify performance or acceptance criteria
- Develop the plan for obtaining data

(USEPA, February 2006)

Resources

Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA/240/B-06/001, January 2006.

Guidance on Choosing a Sampling Design for Environmental Data Collection, EPA/240/R-02/005, December 2002.

Quality System and Technical Procedures for LSASD Field Branches, USEPA Region 4 Laboratory Services and Applied Science Division.

Risk Assessment Guidance for Superfund, Part A, Chapter 4, EPA/540/1-89/002, December 1989.

4.1.1. Sampling Considerations

Sampling Protocols. All sample collection and measurements should be conducted in accordance with the latest procedures outlined in USEPA Region 4 Laboratory Services and Applied Science Division's (LSASD) *Quality System and Technical Procedures for LSASD Field Branches*. Other methodologies, such as an applicable ASTM Method for sampling a certain environmental medium, may be used with EPD approval.

Sampling Soils. In sampling soils, it is important to employ distinct sampling strategies for surface and subsurface soils. For instance, surface soils are defined as soils from 0 to 1 foot below ground surface (this is exclusive of any grass, gravel, or paved surface). Generally, subsurface soils are defined as soils from 1 foot below ground surface (bgs) extending to the top of the groundwater table.

Samples should be collected to reflect the soils that a certain receptor might contact. For instance, if the receptor is an industrial worker, that receptor might be exposed to the first foot of soil; however, a construction worker may be exposed to the first ten feet of soil (USEPA Region 4, March 2018). The CSM should be able to inform you as to what samples are needed to evaluate the risk to the receptors present at your site. Sampling soils from the ground surface to the top of the water table should be used to evaluate leaching via the soil-to-groundwater pathway. Sampling across the surface and subsurface soils may complicate a risk assessment; therefore, please consult with your risk assessor prior to sampling to ensure that the proper samples are collected.

Groundwater. When sampling groundwater, low flow purging techniques should be utilized so that the sample turbidity is below 10 NTUs (USEPA Region 4, March 2018).

Background sampling. Background can generally be defined as the presence of naturally occurring or anthropogenic chemicals not due to the Site or source under evaluation. The decision to collect background samples may rely upon whether inorganic (metal) chemicals may have been released at the site. Background data may assist with delineation efforts, helping to estimate how much of the detected metal is attributable to background.

Types of Background. There are two kinds of background: natural and anthropogenic. The first is naturally occurring concentrations of inorganics or metals present in environmental media from the weathering of geologic materials. The second consists of chemicals that are either ubiquitous or regional in nature. Polycyclic aromatic hydrocarbons (PAHs) and pesticides are common background organic chemicals in soil due to processes such as farming, pest control, run-off, forest fires, atmospheric deposition, and land disturbance activities. Surface water and sediment may also contain these chemicals and may be impacted by water quality issues such as phosphorus, solids, or low dissolved oxygen.

Determination of Background. There are several ways to characterize background. Where possible, collect background data as part of the site investigation. While a detailed evaluation of background investigations is beyond the scope of this guidance, such investigations should follow these basic principles:

Background Soil Sampling Protocols

- Discrete or grab – a single soil sample from the specific location and depth interval
- Composite – a sample comprised of several subsamples of the same volume that are physically mixed to create a homogenous single sample
- Incremental – a structured sampling and processing protocol that reduces data variability to provide an estimate of mean contaminant concentration in a defined volume of soil

To learn about the pros and cons of each sampling method, see the ITRC document *Soil Background and Risk Assessment*, December 2021.

- Background sample locations should be selected to represent regional effects but should be outside the influence of site-specific releases from the subject site or other point sources.
- For flowing water bodies, background locations may be upstream but must account for tidal influence where relevant.
- For air, samples should be upwind at the time of collection. If sampling for a longer duration (such as 24 hours or longer), multiple samples may be necessary to obtain an appropriate background concentration. The sampler should consult wind rose charts for the area to determine where to place the air sampler upwind of the prevalent wind directions (see the resource box for more information on obtaining wind rose diagrams near your site).
- Substrate (soil, sediment) and/or hydrostratigraphic unit (groundwater) should be comparable. Each separate soil type or groundwater aquifer should have its own background concentration.
- Background and site sampling programs should be consistent in terms of collection methods, sampling design (such as incremental sampling or grab sampling), and analytical methods.
- The number of samples should be sufficient to support the anticipated quantitative comparisons between background and Site. It is recommended that USEPA's ProUCL user guide be consulted to determine the number of sampling points needed to calculate a 95% Upper Tolerance Level (UTL).
- Selection of a Reference Area that will be evaluated and sampled for ecological risk assessment purposes has additional requirements in terms of comparable cover type, saturation, habitat and other biological characteristics.

Resources for Determining and Use of Background Levels

Establishing Background Levels, Quick Reference Fact Sheet, USEPA, Directive 9285.7-19FS, EPA/540/F-94/030, September 1995.

Frequently Asked Questions About the Development and Use of Background Concentration at Superfund Sites: Part One, General Concepts, USEPA, OLEM Directive 9200.2-141 A, March 2018.

Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites, OSWER 9285.7-41, EPA 540-R-01-003, September 2002.

Role of Background in the CERCLA Cleanup Program, US EPA OSWER 9285.6-07P, April 26, 2002.

Custom wind roses can be obtained from the link below. Zoom to the area of interest and select different networks to determine which weather stations are closest to the site and have data within the range of dates sampled or anticipated sampling date range.

- https://mesonet.agron.iastate.edu/sites/locate.php?network=GA_ASOS

Various USEPA documents, such as *Frequently Asked Questions About the Development and Use of Background Concentration at Superfund Sites: Part One, General Concepts*, USEPA, OLEM Directive 9200.2-141 A, March 2018and *Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites*, OSWER 9285.7-41, EPA 540-R-01-003, September 2002

are available to assist in developing background sampling programs. Background studies may have been performed in support of investigations at other Georgia contaminated sites. Assessors are encouraged to search State public records and partner with their EPD representatives to identify potentially applicable data sets.

4.1.1.1 Sampling Considerations, Special Circumstances, and Speciation of Certain Chemicals

Certain chemicals pose unique considerations for risk assessment and sampling related to environmental fate and transport, such as mercury, arsenic, chromium, PCBs, dioxins, and VOCs. Naturally occurring bacteria in soil and water may change the form of the chemical into forms that are more readily bioavailable and bioaccumulative. Chemicals may change to lipophilic forms, such as with methylation, may have more toxic ionic forms that require additional assessment, may change to elemental salts, or may easily volatize or degrade into other chemicals requiring additional care in sampling or analyte analysis. Considerations are discussed below.

Metals: Mercury

There are several different forms of mercury that may be present in the environment: elemental, inorganic, methyl mercury and mercury salts.

- Elemental mercury, also known as "quicksilver", is used in thermometers, electric equipment, and fluorescent light bulbs.

- Inorganic mercury is naturally present in certain minerals. It may be released into the environment at mining sites or from coal-fired power plant emissions. It can enter the environment and combine readily with chlorine, sulfur, and other elements to form mercury salts.

- Of the mercury salts, mercuric chloride is the most mobile in the environment. Mercury salts are being cycled from the air, water and land as they undergo complex chemical and physical transformations.

- Methylmercury can be formed when mercury salts enter the environment and are broken down by microscopic organisms. Methylmercury is the most common form of mercury in biota. This is an important consideration as methylmercury is more toxic than mercuric salts and is more readily transferred through the food web. Methylmercury bioaccumulates in fatty tissues of fish. Eating fish contaminated with methylmercury is the primary way humans and wildlife are exposed to mercury. (USEPA, 2024a)

When sampling for mercury in the environment, it is best to use USEPA Test Method 3200 which differentiates mercury species in soils and sediments. (USEPA, 2024c)

Metals: Chromium

When sampling for total Chromium, analysis for hexavalent Chromium may be needed. If the site handled materials containing hexavalent Chromium, was involved in chrome plating, or was a wood treater using chromated copper arsenate, then samples should be analyzed for hexavalent Chromium using the latest version of EPA Method 7196. Failing to speciate Chromium in samples at a site that managed or disposed of wastes containing hexavalent Chromium could result in evaluating total Chromium concentrations using hexavalent Chromium toxicity values.

Volatile Organic Compounds. When sampling for Volatile Organic Compounds (VOCs), care should be taken not to composite or mix the environmental media, thus causing volatiles to escape into the air. For this reason, composite and incremental sampling cannot be used for VOC analysis. Only discrete sampling can be used when sampling for VOCs. The USEPA recommends using analysis method 5021A for analyzing low concentrations of VOCs in solid or liquid matrix (not purified), method 8260 for GC/MS analysis, and #0040 for air emissions sample analysis.

4.1.2 Analysis Methods.

Sample analyses should follow the appropriate methods detailed in USEPA's *SW-846: Test Methods for Evaluating Solid Waste: Chemical/Physical Methods* or an appropriate equivalent. Additionally, in accordance with Georgia Rule 391-3-26 of the Rules for Commercial Environmental Laboratories, data submitted to EPD for regulatory purposes by a commercial analytical laboratory or a customer of a commercial analytical laboratory, shall be accepted by the Division only if the commercial analytical laboratory has received (a) Accreditation or certification by another State acceptable to the Director, (b) Accreditation or certification by the U.S. Environmental Protection Agency (c) Accreditation or certification by an accreditation agency, acceptable to the Director, and which the Division has entered into a Memorandum of Understanding of these purposes, or (d) Certification by the Division pursuant to O.C.G.A. 12-5-174(a)(3) and DNR Rule 391-3-5-.29 for drinking water tests.

The regulated facility and/or laboratory should aim for reporting limits below media-specific screening levels (when feasible). The regulated facility or laboratory may want to consider alternative approaches like re-running samples without dilution or consulting the laboratory for further analysis justification, as recommended in USEPA's *Data Usability in Risk Assessment (Part A-1), Final* (USEPA, April 1992).

4.2 Data Management

Uploading data directly from the analytical laboratory files and importing it into a database is highly recommended to avoid data entry errors. When using Excel files provided by the laboratory, Quality Assurance (QA) procedures should be implemented to verify that no errors have been made during manipulation. Manual data entry from lab reports should be avoided if possible due to the increased potential for transcription errors.

4.3. Requirements for Submitting Quality Environmental Sampling Data to EPD

Under Georgia regulations, all environmental sampling data submitted to EPD must come from samples analyzed by a commercial laboratory that meets specific accreditation or certification requirements (Ga. Comp. R. & Regs. R. 391-3-26-.03 and 391-3-26-.04). Data verified by accredited labs to meet the required analytical and quality standards do not need additional verification when submitted to EPD.

However, verified data may not always be suitable for use in a risk assessment. Guidance documents, such as the USEPA's *Guidance for Data Usability in Risk Assessment* (Part A-1), April 1992, and the 'Data Quality' section of ITRC's *Environmental Data Management (EDM) Best Practices*, can help risk assessors determine if the data is appropriate for their purposes. While a formal data validation following USEPA guidance (e.g., USEPA's *Guidance on Environmental Data Verification and Data Validation,* EPA QA/G-8) is acceptable, it is generally not required.

Including the following information in all reports of sampling and analytical data used in risk assessments is important so that EPD can review the original data and a usability evaluation can be conducted:

- Sampler's field notes
- Specific sampling methods followed
- Field instrument calibration results (if applicable)
- A narrative of the sampling event
- Maps and photographs of the sampling locations
- Chain of custody form(s) including laboratory receipt dates and times
- Analytical methods used
- Analytical data from the laboratory
- Definition of any laboratory qualifiers attached to the data
- Laboratory review of the analytical data and signature of laboratory professional reviewing data
- QC results [Results for trip and field blanks, lab and field duplicates, method blank, laboratory control samples, and matrix spike and duplicates (if applicable)] and a discussion of any QC results outside the acceptance limits (USEPA , November 2002).

Age of Data. Historical data should be used in a risk assessment with caution. Soil data, especially subsurface, may still be representative; however, data from mobile environmental media such as groundwater, surface water, or sediment should not be used in a risk assessment if that data is three (3) years or older. Contaminants in surface soils may volatilize, migrate to subsurface soils, or be moved by stormwater to other locations; thus, surface soils older than a year are in question. Historic data can be used to inform the investigation as to the location of source areas, contaminant trends and migration, etc. If you have questions on whether to include historic data in a risk assessment, please contact your EPD project manager (USEPA, 1989) (USEPA Region 4, March 2018).

4.4 Coordination with the Analytical Environmental Laboratory

Additional coordination with the laboratory may be required as part of the data quality review process when reporting is unclear or the case narrative does not fully account for the report results. Situations that may require follow-up include, but are not limited to, insufficient justification for high dilutions, poor recoveries due to 'matrix', or substitution of a method. In many cases, more precise analytical information is beyond the technical capability of the laboratory or method.

Adequate documentation protects both the laboratory and the data user and may provide information to support future phases of work, such as using more sensitive analytical methods.

Resources

RCRA Groundwater Monitoring: Draft Technical Guidance, USEPA Office of Resources Conservation and Recovery (ORCR), EPA/530R-93/001, NTIS PB 93-139350.

Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504, April 1996.

USEPA's Lead at Superfund Sites: Guidance webpage.

USEPA's Hazardous Waste Test Methods/SW-846 webpage.

Guidance for Data Useability in Risk Assessment, USEPA OSWER, Publication 9285.7-09FS, June 1992.

Georgia Rules for Commercial Environmental Laboratories, Rule 391-3-26.

5.0. Screening

The purpose of screening is to eliminate chemicals that do not contribute significantly to the risk so that the risk assessment may focus on the COPCs that may be important for risk management. Data for each medium (soil, groundwater, etc.) should be summarized in individual tables displaying descriptive statistics for each detected chemical in comparison to the applicable screening criteria. See below for applicable screening criteria for each environmental media.

Where appropriate, surface soil, subsurface soil, and groundwater stratigraphic units should be presented individually. The tables should clearly identify the units of measure for each medium. Care is needed to ensure the screening criteria are presented in the same units as the data.

Example template tables for screening data are provided in Appendix A of this document and Excel versions of the spreadsheets are provided for your use on EPD's website.

5.1 Selection of Human Health Screening Levels

The appropriate screening levels will depend on the type of risk assessment.

For baseline and streamlined risk assessments, screening should be conducted using residential (unrestricted) benchmarks which represent the most conservative exposure assumptions. In cases where a focused risk assessment (an assessment focused on either a certain receptor or a pathway) is being performed for a site with an alternate current or planned use, industrial/commercial screening levels may be appropriate. Alternate uses should be accompanied by justification and supporting covenants as part of the final site documentation.

Risk-based screening levels should be set at an excess lifetime cancer risk (ELCR) of one in a million (10^{-6} or 1E-06) and a Hazard Quotient (HQ) of 0.1 (typically identified as TR=1E-06; HQ=0.1). The screening levels for individual chemicals are set an order of magnitude below EPD's preferred cumulative risk thresholds to prevent the elimination of chemicals that could contribute additively to risk and hazard that then exceed the cumulative thresholds. Any analyte that has a maximum detected concentration or a maximum method detection limit above respective risk-based screening level should be identified as a COPC.

Applicable screening levels are described below and listed in Table 4. Additional contaminant specific considerations are provided below.

Soil: Soil in the vadose zone should be assumed to be unrestricted down to a depth of 10 feet or the water table, whichever is shallower. This provision allows for soil mixing during redevelopment whereby subsurface material may be brought to the surface.

Surface soil is generally considered to be the top 12 inches of soil (0-1 feet) that is available for exposure. The surface soil horizon begins below any vegetative cover (such as grass or ground

cover), asphalt, gravel or concrete surfaces. For the initial screen of data, surface soil data should be compared to the current USEPA Regional Screening Levels (RSLs) for residential soil (TR=1E-06; HQ=0.1).

Subsurface soil is regarded as the soil located from the bottom of the defined depth of surface soil to a depth of 10 feet below ground surface (bgs) or to the groundwater table if groundwater is encountered within the 1-10 feet bgs interval (USEPA Region 4, March 2018). Subsurface soil data should be compared to the current RSLs for residential soil (TR=1E-06; HQ=0.1).

Combined soil includes both surface and subsurface soils that may be excavated together and brought to the surface. Combined soil data should be compared to the current RSLs for residential soil (TR=1E-06; HQ=0.1).

It is recommended to evaluate all three scenarios (e.g., surface soil, subsurface soil, and combined soil), especially when datasets include data from intervals that are not typical of surface or subsurface soil intervals (e.g., 0-3 feet bgs).

Non-Residential Land Use Considerations. In site specific cases, involving non-residential current or planned land use, you may be able to screen data using Industrial RSLs to determine COPCs if an environmental covenant will be used to restrict residential land use.

The USEPA RSL Calculator can be used to develop screening levels for construction workers who could be exposed to the entire soil column or combined soil (surface and subsurface). In some cases, construction worker screening levels can be lower than those for industrial workers due to the assumed higher-intensity exposure rates.

The residential receptor is considered the most conservative receptor with the highest potential for exposure to site media. If site data are screened in comparison to residential screening criteria, the resulting list of COPCs is considered applicable for evaluating other receptors with less exposure such as a recreational user, trespasser, or construction worker, if appropriate, based on site conditions and anticipated future use.

Groundwater: Screen each groundwater unit using the USEPA tapwater RSLs (TR=1E-06; HQ=0.1). Please note in accordance with Region 4 USEPA guidance, MCLs should not be used for screening purposes. However, if all contaminants in the groundwater have MCLs, a brief comparison of maximum detected concentrations or maximum method detection limits with MCLs is recommended. If no exceedances of the MCL are identified, a risk assessment may not be warranted for the groundwater pathway (subject to EPD approval).

Surface Water: For large systems that may serve as a water supply or fishery, use the Georgia Instream Water Quality Standards in Rule 391-3-6 of the Georgia Rules for Water Quality Control. If an Instream Water Quality Standard is not available for a specific contaminant, screen using the USEPA National Recommended Water Quality Criteria (WQC) for human health-

consumption of water plus organism consumption. If there is no WQC, a USEPA tapwater RSL may be used where the water is potentially potable. If the water body supports fishing, but not potable use, use the WQC for organism ingestion only. For smaller water bodies such as intermittent creeks where only incidental contact might occur, the same screening levels may be used.

Sediment: Sediment is not soil, but where it presents a potential for direct contact (wading, etc.), residential soil RSLs (TR=1E-06; HQ=0.1) may be used. In accordance with USEPA guidance, it is unnecessary to evaluate human exposures to sediments that are always covered by surface water (USEPA Region 4, March 2018).

5.2 Screening Process

Screening environmental data to determine if a risk assessment is necessary can be completed using one of the following:

(1) using an Excel template table on EPD's website and depicted in Appendix A of this document;

(2) using the EPD ScreenTool available on EPD's website.

The following chemicals are Chemicals of Potential Concern (COPCs) and should be evaluated further in the risk assessment:

- Any chemicals where the maximum detected concentration (MDC) exceeds the screening level (SL) for that environmental media, unless it is below site-specific background values;
- Any chemicals where the maximum method detection limit (MaxMDL) exceeds the screening level (SL) for that environmental media; (A request to EPD to exclude from the risk assessment chemicals not associated with materials used historically at the site will be considered on a case-by-case basis); and
- Any constituent without a screening level (SL).

5.3 Individual Chemical Screening Considerations

The user should always select screening levels in the context of the CSM and is also responsible for understanding the status of the screening level. Specific examples are discussed below but should not be considered the only chemicals requiring scrutiny. Please note that if speciation/form is unknown, the more conservative screening level should be used.

Arsenic: Soils in Georgia are known to contain background concentrations of arsenic well above the USEPA residential soil RSL, which results in arsenic automatically becoming a COPC and driving risk. To avoid confounding the risk assessment, site-specific evaluation of background for arsenic (see Section 5.4) should be included in the screening process.

Chromium: As indicated in Section 4.2, certain industrial processes (such as chromium ore processing or plating operations) may have produced hexavalent chromium. Ideally both total and hexavalent chromium data will be available. However, where hexavalent chromium data are not available and these processes have occurred at the Site, use of hexavalent chromium screening values is recommended for total chromium until further speciation can be performed.

Mercury: USEPA publishes screening levels for mercuric chloride (mercury salts), elemental mercury, and methyl mercury. These are not interchangeable. In the absence of specific information that elemental mercury may be present (such as spills from meters, chlor alkali sites or visible sheens), presence of elemental mercury need not be assumed. Methylmercury is the predominant form of mercury found in animal tissue such as fish tissue. If elemental mercury and methylmercury are not known to be present, then the presence of mercuric chloride is assumed. Please see Section 4.2 regarding the analysis of mercury and its associated compounds.

Nickel: Nickel is a naturally occurring element found in various forms in the environment, each with differing toxicological properties. The toxicity of nickel depends on its chemical form, concentration, route of exposure, and duration of contact. Determining the form of nickel present at a site is crucial for accurately assessing the associated risks to human health. USEPA publishes screening levels for various forms of nickel. Caution should be used in applying screening levels to total nickel in the absence of additional physicochemical information.

Lead: USEPA's 2024 *Updated Residential Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* memorandum for soil lead risk assessment should be used to determine the lead screening value. When screening soil concentrations, either a Regional Screening Level (RSL) of 200 mg/kg or 100 mg/kg will be used based on site-specific circumstances identified in the USEPA memo. A rationale should be provided for the RSL that is selected (USEPA, January 17, 2024).

5.4 Background Levels

Please see Section 4.2 regarding sampling for background. Background data sets should be used where possible to develop background threshold values (BTVs). These can be calculated using ProUCL, a free statistical program available from U.S. USEPA. In most cases, a 95th percentile upper tolerance limit (UTL) is a useful statistic, selected based on the underlying data distribution. Consultation with a statistician may be helpful where the choice is unclear (if ProUCL does not make a recommendation). The UTL, which is a measure of the upper end of a data range, should not be confused with or used interchangeably with the upper confidence limit (UCL) on the mean, which is

a measure of central tendency. BTVs are generally compared to the highest detected concentrations and should not be compared with UCLs of site data or other estimates of the mean.

Please provide all background sampling locations, plans, reports, data sets and 95% UTLs based on the background data set to EPD for review prior to use as background screening levels. The maximum detected concentration of inorganic chemicals can be screened against approved background screening levels to further eliminate COPCs. Please note that if an inorganic (metal) is used in site processes, it cannot be eliminated based on background, but should be evaluated further in the risk assessment, and eventually discussed in the uncertainty section of the risk assessment.

To simplify screening, or in the absence of background data, it is recommended that 9 mg/kg for arsenic be used to screen out arsenic concentrations in soil that are not associated with known site releases or are related to anthropogenic fill. This concentration was derived using a data set of 93 sample results from US Geological Survey (USGS) data *Geochemical and mineralogical data for soils of the conterminous United States*, collected in surficial soils (0-5 cm or 0-11 inches) in Georgia from 2007 to 2013. The data set was first evaluated for outliers. An outlier was removed and the 95% UTL (9 mg/kg) was calculated from the resulting data set. See Appendix B for the derivation of the default background screening level for arsenic (Smith, et al., 2013).

Table 4: Medium–Specific Screening Levels

Medium	Screening Levels
Surface Soil (0-1' ft) and Subsurface Soil (1-10 ft)	•Current Regional Screening Levels* (RSLs) for Residential soil; or •An alternative level of Industrial Soil RSLs* may be used under certain circumstances with EPD approval. •An EPD-approved background concentration for inorganics.
Entire soil column (0' to top of groundwater table)	SSLs for the Protection of Groundwater**
Groundwater	Tap Water RSLs*
Surface water	1.Instream Standard [Rule 391-3-6-.03], if not available, then #2 2.National Recommended Water Quality Criteria for Human Health for the Consumption of Water and Organism, if not available, then #3 3.Tap Water RSL*
Sediment	Regional Screening Levels* for residential soil or use the RSL calculator to develop recreator RSLs

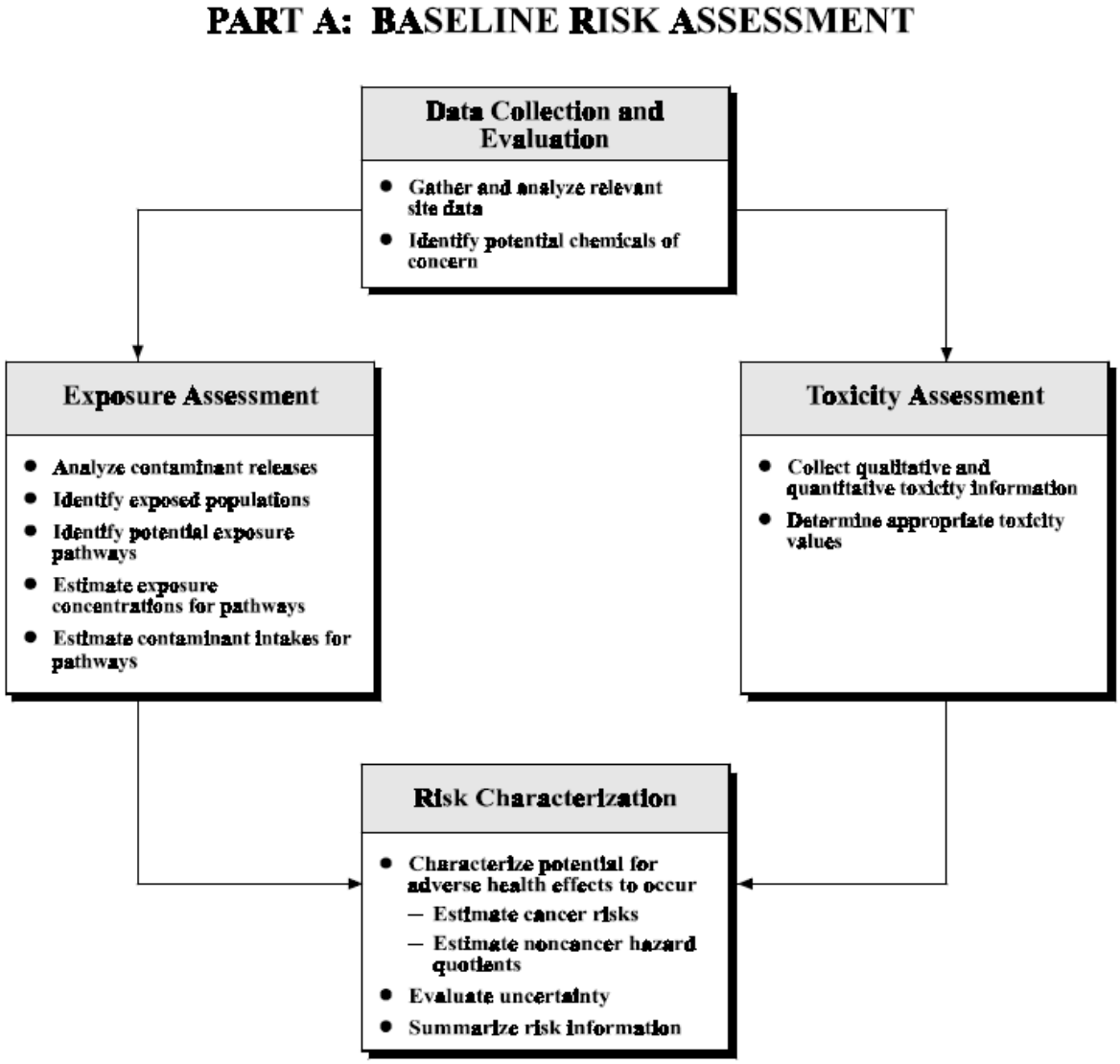
*RSLs should be set at an excess lifetime cancer risk (ELCR) of 1E-06 and Hazard Quotient of 0.1. The screening level is the lower of the cancer and non-cancer screening level.

**Soil Screening Levels for the Protection of Groundwater should be set at a ELCR of 1E-06, HQ of 0.1 and a DAF of 1. The screening level is the lower of the cancer and non-cancer risk-based concentrations. It is recommended that the facility use a separate table to screen for leaching. If a chemical exceeds the screening level, it is recommended that it be evaluated in accordance with GA EPD guidance *FAQs for Evaluating the Soil-to Groundwater Pathway*.

6.0 Baseline Human Health Risk Assessment

A Baseline Risk Assessment (BRA) characterizes conditions in the absence of remediation. It includes both current and reasonably foreseeable future receptor populations and exposures.

BRAs consist of four components as illustrated below:



Source: (USEPA, 1989), Exhibit 1-2

The Data Collection and Evaluation Step has been described separately in Section 4 to emphasize integration with both the human health and ecological (Section 8) risk processes. The remaining three steps of the human health risk process are described below.

6.1 Exposure Assessment

An exposure assessment is the process of evaluating site-related information to estimate the magnitude, frequency and duration of human exposure to COPCs in the environment. It describes qualitatively and quantitatively the contact between a COPC and a potential receptor. Complete exposure pathways consist of four elements:

1. A source and a mechanism of release to the environment;
2. An environmental transport medium;
3. A point of potential contact between a receptor and the environmental medium (referred to as the exposure point); and,
4. An exposure route or uptake mechanism.

An evaluation of the fate and transport of contamination in environmental media, a determination of the exposure point concentration for each COPC in each media, and exposure times and parameters for each receptor are crucial parts of the exposure assessment.

The first two elements of a complete exposure pathway, the source and mechanism of release to the environment and the environmental transport medium, represent the migration pathway, or how chemicals have been released at a site, and how those chemicals have migrated or could potentially migrate in site media. This information should be included as part of the CSM for the site.

6.1.1 Fate and Transport Analysis

The chemical screening or hazard identification step discussed previously in Section 5.2 identified the COPCs of interest in each medium at the site. A general fate and transport analysis should be completed to evaluate the potential for these COPCs to migrate in site media. The purpose of the fate and transport analysis is to evaluate whether the COPCs have the potential to migrate to a point of contact with a potential human receptor, and if so, in what environmental medium the contact will occur. Relevant physical and chemical properties of the COPCs should be summarized in a table and briefly discussed. The primary source of physical/chemical properties is the USEPA RSL Chemical-Specific Parameters Supporting Table. Additional sources of information based on peer-reviewed scientific research studies may be used on a case-by-case basis to obtain physical/chemical property information if a chemical is not included in the primary source document (USEPA, 1989).

The fate and transport analysis does not have to be extensive, but it should evaluate the physical and chemical properties of the COPCs in relation to the site environmental setting (e.g., soil property information, geologic setting, regional hydrogeology) to identify potential migration pathways at a site, including, but not limited to:

- ***Preferential pathways*** – If underground utility lines (e.g., utility corridors, storm sewers, etc.) are present, the potential for the utility to provide a preferential pathway for COPC migration should be evaluated. At a minimum, the depth of the utility line in relation to the source of

impact, material of construction and direction of flow should be evaluated.

- ***Volatilization*** - COPCs with Henry's Law Constants (H) greater than 1 x 10^{-5} atm-m^3/mol or vapor pressure greater than 1 millimeter mercury (mm Hg) are considered to have the potential to volatilize from soil or groundwater (USEPA, May 2014). The potential for COPCs to volatilize should be evaluated at each site with consideration given as to whether this potential migration pathway might be complete to ambient (outside) air, or indoor air. To evaluate the risk due to indoor air vapor intrusion, please use EPD's *Guidance for Evaluating the Vapor Intrusion Exposure Pathway*, August 2021.

- ***Adsorption and/or Leaching*** – Low molecular weight compounds (generally below 200 grams per mole [g/mol] such as chlorinated VOCs) tend to have a relatively low affinity for soil as demonstrated by their organic-carbon partition coefficients (K_{oc}) and would tend to migrate from soil to water. Other compounds, e.g., PAHs such as benzo(a)pyrene, with a high molecular weight tend to have a strong affinity to adsorb to soil as demonstrated by their K_{oc}. The following modified soil mobility classification scheme may be used to evaluate adsorption and potential for migration to groundwater.

Soil Mobility Classification Scheme*		
K_{oc} (mL/g or L/kg)	Log K_{oc} (mL/g or L/kg)	Mobility Class
<10 to 100	<1 to 2	Highly mobile to mobile
>100 to 10,000	2-4	Moderately mobile to slightly mobile
>10,000 to >100,000	4->5	Hardly mobile to immobile

*Modified from guidelines presented in *Guidance for Reporting on Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, USEPA, 2009*. (USEPA, December 2009)

- ***Solubility*** - COPCs with moderate to high water solubility tend to dissolve readily in groundwater. These compounds also tend to have a relative low affinity for soil (based on Koc) and would therefore, have the potential to migrate from soil to groundwater. COPCs that are soluble in groundwater could migrate through advection and dispersion to a secondary point of exposure including discharge to surface water. The following general classification scheme may be used to evaluate the potential for a COPC to be soluble in groundwater.

Water Solubility (mg/L)	Classification*
<0.1	Negligible solubility
>0.1-100	Slightly soluble
>100-1,000	Moderate solubility
>1,000-10,000	Soluble
>10,000	Very soluble

* (USEPA, 2012)

- ***Erosion/Runoff*** – COPCs that bind to soil are considered to have the greatest potential to migrate by mechanical means through erosion/runoff during storm events. Evaluate potential erosion/runoff migration pathways based on chemical-specific K_{oc} values (discussed above), assessment of site cover (grass, pavement, etc.), surface elevation and slope, and site drainage and flow paths.

- ***Migration to Surface Water*** - The potential for migration to surface water should consider both overland drainage as well as the potential for groundwater to discharge to a surface water body. This potential migration pathway should be evaluated by identifying the distance to nearby surface water features, depth to impacted groundwater, direction of groundwater flow and potential for discharge to a nearby surface water body. In general, this migration pathway should be evaluated for surface water features located within 1,000 feet of the site, unless a site-specific feature (e.g., a preferential pathway) could lead to the migration of COPCs to a surface water body located at a greater distance.

- ***Wind Erosion/Dispersion*** - Soil particles have the potential to migrate through wind erosion and dispersion. Typically compounds that adhere to soil have the greatest potential to migrate through this pathway, especially if disturbance of soils will occur under current or future site development (i.e., construction).

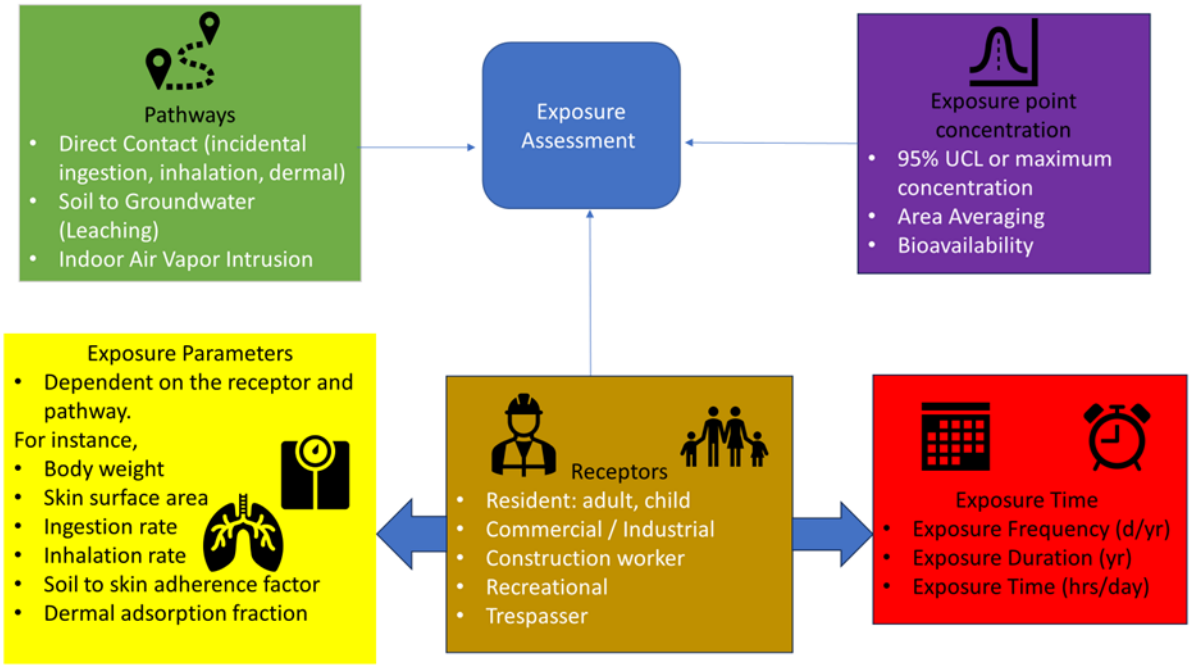
6.1.2 Potential Receptors and Routes of Exposure

The exposure assessment should identify the potential receptors associated with the site as well as the routes of exposure (i.e., items 3 and 4 identified above for a complete exposure pathway). Each medium and exposure route needs to be assessed for potential exposures in the exposure assessment and CSM, although many of the exposure routes may be identified as incomplete and will not require further assessment. Other exposure routes may be secondary compared to receptors or routes already included.

Potential receptors should be evaluated for their presence both on-site and off-site as well as under current and future site conditions. A list of potential receptors evaluated in the exposure assessment would generally include:

- Residents (child and adult)
- Trespassers (adolescent age 7-16)
- Recreators (child, adolescent, adult)
- Indoor commercial/industrial workers (adult)
- Outdoor commercial/industrial workers (adult)
- Construction Workers (exposed to soil from surface to 10 feet below ground surface) (adult)
- Utility or excavation workers (exposed to soil from surface to 4 feet below ground surface) (adult)

Figure 4: Exposure Assessment



Even though residents may not be present at a site under the current use scenario, it is standard practice to assume that a resident may be present in the future, unless a land use restriction (e.g., an environmental covenant) has been implemented for the property. Including potential future residents in the risk assessment allows for the identification of chemicals of concern (COCs) at concentrations greater than residential cleanup levels, but below non-residential cleanup levels and provides support for a land use restriction, if required. The evaluation of a residential receptor either under a current or future site-use scenario in the absence of remediation or institutional controls is considered the baseline risk evaluation. Where anticipated, a presumptive remedy of placement of a land use control on the site to limit the receptors (e.g., commercial/industrial use only) or routes of exposure (e.g., groundwater use for monitoring only with no potable use) in a risk assessment should be discussed with the EPD prior to use in the risk assessment report (USEPA Region 4, March 2018).

Depending on the environmental medium, it is often sufficient to identify the potential for exposure for receptors such as a recreator or trespasser (typically for soil). Exposure to these receptors may not need to be quantified if residential or worker receptors are evaluated, as the residential and worker receptors have increased rates of exposure (e.g., ingestion, dermal contact), as well as greater frequency and duration of exposure and will therefore drive the risk management.

Media and potential exposure routes to be evaluated typically include:

- Surface Soil –incidental ingestion, dermal contact, and inhalation of volatiles and particulates
- Subsurface Soil –incidental ingestion, dermal contact, and inhalation of volatiles and particulates during excavation
- Groundwater – ingestion, dermal contact, and inhalation of volatiles
- Surface Water – incidental ingestion and dermal contact
- Sediment – incidental ingestion and dermal contact
- Ambient Air – inhalation of vapors from soil or groundwater sources
- Indoor Air – inhalation of vapors from soil or groundwater sources

Inhalation of vapors from subsurface sources in ambient (outdoor) air is typically not a medium of concern due to rapid volatilization.

6.1.3 Quantification of Potential Exposure

Exposures are estimated using a combination of exposure point concentrations and default or site-specific exposure parameters.

6.1.3.1 Exposure Point Concentrations (EPCs)

An exposure point concentration (EPC) is typically estimated from sampling data concentrations in a specific medium. The EPC is an estimate of the arithmetic average concentration of a chemical contacted by a receptor within an exposure unit over time. Because there are uncertainties in estimating the true average, statistical methods are used to calculate the EPC. The most current version of the USEPA statistical program ProUCL may be utilized to estimate the 95% UCL. Where supported by the data distribution, ProUCL will recommend a 95% UCL. If ProUCL cannot provide a recommended 95% UCL statistic, the user should evaluate the data and statistical output to make a best judgement, with supporting rationale. When the 95% UCL exceeds the maximum concentration, the maximum concentration may be used as the EPC. Situations where the EPC is associated with bias or a higher-than-usual degree of uncertainty should be discussed in the Uncertainty section of the BRA Report.

Below are some tips for using ProUCL:

- The reporting limit for non-detect data should not be halved.
- When ProUCL recommends more than one UCL, the most conservative or greatest value should be used as the EPC.
- If using discrete sampling, the minimum recommended number of samples is 10. The minimum number of detected concentrations is 6 out of the ten samples.
- If 95% UCL is greater than the maximum detected concentration or MDC, the MDC should be used as the EPC.

In surface soils, area averaging conducted in accordance with EPD's *Area Averaging Approach to Soil Compliance for Direct Contact Exposure Scenarios* (December 15, 2020) can be utilized to calculate an EPC. For lead and arsenic contamination in soils, the Relative Bioavailability (RBA) in soil may be used to adjust the EPC. The USEPA default RBA for lead and arsenic is 0.6. Please note that if using the RSL calculator to determine the risk and hazard for arsenic in soils that the default RBA is already incorporated into the calculations. The default RBA for lead is also incorporated as part of the USEPA lead exposure and risk models (USEPA, January 2021). Be advised that the EPC for lead should be based on the arithmetic average and not the 95% UCL. Any site-specific RBAs should be submitted to EPD for approval.

In groundwater, the EPC is calculated using sampling results from permanent monitoring wells within the core of the plume. It is recommended that the last two sample results (preferably within the last three years) be used from each selected well (minimum of 3 wells in the core of the plume) to calculate the EPC. If more than one aquifer is present, it is recommended that separate EPCs be calculated for each aquifer. When wells monitor multiple depths, it is recommended that the highest concentration from the well be used in calculating the EPC. All groundwater samples should be collected unfiltered using low-flow sampling techniques. For more information, please consult USEPA document *Determining Groundwater Exposure Point Concentrations*, OSWER Directive 9283.1-42 February 2014 (USEPA, February 2014).

6.1.3.2 Exposure Parameters

Exposure parameters such as, body weight, ingestion rate, inhalation rate, skin surface area, exposure frequency, exposure duration and exposure times should be determined based on current and future scenarios for each receptor. The combination of these parameters should represent the reasonable maximum exposure (RME), which reflects the highest exposure reasonably expected at a site. USEPA default parameters) provided in Table 5 may be utilized without justification. For recreators, default assumptions can be found in the Oak Ridge National Laboratory's Risk Assessment Information System (RAIS) User's Guide and can be used with adequate documentation. See Figure 4 for an illustration of the factors considered in an exposure assessment.

Exposure Duration. Exposures may be acute, subchronic or chronic. Acute exposures are usually exposures that occur over a short period of time (hours to days). Subchronic exposures occur for weeks or months, typically up to 10 percent of a lifetime, or seven years, while chronic exposures occur over a significant part (greater than 10 percent) of a lifetime.

Exposure Frequency. The exposure frequency for a trespasser (adolescent adult) is site specific and based upon the distance, accessibility and attractiveness of the site to the trespasser.

The excavation/construction worker is usually considered in a future scenario, with intensive exposure to contaminated surface and subsurface soils up to 10 feet below ground surface for a relatively short duration at a high exposure frequency. A utility worker is exposed to surface and subsurface soils at a lower exposure frequency but a longer duration.

For swimming, due to long warm seasons in Georgia, the exposure frequency of 45 days per year is recommended, except in coastal/lake environments when a frequency of 90 days/year is recommended.

Ingestion Rates. Fish ingestion rates are highly variable; therefore, site-specific values may be used with justification. Ingestion rates (IRs) for a variety of receptors are available from USEPA's *Exposure Factors Handbook*.

When using site-specific exposure parameters, justification should be provided in the text of the BRA Report. All site-specific parameters are subject to EPD approval.

6.2 Toxicity Assessment

The toxicity assessment provides a description of the relationship between the intake (i.e., dose) of a chemical and the anticipated likelihood of an adverse health effect. The purpose of the toxicity assessment is to provide a quantitative estimate of the potential toxicity of COPCs for use in risk characterization. The human health risk assessment framework developed by USEPA, and utilized by EPD, separates the adverse health effects associated with chemicals into two broad categories: i) carcinogenic and ii) noncarcinogenic effects (also known as systemic health effects or hazard). Chemical carcinogens are also capable of producing systemic health effects at some dose (typically higher). These chemicals are generally evaluated for both carcinogenic and noncarcinogenic health effects. Information on the health effects or types of cancer that a chemical can cause can be found on USEPA's Integrated Risk Information System (IRIS) database.

Toxicity values should be selected based upon the hierarchy provided in USEPA's *Human Health Toxicity Values in Superfund Risk Assessments* (USEPA, December 2003) and *Tier 3 Toxicity Value White Paper* (USEPA, May 2013). The following toxicity value hierarchy should be used:

- *Tier 1 sources*: Integrated Risk Information System (IRIS)
- *Tier 2 sources:* USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs)
- *Tier 3 sources*: Other Toxicity Values
    - Agency for Toxic Substance and Disease Registry (ATSDR)
    - The California Environmental Protection Agency (CalEPA)
    - Health Effects Assessment Summary Table (HEAST)

IRIS is the recommended source for human health toxicity values. However, it is acknowledged that other sources, in addition to the ones mentioned in this section, may be available. If alternative credible and relevant toxicity sources are proposed, they will be considered on a case-by-case basis.

Toxicity Values

Cancer toxicity factors:

For ingestion and dermal contact: Slope Factor or SF

For inhalation: Inhalation Unit Risk or IUR

Noncancer Hazard toxicity factors:

For ingestion and dermal contact: Reference Dose or RfD

For inhalation: Reference Concentration or RfC

When Tier 3 toxicity values are proposed, priority should be given to sources using similar methods and procedures of Tier 1 and Tier 2 sources. Additionally, sources should be peer reviewed and publicly accessible (USEPA, May 2013).

Based on the recommendations in the May 26, 2021, USEPA memorandum *Recommendations on the Use of Chronic or Subchronic Noncancer Values for Superfund Human Health Risk Assessments*, subchronic toxicity values should be used when evaluating human health rather than chronic toxicity values for 19 chemicals (see the hyperlink above for the list of chemicals) (USEPA, May 2021).

6.2.1 Surrogate Toxicity Values

In some cases, a toxicity value may not be available from any of the sources discussed above. When a chemical lacks a toxicity value, it may be appropriate to use a surrogate based on a chemically and toxicologically related compound (i.e., structural similarity, toxicokinetics/metabolism, and/or toxicity similarity), A list of common surrogates is available on EPD's website. Draft toxicity values should not be used until the toxicity values have been peer reviewed and approved by EPA, ATSDR, or CalEPA.

6.2.2 Chemical-specific issues

Arsenic. Recent research suggests that the relative bioavailability of arsenic in soil by the oral route is less than 100%. Therefore, EPD follows the USEPA Technical Review Workgroup Bioavailability Committee's recommended relative bioavailability fraction of 0.6 (or 60%) in the absence of site-specific data. USEPA recommends that the in vitro bioaccessibility (IVBA) method for predicting oral relative bioaccessibility (RBA) of arsenic in soil be used to estimate site-specific RBA, when site-specific RBA is needed (USEPA, January 2021). For more information on bioavailability and bioacessibility, see EPA's webpage "Soil Bioavailability at Superfund Sites: Guidance".

Chlordane. When evaluating cis- and trans- chlordane, EPD follows the USEPA 2021 memorandum with the subject "Evaluation of the use of chlordane as a surrogate for cis- and trans-chlordane (STICS: ORD-041306)". USEPA's memo recommends using technical chlordane (12789-03-6)

reference dose as a surrogate toxicity value for oral, noncancer screening assessments of the cis- and trans- isomers (CAS Number 5103-71-9 and 5103-74-2, respectively) (USEPA, April 2021).

Vinyl Chloride. EPD accepts the use of the RSL Calculator's approach to Vinyl Chloride cancer risk assessment. If exposure occurs only during adulthood, then the RSL Calculator's approach is not necessary for assessment. The unadjusted cancer slope factor or inhalation unit risk (twofold uncertainty factor not applied) can be used to determine cancer risk. (USEPA, November 2024)

Vanadium PPRTV vs RSL Calculator assessment of Vanadium. EPD recognizes the availability of a Tier 2 Vanadium reference dose (RfD). However, the Regional Screening Level (RSL) Calculator derived RfD (which uses the Vanadium Pentoxide IRIS RfD but factors out the molecular weight of the oxide ion) can be used for risk assessment to maintain consistency with USEPA Region 4's approach. (USEPA, November 2024)

Assessing Xylenes. It is acceptable to sum the concentrations of the individual isomers together to obtain total Xylene and to assess the individual isomers as total Xylene in the risk assessment. Many labs cannot separate the m- and p- isomers from each other during analysis and report these results as "m,p-xylene".

Hexavalent Chromium. If a site handled materials containing hexavalent Chromium, was involved in chrome plating, or was a wood treater using chromated copper arsenate, then samples should be analyzed for hexavalent Chromium (See Section 4.1.1.1 regarding sampling for hexavalent Chromium).

- If there are only Total Chromium sampling results, consult both the site history and conceptual site model to decide if there are historical or current processes of Chromium associated with the site. If so, assume all the Total Chromium is Hexavalent Chromium and discuss in the uncertainty section of the BRA Report.

- Concerning the Total Chromium Maximum Contaminant Level (MCL) of 0.1 mg/L (100 µg/L), EPD is consistent with USEPA's current understanding that Hexavalent Chromium is covered under USEPA's Total Chromium MCL. Therefore, EPD accepts the Total Chromium MCL as an Applicable or Relevant and Appropriate Requirement or ARAR for Hexavalent Chromium, meaning that the Total Chromium MCL can be selected as the Hexavalent Chromium groundwater and drinking water preliminary remediation goal (PRG) (USEPA, 2025b).

Lead. To evaluate lead in the risk assessment, the most current version of the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) for residential exposure scenarios or the Adult Lead Methodology (ALM) for non-residential lead scenarios should be used for further assessment.

In the models, either 3.5 or 5 µg/dL is used as the 95th percentile target blood lead level based on the site-specific circumstances identified in the USEPA memo (USEPA, January 17, 2024). Lead soil preliminary remediation goals (PRGs) should be derived considering lead concentrations in non-soil media, bioavailability, soil lead background concentrations, and technical limitations (detection/quantification limits) (SRC, Inc., May 2021).

USEPA Adult Lead Model, available on the RAIS website

Model Constraints:

- Minimum averaging time of 90 days (as 3 months of exposure are necessary to reach steady state blood lead levels).
- For excavation worker exposure to soil, use a default exposure frequency of 36 days (12 weeks, 3 days a week) with an ingestion rate of 75 mg per day for contact intensive exposure.

USEPA has recently released the All Ages Lead Model (AALM). The AALM addresses the uncertainties associated with the other two models, specifically the age ranges between 7 years and adult and intermittent exposures. Because lead risk is based on total exposure, information from non-site-related sources such as ambient air, diet and tap water are required for the most reliable estimates (USEPA, 2025a).

Mutagens. Section 5.17 of the RSL User's Guide identifies specific chemicals considered to be carcinogenic by a mutagenic mode of action. Except for vinyl chloride, default age-dependent adjustment factors (ADAFs) provided in USEPA's *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens*, EPA/630/R-03/003F, March 2005 should be applied to the cancer toxicity values before determining cancer risk (USEPA, March 2005). The default ADAFs do not need to be applied for residential or non-residential scenarios where there are no children (anyone less than 16 years of age) present (USEPA, November 2024).

Dioxins & Furans (TEFs). In some cases, chemicals belonging to the same family exhibit similar toxicological properties, but their degree of toxicity differ. In the case of dioxins and furans, EPD follows USEPA's recommendation to calculate a toxicity equivalence quotient (TEQ) by applying a toxicity equivalence factor (TEF) to the measured concentrations in environmental media. The TEQs are summed up and assessed using appropriate toxicity values for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Please note that when using the RSL Calculator, TEFs have been applied to the toxicity values (USEPA, May 2013).

PCBs & congeners. Assess Aroclors using Aroclor-specific toxicity values and parameters. Follow the RSL User's Guide to determine the appropriate tier of human oral slope factor to use in the risk assessment.

- Toxicity values which apply to total PCBs should not be used for assessing individual Aroclors.

- Total PCBs toxicity values can be used to assess congeners analyzed via USEPA Method 1668. Total PCBs is, if all 209 congeners listed in 1668 are analyzed, the sum of only detected (above the reporting limit) chemicals.
- If fewer than 209 congeners are analyzed, Total PCBs is the sum of all congeners analyzed (non-detects should be assessed at the sample reporting limit, but the method detection limit can be used if it can be demonstrated that the concentration is below the MDL) (USEPA, November 2024).

Table 5: Recommended Default Exposure Parameters (USEPA, November 2024)

Parameter	Receptor	Value
Body Weight (BW)	Child	15 kilograms (kg)
	Adult	80 kg
	Trespasser (Adolescent – Age 7-16)	45 kg
Skin Surface Area – Soil (SA)	Child	2,373 cm^2/day
	Adult	6,032 cm^2/day
	Worker	3,527 cm^2/day
Skin Surface Area – Water (SA)	Child	6,365 cm^2/day
	Adult	19,652 cm^2/day
Exposure Frequency (EF)	Resident	350 days/year
	Worker	250 days/year
	Indoor Worker	250 days/year
	Outdoor Worker	225 days/year
Exposure Duration (ED)	Resident	26 years
	Resident Adult	20 years
	Resident Child	6 years
	Worker	25 years
	Construction worker	1 year
Exposure Time (ET) – Air	Resident	24 hours/day
	Worker	8 hours/day
Exposure Time (ET) – Water	Resident	24 hours/day
	Resident Child	0.54 hours/event
	Resident Adult	0.71 hour/event
Exposure Time (ET) – Soil	Resident	24 hours/day
	Worker	8 hours/day
Averaging Time (AT)	Resident	365 days/year
	Indoor worker, composite worker, outdoor worker	365 days/year
Soil Adherence Factor (AF)	Child	0.2 mg/cm^2
	Adult	0.07 mg/cm^2
	Worker	0.12 mg/cm^2
	Construction Worker	0.3 mg/cm^2
Ingestion Rate – Water (IR_W)	Child	0.78 L/day
	Adult	2.5 L/day
Ingestion Rate – Soil (IR_S)	Child	200 mg/day
	Adult	100 mg/day
	Indoor Worker	50 mg/day
	Outdoor Worker	100 mg/day
	Construction Worker	330 mg/day
Lifetime		70 years

6.3 Risk Characterization

Once the Exposure Assessment and Toxicity Assessment are completed, the information gathered for both assessments is combined to calculate the cumulative risk and hazard for each receptor exposed to a pathway(s) of concern. It is recommended that the cumulative risk and hazard be calculated using the RSL or RAIS calculator for consistency. Additionally, cumulative risk and/or hazard may be calculated using the equations in USEPA's *Risk Assessment Guidance for Superfund* or RAGS.

Using the RSL or RAIS calculator, select the appropriate receptor scenario, media, risk output, and COPCs. EPCs and any other site-specific parameters can be entered further. For more information on the RSL or RAIS calculator, please see their individual user guide. Please print out or save electronically the inputs and outputs from the calculator. Risk and hazard should be expressed as one significant figure in a table for each receptor/pathway scenario (e.g., resident child – surface soil pathway, or construction worker – combined soil, etc.). Any cumulative risk or HI exceeding 1E-05 (10^{-5}) and 1 ("thresholds") respectively, may need further action. Any receptor/pathway scenario below the cumulative thresholds do not require further action.

For HIs above 1, a target organ site-specific hazard index (TOSHI) may be calculated for each receptor/pathway scenario. Use the information provided in the toxicity assessment to determine the target organ(s) or system(s) for each chemical. Calculate the TOSHI by adding the HQs for each chemical that has the same target organ or system. If any TOSHI exceeds 1, that receptor/pathway scenario may need further action.

6.3.1 Selection of Chemicals of Concern (COCs)

For each receptor/pathway combination, evaluate what chemicals contribute the most risk or hazard. Select the chemicals that contribute the most risk or hazard to a receptor/pathway scenario until the risk and hazard posed by remaining chemicals are below the thresholds (1E-05/1). Please submit the Chemical of Concern (COC) Worksheet available on EPD's website and in Appendix A of this document. Selected COCs for that receptor/pathway scenario should be addressed in a corrective action plan.

6.3.2 Uncertainty Section

Every risk assessment should include an uncertainty section discussing how the assumptions and parameters used throughout the risk assessment have an impact on the confidence of the quantitative risk and hazard estimates. All key site-related assumptions that contribute the most to uncertainty should be fully discussed. The uncertainty section may also provide insight to whether additional data could be collected to reduce uncertainties.

Many uncertainties involve the exposure assessment which is based on numerous assumptions and estimates such as contact rates, exposure frequency, exposure duration, body weight, etc. Additionally, depending on the amount of data available, there may be uncertainty in determining the

EPC. If ProUCL cannot calculate or recommend an EPC based on the number of non-detects, the maximum concentration is used which may overestimate risk and increase uncertainty. Many toxicity values for chemicals have inherent uncertainties since many of the values were derived from animal studies and transferring that toxicity value to humans involves modeling. These are examples of issues that should be discussed in the uncertainty section of the BRA Report.

All statements in the risk assessment should have substantiating evidence or justification based upon science and information collected during the investigation of the site in question. A justification should be provided for any assumptions made in the document.

6.4 Baseline Risk Assessment (BRA) Report

The following is a recommended outline for a Baseline Risk Assessment (BRA) Report.

1. Introduction
    a. General problem at site
    b. Site-specific objectives of the risk assessment
2. Site Background and Conceptual Site Model
    a. Site description
    b. Map of site and photographs
    c. General history (Ownership, Operations and Contamination)
    d. Area(s) of Contamination and Sources (Include maps of source areas, extent of contamination and sampling locations, and tables of sampling depths and results)
    e. Surrounding land use
    f. Potential receptors
    g. Conceptual site model (pictorial and/or text)
3. Data Evaluation
    a. Evaluation of analytical methods
    b. Evaluation of quantification limits
    c. Evaluation of qualified data
    d. Chemicals in blanks
    e. Background for naturally occurring inorganics
    f. Data gaps
4. Screening to determine Chemicals of Potential Concern (include separate subsections for each contaminated area)
5. Exposure Assessment
    a. Description of exposure setting
    b. Fate and transport of contamination
    c. Potential receptors and routes of exposure
    d. Exposure Point Concentrations
    e. Exposure Parameters (for each receptor)
6. Toxicity Assessment (summarize in table)
    a. Source of toxicity values
    b. Surrogates

   c. Chemical-specific issues (such as bioavailability, Lead model input and outputs, etc.)
7. Risk Characterization
   a. Risk and Hazard Calculations – present either calculations in a table or provide input and outputs from RSL or RAIS calculator
   b. Discussion of Risks and Hazards (separate section per contaminated area)
   c. Chemicals of Concern Selection
   d. Uncertainty Discussion

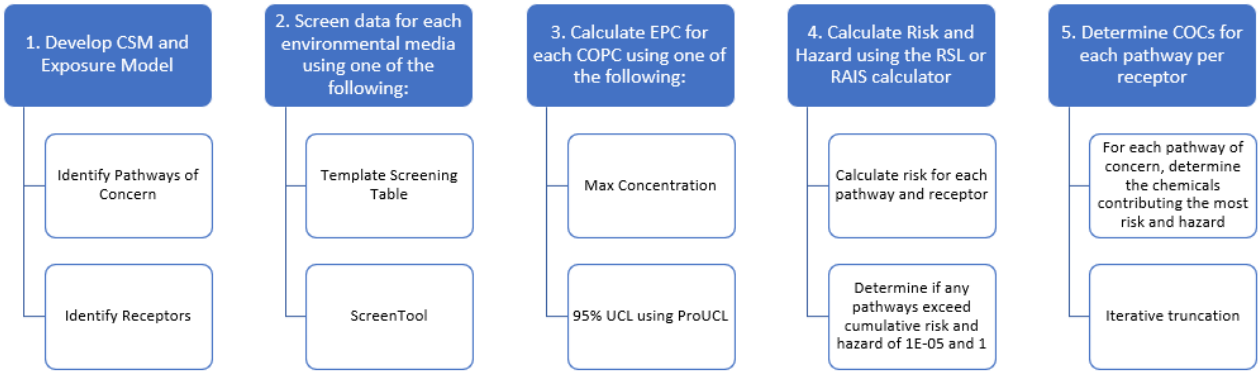
Attachments:

- Screening Tables (See Appendix A for examples. Excel spreadsheets are available on EPD website)
- Maps, Photographs, Aerials, Cross Sections – showing areas of releases, extent of contamination and locations of samples
- Table of Exposure Parameters used (if not using default parameters)
- Table of Toxicity Values used (if not using the RSL or RAIS calculator)
- Table of Risk Calculations (if not using the RSL or RAIS calculator)
- Summary of Risks, Hazards, and COCs for Each Pathway (See Risk Summary Table in Appendix A.)

7.0 Streamlined Human Health Risk Assessment

Another option for conducting a risk assessment in Georgia is a streamlined risk assessment. The Streamlined Risk Assessment utilizes standard exposure assumptions and publicly available tools such as the RSL Calculator to determine an estimated cumulative risk per pathway at a site for each receptor and calculate cleanup levels based on human health, leaching, and direct contact considerations while factoring in Applicable or Relevant and Appropriate Requirements (ARARs). This option is ideal for less complex sites. The streamlined risk assessment can also be completed prior to a Baseline Risk Assessment (Section 6 of this document) to determine which pathways need further assessment in a BRA. It can also be used to determine where to prioritize remedial efforts. To perform a streamlined risk assessment, the PRP should complete delineation and submit a CSM. This section will provide the inputs and protocol for such a risk assessment.

Figure 5: Streamlined Risk Assessment Process

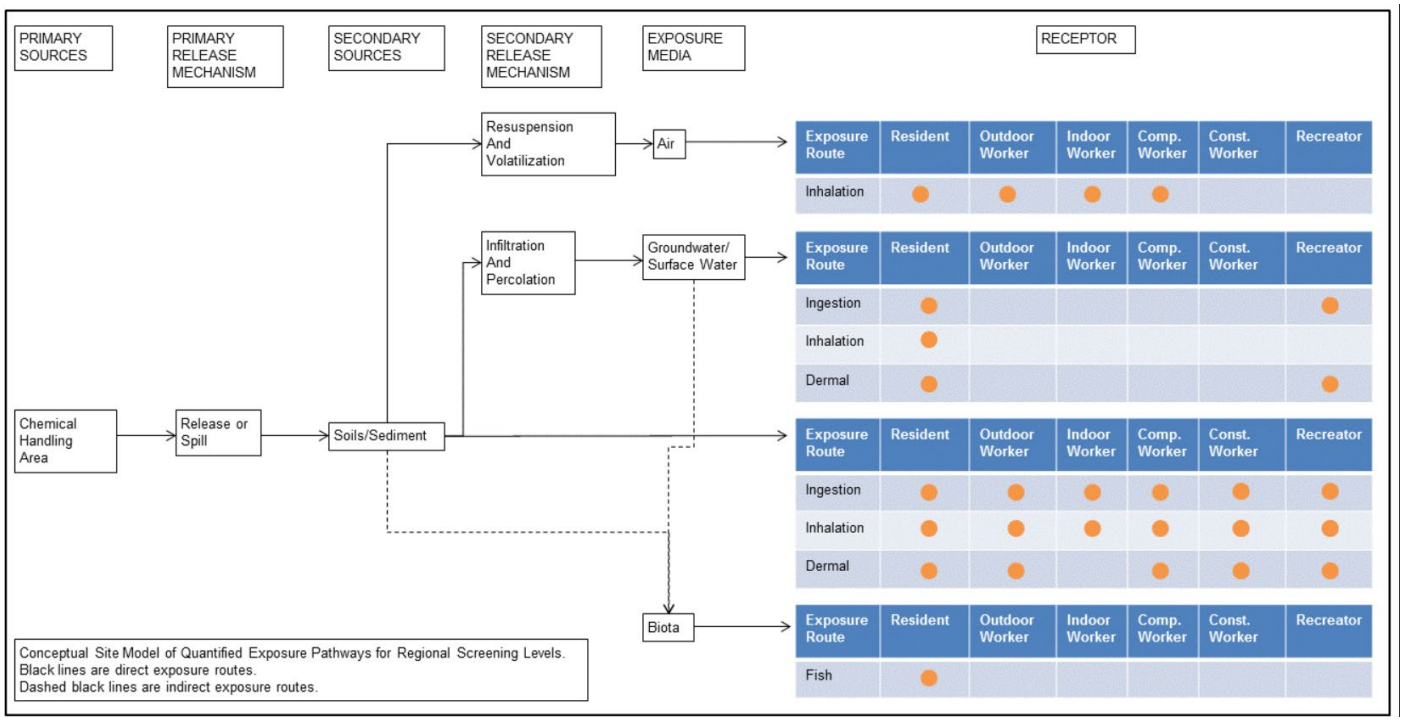


7.1 Conceptual Site Model and Exposure Model

As discussed in Section 3 of this document. The Conceptual Site Model (CSM) is a dynamic roadmap that systematically outlines what we know and suspect about a site, ultimately driving the entire risk assessment process. The CSM facilitates a clear comprehension of potential contaminant sources, exposure pathways, and receptors.

The **first step** in the Streamlined Risk Assessment is to draft a Conceptual Site Model, which will assist in determining where to sample at the site. Sampling of the site should utilize the guidance in Section 4 of this document. Once sampling of the site has delineated contamination and the CSM has been refined based on the data collected, an exposure model can be drafted. The exposure model is a flow diagram that starts with the source of the contamination, the release mechanisms, and fate and transport and ends with the pathway and receptor identifications. An example of an exposure model is provided below in Figure 6. Mapping out the migration of releases and the exposure points assists the assessor in focusing on the receptors and pathways of concern.

Figure 6: Examples of an Exposure Model (USEPA, November 2024)



7.2 Screening Data

The **second step** in the Streamlined Risk Assessment is screening site data to determine what chemicals move forward in the risk assessment. Screening your data can be accomplished in one of two ways:

(1) using the Screening Template Table on EPD's website and depicted in Attachment A of this document;

(2) using the EPD ScreenTool available on EPD's website.

The following chemicals are Chemicals of Potential Concern (COPCs) and should be evaluated further in the risk assessment:

- Any chemical where the maximum detected concentration exceeds the screening level for that environmental medium;
- Any chemical where the maximum method detection limit exceeds the screening level for that environmental medium; and
- Any chemical without a screening level.

7.3 Exposure Point Concentrations

The **third step** in the Streamlined Risk Assessment is to calculate Exposure Point Concentrations or EPCs for all COPCs in each contaminated media. The EPC is an estimate of the arithmetic average concentration of a chemical contacted by a receptor within an exposure unit over time. For more information about the EPC, please see Section 6.1.3.1 of this document. The EPC may be calculated using one of the two methods below:

(1) Use the maximum detected concentration or the maximum reporting limit for that chemical, whichever is greater; or
(2) Use the USEPA program ProUCL to determine the 95% upper confidence limit (UCL) of the mean.

For the first method, risk may be significantly overestimated, but you can quickly determine the EPC with minimal effort. For the second method, the sample result for that chemical and each media, including non-detects, should be entered on an Excel spreadsheet which will be inputted into ProUCL. See Section 1 of the ProUCL User Guide for formatting data in Excel. Please see Section 6.1.3.1 of this document for more information on determining the EPC.

Below are some tips for using ProUCL:

- The reporting limit for non-detect data should not be halved.
- When ProUCL recommends more than one UCL, the most conservative or greatest value should be used as the EPC.
- If using discrete sampling, the minimum recommended number of samples is 10. The minimum number of detected concentrations is 6 out of the ten samples.
- If 95% UCL is greater than the maximum detected concentration or MDC, the MDC should be used as the EPC.

Include printouts of input spreadsheets and ProUCL outputs with your streamlined risk assessment.

7.4 Risk and Hazard Calculations

The **fourth step** in the Streamlined Risk Assessment is to calculate cancer risk and non-cancer hazard for each receptor. Once the EPC is determined for each COPC in the selected media, the RSL calculator can be utilized to calculate the cumulative risk and hazard for that pathway for select receptor scenarios. Using the exposure assessment in your CSM, determine what receptors should be evaluated for exposure to each media. For instance, if your only receptor to on-site surface soils is the composite worker, then you would calculate risk/hazard for that scenario in the RAIS or RSL calculator using the standard exposure parameters for that receptor.

a. Select Screening Type Level – RSLs
b. Select Scenario – click on receptor scenario for the media being evaluated. In this instance "Composite worker".
c. Select Media – In this instance, "Soil"
d. Select Screening Level Choice – Site Specific
e. Select Chemical Info Type – Default
f. Select Risk Output – Yes

g. Select RfC/RfD Choice – Chronic
h. Select Chemicals – enter all COPCs for that media (Enter the CAS number or the chemical name)
i. Click on Retrieve
j. On the next screening enter the EPC corresponding to each COPC in the column "Soil Concentration" paying close attention to units, converting the concentration to the correct units when necessary.
k. Click on Retrieve
l. The cumulative risk should be listed in the 3rd table under the column Carcinogenic Risk and Non-carcinogenic Hazard Index (HI) in the totals row.
m. Provide a pdf copy of results as part of your streamlined risk assessment.

If risk to a receptor in a pathway exceeds an Excess Lifetime Cancer Risk (ELCR) of 1E-05 and a Non-carcinogenic Hazard Index (HI) of 1, corrective action may be necessary to reduce risk.

7.5 Determining Chemicals of Concern (COCs)

The **final step** of the Streamlined Risk Assessment is to determine what chemicals require cleanup. Using the risk and hazard calculations from the RSL or RAIS calculator for each receptor/pathway combination, select the chemicals that contribute the most risk or hazard to a receptor/pathway scenario until the risk and hazard posed by remaining chemicals are below the thresholds (1E-05/1). Please submit the Chemical of Concern (COC) Worksheet available in Appendix A of this document. Selected COCs for each receptor/pathway scenario should be addressed in a corrective action plan.

7.6 Streamlined Risk Assessment Report Contents

Below is a recommended outline for the Streamlined Risk Assessment:

1. Conceptual Site Model and Exposure Model
2. Screening worksheet/ScreenTool printout for each media
3. EPC Excel inputs and Pro UCL outputs and EPC Summary Table
4. RSL calculator output (pdf)
5. Human Health Risk and Hazard Summary
6. Uncertainty discussion

8.0 Ecological Risk Assessment

An ecological risk assessment (ERA) is performed to determine if there are unacceptable risks to ecological receptors exposed to chemicals at a site, identify levels of chemicals that would not pose unacceptable risks, and provide the risk information necessary to assist risk managers in making informed decisions regarding the need and extent of remedial action. This document provides supplemental guidance for sites to perform ecological risk assessments in addition to USEPA guidance, including USEPA's *Region 4 Ecological Risk Assessment Supplemental Guidance* (USEPA Region 4, March 2018) and *Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessment* (USEPA, June 1997), and to streamline EPD's review.

Ecological Risk Assessment Guidance

Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update). USEPA Region 4.

Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments – Interim Final (June 1997), USEPA.

Eco Update: The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments (June 2001), USEPA.

Framework for Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furans, and Biphenyls in Ecological Risk Assessment (June 2008), USEPA.

The ERA process consists of eight steps, as detailed in ERAGS. Scientific management decision points (SMDPs) are included throughout the process which allow for the risk manager, risk assessors, and other stakeholders to reach consensus or redirect before proceeding to the next step. EPD proposes the following phased approach for preparing an ERA based on USEPA guidance to streamline the ERA process. The USEPA Region 4 guidance provides an additional intervening step, refined screening Step 3a.

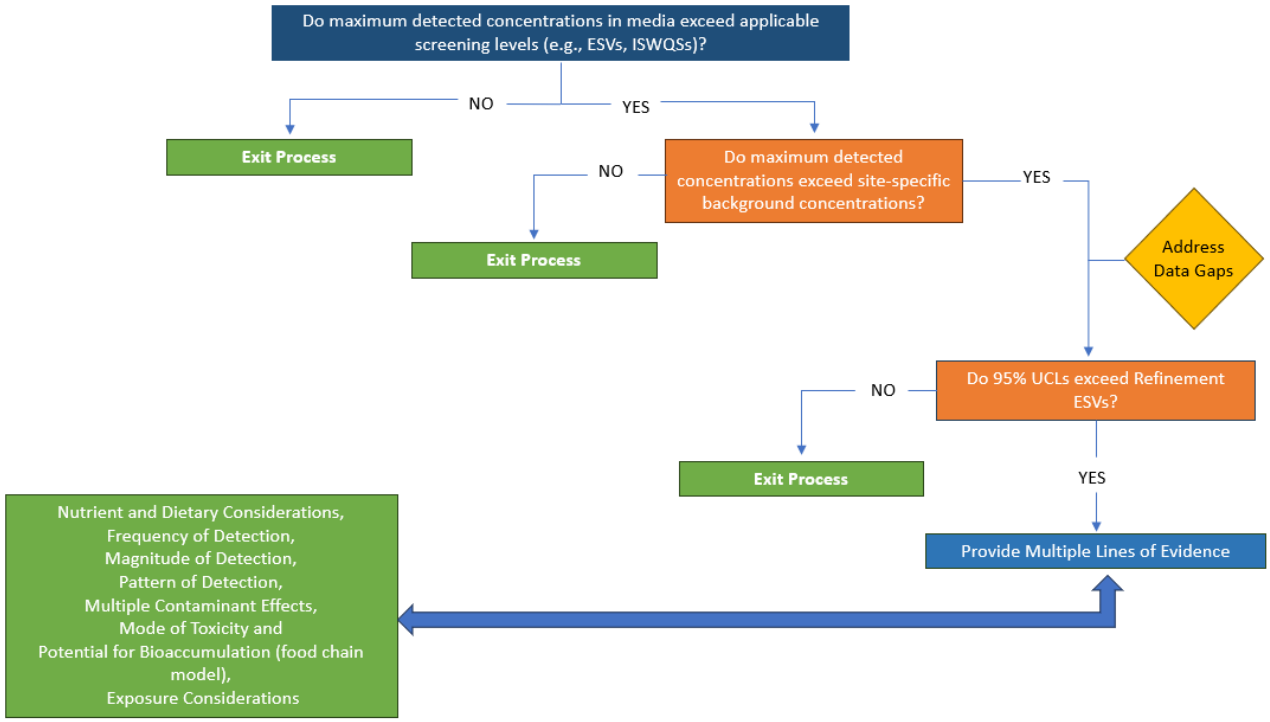
1. ***Ecological Habitat Questionnaire* to Determine Presence of Ecological Pathways** – This preliminary phase should be performed for sites where there is a potential for a habitat to determine if ecological receptors could potentially be exposed to site-related chemicals. The questionnaire (provided as **Appendix C**) is intended to determine the presence of an ecological habitat at or near the site resulting in potentially complete ecological exposure pathways. If there are no potentially complete ecological exposure pathways, no further ecological assessment is warranted. This provides an off-ramp from the ERA process for completely developed sites (e.g., industrial, commercial) with no ecological habitat present or minimal habitat with fully landscaped areas (e.g., mowed lawns or ditches). If potentially complete ecological exposure pathways are identified, then continue to the next phase of the ERA process, the Screening-Level Ecological Risk Assessment (SLERA).

2. **Screening-Level Ecological Risk Assessment** – This phase (ERAGS Steps 1 and 2) provides a quick determination as to whether a site poses a threat to ecological receptors and/or identifies which chemicals and exposure pathways require further evaluation. The main

objective of the SLERA is to provide the risk information necessary to assist risk managers in making informed decisions. The SLERA is designed to produce conservative risk estimates to ensure that risk is not underestimated, typically using conservative exposure assumptions (e.g., maximum concentrations) and literature-derived inputs for risk calculations. The tables "Step 2 ESV SLERA Tables" (in Appendix D/on EPD website) can assist in the determination of these risk estimates. To streamline the process, EPD proposes ERAGS Step 3a of the ERA process to be incorporated into the SLERA reporting, which includes refinement screening to support retaining or eliminating a chemical for further evaluation. The tables "Step 3a SLERA Refinement Screening" (in Appendix D/on EPD website) provide a streamlined framework for determining which chemicals require further evaluation as a COPEC. Figure 7 provides a flowchart of the EPD's refined SLERA process. The SLERA conclusions may lead to: a) the conclusion of negligible ecological risk and the completion of the ERA process; b) the need to complete additional steps in the ERA process (i.e., performing a Baseline Ecological Risk Assessment [BERA]) for chemicals and exposure pathways requiring further evaluation; or c) a recommendation for remedial action based on the SLERA results and development of site-specific RGOs derived from the SLERA assumptions and applicable regulatory requirements.

3. **Baseline Ecological Risk Assessment** – The BERA phase (ERAGS Steps 3 to 7) is conducted at a site if there are ecological risks that require risk management, data gaps critical to the ERA or when the SLERA indicates the need for further evaluation to characterize the potential risk and/or develop RGOs. The BERA may include additional sampling at the site to address the identified data gaps and incorporates the site-specific data and exposure assumptions in the refined risk calculations. Additional lines of evidence are oftentimes collected to support or refute the risk conclusions and reduce the inherent uncertainty in SLERAs due to the limited site-specific information available. RGOs are derived from the BERA assumptions and applicable regulatory requirements.

Figure 7:
SLERA Refinement Process



**

The following sections below provide an overview for guidance.

8.1 Questionnaire to Determine Presence of Ecological Pathways

This preliminary phase of the ERA includes a desktop analysis of site information and completion of the *Ecological Habitat Questionnaire* to determine if ecological receptors could potentially be exposed to site-related chemicals. Sites with a potential ecological habitat will need to complete the questionnaire to evaluate the presence of potentially complete ecological exposure pathways for receptors to be exposed to site chemicals. Similar to human health risk assessments, an ecological exposure pathway is considered complete if there is a potential ecological receptor and a point of contact with a chemical either at, or released from, a site. If there are no potential ecological exposure pathways associated with a site, then no further ecological evaluation is warranted. Depending on the extent of site development, the desktop analysis may need to be supplemented with information collected during a site reconnaissance by a qualified professional ecologist or equivalent. The questionnaire is provided as **Appendix C** and includes the following key questions that need to be answered to determine if there are ecological exposure pathways of concern:

1. Are there undeveloped terrestrial areas on or adjacent to the site (excluding landscaped areas and agricultural lands under cultivation)? If the site will be redeveloped, will these terrestrial areas remain?
2. Are there potential wetlands, marshes, swamps, or vernal pools on or adjacent to the site?
3. Are there surface water bodies (e.g., rivers, intermittent, ephemeral, and perennial streams, lakes, seasonal ponds) on or adjacent to the site?
4. Are there off-site habitats (e.g., terrestrial, wetland, or aquatic) that are downstream, downwind, or downgradient that could be affected by impacted media associated with a release from the site? This question does not apply to sites enrolled in the Brownfield Program.
5. Are there any planned future use(s) of the site, or current or future use(s) near the site, such as conservation areas or arboretums, etc., that would result in undeveloped terrestrial areas, wetlands, or aquatic habitats?

"Habitat" in the context of this document is defined as a place where an ecological receptor resides or forages. Per USEPA Region 5, habitat is defined as: "The place where a population of plants or animals and its surroundings are located, including both living and non-living components."

Sufficient information needs to be provided to the EPD to document site conditions in relation to these questions. Documentation can include:

- *Ecological Habitat Questionnaire*
- Current aerial photograph(s) with site boundaries, known source areas, and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.)
- National Wetland Inventory map with an outline of the site boundaries, known source areas, and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.)
- List of federal and/or state protected species, critical habitats, or other sensitive resources from U.S. Fish & Wildlife Service (USFWS) Information for Planning and Consultation (IPaC), Georgia Department of Natural Resources (GADNR) Biodiversity Portal, and NOAA Fisheries (as applicable)
- Site photographs, if site reconnaissance is performed.

If it can be documented that the responses to the first 5 questions are all "*No*", then no further ecological assessment is warranted, and the site can exit the ERA process. However, if the answer is "*Yes*" to any of the first 5 questions, the remainder of the questionnaire should be completed as instructed. Upon EPD review of the submitted questionnaire and, if warranted, verification by an EPD site visit, if there is a complete exposure pathway for potential ecological receptors of concern you should proceed to the next phase of the ERA, the Screening-Level Ecological Risk Assessment (SLERA). A site-specific sampling plan should be developed in consultation with EPD followed by completion of a SLERA for each potential ecological habitat.

An exposure pathway in the context of the SLERA is defined as either direct contact (exposure to a chemical dissolved in or incorporated into an environmental medium through immediate contact with the medium) or indirect contact (i.e., through the food chain and includes prey ingestion, surface water ingestion, and/or incidental soil or sediment ingestion).

Impacted media can include:

- Surface soil (up to 2 feet below ground surface)
- Subsurface soil for burrowing mammals (depth dependent on receptor)
- Groundwater discharging to receiving surface water body
- Surface water
- Sediment

If there is a known groundwater discharge to a surface water body, contact EPD for discussion on how to incorporate into the ERA.

8.2 Screening-Level Ecological Risk Assessment

The SLERA represents the first two steps in the ERAGS process with the intent to provide a quick determination as to whether a site poses unacceptable ecological risk and/or identifies which chemicals and exposure pathways require further evaluation. In accordance with guidance requirements, the SLERA produces quick conservative risk estimates that are designed to ensure that risk is not underestimated. This guidance allows for refinement of the conservative risk estimates by incorporating refinement steps and multiple lines of evidence from the BERA (Step 3a) as part of the SLERA reporting. This streamlining is considered to be a time- and cost-efficient approach for both risk assessors and risk managers and can reduce the overall schedule for reaching agreement on remedial actions, if necessary.

Under this guidance, the SLERA reporting could consist of the following ERAGS steps:

Step 1. Screening-Level Problem Formulation and Ecological Effects Evaluation

Step 2. Screening-Level Exposure Estimate and Risk Calculation

Step 3a. Baseline Problem Formulation – Refinement of Preliminary Chemicals of Potential Concern

These steps should be conducted following the Region 4 guidance with details specified below.

Step 1. Screening-Level Problem Formulation and Ecological Effects Evaluation

As part of the problem formulation and to aid in the development of the ecological CSM, a site reconnaissance/habitat assessment is recommended and should be conducted by a qualified professional (if not already performed under the first phase of the ERA [Section 8.1]). Completion of USEPA's *Checklist for Ecological Assessment/Sampling* from ERAGS Appendix B is recommended for use during the site reconnaissance to assist in the problem formulation. Photographs of the site and site features should be included in the documentation along with USFWS IPaC and GADNR Biodiversity Portal information (and NOAA Fisheries, as applicable). This information will be used to develop the ecological CSM and identify complete and incomplete ecological exposure pathways and receptors of interest. The CSM should be updated as new information becomes available.

Ecological screening values (ESVs) should be obtained from USEPA Region 4 guidance, except for surface water where chronic Georgia In-Stream Water Quality Standards should be used, where available. The Region 4 ESVs are for screening purposes only and are not intended to be remediation levels. ESVs are based on chemical concentrations associated with a low probability of unacceptable risks to ecological receptors typically based on chronic effect values or No Observed Adverse Effect Levels (NOAELs).

Supplemental sources can be used to obtain appropriate screening values, such as USEPA EcoBox which is an online toolbox for ecological risk assessors that provides links to guidance documents, databases, models, reference materials, and other related resources. Please contact EPD if you have any questions on applicable ESVs.

Supplemental Sources for Screening Values (refer to USEPA EcoBox)

USEPA Region 3 BTAG Screening Benchmarks

National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRTs)

The Region 4 ESVs consider direct toxicity as well as bioaccumulative effects on organisms, and the lowest protective value is chosen as the ESV. Therefore, some chemicals have wildlife-based ESVs (i.e., which accounts for bioaccumulative effects through the food web) in addition to the direct toxicity ESVs. Maximum detected concentrations should be compared to the wildlife-based ESV and the direct contact ESV. Bioaccumulative chemicals are identified in the Region 4 guidance.

Step 2. Screening-Level Exposure Estimate and Risk Calculation

This step provides a conservative estimate of risk to ensure that sites with unacceptable risk will be recommended for further evaluation. Risk is calculated using the Hazard Quotient (HQ) method by comparing the maximum concentrations (or if not detected, a surrogate concentration based on one-half the maximum method detection limit) of chemicals in each medium (e.g., surface water, sediment, soil) to the ESVs to identify preliminary chemicals of potential ecological concern (PCOPECs). Refer to the "Step 2 ESV SLERA Tables" (in Appendix D/on EPD website) for these risk estimates.

PCOPECs are identified based on the following criteria:

- HQ≥1. The maximum detected concentration was greater than or equal to the ESV.
- The chemical was detected, but no ESV was available.
- The chemical was not detected, but the surrogate concentration was greater than or equal to the ESV (including a wildlife-based ESV; HQ≥1). Non-detected bioaccumulative chemicals that do not have a wildlife-based ESV are not retained as PCOPECs.
- The chemical is detected and bioaccumulative and does not have a wildlife-based ESV.

Upon completion of the SLERA, there is an SMDP which may lead to additional steps in the ERA process, or the conclusion of the Ecological Screening process based on risk results. One of the following decisions will be made at the SMDP based on the SLERA:

- Scenario A. There is adequate information to conclude that ecological risks are negligible and therefore, no need for remediation on the basis of ecological risk. This would apply to sites that passed the screening and where no PCOPECs were identified in any media, or sites where the conclusions indicate ecological risk is relatively low and other risk management decisions, such as remediation to address human health risks, would address ecological risk.

- Scenario B. The information is not adequate to make a decision at this point, and the ERA process will continue to Step 3. This would apply to sites that identified PCOPECs, necessitating further evaluation.

- Scenario C. The information indicates a potential for adverse ecological effects, and a more thorough assessment is needed. This would apply to sites where the risk conclusions are used to focus on areas within a site potentially warranting early risk management measures, such as interim removal actions, or focused investigations on exposure pathways or receptors.

If additional assessment is warranted (either Scenario B or C above), EPD recommends incorporating the next step of the process, Step 3a - Baseline Problem Formulation with Refinement of the PCOPECs, into the SLERA reporting to streamline the process.

Step 3a. Baseline Problem Formulation – Refinement of Preliminary Chemicals of Potential Ecological Concern

The intent of Step 3a, PCOPEC refinement, is to evaluate the chemicals identified as PCOPECs using the conservative SLERA assumptions and determine if those PCOPECs would still pose potential ecological risk if more site-specific assumptions were used. The refinement of PCOPECs includes multiple lines of evidence to support retaining or eliminating a chemical for further evaluation with justification provided. Refinement should use more than one line of evidence. Refer to "Step 3a SLERA Refinement Screening" (in Appendix D/on EPD website) for determining which chemicals require further evaluation as a COPEC.

Refer to the flowchart in Figure 7 above for the refinement process using the following multiple lines of evidence outlined in Section 3.1 of Region 4 guidance:

Additional Screening Steps (In Sequential Order):

- Background Screening – Comparison of maximum concentrations to EPD-approved site-specific background levels, if available (See Section 4.1.1 for discussion on background sampling).

- 95% upper confidence limit of the arithmetic mean (95% UCL) to Refinement Screening Value (RSV) Screening – Screening the 95% UCL (see discussion in Section 7.3 on how to calculate a 95% UCL) to RSVs typically based on less conservative values or Lowest Observed Adverse Effect Levels (LOAELs). For surface water, chronic Georgia In-Stream Water Quality Standards should continue to be the screening value as these values automatically become the RGOs and chemicals cannot screen out by less restrictive RSVs. However, acute Georgia In-Stream Water Quality Standards can be used if deemed appropriate by EPD.

These screenings will generate a refined list of PCOPECs to carry forward into the additional lines of evidence consideration for further refinement using:

- Nutrients & dietary considerations
- Frequency, magnitude, & pattern of detection
- Multiple contaminant effect & sum toxic units for organic chemicals in a mixture
- Mode of toxicity & potential for bioaccumulation
- Exposure considerations

Refer to USEPA Region 4 guidance and USEPA's *Eco Update: The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (2001) for detailed information regarding these refinement steps. Please see Appendix D for a PDF copy of the Step 3a worksheet. An Excel copy of the worksheet is available on EPD's webpage.

No Observed Adverse Effect Level (NOAEL) = The highest level of a stressor evaluated in a test that does not cause statistically significant differences from the controls.

Lowest Observed Adverse Effect Level (LOAEL) = The lowest level of a stressor evaluated in a test that causes statistically significant differences from the controls.

Additional information is provided below for sites where the mode of toxicity and bioaccumulation potential are provided as lines of evidence. PCOPECs can be further screened for direct toxicity to receptors (e.g., plants, terrestrial invertebrates, and benthic macroinvertebrates) using 95% UCL concentrations and low effect levels protective of the receptor of interest. Food chain modeling can be performed for the refined list of PCOPECs, especially those chemicals that bioaccumulate, bioconcentrate, or biomagnify in the food chain, using representative receptors of interest in terrestrial and aquatic habitats. Conservative exposure assumptions and literature-derived inputs are used in the food chain modeling as typically site-specific data are not available at this step of the ERA process. Risk estimates are calculated for a spatial exposure unit(s), as defined on a site-specific basis, and more than one exposure unit may be defined, which can focus the list of chemicals to certain spatial areas of a site. Lower bound risk estimates using the maximum concentrations (or one-half the maximum detection limit for non-detect chemicals) and NOAEL toxicity reference values (TRVs) along with upper bound risk estimates using the 95% UCL concentrations and LOAEL TRVs can be included. Region 4 default food-chain model assumptions and TRVs should be used. Other supplemental sources for food-chain modeling inputs can be used with appropriate justification. A food chain model calculator has been developed and will be available soon on EPD's website.

The HQ method is used to estimate risk by dividing the chemical-specific calculated average daily dose by the TRV and incorporating conservative assumptions for chemical bioavailability and exposure (i.e., 100% site use) and literature-based bioaccumulation factors (BAFs) or bioconcentration factors (BCFs) due to a lack of site-specific data at this step. A NOAEL HQ value greater than (>) 1.0 indicates potential for unacceptable risk. A NOAEL HQ less than or equal to (≤) 1.0 is considered unlikely to cause unacceptable risk or adverse ecological effects. A low effect or LOAEL HQ value ≥ 1.0 indicates concentrations are likely to pose an unacceptable risk. When the no effect or NOAEL HQs are > 1.0, but the low effect or LOAEL HQs are < 1.0, concentrations have the possibility of an unacceptable risk as "the threshold for effects is assumed to be between the NOAEL and the LOAEL of a toxicity test" (ERAGS).

$$HQ = \frac{ADD}{TRV}$$

Where:

- *HQ = Hazard Quotient*
- *ADD = Average Daily Dose (mg/kg BW-day)*
- *TRV = Toxicity Reference Value*

The additional lines of evidence outlined above will then generate the list of chemicals of potential ecological concern (COPECs). The lines of evidence should be clearly presented for each chemical and medium with summary tables(s) and figure(s) of maps showing the distribution of COPEC concentrations recommended. Data gaps and uncertainties must be identified as part of the SLERA report to aid in the risk conclusions. At the end of this step, a SMDP occurs, and the decisions noted above as Scenarios A through C also apply at this SMDP.

The SLERA conclusions may lead to: a) the conclusion of negligible ecological risk and the completion of the ERA process at Step 3a; b) the continuation of the ERA process to Step 3b of the BERA for chemicals and exposure pathways requiring further evaluation; or c) a recommendation for remedial action based on the SLERA results and development of site-specific RGOs (refer to Section 9 for further discussion on RGO development) derived from the SLERA assumptions and applicable regulatory requirements.

8.3 Baseline Ecological Risk Assessment

The BERA (Steps 3b through 7) includes additional sampling at the site to address the identified data gaps and incorporates the site-specific data and exposure assumptions in refined risk calculations. The BERA work plan will identify the specific data needed to refine the risk estimates, reduce uncertainties, and fill identified data gaps to ultimately refine the RGOs for Step 8 (risk management). Site-specific information collected for the BERA can include the following lines of evidence outlined in ERAGS Appendix B:

- Tissue residue studies or bioavailability/bioaccumulation studies
- Population or Community Studies
    - Terrestrial vertebrate surveys
    - Benthic macroinvertebrate surveys
    - Fish surveys
- Toxicity tests (surface soil or sediment)

Site-specific exposure assumptions (e.g., site-specific area use factor based on home range instead of assuming 100% site use) and data (e.g., tissue concentrations, calculated BAFs for dietary items, pH levels in media to assess bioavailability) are also used to refine risk calculations. RGOs are then derived from the BERA assumptions and applicable regulatory requirements (refer to Section 9 for further discussion on RGO development).

9.0 Determining Remedial Goal Options

To establish remedial goals, EPD recommends several methodologies. These methodologies incorporate a combination of scientific analysis, regulatory standards, and stakeholder input to ensure that the remedial goals are both protective and attainable. Remedial Goal Options (RGO) should be proposed for review in the corrective action plan submitted to EPD by the facility/responsible party. The methodologies recommended by the EPD include:

Remedial Goals for Human Health

Regulatory Standards and Applicable or Relevant and Appropriate Requirements (ARARs):

- **Federal Standards**
  - **Groundwater**: Maximum Contaminant Levels (MCLs)
  - **Soil. Groundwater, Soil-to-Groundwater Pathway**: USEPA Regional Screening Levels (RSLs)
  - **Surface Water:** USEPA National Recommended Water Quality Criteria
- **State Standards**
  - **Surface Water:** Georgia Instream Water Quality Standards

Risk-Based Remedial Goals:

- **Carcinogenic Risks**: Concentrations are set to limit cancer risk, generally set to a cumulative risk of 1E-05.
- **Non-carcinogenic Risks**: Generally, targets are set to maintain a cumulative hazard quotient (HQ) of 1.

$$Remedial\ Goal\ (RG) = \frac{EPC\ x\ TR\ or\ THQ}{Cancer\ Risk\ or\ Non\ Cancer\ Hazard\ Quotient}$$

Where:

- *RG = Remedial Goal*
- *EPC = Exposure Point Concentration*
- *TR = Target Risk (cancer)*
- *THQ = Target Hazard Quotient (noncancer)*

- **Site specific Soil-to Groundwater (Leaching) Concentrations –** determined by using EPD's *FAQs for Evaluating the Soil-to-Groundwater Pathway*

Remedial Goals for Ecological

Ecological remedial goals are dependent on the assessment endpoints selected and the results of the SLERA/BERA. An acceptable level of adverse effects should be discussed with the RAP.

Regulatory Standards and Applicable or Relevant and Appropriate Requirements (ARARs):

State Standards

- Surface Water: Georgia Instream Water Quality Standards

Risk-Based Remedial Goals

Site-specific, risk-based RGOs can be back-calculated from the food chain models using a HQ of 1 and the NOAEL and LOAEL TRVs for the chemicals and exposure pathways posing unacceptable risk. The back-calculations can be performed using the SLERA or BERA assumptions depending on the ERA step where the RGOs are calculated.

For Both Human Health and Ecological

When establishing remedial goals for both human health and ecological risks, it is essential to compare these goals to determine which will guide the selection of remedial options. In most cases, the more conservative remedial goal should be prioritized. However, it is equally important to consider the potential impacts on habitat and/or biotic communities, including its destruction or disturbance, when making a final decision.

Background Levels:

- Background Comparison: For naturally occurring inorganics, remedial goals can be based on approved site-specific background concentrations. Literature-based regional background concentrations can also be used as remedial goals

- Reference Area Comparison: If site-specific background concentrations are not well-documented or attainable, reference sites with similar characteristics can provide comparison data to set remedial goals.

Different Approaches to Corrective Action that can be Utilized:

- Iterative Truncation: This method is based on the identification and removal of soils or sediments with high containment concentrations to lower estimated post-remediation EPCs to levels at or below the acceptable risk levels. Iterative truncation involves removing (truncating) high values in the sample concentration and calculating a hypothetical post-remediation EPC.

- Area-Averaging Approach: This method involves calculating the average concentration of discrete site-specific data. The average concentration of contaminants remaining in soil after remediation (if necessary) are at or below the remedial goals. This method is primarily for surface soils. Please see EPD's *"Area Averaging Approach to Soil Compliance Direct Contact Exposure Scenarios."*

Please note that this is not an exhaustive list of how to determine remedial goals. However, if other methods are proposed, please discuss with EPD.

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Appendices

Appendix A: Human Health Template Tables

Appendix B: Derivation for Default Background for Arsenic

Appendix C: Ecological Habitat Questionnaire

Appendix D: Screening Level Ecological Risk Assessment (SLERA) and Refinement Screening Worksheets

Appendix A:

Human Health Template Tables

Surface Soil Screening

Subsurface Soil Screening

Groundwater Screening

Surface Water Screening

Exposure Point Concentration (EPC) Summary

Risk and Hazard Summary

Directions for screening using the Screening Template Table in Appendix A:

To determine if a risk assessment is necessary and if so, the type of risk assessment that is appropriate, consider the following steps:

1. Data Organization: Organize environmental sampling data into separate media as listed below. Be sure to evaluate the useability of the data for the risk assessment (see Section 3 of this document):

- Surface soil (0-1 ft below ground surface, excluding paved or graveled surfaces)
- Subsurface soil (1 ft – groundwater table)
- Groundwater
- Surface water
- Sediment

2. Data Screening:

a. For each medium, create a table containing the following information (an example table can be found in Appendix A and a copy of the excel spreadsheet is available on EPD's website):

- CAS number
- Constituent
- Frequency of detection presented as number of detections per number of observations
- Minimum and maximum detection limits
- Minimum and maximum detections
- Maximum detected concentration (MDC)
- Maximum method detection limit (MAX MDL)
- Concentration used for screening (greater of MDC and MAX MDL)
- Screening level: See Table 1 below for media specific screening levels. Sources of Screening Levels can be fou
- EPD-approved background concentration for inorganics
- Chemical of Potential Concern (COPC) designation (Yes/No)
- Rationale for COPC designation (e.g., MDC > screening level)

b. Compare the greater of the Contaminant MDC or MAX MDL to the EPD-approved background value, if available. If the greater of the Contaminant MDC or MAX MDL exceeds the EPD-approved background value, compare the greater of the Contaminant MDC or MAX MDL to the media-specific screening level. Any chemicals that exceed the media-specific screening levels and EPD-approved background levels are considered Chemical of Potential Concern (COPCs). If no COPCs are identified, no further action is required for that chemical in that media.

Surface Soil Screening Table

Units (i.e., mg/kg, ug/kg, etc.)	mg/kg

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

CAS Number	Constituent	Frequency of Detection (number of detections/ number of samples)	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (Max MDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	EPD- Approved Site Background Concentration (BG)	USEPA *Residential* Regional Screening Level (RSL) (TR1E-06/HQ=0.1)	CoPC ("Y" for Yes, "N" for No)	Rationale (i.e., MDC > RSL, MaxMDL> RSL, BG>MDC, etc.)
7440-38-2	Arsenic	7/28	0.0012 - 0.0015	0.81 - 42.33	0.0015	42.33	42.33	9	0.68	Y	MDC>RSL
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Subsurface Soil Screening Table

Units (i.e., mg/kg, ug/kg, etc.)	mg/kg

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

CAS Number	Constituent	Frequency of Detection (number of detections/ number of samples)	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (Max MDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	EPD-Approved Site Background Concentration (BG)	USEPA *Industrial* Regional Screening Level (RSL) (TR=1E-06/HQ=0.1)	CoPC ("Y" for Yes, "N" for No)	Rationale (i.e., MDC > RSL, MaxMDL>RSL, BG>MDC, etc.)
7440-38-2	Arsenic	3/28	0.0012-0.0016	0.7 - 2.45	0.0016	2.45	2.45	9	3	N	MDC<RSL
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Groundwater Screening Table

Units (i.e., mg/L, ug/L, etc.)	ug/L

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

CAS Number	Hazardous Constituent	Frequency of Detection (number of detections/ number of samples)	Minimum - Maximum Method Detected Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (Max MDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	EPD-Approved Site Background Concentration (BG)	USEPA *Tapwater* Regional Screening Levels (RSLs) (TR=1E-06/HQ=0.1)	CoPC ("Y" for Yes, "N" for No)	Rationale (i.e., MDC > RSL, MaxMDL> RSL, BG>MDC, etc.)
7440-38-2	Arsenic	3/13	0.09 - 0.26	0.09 - 0.18	0.26	0.18	0.18		0.052	Y	MaxMDL>RSL
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Surface Water Screening Table

Units (i.e., mg/L, ug/L, etc.)	ug/L

The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

CAS Number	Hazardous Constituent	Frequency of Detection (number of detections/ number of samples)	Minimum - Maximum Method Detection Limits	Minimum - Maximum Detected Concentrations	Maximum Method Detection Limit (Max MDL)	Maximum Detected Concentration (MDC)	Concentration used for Screening (greater of the MDC and MaxMDL)	EPD-Approved Site Background Concentration (BG)	1. Georgia Instream Water Quality Standard (Human Consumption of Fish and Drinking Water)	2. USEPA National Recommended Water Quality Criteria (Human Health and Organism)	3. USEPA Tapwater Regional Screening Level (TR=1E-06/HQ=0.1)	CoPC ("Y" for Yes, "N" for No)	Rationale (i.e., MDC > SL, MaxMDL>SL, BG>MDC, etc.)
7440-38-2	Arsenic	7/18	0.09 - 0.26	0.09 - 7.7	0.26	7.7	7.7		10			N	No screening levels
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Exposure Point Concentration (EPC) Summary Table

Please include copies of any ProUCL data inputs and outputs in your report

Units: (Select One)

Media Type	CAS Number	Chemical Of Potential Concern	Frequency of Detection (number/number)	Maximum Method Detection Limit	Maximum Detected Concentration	95 % Upper Confidence Limit (95% UCL) on the mean using ProUCL recommendation	EPC	Basis
Ground Water	71-43-2	Benzene						Select One
Subsuface Soil	108-88-3	Toluene						Select One
Surface Soil	1330-20-7	Xylenes						Select One
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Human Health Risk and Hazard Summary

Please provide a Risk and Hazard Summary of the pathways and receptors evaluated in the Human Health Risk Assessment

The first two rows (highlighted in gray) are examples. Please delete them before submitting your table to the EPD.

Pathway	Receptor	*Cumulative Excess Lifetime Cancer Risk Above 1E-5?*	*Hazard Index Above 1?*	*Need to be addressed in Corrective Action Plan?*	*Chemicals of Concern (Risk Drivers)*	*Notes*
Surface Soil	Child Resident	☐	☐	☐	1,1-dichloroethylene	
Groundwater	Resident (adult & child)	☐	☐	☐		
(Select one)	(Select one)	☐	☐	☐		
(Select one)	(Select one)	☐	☐	☐		
(Select one)	(Select one)	☐	☐	☐		
(Select one)	(Select one)	☐	☐	☐		
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Appendix B:

Derivation for Default Background for Arsenic

Appendix B: Derivation of default background for Arsenic

Geochemical and mineralogical data for samples of surface soils collected from a depth of 0 to 5 centimeters in the conterminous United States; Data from the USGS Mineral Resources/Online Spatial Data- https://mrdata.usgs.gov/ds-801/

Top5_LabID	SiteID	StateID	Latitude	Longitude	CollDate	LandCover1	LandCover2	Top5_Depth	Top5_As
C-328120	160	GA	32.2704	-81.3716	03/04/09	Developed	Low Intensity Residential	0-5	0.7
C-328081	464	GA	33.6933	-84.5927	03/03/09	Developed	Low Intensity Residential	0-5	1.4
C-328110	544	GA	31.8844	-84.7292	03/10/09	Planted/Cultivated	Pasture/Hay	0-5	2.5
C-328082	672	GA	30.823	-82.8522	03/09/09	Planted/Cultivated	Pasture/Hay	0-5	<0.6
C-328102	720	GA	33.8041	-84.8897	03/03/09	Forested Upland	Mixed Forest	0-5	1
C-328116	864	GA	33.3594	-82.8837	03/04/09	Forested Upland	Evergreen Forest	0-5	0.8
C-328026	976	GA	32.7967	-84.2864	03/06/09	Forested Upland	Mixed Forest	0-5	1.2
C-328106	1056	GA	30.8109	-84.8918	03/10/09	Developed	Low Intensity Residential	0-5	2.2
C-327985	1184	GA	32.2425	-82.0065	03/05/09	Developed	Low Intensity Residential	0-5	1.3
C-328041	1568	GA	31.8935	-83.6877	03/10/09	Developed	Low Intensity Residential	0-5	1.1
C-328002	1696	GA	31.628	-83.4223	03/10/09	Developed	Low Intensity Residential	0-5	2.2
C-328072	1744	GA	33.3294	-85.2325	03/03/09	Forested Upland	Evergreen Forest	0-5	1.6
C-328121	1888	GA	31.9367	-82.8017	03/07/09	Planted/Cultivated	Row crops	0-5	0.8
C-327977	2000	GA	32.3134	-84.7742	03/06/09	Developed	Low Intensity Residential	0-5	1.2
C-327984	2208	GA	32.763	-82.0166	03/05/09	Planted/Cultivated	Pasture/Hay	0-5	1.2
C-327980	2256	GA	33.111	-83.4908	03/05/09	Forested Upland	Evergreen Forest	0-5	1.4
C-328038	2412	GA	34.4683	-84.4829	02/28/09	Forested Upland	Deciduous Forest	0-5	3
C-328123	2464	GA	31.0355	-83.2649	03/09/09	Planted/Cultivated	Pasture/Hay	0-5	1.8
C-328132	2512	GA	34.3951	-85.2298	02/27/09	Developed	Low Intensity Residential	0-5	7.1
C-328085	2592	GA	31.4873	-84.8607	03/10/09	Developed	Low Intensity Residential	0-5	5.6
C-328034	2656	GA	33.2092	-82.3587	03/04/09	Developed	Low Intensity Residential	0-5	0.9
C-328043	2912	GA	32.5937	-82.2415	03/05/09	Developed	Low Intensity Residential	0-5	1
C-328096	3024	GA	32.3189	-84.2203	03/06/09	Planted/Cultivated	Row crops	0-5	3.1
C-328122	3180	GA	34.6147	-83.4232	02/28/09	Forested Upland	Deciduous Forest	0-5	2.5
C-327999	3280	GA	34.1094	-83.9357	02/28/09	Developed	Low Intensity Residential	0-5	1.6
C-327983	3360	GA	30.8963	-84.4049	03/11/09	Planted/Cultivated	Pasture/Hay	0-5	1.8
C-328103	3436	GA	34.9233	-85.5628	02/27/09	Developed	Low Intensity Residential	0-5	4.3
C-327995	3488	GA	31.4615	-82.5845	03/07/09	Planted/Cultivated	Row crops	0-5	1.4
C-328091	3936	GA	32.6712	-82.7933	03/05/09	Developed	Low Intensity Residential	0-5	<0.6
C-327988	4560	GA	33.6865	-84.037	03/04/09	Developed	Low Intensity Residential	0-5	4.2
C-328099	4640	GA	31.7366	-84.6235	03/10/09	Planted/Cultivated	Row crops	0-5	11.7
C-328109	4768	GA	31.5555	-83.212	03/10/09	Developed	Low Intensity Residential	0-5	2.9
C-328027	4960	GA	33.572	-82.9533	03/04/09	Developed	Low Intensity Residential	0-5	1.2
C-328071	5024	GA	31.1302	-81.8595	03/09/09	Developed	Low Intensity Residential	0-5	0.7
C-328035	5072	GA	32.8572	-83.9318	03/06/09	Forested Upland	Mixed Forest	0-5	1.6
C-328074	5280	GA	32.6338	-81.5207	03/04/09	Developed	Low Intensity Residential	0-5	0.9
C-328129	5584	GA	34.4748	-85.282	02/27/09	Forested Upland	Deciduous Forest	0-5	26.7
C-328115	5664	GA	31.8164	-84.113	03/10/09	Planted/Cultivated	Pasture/Hay	0-5	3.5
C-328077	5728	GA	33.8277	-82.47	02/28/09	Forested Upland	Evergreen Forest	0-5	1.6
C-327989	5840	GA	32.8565	-85.0364	03/06/09	Planted/Cultivated	Pasture/Hay	0-5	1.2
C-328080	5984	GA	32.6603	-82.1995	03/05/09	Developed	Low Intensity Residential	0-5	1.1
C-328113	6096	GA	32.2387	-84.5338	03/06/09	Planted/Cultivated	Row crops	0-5	0.8
C-328033	6176	GA	30.7233	-83.9138	03/11/09	Forested Upland	Evergreen Forest	0-5	1.1
C-328000	6304	GA	31.8527	-81.255	03/07/09	Forested Upland	Mixed Forest	0-5	0.9
C-327987	6352	GA	33.732	-83.8514	03/04/09	Developed	Low Intensity Residential	0-5	1.5
C-328130	6508	GA	34.7178	-84.713	02/27/09	Forested Upland	Mixed Forest	0-5	0.9
C-328045	6560	GA	30.7811	-83.158	03/09/09	Developed	Low Intensity Residential	0-5	<0.6
C-328086	6608	GA	34.3627	-84.7396	03/27/09	Planted/Cultivated	Pasture/Hay	0-5	6.3
C-328078	6752	GA	33.1098	-82.1885	03/04/09	Planted/Cultivated	Pasture/Hay	0-5	1.8
C-328070	7008	GA	32.343	-83.1491	03/06/09	Forested Upland	Evergreen Forest	0-5	0.7
C-328092	7072	GA	30.9971	-81.9603	03/09/09	Developed	Low Intensity Residential	0-5	<0.6
C-327981	7120	GA	32.4336	-83.8865	03/06/09	Planted/Cultivated	Pasture/Hay	0-5	2.4
C-328030	7276	GA	34.2749	-83.2362	02/28/09	Planted/Cultivated	Pasture/Hay	0-5	8.9
C-328125	7376	GA	33.6503	-83.2592	03/04/09	Forested Upland	Evergreen Forest	0-5	3.2
C-327993	7456	GA	30.866	-84.0304	03/11/09	Forested Upland	Evergreen Forest	0-5	1.1
C-327991	7520	GA	33.0154	-81.9055	03/04/09	Forested Upland	Evergreen Forest	0-5	2.1
C-328114	7532	GA	34.8042	-85.4684	02/27/09	Planted/Cultivated	Pasture/Hay	0-5	2.7
C-328095	7584	GA	31.1627	-82.4239	03/09/09	Developed	Low Intensity Residential	0-5	<0.6
C-328100	7840	GA	30.3922	-82.1786	03/09/09	Planted/Cultivated	Pasture/Hay	0-5	0.9
C-328079	8032	GA	32.7419	-83.1647	03/05/09	Developed	Low Intensity Residential	0-5	2.2
C-328087	8352	GA	31.8562	-81.7293	03/07/09	Forested Upland	Evergreen Forest	0-5	1.2
C-328076	8656	GA	33.3986	-84.4361	03/03/09	Planted/Cultivated	Fallow	0-5	8.5
C-328127	8736	GA	31.5872	-84.061	03/10/09	Planted/Cultivated	Fallow	0-5	1.1
C-328036	8864	GA	31.6333	-83.6128	03/10/09	Planted/Cultivated	Row crops	0-5	1.1
C-328098	9056	GA	32.1946	-82.8312	03/07/09	Developed	Low Intensity Residential	0-5	0.7
C-328126	9120	GA	31.496	-82.0381	03/07/09	Developed	Low Intensity Residential	0-5	1.1
C-328001	9168	GA	32.8098	-83.5151	03/05/09	Developed	Low Intensity Residential	0-5	2.2
C-328093	9376	GA	32.3494	-81.9418	03/05/09	Developed	Low Intensity Residential	0-5	1.7
C-327996	9580	GA	34.3569	-84.1412	02/28/09	Forested Upland	Evergreen Forest	0-5	3
C-328101	9760	GA	30.9548	-84.6111	03/10/09	Forested Upland	Evergreen Forest	0-5	1.1
C-327979	9824	GA	34.1522	-83.0924	02/28/09	Planted/Cultivated	Pasture/Hay	0-5	5.4
C-327994	10080	GA	32.651	-82.4204	03/05/09	Developed	Low Intensity Residential	0-5	0.9
C-328128	10144	GA	31.4664	-81.3672	03/09/09	Developed	Low Intensity Residential	0-5	2.4
C-327992	10192	GA	32.4803	-84.3115	03/06/09	Planted/Cultivated	Fallow	0-5	1.7
C-328031	10400	GA	32.0196	-81.2651	03/07/09	Planted/Cultivated	Pasture/Hay	0-5	3.3
C-328088	10448	GA	34.2936	-84.4965	02/28/09	Forested Upland	Deciduous Forest	0-5	2.8
C-328073	10604	GA	34.5862	-85.0297	02/27/09	Planted/Cultivated	Fallow	0-5	6.5
C-328131	10656	GA	30.8132	-83.6676	03/11/09	Planted/Cultivated	Pasture/Hay	0-5	2.4

C-328032	10848	GA	33.1445	-82.5223	03/04/09	Planted/Cultivated	Row crops	0-5	1.4
C-328107	11104	GA	32.0406	-83.1038	03/07/09	Planted/Cultivated	Row crops	0-5	2.4
C-328094	11168	GA	30.7394	-82.0741	03/09/09	Forested Upland	Mixed Forest	0-5	0.6
C-328104	11216	GA	32.368	-83.6587	03/06/09	Planted/Cultivated	Pasture/Hay	0-5	2.1
C-328037	11472	GA	34.2618	-83.7891	02/28/09	Forested Upland	Deciduous Forest	0-5	4.1
C-328117	11552	GA	31.1434	-83.9273	03/11/09	Developed	Low Intensity Residential	0-5	3.9
C-328108	11680	GA	31.1163	-82.5787	03/09/09	Planted/Cultivated	Row crops	0-5	1.1
C-327978	11728	GA	33.6123	-84.965	03/03/09	Forested Upland	Mixed Forest	0-5	1.8
C-328084	11872	GA	33.6342	-82.2998	02/28/09	Forested Upland	Mixed Forest	0-5	2.1
C-327998	11984	GA	32.9053	-84.7239	03/06/09	Planted/Cultivated	Pasture/Hay	0-5	2.6
C-328119	12128	GA	32.4501	-83.0783	03/07/09	Forested Upland	Deciduous Forest	0-5	1
C-328028	12448	GA	31.8051	-82.132	03/07/09	Developed	Low Intensity Residential	0-5	1.1
C-328042	12752	GA	33.2886	-84.2136	03/03/09	Developed	Low Intensity Residential	0-5	2.6
C-327986	12832	GA	31.7467	-84.3179	03/10/09	Developed	Low Intensity Residential	0-5	3.5
C-328044	12960	GA	31.4221	-83.2474	03/10/09	Forested Upland	Evergreen Forest	0-5	<0.6
C-328040	13152	GA	31.8666	-82.5703	03/07/09	Developed	Low Intensity Residential	0-5	1.5

["Top5_" in any column heading indicates the data in that column are for soils collected from a depth of 0 to 5 centimeters; LabID, unique identifier assigned by the analytical laboratories; SiteID, unique identifier assigned by generalized random tessellation stratified design software; StateID, abbreviation for state name as follows: AL, Alabama; AR, Arkansas; AZ, Arizona; CA, California; CO, Colorado; CT, Connecticut; DE, Delaware; FL, Florida; GA, Georgia; IA, Iowa; ID, Idaho; IL, Illinois; IN, Indiana; KS, Kansas; KY, Kentucky; LA, Louisiana; MA, Massachusetts; MD, Maryland; ME, Maine; MI, Michigan; MN, Minnesota; MO, Missouri; MS, Mississippi; MT, Montana; NC, North Carolina; ND, North Dakota; NE, Nebraska; NH, New Hampshire; NJ, New Jersey; NM, New Mexico; NV, Nevada; NY, New York; OH, Ohio; OK, Oklahoma; OR, Oregon; PA, Pennsylvania; RI, Rhode Island; SC, South Carolina; SD, South Dakota; TN, Tennessee; TX, Texas; UT, Utah; VA, Virginia; VT, Vermont; WA, Washington; WI, Wisconsin; WV, West Virginia; WY, Wyoming; CollDate, date sample was collected in MM/DD/YY; LandCover1, primary classification from National Land Cover Database 1992 Classification System; LandCover2, secondary classification from National Land Cover Database 1992 Classification System; Tot, total; Tot_K_fs, total potassium feldspar; Tot_Plag, total plagioclase feldspar; Tot_Flds, total feldspar; Tot_14A, total 14-angstrom clay minerals; Tot_10A, total 10-angstrom clay minerals; Kaolinit, kaolinite; Aragon, aragonite; Tot_Carb, total carbonate minerals; Heuland, heulandite; Tot_Zeol, total zeolite minerals; Hornbl, hornblende; Serpent, serpentine; Amorph, amorphous; Ag, silver; Al, aluminum; As, arsenic, Ba, barium, Be, beryllium, Bi, bismuth; C_Tot, total carbon; C_Inorg, inorganic (carbonate) carbon; C_Org, organic carbon (difference between C_Tot and C_Inorg); Ca, calcium; Cd, cadmium; Ce, cerium; Co, cobalt; Cr, chromium; Cs, cesium; Cu, copper; Fe, iron; Ga, gallium; Hg, mercury; In, indium; K, potassium; La, lanthanum; Li, lithium; Mg, magnesium; Mn, manganese; Mo, molybdenum; Na, sodium; Nb, niobium; Ni, nickel; P, phosphorus; Pb, lead; Rb, rubidium; S, sulfur; Sb, antimony; Sc, scandium; Se, selenium; Sn, tin; Sr, strontium; Te, tellurium; Th, thorium; Ti, titanium; Tl, thallium; U, uranium; V, vanadium; W, tungsten; Y, yttrium; Zn, zinc; cm, centimeters; wt. %, weight percent; mg/kg, milligrams per kilogram; <, less than; N.S., no sample (either not collected or lost in shipping)]

	A	B
1	As	D_As
2	0.7	1
3	1.4	1
4	2.5	1
5	0.6	0
6	1	1
7	0.8	1
8	1.2	1
9	2.2	1
10	1.3	1
11	1.1	1
12	2.2	1
13	1.6	1
14	0.8	1
15	1.2	1
16	1.2	1
17	1.4	1
18	3	1
19	1.8	1
20	7.1	1
21	5.6	1
22	0.9	1
23	1	1
24	3.1	1
25	2.5	1
26	1.6	1
27	1.8	1
28	4.3	1
29	1.4	1
30	0.6	0
31	4.2	1
32	11.7	1
33	2.9	1
34	1.2	1
35	0.7	1
36	1.6	1
37	0.9	1
38	26.7	1
39	3.5	1
40	1.6	1
41	1.2	1
42	1.1	1
43	0.8	1
44	1.1	1
45	0.9	1
46	1.5	1
47	0.9	1
48	0.6	0
49	6.3	1
50	1.8	1

	A	B	C	D	E	F	G	H	I	J	K	L
1					**Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit**							
2			**User Selected Options**									
3		Date/Time of Computation		ProUCL 5.2 1/9/2025 3:34:49 PM								
4				From File	WorkSheet_a.xls							
5				Full Precision	OFF							
6												
7												
8				**Rosner's Outlier Test for 1 Outliers in As**								
9												
10												
11				**Total N**	**94**							
12				**Number NDs**	**6**							
13				**Number Detects**	**94**							
14				**Mean with NDs=DL/2**	**2.449**							
15				**SD with NDs=DL/2**	**3.202**							
16				**Number of data**	**94**							
17				**Number of suspected outliers**	**1**							
18				**NDs replaced with half value.**								
19												
20				Potential	Obs.	Test	Critical	Critical				
21	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
22	1	2.449	3.185	26.7	37	7.615	3.362	3.732				
23												
24	For 5% Significance Level, there is 1 Potential Outlier											
25	Therefore, Observation 26.7 is a Potential Statistical Outlier											
26												
27	For 1% Significance Level, there is 1 Potential Outlier											
28												

Histogram for As
Reported values used for nondetects

As

Number of Values	94
Number of Detects	88
☐ Nondetect Limit	0.60
Minimum Detect	0.60
Maximum Detect	26.70
SD of Detects	3.26
Skewness of Detects	5.21
Kurtosis of Detects	34.97
☐ Mean of Detects	2.60
☐ Median of Detects	1.65
☐ Normal Distribution	

☐ Less Bins
☐ More Bins

	A	B
51	0.7	1
52	0.6	0
53	2.4	1
54	8.9	1
55	3.2	1
56	1.1	1
57	2.1	1
58	2.7	1
59	0.6	0
60	0.9	1
61	2.2	1
62	1.2	1
63	8.5	1
64	1.1	1
65	1.1	1
66	0.7	1
67	1.1	1
68	2.2	1
69	1.7	1
70	3	1
71	1.1	1
72	5.4	1
73	0.9	1
74	2.4	1
75	1.7	1
76	3.3	1
77	2.8	1
78	6.5	1
79	2.4	1
80	1.4	1
81	2.4	1
82	0.6	1
83	2.1	1
84	4.1	1
85	3.9	1
86	1.1	1
87	1.8	1
88	2.1	1
89	2.6	1
90	1	1
91	1.1	1
92	2.6	1
93	3.5	1
94	0.6	0
95	1.5	1

	A	B	C	D	E	F	G	H	I	J	K	L
1				**Background Statistics for Data Sets with Non-Detects**								
2		**User Selected Options**										
3		Date/Time of Computation		ProUCL 5.2 1/9/2025 3:36:50 PM								
4		From File		WorkSheet_a.xls								
5		Full Precision		OFF								
6		Confidence Coefficient		95%								
7		Coverage		95%								
8		Different or Future K Observations		1								
9		Number of Bootstrap Operations		2000								
10												
11	**As**											
12												
13						**General Statistics**							
14				Total Number of Observations		93			Number of Missing Observations			1
15				Number of Distinct Observations		38						
16				Number of Detects		87			Number of Non-Detects			6
17				Number of Distinct Detects		38			Number of Distinct Non-Detects			1
18				Minimum Detect		0.6			Minimum Non-Detect			0.6
19				Maximum Detect		11.7			Maximum Non-Detect			0.6
20				Variance Detected		3.907			Percent Non-Detects			6.452%
21				Mean Detected		2.318			SD Detected			1.977
22				Mean of Detected Logged Data		0.597			SD of Detected Logged Data			0.66
23												
24						**Critical Values for Background Threshold Values (BTVs)**							
25				Tolerance Factor K (For UTL)		1.935			d2max (for USL)			3.185
26												
27						**Normal GOF Test on Detects Only**							
28				Shapiro Wilk Test Statistic		0.73			**Normal GOF Test on Detected Observations Only**			
29				1% Shapiro Wilk P Value		0			Data Not Normal at 1% Significance Level			
30				Lilliefors Test Statistic		0.195			**Lilliefors GOF Test**			
31				1% Lilliefors Critical Value		0.11			Data Not Normal at 1% Significance Level			
32						**Data Not Normal at 1% Significance Level**							
33												
34						**Kaplan Meier (KM) Background Statistics Assuming Normal Distribution**							
35				KM Mean		2.208			KM SD			1.947
36				95% UTL95% Coverage		5.975			95% KM UPL (t)			5.46
37				90% KM Percentile (z)		4.703			95% KM Percentile (z)			5.41
38				99% KM Percentile (z)		6.737			95% KM USL			8.409
39												
40						**DL/2 Substitution Background Statistics Assuming Normal Distribution**							
41				Mean		2.188			SD			1.975
42				95% UTL95% Coverage		6.01			95% UPL (t)			5.488
43				90% Percentile (z)		4.719			95% Percentile (z)			5.437
44				99% Percentile (z)		6.783			95% USL			8.478
45						**DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons**							
46												
47						**Gamma GOF Tests on Detected Observations Only**							
48				A-D Test Statistic		2.468			**Anderson-Darling GOF Test**			
49				5% A-D Critical Value		0.763			Data Not Gamma Distributed at 5% Significance Level			
50				K-S Test Statistic		0.126			**Kolmogorov-Smirnov GOF**			
51				5% K-S Critical Value		0.097			Data Not Gamma Distributed at 5% Significance Level			
52						**Data Not Gamma Distributed at 5% Significance Level**							
53												
54						**Gamma Statistics on Detected Data Only**							
55				k hat (MLE)		2.204			k star (bias corrected MLE)			2.136
56				Theta hat (MLE)		1.052			Theta star (bias corrected MLE)			1.085
57				nu hat (MLE)		383.5			nu star (bias corrected)			371.6
58				MLE Mean (bias corrected)		2.318						
59				MLE Sd (bias corrected)		1.586			95% Percentile of Chisquare (2kstar)			9.925
60												
61						**Gamma ROS Statistics using Imputed Non-Detects**							
62						GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
63						GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)							
64						For such situations, GROS method may yield incorrect values of UCLs and BTVs							
65						This is especially true when the sample size is small.							

	A	B	C	D	E	F	G	H	I	J	K	L
66	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
67					Minimum	0.01					Mean	2.169
68					Maximum	11.7					Median	1.6
69					SD	1.994					CV	0.919
70					k hat (MLE)	1.112					k star (bias corrected MLE)	1.083
71					Theta hat (MLE)	1.951					Theta star (bias corrected MLE)	2.003
72					nu hat (MLE)	206.8					nu star (bias corrected)	201.5
73					MLE Mean (bias corrected)	2.169					MLE Sd (bias corrected)	2.085
74					95% Percentile of Chisquare (2kstar)	6.31					90% Percentile	4.898
75					95% Percentile	6.319					99% Percentile	9.599
76	**The following statistics are computed using Gamma ROS Statistics on Imputed Data**											
77	**Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods**											
78					WH	HW					WH	HW
79	95% Approx. Gamma UTL with 95% Coverage				7.182	8.065	95% Approx. Gamma UPL				6.104	6.689
80	95% Gamma USL				14.01	17.63						
81												
82	**Estimates of Gamma Parameters using KM Estimates**											
83					Mean (KM)	2.208					SD (KM)	1.947
84					Variance (KM)	3.791					SE of Mean (KM)	0.203
85					k hat (KM)	1.285					k star (KM)	1.251
86					nu hat (KM)	239.1					nu star (KM)	232.7
87					theta hat (KM)	1.718					theta star (KM)	1.765
88					80% gamma percentile (KM)	3.481					90% gamma percentile (KM)	4.81
89					95% gamma percentile (KM)	6.116					99% gamma percentile (KM)	9.101
90												
91	**The following statistics are computed using gamma distribution and KM estimates**											
92	**Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods**											
93					WH	HW					WH	HW
94	95% Approx. Gamma UTL with 95% Coverage				5.946	6.017	95% Approx. Gamma UPL				5.19	5.204
95	95% KM Gamma Percentile				5.121	5.13	95% Gamma USL				10.51	11.21
96												
97	**Lognormal GOF Test on Detected Observations Only**											
98				Shapiro Wilk Approximate Test Statistic		0.945	**Shapiro Wilk GOF Test**					
99				10% Shapiro Wilk P Value		0.00233	Data Not Lognormal at 10% Significance Level					
100				Lilliefors Test Statistic		0.115	**Lilliefors GOF Test**					
101				10% Lilliefors Critical Value		0.0871	Data Not Lognormal at 10% Significance Level					
102	**Data Not Lognormal at 10% Significance Level**											
103												
104	**Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects**											
105					Mean in Original Scale	2.194					Mean in Log Scale	0.497
106					SD in Original Scale	1.97					SD in Log Scale	0.746
107					95% UTL95% Coverage	6.958					95% BCA UTL95% Coverage	8.5
108					95% Bootstrap (%) UTL95% Coverage	8.5					95% UPL (t)	5.713
109					90% Percentile (z)	4.275					95% Percentile (z)	5.604
110					99% Percentile (z)	9.316					95% USL	17.67
111												
112	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
113					KM Mean of Logged Data	0.526					95% KM UTL (Lognormal)95% Coverage	6.431
114					KM SD of Logged Data	0.69					95% KM UPL (Lognormal)	5.358
115					95% KM Percentile Lognormal (z)	5.264					95% KM USL (Lognormal)	15.24
116												
117	**Background DL/2 Statistics Assuming Lognormal Distribution**											
118					Mean in Original Scale	2.188					Mean in Log Scale	0.481
119					SD in Original Scale	1.975					SD in Log Scale	0.778
120					95% UTL95% Coverage	7.283					95% UPL (t)	5.929
121					90% Percentile (z)	4.382					95% Percentile (z)	5.812
122					99% Percentile (z)	9.873					95% USL	19.24
123	**DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.**											
124												
125	**Nonparametric Distribution Free Background Statistics**											
126	**Data do not follow a Discernible Distribution**											
127												
128	**Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)**											
129					Order of Statistic, r	91					95% UTL with95% Coverage	8.9
130					Approx, f used to compute achieved CC	1.596	Approximate Actual Confidence Coefficient achieved by UTL					0.85

	A	B	C	D	E	F	G	H	I	J	K	L
131	Approximate Sample Size needed to achieve specified CC					93					95% UPL	6.68
132					95% USL	11.7					95% KM Chebyshev UPL	10.74
133												
134	Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.											
135	Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers											
136	and consists of observations collected from clean unimpacted locations.											
137	The use of USL tends to provide a balance between false positives and false negatives provided the data											
138	represents a background data set and when many onsite observations need to be compared with the BTV.											
139												

Appendix C:
Ecological Habitat Questionnaire

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

Ecological Habitat Questionnaire

Part 1: Key Questions

Please respond to the following questions regarding potential *habitats* at or near the site. Supporting documentation should be provided to validate the responses. (refer to the paragraph after the questions for details of acceptable forms of documentation). Definitions for all italicized terms can be found on page 5 of this questionnaire.

1.1 Are there undeveloped terrestrial areas on or adjacent to the site (excluding landscaped areas and agricultural lands under cultivation)?

☐ Yes (Provide information below) ☐ No

Please describe the area and if any wildlife has been observed there. Click or tap here to enter text.

1.1.1 If the site will be redeveloped, will these terrestrial areas remain?

☐ Yes ☐ No

1.2 Are there potential wetlands, marshes, swamps or *vernal pools* on or adjacent to the site (do not include constructed surface water run-off controls)?

☐ Yes (Provide information below) ☐ No

Please describe the area and if any wildlife has been observed there. Click or tap here to enter text.

1.3 Are there surface water bodies (e.g., rivers, *intermittent, ephemeral* and *perennial streams*, lakes, *seasonal ponds*; do not include constructed surface water run-off controls) on or adjacent to the site?

☐ Yes (Provide information below) ☐ No

Please describe the area and if any wildlife has been observed there. Click or tap here to enter text.

1.4 Are there off-site habitat*s* (e.g., terrestrial, wetland, aquatic) that are downstream, downwind, or downgradient, that could be affected by impacted media associated with a release from the site? This question does not apply to sites enrolled in the Georgia Brownfield Program.

☐ Yes ☐ No ☐ Not applicable (Brownfield site)

Please provide a description of the *habitat* and its distance from the facility boundary. Click or tap here to enter text.

1.5 Are there any planned future use(s) of the site, or current or future use(s) near the site, such as conservation areas or arboretums, etc., that would result in undeveloped terrestrial areas, wetlands, or aquatic *habitats*?

☐ Yes ☐ No

Sufficient information needs to be provided to the EPD to document site conditions in relation to these questions. If it can be documented that the answer to all of these questions is "no", then no further ecological assessment is warranted. Typical documentation includes the following:

- A current aerial photograph(s) showing 3 miles beyond the facility boundary. The map should illustrate site boundaries, known source areas, extent of contamination and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.).
- National Wetland Inventory map with an outline of the site boundaries, known source areas, extent of contamination, and potential migration pathways (e.g., drainage swales, stormwater discharge points, etc.).
- U.S. Fish & Wildlife Service (USFWS) Information for Planning and Consultation (IPaC)
- Site information from the Georgia Department of Natural Resources (GADNR) Biodiversity Portal

If the answer to any of the above questions is "yes", please complete the remainder of the questionnaire as instructed below.

Part 2: Harm to wildlife

2.1 Have there been any incidents where contaminants originating from the site evidently harmed wildlife?

☐ Yes ☐ No (Skip to Question 3.1 below)

Please describe the incident and what harm was caused to wildlife: Click or tap here to enter text.

2.1.1 Has the cause of such harm been eliminated?

☐ Yes (Briefly describe the actions taken below and complete the remainer of the questionnaire)

☐ No (Implement actions necessary to eliminate the harm. Please complete the remainer of the questionnaire.)

Actions Taken: Click or tap here to enter text.

Part 3:
Contamination associated with Potential Ecological *Habitats*

3.1 Have environmental media (e.g., soil, surface water, sediments, biota) associated with the ecological *habitat* been sampled and analyzed for site-related contaminants?

☐ Yes (Provide comments below and proceed to the next question)

☐ No (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination will or has impacted that *habitat*. Proceed to next question and also answer question 3.4. Submit questionnaire to EPD for verification.)

What media has been sampled? Click or tap here to enter text.

3.2 Have site-related releases been delineated, and has migration of contamination been controlled?

☐ Contamination has been delineated, but no measures to control migration are in place (Provide comment below and proceed to the next question. Actions to control migration of contamination could be necessary)

☐ Migration has been controlled and delineation is continuing (Provide comments below and proceed to next question. Complete delineation efforts.)

☐ Yes to both (Provide comment below and proceed to the next question)

☐ No (Provide comments below and take necessary actions to complete delineation and control migration.)

Information on delineation and migration control: Click or tap here to enter text.

3.3 Have any site-related contaminants been detected above EPD-approved background concentrations in environmental media collected from a terrestrial *habitat*?

☐ Yes (Provide additional information below including the contaminants and their respective, exceeding background value and proceed to the next question)

☐ No (Proceed to the next question. No further action is required for the terrestrial habitat)

☐ Site-related contaminants have been detected, but no background concentrations have been derived for comparison (Provide additional information below and proceed to the next question)

☐ Unknown (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination has impacted that *habitat*. Proceed to the next question.)

☐ N/A. No terrestrial habitat at site. (Proceed to the next question)

Comments: Click or tap here to enter text.

3.4 Are site-related contaminants currently or likely to migrate to aquatic *habitats*?

☐ Yes, an aquatic habitat has been impacted by site-related contaminants. (Provide information below and proceed to next question)

☐ Yes, likely (Provide information below. A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination will impact that *habitat*. Additional actions may be required to prevent migration to the aquatic habitat. Submit questionnaire to EPD for verification.)

☐ No. There is no complete migration pathway or discharge to the aquatic *habitat.* (Submit questionnaire to EPD for verification.)

☐ Unknown (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination could impact the *habitat*.)

☐ N/A. No aquatic *habitat* at site. (Submit questionnaire to EPD for verification)

Type of aquatic *habitat*: Click or tap here to enter text.

3.5 Have any site-related contaminants been detected above EPD-approved background concentrations in environmental media collected from a wetland or aquatic *habitat*?

☐ Yes (Proceed to the next question)

☐ No (Submit questionnaire to EPD for verification)

☐ Site-related contaminants have been detected, but no background concentrations have been derived for comparison (Proceed to next question)

☐ No background concentrations have been derived, and no site-related contaminants have been detected (Submit questionnaire to EPD for verification)

☐ Unknown (A workplan for sampling environmental media at the potential *habitat* may be required to determine if site-related contamination could impact the *habitat*.)

3.6 Is the site contamination causing exceedances of the Georgia Instream Water Quality Standards established for the protection of aquatic life?

☐ Yes (Provide information below regarding the location, contaminant and concentration of exceedances. Implement actions necessary to eliminate the discharge of contamination to the surface water body. Additional information/samples may need to be collected to evaluate risks to aquatic life.)

☐ No, but the potential for site-related contaminant migration to a surface water body exists. (Provide information regarding the potential for contaminant migration to the surface water below)

☐ No, contaminants have been detected, but those contaminants do not have Georgia Instream Water Quality Standards. (Provide information regarding the contaminants that have been detected below)

☐ No, contaminants have been detected, but not above Georgia Instream Water Quality Standards. (Provide information regarding the contaminants that have been detected below)

☐ Unknown (A workplan for sampling environmental media at the potential habitat may be required to determine if site-related contamination could impact or has impacted the habitat.)

Comments: Click or tap here to enter text.

Please submit questionnaire to your EPD for verification. Thank you.

Glossary:

- "*Habitat*": a place where an ecological receptor resides or forages. Per USEPA Region 5, habitat is defined as "the place where a population of plants or animals and its surroundings are located, including both living and non-living components."
- "Intermittent streams": streams that flow during certain times of the year when smaller upstream waters are flowing and when groundwater provides enough water for stream flow.
- "Vernal pools" or "seasonal pond": seasonally flooded depressional wetlands that hold water during portions of the year but not for the entire year, which also include ephemeral ponds which hold water in direct response to precipitation.
- "Ephemeral Stream": a stream that typically has no well-defined channel, and which flows only in direct response to precipitation with runoff. (O.C.G.A. 12-7-6(b)(15))
- "Intermittent Stream": a stream that flows in a well-defined channel during wet seasons of the year but not for the entire year.
- "Perennial Stream": a stream that flows in a well-defined channel throughout most of the year under normal climatic conditions.

Appendix D:

Screening Level Ecological Risk Assessment (SLERA) and Refinement Screening Worksheets

Screening Level Ecological Risk Assessment (SLERA): Step 2 -- Screening-Level Preliminary Exposure Estimate and Risk

Refer to Table 3 of the EPA Region 4 Ecological Risk Assessment Supplemental Guidance for help filling out this table.
To determine the Hazard Quotient (HQ), divide the maximum detected concentration (MDC) by the EPA Region 4 Ecological Screening Value (ESV).
The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

Key:
MDC > ESV: Maximum Detected Concentration is greater than the Ecological Screening Value
MDC < ESV: Maximum Detected Concentration is less than the Ecological Screening Value
MaxMDL > ESV: Maximum Method Detection Limit is greater than the Ecological Screening Value
MaxMDL < ESV: Maximum Method Detection Limit is less than the Ecological Screening Value
Detected, is bioaccumualtive, and does not have wildlife ESV
Detected and no ESV: The contaminant was detected by the laboratory, but there is no Ecological Screening Value to compare its concentration to (not all contaminants have ESVs)
Lacks EPA R4 ESV and was not detected in any sample
Chemical is a member of a class of compounds and total concentration is screening against the screening values for that class

Soil Screening

Units:	mg/kg

CAS Number	Constituent	Frequency of Detection	Minimum - Maximum Method Detection Limit (MinMDL - MaxMDL)	1/2 MaxMDL	Minimum - Maximum Detected Concentration (MinDC - MaxDC)	Location(s) of MDC	Concentration used for Screening	EPA R4 Ecological Screening Value (ESV; mg/kg)	Hazard Quotient (HQ)	Frequency of ESV Exceedances	Bioaccumulative?	Contaminant of Potential Concern (PCoPEC; Y/N)	Basis	Notes
7440-38-2	Arsenic	2/30	0.0012 - 0.0012	0.0006	2.37 - 27.37	C-8	27.37	18	2.000	1/30	N	Y	MDC > ESV	
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Screening Level Ecological Risk Assessment (SLERA): Step 2 -- Screening-Level Preliminary Exposure Estimate and Risk

Refer to Tables 1a-e of the EPA Region 4 Ecological Risk Assessment Supplemental Guidance for help filling out this table.
To determine the Hazard Quotient (HQ), divide the maximum detected concentration (MDC) by the EPA Region 4 Ecological Screening Value (ESV).
The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

Key:
MDC > ESV: Maximum Detected Concentration is greater than the Ecological Screening Value
MDC < ESV: Maximum Detected Concentration is less than the Ecological Screening Value
MaxMDL > ESV: Maximum Method Detection Limit is greater than the Ecological Screening Value
MaxMDL < ESV: Maximum Method Detection Limit is less than the Ecological Screening Value
Detected, is bioaccumualtive, and does not have wildlife ESV
Detected and no ESV: The contaminant was detected by the laboratory, but there is no Ecological Screening Value to compare its concentration to (not all contaminants have ESVs)
Lacks EPA R4 ESV and was not detected in any sample
Chemical is a member of a class of compounds and total concentration is screening against the screening values for that class
*Provide source for any supplemental screening levels in a separate table

Surface Water Screening

Units: ug/L

CAS Number	Constituent	Freshwater or Marine/Estuarine	Frequency of Detection	Minimum - Maximum Method Detection Limit (MinMDL - MaxMDL)	1/2 MaxMDL	Minimum - Maximum Detected Concentration (MinDC - MaxDC)	Location(s) of MaxDC	Concentration used for Screening	Georgia Instream Water Quality Standard (GIWQC)	GIWQC Hazard Quotient	EPA Region 4 Ecological Screening Value (ESV)	ESV Hazard Quotient	Bioaccumulative ?	Contaminant of Potential Concern (PCOPEC; Y/N)	Basis	Notes
7440-38-2	Arsenic	Freshwater	8/30	0.112- 0.118	0.059	0.00188 - 0.208	A-2	0.208	150	0.00	150	0.0	N	N	MDC < ESV	
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Screening Level Ecological Risk Assessment (SLERA): Step 2 -- Screening-Level Preliminary Exposure Estimate and Risk

Refer to Tables 2a-c of the EPA Region 4 Ecological Risk Assessment Supplemental Guidance for help filling out this table.
To determine the Hazard Quotient (HQ), divide the maximum detected concentration (MDC) by the EPA Region 4 Ecological Screening Value (ESV).
The first row (highlighted in grey) is an example. Please delete it before submitting your table to EPD.

Key:
MDC > ESV: Maximum Detected Concentration is greater than the Ecological Screening Value
MDC < ESV: Maximum Detected Concentration is less than the Ecological Screening Value
MaxMDL > ESV: Maximum Method Detection Limit is greater than the Ecological Screening Value
MaxMDL < ESV: Maximum Method Detection Limit is less than the Ecological Screening Value
Detected, is bioaccumualtive, and does not have wildlife ESV
Detected and no ESV: The contaminant was detected by the laboratory, but there is no Ecological Screening Value to compare its concentration to (not all contaminants have ESVs)
Lacks EPA R4 ESV and was not detected in any sample
Chemical is a member of a class of compounds and total concentration is screening against the screening values for that class

Sediment Screening

Units:	mg/kg

CAS Number	Constituent	Freshwater or Marine/Estuarine	Frequency of Detection	Minimum- Maximum Method Detection Limit (MinMDL - MaxMDL)	1/2 MaxMDL	Minimum - Maximum Detected Concentration (MinDC - MaxDC)	Location(s) of MaxDC	Concentration used for Screening	EPA Region 4 Ecological Screening Value (ESV)	Hazard Quotient (HQ)	Frequency of ESV Exceedances	Bioaccumulative?	Contaminant of Potential Concern (PCoPEC; Y/N)	Basis	Notes
7440-38-2	Arsenic	Freshwater	3/30	0.0072 - 0.0072		0.083 - 10.47	B-27	10.47	9.8	1.00	1/30	N	Y	MDC > ESV	
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Step 3a COPC Refinement Table - Soil

Refer to Section 8.2, "Baseline Problem Formulation - Refinement of Preliminary Chemicals of Potential Ecological Concern", of EPD's Georgia Risk Assessment Guidance

The first two rows row (highlighted in gray) are examples. Please delete them before submitting your table to EPD.

Units	(Select one)

Constituents	CAS #	Frequency of Detection	Maximum Detected Concentration (MDC)	1/2 Method Detection Limit for non-detected constituents	Background Screening Value (BSV)	Frequency Exceeding BSV	Refinement Screening Value (RSV)	Frequency Exceeding RSV	RSV Source	Refinement Hazard Quotient	95% UCL	95% UCL Hazard Quotient	Refined PCOPEC?	Basis	Notes
1,2-Dichlorobenzene	95-50-1	2/10	100		NA	NA	920	0/10	R4 Mammalian	0.1	60	0.07	No	95% UCL hazard quotient was less than 1 and concentration was less than background screening value.	
Copper	7440-50-8	9/10	180		13	1/10	70	0/10	R4 Mammalian	3.0	140	2	Yes	Chemical was frequently detected and 95% UCL HQ was greater than 1.	
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Step 3a COPC Refinement Table - Sediment

Refer to Section 8.2, "Baseline Problem Formulation - Refinement of Preliminary Chemicals of Potential Ecological Concern", of EPD's Georgia Risk Assessment Guidance

Units	(Select one)

Constituents	CAS #	Frequency of Detection	Maximum Detected Concentration (MDC)	1/2 Method Detection Limit for non-detected constituents	Background Screening Value (BSV)	Frequency Exceeding BSV	Refinement Screening Value (RSV)	Frequency Exceeding RSV	RSV Source	Refinement Hazard Quotient	95% UCL	95% UCL Hazard Quotient	Refined PCOPEC?	Basis	Notes
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Step 3a COPC Refinement Table - Surface Water

Refer to Section 8.2, "Baseline Problem Formulation - Refinement of Preliminary Chemicals of Potential Ecological Concern", of EPD's Georgia Risk Assessment Guidance

Units	(Select one)

Constituents	CAS #	Frequency of Detection	Maximum Detected Concentration (MDC)	1/2 Method Detection Limit for non-detected constituents	Background Screening Value (BSV)	Frequency Exceeding BSV	Georgia Instream Water Quality Criteria (GIWQC)	Frequency Exceeding GIWQC	Refinement Screening Value (RSV)	Frequency Exceeding RSV	Refinement Hazard Quotient	95% UCL	95% UCL Hazard Quotient	Refined PCOPEC?	**Basis**	Notes
											#DIV/0!		#DIV/0!	(Select one)	(Select one)	
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