Prepared for:

ARMSTRONG WORLD INDUSTRIES SUPERFUND SITE
Operable Unit 2
Macon, GA
Docket Number: CERCLA-04-2018-3759

FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN OPERABLE UNIT 2 Revision 1

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August 2019

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Acronyms and Abbreviations

1,1-DCE	1,1-dichloroethene
1,3-DNB	1,3-dinitrobenzene
2,4-DNT	2,4-dinitrotoluene
AIP	Allied Industrial Park
Allied	Allied Chemical Corporation
AMSL	Above Mean Sea Level
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
AWI	Armstrong World Industries
BEHP	bis(2-ethylhexyl)phthalate
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
cis-DCE	cis-1,2-dichloroethene
Cfs	Cubic Feet per Second
COPC	Constituents of Potential Concern
CSM	Conceptual Site Model
CT	Carbon Tetrachloride
DDD	4,4-Dichlorodiphenyldichloroethane
DDE	4,4’- Dichlorodiphenyldichloroethylene
DDT	4,4’-Dichlorodiphenyltrichloroethane
DNR	Georgia Department of Natural Resources
DNT	Dinitrotoluene
DQO	Data Quality Objectives
DU	Decision Unit
EDR	Environmental Data Resources, Inc.
ELCR	Excess Lifetime Cancer Risk
EPA	United States Environmental Protection Agency
EPD	Georgia Environmental Protection Division
EPS	Environmental Planning Specialists, Inc.
ESE	Environmental Science and Engineering, Inc.
ESI	Expanded Site Inspection
FMNOL	Former Macon Naval Ordnance Plant Landfill
FS	Feasibility Study
FSP	Field Sampling Plan
GRA	General Response Actions
HASP	Health and Safety Plan
HMWPAH	High Molecular Weight PAH
HQ	Hazard Quotient
HSRA	Hazardous Site Response Act
ISM	Incremental Sampling Methodology
ITRC	Interstate Technology Regulatory Council

ISWQS	InStream Water Quality Standard
Landfill Area	Remote Landfill, FMNOL, Explosives Demolition Area
MBCIA	Macon Bibb County Industrial Authority
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/kg	milligram per kilogram
MNOP	Macon Naval Ordnance Plant
MWA	Macon Water Authority
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU1	Operable Unit – 1
OU2	Operable Unit – 2
PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PETN	Pentaerythritol tetranitrate
PFAC	Polyfluoroalkyl Substances
PRP	Potential Responsible Party
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
RAA	Remedial Action Alternatives
RI	Remedial Investigation
RQSM	Reportable Quantities Screening Method
RI/FS	Remedial Investigation / Feasibility Study
RSL	EPA Regional Screening Level
RSV	Refined Ecological Screening Value
RUST	Rust Environment and Infrastructure Inc.
SAIC	Science Applications International Corporation
Site	OU-2
SLERA	Screening Level Ecological Risk Assessment
SMCL	Secondary Maximum Contaminant Level
SOW	Statement of Work
SU	Sampling Unit
SVOC	Semi-volatile Organic Compounds
TAL	Target Analyte List
TAP	Technical Assistance Plan
TCE	Trichloroethene
TCL	Target Compound List
TOC	Total Organic Carbon
U.S.	United States
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VC	Vinyl Chloride

VOC	Volatile Organic Compounds
VSQG	Very Small Quantity Generator
Westinghouse	Westinghouse Environmental and Geotechnical Services, Inc.
Work Plan	RI/FS Work Plan
WWTP	Wastewater Treatment Plant

1 INTRODUCTION

1.1 Purpose of Report

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan) is submitted on behalf of the Respondents[1] in satisfaction of the RI/FS Work Plan requirement under paragraph 45 of the United States Environmental Protection Agency (EPA) Region 4 Administrative Settlement Agreement and Order on Consent (AOC) for Remedial Investigation/Feasibility Study, U.S. EPA Region 4, Docket No. CERCLA-04-2018-3759: Armstrong World Industries (AWI) Superfund Site, Operable Unit 2 (OU2), Macon, Macon-Bibb County, Georgia (the Site).

1.2 Project Objective

1.2.1 Problem Statement and Purpose of RI/FS

Historical data collected indicate that environmental conditions at the Site have been impacted by the presence of historic landfills on the Site, as well as potential impacts from upgradient and/or offsite sources. As much of the Site is a bottom land area prone to flooding, the transport mechanisms across and through the Site are complicated. A fish advisory[2] is in place for Rocky Creek and is based on the presence of polychlorinated biphenyls (PCBs) in fish tissue collected from Rocky Creek in 1996 and 1998, about 20+ years ago. The purpose of the RI/FS process is to characterize the nature and extent of contamination, potential risks, and to evaluate potential remedial options (EPA, 1988).

1.2.2 Overall Process

Per the Statement of Work (SOW) for the RI/FS, the major tasks that are part of this RI/FS include:

Task 1: Project Scoping and RI/FS Planning Documents
Task 2: Site Characterization and RI Report
Task 3: Baseline Risk Assessment
Task 4: Treatability Studies (if required)
Task 5: Develop and Screen Remedial Action Alternatives
Task 6: Detailed Analysis of Alternatives and Feasibility Study Report
Task 7: Community Involvement and Technical Assistance Plan
Task 8: Progress Reports

[1] Those parties listed in Appendix C of the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study, U.S. EPA Region 4, Docket No. CERCLA-04-2018-3759.

[2] Since 2011 the EPA has advised the public not to consume any fish from Rocky Creek. Macon-Bibb County has posted signs advising anglers that the fish in Rocky Creek contain PCBs.

The major elements of the overall RI/FS process include the following:

- Remedial Investigation (RI) – field investigation(s) to gather data to evaluate the nature and extent of contamination and to refine understanding of the fate and transport of these constituents at the Site;
- Risk Evaluation – uses the data collected from the RI to evaluate risk to human and ecological receptors as part of a Human Health Risk Assessment and Ecological Risk Assessment; and
- Feasibility Study (FS) – identifies remedial alternatives and evaluates whether they will meet remedial goals and are technically feasible.

1.2.3 Preliminary RI/FS Objectives

The preliminary objectives of the RI/FS process as specified in the SOW are outlined below; these objectives may change throughout the study:

1. Collect sufficient environmental data to support the baseline risk assessment and selection of a remedy;
2. For each known or potential contaminant source area, determine whether a release to the environment of hazardous substances, pollutants or contaminants has occurred, as defined by the National Contingency Plan (NCP), and determine the nature and extent of contamination associated with any such releases;
3. Based on operational history, disposal history, spill records, observation, sampling results, or other means of detection, identify all additional releases or threatened releases of hazardous substances, pollutants or contaminants to the environment;
4. Determine the nature and spatial extent of contamination in all media;
5. Identify active releases and imminent releases of hazardous substances which may warrant Removal Actions;
6. Identify opportunities for source control measures, early remedial actions, and removal actions;
7. Identify all Federal and State applicable or relevant and appropriate requirements (ARARs).
8. Identify human and ecological receptors for all media. Conduct a well survey, a surface water use survey and delineate wetlands;
9. Refine the Remedial Action Objectives;
10. Identify and screen potential treatment technologies along with containment and disposal requirements for residual or untreated impacted media;
11. Develop a full range of Remedial Action Alternatives and screen alternatives;
12. Conduct bench or pilot Treatability Studies, as necessary, to support evaluation of remedial alternatives; and
13. Provide detailed analysis and comparison of Remedial Action Alternatives.

1.2.4 Work Plan Goal and Objectives

The goal of this Work Plan is to provide an approach for investigating the nature and extent of contamination at the Site. The information obtained from implementation of this Work Plan, along

with some of the historical data for the Site will be used to assess the potential risk to human health and the environment, which in turn will be used to develop and evaluate potential remedial alternatives, as necessary.

The following tasks have been considered and/or implemented in development of this Work Plan:

- Conducted multiple site visits, including one with EPA and Georgia Environmental Protection Division (EPD) personnel (incorporated into Section 2 and Section 5.3);
- Compiled and evaluated historical information and data for the Site (see Section 3);
- Identified and evaluated Constituents of Potential Concern (COPCs) from both a human health and ecological risk perspective (*i.e.*, risk screening, see Section 4.1);
- Developed a preliminary Conceptual Site Model (CSM) including evaluating fate and transport mechanisms and nature and extent of COPCs (see Section 5 and 6);
- Identified data gaps associated with the existing information (see Section 7);
- Based on the data gap analysis, developed a sampling strategy for the collection of data necessary to fill those data gaps and focus on potential risks (see Section 8); and
- Identified preliminary remedial action alternatives and treatability study needs (see Section 9).

1.3 Quality Assurance Project Plan, Field Sampling Plan and Health and Safety Plan

Additional related documents are being submitted concurrently with this Work Plan:

- Quality Assurance Project Plan (QAPP), which outlines the procedures for collecting, analyzing and managing data collected during the RI/FS process and provides Data Quality Objectives (DQOs);
- Field Sampling Plan (FSP), which provides detailed information on how environmental data (*e.g.*, soil, sediment, fish tissue samples) will be collected; and
- Site Health and Safety Plan (HASP), which identifies likely hazards at the Site and outlines safety measures and procedures to mitigate the hazards during on-Site work.

1.4 Site Management Strategy

As specified in the SOW, the site management strategy is as follows:

a. A complete investigation of the Site including any and all off-site areas where hazardous substances, pollutants or contaminants from the Site have, may have, or will come to be located;

b. Identification of other Potentially Responsible Parties (PRP), if applicable;

c. EPA oversight, in consultation with the EPD, of the Respondents' conduct of the work (*i.e.,* the RI/FS and any response action) to ensure compliance with applicable laws, regulations and guidance and to ensure that the work proceeds in a timely fashion;

d. Preparation of the Baseline Risk Assessment by Respondents; and

e. EPA management of the Remedy Selection and Record of Decision phase with input from state agencies, Natural Resource Trustees and the public (including the Respondents).

1.5 Preliminary Objectives for Remedial Action

The preliminary objectives for remedial action as specified in the SOW are as follows and may be adjusted throughout the RI/FS process:

- Return the groundwater to its beneficial uses, wherever practicable, within a reasonable time frame, except where beneficial uses are restricted by means acceptable to EPA;
- To the extent attributable to the Site, return the surface water, surface water sediments, and associated wetlands to their beneficial use, including ecological uses;
- Prevent exposure to contaminated groundwater, surface water, soils, subsurface soil, and sediments above acceptable human health and ecological risk levels;
- Eliminate or otherwise control sources of contamination at or from the Site;
- Prevent or minimize further migration of contaminants in all media;
- Treat or eliminate media contaminated with high levels of hazardous substances, pollutants, or contaminants; and
- Mitigate or abate, not inconsistent with the NCP, other situations or factors that may pose a threat to public health, welfare, or the environment.

1.6 EPA and EPD Comments on Draft Work Plan

A draft version of this Work Plan and the related documents (QAPP, FSP, and HASP) were submitted to the EPA and EPD on April 30, 2019. EPA and EPD provided comments on these documents. The comments and responses from the Respondents are included in Appendix 0. This version of the Work Plan incorporates the changes referred to in the responses.

2 SITE BACKGROUND

2.1 Site Description

The Site is in an industrial area located on the southern side of Macon, Georgia in Macon-Bibb County (Figure 1). As depicted on Figure 1, the Site includes the AWI Remote Landfill, the former Macon Naval Ordnance Plant landfill (FMNOL), the drainage ditches to and from these landfills, and affected sediments and biota in and around Rocky Creek. There are no exact boundaries for the Site; accordingly, the figures show an *approximate* outline of OU2. There are two other related, but separate sites neighboring the Site (OU2): the AWI Facility (located northwest of the Site) and directly north of the Site is the former Macon Naval Ordnance Plant (MNOP), which is now called the Allied Industrial Park (AIP).

The Site is bounded to the east and west by railroad tracks. Rocky Creek flows through the southern portion of the Site. The property to the north was part of what was formerly called the MNOP and is currently occupied by AIP. The AWI Facility is located northwest of the Site. The area of the Site is approximately 350 acres. Macon Water Authority's Rocky Creek Water Reclamation Facility is in the northeast portion of the Site. Graphic Packaging International is located off-Site further to the east. The initial footprint of the Remote Landfill is located on a parcel owned by AWI. The initial footprint of the FMNOL is located on a parcel currently owned by Macon Water Authority (MWA). The aerial photography review indicates that the footprints of each landfill merged in select areas. As such, the exact borders of each landfill are unknown. Other parcels on the Site to the north and east of the landfills are owned by Macon-Bibb County Industrial Authority (MBCIA) and MWA. The relevant site features, parcel owners, and neighboring properties are shown in Figure 2.

Analysis of aerial photographs (Appendix A) show that the FMNOL first appears in an aerial from 1951 and starts growing between 1954 and 1955. The Remote Landfill starts at some time between 1955 and 1958. Aerial photographs show that the Remote Landfill and FMNOL may have overlapped along their shared boundary over time. The two landfills grow together between 1972 and 1975 and were later covered with two feet of soil in 1977. Just southeast of the FMNOL is an area called the Explosives Demolition Area. An area historically designated as the "Drum Storage Area" by the Army Corps of Engineers was located southwest of the FMNOL landfill (see Figure 4). Collectively, these areas are referred to as the "Landfill Area" in this Work Plan.

2.2 Site and Regulatory History

2.2.1 Regulatory History and Past Disposal Practices

2.2.1.1 AWI Facility and Remote Landfill

AWI owns two neighboring parcels. The northern parcel is an operating facility, referred to herein as the AWI Facility (which contains Operable Unit 1, OU1). The AWI Facility is not part of OU2. The southern parcel, which is part of OU2, is directly southeast of the AWI Facility and contains the Remote Landfill. The property where the Remote Landfill is located has been owned by AWI since 1959. The AWI Facility (see Figure 2) is made up of the manufacturing operation, a wastewater treatment plant (WWTP), a landfill referred to as the Woodyard Landfill (approximately 3.8 acres) and the WWTP Landfill (OU1), which is approximately 4 acres. The AWI Facility has operated an acoustic ceiling tile manufacturing facility at the site since 1948. AWI began disposing of general and industrial trash, old equipment, and excess bark and scrap wood in the AWI Remote Landfill in the 1960s (EPD, 2007b), although aerial photographs indicate disturbance in this area some time after 1955 and before 1958.

The general manufacturing process revolves around the formation of fiber board. In late 1971, AWI outfitted its WWTP with two large coil filters that removed excess fiber from the WWTP influent. The fibrous material removed by the coil filters was subsequently disposed of in either the Remote Landfill or in the WWTP Landfill. Historically, waste material from the manufacturing process included extraneous raw materials, fluff and waste from the fabrication (cutting/forming) process, excess fibrous material from the WWTP coil filters, and WWTP sludge. This material has historically been sent to one of three waste disposal areas located on the AWI property: the Remote Landfill, the WWTP Landfill, or the Woodyard Landfill. AWI ceased disposing of sludge material in the Remote Landfill in 1977, at which time two feet of soil was placed on top of both the Remote and FMNOL landfills at the request of EPD (EPD, 2007b).

On November 19, 1980, AWI notified the EPD that it was a generator of hazardous waste. In 1996, AWI submitted a release notification form to the GAEPD Hazardous Site Response Program reporting the presence of PCBs in waste sludge disposed of in the WWTP Landfill and in the Remote Landfill (EPD, 2004). In July 1996, the GAEPD used its Reportable Quantities Screening Method (RQSM) and advised AWI that insufficient evidence of a reportable release of a regulated substance had occurred. Consequently, the site was not listed on GAEPD's Hazardous Site Inventory. The Woodyard Landfill was officially closed in 2004 following the implementation of an EPD-approved closure plan (AWI, 2006; AWI, 2009).

The AWI Facility was placed on the National Priorities List (NPL) in September 2011, based on the presence of PCBs and metals (EPA, 2011). AWI proposed, even before the listing was finalized, to perform a non-time critical removal action on the WWTP Landfill, which then became known as OU1. After performing an Engineering Evaluation/Cost Analysis, AWI performed a removal action, expected to be the final remedy for the WWTP, which included capping the entire landfill and other improvements. AWI's Remote Landfill is part of OU2.

The AWI Facility also operates under a National Pollutant Discharge Elimination System (NPDES) permit, for its wastewater treatment system. The AWI Facility outfall discharges to an on-site drainage easement (referred to as Ditch 1 in this Work Plan) that joins with Ditch 2 (originating on AIP property), which then leads to Rocky Creek. This drainage easement was created in 1959 to carry stormwater and process wastewater from the AWI plant area, and includes the portion of Ditch 2 running from its confluence with Ditch 1 southward around the Remote Landfill and FMNOL to Rocky Creek.

2.2.1.2 FMNOL

The FMNOL is located on a property formerly owned by the City of Macon. The FMNOL was first used as a landfill by the Reynolds Corporation in the early 1940s under contract with and on behalf of the U.S. Navy in connection with operations at MNOP. From 1941 to November 1945, Reynolds Corporation was engaged in producing munitions at MNOP under contract with and on behalf of the U.S. Navy. The Navy continued to use the FMNOL after it assumed operations in November 1945. Ordnance manufactured at the MNOP included flares, small primers, detonators, and other triggering mechanisms. The FMNOL was acquired in 1960 by the Navy from the City of Macon. In 1965, the Navy sold the MNOP property (including the FMNOL) to Maxson Electronics Company. Maxson Electronics Company (later merged into Riker-Maxson Corp.) continued to produce ordnance at the MNOP under contract with the Navy until 1973 when it sold the property (MNOP including the FMNOL) to Allied Chemical Corporation (Allied), which manufactured automobile seat belts at the MNOP. In 1980, the MNOP property (including the FMNOL) was sold by Allied Chemical Corp. to the Macon-Bibb County Industrial Authority (MBCIA). In 1989, the MBCIA conveyed the FMNOL (the southern portion of the MNOP property) to the Macon-Bibb County Water & Sewerage Authority, currently called the Macon Water Authority (MWA).

After 1965, the FMNOL was primarily used by Maxson and later by Allied Chemical from 1973 to 1977 for general solid waste disposal. Throughout the operation of the MNOP site (1941-1973, the FMNOL was reportedly used for disposal of solid wastes and ordnance. Through 1988 the FMNOL was also used for disposal of used parts and construction debris. Structures/features associated with the FMNOL (Figure 4) consist of the landfill itself, an explosives demolition area, a suspected cyanide contaminated box or tank, a drum storage area, and a ponded area (MWA, 1994). One ponded area exists between the FMNOL and Remote Landfill just north of where the two landfill footprints merged. A second ponded area is located between the FMNOL and Remote Landfill south of where the two landfill footprints merged. The size of the ponds have changed over time and the exact location of these ponds with regard to property boundaries is not known; however, both ponded areas appear to border both landfills based upon known land features.

The U.S. Army Corps of Engineers (USACE), who is responsible for investigating all former Department of Defense sites, conducted several investigations in the 1990s, including evaluation of potential remedial alternatives. USACE investigated the presence of the suspected cyanide contaminated tank in 1989 (ESE, 1990). USACE excavated the object and discovered it to be a large steel box containing non-native soil that had apparently been cleaned prior to disposal (ESE,

1990). After inspecting the box, USACE filled it and covered it with existing excavated materials (ESE, 1990).

2.2.1.3 Explosives Demolition Area

A fenced explosives demolition area, located near the southeastern toe of the FMNOL, was used for testing and demolishing explosives, primarily detonators, flares, and primers manufactured at the MNOP (ESE, 1990). Flammable materials were reportedly burned in this area as well.

2.2.2 Previous Response Actions

2.2.2.1 Historical Drum Removal

In September 1989, USACE observed approximately 500 deteriorated, unlabeled drums west and southwest of the FMNOL in a pond occupying a low-lying area that contained reddish-orange water (of unknown cause) (ESE, 1990). Subsequently the USACE removed an unknown number of these drums. Many of these drums were allegedly removed by the USACE, but documentation has not yet been found to substantiate this. Available file information does not indicate the contents of the drums, if any. In 2007, EPD personnel observed deteriorated drums (number observed not specified) at the FMNOL. However, it is not known whether these are the same drums that were observed in 1989.

2.2.2.2 Public Health Assessment

The Georgia Division of Public Health issued a Public Health Assessment for the AWI OU1, Remote Landfill and FMNOL in 2012 (ATSDR, 2012). The conclusions from the assessment are:

1. Fish tissue from fish caught in Rocky Creek south and southeast of the AWI site contain PCBs at levels that could harm human health;
2. People who eat fish caught in Rocky Creek south and southeast of the AWI site have an increased risk of cancer; and
3. Human exposure to soil in the Landfill Area and sediment and surface water in the ditches is not hazardous.

A sign stating “PCB’s Present, Fish at Your Own Risk” was placed near the Houston Road bridge over Rocky Creek (Figure 2).

2.3 Previous Investigation Activities

2.3.1 Introduction

Potential on-Site sources include the Remote Landfill, FMNOL, and explosives demolition area. Potential current and/or historical off-site sources include the AWI WWTP Landfill (OU1), and drainages from the AWI Facility and MNOP/AIP site, as well as other possible sources upgradient of AWI/MNOP and/or upstream areas of Rocky Creek. As part of RI/FS process these other potential sources will continue to be evaluated. No engineered run-on/run-off control systems or

liners have been constructed for the Landfill Area, and the total amount of wastes disposed is unknown. A summary of past investigation activities for the Site and other nearby areas is provided below. On-Site data obtained during these previous activities have been summarized and evaluated as part of the COPC analysis described in Section 4 below.

2.3.2 1989, 1990, and 1991 MNOP Investigations

In 1989, an environmental assessment was conducted by Beaver Engineering at the former MNOP site. Four eight-point composite soil samples were collected from the former MNOP site. Analytical results revealed the presence of various metals, methylene chloride, bis-(2-ethylhexyl)-phthalate, and chloroform.

In 1990, Environmental Science and Engineering, Inc. (ESE) advanced two shallow boreholes in a flat drainage area that was used for oil recovery during MNOP operations. Analytical results for soil samples revealed the presence of arsenic, cadmium, chromium, lead, pentaerythritol tetranitrate (PETN), and petroleum hydrocarbons. PETN is an explosive most commonly used in detonating fuses, boosters, priming compositions, blasting caps, and detonators.

In 1991, Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse), conducted a preliminary environmental investigation at the former MNOP site. During the investigation, Westinghouse collected four groundwater samples near storm water drainage outfalls on the former MNOP site. Analytical results revealed the presence of chromium, lead, and trichloroethene (TCE). PCBs were not analyzed during these investigations.

2.3.3 1992 AWI Sampling

In 1992, AWI collected two waste samples from old, stockpiled WWTP sludge and from fresh WWTP sludge. The samples were analyzed for metals and PCBs, among other constituents. The sludge samples contained chromium, copper, and zinc. PCBs were not detected.

2.3.4 1996 RUST Site Investigation

In 1996, Rust Environment and Infrastructure Inc. (RUST), on behalf of USACE, Savannah District, conducted a site investigation at the FMNOL and the results were presented in a Final Investigation Report (RUST, 1997). Soil, groundwater, surface water, sediment, and biota samples were collected during the investigation. Monitoring wells were also installed and sampled. Analysis of soil samples collected from the FMNOL indicated the presence of heavy metals and PCBs in soil. Analysis of groundwater samples collected from monitoring wells located in the vicinity of the Landfill Area indicated the presence of TCE, cis-1,2-dichloroethene (cis-DCE), and vinyl chloride (VC). Low levels of heavy metals were also detected in groundwater samples.

Surface water and sediment samples were collected from the AWI Ditch 1/Ditch 2 drainage easement as well as from Rocky Creek itself. Analytical results for surface water samples collected from this drainage easement contained lead, zinc, cis-DCE, and TCE. Analytical results for

sediment samples collected from the drainage easement contained cadmium, chromium, lead, mercury, cis-DCE, TCE, VC, and benzo(a)pyrene.

Analytical results for the surface water samples collected from Rocky Creek downstream of the FMNOL and the Remote Landfill did not indicate the presence of heavy metals, volatile organic compounds (VOCs), or semi-volatile organic compounds (SVOCs). Analytical results for sediment samples collected from Rocky Creek downstream of the FMNOL and Remote Landfill contained cadmium, chromium, lead, and benzo(a)pyrene. Fish tissue samples were also collected during the site investigation from several species caught from Rocky Creek at locations upstream and downstream of the Landfill Area. Analytical results for the fish tissue samples indicated the presence of barium, selenium, and total petroleum hydrocarbons. In addition, Aroclor-1254 (a form of PCB) was detected in all the fish tissue analyzed.

2.3.5 1996 AWI Sampling

In 1996, AWI collected three composite sludge samples from excavated test pits in the WWTP Landfill. The results were presented in a Supplemental Release Notification (AWI, 1998). PCBs were detected at concentrations of 1.36 mg/kg and 9.31 mg/kg in two of the composite sludge samples collected from the WWTP Landfill. One of the samples contained PCBs at a level above the EPD Hazardous Site Response Act (HSRA) notification concentration of 1.55 mg/kg for PCBs. The sludge samples collected from the WWTP Landfill also contained chromium, copper, lead, nickel, and zinc; however, the metals concentrations were below the HSRA notification concentrations. AWI also collected four composite sludge samples from excavated test pits in the Woodyard Landfill. Analytical results revealed the presence of chromium, copper, lead, and zinc. PCBs were not detected in the sludge samples collected from the Woodyard Landfill.

Also, in 1996, AWI collected sludge samples from the Remote Landfill as part of its solid waste management program. Composite sludge samples were collected from four excavated test pits. PCBs were detected at concentrations ranging from 1.65 to 6.65 mg/kg., above the EPD HSRA notification concentration of 1.55 mg/kg. Analytical results for the sludge samples also revealed the presence of chromium, copper, lead, nickel, and zinc, but at concentrations below the HSRA notification concentrations. Note that in July 1996, the EPD used its RQSM and advised AWI that insufficient evidence of a reportable release of a regulated substance had occurred. Consequently, the site was not listed on EPD's Hazardous Site Inventory.

2.3.6 1998 and 1999 SAIC Phase I Remedial Investigation

From February 1998 to March 1999, Science Applications International Corporation (SAIC), on behalf of the USACE, Savannah District, conducted a Phase I remedial investigation at the FMNOL (SAIC, 2000). Soil, surface water, sediment, and biota samples were collected during the investigation. Groundwater samples were also collected from existing and newly installed monitoring wells located in the Landfill Area.

Analytical results for surface soil samples collected from the FMNOL and the Remote Landfill, as well as the surrounding area, contained arsenic, cadmium, chromium, lead, mercury, TCE, cis-

DCE, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, pyrene, and PCBs. Analytical results for groundwater samples contained arsenic, chromium, zinc, tetrachloroethene (PCE), TCE, cis-DCE, VC, and PCBs. Surface water and sediment samples were collected from the drainage easement and from Rocky Creek. Analytical results for surface water and/or sediment samples collected from the drainage easement contained arsenic, beryllium, cadmium, chromium, lead, PCE, TCE, cis-DCE, VC, and Aroclor-1248. Analytical results for surface water and/or sediment samples collected from Rocky Creek downstream of the Landfill Area contained arsenic, beryllium, cadmium, chromium, lead, mercury, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, pyrene, Aroclor-1248, and Aroclor-1254.

Biota (fish tissue) samples were collected from several fish species caught from Rocky Creek and were analyzed for PCBs. Fish species including redear sunfish (*Lepomis microlophus*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), American eel (*Anguilla rostrata*), and brown bullhead catfish (*Ictalurus nebulosus*), among others, were caught from Rocky Creek at locations upstream and downstream of the Landfill Area. Analytical results for biota samples collected downstream of the Landfill Area indicated the presence of the Aroclor-1248 and Aroclor-1254.

2.3.7 2005 EPD Surface Water Sampling Event

On November 3, 2005, the EPD conducted a surface water sampling event to determine whether contamination was present at the FMNOL (EPD, 2006b). Eight surface water samples were collected: four sequentially downstream from the previously existing pond located adjacent to the southern end of the FMNOL, one adjacent to the Remote Landfill fence line, one near Rocky Creek, and two from the drainage easement located adjacent to the FMNOL, one believed by the EPD to be the outfall for the drainage easement, and one upstream closer to the AWI WWTP discharge point. Surface water samples collected down-gradient from the previously existing pond located adjacent to the southern end of the FMNOL contained TCE, cis-DCE, trans-1,2-dichloroethene, and VC. These ponds were likely created by standing water in temporarily flooded areas.

2.3.8 2009 Tetra Tech Expanded Site Inspections for AWI, MNOP, and FMNOL

In May 2009, Tetra Tech conducted Expanded Site Inspections (ESI) at the AWI WWTP Landfill (OU1) and Remote Landfill, the FMNOL, and the former MNOP. As part of these inspections, samples were collected from the soil, surface water, groundwater and sediment. The results were presented in separate reports for each area (Tetra Tech, 2009a, 2009b, 2009c) and what follows is a synopsis of the summaries included in the reports.

Soils: Soil samples collected from the WWTP Landfill contained Aroclor-1248, Aroclor-1254, and Aroclor-1260. Soil samples from the Remote Landfill contained SVOCs, pesticides, PCBs, metals, and polyaromatic hydrocarbons (PAHs) including benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene. Soil samples from the Woodyard Landfill did not contain PCBs. Soil

samples collected from the FMNOL property contained PCBs metals, VOCs, SVOCs and pesticides, including 4,4'-Dichlorodiphenyldichloroethylene (DDE), 4,4'-Dichlorodiphenyltrichloroethane (DDT), alpha-chlordane, and gamma-chlordane. SVOCs, pesticides, and metals (cadmium, arsenic, lead, and mercury) were found in soils from the former MNOP site.

Groundwater: Groundwater samples collected from a well in the vicinity of the Remote Landfill and FMNOL identified VOCs including cis-DCE, 1,1-dichloroethene, and TCE. Inorganic constituents and explosives were not detected at elevated concentrations. Samples collected from MNOP revealed VOCs (*e.g.*, TCE, VC, cis-DCE, and PCE) and the explosive compound perchlorate.

Surface water: Surface water collected from drainage ditches that receive runoff from the FMNOL and Remote Landfill contained gamma-chlordane, Aroclor-1248, and lead. Surface water samples from drainage ditches that receive runoff from the AWI Facility and MNOP contained pesticides (*e.g.,* gamma-chlordane), PCBs, and metals (*e.g.,* cadmium, mercury, lead). The explosive compound perchlorate was also detected in those surface water samples. Water samples collected from Rocky Creek did not indicate any constituents at elevated concentrations (*i.e.,* greater than three times background).

Sediments: Sediment samples collected from drainage ditches that receive runoff from the AWI Facility, the Remote Landfill, MNOP and FMNOL contained SVOCs, pesticides, PCBs, and metals. Sediments collected from Rocky Creek downstream of the drainage ditches also contained pesticides, PCBs, and metals.

3 HISTORICAL DATA ASSIMILATION

Historical data for the Site and neighboring properties (AWI and MNOP located northwest and north of the Site, respectively) were compiled and reviewed in accordance with the SOW. Historical data were assembled from various reports and entered into a relational database. The primary reports from which data were obtained and the method of data entry is shown below.

- Confirmation Study of the Former Macon Naval Ordnance Plant, ESE (September, 1990) – Hand entered
- Reportable Quantity Release Reporting: Response for Additional Information, AWI (August, 1994) – Hand entered
- Delisting Status Report: Armstrong World Industries, ERM (June 1995) – Hand entered
- Final Site Investigation Report Former Macon Naval Ordnance Plant Landfill Site, RUST (September, 1997) – Hand entered
- HSRA Compliance Status Report, SAIC (August, 2000) – Electronic sediment and surface water data
- Phase 1 Remedial Investigation Report Former Macon Naval Ordnance Plant Landfill Site, SAIC (October, 2000) – Hand entered
- Phase 1 Remedial Investigation Report Addendum Former Macon Naval Ordnance Plant Landfill Site, SAIC (October, 2001) – Hand entered
- Monitoring Report for Post-Test Groundwater Sampling (October-November 2004), SAIC (January, 2005) – Hand entered
- Former Macon Naval Ordnance Plant Surface Water Sampling Trip Report and Results, EPD (January, 2006) – Hand entered
- Final Site Inspection Report Armstrong World Industries, Tetra Tech (September, 2009) – EqUIS download
- Final Expanded Site Inspection Report Former Macon Naval Ordnance Landfill, Tetra Tech (September, 2009) – EqUIS download
- Final Expanded Site Inspection Report Allied Industrial Park, Tetra Tech (September, 2009) – EQuIS download
- June 2011 Supplemental Sampling Event, Tetra Tech (September, 2011) – EQuIS download

Of the data that has been entered into the database, the following table summarizes the amount of information that has been collected for just the Site and entered into the database. These data were collected between 1989 and 2011.

		Site (OU2)
Soil	# Locations	118
	# Samples	174
	# Results	14,151
Sediment	# Locations	48
	# Samples	57
	# Results	4,228
Surface Water	# Locations	40
	# Results	2,890
Groundwater	# Locations	57
	# Samples	109
	# Results	3,371
Total	# Locations	263
	# Samples	380
	# Results	24,640

For this RI/FS Work Plan, only data collected on the Site were used in the COPC determination and evaluation. The data used in this report (in Excel tables) are provided on a CD-ROM in Appendix B.

This historical dataset was used to determine the constituents to be carried forward in the RI/FS process (Section 4.1), develop the preliminary CSM (Section 6), complete a gap analysis (Section 7), and to inform the scope of work (Section 8). However, future risk assessments will be primarily based on the data collected as outlined in this Work Plan.

4 CONSTITUENTS OF INTEREST

4.1 COPC – Risk Screening

In preparation for the RI/FS process, the historical data collected at the Site were compiled into a project database and evaluated and screened against both human health and ecological screening values. The purpose of this screening was to develop a list of constituents to take forward into the RI/FS process for further sampling and/or evaluation. The SOW indicates that the analytical program would generally include the Target Compound List (TCL), Target Analyte List (TAL), methane and 1,3-butadiene; however, the SOW allows that the analytical program may vary if adequate justification and information is available. As described in the previous section, 380 samples have been collected at the Site for a total of 24,640 sampling results. Previous sampling events involved analysis for a broad range of constituents (a total of 445 different constituents). For example, the ESI involved analysis of constituents on the TCL and TAL. Thus, this large dataset of historical data is more than adequate to determine the list of constituents that are true potential drivers for risk and/or remediation for the Site.

The SOW indicates that three risk assessment technical memoranda (#1: identification of COPCs, #2: toxicity and exposure assessments, and #3: screening level ecological risk assessment (SLERA)) be submitted as part of the RI Report. However, as there is a plethora of historical data available for the Site, it is reasonable that the human health screening (COPC selection) and ecological screening be conducted as an element of the scoping process within the Work Plan. Accordingly, these screenings have been conducted and are provided as a technical memorandum, which is provided as Appendix C of this document.

The historical data collected at the Site were screened against EPA published values, based on EPA Region 4 human health (EPA 2018b) and ecological (EPA 2018a) guidance. The ecological screening involved Steps 1 through 3a of the Ecological Risk Assessment Guidance for Superfund (EPA, 1997) process, which includes the SLERA and Step 3a (a refinement of the screening including limited food web modeling).

The purpose of this evaluation was not to conduct a thorough risk assessment, but rather to determine what constituents are the potential drivers for risk and/or remediation at the Site. A future risk assessment will be conducted using the data collected after the work described in this Work Plan is implemented. The outcome of this evaluation is a list of constituents, by media.

4.2 Constituents to be Analyzed for the RI/FS

4.2.1 Constituents by Medium

The table below includes the results of the COPC screening and also includes information that was not included as part of the COPC screening: 1) fish tissue was not included as part of the COPC

screening; however, as described later in this document, fish tissue will be analyzed for mercury and PCBs based on the results of historical fish tissue analysis; and 2) total organic carbon (TOC) and nitrates have been added to the groundwater list to evaluate the potential for natural attenuation of energetics in groundwater.

Constituents to be Evaluated in all Areas by Medium

Medium	Inorganic List	PAH[3]	PCBs	Pesticides	SVOCs	VOCs	Energetics	Other
Soil	X	X	X					
Sediment	X	X	X					
Surface Water	X		X			PCE, TCE, cis-DCE, VC		
Groundwater	X		X	Dieldrin	BEHP	PCE, TCE, cis-DCE, VC, CT, 1,1-cis-DCE	X	TOC, Nitrate
Fish Tissue	Mercury		X					

Where

Inorganic list: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron, lead, manganese, mercury, nickel, silver, thallium, vanadium, zinc. Note that metals may be naturally

PCBs: full suite of PCBs (aroclors and the 59 congeners analyzed by the ALS Kelso laboratory)

BEHP: bis(2-ethylhexyl)phthalate

1,1-DCE: 1,1-dichloroethene

VC: vinyl chloride

CT: carbon tetrachloride

TOC: total organic carbon

4.2.2 Additional Constituents by Area

There are a few constituents that would only be analyzed in specific areas of the Site as shown in the table below. As described more fully in Section 6.3, TCE in subsurface soil and bis(2-ethylhexyl)phthalate (BEHP) in surface and subsurface soil are COPCs only in the landfills. Accordingly, BEHP will be analyzed in soil samples collected from the two former landfills. Subsurface soil sampling is not planned for the landfills.

Due to the unusual nature of the Explosives Demolition Area, several constituents are being analyzed only in this area. Energetics will be analyzed as previous testing did not include the full suite of energetics. Perchlorates will be analyzed as they can be found in areas where flares are burned, and perchlorates have not previously been analyzed in this area. Chromium speciation (*i.e.,* total, hexavalent and trivalent) will also be conducted in samples from the Explosives Demolition Area. The chromium speciation is primarily to determine whether or not hexavalent chromium is present rather than for risk evaluation.

There are two other constituent groups (*i.e.*, dioxins/furans and per- and polyfluoroalkyl substances, PFAS) that can be of interest in soils at industrial sites depending on past uses and

[3] Although only high molecular weight PAHs (HMWPAHs) are COPCs, the samples will also be analyzed for low molecular weight PAHs.

operations. These constituent groups have not previously been analyzed at the Site; however, these constituent groups are not expected to be present as described below.

Dioxins/furans are ubiquitous in the environment (ATSDR, 1998) as they are byproducts of combustion. These combustion sources can be anthropogenic or naturally occurring (*e.g.*, through forest fires). For example, in 2014 there was a wildfire in west Macon-Bibb County, in 2016 Macon-Bibb County was shrouded in smoke from wildfires in north Georgia, and in 2017 a nearly 100,000-acre fire took place in south Georgia. A common anthropogenic source is from the chlorine bleaching process used by wood and paper pulp mills, and there are at least two historical pulp mills in Macon-Bibb County (Montgomery and Chaffin, 1982). Additionally, the business just to the east of the Site is Graphics Packaging, which is known to have releases of dioxins/furans according to the EPA's Toxic Release Inventory. Having known source in close proximity to the Site makes it difficult if not impossible to attribute the source, especially where there is no likely on-Site source. Theoretically, the demolition of explosives in the Explosives Demolition Area could have produced small amounts of dioxin if burned in the presence of chlorine or organochlorine substances (Stucki, 2004). However, 2,4-dinitrotoluene (2,4-DNT) can be used a surrogate for the presence of dioxins in areas where flares are used to detonate propellants (Poulin *et al.,* 2011). At the Site, 2,4-DNT has been analyzed in 34 soil samples and was non-detect in all samples. Although it is not believed that dioxins/furans are present at the Site due to site activities, at the request of the EPA dioxins/furans will be analyzed in the soil samples from the Explosives Demolition Area. The purpose of this sample is primarily to determine the presence/absence of dioxins/furans.

PFAS are man-made chemicals that impart oil and water repellency, temperature resistance and friction reduction. Certain PFAS chemicals are no longer manufactured in the United States. Historically, PFAS chemicals were commonly found in surface coating and protectant formulations (such as for cookware and textiles), fire-fighting foams, and chromium plating operations. There is no evidence to indicate that any of these materials were used or disposed at the Site. The MNOP site had a chrome plating operation from 1973 to 1980; however, it is unknown if PFAS were used as wetting agents or fume suppressants. It is known that the discharge from these operations were treated and then sent to the municipal treatment plant. The distribution of chromium at the MNOP site does not suggest a source of chromium co-located with the known TCE source adjacent to the on-site WWTP. As such, this Work Plan is not proposing to collect samples for PFAS.

The table below specifies the area-specific constituents that will be analyzed in addition to the medium-specific constituents shown in Section 4.2.1.

Additional Constituents Localized in Specific Areas

Medium	BEHP	Energetics	Perchlorates	Chromium Speciation	Dioxins/ Furans
Landfill Surface Soil	X				
Explosives Demolition Area Soil		X	X	X	X

5 SITE SETTING

5.1 General Setting

5.1.1 Surface Features

The majority of the Site is covered in dense vegetation. The southern portion of the Site is comprised of forested wetlands and is within the floodplain of Rocky Creek. The elevation of the area ranges from about 345 feet above mean sea level (amsl) on the top of the ridge on the northeast portion of the property to about 275 feet amsl in the stream valley south of the Site. Several drainage ditches flow north to south across the Site. Additionally, during Site reconnaissance two seeps were identified due east of the FMNOL on the Site (Figure 3). The ditches and seeps flow directly to Rocky Creek. There are active rail lines east and west of the Site and an abandoned Central Georgia Railroad tracks lie in the northern portion of the Site. There are two former unpaved roads that provide access to the Landfill Area. A chain link fence surrounds the Remote Landfill, but it is damaged in multiple locations, allowing access. The surface of the Remote Landfill is uneven due to settling and is littered with debris. During site reconnaissance in 2018 and 2019, Environmental Planning Specialists (EPS) observed large piles of concrete and rebar exposed throughout the FMNOL and areas where the FMNOL and Remote Landfills merge, and that several open pockets or voids have formed in the surface. Several abandoned drums can still be seen in the area around the two landfills, in what may have been the drum storage area. An explosives blind still exists near the explosives demolition area. A photographic log is included in Appendix D.

5.1.2 Geology

The Site is located in what is known as the Fall Line Hills District, a sub-ecoregion of the Coastal Plain Physiographic Province. The topography of this area is referred to as the Sand Hills, which consists of gently rolling to swampy flatlands. The geology of the area, in descending stratigraphic order, consists of recent alluvial deposits, Pleistocene alluvial deposits, and the Tuscaloosa Formation.

Boring logs and well construction summaries reported by Rust (1997) indicated that there are two distinctive (shallow) lithographic units: surficial deposits composed of silty sand, clay, peat, and organic silts/clay (Quaternary); and clayey sand, clean sands, clay, and silt (Tuscaloosa). The base of the surficial unit is estimated to be at an elevation of 280 feet msl sloping to 272 feet msl near Rocky Creek (Rust, 1997).

The Tuscaloosa Formation, which lies unconformably beneath the surficial deposits, has distinctive grey/green-grey silts and clays and white-tan kaolinitic clayey sands. It is not well bedded, and the beds do not indicate regular or cyclic deposition; hence the basal part of the formation may be lithologically similar to the top. The Tuscaloosa Formation is approximately

280 to 285 feet thick and directly overlies what has been described as “granite”, “marl”, or “limestone” (Rust, 1997).

5.1.3 Soils and the Vadose Zone

The surficial unit varies in thickness from 4 to 7 feet and composed of residual soils to the north and organic rich, mostly clayey deposits to the south. Generally, these soils are well drained, gently sloped, and acidic consisting of sandy loams, sandy clay loams, and loamy sands. The recent alluvial deposits that underlie the Site and adjacent properties consist of four major soil types which include the Cowarts Sandy Loam, 2 to 5 percent slopes, the Cowarts Sandy Loam, 5 to 8 percent slopes, the Norfolk Sandy Loam, 0 to 2 percent slopes, and the Vaucluse-Urban Land Complex, 2 to 8 percent slopes. The organic rich deposits were probably laid down as a result of the vertical accretion of the flood plain adjacent to Rocky Creek. The underlying Pleistocene alluvial deposits consist of unconsolidated sediments of interbedded clayey silts and silty clays that grade with depth into silty sands and gravel, and the depth of these deposits can be up to 40 feet (Rust, 1997).

5.1.4 Hydrogeology

The surficial materials are saturated throughout the floodplain and are sufficiently thick to form a distinctive hydrogeologic feature in this area. Depth to groundwater varies from approximately 14 feet to less than 2 feet in the bottomland wetlands.

Groundwater in the area is available in a surficial aquifer system, consisting of the recent alluvium, Pleistocene alluvium, and the Tuscaloosa Formation. Soils in this aquifer system range from moderate to low permeability. These three geologic units act as a recharge for the surficial aquifer located in the Tuscaloosa Formation. The Tuscaloosa Formation furnishes water to almost all drilled wells on the Coastal Plain of Macon-Bibb County. The hydraulic conductivity for the silty sands found in the Tuscaloosa is on the order of 10^{-3} centimeters per second (cm/s). The regional flow direction for this aquifer is to the south-southeast towards Rocky Creek (Rust, 1997).

5.1.5 Surface Water Hydrology

The Site lies within the drainage basin of Rocky Creek. Rocky Creek exhibits a well-developed floodplain and flows into Tobesofkee Creek approximately 1.5 miles southeast of the Site. Tobesofkee Creek confluences with the Ocmulgee River another 4 miles downstream. The flow rate for Rocky Creek is estimated to be about 40 cubic feet per second (cfs). Rocky Creek has multiple braids. Specific stream channels are difficult to discern due to extensive wetlands in the area. According to the U.S. Geological Survey (USGS), the average discharge for Tobesofkee Creek near Macon, GA (USGS 02213500) is 297 cfs with an average annual maximum flow of 349 cfs and a peak flow of 54,000 cfs per USGS 1938 to 2017 records. The average discharge for the Ocmulgee River at Macon, GA (USGS 02213000) is 2,621 cfs with an average annual maximum flow of 4,848 cfs and a peak flow of 107,000 cfs per USGS 1911-2018 records.

The surface water features of the Site are shown in Figure 3. Surface water runoff flows south-southeast from the Landfill Area into a drainage easement and wetlands along Rocky Creek. Several drainage ditches also direct surface water from both AWI and AIP. Ditch 1 flows from AWI and joins with Ditch 2 that originates on the AIP property. Ditch 3 originates on the AIP property and joins with Ditch 2 before flowing into Rocky Creek. Ditch 4 is on the eastern side of the Site and originates on the AIP property and flows to Rocky Creek. Ditch 1, Ditch 2, Ditch 3, and Ditch 4 are included as part of OU2. Ditch 1 merges with Ditch 2, which then runs northwest to southeast on the east side of the FMNOL and Explosives Demolition Area before splitting to join Rocky Creek at two locations. Ditch 3 runs north to south to Rocky Creek in OU2. Ditch 4 runs northeast to southwest and then bends southeast to Rocky Creek in OU2.

The southern half of the Landfill Area is located within the 100-year flood plain of Rocky Creek. Wetlands (from the National Wetlands Inventory) cover over half of the Site as shown in Figure 3. Also shown on this figure is the boundary between the wetlands and the upland areas. This boundary is also shown on other figures in this report.

5.1.6 Climate

The climate at the Site is consistent with that of humid, subtropical climate, with an average temperature of 64°F. Summers are hot and humid with temperatures that reach to 90 °F and an average relative humidity of near 80%. Winters are mild with temperature averaging a low of 38 °F with little snow. Macon receives moderate to heavy rainfall throughout the year with an average annual precipitation of 45 inches. However, Georgia has experienced severe droughts in the past, such as the one in 2007. Macon-Bibb County lies in Plant Hardiness Zone 8a and has an average annual extreme minimum temperature of 5 °F-10°F.

5.1.7 Demographics

According to 2010 census data, there are 127 people that live within one mile of the Site, and no one lives within 0.5 mile of the Site (Censusviewer, 2019). Of the people living within one mile, 12 are above the age of 65 and 8 are below the age of 5.

5.2 Aerial Photo Review

In a November 1999 report, the EPA published a document detailing past land uses and apparent land scarring from the landfills and facilities in a series of aerial photographs taken from 1938 to 1988 (EPA, 1999). EPS reviewed aerial photographs from 1938-2015 to determine the approximate extent of the Landfill Area and identify other significant features. Additional aerial photographs were obtained via Environmental Data Resources, Inc. (EDR). The principal environmental features of the Site are most distinct in the color-infrared[4] aerial photograph

[4] Red is associated with live vegetation. Intense reds indicate vigorous growth and dense vegetation. As vigor and density decreases, the tones change to light reds and pinks. Dead vegetation is shown as green or tan. Bare soils are shades of white, blue or green. Water will show as various shades of blue, varying from light blue to black.

provided below: (i) the Remote Landfill, FMNOL, and explosives demolition area (left yellow circle), (ii) an excavation pit (middle yellow circle), and (iii) a water feature anomaly (right yellow circle). Other human activity appears to have been limited to land clearing in the northern portion of the Site. No construction occurred in this area indicating that the land was likely cleared to farm trees; thus, these areas are considered absent of a practical historical pathway for the occurrence of chemical constituents in environmental media at the Site. Copies of aerial photographs reviewed are provided in Appendix A.

EDR Aerial photograph captured in 1981 using infrared radiation thermography

Landfill Area. The FMNOL and Remote Landfill are first visible in the 1950s and 1966, respectively, and by 1975 had merged into one feature. Aerial photographs captured after 1981 do not reveal any significant change in the footprint of the Remote Landfill and FMNOL; thus, the 1981 color-infrared aerial photograph (above) approximately captures the present-day extent of the landfills. The landfill outlines shown on the figures in this Work Plan are based on this aerial photograph.

The explosives demolition area follows a similar timeline to the FMNOL, first appearing in the early to mid-1950s with no visible expansion after 1981. The 1981 color-infrared aerial photograph (above) approximately captures the present-day extent of the explosive's demolition area.

Former Excavation Pit. The purpose of the former excavation pit is unknown and no historical soil data are available to characterize the environmental condition in this area. The former excavation pit is first visible in a 1972 aerial photograph but is concealed by vegetation in the available aerial photography after 1981. The footprint of the former excavation pit was identified during site reconnaissance conducted in January 2019 (the area contained topography uncharacteristic to the local area and consistent with that of an open excavation).

Water Feature Anomaly. The origin of this feature is unknown. Due to its proximity to the water reclamation facility, it is possible that it is discharge from the facility. This area is only visible in the 1981 color infrared aerial photograph (above), not in other aerial photographs. No historical data are available indicating potential contamination of this area and black color on infrared photography can indicate clear water. As such, this area will not be sampled as part of the work proposed in this Work Plan. However, data collection in this area may be proposed at a later date should data collected as part of this Work Plan indicate a need for sampling of this area.

5.3 Physical Surveys

Physical surveys were performed for the Landfill Area, surface conveyances, and wetlands. Drone-based LiDAR topography was collected at 1 ft. contours/intervals for approximately 45 acres encompassing the Landfill Area to assess the nature and extent of the landfill settlement over time. Surface conveyances were traversed from their point of origin on the AIP property to Rocky Creek and mapped using a survey grade GPS device for accurate depiction at scale.

5.4 2019 Field Survey with Habitat/Wildlife Survey

A field survey of the Site was conducted January 15-17, 2019, to document the ecology and landscape of the Site. The survey began in the vicinity of the Landfill Area then proceeded east across the Site (Figure 5). The focus of the survey was to provide a general description of the Site, delineate ditches, and assess the vegetation and potential wildlife uses. In general, the northern portion is predominantly uplands areas whereas further south, wetlands become more prominent and are directly influenced by the floodplain of Rocky Creek. According to the National Wetlands Inventory, these wetlands are classified as palustrine forested wetlands that are either temporarily or seasonally flooded (*i.e.,* PFO1A and PFO1C). The photographic log in Appendix A contains photos taken from this survey.

The landscape of the Landfill Area is uneven due to settling, which has also resulted in the formation of several voids in the surface. Exposed refuse (*i.e*., tires, scrap metal, concrete debris, abandoned drums) also covers Landfill Area. The fence surrounding the Remote Landfill is damaged in several locations, allowing wildlife to move between it and adjacent wetlands (Figure 6). An explosives blind at the Explosives Demolition Area still exists nearby.

There is evidence of an excavation pit near the center of the Site. The total area of the pit is unknown but the depth averages 4-5 feet and has a diameter of approximately 270 feet.

The main drainage (Ditch 2) that enters from the northwest corner of the Site was flowing at the time of the field survey. The remaining drainages were either dry or contained only standing water. All ditches have a defined flow and a distinct channel. These drainage features flow south, converge in the wetland area, and eventually confluence with Rocky Creek. Additionally, two seeps were observed on the downward slope of the upland area.

Tree species are somewhat uniform across the Site and include holly, sweetgum, hawthorn, sweetbay magnolia, water oak, southern red oak, and silvery olive. Sycamore and river birch are also found in the wetlands area and Chinese privet dominates most of the understory on the Site; however, palmetto, river cane, and river oat become more common in the riparian area. An herbaceous layer of vegetation (*e.g.,* henbit) covers the top of the Landfill Area, but is missing in other areas of the Site.

Evidence of deer, medium-sized mammals (*e.g.,* raccoon, armadillo) and feral pigs are present throughout the Site (*i.e.,* scat, tracks). There is additional evidence of feral dogs and/or coyotes and bobcat. Several small mammal burrows are located across the top of the Landfill Area. Several species of bird occur at the Site such as mockingbird, cedar waxwing, northern cardinal, hooded warbler, tufted titmouse, red-tailed hawk, red-bellied woodpecker, and waterfowl.

5.5 Endangered and Threatened Species

According to Georgia's Department of Natural Resources (DNR), twelve protected species have been documented in Macon-Bibb County. Atlantic Sturgeon, Fringed Campion, and Relict Trillium are listed as endangered under the Endangered Species Act and by the state of Georgia. The only other species with Federal Protection Status is the Gopher Tortoise, a candidate species for listing as endangered or threatened. All remaining threatened, rare, or unusual species are only provided state-level protection. The details the occurrences and status of threatened and endangered species known observed in Macon-Bibb County are detailed in the table below.

Group	Common Name	Scientific Name	Federal Protection Status	State Protection Status
Birds	Bald Eagle	Haliaeetus leucocephalus		Threatened
Fishes	Atlantic Sturgeon	Acipenser oxyrinchus	Endangered	Endangered
Fishes	Altamaha Shiner	Cyprinella xaenura		Threatened
Fishes	Goldstripe Darter	Etheostoma parvipinne		Rare
Mammals	Rafinesque's Big-eared Bat	Corynorhinus rafinesquii		Rare
Reptiles	Gopher Tortoise	Gopherus polyphemus	Candidate	Threatened
Reptiles	Southern Hognose Snake	Heterodon simus		Threatened
Plants	Yellow Flytrap	Sarracenia flava		Unusual
Plants	Gulf Sweet Pitcherplant	Sarracenia rubra ssp. gulfensis		Threatened
Plants	Ocmulgee Skullcap	Scutellaria ocmulgee		Threatened
Plants	Mountain Catchfly	Silene ovata		Rare
Plants	Fringed Campion	Silene polypetala	Endangered	Endangered
Plants	Relict Trillium	Trillium reliquum	Endangered	Endangered

6 CONCEPTUAL SITE MODEL

6.1 Introduction

A CSM is a framework that depicts the complex interplay between physical, chemical and biological processes that occur at a site. It is a dynamic model that evolves over time as additional information is obtained. Primary components of the CSM include sources of constituents present in the environment, physical and chemical process that control the fate of the constituents over time (including how they are transported within and among the various media), and exposure pathways for receptors (human or ecological) to come into contact with the constituents. As additional information is collected and evaluated, the CSM will be refined and adapted as needed. The preliminary CSM is based on historical data and may not be representative of current conditions; accordingly, an updated CSM will be provided in the RI report.

6.2 Sources and Transport Mechanisms

Potential COPC sources that may have impacted environmental quality at the Site (note impact to human and ecological receptors are considered in a later section) and the associated transport mechanisms are shown in the table below. An overhead view of the ground surface CSM indicating transport of water in ditches/streams, stormwater runoff, and flooding/deposition is shown in Figure 6 and a cross-section view of the CSM is shown in Figure 7. This CSM including a better understanding of the transport mechanisms will be refined throughout the RI/FS process. As sediment transport may be a primary mechanism, this refinement may include evaluations such as sediment transport modeling and mapping of geomorphology in sensitive areas.

Potential Source of COPCs	Potential Transport Mechanisms	Potential Impacted Media
Primary Sources		
Waste materials in Landfill Area	Leaching to groundwater Hydrodynamic transport of stormwater runoff in areas of erosion and/or subsidence	Groundwater Soil, Surface Water, Sediment
Ditches/Rocky Creek	Hydrodynamic transport of impacted surface water and sediment onto and through the Site	Surface Water, Sediment
Ditches/Rocky Creek	Flooding / deposition within the Site	Soil
Groundwater	Hydrodynamic transport of impacted groundwater flowing onto and through the Site	Groundwater Potentially Surface Water
Soil/Rock	Many constituents (most notably metals) are naturally occurring in soil and rock	Soil, Sediment
Secondary Sources		
Stormwater Runoff	Hydrodynamic transport of impacted stormwater runoff flowing onto the Site from higher elevations	Soil, Surface Water, Sediment
Air	Deposition of constituents from the air	Soil, Surface Water, Sediment

Hydrodynamic transport includes inflow onto and from the Site from a) groundwater coming onto the Site in the underground aquifer, b) surface conveyances (the ditches and Rocky Creek) coming onto and passing through the Site and, to a lesser extent, c) overland flow (runoff) from rain events. The inflow is dependent on the hydrogeology of the subsurface for groundwater and the watershed hydrology for runoff and surface water. The surface water in the ditches and Rocky Creek may transport constituents onto the Site either as dissolved constituents in the surface water or as suspended particulates. Constituents can also be redistributed in the groundwater or surface water through hydrodynamic transport processes of advection and turbulent mixing, which result in dilution and dispersion of the constituents.

Rainfall serves as an additional source of flow both through infiltration through the subsurface to groundwater (leaching) and by surface runoff into the ditches and Rocky Creek. As the water flows either through the subsurface or across the land it can transport constituents from soils into either the groundwater or surface water.

Various hydrodynamic processes also regulate particle deposition and resuspension between sediments and surface water. Bed scour may result in resuspension of sediments, which are then

transported further downstream before being redeposited. Constituents can absorb to sediment particles and can be transported downstream. The lower velocities in the ditches result in transport via small particles and detritus as suspended load. The higher velocities in Rocky Creek may induce movement of larger particles. In general, an accumulation/concentration of constituents often occurs due to particle deposition in localized deposition regions such as sheltered embayments. Additionally, native (non-impacted) soils can also accumulate in these depositional areas.

In the Landfill Area there is a potential for buried materials to be exposed to the surface due to erosion and surface subsidence. Significant subsidence has been observed over parts of the Landfill Area. This subsidence may be the result of decomposition and/or compression settlement of the landfill materials deposited there.

During rainfall events, flooding occurs in the low-lying areas, most notably between the Landfill Area and Rocky Creek. Much of the Site is a wetland area (Figure 6). The water and suspended sediment may breach the banks of the conveyances and transport constituents across the low-lying grounds surrounding the conveyances. This is likely one of the most important transport mechanisms occurring at the Site.

To a lesser extent, constituents may enter the Site through deposition from the air and some may leave the Site through volatilization into the air.

These various factors have influenced the historical distribution of constituents throughout the Site and will continue to influence their redistribution.

6.3 Chemical CSM

6.3.1 Metals

Metals have been detected above human health and ecological screening criteria in all media (see Appendix C). It is possible that metals may be present from releases at the Site, but it is likely that a significant portion of the metal concentrations are the result of naturally occurring metals in soil and rock (USGS, 2019). A background study will be needed to differentiate between naturally occurring concentrations and those due to releases at the Site (Section 8.1.7).

The extent of metals exceedances of human health[5] and ecological screening criteria for each medium are shown in Figure 8. The figure depicts the number of constituents that exceed criteria for each medium. This figure shows that there is not a consistent spatial extent of metals exceedances.

[5] For soil and sediment, industrial receptor regional screening levels (RSLs) are used. For surface water, federal Water Quality Standards are used and where not available Tapwater RSLs are used. For groundwater, federal Maximum Contaminant Levels are used and where not available Tapwater RSLs are used.

The metal COPCs are not the same across media nor between human and ecological receptors. However, for consistency, the same group of metals[6] will be carried forward in the RI/FS evaluation for all media.

6.3.2 Cyanide

Cyanide is only a COPC in groundwater. The extent/concentrations of cyanide across the Site is shown in Figure 9. The higher concentrations have been observed in the Landfill Area. Cyanide will be carried forward in the groundwater investigation.

6.3.3 PCBs

PCBs have been detected in all media at the Site. The presence of PCBs is likely due to a combination of releases at the Landfill Area and/or potential upgradient sources of the Site. PCBs are anthropogenic, commonly found from certain historical industrial operations. PCBs are also persistent in the environment. PCBs are no longer produced or utilized, but their persistence and toxicity make them an ongoing concern at legacy sites.

The extent of PCB exceedances of human health[5] and ecological screening criteria for each medium is shown in Figure 10. The figure depicts the number of Aroclors that exceed criteria for each medium. The total PCB concentration in each sample and the extent of these concentrations across the Site in each medium are shown in Figure 11. These figures show that PCBs show no discernable concentration gradient, but appear mostly in soils and sediment. Additional information about PCB detections at and near the Site is provided in Figure 23, which is discussed in Section 6.4.4.4.

PCBs can move from surface water and sediments into fish, which bioaccumulate higher concentrations of PCBs than are found in the water and sediment. Fish tissue in Rocky Creek has been analyzed for PCBs by both the USACE in 1996 and by SAIC in 1998 (SAIC, 2000). Aroclor 1254 was detected in all fish sampled by USACE. The locations where the fish were caught were not specified. PCB concentrations ranged from 0.35 to 0.49 mg/kg. In 1998, fish were collected from six locations. Of the twelve species of fish caught, seven had detectable concentrations of PCBs, all of which were located downstream of the Landfill Area. Aroclor 1254 (ranging from 0.0581 to 2.55 mg/kg) was detected in seven species and Aroclor 1248 (ranging from 0.299 to 1.86 mg/kg) was detected in five species. The Redbreast Sunfish had the highest total PCB concentration (2.55 mg/kg). The Food and Drug Administration's tolerance level for residues of PCBs in fish is 2 mg/kg. The EPD uses the following trigger concentrations for determining fish advisories for total PCBs (Miklos, 2019):

[6] Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, silver, thallium, vanadium and zinc. Note that metals may be naturally occurring.

EPD Fishing Restriction	Total PCB (mg/kg)	Aroclor 1254 (mg/kg)
No Restriction	< 0.1	< 0.05
Once per week	> 0.1 and < 0.3	> 0.05 and < 0.14
Once per month	> 0.3 and < 1	> 0.14 and < 0.47
Do not eat	> 1	> 0.47

PCBs are a COPC and will be carried forward in the RI/FS process for further evaluation in all media and in fish tissue.

6.3.4 Pesticides

Dieldrin is only a COPC in groundwater. The concentration ranges of dieldrin across the Site are shown in Figure 12. This figure shows that dieldrin detections are not pervasive across the Site. However, as dieldrin was analyzed in a limited number of groundwater samples and the only detection is above the residential screening level, dieldrin will be carried forward for further evaluation in groundwater.

6.3.5 Polyaromatic Hydrocarbons (PAHs)

PAHs have been detected in soil and sediment, but not in surface water or groundwater. PAHs can be naturally occurring (mainly from burning vegetation) or anthropogenic (mainly from internal combustion engines and petroleum products).

High molecular weight PAHs (HMWPAHs) are a COPC in soil and sediment. A comparison of the HMWPAH results to screening values[5] is shown on Figure 13. The concentrations of total PAHs are shown on Figure 14. These figures show that PAHs are widespread in soil or sediment and are not generally found in groundwater or surface water. Although only HMWPAHs are COPCs, both high and low molecular weight PAHs will be evaluated as part of the soil and sediment sample analyses for the RI/FS.

6.3.6 BEHP

BEHP is most commonly used in the production of polyvinyl chloride (PVC) and vinyl chloride resins. BEHP is anthropogenic and is a commonly found at industrial sites. BEHP is neither easily degraded nor highly mobile.

BEHP is a COPC in soil and groundwater. The concentrations of BEHP across the Site are shown in Figure 15. It is of note that the concentrations are not indicative of risk; for example, the highest concentrations in sediment are seen in Rocky Creek, but they are below the screening criteria. These data indicate that the elevated BEHP condition in soil and groundwater is localized to the Landfill Area. BEHP results in soil outside the Landfill Area is largely undetected and are below

screening criteria. Thus, in soil, BEHP will only be evaluated for the Landfill Area and not the remainder of the Site. BEHP will also be evaluated further in the RI/FS process in groundwater.

6.3.7 Chlorinated Solvents

Chlorinated solvents are chemical compounds containing chlorine and have been widely used in various industries as cleaning and degreasing solvents. Chlorinated solvent COPCs at the Site include carbon tetrachloride and chlorinated ethenes (PCE, TCE, cis-DCE, 1,1-DCE and VC). All of these are COPCs in groundwater. Several of the chlorinated ethenes (TCE, cis-DCE and VC) are COPCs in surface water and the only chlorinated solvent that is a COPC in soil is TCE in subsurface soils at the landfills. None are COPCs in sediment. Chlorinated ethenes are sequentially biodegraded into daughter products: PCE into TCE into cis-DCE into VC into ethene.

The exceedances of screening criteria[5] of the chlorinated solvents across the Site are shown in Figure 16. This figure shows that potential risk from chlorinated solvents is nearly exclusively in groundwater and surface water. The concentrations of carbon tetrachloride across the Site, which was only detected in groundwater, is shown in Figure 17.

TCE is the most commonly detected of the chlorinated ethenes. TCE concentrations across the Site are shown in Figure 18. TCE is most prevalent in groundwater, then in surface water. Although TCE was detected in soil and surface water, it was only above the residential criteria in one location in subsurface soil and was not above any criteria in surface soil or sediment. The one soil exceedance is in the Landfill Area. Thus, although TCE is a COPC in soil, it is localized to subsurface soil in the former landfills. The six chlorinated solvent COPCs will be evaluated further in groundwater and four chlorinated ethenes (PCE, TCE, cis-DCE and VC) will be evaluated further in surface water. Parameters to evaluate monitored natural attenuation will be analyzed in addition to COPCs.

6.3.8 Energetics

Energetics are constituents used in military explosives and propellants. Energetics are of interest due to the Explosive Demolition Area. Energetics have been analyzed in soil, groundwater, sediment and surface water; however, they have only been detected in groundwater. In groundwater only two wells have had energetic (*i.e.*, PETN, 1,3-dinitrobenzne and 2,4-dinitrotoluene) results above screening criteria[5] (Figure 19). Although they are infrequently detected, energetics will be carried forward in the RI/FS groundwater evaluation in large part due to the operations in the Explosives Demolition Area. As such, energetics will also be analyzed in the soil samples collected from the Explosives Demolition Area.

6.3.9 Conclusion

For the vast majority of COPCs, there is no discernable distribution pattern (*i.e.*, concentration gradient) across the Site based on historical data. This indicates the likelihood that flooding of the conveyances and/or runoff may be the primary transport mechanisms. This movement of flooding

back and forth across the low-lying areas (wetland areas) could result in constituents being distributed across larger areas. A lack of a pattern may also indicate background conditions due to naturally occurring constituents or atmospheric deposition. Thus, the scope of work (Section 8) will primarily be focused on investigating these low-lying areas.

6.4 Human Health and Ecological CSM (Exposure Pathways)

6.4.1 Introduction

For a risk to exist there must be a complete exposure pathway between a receptor and a source. An exposure pathway is a description of the ways in which a receptor (human or ecological) could be exposed to chemicals in the environment and is defined by four elements: (1) a source and mechanism of chemical release to the environment (*e.g.,* materials in the Landfill Area transported via stormwater runoff); (2) an environmental transport medium (*e.g.*, surface water) for the released chemical; (3) a point of potential contact with the contaminated medium (*e.g.*, surface water); and (4) an exposure route (*e.g.*, actual ingestion of contaminated water and subsequent absorption from the gastrointestinal tract into the body). In order for an exposure pathway to be considered complete, all four elements must occur. This section discusses the exposure pathways between anticipated receptors and the sources of COPCs in various media. A complete pathway is one where all elements of the exposure pathway are present, including a known exposure. A potential pathway is one in which exposure is possible, but not known. The potential exposure pathways are shown in the receptor CSM (Figure 20).

6.4.2 Human Health

The majority of the Site is not suitable for human activity. The presence of the Landfill Area and the large percentage of the Site that is a wetland and/or in a floodplain make it unsuitable for development and difficult to assess. Currently the only human receptors are site workers who infrequently visit the area (to keep roads clear), and potential trespassers (anglers, hunters, adolescents). However, the Site is not attractive to trespassers due to the physical hazards and swampy terrain. The ATSDR indicated that human exposure is unlikely "because the Landfill Area and drainage ditch are located in a forested wetland area. The area is often partially submerged by Rocky Creek floodwaters making access difficult and unlikely" (ATSDR, 2012). Additionally, signs are posted advising against fishing in Rocky Creek. Furthermore, the Landfill Area is mostly fenced and overgrown with vegetation. As the surrounding area is industrial, it is unlikely that the public would casually access the Site (ATSDR, 2012).

Anglers have historically fished in Rocky Creek (upstream and downstream of the Landfill Area). Access is limited with the easiest access being a bridge on Houston Road approximately one mile southwest of the AWI Facility (ATSDR, 2012). In 2011, the Georgia Department of Public Health distributed 85 community environmental health surveys to the public in part to ascertain fishing habits. Only six surveys were returned, indicating a general lack of community concern. However, as fishing is known to occur in Rocky Creek, this is a complete exposure pathway.

The property owners do not intend to develop the Site any further, especially in the areas around the Landfill Area[7]. Thus, the human exposure pathway to soil is only a potential pathway for infrequent access by site workers and trespassers (primarily anglers, hunters and potentially adolescents).

The human health CSM may be updated as needed based on additional information obtained during the RI/FS process. Site workers and trespassers have potential exposure to COPCs by exposure to surface soils, sediment and surface water via incidental ingestion and/or dermal contact as well as inhalation. Anglers have a complete exposure to COPCs by fish ingestion and potential exposure by incidental ingestion and/or dermal contact with sediment and surface water.

Groundwater as a drinking water source is not a complete exposure pathway as the area is serviced by water from MWA. There is no impetus for installing drinking wells at the Site, which is intended to remain undeveloped. The intakes for the public water are from surface water intakes located upstream of the Site.

Vapor intrusion is also not a complete exposure pathway. There are no buildings on the Site and the flood-prone low-lying nature of the Site precludes industrial development.

6.4.3 Ecological

The Site is primarily a heavily vegetated and forested area that is not currently being used, with the exception of the water reclamation facility on the northeast side. A large portion of the Site is a wetland area that is at times inundated with water (Figure 3). For these reasons the Site is a viable habitat for many different species.

The preliminary receptor CSM, which will be refined as needed based on additional information gathered during the RI/FS process, is shown in Figure 20. For ecological receptors, there are four media of interest: surface water, sediment, surface soil and biota. In surface water, aquatic organisms (including sediment dwelling organisms) are exposed to COPCs in surface water through ingestion and direct contact. Aquatic organisms and benthic organisms may also be exposed to COPCs in sediment through ingestion and direct contact. Terrestrial organisms may be exposed to COPCs in surface soil through ingestion and direct contact. Upper trophic level receptors may be exposed to COPCs through ingestion of vegetation or prey animals that have direct contact to COPCs in surface water, sediment and soil. Many constituents (*e.g.*, PCBs) can bioaccumulate and/or bio magnify as the COPCs are transferred through a food web from lower to higher trophic levels. Specific ecological receptors that may be evaluated further include plants (aquatic and terrestrial), invertebrates (aquatic and terrestrial), fish, birds and mammals.

[7] During the remedy selection process it will be determined if any legal mechanism (*e.g.* zoning, deed restrictions) are necessary to ensure this condition into the future,

6.4.4 Risk Drivers

6.4.4.1 Process

A preliminary risk evaluation was conducted to discern what the risk drivers are at the Site for use in developing the proposed additional environmental sampling. The purpose of this analysis was not to conduct a risk assessment, but to determine the receptor(s) (human or ecological) that may drive the risk assessment and therefore, inform the sample design. Additionally, the purpose was to determine the constituents that are the primary risk drivers. The "risk" for each COPC at each historical sample point was estimated for human and ecological receptors using screening criteria.

Human health risk calculations differ between carcinogenic and non-carcinogenic compounds. The risk due to a carcinogenic compound is called the theoretical upper-bound excess lifetime cancer risk (ELCR). The risk due to a noncarcinogenic compound is called the hazard quotient (HQ). The risk was estimated using the industrial (for soil and sediment) or tapwater (for surface water and groundwater) Regional Screening Level (RSL) values, which are based on an ELCR of 10^{-6} (*e.g.,* one in a million) and an HQ of 0.1. A simple ratio was used to determine the ELCR or HQ for the sampling data as follows:

- Carcinogenic COPCs: ELCR = Sample Concentration x 10^{-6} / RSL
- Noncarcinogenic COPCs: HQ = Sample Concentration x 0.1 / RSL

It is important to note that the risk evaluation that will be conducted as part of the RI/FS process will be based on site-specific exposure considerations for a site worker, trespasser, and angler. This exercise is simply to determine whether human receptors or ecological receptors are likely to drive the evaluation in different media at the Site. As a reference point for evaluating the results, the remediation levels for carcinogens are usually selected within an ELCR range of 10^{-6} to 10^{-4} and the remediation levels for noncarcinogens are usually selected with an HQ range of 0.1 to 3, with an HQ of 1 being preferred.

Ecological risk evaluations are based only on HQs. For ecological receptors, the HQ was determined for individual COPCs by dividing the sample concentration by the refined screening value (RSV). To be protective, the wildlife RSV was used over the aquatic RSV, when available. The average HQ for each COPC was calculated for each COPC or COPC group (such as total PCBs). An HQ less than or equal to unity (1) indicates that adverse impacts to wildlife are considered unlikely. An HQ greater than unity does not mean that there is an adverse impact, but that further evaluation is warranted. In interpreting ecological HQ values, it is important to bear in mind that the values are predictions and are subject to the uncertainties that are inherent in both the estimates of exposure and the estimates of toxicity benchmarks. Therefore, HQ values should be interpreted as estimates rather than highly precise values and should be evaluated as part of the weight-of-evidence along with other relevant measurement endpoints.

6.4.4.2 Receptor Driving Risk

In order to compare the risks to receptors, the average HQ[8] in each medium for human[9] and ecological receptors was calculated. Figure 21 shows that the hazard to ecological receptors in soil, sediment and surface water is far greater than for human receptors. Because there is not a complete exposure pathway for ecological receptors to groundwater, human receptors have the only potential risk.

ELCRs are not presented in Figure 21 as the ELCR to human receptors is not directly comparable to ecological HQs. The average ELCRs in soil and sediment are within the acceptable risk range. The average surface water and groundwater ELCRs exceed the acceptable risk range; however, that assumes that humans would be use the groundwater or surface water as the primary drinking water source, which greatly overestimates the actual risk to human receptors in contact with these media.

6.4.4.3 Constituents Driving Risk

For each COPC, the ELCRs and HQs in each sample were calculated and then the average ELCR and HQ for each COPC was calculated. This gives an estimate of the overall risk/hazard for each COPC at the Site. Figure 22 shows the average ELCR/HQ for COPCs in each medium and for each receptor that drive risk/hazard. Only those COPCs that have an ELCR greater than 1E-6 or HQ greater than 1 are shown.

Soil: For human receptors, the primary drivers are split fairly equally between PCBs (predominantly Aroclor 1248) and arsenic. For ecological receptors, the largest single driver is cadmium. Ecological receptors have significantly greater risk/hazard than human receptors.

Sediment: For human receptors the primary driver is PCBs (predominantly Aroclor 1248). For ecological receptors the primary driver is PCBs. Ecological receptors have a much greater risk/hazard than human receptors.

Surface Water: For human receptors the primary drivers are chlorinated ethenes (namely TCE and VC). For ecological receptors the primary driver is PCB. Ecological receptors have a greater risk/hazard than human receptors.

Groundwater: Groundwater is only theoretically a risk to human health. The majority of the risk/hazards are due to chlorinated ethenes (namely TCE and VC).

6.4.4.4 Risk: Fish

The Public Health Assessment indicates that exposure to average PCB concentrations results in a theoretical cancer risk of 1E-4 (1 in 10,000) for recreational anglers (ATSDR, 2012). The locations

[8] The total HQ at each location (which is the Hazard Index) was determined, then the average of all HQs was calculated for each medium.

[9] For soil and sediment, industrial RSLs are used. For surface water and groundwater, tapwater RSLs are used.

where fish were collected in 1998 compared to EPD trigger levels for fishing advisories are shown in Figure 23. Also shown on this figure are locations where soil, sediment and surface water samples have exceeded risk-based criteria.

6.4.4.5 Risk Drivers – Summary

In summary, ecological receptors are the primary drivers for soil, sediment and surface water. The risk to human exposure to chemicals in soil, sediment and surface water is minimal, which is supported by the Public Health Assessment (ATSDR, 2012). Human receptors are the primary drivers for evaluating groundwater and fish tissue. PCBs and metals are the primary risk drivers for human and ecological receptors in soil and sediment (and in surface water for ecological receptors); whereas chlorinated ethenes are the primary risk drivers in surface water and groundwater for human receptors.

7 DATA GAP ANALYSIS

7.1 Purpose

A data gap analysis was performed to direct data acquisition for the RI/FS. The results of this analysis for the various environmental media (soil, sediment, surface water, and groundwater) and biota (fish tissue) are summarized below. The results of the environmental sampling and analysis will be utilized in human health and ecological risk assessments.

7.2 Soil

A spatial bias is present in the historical soil data with high sampling density in the area of the Landfill Area and sparser coverage moving east across the low-lying grounds (wetlands). The Landfill Area has been sufficiently characterized by the historical sampling (Figure 24). Approximately 121 discrete soil samples (representing 9,642 analytical results) have been collected from within the footprint of the Landfill Area, which represents about 69% of the total soil sample collection and analytical results for the Site to date. The breadth of historical data is sufficient to perform a risk evaluation and to inform remedial action decisions. However, the surface soil in the Landfill Area will be sampled to maintain consistency of sampling and to provide additional information about the potential risk to receptors based on contact to the surface soil. A data gap for the Explosives Demolition Area is that perchlorates have not been sampled historically and they may be present due to the use of flares in the area and that a full suite of energetics have not been sampled in the area.

Historical soil data collected outside the footprint of the Landfill Area are insufficient to account for large-scale spatial heterogeneity (*i.e.*, variation in chemical concentration from location to location across an area) anticipated as a result of site-specific release and fate/transport mechanisms and may not be representative of actual conditions. Additionally, not all COPCs were analyzed in each sample. Furthermore, soil data exceeding applicable screening levels are not bounded across the low-lying areas (wetlands). Additional data gaps (*i.e.*, no historical data collected in these areas) exist for a former excavation pit at the center of the Site and the water feature anomaly south of the wastewater treatment facility (Section 5.2) where an anomaly was observed on aerial photography in 1981.

7.3 Groundwater

Historical groundwater data indicate potentially two VOC plumes (primarily TCE) underlying the Site: one emanating from the AIP property and the other from the area of the Landfill Area. Given that these releases occurred a minimum of 20 years prior to their characterization, it is reasonable to assume that the VOC plumes have attained a level of stability in the aquifer (*i.e.*, fully expressed

condition) and natural attenuation; however, additional sampling is proposed to further characterize and confirm the current groundwater condition.

7.4 Sediment

Historical sediment data encompass each surface conveyance (Ditch 2, Ditch 3 and Ditch 4) from the point of origin (on the AIP or AWI property) to the Rocky Creek confluence and Rocky Creek from Interstate-75 to the eastern boundary of the Site. However, the sampling density is insufficient to account for large-scale spatial heterogeneity and may not be representative of the actual condition. Furthermore, not all COPCs were analyzed in each sample. Additional sediment sampling is proposed to characterize current sediment conditions and evaluate hydrodynamic transport of sediment to and from OU2.

7.5 Surface Water

Historical surface water data are concentrated in the western surface conveyance (Ditch 2), and in Rocky Creek. No surface water samples were collected from the eastern conveyance (Ditch 4). As surface water is constantly moving, the conditions can vary greatly over time, thus additional surface water sampling is proposed to characterize present OU2 surface water conditions and evaluate hydrodynamic transport of sediment to and from OU2.

7.6 Fish Tissue

Historical fish collection occurred at six sites in Rocky Creek from Interstate-75 to the Site and one site in Tobesofkee Creek approximately 1.4 miles downgradient of the Rocky Creek confluence. Fish tissue samples contained concentrations of PCBs that would warrant a restriction on consumption per DNR's protocol for fish consumption advisories. Additional fish tissue collection is proposed to determine if conditions presently warrant such a restriction as the last fish sampling event was conducted over 20 years ago.

8 SCOPE OF WORK

8.1 Environmental Sampling

8.1.1 Sampling Rationale

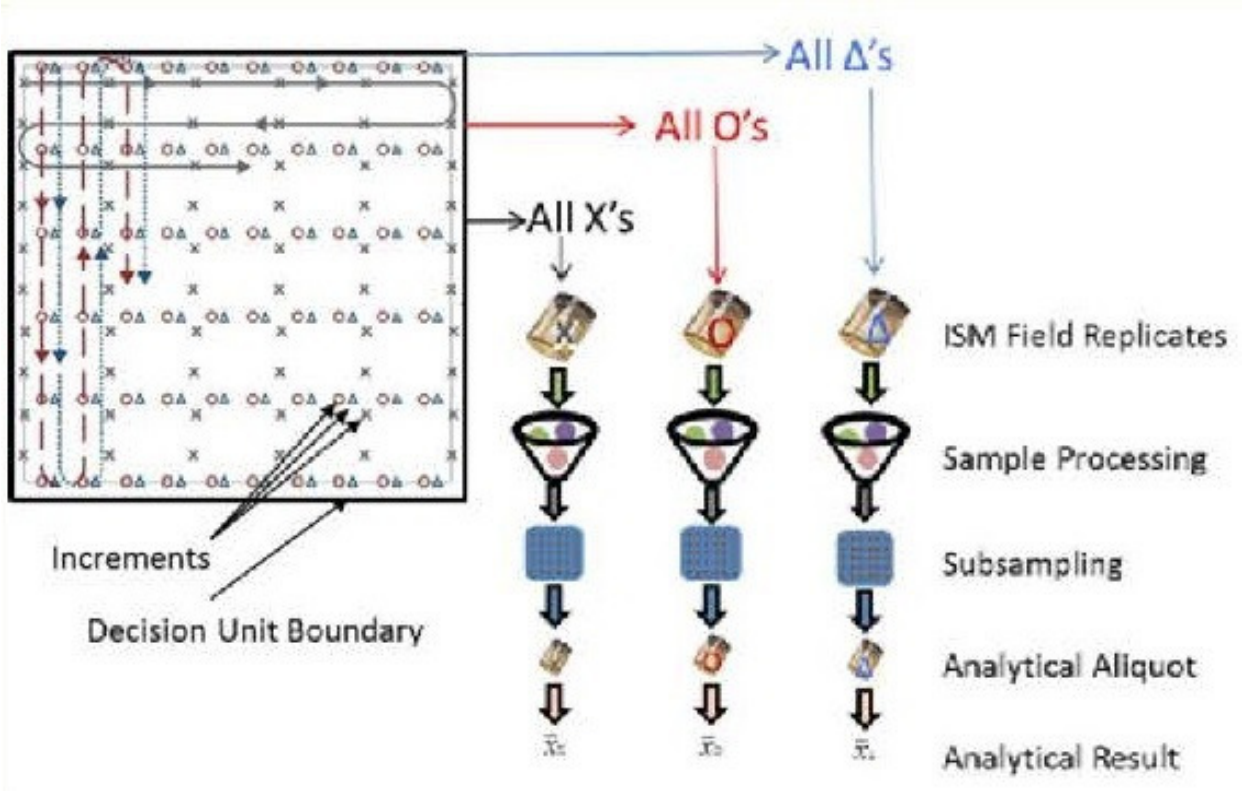
The Work Plan serves as a mechanism for collecting data to characterize Site conditions, evaluate risk to human health and the environment, and support the development, screening, and evaluation of alternative remedial actions. The purpose is not to delineate the condition, but rather to obtain sufficient information for determining alternative remedial actions to address potential risks. The proposed scope of work was developed to address existing data gaps outlined in Section 7. The proposed scope of work includes sampling of the various environmental media (soil, groundwater, sediment, surface water), and biota (fish tissue) for applicable COPCs (determined by screening process described in Section 4.1) and surveying of site features. Material in the Landfill Area will also be evaluated for its physical properties pertaining to settlement. The environmental sampling proposed is focused on the wetlands north of Rocky Creek and south of the historical rail line (on the north end of the Site) as these areas are more likely to contain higher chemical concentrations than the upland areas based on the CSM (Section 6.3). The results of this sampling of the lower lying areas will be used to inform whether additional sampling in the upland areas and/or south of Rocky Creek is warranted. Additional sampling within the wetlands may be necessary during a subsequent work phase should the results of the proposed sampling indicate a risk requiring further delineation. Fish tissue collection is proposed for the initial phase of the RI/FS field efforts as historical fish tissue sampling results warranted a restriction on consumption per DNR's protocol for fish consumption advisories. Additional biota sampling (*e.g.*, invertebrates in soil and/or sediment) may be conducted in a future phase for the ecological risk evaluation. The primary receptors that are driving the RI/FS process in soil, sediment and surface water are ecological receptors (see Section 6.4.4). Human receptors are the risk drivers for fish and groundwater.

8.1.2 Soil Sampling

Additional soil characterization is proposed for evaluation of potential human and ecological risk and potential of leaching of soil constituents into groundwater. The sampling design is based on ecological receptors as they are the primary risk driver of the soil risk assessment (See Section 6.4.4). Traditional (discrete) sampling methods are not structured to overcome large-scale spatial heterogeneity (*i.e.*, variation in chemical concentration across an area or volume) anticipated as a result of site-specific release and fate/transport mechanisms, and thus are not suitable to characterizing the vast geographic footprint of the Site. Accordingly, soil sampling is proposed using incremental sampling methodology (ISM).

ISM is a structured composite sampling and processing protocol that reduces data variability and sampling error, improves spatial coverage, and provides a more representative and unbiased

measure of a chemical mean concentration across a sampled region (ITRC, 2012). The region for which a decision will be made based on the ISM sampling is defined as a Decision Unit (DU). A DU may be comprised of one or more Sampling Units (SUs) for which ISM samples are collected. Should a DU consist of a single SU, the DU and the SU are one in the same and results from replicate ISM samples collected from within the DU are used to make a decision. For a DU comprised of multiple SUs, ISM samples from the SUs may be used collectively to make the decision on that DU. ISM requires that the total sample mass be sufficient to represent the heterogeneity of soil particles and that a sufficient number of equal-volume increments are collected in an unbiased manner from throughout the entire SU so that all particles in the unit have an equal probability of being included in the sample. To this end, an ISM sample is typically established by collecting 30 to 100 aliquots of soil that are combined, processed, and subsampled according to specific protocols (see graphic below). Three replicate samples from a DU are needed to assess variability and to calculate a 95% upper confidence limit of the mean.



Graphic Credit: ITRC Guidance Information, April 2012

Proposed soil DUs (shown on Figure 25) are based on physical/topographic features and encompass areas potentially receiving chemical constituents because of hydrodynamic transport or are specifically for evaluating potential impacts of historical phenomena. Note that all proposed DUs consist of one SU. On average, the DUs are sized at 4 acres to determine if the soil condition within each DU is protective of local populations of a sessile small mammals (*i.e.*, the most sensitive wildlife guild). The DUs are described below. The size and shape of the DUs are approximate based on wetlands inventory maps and the actual extent of the DUs may be altered based on the results of wetlands delineation or other physical factors.

Decision Units	Acre age	Purpose	Constituents
1, 2, 3, 5	4.3, 1.2, 3.2, 1.6	Assess condition near the Landfill Area and demolition debris area; these DUs may receive surface runoff from eroded or subsided areas of the Landfill Area; DUs 3 and 5 may also receive impacted surface water and sediment from Ditch 2	Metals, PAHs, PCBs
4, 12	4.1, 4.0	Assess floodplain near confluence of merged Ditch 2 and Ditch 3 conveyance and Rocky Creek; these DUs may receive impacted surface water and sediment from the merged conveyance and Rocky Creek	Metals, PAHs, PCBs
6	2.7	Assess floodplain of Ditch 2 above the Landfill Area; this DU may receive impacted surface water and sediments from Ditch 2	Metals, PAHs, PCBs
7, 9	4.2, 3.1	Assess floodplain between Ditch 2 and Ditch 3; these DUs may receive impacted surface water and sediments from Ditch 2 and Ditch 3	Metals, PAHs, PCBs
8, 10	4.1, 5.5	Assess floodplain east of Ditch 3; these DUs may receive impacted surface water and sediments from Ditch 3	Metals, PAHs, PCBs
11, 14	3.7, 5.2	Assess floodplain of Ditch 4 south of the water treatment facility; these DUs may receive impacted surface water and sediments from the Ditch 4	Metals, PAHs, PCBs
13, 15	5.2, 5.7	Assess floodplain near confluence of Ditch 4 and Rocky Creek; these DUs may receive impacted surface water and sediment from the Ditch 4 and Rocky Creek	Metals, PAHs, PCBs
16	0.6	Assess footprint of the former excavation pit	Metals, PAHs, PCBs
17 (Figure 33)	4.0	Testing of the local area background condition (metals and PAHs)	Metals, PAHs, PCBs
ARMREM FMNOL	6.7, 4.1	Assess footprint of the Remote and FMNOL Landfills	Metals, PAHs, PCBs, BEHP
EXPLDEMO	0.7	Assess the former explosive demolition debris area; this DU may receive run-off from eroded or subsided areas of the Landfill Area and impacted surface water and sediment from Ditch 2	Metals, PAHs, PCBs, perchlorates, energetics, chromium speciation, dioxin/furans

Within each SU, 30 or more aliquots of equal volume will be collected in triplicate from random locations in the upper 6 inches of the soil column. The 30+ aliquots for each replicate (total of 90+ aliquots per SU) will be sent to the laboratory for further processing. The laboratory will process, composite and subsample the aliquots for each replicate (keeping the aliquots for each

replicate separate), resulting in three different subsamples for each SU. The 3 samples from each SU will be analyzed according to the following soil testing regimen[10]:

- Metals[11] by EPA Method 6010C;
- Mercury by EPA Method 1631E;
- PAHs by EPA Method 8270C SIM;
- PCB Aroclors and congeners by Method 8082A;
- BEHP (landfills only) by EPA Method 8270D;
- Energetics (Explosives Demolition Area only) by EPA Method 8330B;
- Perchlorates (Explosives Demolition Area only) by EPA Method 6850;
- Hexavalent chromium (Explosives Demolition Area only) by EPA Method 7196A; and
- Dioxins/Furans (Explosives Demolition Area only) by EPA Method 8290.

The locations of historical data overlain on the DUs are shown in Figure 26. An ISM approach aimed at a comprehensive list of COPCs will provide data more representative of the actual condition than discrete samples collected at different times in the past.

8.1.3 Groundwater Sampling

Groundwater sampling will be performed for a subset of existing monitoring wells (21 wells, Figure 27) to characterize the present condition emanating from the Landfill Area, as well as the condition prior to entering the Landfill Area. Monitoring wells targeted for sampling were selected to provide a lateral and vertical profile of the condition. Redundancies (*i.e.*, co-located wells with similar construction and/or reporting a similar TCE result[12]) and damaged/destroyed wells within the Remote Landfill were screened out of the monitoring regimen. Monitoring wells selected for sampling are sufficient to adequately characterize the groundwater condition; thus, no new wells are proposed. The specific wells to be sampled are listed below along with their total depth:

Well	Depth (ft bgs)	Well	Depth (ft bgs)	Well	Depth (ft bgs)	Well	Depth (ft bgs)
MW-1	32	MW-5	19	MW-13	9.5	MW-20	17
MW-2	24.5	MW-7	11.5	MW-14	11.5	MW-21	11.5
MW-2B	57	MW-8	10	MW-15	19	MW-79	14.5
MW-3	23.5	MW-9	10.5	MW-16	9		
MW-4	19	MW-10	11	MW-17	19		
MW-4B	96	MW-12	19	MW-18L	20		

[10] TCE and BEHP are COPCs for soil; however, historical soil data exceeding screening levels are limited to the footprint of the Landfill Area, with TCE being a COPC in subsurface soil and BEHP being a COPC in surface soil and subsurface soil. Although the Landfill Area is sufficiently characterized by the historical sampling, the surface soil will be sampled as part of the ISM sampling efforts. Thus, the ISM sampling of the Landfill Area will include BEHP, but not TCE.

[11] Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, silver, thallium, vanadium and zinc. Note that metals may be naturally occurring.

[12] TCE results were used in the evaluation/selection of monitoring wells to sample because TCE is the primary COPC in groundwater based on risk (see Section 6.4.4.2).

The monitoring well analytical testing regimen is comprised of the following:

- Metals by EPA Method 6010C (same list as for soil)[13];
- Mercury by EPA Method 1631E;
- Cyanide by EPA Method 335.4;
- Dieldrin by EPA Method 8081B;
- Bis(2-ethylhexyl)phthalate by EPA Method 3520C;
- PCB Aroclors and congeners by Method 8082A;
- Specific VOCs[14] by EPA Method 8260C;
- Energetics by EPA Method 8330B;
- TOC by EPA Method SM5310; and
- Nitrates by EPA Method 300.

8.1.4 Sediment Sampling

Additional sediment characterization is proposed for evaluation of potential human and ecological risk. The sampling design is based on ecological receptors as they are the primary risk driver in sediment (See Section 6.4.4). Characterization of sediment will be accomplished using ISM to mitigate the effects of large-scale spatial heterogeneity. Proposed DUs (shown on Figure 28) target the ditches and Rocky Creek and, instead of being based on size, are generally divided (or subdivided) at confluences or near pertinent site features (Landfill Area, wastewater treatment facility). DUs proposed in Rocky Creek extend upstream and downstream of the Site to allow for assessment of hydrodynamic transport of impacted sediments onto and away from the Site, respectively, and are generally co-located with fish collection sites to evaluate potential bioaccumulation of sediment COPCs in edible fish tissue. The DUs are described in the table below (these may be modified based on field conditions).

[13] Samples analyzed for metals will be not be filtered in the field.

[14] 1,1-dichloroethene, carbon tetrachloride, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, and VC

Water Feature	Decision Unit	Acreage	Sampling Units[15]	Purpose
Ditch 2	1	0.4	DU	Assess Ditch 2 downgradient of AWI and AIP confluence
Ditch 2	2	2.0	DU	Assess Ditch 2 near Landfill Area and former demolition area
Ditch 3	3	1.2	DU	Assess Ditch 3 in wetlands
Ditch 2/3	4	0.4	DU	Assess condition downgradient of confluence of Ditch 2 and Ditch 3
Ditch 4	5	1.1	DU	Assess sediments in Ditch 4 downgradient of wastewater treatment facility
Rocky Creek	6	4.6	A,B,C,D,E	Assess Rocky Creek sediments within the boundaries of OU2
Rocky Creek	7	4.2	DU	Assess Rocky Creek sediments immediately downgradient of OU2
Tobesofkee Creek	8 (see Figure 33)	0.4	DU	Assess sediments in Tobesofkee Creek downgradient of Rocky Creek confluence; encompassing fish collection Site #7
Rocky Creek	9 (see Figure 33)	0.3	DU	Assess background sediment condition in Rocky Creek; near I-75 and 4319 Pio Nono Ave (currently Penske Truck Rental); encompassing fish collection Site #1
Rocky Creek	10 (see Figure 33)	0.3	DU	Assess background sediment condition in Rocky Creek; near 4425 Pio Nono Ave (currently Tall Paul's Campers & Awnings); encompassing fish collection Site #2
Rocky Creek	11 (see Figure 33)	0.4	DU	Assess background sediment condition in Rocky Creek; near 4599 Pio Nono Ave. (currently Houston Auto Auction); encompassing fish collection Site #3

Within each SU, three replicate ISM samples will be established by compositing 30 or more aliquots of equal volume from random locations with the upper 6 inches of the sediment column as described in Section 8.1.2. Sediment samples will be analyzed according to the following testing regimen:

- Metals by EPA Method 6010C (same list as for soil);
- PAHs by EPA Method 82707C SIM; and
- PCB Aroclors and congeners by EPA Method 8082A.

[15] "DU" designation means that the DU and SU are one in the same.

The locations of historical data compiled from sampling at OU2, AWI and AIP overlaying the DUs are shown in Figure 29. Although a number of samples have been collected in the ditches in the past, not all COPCs were analyzed in each sample. Additionally, ISM data are more representative of the actual condition than discrete samples collected at different times in the past.

8.1.5 Surface Water Sampling

8.1.5.1 General Surface Water Sampling

Surface water sampling is proposed along the conveyances and Rocky Creek to evaluate human and ecological risk and hydrodynamic transport of impacted surface water onto the Site from upgradient sites. Proposed surface water sampling sites (shown on Figure 30) are generally proposed upgradient or downgradient of confluences or near pertinent site features (Landfill Area, wastewater treatment facility). Surface water sampling stations are described in the table below (these may be modified based on field conditions).

Location ID	Description/Purpose
SW-1	Ditch 2 upstream of Landfill Area
SW-2	Ditch 2 near Landfill Area and former demolition area
SW-3	Ditch 3 in the wetlands
SW-4	Confluence of Ditch 2 and Ditch 3
SW-5	Ditch 4 downstream of the wastewater treatment facility
SW-6	Rocky Creek background; upstream of OU2 near Houston Road
SW-7	Rocky Creek at southern tip of the Landfill Area
SW-8	Rocky Creek at confluence of Ditch 2
SW-9	Rocky Creek at confluence of merged Ditch 2/Ditch 3 conveyance
SW-10	Rocky Creek at confluence of Ditch 4
SW-11 (see Figure 33)	Tobesofkee Creek immediately downstream of Rocky Creek confluence

The locations of historical data compiled from sampling at OU2, AWI and AIP are shown in Figure 31. Although a number of samples have been collected in the ditches in the past, not all COPCs were analyzed in each sample. Additionally, due to the constantly flowing nature of surface water, conditions change over time. It is also important to collect surface water in the same general time period as sediment samples. The surface water analytical testing regimen will consist of:

- Metals by EPA Method 6010C (same list as for soil);
- PCB Aroclors and congeners by EPA Method 8082A; and

- Specific VOCs by EPA Method 8260C.

8.1.5.2 Seeps

Seeps have been observed in the Landfill Area. During the habitat survey two seeps were noted (as shown on Figure 3). We will field verify seep locations prior to conducting sampling and attempt to determine the amount of flow relative to recent precipitation in order to determine if it is indeed an active seep. The goal will be to sample two active seep locations per landfill or Explosives Demo Area, if they are observed. If more than two active seeps at a landfill/area are observed, the ones that are sampled will be based on location (to be most representative of potential landfill impact), distance from other active seeps, and rate of flow (preference for seeps that have greater flow). Seep samples adjacent to the two landfills will be analyzed for constituents being analyzed in surface water, PAHs and BEHP. Seeps adjoining the Explosives Demo Area will be analyzed for constituents being analyzed in surface water, PAHs, perchlorates and energetics.

8.1.6 Fish Tissue Sampling

Fish collection is proposed to evaluate potential risks to human health by consumption of edible fish tissue. Collection is proposed at 7 locations (shown on Figure 32) co-located with sediment sampling sites:

Site ID	Description	Primary Receptor of Concern	Sampling Methodology and Constituents
Site 1	Rocky Creek upstream of OU2 near I-75 and 4319 Pio Nono Ave (currently Penske Truck Rental); co-located with sediment DU #9	Human consumption of fish	Discrete sampling – PCBs and Hg
Site 2	Rocky Creek upstream of OU2 near 4425 Pio Nono Ave (currently Tall Paul's Campers & Awnings); co-located with sediment DU#10	Human consumption of fish	Discrete sampling – PCBs and Hg
Site 3	Rocky Creek upstream of OU2 near 4599 Pio Nono Ave. (currently Houston Auto Auction); co-located with sediment DU #11	Human consumption of fish	Discrete sampling – PCBs and Hg
Site 4	Rocky Creek within OU2 and upstream of Landfill Area	Human consumption of fish	Discrete sampling – PCBs and Hg
Site 5	Rocky Creek at merged Ditch 2 / Ditch 3 conveyance confluence	Human consumption of fish	Discrete sampling – PCBs and Hg
Site 6	Rocky Creek at Ditch 4 confluence	Human consumption of fish	Discrete sampling – PCBs and Hg

Site 7	Tobesofkee Creek immediately downstream of Rocky Creek confluence; co-located with sediment DU#8	Human consumption of fish	Discrete sampling – PCBs and Hg

Routes of chemical uptake have important implications for the accumulation of chemical constituents in fish tissue; thus, proposed target species exhibit a wide-range of feeding behaviors. Edible game species documented in Rocky Creek include Large-Mouth Bass (*Micropterus Salmoides*), Bluegill (*Lepomis Macrochirus*), Channel Catfish (*Ictalurus Punctatus*), Black and White Crappie (*Promoxis nigromaculatus* and *Promoxis Annularis*, respectively), and Spotted Sucker (*Minytrema Melanops*). Secondary game species include Redfin Pickerel (*Esox Americanus Americanus*), Chain Pickerel (*Esox Niger*), Brown Bullhead (*Ameriurus Nebulosus*), and Redbreast Sunfish (*Lepomis Auritus*).

The collection goal is three composite samples of each of the five target game species comprised of five specimens in each composite. The collection goal stems from the State of Georgia Department of Natural Resources fish sampling protocols. This idealistic collection goal is not typically obtainable in practice. Every effort will be made to collect only fishes of harvestable size (minimum creel size length, if such limit exists); however, it is recognized that this may not be possible in all cases. In addition, the goal for each composite sample is to adhere to the "75% rule," which requires the smallest fish in the composite to be at least 75% of the length of the largest fish. All fish will be measured, weighed, photographed prior to processing, and composite samples will be analyzed for total mercury (EPA Method 1631E) and PCB Aroclors and congeners (8082A). We will interact with agency biologists as necessary to determine which to include for analysis.

The results of the sediment, soil and surface water sampling may indicate the need to perform ecological food web modeling as part of the ecological risk evaluation. The collection of additional biota (such as fish and/or invertebrates) may be useful for future ecological modeling exercises. As fish collection is already planned for Rocky Creek, at the same time additional (smaller) fish will be collected for the purposes of ecological risk modeling, if needed. These smaller fish will be frozen and analyzed in the future (as needed) based on what constituents are included in food web modeling. For ecological receptor purposes, smaller fish are preferred. Additionally, whole fish analysis is needed instead of fish tissue analysis. Accordingly, small fish (approximately 4-6" in length) will be collected and the whole fish will be composited. Each composite will consist of 5-10 whole individuals to provide a sufficient sample mass for analysis.

8.1.7 Background Assessment

As mentioned in Section 6.3, metals and PAHs are ubiquitous and may not be indicative of releases at the Site. Accordingly, a background study will be conducted to determine site-specific background concentrations for metals and PAHs in soil. The results of the ISM sampling will be statistically evaluated to determine the Site background concentrations. The location of DU 18, which will be used to collect soil background data, is shown in Figure 33. Aerial photographs

indicate that this area has not been developed. Permission will need to be obtained from the property owner to access the property.

In addition, background assessments will be performed for sediment and surface water. There are three sediment DUs (9, 10 and 11) that will be used to determine the upstream (or background) sediment condition. One up-stream surface water sample (SW-6) is being collected to determine the upstream (*i.e.,* background) surface water condition. These locations are shown in Figure 33.

8.2 Landfill Settlement

The settlement characteristics of waste material within the Landfill Area are important to understand as excessive or differential settlement can cause deformations that may compromise the integrity of post-closure constructions (cover, liner, liquid collection systems, etc). A sample of the landfill material will be collected for testing of degradable organic matter and moisture content to estimate settlement attributable to biodegradation and dissipation of pore water from void spaces.

8.3 Receptor Surveys

8.3.1 Well Survey

A well survey will be conducted to identify or update potential ground water use in the area. The well survey will include a desktop survey/records search of municipal and private wells located within a three-mile radius of the Site and will also involve a windshield survey of all residences and businesses located within a 1-mile radius of the Site. Information gathered from this survey will include: water uses, well construction methods used, the number of users, and the volume and rate of water usage.

8.3.2 Surface Water Use Survey

EPS will conduct a surface water use survey of Rocky Creek from Houston Road to the Ocmulgee River. This will be done by contacting the local water resource municipality and assessing their local sources, as well as visually identifying any intake or discharge pipes located along this stretch. Human surface water receptors include recreational use of the rivers and streams. Assessments of local fishing and hunting pressure in the area will be conducted by analyzing creel surveys and reported harvests of the area of interest. To analyze potential ecological receptors in the surface water, an assessment of the area will include review of historical ecological surveys of neighboring localities and conducting on-Site fish surveys.

8.3.3 Wetlands Survey

Wetlands will be delineated from Houston Road to the Ocmulgee River (approximately 8 miles). Wetland areas will be delineated using a desktop evaluation. The desktop method will involve

topographical analysis using pre-existing base maps, information from US Fish and Wildlife's National Wetlands Inventory, historical aerial photography, and local Site knowledge. To ground-truth the desktop survey, a field crew will survey locations along the wetland-upland boundary within the boundaries of the Site shown on Figure 3 and validate the desktop derived boundaries.

8.4 Potential ARARs

Federal and state ARARs will be formulated while progressing through the RI/FS process. The ARARs may be chemical-specific, location-specific, media-specific, and/or action-specific and will be used to assist in the refinement of remedial action alternatives.

8.5 Risk Evaluation

The environmental data will be used to determine estimated risks to human and ecological receptors. The ecological evaluation will likely be conducted based on the DUs as exposure domains. For human health, the data from multiple DUs will be combined into larger exposure domains. For soil and sediment, the ISM results will be used in the risk evaluation. For surface water and groundwater, the discrete sample results may be used along with any historical data that is deemed relevant, if any, (for example data collected in recent years with low detection limits and good quality control) for the analysis. For fish consumption, new data will be used in the risk evaluation. Historical fish data are 20 plus years old and not representative of the current condition, although that data might be useful for comparison purposes.

9 PRELIMINARY IDENTIFICATION OF REMEDIAL ACTION ALTERNATIVES

In accordance with Task 1 of the SOW, the RI/FS Work Plan is to provide preliminary identification of Remedial Action Alternatives (RAA) for each contaminated medium, including identification of probable treatability studies for their evaluation. The range of potential RAA preliminarily described below include technologies and processes that could potentially be suitable depending on further evaluation during the course of the RI/FS process for the Site. The assessment of these alternatives, and any associated treatability studies, will be performed in accordance with the SOW and NCP.

To date, sufficient testing data is available to develop a preliminary assemblage of general response actions (GRA) and associated remedial technologies and process options. These items will be updated and refined to specific RAA for each medium following completion of the investigative work scope detailed herein and identified in the forthcoming Feasibility Study and/or a technical memo.

Summary of Remedial Technologies and Associated Process Options

General Response Action	Remedial Technologies	Process Options
No Further Action		
	No Further Action	- Signage
		- Deed Restrictions
Natural Recovery		
	Monitored Natural Recovery	- Monitoring and Data Evaluation
	Institutional Controls	- Deed Restriction
		Fisheries Ban
		Community Outreach
		Access Security
Containment		
	Capping	Soil Cover
		Engineered Cover (geomembrane)
		Soil or Engineered cover with a vertical isolation barrier
		Infill Capping
Treatment		
	In-Situ Physical	Solidification
	In-Situ Chemical	Chemical Oxidation/ Reduction
	In-Situ Bioremediation	Enhanced Bioremediation
	In-Situ Stabilization	Sequestration/Mineralization (metals)
Removal		
	Excavation	Excavation
	Dredging	Mechanized
	Disposal	Subtitle D Landfill
		Subtitle C Landfill

10 PROJECT MANAGEMENT PLAN

10.1 Reporting

Respondents will provide the EPA with monthly progress reports (Task 8) to document the RI/FS process. These progress reports will cover the activities conducted the previous calendar month and describe the anticipated activities for the next month. Additionally, Respondents will submit Annual Progress Reports to the EPA and EPD, which summarize the overall progress in completing the RI/FS.

The results of the RI field work will be compiled and presented in a Site Characterization Summary and Draft RI Report (Task 2). The RI Report will include tables, figures, a description of major deviations from the Work Plan, and analysis required to identify and scope any subsequent phases of field work (if needed). Other Data Summary Reports will be submitted as needed. After completion of all phases of field work a final RI Report will be submitted to present the results of all the field work and to identify the scope of subsequent FS activities.

Once the data from the field work has been completed, the data will be evaluated to estimate the potential risk to humans and the environment in a Baseline Risk Assessment (Task 3). The Baseline Risk Assessment includes a Baseline Human Health Risk Assessment (BHHRA) and Baseline Ecological Risk Assessment (BERA). The findings of the risk assessments will be incorporated into the Draft FS Report (Task 5 and Task 6).

Other work plans (*e.g.,* BERA work plan, treatability testing work plan), reports (*e.g.*, treatability study evaluation report), and memorandum (*e.g.*, identification of candidate technologies memorandum) will be submitted as needed based on the progression of the RI/FS process.

10.2 Data Management Plan

Significant quantities of historical data have been obtained and additional data will be collected during the RI/FS process. These data will be managed according to the strategy presented in this section. Data management procedures are in place to effectively process data generated such that the data are accurately maintained. The primary steps for data management include:

- Development and maintenance of a relational database;
- Determination of coordinates for discrete data locations (details presented in the FSP);
- Documentation of field activities (details presented in the FSP);
    - Locations
    - Sample collection
    - Field measurements
- Establishment of DQOs (details presented in the QAPP);

- Management of laboratory data (details presented in the QAPP); and
- Data validation (details presented in the QAPP).

Data will be collected and recorded in different ways, such as in hardcopy paper form (*e.g.*, field books, chain-of-custody forms), electronically-recorded field measurements, and laboratory data. Hardcopy documents will be scanned and maintained in an electronic archive. The laboratory data and relevant field data will be maintained in the relational Access database. Only authorized and trained personnel have access to the master database. Further details are presented in the Database Management Plan (Appendix E).

Data collected during the RI/FS will be presented in reports in a clear and logical manner through tables, graphs and figures. Laboratory data collected (after data validation is complete) will be made available to the EPA in the EPA Region 4 Electronic Data Deliverable (EDD) format.

10.3 Schedule

The schedule (per the SOW[16]) is as follows:

DELIVERABLE/ACTIVITY	SCHEDULE
TASK 1	
Draft RI Work Plan Draft Field Sampling Plan Draft Quality Assurance Project Plan Draft Health and Safety Plan	This submission.
Final RI Work Plan, FSP, WAPP, HASP	60 days after EPA comments on the draft plans.
TASK 2	
Initiate Site Characterization Field Work	Within 60 days of EPA approval of RI Work Plan.
Site Characterization Summary Report	60 days after receipt of all sample analysis results from laboratory.
Draft RI Report	180 days after collection of the last field sample required in the Final Work Plan/FSP.
Final RI Report	60 days after receipt of EPA's comments on the Draft RI.

[16] The Respondents identified inconsistencies between the schedule presented in the AOC and the SOW. Respondents have elected to use the timeline that provides better flexibility for the Respondents.

DELIVERABLE/ACTIVITY	SCHEDULE
TASK 3	
Risk Assessment Technical Memorandum #1: Identification of COPCs, #2: Exposure Assessments, #3: Screening Level Ecological Risk Assessment	Concurrent with the Site Characterization Summary Report (Note: a technical memorandum for COPC screening is included as Appendix C)
Ecological Baseline Risk Assessment Report • Baseline Ecological Risk Assessment Problem Formulation (step 3) (if required); • Study Design and DQO Process (step 4) (if required); • Field Verification of Sampling Design (step 5) (if required);	If required, • Draft Ecological Risk Assessment Report (documenting Steps 3-7 of the ecological risk assessment process) is due concurrent with the draft RI Report. • Final documents due 60 days after receipt of EPA's comments on the draft report.
Human Health Baseline Risk Assessment Report	• Draft is due concurrent with the draft RI Report. • Final documents due 60 days after receipt of EPA's notification of direction to modify.
TASK 4	
Candidate Technologies and Testing Needs Technical Memorandum	60 days after the effective date of the Final RI Report
Treatability Study Work Plan and SAP or Amendments to the Original RI/FS Work Plan, FSP and/or QAPP. Treatability Study Health and Safety Plan or Amendment to the Original Health and Safety Plan	• Draft due within 60 days of request by EPA. • Final documents due 60 days after receipt of EPA's comments on the draft plan.
Treatability Study Evaluation Report	60 days after approval of the Treatability Study Work Plan/Field Sampling Plan.
TASK 5	
Remedial Action Objectives Technical Memorandum	With the draft RI Report (Task 2).
Alternatives Screening Technical Memorandum	90 days after receipt of EPA's comments on the Remedial Action Objectives Technical Memorandum.

DELIVERABLE/ACTIVITY	SCHEDULE
TASK 6	
Comparative Analysis of Alternatives Technical Memorandum	60 days after receipt of EPA's comments on the Alternatives Screening Technical Memorandum.
Feasibility Study Report	• Draft FS Report due 90 calendar days after receipt of EPA's comments on the Comparative Analysis of Alternatives Technical Memorandum. • Final FS Report due 60 days after receipt of EPA's notification of deficiency on the draft FS Report.
TASK 7	
Technical Assistance Plan (TAP)	• TAP due 60 days after request by EPA. • Final TAP due 60 days after receipt of U.S. EPA's notification of deficiencies.
Quarterly Progress Reports on Implementation of the TAP (if TAP is requested)	15 days after the end of each calendar year quarter; first report due in the first full calendar year quarter after the date the TAP is requested by EPA.
TASK 8	
Monthly Progress Reports	On the 15th day of each month or the first business day after the 15th of the month.
Annual Progress Reports	Due one year after the effective date of the AOC and every year thereafter until termination of the AOC.

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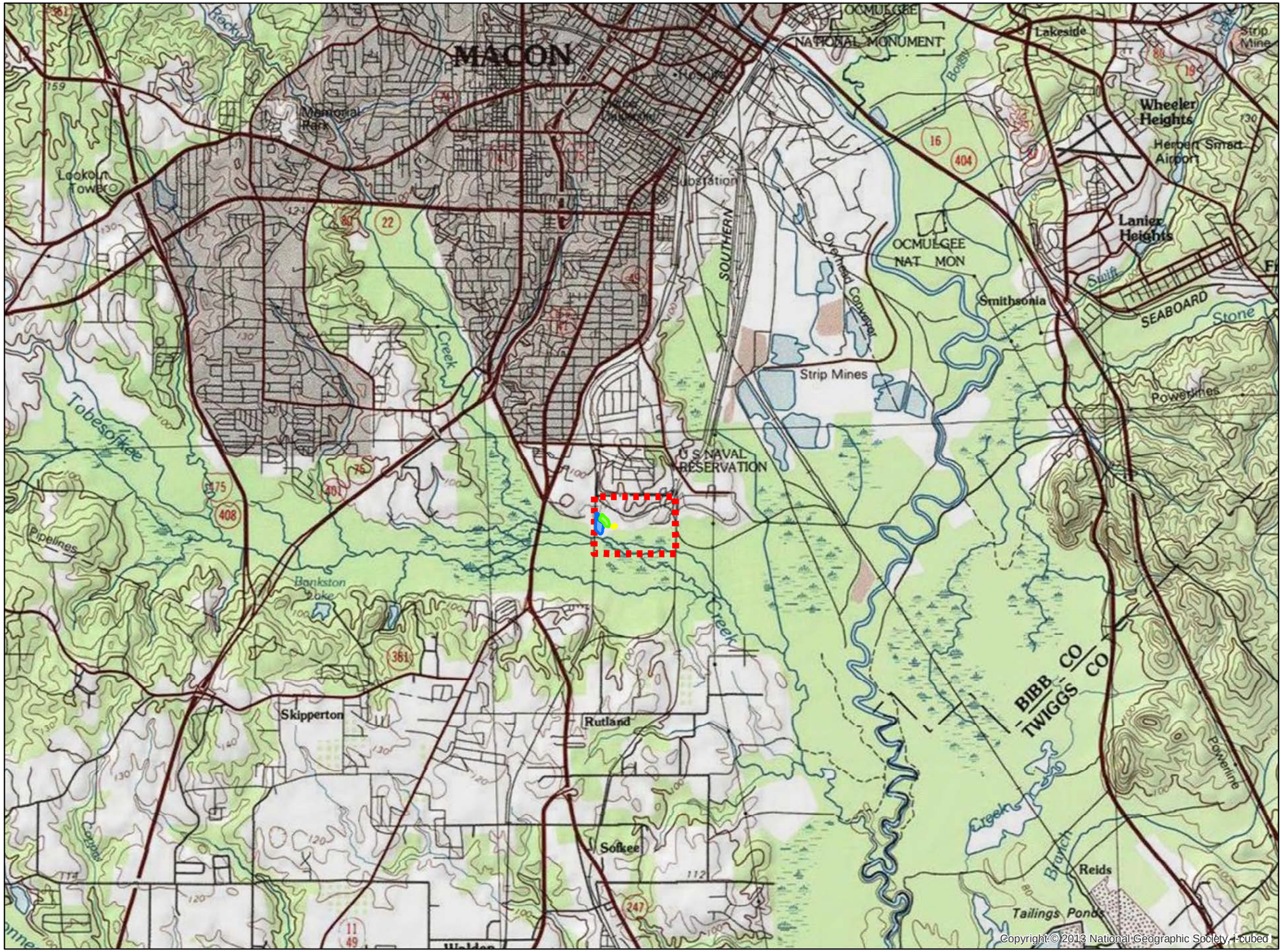
FIGURES



N

Legend

- OU2 (approx)
- Explosives Demo Area
- Remote Landfill
- FMNOL

0 0.5 1 2
Miles

Site Location Map

Figure No. 1

EPS
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Legend

- Railroads
- OU1 (approx)
- AWI Facility (approx)
- MNOP/AIP (approx)
- Remote Landfill
- FMNOL
- Explosives Demo Area
- Parcels
- OU2 (approx)

N

0 400 800 1,600
Feet

EPS
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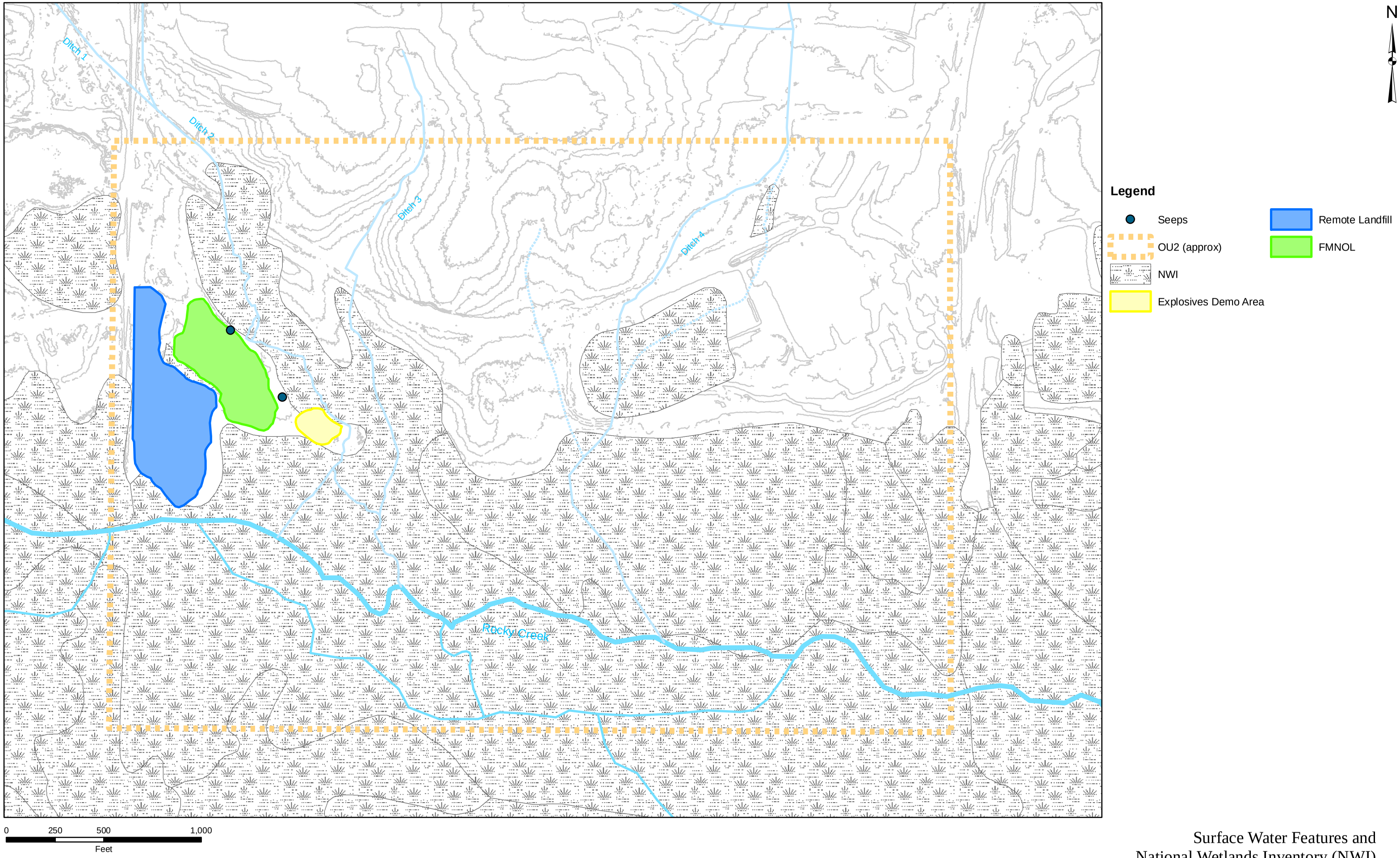
Site Vicinity Map
Figure No. 2



Surface Water Features and
National Wetlands Inventory (NWI)

Figure No. 3

EPS
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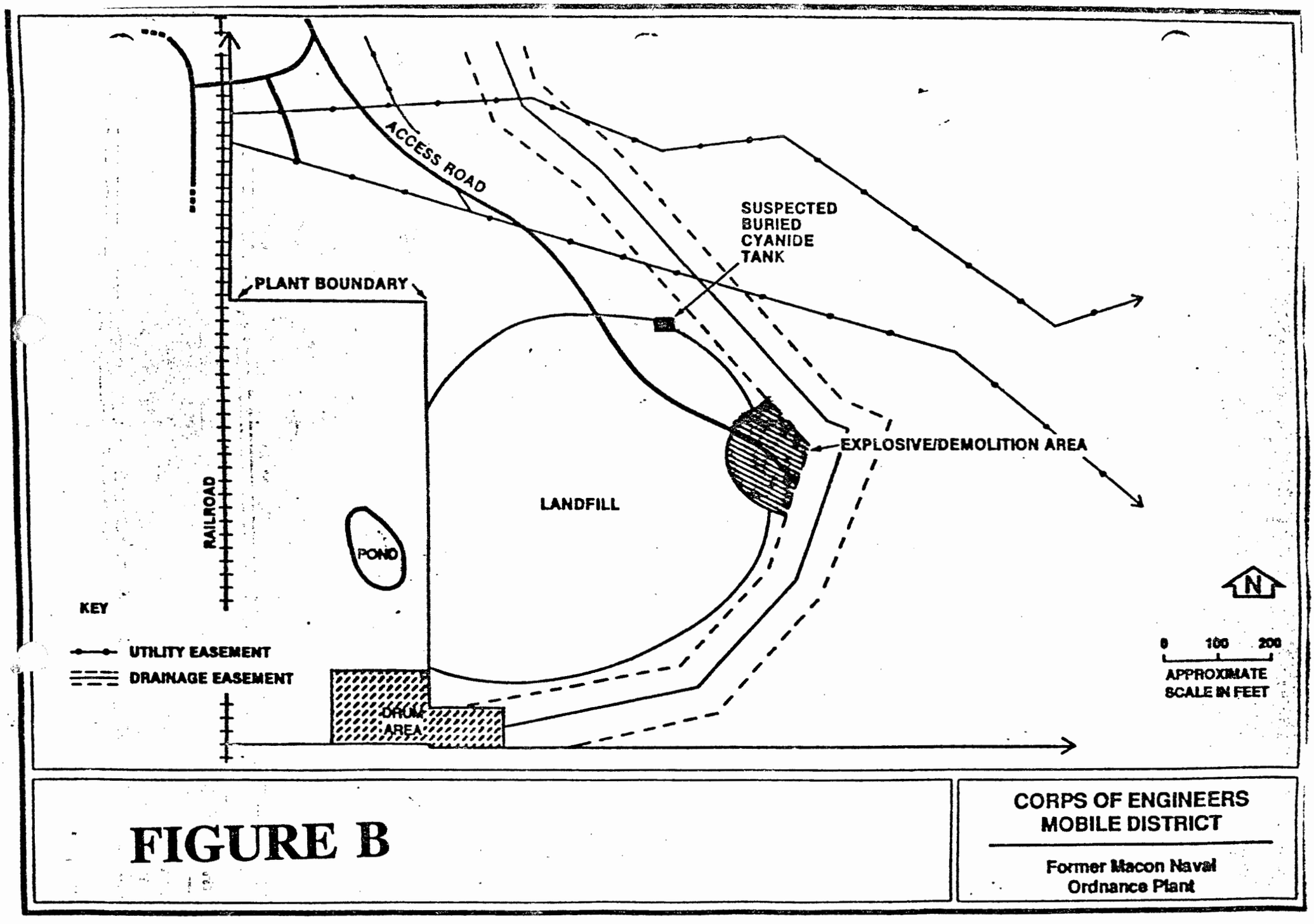
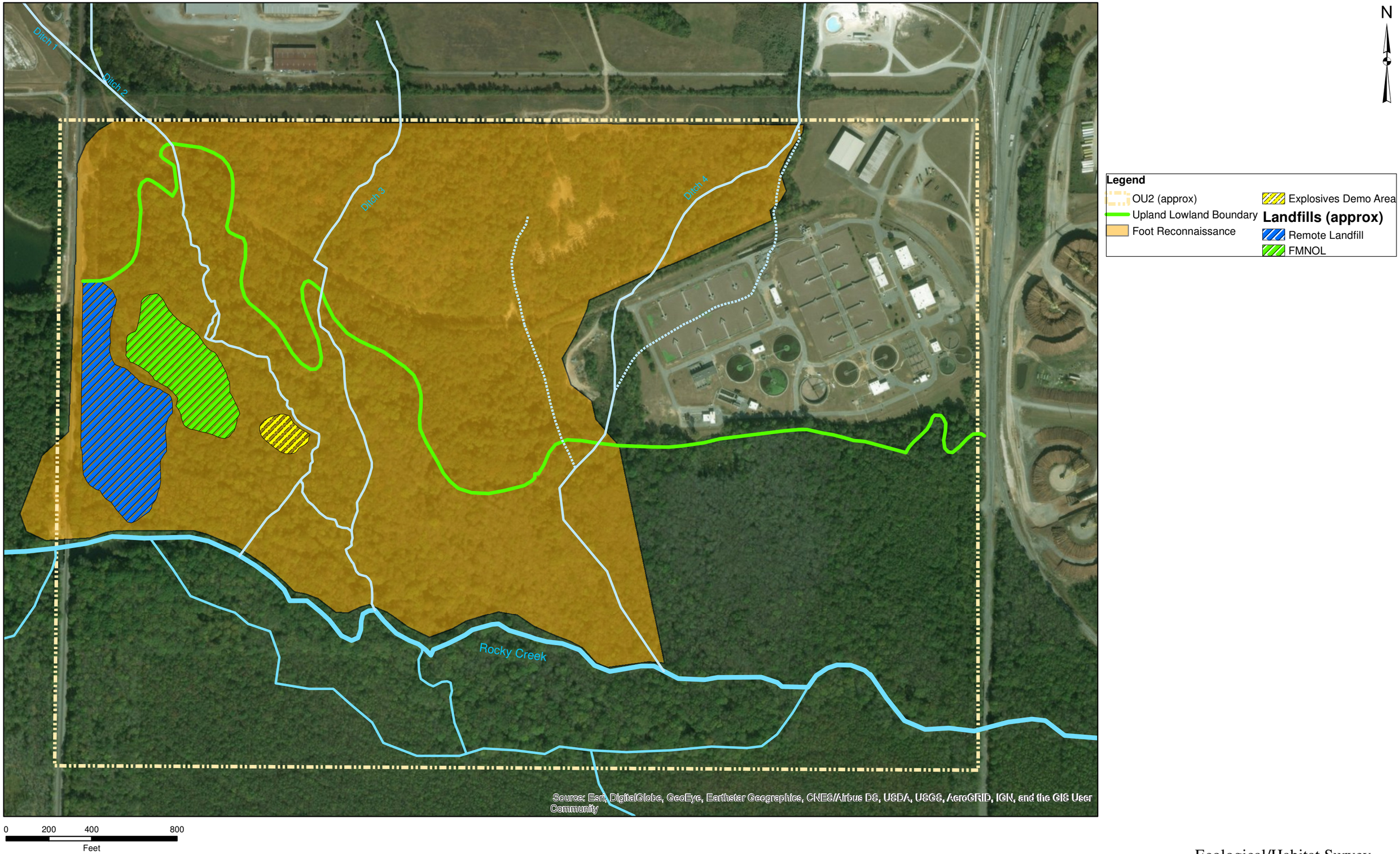


Figure taken from Release Notification/Reporting Form (MWA,1994).

Figure 4



Ecological/Habitat Survey

Figure No. 5

EPS
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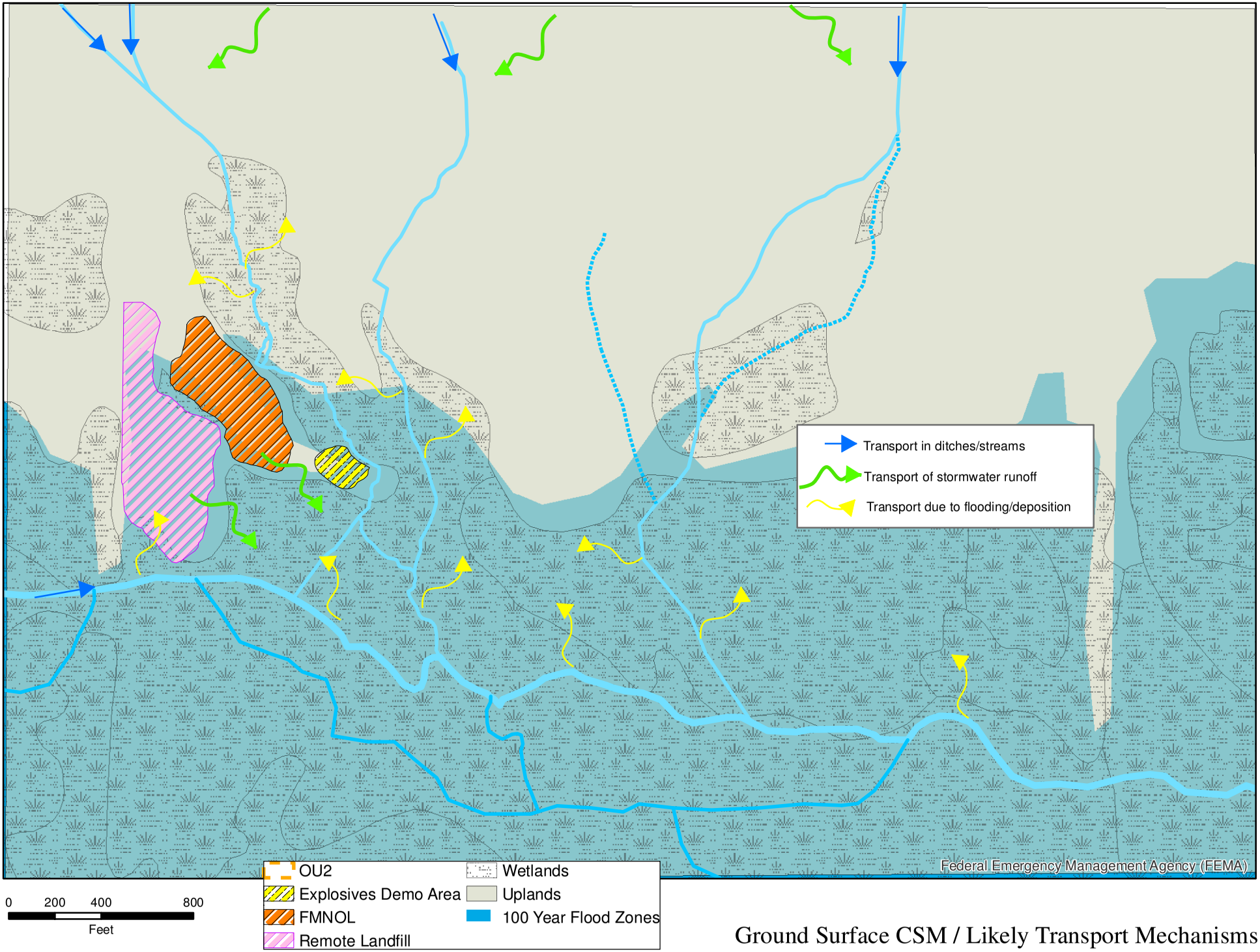

Ground Surface CSM / Likely Transport Mechanisms

EPS

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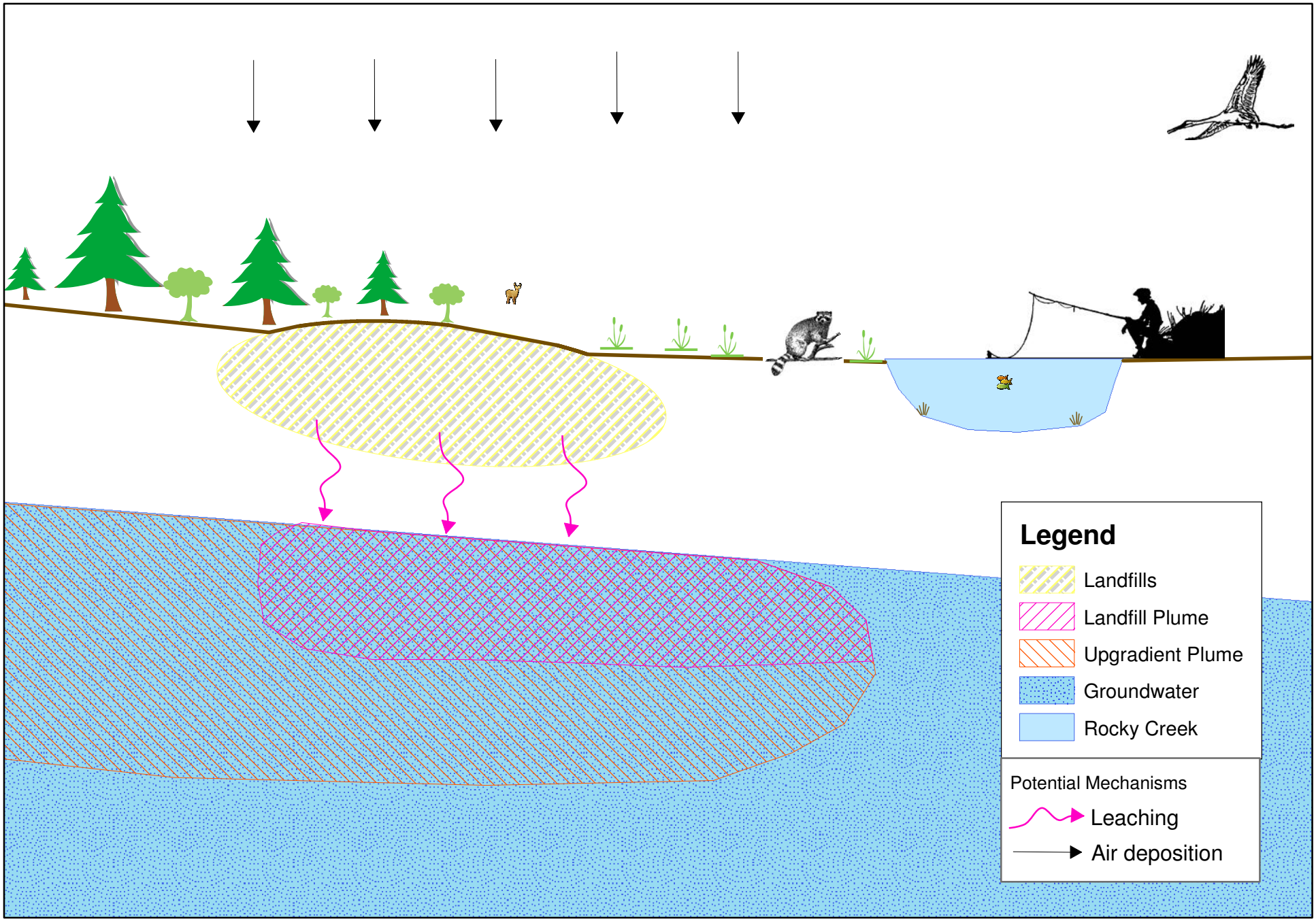
Figure No. 6



Cross-Section CSM

Figure No. 7

EPS
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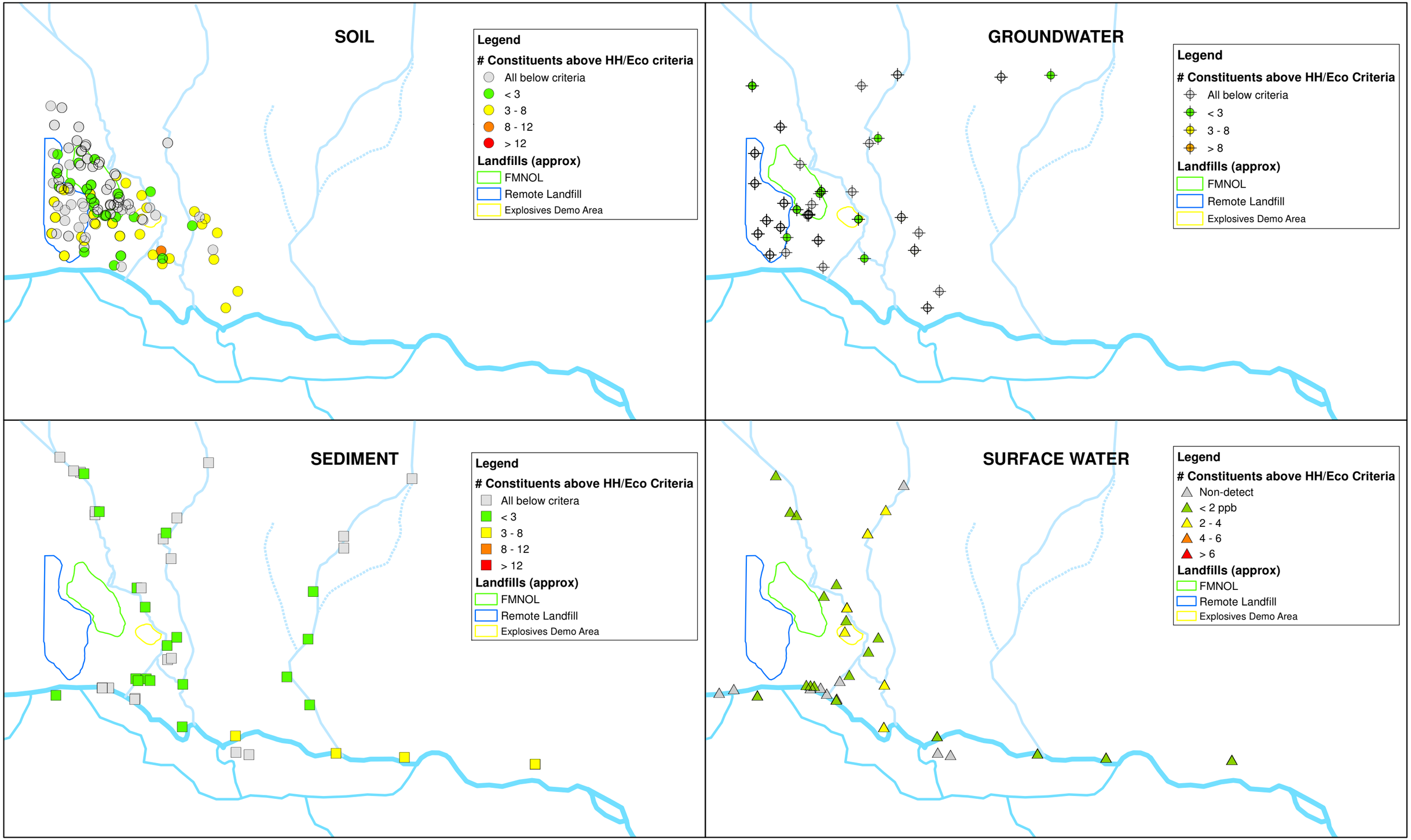

0 200 400 800
Feet

HH: Human health citeria: Soil/Sediment - Industrial RSLs; SW - federal Water Quality Standards (or Tapwater RSL); GW - MCL or (Tapwater RSL)
Eco: Ecological criteria are RSVs or Georgia In-Stream Water Quality Standards

Extent of Metals Exceeding Criteria

EPS
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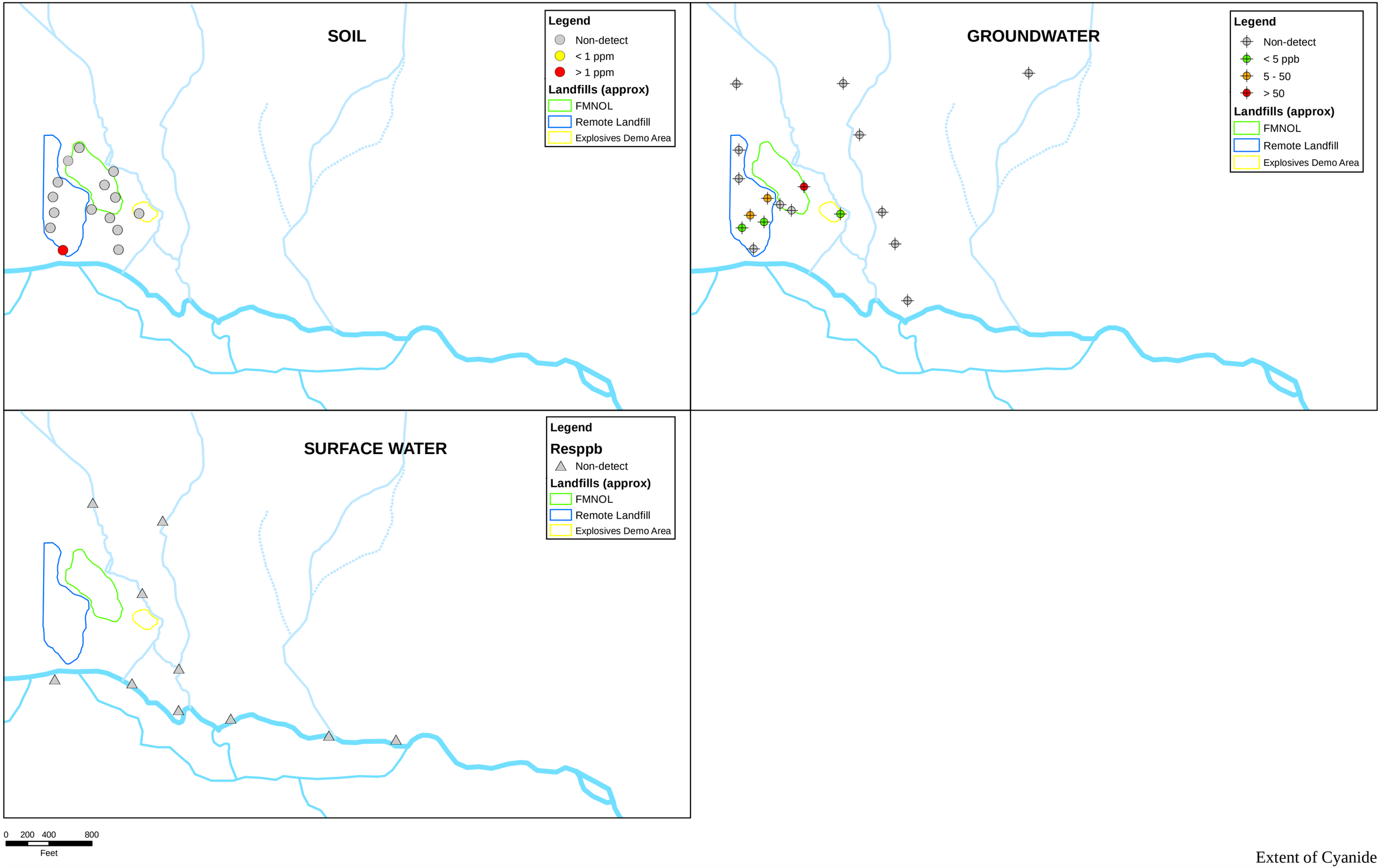
Figure No. 8



Extent of Cyanide

Figure No. 9

EPS
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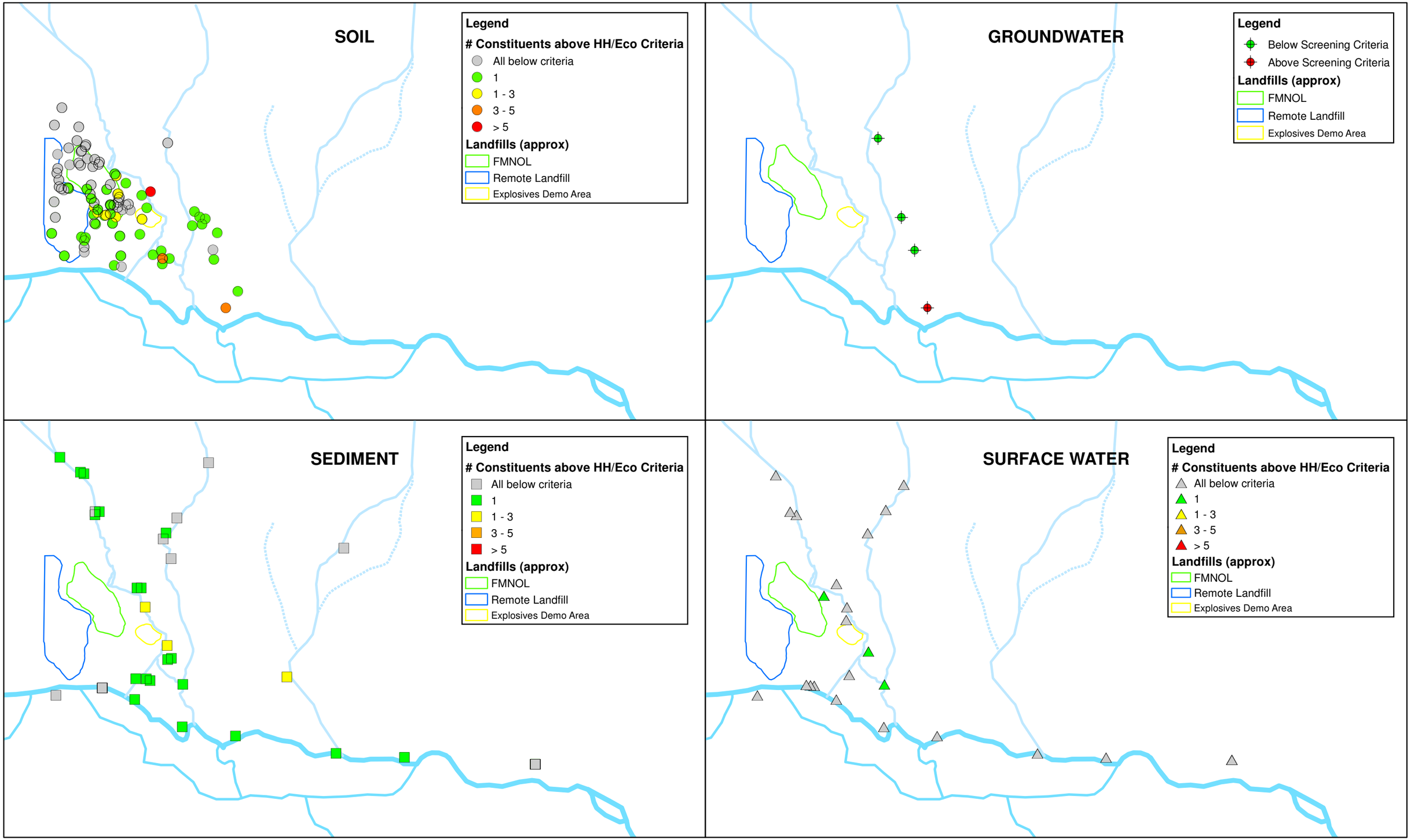

0 200 400 800
Feet

HH: Human health citeria for individual aroclors: Soil/Sediment - Industrial RSLs; SW - federal Water Quality Standards (or Tapwater RSLs); GW - MCLs (or Tapwater RSLs)
Eco: Ecological criteria are RSVs for total PCBs (excluding non-detects) or Georgia In-Stream Water Quality Standards

Extent of PCBs Exceeding Criteria

EPS
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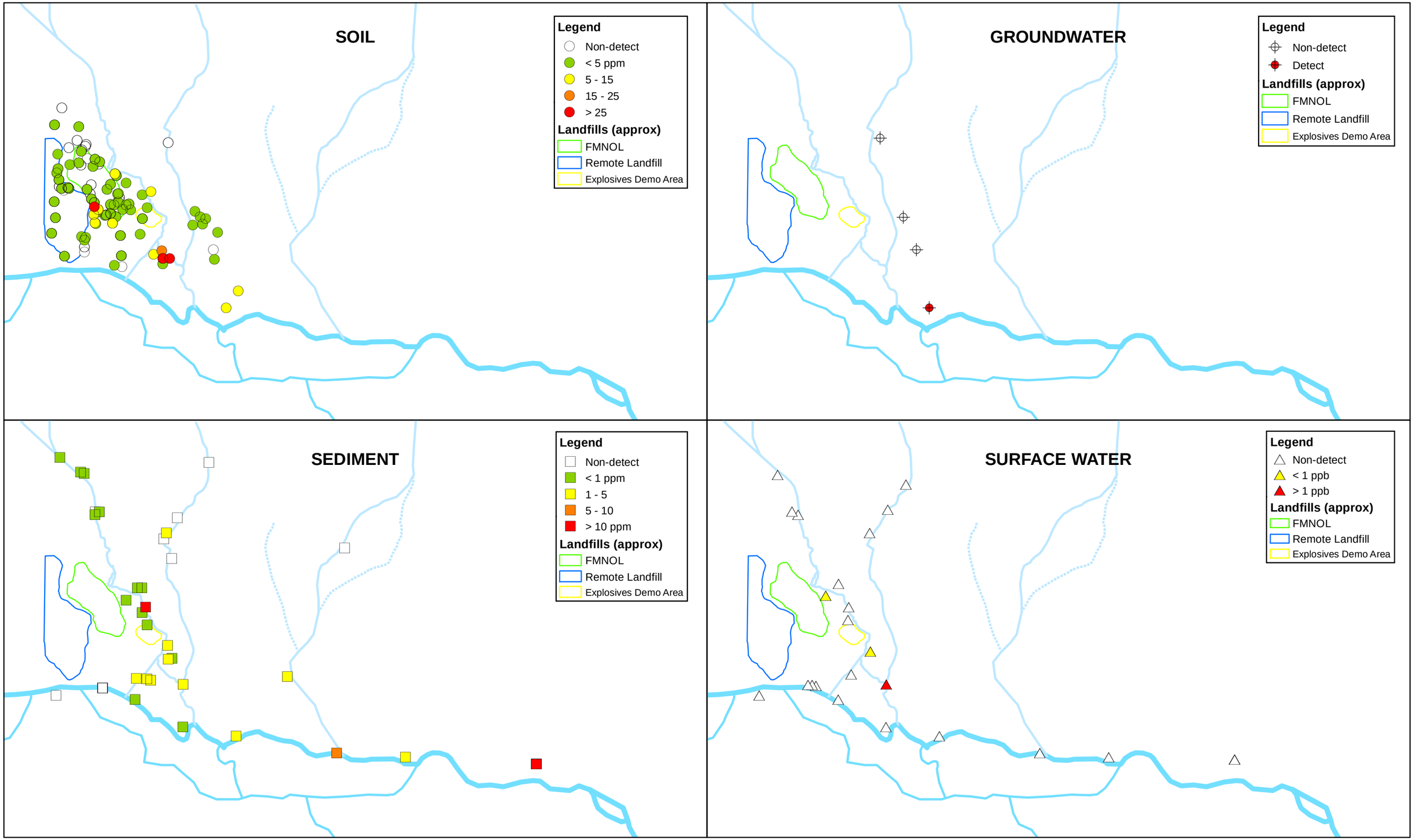
Figure No. 10



Extent of Total PCBs

Figure No. 11

EPS

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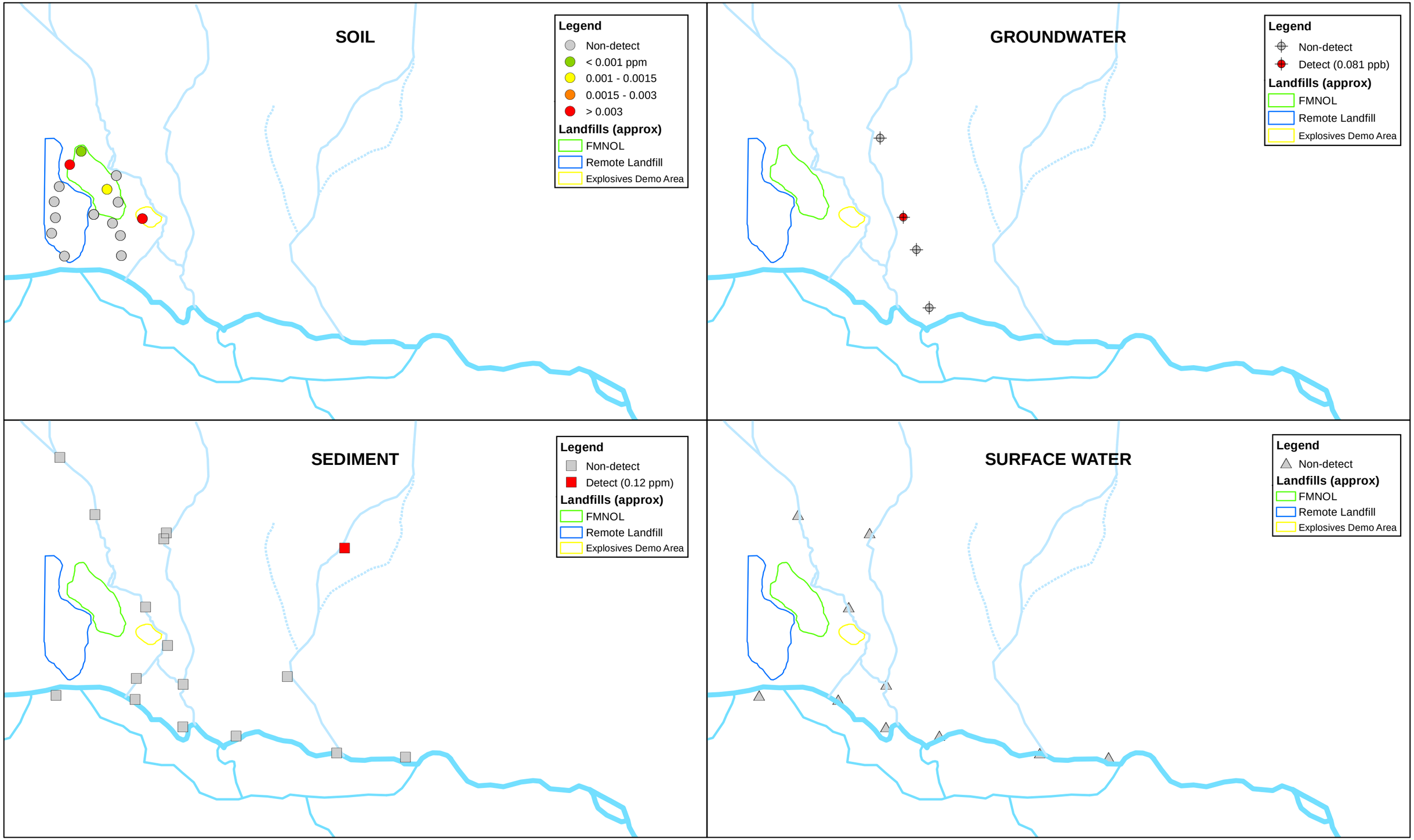

Extent of Dieldrin

Figure No. 12

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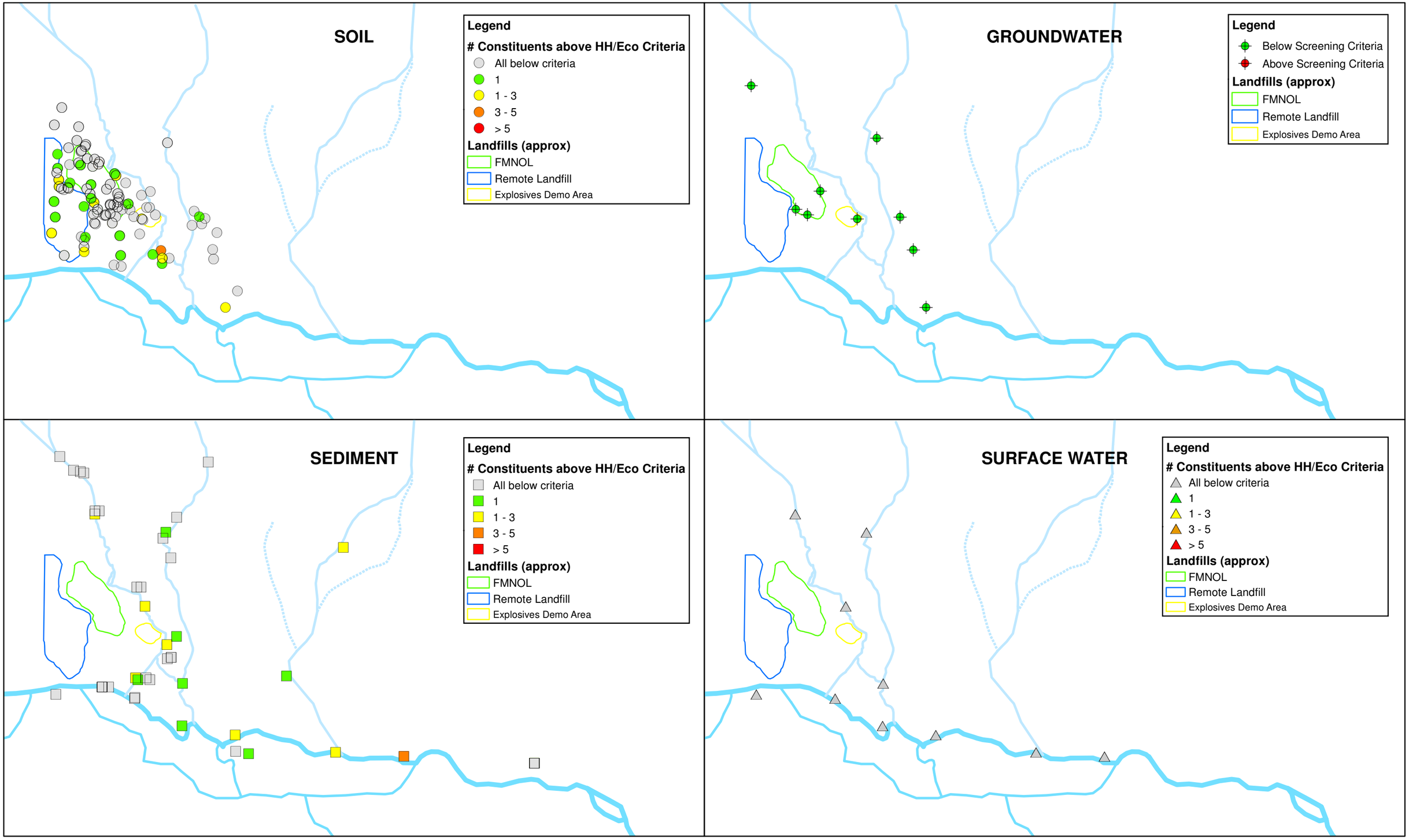

0 200 400 800
Feet

HH: Human health citeria for individual constituents: Soil/Sediment - Industrial RSLs; SW - federal Water Quality Standards (or Tapwater RSLs); GW - MCLs (or Tapwater RSLs)
Eco: Ecological criteria are RSVs for total PCBs (excluding non-detects) or Georgia In-Stream Water Quality Standards

Extent of HMWPAHs Exceeding Criteria

EPS
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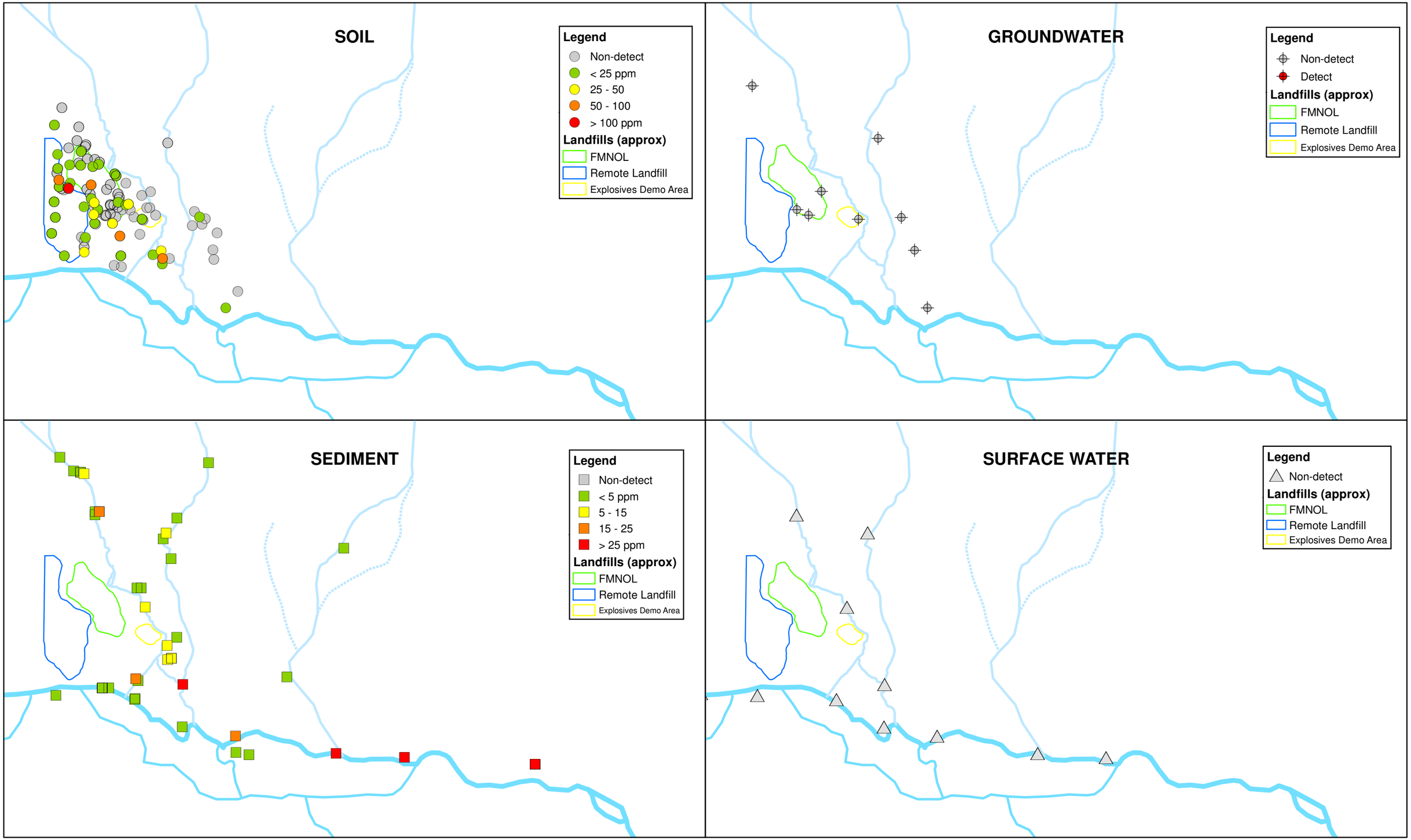

Extent of Total PAHs

EPS

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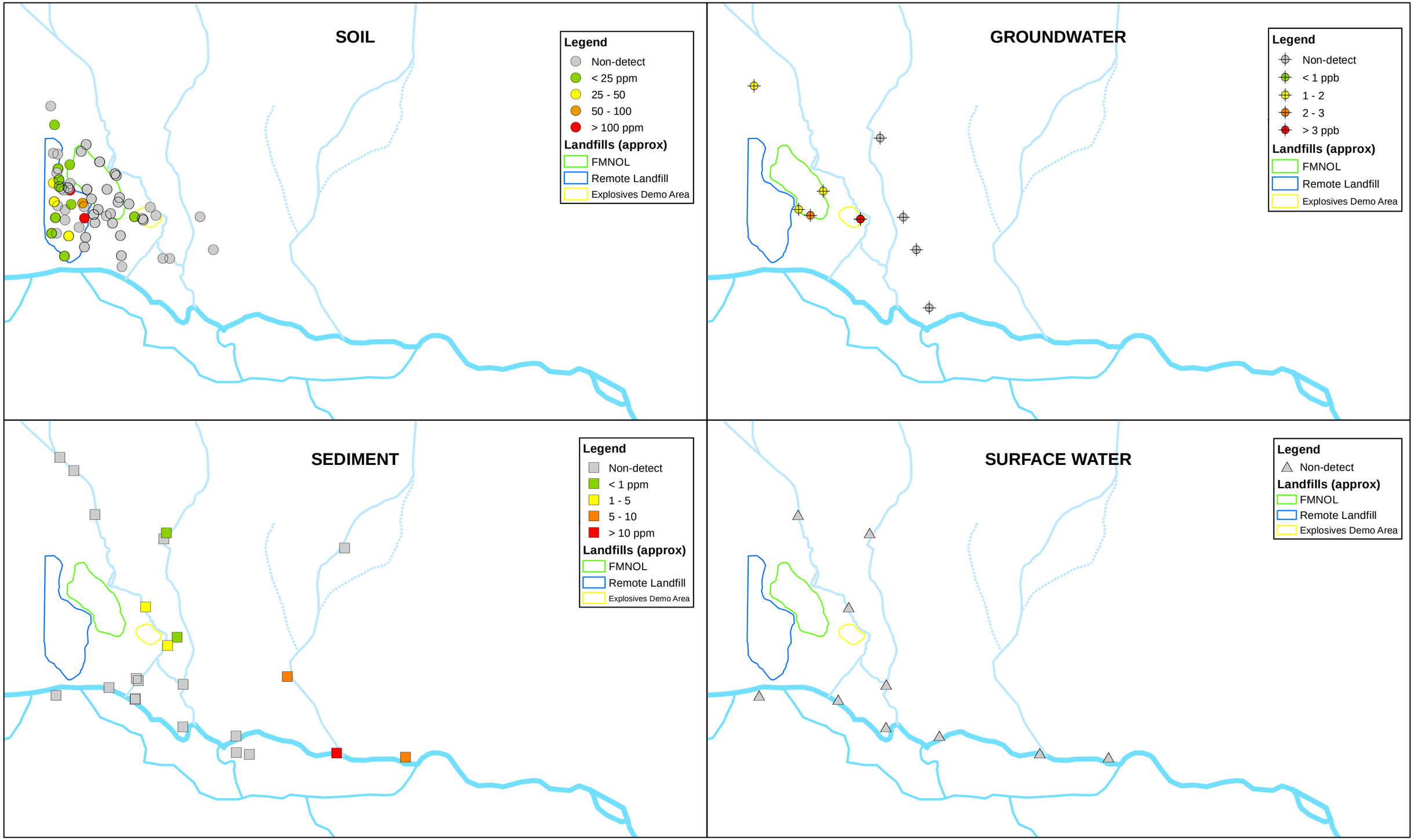

Extent of Bis (2-ethylhexyl) Phthalate

EPS

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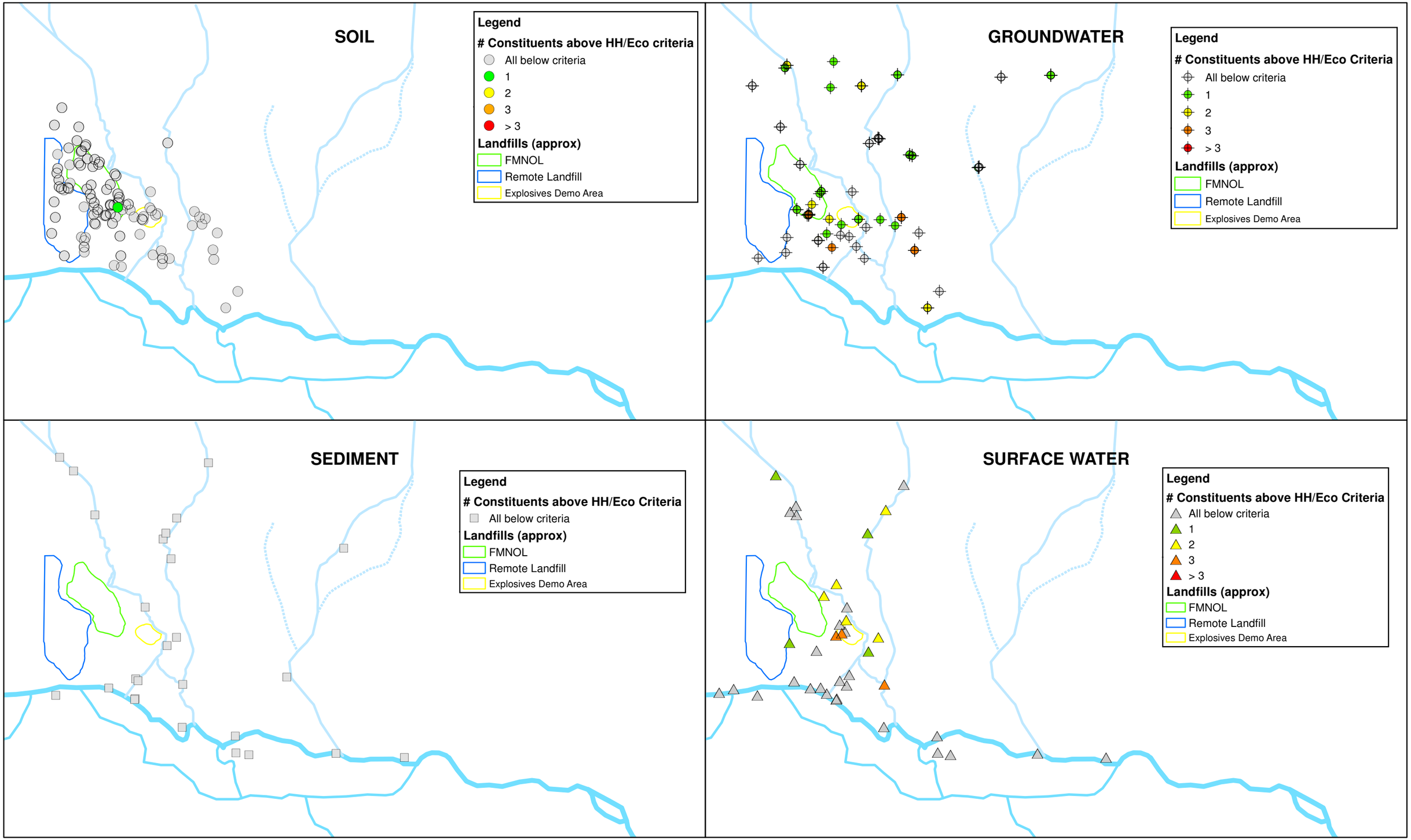

0 200 400 800
Feet

HH: Human health citeria: Soil/Sediment - Industrial RSLs; SW - federal Water Quality Standards (or Tapwater RSLs); GW - MCLs (or Tapwater RSLs)
Eco: Ecological criteria are RSVs or Georgia In-Stream Water Quality Standards

Extent of Chlorinated Solvents Exceeding Criteria

EPS
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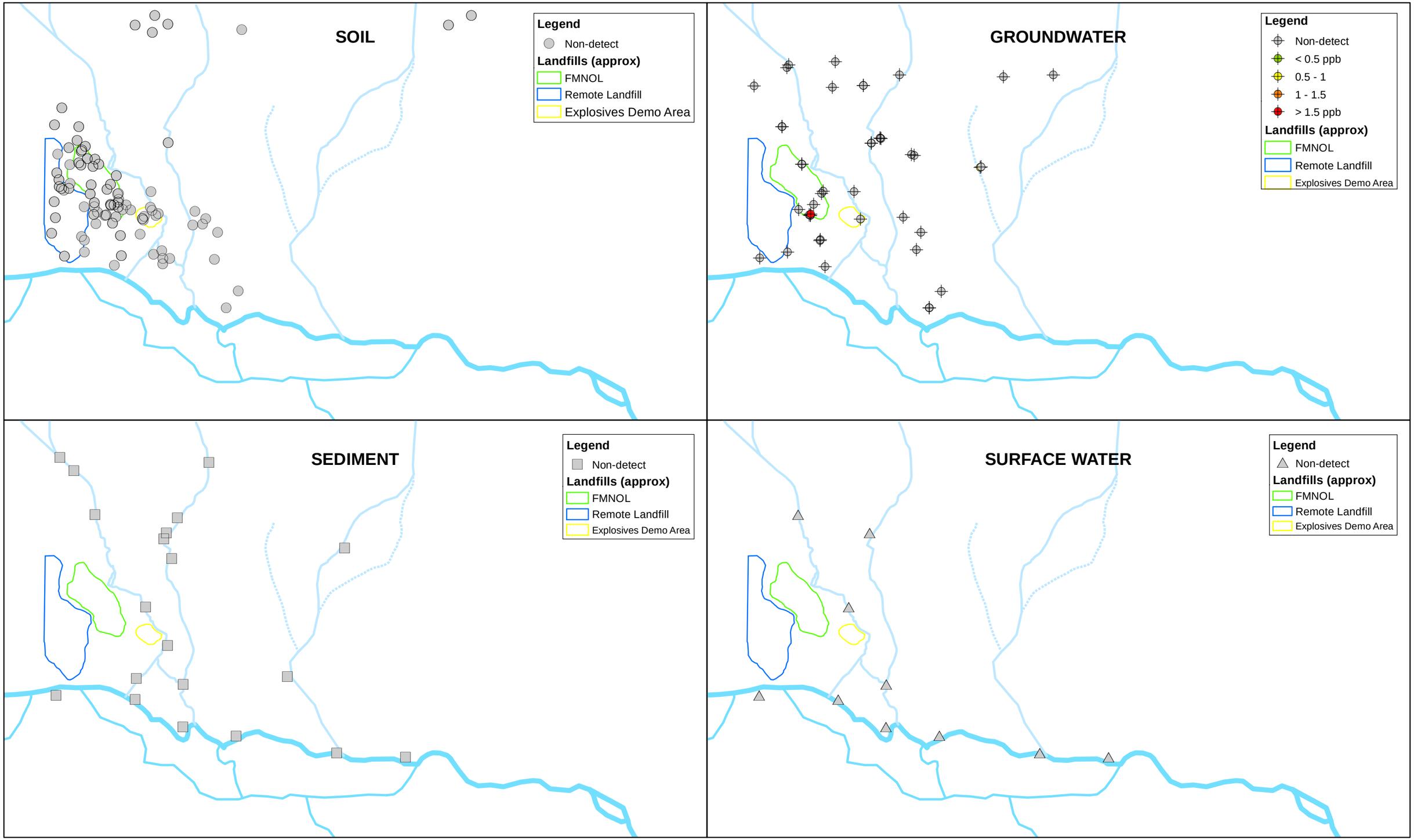
Figure No. 16



Extent of Carbon Tetrachloride

EPS

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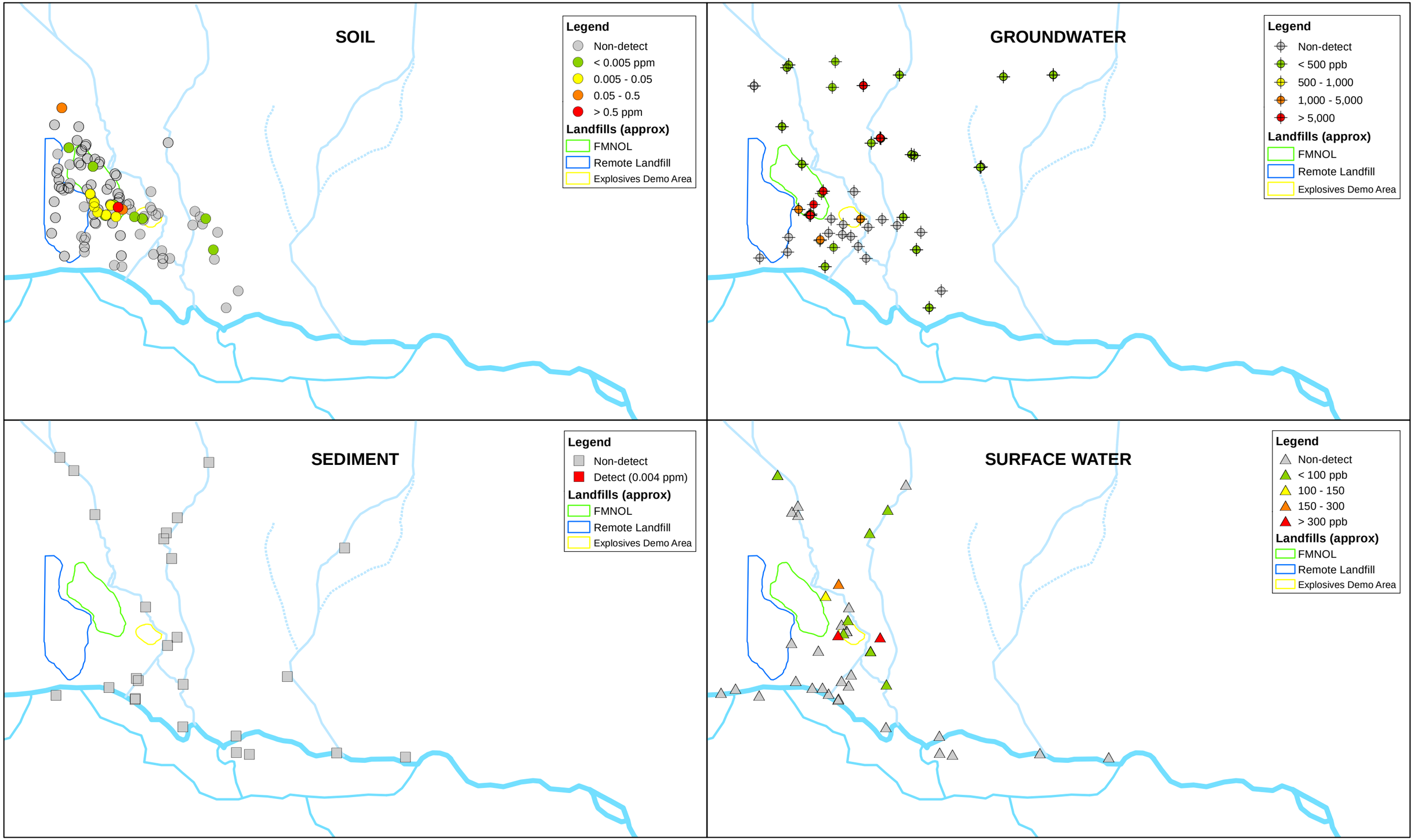
Figure No. 17



Extent of Trichloroethene

EPS

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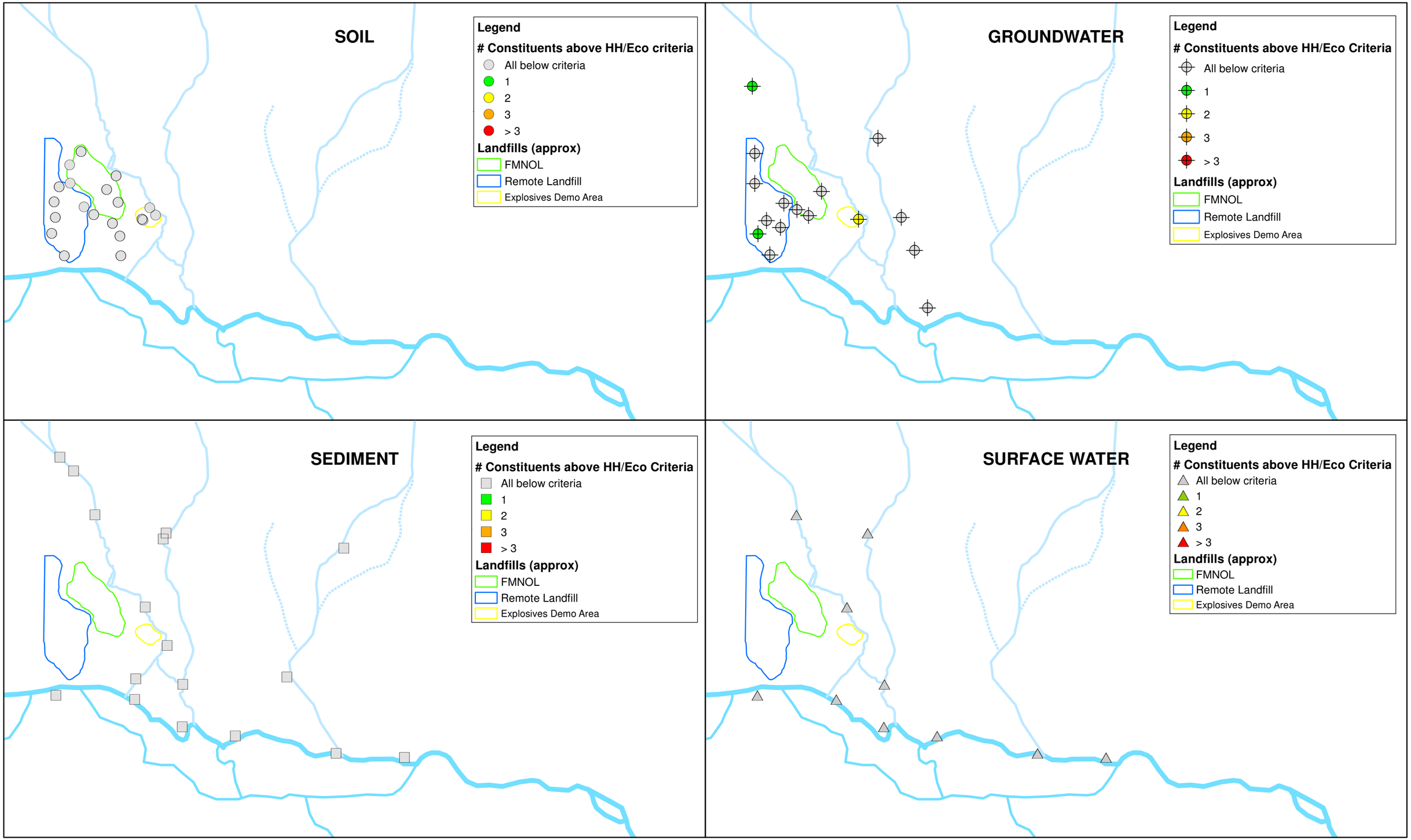
Figure No. 18



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Feet

HH: Human health citeria: Soil/Sediment - Industrial RSLs; SW - federal Water Quality Standards (or Tapwater RSLs); GW - MCLs (or Tapwater RSLs)
Eco: Ecological criteria are RSVs or Georgia In-Stream Water Quality Standards

Extent of Energetics Exceeding Criteria

EPS
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Figure No. 19

Figure 20. Preliminary Receptor Conceptual Site Model

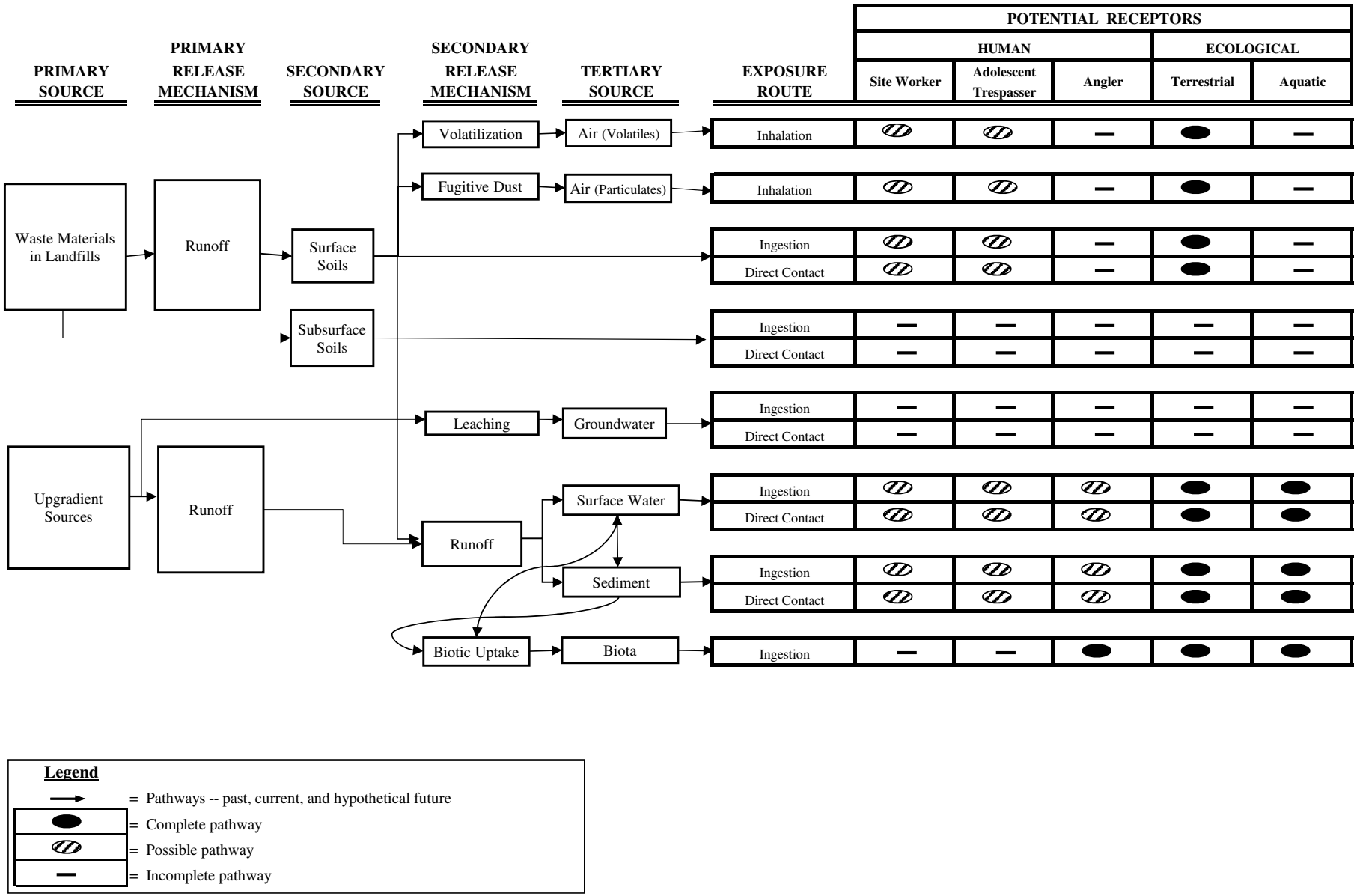


Figure 21. Risk Drivers by Receptor in each Medium

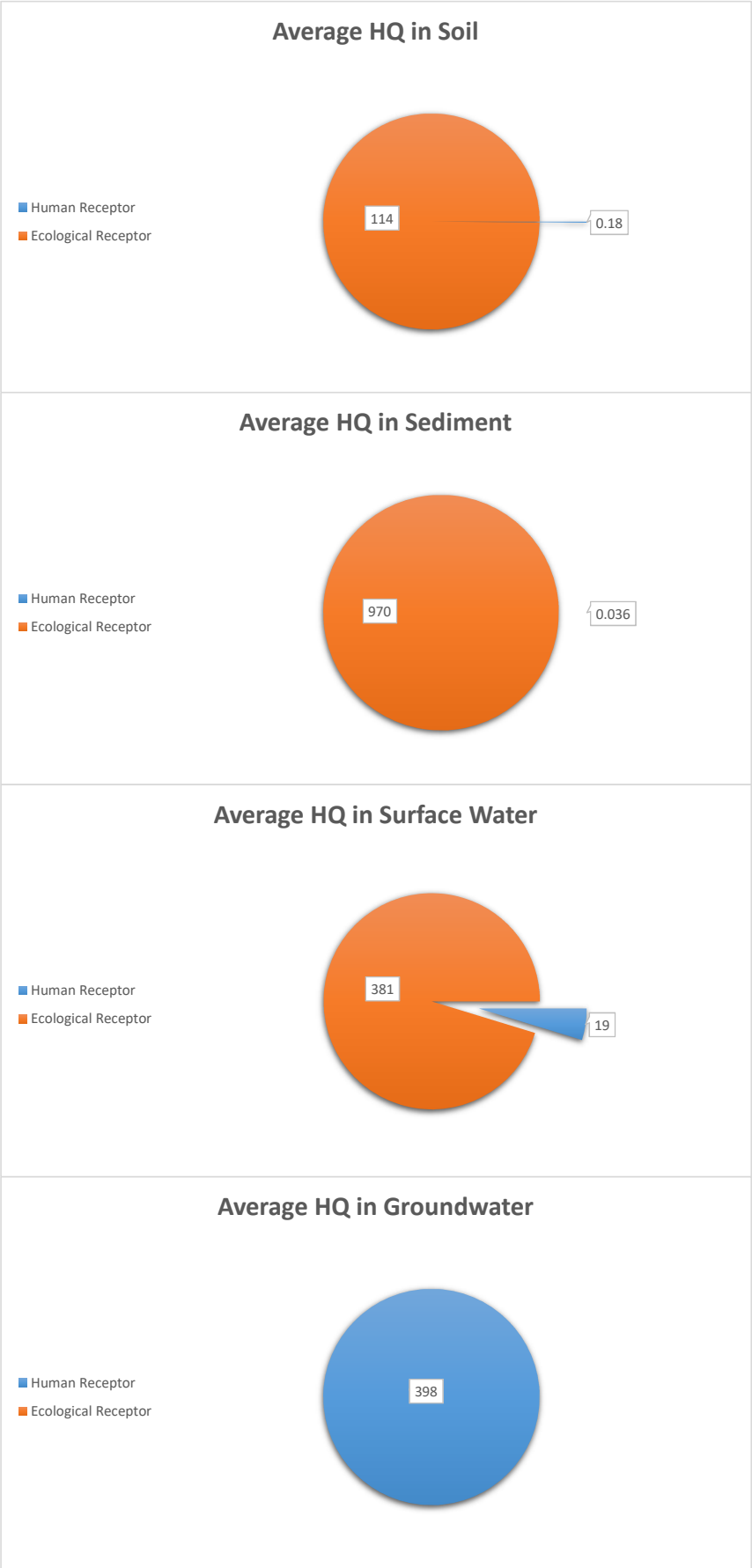
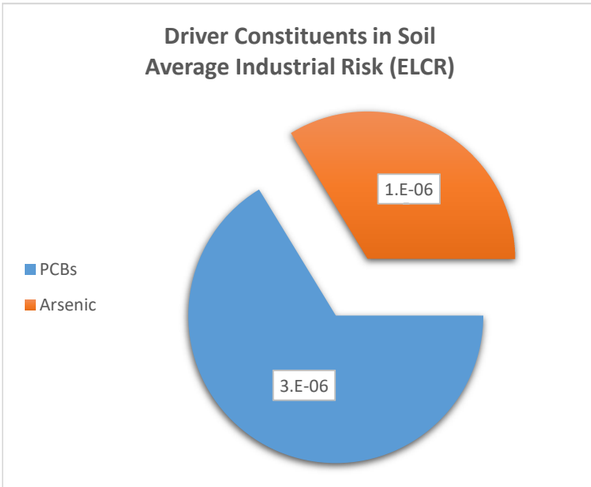
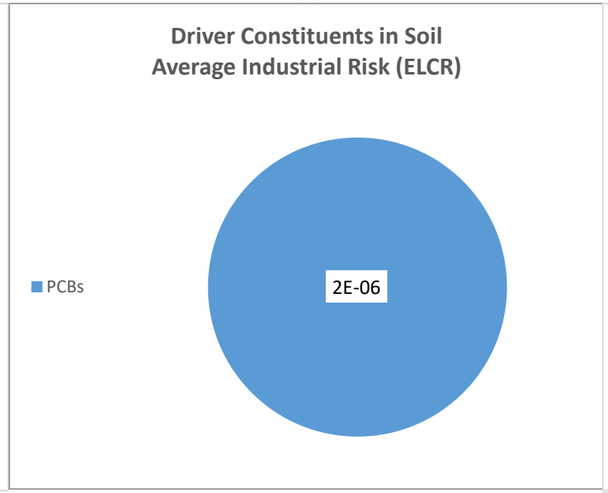
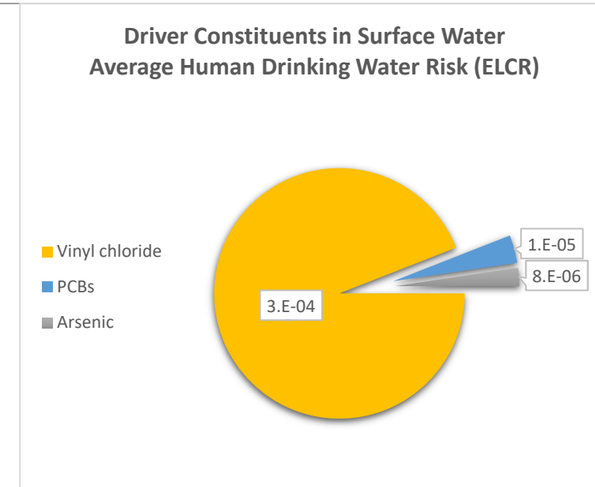
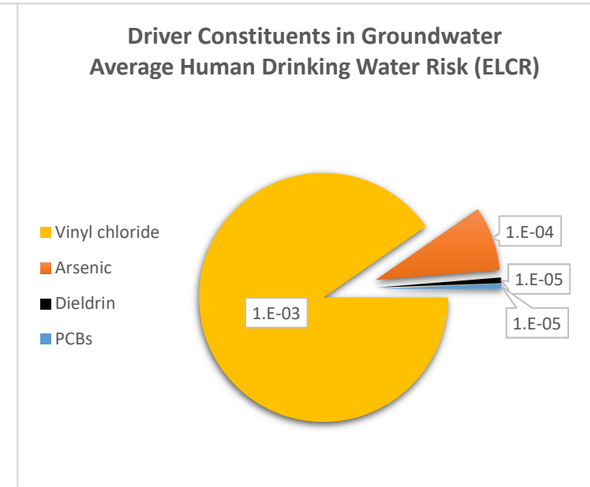


Figure 22. Risk Drivers by Constituent for each Medium



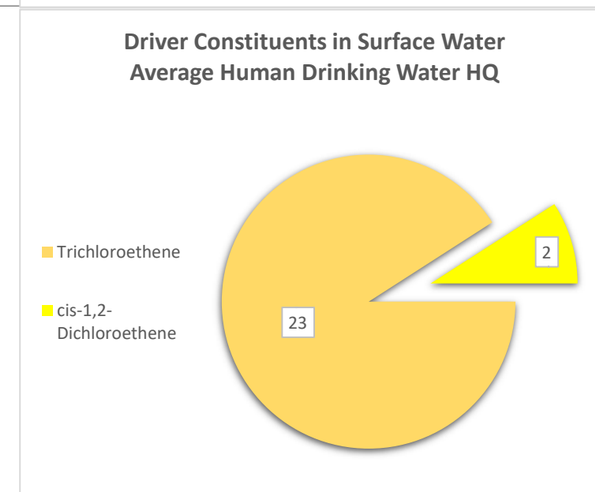


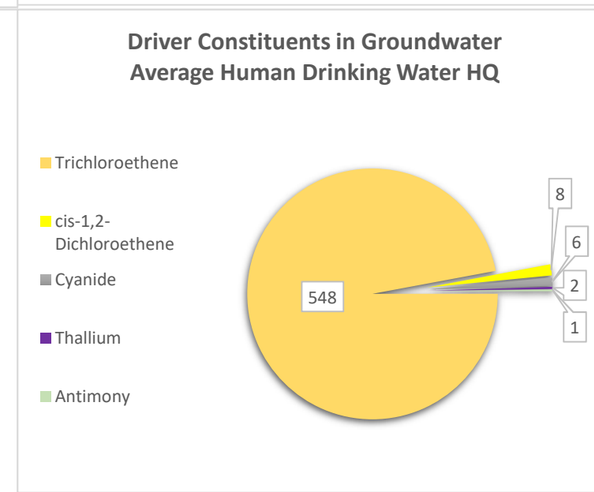


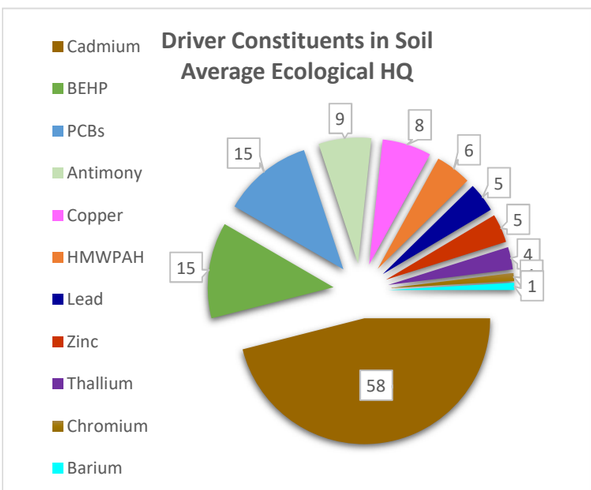


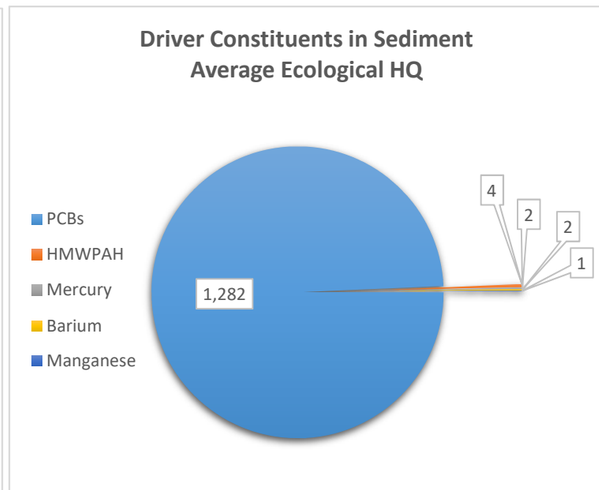
All Industrial HQs in soil < 1

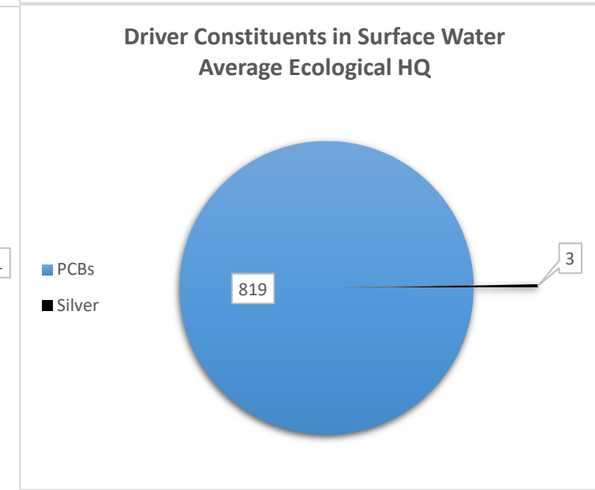
All Industrial HQs in sediment < 1



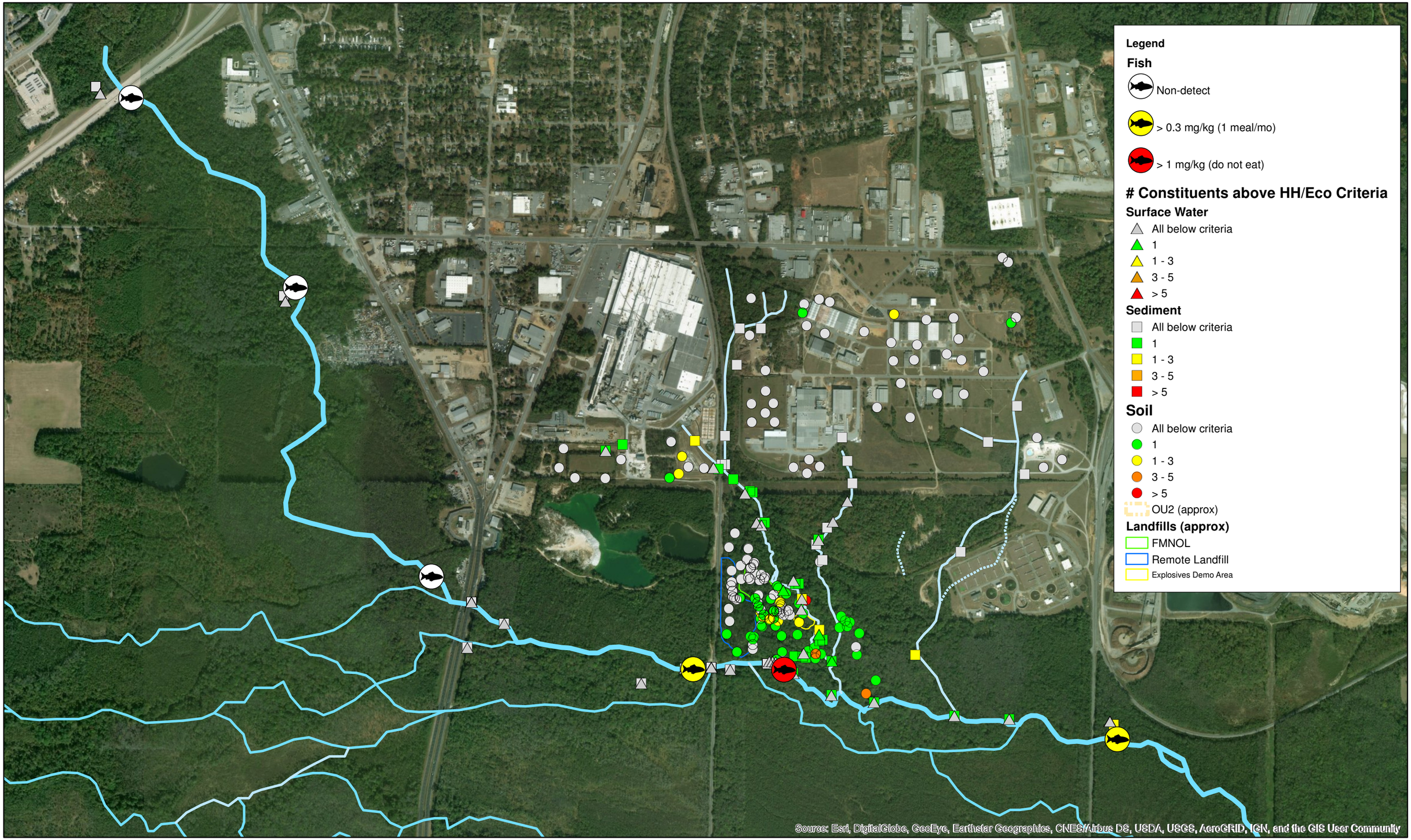








Groundwater is not an ecological medium.



1,000 500 0 1,000 Feet

HH: Human health citeria for individual congeners: Soil/Sediment - Industrial RSLs; SW - federal Water Quality Standards (or Tapwater RSLs); GW - MCLs (or Tapwater RSLs)
Eco: Ecological criteria are RSVs for total PCBs (excluding non-detects) or Georgia In-Stream Water Quality Standards

PCBs in Fish and other Media

EPS
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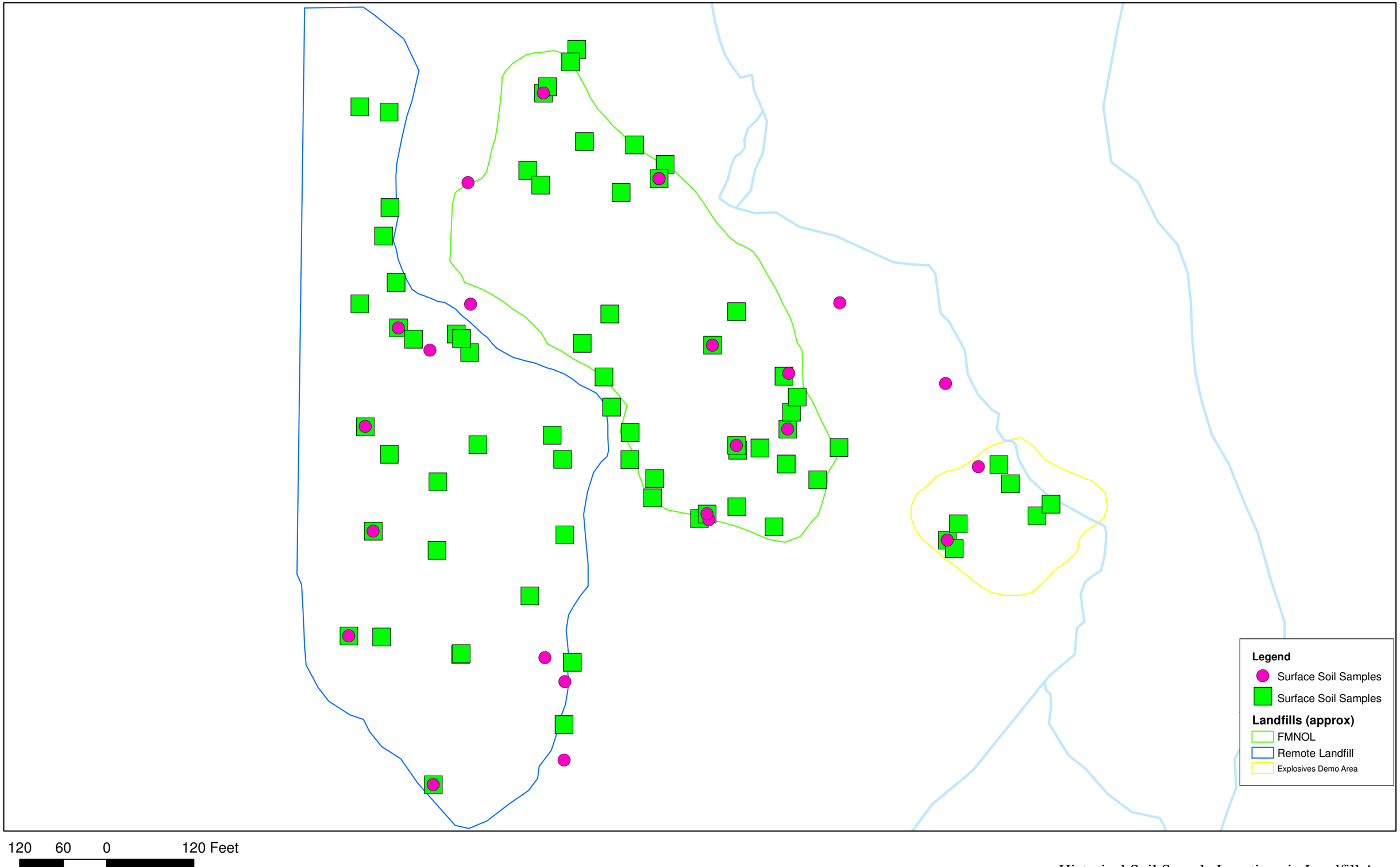
Figure No. 23



Historical Soil Sample Locations in Landfill Area

EPS
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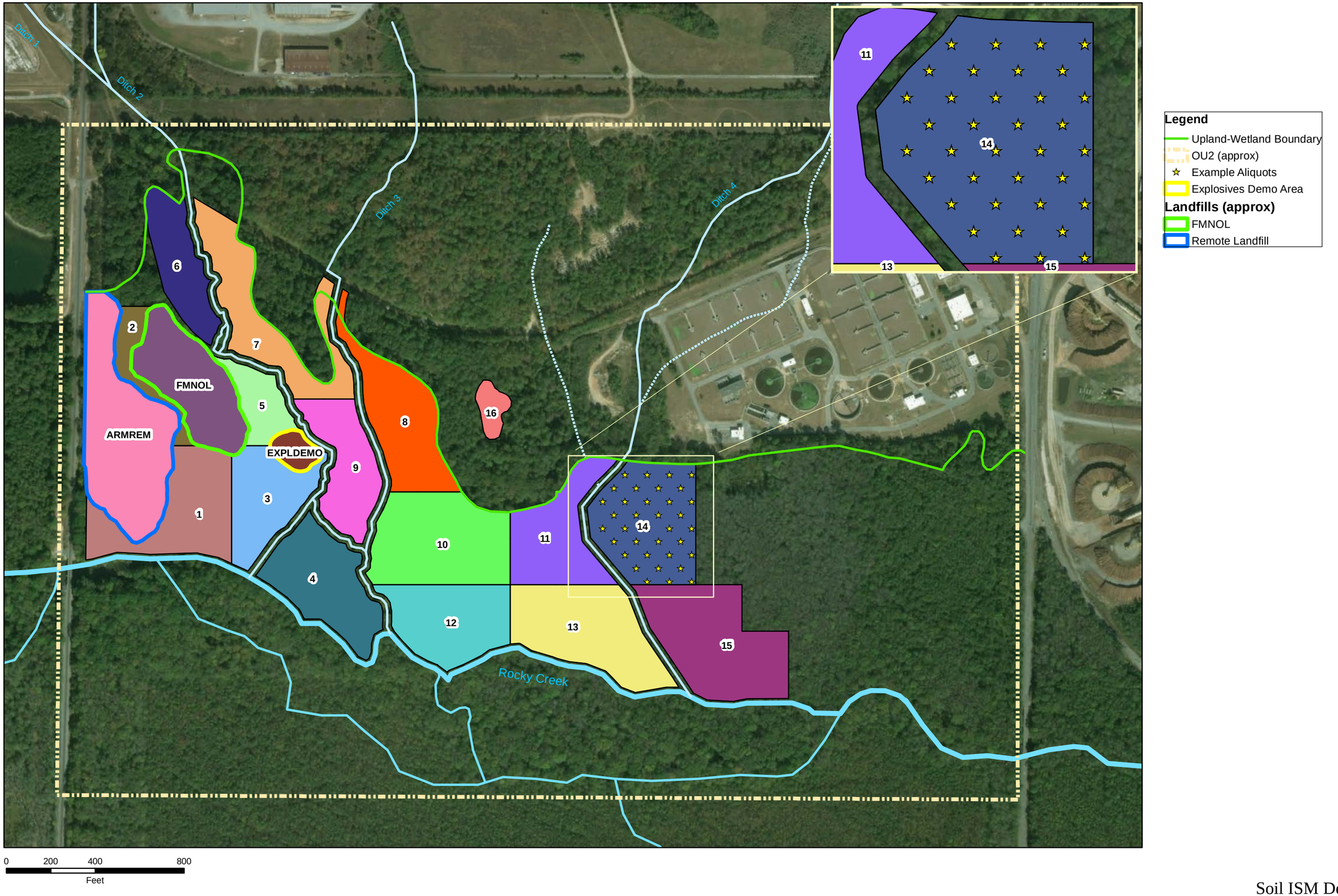
Figure No. 24



Soil ISM Decision Units

Figure No. 25

EPS

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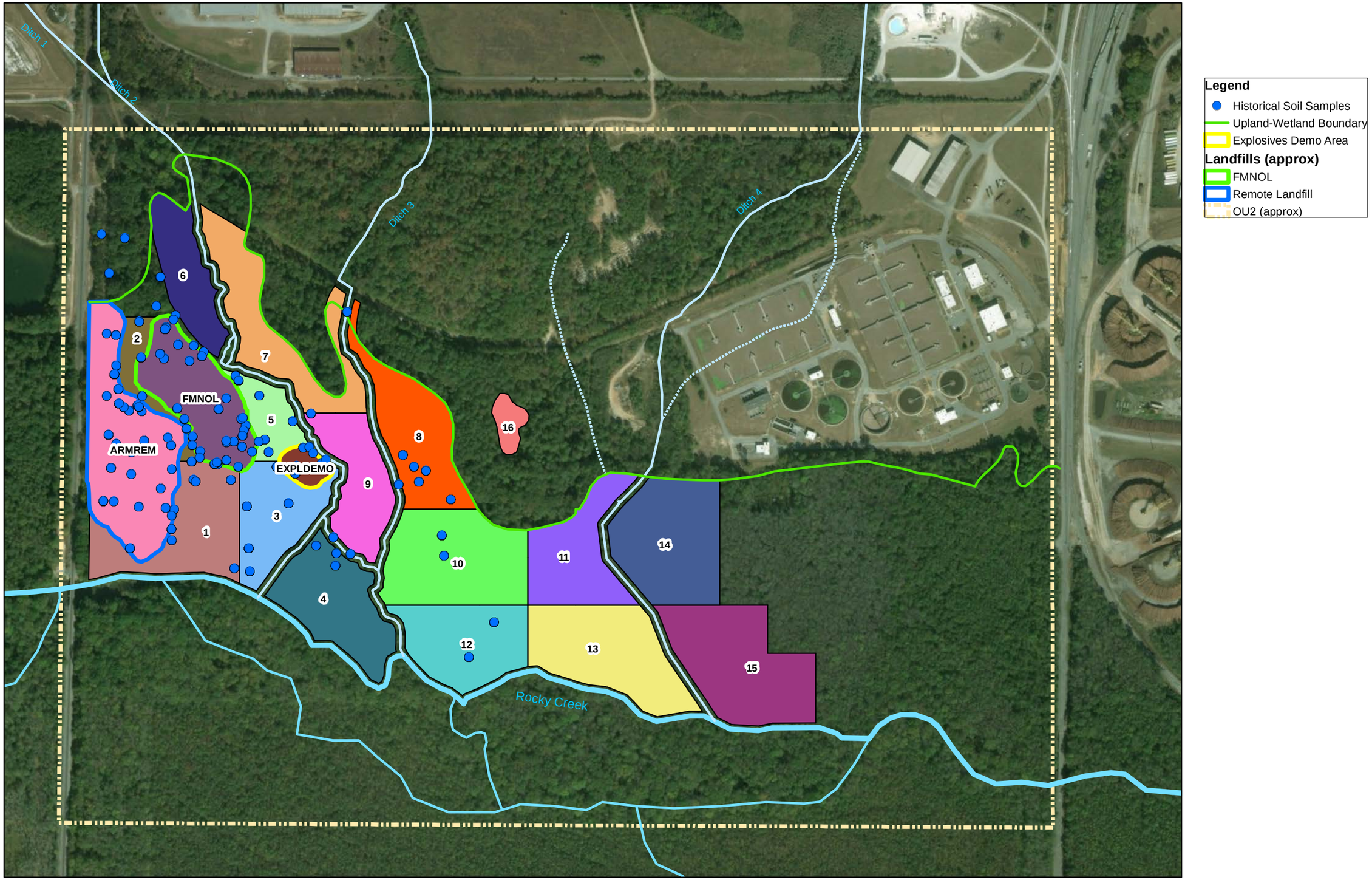

Soil Historical Sample Locations with DUs

EPS

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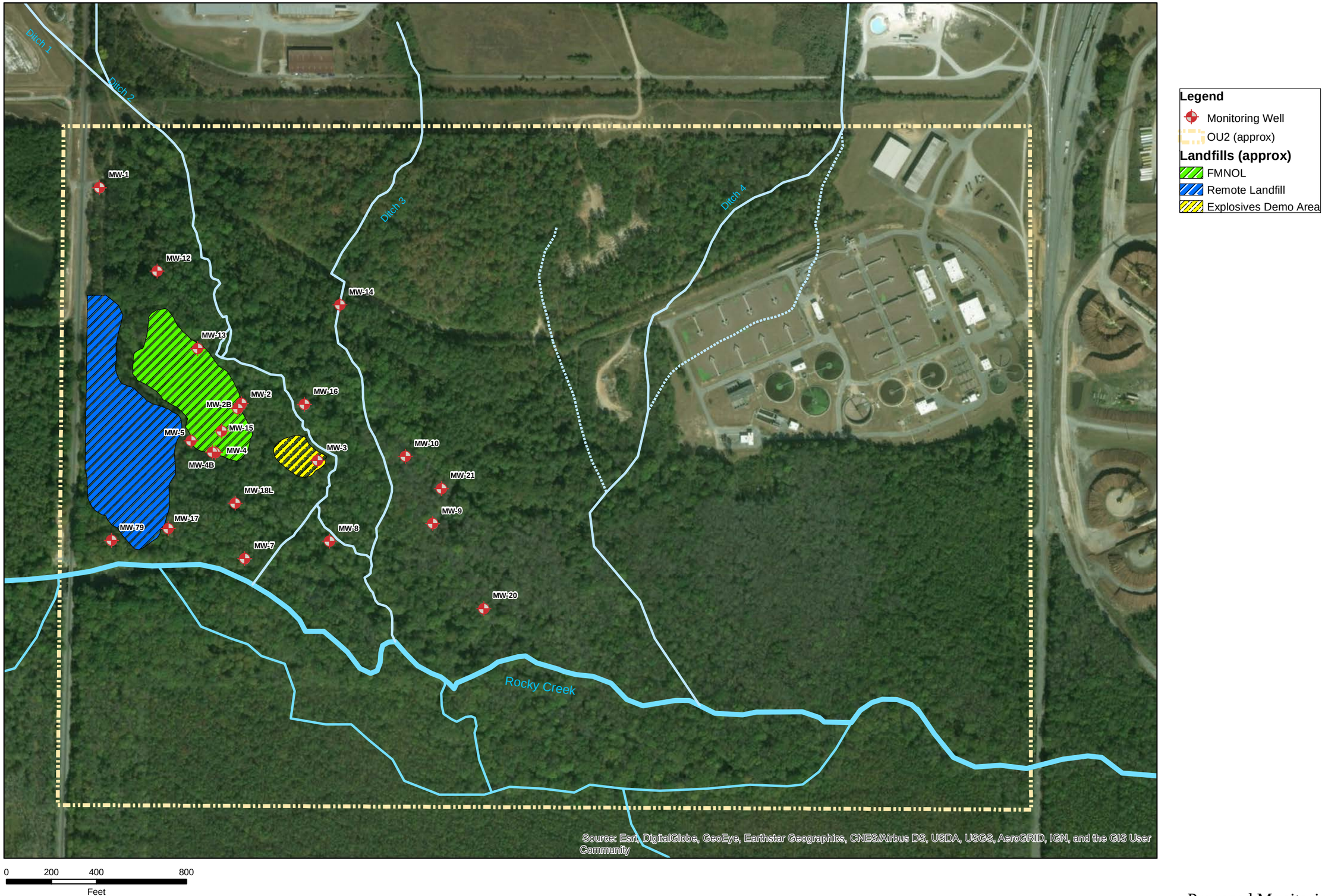
Figure No. 26



Proposed Monitoring Well Sampling

Figure No. 27

EPS

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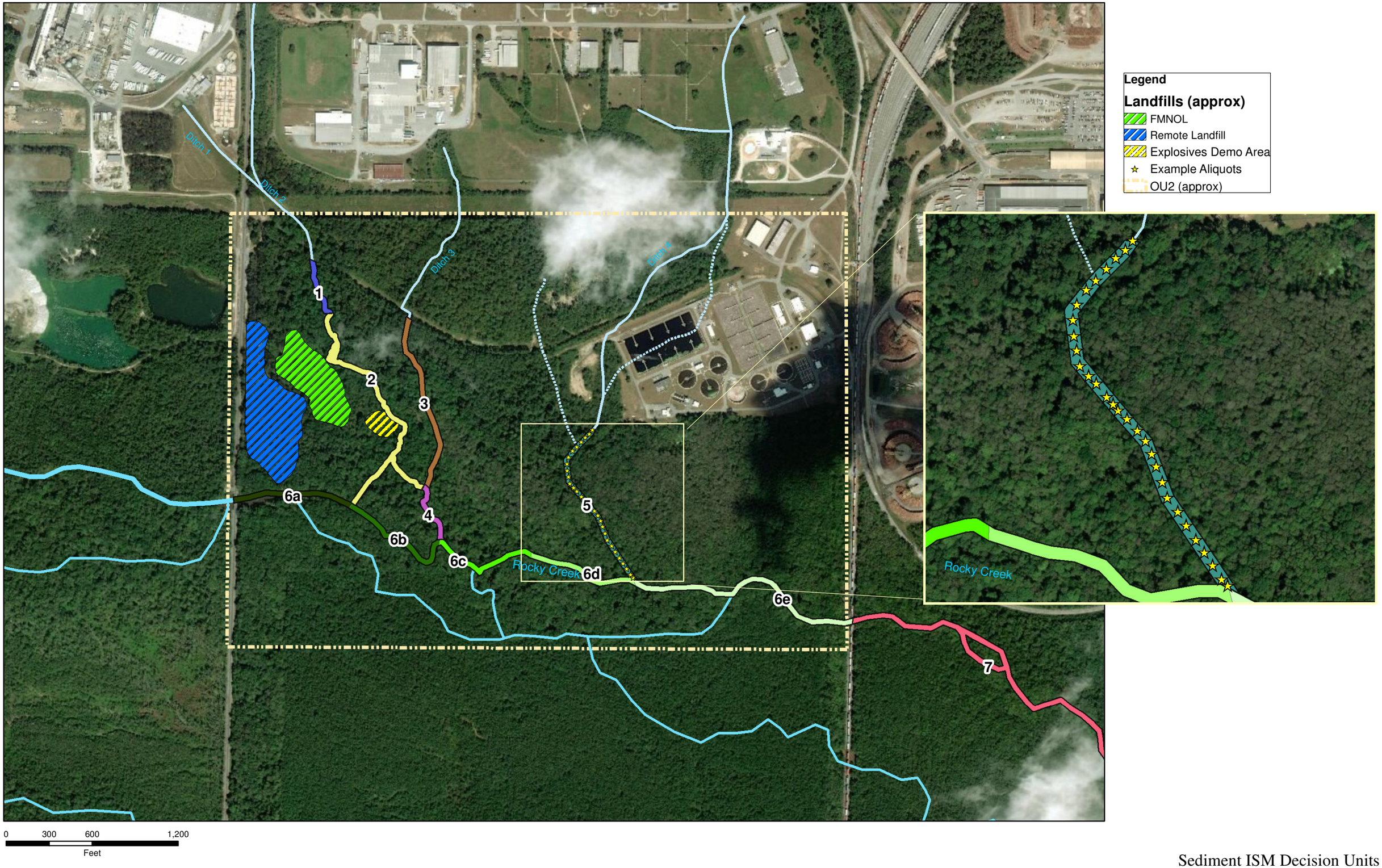

Sediment ISM Decision Units

EPS

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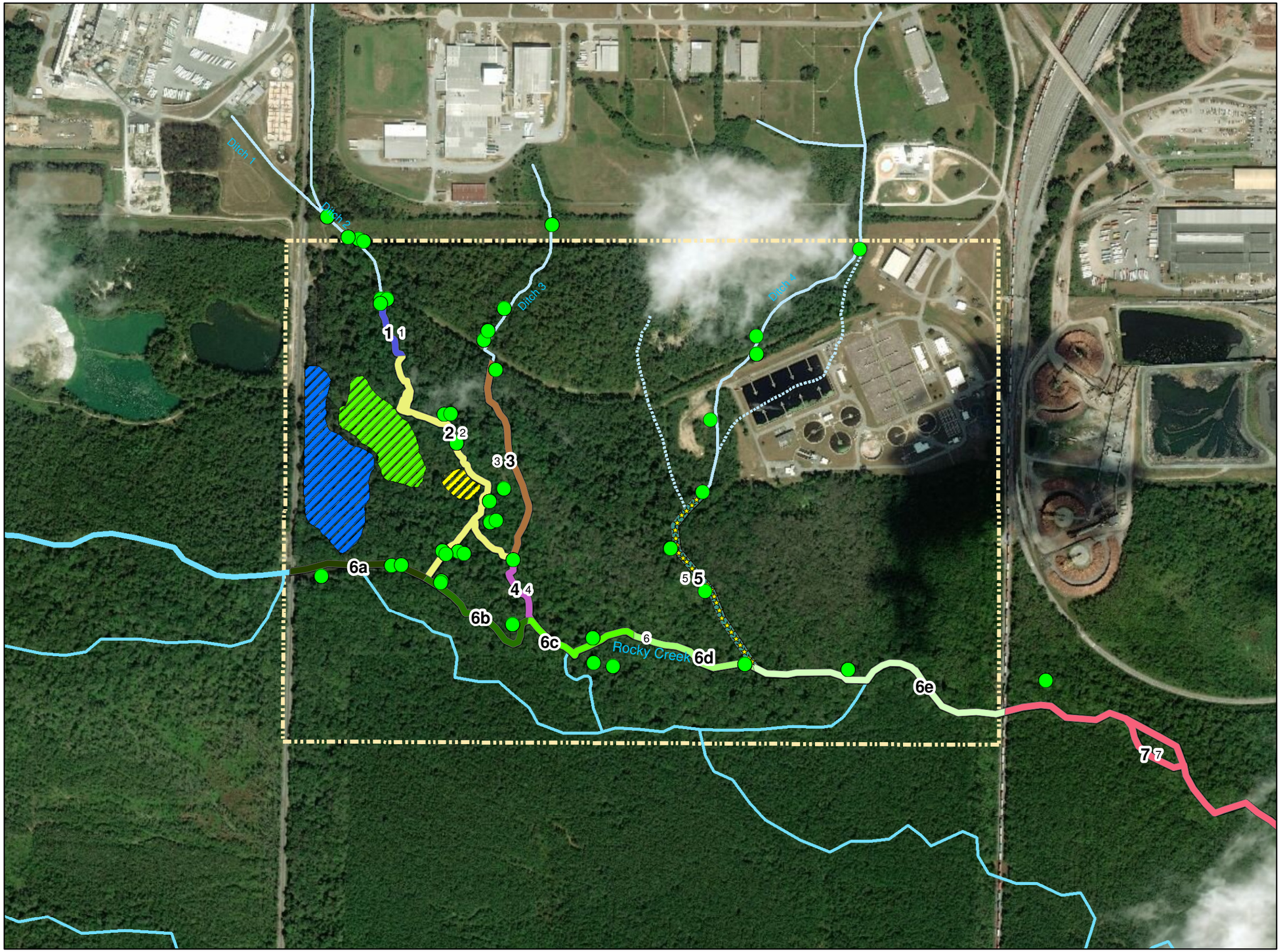
Figure No. 28



Legend

- Historical Sediment Samples
- Example Aliquots
- OU2 (approx)

Landfills (approx)

- FMNOL
- Remote Landfill
- Explosives Demo Area

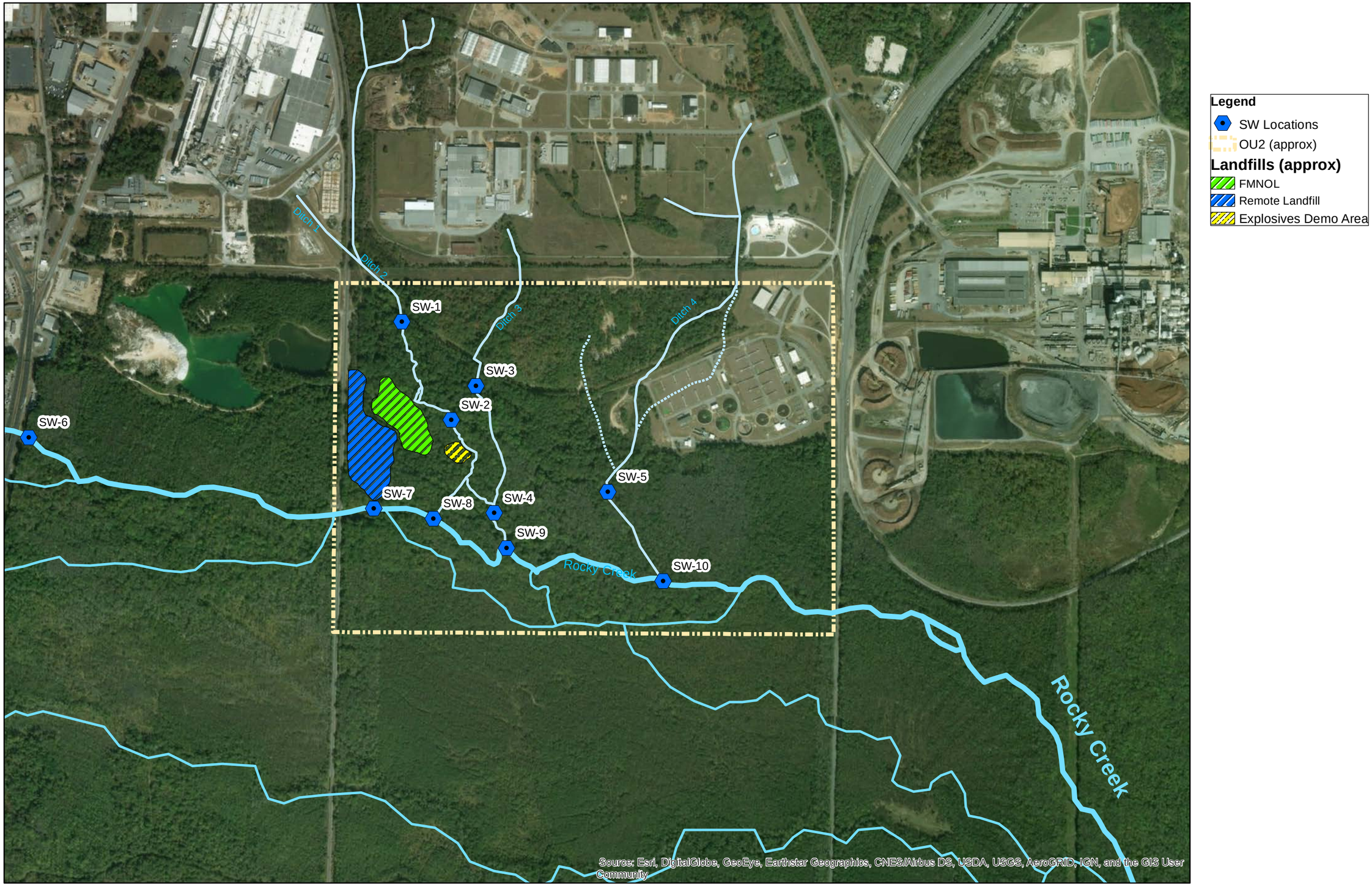
N

0 300 600 1,200
Feet

Sediment Historical Sample Locations and DUs

EPS
F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig 29_Sediment Data DUs_rev.mxd

Figure No. 29

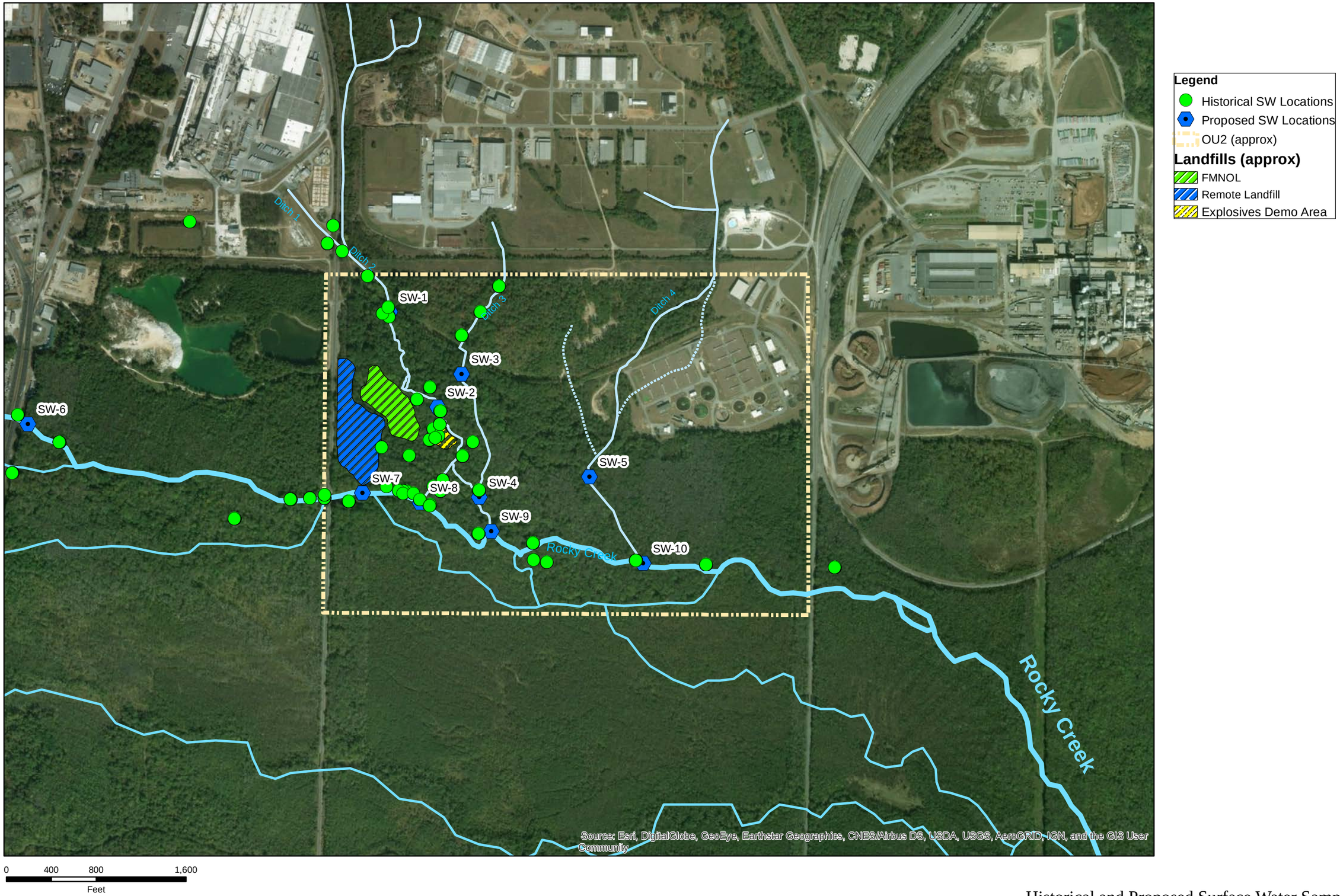


Proposed Surface Water Sampling Locations

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig 30_Surface Water.mxd

Figure No. 30

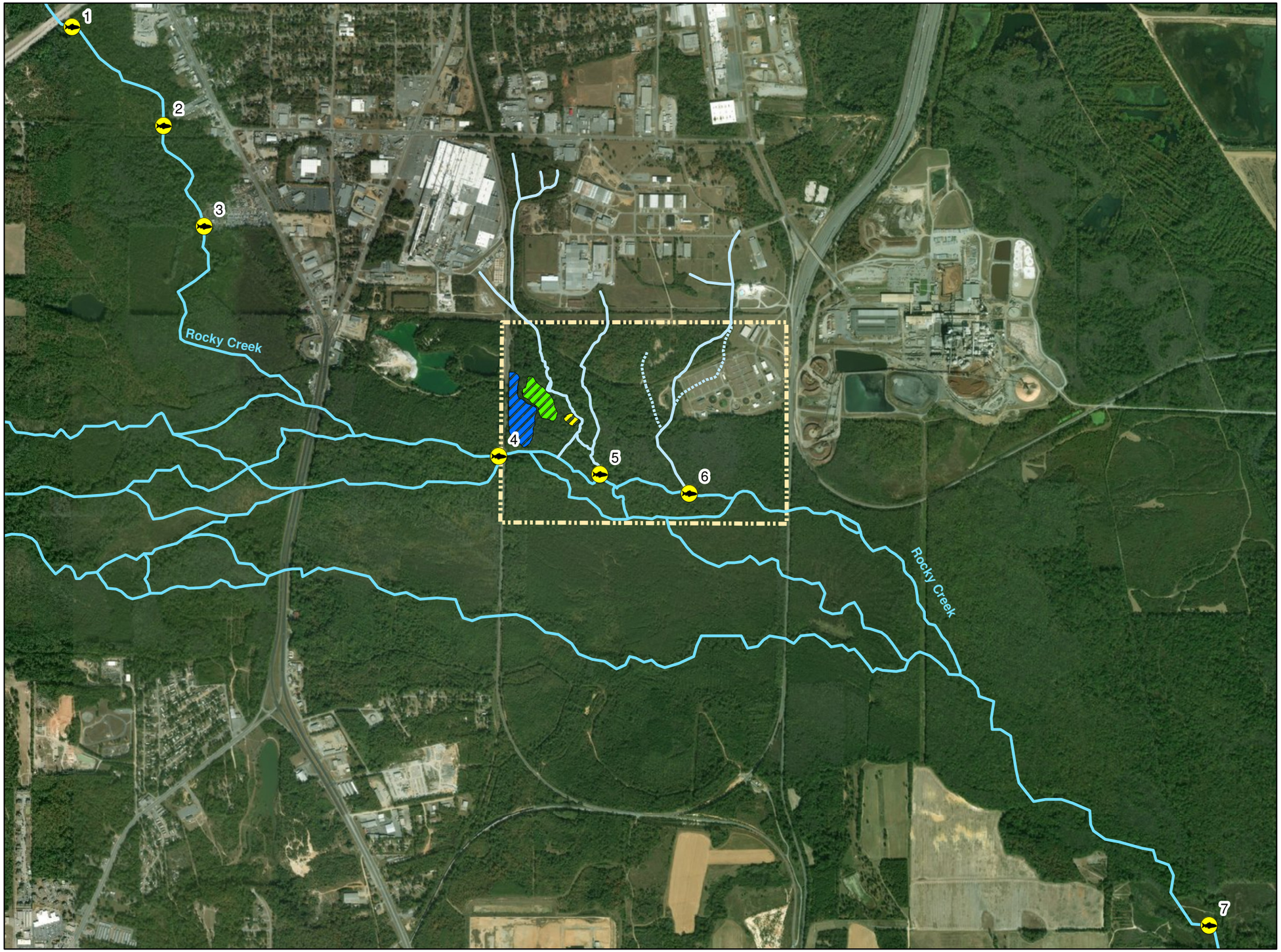


Historical and Proposed Surface Water Sampling Locations

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig 31_SW Data_prop.mxd

Figure No. 31



Legend

- Fish Tissue Collection Site
- OU2 (approx)

Landfills (approx)

- FMNOL
- Remote Landfill
- Explosives Demo Area

N

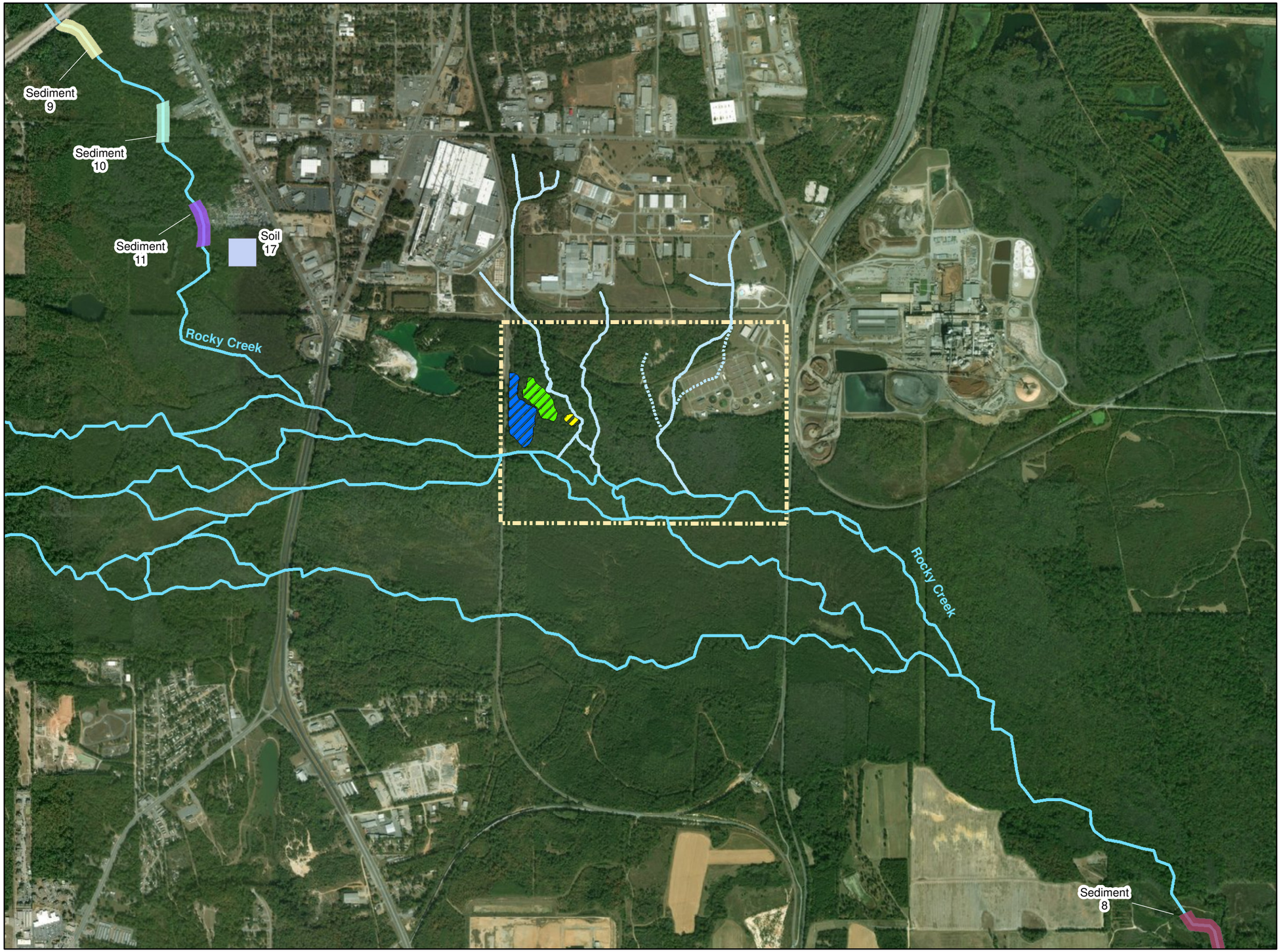
0 375 750 1,500
Feet

Proposed Fish Collection Sites

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig 32_Fish Sampling Locations.mxd

Figure No. 32



N

Legend

OU2 (approx)

Landfills (approx)

FMNOL

Remote Landfill

Explosives Demo Area

0 375 750 1,500

Feet

Proposed Background/Off-site Locations

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig 33_Proposed Background Locations.mxd

Figure No. 33

APPENDIX 0
Comments and Responses for Draft Documents

a Montrose Environmental Group company

July 24, 2019

Via Email

Mr. Brian Farrier
U.S. EPA Region IV
Superfund Remedial Section C
61 Forsyth Street, S.W.
Atlanta, GA 30103-8960
farrier.brian@epa.gov

Subject: **EPA Comments on the Draft Remedial Investigation/Feasibility Study Work Plan, Draft Field Sampling Plan and Draft Quality Assurance Plan**
Armstrong World Industries Superfund Site Operable Unit 2, Macon, GA
Administrative Settlement Agreement and Order on Consent for RI/FS Docket Number: CERCLA-04-2018-3759

Dear Mr. Farrier:

Thank you for EPA's timely review of the Draft Remedial Investigation/Feasibility Study Work Plan (Work Plan), Draft Field Sampling Plan (FSP) and Draft Quality Assurance Plan (QAPP) for the Armstrong World Industries AWI Superfund Site Operable Unit 2, Macon, GA (Site). We have received three separate memoranda and two emails from the USEPA containing comments on these documents. This letter provides responses to these comments. The original comments are provided below in italics.

May 23, 2019 Memorandum from Ben Bentkowski

General Comments

Work Plan

1. *There needs to be some clarification of geography of the site definition. The figures show a red line which bounds the study area that is AWI OU2. The Work Plan for the former Macon Naval Ordnance Plant (FMNOP) shows that the site figures overlap. The trichloroethene plume depicted on Figure 40 of the FMNOP Work Plan extends 2,500' south of the red line site definition. The Explosive Demo Area shown in yellow on Figure 3 of the FMNOP and AWI OU2 Work Plans is likely to be included in the definition of the FMNOP site as it appears to be excluded from the definition of Armstrong World Industries OU2, as described in Section IV(u) of the September 2018 AOC. The identification of the Armstrong OU2 'site' as overlapping with the MNOP 'site', as understood in Superfund, needs to be clarified.*

   Response: The outline for OU2 shown on the figures – including the Explosive Demo Area – is consistent with EPA's separate NPL listings for the AWI and FMNOP sites, as well as the definitions of "site" in the AOCs governing the RI/FS work for each site. EPA expressly included the FMNOP landfill within OU2, and the Explosive Demo Area was either part of or

adjacent to that landfill. The Explosive Demo Area is not excluded from the definition of "Site" in the OU2 AOC simply because it is not specifically identified in the definition. The definition of "Site" in the FMNOP AOC likewise does not identify the Explosive Demo Area. Thus, it is appropriate for the OU2 Work Plan to cover all of these areas.

The performing parties and their respective contractors for AWI OU2 and the FMNOP site plan to work cooperatively to share RI/FS data and appropriately apportion the RI/FS activities to avoid unnecessary duplication of effort between these two sites, particularly in any areas where the two sites' respective impacts may overlap somewhat. Thus, as described in the FMNOP Work Plan, ERM as the FMNOP site contractor will be investigating groundwater in the area south of the AIP/FMNOP property line, while EPS as the OU2 contractor will be gathering groundwater data in the vicinity of the AWI OU2 landfills. Likewise, EPS will gather any necessary data for the drainage ditches south of the AIP/FMNOP property line. As data are obtained for these and other media, the contractors will be sharing access to the available data for use in each site's respective RI/FS and to coordinate associated risk assessment activities.

2. *There is insufficient supporting information in the Work Plan about energetic compounds. There is no discussion about the type of devices that were disposed of in the Explosives Demo Area or the specific energetics associated with them. There is no indication that a full scan analysis was performed during the various previous site investigations. If full scan energetic analyses were used, please describe in detail history of the disposal area and the previous sample analysis methods and results. Based upon the information provided in response to this comment, EPA may recommend the AWI analyze those samples for energetic compounds by Method 8330/8095, as appropriate. Also, please provide a justification for limiting the Method 8330/8095 analytes, if that is part of the response to this comment.*

   Response: Limited information is available as to the type of devices that were present in the Explosives Demo Area. Although several energetic compounds were analyzed in the past, a full scan was not performed. Accordingly, the soil samples collected in the Explosives Demo Area decision unit will be analyzed for a full scan of energetics (Method 8330B). Additionally, the groundwater samples will also be analyzed for a full energetic scan instead of the limited analytes originally proposed.

Field Sampling Plan

1. *Based upon the resolutions about comments for the Work Plan, the Field Sampling Plan should be revised, as appropriate.*

   Response: The FSP will be revised as needed based on responses provided in this letter.

Quality Assurance Project Plan

1. *Based upon the resolution of General Comment 2 above, the Field Sampling Plan should be revised, as appropriate. Please reference WORKSHEET 15-7 energetics.*

   Response: The QAPP will be revised based on responses provided in this letter, which includes a full energetic scan for soil (Explosives Demo Area decision unit) and groundwater.

Specific Comments

Work Plan

None

Field Sampling Plan

1. *Section 2.6, pg.6 - This brief section discussed the collection of surface water from seeps that would be at the downgradient of the western-most landfill. Given the topography of the historical waste disposal, all three landfills are likely to have seeps. These seeps are groundwater merging into the surface water after some residence time in the landfill. As such, they may be the best representation of the remaining contaminants leeching from these landfills. Please plan on collecting two seep/surface water samples from the edge of each landfill as seasonal conditions allow at the time. All samples should be analyzed for the same suite of constituents as the other surface water samples with the exception of the samples collected adjacent to the explosives/demo landfill which should have analysis by Method 8330/8095 as appropriate to provide detection limits low enough to allow proper comparison the ecological and human health screening criteria.*

   Response: Two seeps were identified as part of our field site reconnaissance surveys conducted in December 2018 /January 2019. We will field verify seep locations prior to conducting sampling and attempt to determine the amount of flow relative to recent precipitation in order to determine if it is indeed an active seep. The goal will be to sample two active seep locations per landfill or Explosives Demo Area, if they are observed. If more than two active seeps at a landfill are observed, the ones that are sampled will be based on location (to be most representative of potential landfill impact), distance from other active seeps, and rate of flow (preference for seeps that have greater flow). Seep samples will be analyzed for constituents being analyzed in surface water and those constituents being analyzed in soils of the neighboring areas. In addition to the constituents being analyzed in surface water, all seep samples will be analyzed for PAHs and BEHP. Seeps adjoining the Explosives Demo Area will also be analyzed for perchlorates and energetics.

Quality Assurance Project Plan

None

May 30, 2019 Memorandum from Brett Thomas

Section 3, p. 23/406

The historical data were used to narrow down the COPC list for the site. There appeared to have been a substantial amount of sampling done in the past (between 1989 and 2011) that provided data for this COPC screening, but I do not know if the nature and spatial extent of sampling has been complete enough to provide a dataset appropriate for COPC screening. Those more familiar with the site will need to make that assessment. [Section 4 states that EPS believes the data set is

considered adequate for COPC screening.]

Response: The historical dataset is more than adequate to determine the list of constituents that are potential drivers of risk and/or remediation at the Site. As described in the Work Plan, 380 samples have been collected at the Site for a total of 24,640 sampling results comprising a broad range of constituents (a total of 445 different constituents). Additionally, these sample locations were biased toward areas expected to have potential impacts. The spatial extent of sample locations is provided in Figures 8-19 in the Work Plan.

Section 4, P. 26/406

The plan proposes to not analyze for dioxins/furans in the samples. A narrative argument is presented to explain why the report writers believe these compounds are not present due to site activities. These compounds have not been looked for previously either, so there is not information available as far as screening them out. Those more familiar with the site will need to make the assessment whether screening out dioxins/furans with a narrative statement rather than using site data is supportable or not.

Response: As discussed in the Work Plan, it is not believed that dioxins/furans are present at the Site due to historical site activities. It is likely that if dioxins/furans were detected at the site that they would be either from other anthropogenic (*e.g.*, the historical pulp mills and/or Graphics Packaging east of the site with known dioxin/furan releases) or naturally occurring (*e.g.*, the 2014, 2016, and 2017 wildfires) sources. However, to address USEPA's concern, we propose to conduct dioxin/furan analysis for the soil ISM samples collected from the Explosives Demo Area exposure unit, as this is the area most likely for dioxins to be potentially present (demolition of explosives could have produced small amounts of dioxin if burned in the presence of chlorine or organochlorine substances).

Section 6.3.5

HMW PAHs are a COPC and will be analyzed for in the risk assessments; are we sure that the LMW PAHs can be dropped? The LMW PAHs usually are present if the HMW PAHs are. It is true that the screening values for HMW PAHs are often lower than for LMW PAHs, but there are toxicological benefits for having a total PAH concentration (especially for assessments in aquatic systems). So I would recommend keeping the LMW PAHs in the analysis and reporting.

Response: Based on USEPA's comment, LMW PAH analysis will be added where HMW PAH analysis is being conducted (*i.e.*, soil and sediment samples).

Section 6.4.4.1, P. 41/406

For the risk driver evaluation, they calculated HQs by dividing the sample COPEC concentration by the Refined Screening Values (RSVs). And then of these HQs, they calculated an "average HQ" assumedly as a simple arithmetic average of the HQs. This is not really a conservative look at the contamination. The RSVs are often based on short term exposures, less sensitive organisms, etc. and therefore are often not applicable in areas that are expected to exhibit full ecological function, such as most of OU2. If the screening was simply to get an idea of what compounds may be risk drivers, that should be fine, but it should not be used for COPEC refinement, etc.

Response: The purpose of this evaluation was merely to determine the risk drivers and was not used for COPEC refinement.

Section 8.1.4. P. 50/406 and Figure 28, P.93/406

I have some concern about the large sizes of the DUs for Rocky Creek itself. SUs 6a, 6b, 6c (all part of DU6) are each roughly 1200-1500 feet long. I have concern that significant yet smaller portions of the creek sediments could have contamination in the sediments that could be detrimental to aquatic life and/or that could represent sources of contaminants like PCBs that could accumulate in aquatic biota. The concern with such large SUs/DUs is that we may not be able to identify these hotspot areas if they are small, yet they still could be causing issues. I agree that an "averaging" of contaminant concentrations gives a spatially integrated look at exposures, but sediment contaminant distribution can be very spotty, so I recommend using smaller DUs or at least smaller SUs in Rocky Creek and potentially the drainage ditches as well to better enable us to find hotspots if they are present.

Response: Additional comments were provided by the EPA on this subject. Please see the last comment and response in this document.

Section 8.1.5, P. 52/406

For surface water, Figure 14 shows that high concentrations of total PAHs were detected in a few water samples. Therefore, it is recommended to consider adding PAHs to the analyte list for surface water samples.

Response: All historical PAH results in surface water were below the screening criteria. The condition at the site is mature (*i.e.*, has had ample time to express itself). Furthermore, PAHs have low water solubility and readily absorb to sediments; thus, they are unlikely to be detected in surface water. Accordingly, we do not plan to analyze surface water for PAHs, however, PAH's are being analyzed in soil and sediment samples.

Section 8.1.7, P 54/406

It is stated that groundwater surface seeps observed will be sampled, and I agree this will likely be very important as far as potential identification of ongoing sources of contamination. For the locations, we had observed a major seep at the toe of one of the landfills. It is envisioned that there may be a number of seeps along the toes of all of the landfills and it is believed necessary to look for these seeps thoroughly and sample those that are found to make sure we do not miss a potential ongoing source of contamination to the wetland/creek. As far as analytes, the analytes proposed are the same as for surface water (P. 53/406) and are metals, PCBs, and specific VOCs. Because the seeps (likely landfill leachate?) may contain additional COPECs, it is recommended to consider adding PAHs, BEHP and anything else that we think may be reflective of whatever is buried in the landfills.

Response: We will perform a reconnaissance of the area near the landfills and Explosives Demo Area as part of our initial site field work to identify/locate seeps. Seep samples will be analyzed for those constituents being analyzed in surface water and soils of the neighboring area. In addition

to the constituents being analyzed in surface water, all seep samples will be analyzed for PAHs and BEHP. Seeps adjoining the Explosives Demo Area will also be analyzed for perchlorates and energetics.

June 17, 2019 Memorandum from Sydney Chan

Soil and Sediment Sampling

1. *Describe the sub-sampling methods to be used to limit bias when selecting the 10 gram subsample from each sampling unit. SSS recommends considering the use of a sampling device made for incremental sampling methodology (ISM) to reduce the need for subsampling, e.g. https://www.itrcweb.org/ism-1/5_2_Sampling_Tools.html*

   Response: Section 2.2 of the Field Sampling Plan specifies that where feasible the Collect-N-Go sampling kit will be used to collect 10-gram samples in accordance with ITRC guidance. However, we are also considering other sampling devices such as a soil probe type sampler (e.g., https://soilprobe.us/) and will consider the specific sampling device that will achieve a total volume of 1 kg per sample. ITRC guidance will be consulted to finalize the sampling methodology.

2. *Describe the sub-sampling methods to be used to limit bias when sorting into individual sampling containers for analysis, i.e. ensure equal particle size in each sample, https://www.itrcweb.org/ism-1/5_4_Field_Handling_of_ISM_Samples.html*

   Response: The sample collection methodology is random and unbiased by design as samples are collected at random locations. As described in Section 2.2 (soil) and 2.4 (sediment), each unit will be gridded into at least 30 grids. For each replicate, one aliquot will be collected at a random location within each of the grids, resulting in 30 or more aliquots. These aliquots will be placed in an individual bag. The 30 individual bags will then be placed in one larger bag. This entire process is completed three times to obtain triplicate samples (*i.e.*, a minimum of 90 aliquots will be collected in each unit). The sample bags will be sent to the laboratory. The laboratory will composite, dry, and sieve the material to the standard 2 mm sieve size, as specified in the ITRC guidance. The language in the FSP will be updated to clarify this process and the laboratory's Standard Operating Procedure for soil preparation will be added to the FSP and QAPP.

3. *Will soil/sediment samples be sieved and dried? If so, through what fraction size and how will drying occur. If not, SSS recommends sieving through a minimum of a No. 60 sieve (250 microns).*

   Response: Please see the response to the previous comment (#2).

4. *Within each Sampling Unit (SU) to be sampled with ISM, ensure that there is a minimum of 30-aliquots per sample. The sampling should specify how many aliquots are planned to be collected within each SU.*

   Response: As described in Section 2.2 (soil) and Section 2.4 (sediment) of the FSP: Each SU will be divided into 30 or more incremental sampling grids and 1 soil aliquot will be collected at random from each incremental grid to establish 1 replicate sample for each SU (each replicate sample is

comprised of 30 or more soil aliquots, 1 from each incremental sampling grid). The language in the FSP will be updated to clarify this process further.

5. *Please describe the sub-sampling procedures that will be used to process each sample in the lab. i.e. how will the lab maintain representativeness of each sample collected?*

   Response: Please see the response to comment # 2.

Fish Tissue Sampling

1. *Please add to the text how many fish of each species is proposed to be collected for analysis.*

   Response: The goal of how many fish to collect is specified in Section 2.7.3: "collection goal is three composite samples of each of the 5-target species comprised of 5 specimens in each composite." The 5 target species are specified in Section 2.7.1: Large-Mouth Bass, Bluegill, Channel Catfish, Black and White Crappie, and Spotted Sucker. It is important to note that this idealistic collection goal stems from DNR fish sampling protocols; however, it is a goal that is not typically obtainable. The collected specimens will be processed, measured and archived and we will interact with agency biologists as necessary to determine which to include for analysis.

General Comment

1. *This is not a risk assessment comment but a grammatical error. In section 2.8.1, the second sentence in the paragraph is missing the word "of". "A stainless-steel hand shovel will be used to penetrate the soil cover and to collect a sample* ***of*** *the underlying waste material.*

   Response: This correction will be made.

July 3, 2019 E-mail from Amy Potter (GAEPD) to Brian Farrier

Jill and I have completed our review of the workplan and have many of the same comments as EPA. We do have one new comment. The workplan includes analysis for RCRA metals, but does not include speciation for Chromium (III and VI). It may be prudent to speciate Chromium for a certain percentage of samples to determine if hexavalent Chromium is an issue at the site.

Response: Based on our review of historical documents there is no evidence that hexavalent chromium was used or generated as a part of OU2 site operations, or discharged to OU2 by the historic wastewater treatment plant operations upstream of OU2 at either FMNOP or AWI. Accordingly, we do not plan to perform chromium speciation.

July 9, 2019 E-mail from Glenn Adams to Joe Nicolette

I met with my staff and we discussed the concerns Brett raised on the "creek reaches" being proposed for ISM sampling. The main comment, concern, and request comes down to reaches 6A, 6B, and 6C. Because the other creeks feed into this part and there is more concern of potential hot spots in this part of the creeks, we request that those 3 "reaches" or sub-sections of the creek be divided into 5 sub-sections for sediment

sampling. This would only result in 2 additional samples, but from an ecological point of view would better cover the potential hot spot type exposure that may occur.

> **Response**: The sediment ISM sampling is focused on ecological risk and is not designed to identify hot spots. However, to address the EPA's concerns, this reach will be divided into 5 sections as shown on the attached figure.

Should you have any questions or comments regarding these responses, please do not hesitate to contact me.

Sincerely,

Joseph Nicolette
Project Coordinator
EPS, Inc.

cc:

Amy Potter: GA Department of Natural Resources (via email to Amy.Potter@dnr.ga.gov)
Timmerly Bullman (via email to tbullman@montrose-env.com)
Kirk Kessler (via email to kkessler@montrose-env.com)
John Ackiewicz (via email to jaackiewicz@armstrongceilings.com)
Joe Davis (via email to jadavis@armstrongceilings.com)
Bill Hahn (via email to wthahn@armstrongceilings.com)
Melinda Morrison, Esq. (via email to mlrmorrison@armstrongceilings.com)
Bonnie A. Barnett, Esq. (via email to bonnie.barnett@dbr.com)
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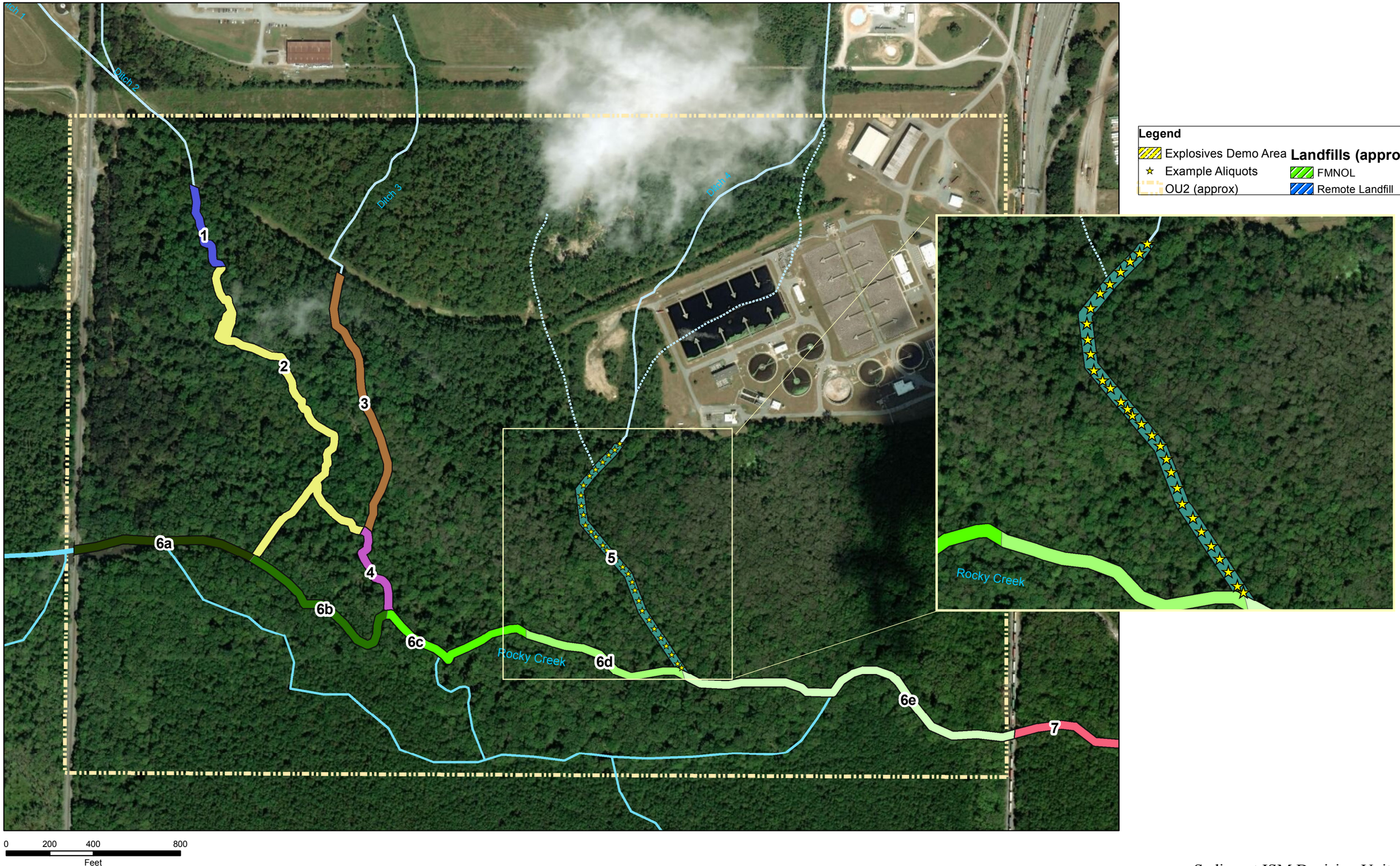
Chris S. Walker, Esq. (via email to chris.walker@klgates.com)
Max Wilson (via email to john.m.wilson@usace.army.mil)
E.J. Colbert (via email to eldries.j.colbert@usace.army.m



Sediment ISM Decision Units

EPS

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Figure No. 28

Timmerly Bullman

From: Joe Nicolette
Sent: Friday, August 9, 2019 8:39 AM
To: Farrier, Brian
Cc: Amy.Potter@dnr.ga.gov; Chan, Sydney; Thomas, Brett; Timmerly Bullman
Subject: RE: AWI OU2 RI Work Plan: Response to Comments
Attachments: SOILPREP- SUBS r1.pdf; Fig 14_PAH_revised.pdf; Table 9_Eco SW PCOPC_rev.pdf

Hi Brian,

Below are responses to the remaining comments you raised in recent e-mails.

From the e-mail dated July 29, 2019

> Sydney indicates that your draft response to her second comment focused on the collection process in the field, whereas she also wants clarification on the subsampling which is a an integral part of ISM. Is your response saying that the entire sample will be sent to the lab and the lab will subsample? If so, how will the lab be subsampling?
>
> *Response: The entire sample will be sent to the lab, who will conduct the subsampling. The lab's SOP for this is attached. This SOP will be included in the revised Field Sampling Plan. This methodology has been used at other Region IV superfund sites (e.g., LCP Chemicals).*
>
> Brett writes that: "… all of my comments from my May 30 memo appear to have been adequately addressed except for the one addressing the screening out of PAHs from surface water analysis, which is a comment for Section 8.1.5, P. 52/406. For this comment, regarding Figure 14, their response was that all of the PAH detections in surface water were below screening criteria, but they have at least one hit that was greater than 1 mg/L in surface water according to Figure 14. What was the screening value they used? I can't imagine this >1 mg/L sample passed. Table 12 (P. 246/406) presents a "refined screening" for eco and surface water where the only PAH they have listed is anthracene, and it says out of 10 samples they died not detect it. So, did they look for all of the PAHs? They are saying that "total PAHs" are being screened out of surface water. And Figure 14 shows 23 sample locations for PAHs in surface water. Like I say, Table 12 says there were 10 samples. So perhaps I have missed something, but I am not following their logic regarding PAHs in surface water. And I do agree with them that PAHs are not often in surface water due to solubility issues, but Figure 14 says they found them."
>
> *Response: Thank you for pointing out this inconsistency. There was an error in the surface water portion of Figure 14. It was mistakenly showing PCBs instead of PAHs. This has been corrected and the revised figure is attached and will be included in the final Work Plan. Table 9 from Appendix C (attached) of the Work Plan shows all of the PAHs that were analyzed in surface water. All of the samples were non-detect for all PAHs.*

From e-mail dated August 5, 2019

> "Jill and I have completed our review of the workplan and have many of the same comments as EPA. We do have one new comment. The workplan includes analysis for RCRA metals, but does not include speciation for Chromium (III and VI). It may be prudent to speciate Chromium for a certain percentage of samples to determine if hexavalent Chromium is an issue at the site."

Please consider adding Cr speciation for a select group of samples. We had asked the same of ERM for the MNOP site and their draft response was the same as yours; however, for that site we will also repeat this request again. For the MNOP site, we will propose Cr speciation for only about a half dozen samples, at most, and the AWI OU2 sample set can likewise be relatively small. We agree that the historical record may not show the use of hexavalent chromium at either site; however, the small sampling cost will have the benefit of ruling out this data gap. In a sense, this situation is somewhat analogous to the composite sample collected along Guy Paine Road during the OU1 EE/CA, which showed that PCBs were unlikely to be impacting offsite areas to the north.

Response: At the request of EPA and EPD, we will conduct chromium speciation in the soil samples collected from the Explosives Demolition Area decision unit.

We are moving forward with the edits to the RI/FS documents. Please note that the addition of chromium speciation will cause significant changes to the RI/FS documents, specifically the QAPP. Accordingly, we anticipate that we should be able to deliver the revised documents to you by **August 30th, 2019.**

Best Regards, Joe

Joseph Nicolette
Senior Principal

a Montrose Environmental Group company

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From: Farrier, Brian <Farrier.Brian@epa.gov>
Sent: Monday, August 5, 2019 9:32 AM
To: Joe Nicolette <jnicolette@montrose-env.com>; Jnicolette@envplanning.com
Cc: Amy.Potter@dnr.ga.gov; Chan, Sydney <chan.sydney@epa.gov>; Thomas, Brett <Thomas.Brett@epa.gov>
Subject: RE: AWI OU2 RI Work Plan: Response to Comments

Joe:

While reviewing the response to comments on the OU2 RI/FS Workplan, I noticed that Amy did not copy you (nor did I forward) their comment, as follows:

"Jill and I have completed our review of the workplan and have many of the same comments as EPA. We do have one new comment. The workplan includes analysis for RCRA metals, but does not include speciation for Chromium (III and

VI). It may be prudent to speciate Chromium for a certain percentage of samples to determine if hexavalent Chromium is an issue at the site."

Please consider adding Cr speciation for a select group of samples. We had asked the same of ERM for the MNOP site and their draft response was the same as yours; however, for that site we will also repeat this request again. For the MNOP site, we will propose Cr speciation for only about a half dozen samples, at most, and the AWI OU2 sample set can likewise be relatively small. We agree that the historical record may not show the use of hexavalent chromium at either site; however, the small sampling cost will have the benefit of ruling out this data gap. In a sense, this situation is somewhat analogous to the composite sample collected along Guy Paine Road during the OU1 EE/CA, which showed that PCBs were unlikely to be impacting offsite areas to the north.

Thank you for your consideration of our comments on the AWI OU2 Work Plan.

Brian

From: Farrier, Brian
Sent: Monday, July 29, 2019 3:05 PM
To: Joe Nicolette <jnicolette@montrose-env.com>; Jnicolette@envplanning.com
Cc: Potter, Amy <Amy.Potter@dnr.ga.gov>; Chan, Sydney <chan.sydney@epa.gov>; Thomas, Brett <Thomas.Brett@epa.gov>
Subject: RE: AWI OU2 RI Work Plan: Response to Comments

Joe:

Thank you for the opportunity to review your draft response to our comments on the AWI OU2 RI/FS Work Plan. Sydney and Brett have asked for additional clarification on two issues, see below (Ben had no further comments). If you have any questions, please call Sydney and Brett and feel free to discuss before finalizing the work plan documents.

- Sydney indicates that your draft response to her second comment focused on the collection process in the field, whereas she also wants clarification on the subsampling which is a an integral part of ISM. Is your response saying that the entire sample will be sent to the lab and the lab will subsample? If so, how will the lab be subsampling?

- Brett writes that: "… all of my comments from my May 30 memo appear to have been adequately addressed except for the one addressing the screening out of PAHs from surface water analysis, which is a comment for Section 8.1.5, P. 52/406. For this comment, regarding Figure 14, their response was that all of the PAH detections in surface water were below screening criteria, but they have at least one hit that was greater than 1 mg/L in surface water according to Figure 14. What was the screening value they used? I can't imagine this >1 mg/L sample passed. Table 12 (P. 246/406) presents a "refined screening" for eco and surface water where the only PAH they have listed is anthracene, and it says out of 10 samples they died not detect it. So, did they look for all of the PAHs? They are saying that "total PAHs" are being screened out of surface water. And Figure 14 shows 23 sample locations for PAHs in surface water. Like I say, Table 12 says there were 10 samples. So perhaps I have missed something, but I am not following their logic regarding PAHs in surface water. And I do agree with them that PAHs are not often in surface water due to solubility issues, but Figure 14 says they found them."

Amy, please let Joe know if GAEPD will comment further, re their draft response to comments.

Thanks,

Brian

From: Joe Nicolette <jnicolette@montrose-env.com>
Sent: Wednesday, July 24, 2019 5:14 PM
To: Farrier, Brian <Farrier.Brian@epa.gov>
Cc: Timmerly Bullman <tbullman@montrose-env.com>; Kirk Kessler <kkessler@montrose-env.com>; amy.potter@dnr.ga.gov; John A. Ackiewicz <jaackiewicz@armstrongceilings.com>; jadavis@armstrongceilings.com; wthahn@armstrongceilings.com; Melinda Lr. Morrison <mlrmorrison@armstrongceilings.com>; Barnett, Bonnie A. <Bonnie.Barnett@dbr.com>; Josko, Nicole D. <Nicole.Josko@dbr.com>; RDavis@seyfarth.com; VAdams@adamsjordan.com; Gupta, Prashant K <prashant.gupta@honeywell.com>; Brett.Marston@arnoldporter.com; bart.seitz@bakerbotts.com; Gribben, Kirk J. <Kirk.Gribben@arconic.com>; Prezbindowski, Robert <Robert.Prezbindowski@arconic.com>; Chris.Walker@klgates.com; john.m.wilson@usace.army.mil; eldries.j.colbert@usace.army.mil
Subject: AWI OU2 RI Work Plan: Response to Comments

Hi Brian,

On behalf of the AWI OU2 Respondents, I have attached our response to the comments received from the USEPA. Please let me know as soon as possible if you have any questions so that we can initiate changes and finalize the RI Work Plan.

Best Regards, Joe

Joseph Nicolette
Senior Principal

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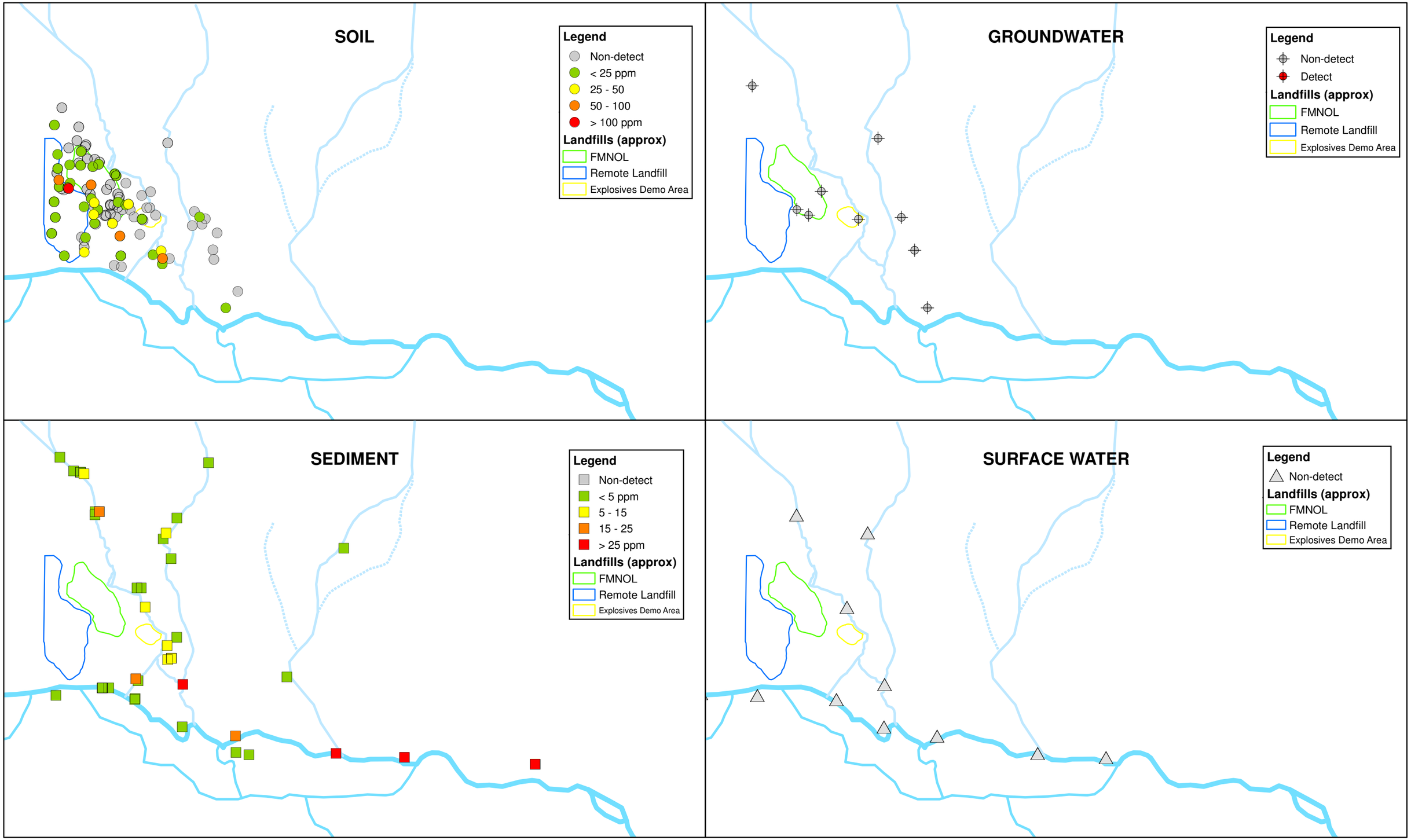

Extent of Total PAHs

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig 14_PAH_revised.mxd

Figure No. 14

SUBSAMPLING AND COMPOSITING OF SAMPLES

DOCUMENT I.D. SOILPREP-SUBS

Approved By: _____ Date: 8/8/18
Sample Preparation Manager, Jonathon Walter

Prepared By: _____ Date: 8/8/18
Quality Assurance Manager, Carl Degner

Prepared By: _____ Date: 8/9/18
General Manager, Ambrose Hughey

Annual Review:

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Reviewed By: _____ Date: _____

Doc Control ID:	_____	Archived Date:	_____

ALS-Kelso SOP Annual Review Statement

SOP Code: SOILPREP-SUBS
Revision: 1

An annual review of the SOP listed was completed on (date): **7/13/18**

☐ The SOP reflects current practices and requires no procedural changes.

Supervisor: Date:

☒ Revision of the SOP is needed to reflect current practices. Draft revisions are listed below.

SOP Section Number	**Description of Revision Needed**	**Date Procedure Change Implemented**	**Supervisor Initials** Indicating Approval of Revision
11.7.2	When creating aliquots for METALS, Mercury aliquots should be 5 grams and all other metals aliquots should be 10 grams.	5/30/17	SC
	Current Templates with locked calculation cells to be added to the SOP.	2/1/18	SC
11.2	Remove all of this section on aqueos samples.	7/16/18	SC
11.10.2	Remove	7/16/18	SC
11.10.3	Remove	7/16/18	SC

ALS-Kelso SOP Annual Review Statement

SOP Code: SOILPREP-SUBS

Revision: 1

11.10.4	Remove	7/16/18	SC
11.10.5	Third bullet point should read "Cut strips 7 1/2, 5, and 2 1/2 inches. This will make a total of 16 2 1/2" squares. The fourth bullet point should read place all squares into a large ziploc bag.	7/16/18	SC
11.10.7	Should read " Determine the total mass of sample neeed to aliquot for all tests. Divide the total mass by the number of samples to be composited. Shed that mass of each sample to be composited together into a single container. Homogenize throughly once all fractions have been shredded. Aliquot each sub sample from this final mass."	7/16/18	SC
11.10.8	Remove	7/16/18	SC
11.10.9	Remove	7/16/18	SC
11.3.4	Add section: Air drying: If samples are to be air dried they will be set out in cleaned pans to dry at room temp and conditions. If the samples are for DOD work, they will be dried to a constant weight with a confirmation of 4% or less weight loss. The sample weights will be recorded on the constant weight bench sheet.	8/23/18	SC/JW

Attach additional pages or information if necessary

X

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1) Scope & Applicability

1.1 This standard operating procedure describes procedures for obtaining subsamples used for laboratory analysis. The procedure also describes general practices for making composite samples from multiple individual samples. Procedures are given for aqueous, soil, sediment, vegetation and miscellaneous matrices. The SOP does not apply to tissue samples. Procedures for tissue samples are described in the GEN-TISP and MET-TDIG SOPs.

1.2 The SOP describes routine, or default, procedures for samples that do not require VOC analyses. Handling of VOC samples is described in SOP VOC-5035. Program or project-specific requirements may differ from those described in the SOP. Samples analyzed by EPA CLP procedures are specifically excluded from this procedure, and will be handled according to the applicable SOW.

1.3 Multi-increment samples require special handling and subsampling procedures. In addition to routine procedures, this SOP also includes instructions for handling and sampling from multi-increment samples submitted to the laboratory.

1.4 This procedure does not apply to situations where the entire sample (container) is used for the analysis.

1.5 In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. For example, projects falling under DOD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD/ADM-DOD5)* may supersede the requirements defined in this SOP,

2) Summary of Procedure

2.1 Obtaining a representative analytical subsample from the field sample submitted is essential to providing meaningful data. The subsample must be taken to most closely reflect the predominant composition of the sample. For aqueous and liquid samples, this is usually accomplished by shaking or inverting the sample. For soil, sediment, powders, and other solids the procedures are more involved. Procedures for subsampling are based on the information given in the references listed.

2.2 Some projects may employ multi-increment (MI) sampling in the field. The primary objective of MI sampling is to control the certain statistical errors associated with discrete sampling. Some studies have shown that MI sampling, using 30+ sample increments within a decision unit (a defined field sampling area) may provide a more representative view of contaminant concentrations than traditional discrete sampling approaches. References listed provide additional background on MI sampling. When this approach is taken it is important that laboratory procedures are consistent with field procedures when taking samples.

2.3 Unique sample matrices such as vegetation, wood and wood chips, mechanical parts and filters, etc. pose additional challenges to obtaining representative samples. For these samples the laboratory staff should consult with the Project Manager to determine the subsampling strategy. These special situations will be handled on a case-by-case basis. Service requests should list any specific sample preparation required.

3) Definitions

3.1 Batch - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.1.1 Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.

3.1.2 Analysis Batch - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc.) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2 Sample

3.2.1 Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2 Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.2.3 Sample – A portion of material taken from a larger quantity for the purpose of estimating properties or composition of the larger quantity (ASTM).

3.2.4 Subsample – A portion of a sample taken for the purpose of estimating properties or composition of the whole sample (ASTM).

3.2.5 Composite sample – A mixture of multiple samples or subsamples produced to result in one sample representative of multiple field samples.

3.2.6 Representative subsample – A subsample collected in such a manner that it reflects one or more characteristics of interest (a defined by the project objectives) of the laboratory sample from which it was collected (ASTM).

3.2.7 Multilayered sample – A sample consisting of two or more clearly differentiated components (ASTM).

3.2.8 Multi-increment sample (MIS) – A field sample consisting of multiple bulk containers from one decision unit (defined in a MIS sampling plan) submitted to the lab for subsampling into a representative sample for analysis. Also known as Incremental Sampling Methodology (ISM).

3.3 Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.4 Laboratory Control Samples (LCS) – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts of target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

3.5 Duplicates and Duplicate Matrix Spikes are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed.

4) Responsibilities

4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.

4.2 It is the responsibility of the department supervisor/manager to document analyst training and method proficiency, as described in the *ALS-Kelso Training Procedure* (ADM-TRAIN).

5) Interferences

5.1 When obtaining subsamples it is important to minimize any chances for sample contamination or cross-contamination between samples. Work should be performed in an organized and neat manner. Spilling of samples (from overfilled containers, etc.) should be minimized and spills cleaned up. Equipment and laboratory tools used with samples should be cleaned between samples to prevent cross-contamination.

5.2 Analysis-specific interferences are described in the applicable analytical SOP.

6) Safety

6.1 All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

6.2 Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Chemical Hygiene Plan and the appropriate SDSs prior to beginning this method.

7) Sample Collection, Containers, Preservation, and Storage

7.1 Refer to the analytical SOP for sample collection preservation and storage of samples. Subsamples and composite samples held for later analysis should be preserved and stored in the same manner as specified for field samples.

7.2 MIS Projects

7.2.1 Projects for MI samples may include additional instructions not found in the analytical SOP. The analyst should consult with the Project Manager, or refer to the Project Manager's instructions, prior to working with these samples.

7.2.2 LIMS test codes are used to specify which MIS-analytical tests are needed (e.g. ISM-PAH). These test codes will have holding times associated with them that will ensure the completion of the MIS work before the initial analytical holding times (e.g. sample extraction) lapse.

8) Apparatus and Equipment

8.1 Laboratory balance capable of weighing the desired sample mass. There are various makes and models of balances available for use, with each department having balances appropriate for its use. For weighing solids and non-aqueous liquids (wastes), use a top-loader balance. Ensure that the mass (sample + container) to be placed on the pan is within the calibration-verified range of the balance.

8.2 Balance calibration verifications must be performed prior to use on each day of use. The calibration verification weights must bracket the range of use. For additional information, refer to the SOP *Documenting Laboratory Balance and Temperature Checks* (ADM-BAL).

8.3 Wiley laboratory mill, Model 4. Operate the Wiley mill following the manufacturer's recommendations.

8.4 Sieve shakers.

8.5 Shatter box.

8.6 Mechanical mixer and/or shaker.

8.7 Stainless steel or Glass mixing bowl.

8.8 Metal or disposable spoons and spatulas.

8.9 Aluminum foil.

8.10 Weighing boats, plastic or aluminum.

8.11 Clean sample containers and lids (various sizes) as specified in the applicable test SOP.

8.12 Common laboratory glassware/apparatus (beakers, flasks, pipets, syringes, etc.).

8.13 Multi-Increment Samples

8.13.1 Flat spatula, modified to create sides perpendicular to the flat surface used to scoop.

8.13.2 Flat stainless steel masons trowel.

8.13.3 Volatile sample containers.

8.13.3.1 250-500 milliliter (mL) narrow mouth, amber bottles (recommended).

8.13.3.2 4-8 ounce (oz.) amber jars with Teflon lined septum lids.

8.13.4 Large stainless steel spoon or scoop.

8.13.5 Large clean containers (a large stainless steel or glass bowl, Ziploc bags, or 5 gallon bucket).

8.13.6 #10 (2 mm) sieve.

8.13.7 Stainless steel cookie sheet or other tray.

9) Standards, Reagents, and Consumable Materials

9.1 All stocks, working solutions and sample dilutions should be prepared using deionized water (DI) conforming to ASTM Type I or ASTM Type II reagent water. For more information on reagent water generation, refer to the related SOP, Operation and Maintenance of Laboratory Reagent Water Systems.

9.2 To provide traceability, manufacturer lot numbers of solvents, reagents, standards and supplies used in an analysis shall be recorded on each analytical procedure's batch record, whether it is on the analytical record and/or into a logbook.

9.3 Dichloromethane, acetone, methanol, and acetonitrile may be used during the noted procedures for cleaning and decontamination of equipment.

10) Preventive Maintenance

10.1 All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described herein. The entry in the log must include: date of event, the initials of who performed the work, and a reference to return to analytical control.

11) Procedure

11.1 Aqueous samples - Subsampling

11.1.1 Examine the sample. Thoroughly mix all samples by vigorous shaking. Immediately open the container and obtain the subsample. Additional filtering of the subsample may be required by the analytical SOP.

11.1.2 If the sample is multi-layered (a water layer with a sand/sediment layer that cannot be mixed or non-aqueous liquid layer) the Project Manager should be consulted on how to proceed with the sample. Additional analyses or sample preparations may be necessary depending on the client's data needs. Document the condition of the sample and decision made on subsampling.

11.2 General considerations – Non-liquid samples

11.2.1 The analyst must first understand what the sample matrix of interest is. The project information should be consulted. If the sample appears to be homogeneous (other than extraneous materials described below) particle size reduction is not necessary. Particle size reduction should be performed only when required by the project QAPP, project specifications, or client request. If particle size reduction is required, use the appropriate apparatus (Wiley mill, shatter box, etc.) to perform crushing, grinding, milling, or sieving, and document. Refer to ASTM D6323 for guidelines on performing particle size reduction.

11.2.2 Once the matrix of interest is known, examine the sample for presence of extraneous material. The default procedure is to remove these items, or not include in the representative subsample. However, the presence of these materials should be documented in lab records and the Project Manager should be consulted prior to subsampling. Some examples are given below.

- Soil, solid, and sediment samples may include such material as larger, rocks, sticks, leaves, pieces of metal, man-made materials, etc.
- Wood or bark samples may include chunks of soil, mud, rocks, etc.
- Vegetation samples may include chunks of soil, mud, rocks, sticks (not of the sample type, etc.).
- Sediment samples may include rocks, twigs, vegetation, organisms, etc.
- Sediment/marine projects, organisms are typically analyzed under separate sampling and analysis plans.
- Mechanical parts, filters, etc., may include chunks of soil, mud, rocks, sticks, etc.

11.2.3 Examine soil samples to determine if the sample contains significant amounts of water. If the amount of water is greater than approximately 30%, treat the sample as a sediment sample.

11.2.4 Samples which are especially heterogeneous, as well as various special matrices, may require additional preparation. These will be handled on a

case-by-case basis after consultation with the appropriate supervisors and Project Manager. Unique matrices for TCLP and other leaching procedures should be handled according to the applicable SOP or reference method.

11.3 Soil/solid Samples

11.3.1 Subsampling samples in jars

11.3.1.1 Using a spatula or other utensil made of an inert material, thoroughly mix and homogenize the sample, making sure to loosen sample from the sides of the container, and continue mixing the entire contents, breaking up soil clumps, etc., until there is no visible segregation of the sample by layer, grain size, color, etc. The sample should appear uniform in color and texture.

11.3.1.2 Once mixed, remove the desired mass of sample for the analysis and document accordingly. Recap the jar and return to storage.

11.3.2 Subsampling samples in sleeves (core samples) and large bulk containers.

11.3.2.1 Empty samples in sleeves into a metal or glass homogenizing container and thoroughly stir using a spatula or other utensil. When homogenized the appropriate sample portions are placed in jars. Perform additional drying and grinding only when specified for the project. Client specifications for drying and grinding will be communicated by the Project Manager.

11.3.2.2 When working with sleeves and resulting homogenized samples or subsamples, always double-check the sample ID on the sleeve against the sample numbers on the samples.

11.3.3 Compositing soil/solid samples

11.3.3.1 Thoroughly mix each individual sample as described above.

11.3.3.2 Combine equal masses from each of the individual samples into a clean stainless steel mixing bowl. The amount used will depend upon the number of analyses to be performed on the composite and/or the amount available. The analyst preparing the composite will document the mass of each individual sample used for the composite, the date and time of compositing, and any other pertinent observations using the Composite Data benchsheet.

11.3.3.3 Thoroughly homogenize the sample using a spatula or other utensil and returned to clean glass jars. The sample container is labeled as a composite and with the sample identification.

11.3.3.4 Return the composite sample and remaining individual samples to storage.

11.4 Sediment Samples - Subsampling

11.4.1 Standard procedure calls for mixing overlying water into the sample. EPA SW-846 methods for organic extractions specify to decant and discard overlying water. However, the Puget Sound Protocols and others have options for decanting and discarding this water, decanting and performing a separate water analysis, or mixing the water into the sample. The analyst should confirm which option is to be used on the sample. For projects not within the scope of the Puget Sound Protocols or similar project plans, the overlying water should be decanted and discarded for organics analysis. For metals and inorganics, mix the overlying water into the sample.

Note: If water is decanted and discarded and percent solids is to be applied or determined, a separate solids determination must be made on the decanted sample.

11.4.2 Thoroughly mix and homogenize the sample, making sure to mix the entire contents of the jar. Additional steps may be needed to homogenize the sample (break up soil clumps, etc.). The sample should be mixed so there is a uniform color and texture.

Note: Sediment samples may contain considerable amounts of organics matter. Ensure that samples are thoroughly mixed. Document the presence of substantial organic matter, shells, etc.

11.4.3 Once mixed, remove the desired mass of sample for the analysis and document accordingly. Recap the jar and return to storage.

11.4.4 The subsample is transferred to an appropriate, labeled container. The sample container is stored in the appropriate refrigerator in sample receiving and any empty sleeve can be stored at room temperature.

11.5 Sediment Samples - Compositing

11.5.1 Thoroughly mix each individual sample as described above.

11.5.2 Combine equal masses from each of the individual samples into a clean stainless steel or glass mixing bowl. The amount used will depend upon the number of analyses to be performed on the composite and/or the amount available. The analyst preparing the composite will document the mass of each individual sample used for the composite, the date and time of compositing, and any other pertinent observations using the Composite Data benchsheet.

Note: Equal masses are used unless otherwise instructed. It may be required to use the entire jar or other measure.

11.5.3 The sample is thoroughly homogenized using a spatula or other utensil and returned to clean glass jars. The sample container is labeled as a composite and with the sample identification, dated, and initialed.

11.5.4 The composite sample and remaining individual samples are returned to storage.

11.5.5 Samples should be received prepared from the field as sample increments.

Although unlikely, in cases where proper preparation of increments from large bulk samples does not occur in the field, the following steps will be taken.

11.5.5.1 When obtaining sample increments from a large bulk container (bucket, large jar, large bag, etc.) be sure to sample from the center and remove the soil 1-2 inches deep. Using the large spoon or scoop, collect the sample increment according to the work plan. Scoop approximately 30-60 grams into a large, clean container and move on to the next sample increment location. Be cautious of oversize material, which means more mass may need to be taken from each increment to end with the 30–50 g sub-sample after sieving (a 5 Kg field sample may not be uncommon). Increments can be sieved directly into the bucket, or they can be bagged and sieved later.

11.6 Multi-Incremental Sampling (or Incremental Sampling Methodology (ISM)) – When laboratory subsampling using MIS/ISM is to be used to produce the analytical subsample(s), the following procedures are used. If, after reviewing the project and Service Request information, the analyst has any uncertainty of the MIS approach to take, they must confirm with the Project Manager the protocol to be used.

NOTE: The default procedure is to be used when no other client or project specifications or modifications are given. This section refers to two tables – one specifying default increment amounts for analytical and one listing a "large mass" option that is to be used only when project specified. In addition, the State of Hawaii DOH protocol is to be used when requested. A procedure for the analysis by Method 8330B is also given.

11.6.1 Default procedure

11.6.1.1 After the 30-50 sample increments have been field collected into a container (a 5 Kg field sample may not be uncommon) air dry the entire sample (all received containers) in aluminum pans pre-rinsed 3 times with DCM (dichloromethane/methylene chloride). Note, if Aluminum is a target analyte of interest then substitute the aluminum pans for glass or stainless steel. Air drying may take 2-4 days with occasional stirring.

11.6.1.2 The intent of air drying is to convert the sample to a more manageable form prior to sieving. The sample is considered air-dried when the material appears dry enough to enable disaggregation and sieving. Due to high variability of laboratory samples, sample dryness should be confirmed by a senior analyst or supervisor prior to going further with the procedure. For work performed under DOD QSM, constant weight data will be recorded on the Constant Weight Data Sheet (Hyperlink in Section 20).

11.6.1.3 Rinse all utensils and equipment with DCM three times prior to use (stainless steel tray, mortar & pestle, 2 mm sieve & catch pan, trowel, ISM spatula).

11.6.1.4 Lightly grind the air dried sample with a mortar & pestle in order to break up dirt and clay chunks (do not size reduce rocks or vegetation) and pass sample through a 2 mm sieve.

11.6.1.5 Weigh the remaining +2 mm fraction in an appropriate sized jar and record the weight on the Air Dried Sieve Data benchsheet (Figure 1). Describe the +2mm fraction on the bench sheet (size of rocks, type of any vegetation, etc.).

11.6.1.6 Weigh and record the weight of the -2 mm fraction on the Air Dried Sieve Data benchsheet (Figure 1).

11.6.1.7 Mix the sample, dump on a DCM-rinsed stainless steel pan, and spread the sample out with a trowel, forming a rectangle no more than 1cm deep.

11.6.1.8 Divide the sample into a minimum of 30 equal sections (30 to 50 sections is recommended) using the trowel blade. Note that the entire sample should be included in the grid and amount of sample 'outside' the grid outer edges minimized (however, do not overly manipulate the sample in an attempt to create a perfect grid).

11.6.1.8.1 Collect an equal (approximate) amount of sample from each of the sections based on the applicable table (Table 1 or Table 2) and place into a labeled container (see Tables 1 and 2). Scrape the modified flat spatula along the bottom of the tray and pull straight up to make sure all depths and particle sizes are represented in the collection area. Avoid collecting portions from the edge of gridlines (where the slab has been disturbed). Record the exact final weight of sample for each test on the ISM bench sheet and on the jar. All weights shall be measured using an analytical balance.

11.6.1.8.2 Since each laboratory area must analyze the entire contents of the prepared (or submitted) jar, the subsampling process must be repeated for each separate analysis to be performed on the sample. The subsampling process must be performed for each individual QC sample as well. The entire mass in the jar will be analyzed (TOC is the exception). The results may be less defensible if only a subsample or fraction of the jar contents is analyzed.

11.6.1.8.3 If sample amount is sufficient, it is recommended to repeat the process to obtain a backup sample in the event that re-analysis is required. This 'As Received' backup is placed back in the original sample jar and returned to sample management/custody.

11.6.1.9 Labeling and storage

11.6.1.9.1 Refer to Table 3 for default storage conditions, which are based on how the MIS sample was prepared and on the stability/volatility of target analytes.

11.6.1.9.2 MIS subsamples do not need to be returned to SMO for barcode labeling. Label the aliquots with labels from "prep App" and deliver them directly to the labs. Document the internal custody transfer directly on the benchsheet that is delivered with the samples.

11.6.1.9.3 Place any remaining -2mm sample into jars labeled as "-2 mm archive." If there are multiple jars, label them as "1 of 3", "2 of 3", etc. All remaining bulk sample jars must be returned to SMO for barcode labeling and storage.

11.6.1.9.4 Usually, the -2 mm archive and test archive (back-up samples) jars are placed in a freezer, while the +2 mm archive and test jars (with QC) are placed on the room temperature shelves.

11.6.2 Procedure for ISM following State of Hawaii DOH Protocol (see references)

11.6.2.1 Samples requesting the Hawaii DOH procedure require wet and/or dry sieving depending on the test/analytes for which subsamples are being prepared. Refer to a copy of the Hawaii DOH procedure and/or the Project Manager for details before beginning.

11.6.2.2 Obtain instructions from the Project Manager or Service Request for increment amounts and test subsample amounts. Also refer to the *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, November 12, 2008, Section 4.2.2 for guidance on increment/sample amounts.

11.6.2.3 Subsample bulk MI samples to be tested for SVOCs, including TPH-D, some PAHs, Mercury, and unstable pesticides, should be subsampled without drying or sieving in order to minimize chemical loss or alteration and meet holding times for analysis. Refer to Table 2a of *Technical Guidance Manual Notes: Decision Unit and Multi-Increment Sample Investigations*, March 2011, State of Hawaii, Department of Health, and Reference document number 2011-143-RB.

11.6.2.4 If both SVOC and non-volatile PAHs are targeted contaminants of interest then include testing for both in laboratory subsamples collected from the multi-Increment sample prior to drying and sieving.

11.6.2.5 When creating aliquots for METALS, Mercury aliquots should be 5 grams and all other materials aliquots should be 10 grams.

11.6.2.6 For wet ISM aliquots, organic tests (SVG/SVM) require a larger aliquot size to accommodate for the extra water content. In most cases, low-level organic tests will require a 40 g wet aliquot (max weight capacity for most tests) and normal level tests will require a 20 g wet aliquot (double the target dry weight).

11.6.2.7 Use a separate sample from the wet material and test for soil moisture in order to convert analytical results to dry-weight basis.

11.6.2.8 Not all samples from Hawaii require the State of Hawaii DOH procedure. See service request and/or verify with the Project Manager.

11.6.3 Procedure for ISM on 8330B Explosives

11.6.3.1 Samples from Ammunition Depots and anywhere except Firing Ranges (not DOD).

11.6.3.1.1 Follow the basic ISM procedure, except all utensils/pans need rinsed 3 times with Acetonitrile (instead of DCM). Collect a 10.00 g aliquot and place in a 4 oz. amber jar (explosives are UV sensitive).

11.6.3.2 Samples from Firing Ranges

11.6.3.2.1 Grinding: For firing ranges, the entire -2 mm portion collected from the sieving procedure must be ground to a powder in the shatter box.

11.6.3.3 Method 8330B DOD samples

11.6.3.3.1 Grinding: For DOD work, the entire -2 mm portion collected from the sieving procedure <u>must</u> be ground to a powder in the shatter box prior to proceeding. Note: high-speed milling, such as in the shatter box, can elevate sample temperature due to friction. The thermal stability of the target analytes should be considered when performing this grinding procedure. Method 8330B specifies a 2 minute (or longer) cool down period between every five, 60 second grinding intervals to maintain acceptable temperatures and minimize loss of volatile energetic contaminants.

11.6.3.3.2 An SRM (supplied by the Organic LC instrument lab) must be taken through the grinding and ISM procedure (already dry so doesn't need to be air dried or sieved). Shatter box 50 - 100 g of the well-mixed SRM, and then make a 10 g aliquot after grinding. Place the aliquot in 4 oz. amber jar. Archive the remaining SRM in an amber jar.

11.6.3.3.3 Grinding Blank: Matrix sand blanks (use baked sand) must be ground in the shatter box between each sample and aliquoted following the ISM procedure. The blanks can be ground in equal portions and then recombined at the end to make one sample requiring one ISM aliquot procedure. (Example: To ISM a 200 g portion for use in making the final 10 g aliquot, divide 200 g by the number of samples needing shatter box and grind that amount of matrix sand between each sample. Recombine all ground matrix sand at the end and ISM one 10 g aliquot from the 200 g of

ground matrix sand.) Archive the remaining matrix sand in an amber jar.

11.7 Analyte-Specific Considerations

11.7.1 Metals

11.7.1.1 It has been proven that grinding can greatly improve the reproducibility for metals analyses. However, erosion of the metals surfaces used in grinding may contribute to a high bias in the samples. It is recommended that the tungsten carbide grinding mill is used when grinding soils in the shatter box thereby limiting the amount of potential bias in the prepared samples.

11.7.1.2 When grinding soil samples that may potentially contain ores of malleable metals (e.g. Lead, Copper, Tin) be aware that the malleable particles may tend to smear during grinding, and may be lost from the samples to equipment surfaces. This anomaly may bias sample results low, decontamination of equipment surfaces may be difficult and could result in high bias in subsequent samples from carry over.

11.7.1.3 Reproducibility for Lead analyses in unground, incrementally sampled (IS) samples from small arms firing ranges may have an unacceptable large variability. The large variability for Lead may be due to single particles of Lead between one and two millimeters in diameter being present in only some of the replicate splits. If the end data is to assess risk of accidental ingestion of Lead, precision for the concentration of lead contained in larger particles may be of less interest then the Lead contained in the finer, less than 0.25 mm, fraction. Using a finer mesh sieve (0.25 mm rather than 2 mm) may improve precision and reproducibility. However, sieving unground samples through sieves finer than two millimeters is not appropriate if analyzing for high explosives or propellants. Typical mass sizes for energetic analytes are in particles sizes greater than 0.59 millimeters.

11.7.1.4 MI samples collected for Arsenic analyses that contain greater than 20 mg/Kg total Arsenic should be tested for bioaccessible Arsenic. This should be discussed with the project manager. If deemed appropriate, the entire <2 mm fraction of the respective samples should be sieved to a ≤0.25 mm, representatively sub-sampled and analyzed for bioaccessible Arsenic using SBRC methodology, 1-2 grams are required.

11.7.2 Polycyclic Aromatic Hydrocarbons (PAHs)

11.7.2.1 Currently there is little information in published procedures specific to the laboratory processing of ISM samples for PAHs. The default procedure above is used, but the 8330B procedure is an acceptable option if specified.

11.7.3 Perchlorate

11.7.3.1 Currently there is little information in published procedures specific to the laboratory processing of ISM samples for Perchlorate. Laboratory processing of samples per EPA Method 8330B as described in Section 11.7.3 is recommended. A 10 gram sample is required for propellants and explosives. It is recommended that a 10 gram ISM sample should be extracted with 100 mL of DI water for Perchlorate analysis by EPA Method 314.0.

11.8 Vegetation samples

11.8.1 Since vegetation samples often are not amenable to standard mixing and homogenization techniques, or because specific sections of the vegetation are targeted, these are handled on a case-by-case basis with instructions from the Project Manager. The PM will obtain sample-specific instructions from the client, and then communicate the specifications to the lab personnel using the ALS Form V or similar project specification document for the project. If the client makes reference to specific procedures, methods, or technical references, the PM will make the document(s) available to the laboratory personnel.

11.9 Paperboard samples

11.9.1 In general, prepare paperboard samples as described below. Project-specific instructions may replace these.

11.9.2 Prepare the FDA Ext first.

- Cut the sheet of paper into one 10” x 10” square.
- Cut the 10” x 10” into strips at the cut lines 7 ½, 5, and 2 ½.
- Cut strips at 7 ½, 5, and 2 ½ inches. This will make a total of 16, 2½” squares.
- Place all the squares into a large Zip Lock™ bag.

11.9.3 Put one sheet of paper into shredder, run the shredder back and forth to get the entire sample out. Use tongs to remove any remaining sample in bottom of shredder. As a safety precaution, ensure the unit is in the “OFF” position.

11.9.4 Determine the total mass of sample needed to aliquot for all tests. Divide the total mass by the number of samples to be composited. Shred that mass of each sample to be composited together into a single container. Homogenize thoroughly once all the fractions have been shredded. Aliquot each sub sample from this final mass.

11.9.5 Update composites as being done. Open StarLIMS, double click on Ad Hoc by Test (Under Results entry), highlight samples composited and click the Update to Done button at the top of page. Do not add jars when asked. Just click the X on the right hand corner.

12) Quality Assurance/Quality Control Requirements

12.1 This method shall operate under the formal Quality Assurance Program established at ALS and must maintain records that define the quality of data that is generated. Data shall be compared to established criteria in order to determine if the results meet the performance characteristics of the determinative method(s).

12.2 Ongoing QC Samples required for each sample batch (20 or fewer samples) are described in the SOP for Sample Batches and in the determinative SOPs.

13) Data Reduction and Reporting

13.1 All compositing and subsampling data must be recorded into the bench records by the analyst. In addition to sample volumes and masses, sample identifications, etc., this should include descriptions of unique samples or sample components. Figure 1 shows the current MIS benchsheet template used to record MIS subsampling. Other project-specific benchsheets may apply.

13.2 It is the supervisor's responsibility to ensure that analytical data is reviewed and to ensure that all quality control requirements have been met.

14) Method Performance

14.1 Not applicable.

15) Pollution Prevention and Waste Management

15.1 It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

15.2 The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Lab Waste Management Plan.

15.3 This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

15.4 This method uses Dichloromethane and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.

16) Corrective Actions for Out-of-Control Data or Unacceptable Data

16.1 Refer to the SOP for *Non Conformance and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

16.2 Handling out-of-control or unacceptable data

16.2.1 On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, run logs, for example.

16.2.2 Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision.
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels.
- Sample holding time missed due to laboratory error or operations.
- Deviations from SOPs or project requirements.
- Laboratory analysis errors impacting sample or QC results.
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc).
- Sample preservation or handling discrepancies due to laboratory or operations error.

17) Training

17.1 Refer to the SOP *ALS-Kelso Training Procedure* (ADM-TRAIN).

17.2 Training outline

17.2.1 Review literature (see references section). Read and understand the SOP. Also review the applicable SDS for all reagents and standards used. Following these reviews, observe the procedure performed by an experienced analyst at least three times.

17.2.2 The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.3 Training is documented following the SOP *ALS-Kelso Training Procedure* (ADM-TRAIN).

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18) Method Modifications

18.1 Not applicable.

19) Summary of Changes

19.1 Updated to the latest ALS SOP format.

19.2 Minor typographical, grammatical, and formatting revisions.

19.3 Signature Page: Updated signatories.

19.4 Section 11.6.2.5: Updated Metals Hg aliquot sampling.

19.5 Section 11: Numerous edits, additions, and changes to reflect current practice.

19.6 Section 20: Current templates with locked calculation cells added to the SOP.

20) References and Related Documents

20.1 Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples, U.S. Environmental Protection Agency, EPA/600/R-03/027, November 2003.

20.2 Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities, ASTM D 6323, Annual Book of ASTM Standards, 1999.

20.3 Test Methods for Evaluating Solid Waste, EPA SW-846, Final Update III, December 1996.

20.4 Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, January, 1996.

20.5 Draft Guidance on Multi-Increment Soil Sampling State of Alaska, Department of Environmental Conservation, March 2007.

20.6 Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, November 12, 2008.

20.7 Technical Guidance Manual Notes: Decision Unit and Multi-Increment Sample Investigations, March 2011, State of Hawaii, Department of Health, 2011-143-RB.

20.8 Standard operating Procedure, In Vitro Method for Determination of Lead and Arsenic Bioavailability; Solubility/Bioavailability Research Consortium, Document 8601-102.011- 0601-1099-RN01.

20.9 Figure 1: Multi Incremental Sampling Worksheet.

20.10 Analytical Worksheets:

20.10.1 Blank Bench Sheet: R:\Soil Prep\Templates\Blank Bench sheet REV1.xltx.
20.10.2 Constant Weights Data Sheet: R:\Soil Prep\Templates\Constant Weight Data Sheet REV1.xltx.
20.10.3 Foil Rinse Bench sheet: R:\Soil Prep\Templates\Foil Rinse Bench Sheet REV1.xlsx.

20.10.4 Paperboard Composite Data: R:\Soil Prep\Templates\Paperboard Composite Data REV2.xlsx.

20.10.5 Sieve Data Sheet: R:\Soil Prep\Templates\Sieve Data Sheet REV3.xltx.

20.10.6 Soil Composite Data Sheet: R:\Soil Prep\Templates\Soil Composite Data Sheet REV3.xltx.

20.10.7 Soil Grinding Data Sheet: R:\Soil Prep\Templates\Soil Grinding Data Sheet. REV2.xltx.

20.11 TNI Standard, Volume 1- 2009.

20.12 DoD Quality Systems Manual for Environmental Laboratories Version(s) 5.0/5.1.

21) Attachments/Appendices

21.1 Table 1: Default Multi – Incremental Sampling Information.

21.2 Table 2: Large Mass Multi – Incremental Sampling Information.

21.3 Table 3: Storage of Multi-Incremental Subsamples.

21.4 Figure 1: Air Dried Sieve Data Benchsheet Template.

TABLE 1
Default Multi-Incremental Sampling Information

Test	Subsample Basis	Aliquot	Approximate Amount per Increment	Container
Total Solids	Air Dried	15.00 g	0.50 g	2 oz. soil jar
200.7 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube
6010 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube
200.8 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube
6020 Metals	Air Dried	1.0000 g	0.0333 g	Metals digestion tube
Mercury	Air Dried	0.5000 g	0.0167 g	Mercury digestion cup
8081 PEST	As Received	15.00 g	0.50 g	2 or 4 oz. soil jar
8081 PEST-LL	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
8082 PCB	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar
8082 PCB-LL	Air Dried	30.00 g	1.00 g	2 or 4 oz. soil jar
8151	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
8270	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
8270 LL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar
PAH	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar
PAH ULL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar
8290/Dioxin	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar
8330B*	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar
Diesel or Residual Range Organics (DRO, RRO)**	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
TOC	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar
Backup Sample	As Received	30.00 g	1.00 g	Back into original jar

For DOD projects refer to the DOD 8330B protocols.

** Alaska Methods AK102 and AK103 call for the extraction of from 10-30 g of sample material (soil). For MIS purposes, the minimum required amount of material per analysis is 30 g.

TABLE 2

"Large Mass" Multi-Incremental Sampling Information

Test	Subsample Basis	Aliquot	Approximate Amount per Increment	Container
Total Solids	Air Dried	15.00 g	0.50 g	2 oz. soil jar
200.7 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube
6010 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube
200.8 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube
6020 Metals	Air Dried	10.00 g	0.333 g	Metals digestion tube
Mercury	Air Dried	5.00 g	0.167 g	Mercury digestion cup or 2 oz. soil jar
8081 PEST	As Received	15.00 g	0.50 g	2 or 4 oz. soil jar
8081 PEST-LL	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
8082 PCB	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar
8082 PCB-LL	Air Dried	30.00 g	1.00 g	2 or 4 oz. soil jar
8151	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
8270	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
8270 LL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar
PAH	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar
PAH ULL	As Received	20.00 g	0.67 g	2 or 4 oz. soil jar
8290/Dioxin	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar
8330B*	As Received	10.00 g	0.33 g	2 or 4 oz. soil jar
Diesel or Residual Range Organics (DRO, RRO)**	As Received	30.00 g	1.00 g	2 or 4 oz. soil jar
TOC	Air Dried	15.00 g	0.50 g	2 or 4 oz. soil jar
Backup Sample	As Received	30.00 g	1.00 g	Back into original jar

* For DOD projects refer to the DOD 8330B protocols.

** Alaska Methods AK102 and AK103 call for the extraction of from 10-30 g of sample material (soil). For MIS purposes, the minimum required amount of material per analysis is 30 g.

TABLE 3
Storage of Multi-Incremental Subsamples

Test	Storage
Total Solids	Room Temperature
200.7 Metals	Room Temperature
6010 Metals	Room Temperature
200.8 Metals	Room Temperature
6020 Metals	Room Temperature
Mercury	Room Temperature
8081 PEST	4 ± 2°C
8081 PEST-LL	4 ± 2°C
8082 PCB	Room Temperature
8082 PCB-LL	Room Temperature
8151	4 ± 2°C
8270	4 ± 2°C
8270 LL	4 ± 2°C
PAH	4 ± 2°C
PAH ULL	4 ± 2°C
8290/Dioxin	Room Temperature
8330B*	4 ± 2°C
Diesel or Residual Range Organics (DRO, RRO)*	4 ± 2°C
TOC	Room Temperature
Backup Sample	4 ± 2°C

FIGURE 1
Air Dried Sieve Data Benchsheet Template

ALS Inc.

Service Request Number(s):

Air Dried Sieve Data

Service Request #	Sample Weight (g)	Weight of Passing Fraction(g)	Weight of Retainied Fraction (g)	Sieve Size
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			
	0.00			

Balance ID:	
Analyst:	Date:
Reviewed:	Date:

R:\ICP\misc\digforms\Air Dried Sieve Bench Sheet-Compatible

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
Inorganics																	
Aluminum			9/19	47%	58-790	DD-514-SW	200-200	100	87		87	9	1	7	10	Yes	E
Antimony			2/33	6%	2-3.2	LSW-17-01	2-60	30	190	640	190	0	0.2	0	0	No	A
Arsenic			5/33	15%	2.1-4.4	DD-508-SW	2.1-10	5	150	50	50	0.1	0.1	0	0	No	A
Barium			19/19	100%	34-100	DD-508-SW			220		220	0.5		0	0	No	A
Beryllium			1/33	3%	0.17-0.17	ISW-203	0.13-5	2.5	11		11	0	0.2	0	0	No	A
Cadmium			2/42	5%	0.23-2.3	LSW-10	0.23-5	2.5	0.45		0.45	5	6	1	39	Yes	E
Calcium			19/19	100%	5100-130000	DD-513-SW			116000		116000	1		3	0	No	A
Chromium			14/42	33%	0.86-2.5	LSW-16-01	4.5-10	5								Yes	G
Cobalt			0/19	0%			50-50	25	19		19		1		19	No	C
Copper			20/42	48%	0.91-9.7	LSW-11	0.74-25	12.5	4.95		4.95	2	3	1	6	Yes	E
Cyanide			0/10	0%			10-10	5	5.2		5.2		1		0	No	C
Iron			18/19	95%	120-3400	DD-508-SW	100-100	50	1000		1000	3	0.1	11	0	Yes	E
Lead			11/42	26%	1.5-6.2	DD-514-SW	0.89-10	5	1.25		1.25	5	4	11	16	Yes	E
Magnesium			19/19	100%	1600-4200	DD-513-SW			82000		82000	0.1		0	0	No	A
Manganese			19/19	100%	16-710	RC-504-SW			93		93	8		16	0	Yes	E
Mercury	Aquatic	Y	1/42	2%	0.3-0.3	LSW-11	0.043-0.5	0.25	0.77		0.77	0.4	0.3	0	0	No	A
Mercury	Wildlife	Y	1/42	2%	0.3-0.3	LSW-11	0.043-0.5	0.25	0.0013		0.0013	231	192	1	41	Yes	E
Nickel			10/42	24%	1.3-14	LSW-6	1.09-40	20	28.9		28.9	0.5	0.7	0	0	No	A
Potassium			19/19	100%	2100-3200	DD-508-SW			53000		53000	0.1		0	0	No	A
Selenium		Y	3/33	9%	2.1-3.3	LSW-30	2.1-35	17.5	5		5	0.7	4	0	19	Yes	H
Silver			15/33	45%	2-7.9	LSW-29	1.1-10	5	0.06		0.06	132	83	15	18	Yes	E
Sodium			19/19	100%	3200-29000	DD-507-SW			680000		680000	0		0	0	No	A
Thallium			2/33	6%	1.7-3.6	ISW-203	3.6-25	12.5	6	0.47	0.47	8	27	2	31	Yes	E
Vanadium			10/19	53%	1.2-13	DD-513-SW	50-50	25	27		27	0.5	0.9	0	0	No	A
Zinc			18/42	43%	7.7-120	DD-508-SW	16-60	30	66		66	2	0.5	3	0	Yes	E
High Molecular Weight PAHs																	
Benzo(a)anthracene		Y	0/10	0%			5-5.6	2.8	4.7	0.018	0.018		156		10	No	I
Benzo(a)pyrene		Y	0/10	0%			5-5.6	2.8	0.06	0.018	0.018		156		10	No	I
Benzo(b)fluoranthene		Y	0/10	0%			5-5.6	2.8	2.6	0.018	0.018		156		10	No	I
Benzo(g,h,i)perylene		Y	0/10	0%			5-5.6	2.8	0.012		0.012		233		10	No	I
Benzo(k)fluoranthene		Y	0/10	0%			5-5.6	2.8	0.06	0.018	0.018		156		10	No	I
Chrysene		Y	0/10	0%			5-5.6	2.8	4.7	0.018	0.018		156		10	No	I
Dibenzo(a,h)anthracene		Y	0/10	0%			5-5.6	2.8	0.012	0.018	0.012		233		10	No	I
Fluoranthene		Y	0/10	0%			5-5.6	2.8	0.8	140	0.8		4		10	No	I
Indeno(1,2,3-cd)pyrene		Y	0/10	0%			5-5.6	2.8	0.012	0.018	0.012		233		10	No	I
Pyrene			0/10	0%			5-5.6	2.8	4.6	4000	4.6		0.6		0	No	C
Low Molecular Weight PAHs																	
2-Methylnaphthalene			0/10	0%			5-5.6	2.8	4.7		4.7		0.6		0	No	C
Acenaphthene			0/10	0%			5-5.6	2.8	15	900	15		0.2		0	No	C
Acenaphthylene			0/10	0%			5-5.6	2.8	13		13		0.2		0	No	C
Anthracene			0/10	0%			5-5.6	2.8	0.02	40000	0.02		140		10	Yes	D
Fluorene			0/10	0%			5-5.6	2.8	19	5300	19		0.1		0	No	C
Naphthalene			0/18	0%			5-5.6	2.8	21		21		0.1		0	No	C
Phenanthrene		Y	0/10	0%			5-5.6	2.8	2.3		2.3		1		10	No	I

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
Pesticides																	
Aldrin		Y	0/10	0%			0.05-0.05	0.025	0.04	0.00005	0.00005		500		10	No	I
alpha-BHC		Y	0/10	0%			0.05-0.05	0.025	0.01	0.0049	0.0049		5		10	No	I
alpha-Chlordane			0/10	0%			0.05-0.05	0.025								No	B
beta-BHC		Y	0/10	0%			0.05-0.05	0.025	0.01	0.017	0.01		3		10	No	I
delta-BHC			0/10	0%			0.05-0.05	0.025								No	B
Dieldrin	Aquatic	Y	0/10	0%			0.1-0.1	0.05	0.06	5.4E-05	0.000054		926		10	Yes	D
Dieldrin	Wildlife	Y	0/10	0%			0.1-0.1	0.05	0.06	5.4E-05	0.000054		926		10	Yes	D
Endosulfan I			0/10	0%			0.05-0.05	0.025	0.06	89	0.06		0.4		0	No	C
Endosulfan II			0/10	0%			0.1-0.1	0.05	0.06	89	0.06		0.8		0	No	C
Endosulfan sulfate			0/10	0%			0.1-0.1	0.05	0.06	89	0.06		0.8		0	No	C
Endrin		Y	0/10	0%			0.1-0.1	0.05	0.04	0.06	0.04		1		10	No	I
Endrin Aldehyde			0/10	0%			0.1-0.1	0.05		0.3						No	B
Endrin ketone			0/10	0%			0.1-0.1	0.05								No	B
gamma-BHC (Lindane)			0/10	0%			0.05-0.05	0.025								No	B
gamma-Chlordane			1/10	10%	0.15-0.15	DD-514-SW	0.05-0.05	0.025								Yes	G
Heptachlor		Y	0/10	0%			0.05-0.05	0.025	0.004	7.9E-05	0.000079		316		10	No	I
Heptachlor epoxide			0/10	0%			0.05-0.05	0.025	0.004	3.9E-05	0.000039		641		10	Yes	D
Methoxychlor		Y	0/10	0%			0.5-0.5	0.25	0.03	0.03	0.03		8		10	No	I
Toxaphene		Y	0/10	0%			5-5	2.5	0.0002	0.00028	0.0002		12500		10	No	I
DDD/DDE/DDT																	
4,4'-DDD		Y	0/10	0%			0.1-0.1	0.05	0.01	0.00031	0.00031		161		10	No	I
4,4'-DDE		Y	0/10	0%			0.1-0.1	0.05	0.3	0.00022	0.00022		227		10	No	I
4,4'-DDT	Aquatic	Y	0/10	0%			0.1-0.1	0.05	0.001	0.00022	0.00022		227		10	Yes	D
4,4'-DDT	Wildlife	Y	0/10	0%			0.1-0.1	0.05	0.001	0.00022	0.00022		227		10	Yes	D
PCBs																	
Aroclor 1016			0/24	0%			0.04-1	0.5								Yes	F
Aroclor 1221			0/24	0%			0.04-1	0.5								Yes	F
Aroclor 1232			0/24	0%			0.05-1	0.5								Yes	F
Aroclor 1242			0/24	0%			0.05-1	0.5								Yes	F
Aroclor 1248			3/24	13%	0.08-2.2		0.03-1	0.5								Yes	F
Aroclor 1254			0/24	0%			0.03-1	0.5								Yes	F
Aroclor 1260			0/24	0%			0.05-1	0.5								Yes	F
Aroclor 1262			0/10	0%			1-1	0.5								Yes	F
Aroclor 1268			0/10	0%			1-1	0.5								Yes	F
Total PCB		Y	3/24	13%		0.13 - 6.2		6.2	0.014		0.014		443	3	21	Yes	F
Total PCB	WIldlife	Y	3/24	13%		0.13 - 6.2		6.2	0.00012		0.00012		51667	3	24	Yes	F
SVOCs																	
1,1-Biphenyl			0/10	0%			5-5.6	2.8	6.5		6.5		0.4		0	No	C
1,2,4,5-Tetrachlorobenzene			0/10	0%			5-5.6	2.8	8.3		8.3		0.3		0	No	C
1,4-Dioxane			0/10	0%			100-100	50	2.2E+07		22000000		0		0	No	C
2,3,4,6-Tetrachlorophenol			0/10	0%			5-5.6	2.8	1		1		3		10	Yes	D
2,4,5-Trichlorophenol			0/10	0%			5-5.6	2.8	1.9		1.9		1		10	No	C
2,4,6-Trichlorophenol			0/10	0%			5-5.6	2.8	4.9	2.4	2.4		1		10	No	C
2,4-Dichlorophenol			0/10	0%			5-5.6	2.8	11	290	11		0.3		0	No	C
2,4-Dimethylphenol			0/10	0%			5-5.6	2.8	15	850	15		0.2		0	No	C

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
2,4-Dinitrophenol			0/10	0%			10-11	5.5	71	5300	71		0.1		0	No	C
2-Chloronaphthalene			0/10	0%			5-5.6	2.8		1600						No	B
2-Chlorophenol			0/10	0%			5-5.6	2.8	18	150	18		0.2		0	No	C
2-Methylphenol			0/10	0%			5-5.6	2.8	67		67		0		0	No	C
2-Nitroaniline			0/10	0%			10-11	5.5	17		17		0.3		0	No	C
2-Nitrophenol			0/10	0%			5-5.6	2.8	73		73		0		0	No	C
3,3'-Dichlorobenzidine			0/10	0%			5-5.6	2.8	4.5	0.028	0.028		100		10	Yes	D
3-Nitroaniline			0/10	0%			10-11	5.5								No	B
4,6-Dinitro-2-methylphenol			0/10	0%			10-11	5.5		280						No	B
4-Bromophenyl-phenylether			0/10	0%			5-5.6	2.8	1.5		1.5		2		10	Yes	D
4-Chloro-3-methylphenol			0/10	0%			5-5.6	2.8								No	B
4-Chloroaniline			0/10	0%			5-5.6	2.8	0.8		0.8		4		10	Yes	D
4-Chlorophenyl-phenylether			0/10	0%			5-5.6	2.8								No	B
4-Nitroaniline			0/10	0%			10-11	5.5								No	B
4-Nitrophenol			0/10	0%			10-11	5.5	58		58		0.1		0	No	C
Acetophenone			0/10	0%			5-5.6	2.8								No	B
Atrazine			0/10	0%			5-5.6	2.8	0.03		0.03		93		10	Yes	D
Benzaldehyde			0/10	0%			5-5.6	2.8	143		143		0		0	No	C
Bis(2-Chloro-1-methylethyl)Ether			0/10	0%			5-5.6	2.8		65000						No	B
bis(2-Chloroethoxy) methane			0/10	0%			5-5.6	2.8								No	B
bis(2-Chloroethyl) ether			0/10	0%			5-5.6	2.8		0.53						No	B
bis(2-Ethylhexyl) phthalate		Y	0/10	0%			5-5.6	2.8	8	2.2	2.2		1		10	No	I
Butylbenzylphthalate			0/10	0%			5-5.6	2.8	23	1900	23		0.1		0	No	C
Caprolactam			0/10	0%			5-5.6	2.8								No	B
Carbazole			0/10	0%			5-5.6	2.8	4		4		0.7		0	No	C
Dibenzofuran			0/10	0%			5-5.6	2.8	4		4		0.7		0	No	C
Diethylphthalate			0/10	0%			5-5.6	2.8	220	44000	220		0		0	No	C
Dimethylphthalate			0/10	0%			5-5.6	2.8	1100	1100000	1100		0		0	No	C
Di-n-butylphthalate			0/10	0%			5-5.6	2.8	19	4500	19		0.1		0	No	C
Di-n-octylphthalate			0/10	0%			5-5.6	2.8	215		215		0		0	No	C
Hexachlorobenzene	Aquatic	Y	0/10	0%			5-5.6	2.8	0.15	0.00029	0.00029		9655		10	Yes	D
Hexachlorobenzene	Wildlife	Y	0/10	0%			5-5.6	2.8	0.0003	0.00029	0.00029		9655		10	Yes	D
Hexachlorobutadiene	Aquatic	Y	0/18	0%			5-5.6	2.8	1	18	1		3		16	Yes	D
Hexachlorobutadiene	Wildlife	Y	0/18	0%			5-5.6	2.8	1	18	1		3		16	Yes	D
Hexachlorocyclopentadiene			0/10	0%			5-5.6	2.8	0.45	1100	0.45		6		10	Yes	D
Hexachloroethane			0/10	0%			5-5.6	2.8	12	3.3	3.3		0.8		0	No	C
Isophorone			0/10	0%			5-5.6	2.8	920	960	920		0		0	No	C
Nitrobenzene			0/10	0%			5-5.6	2.8	230	690	230		0		0	No	C
N-Nitroso-di-n-propylamine			0/10	0%			5-5.6	2.8								No	B
N-Nitrosodiphenylamine/Diphenylamine			0/10	0%			5-5.6	2.8	25	0.51	0.51		5		10	Yes	D
Pentachlorophenol		Y	0/10	0%			10-11	5.5	15	3	3		2		10	No	I
Phenol			0/10	0%			5-5.6	2.8	160	857000	160		0		0	No	C
3-Penten-2-ol			1/1	100%	70-70	DD-507-SW										Yes	G
Cresols, Total			0/10	0%			5-5.6	2.8								No	B
Prometon			2/2	100%	7-8	DD-507-SW										Yes	G

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
VOCs																	
1,1,1,2-Tetrachloroethane			0/8	0%			5-5	2.5	85		85		0		0	No	C
1,1,1-Trichloroethane			0/27	0%			1-5	2.5	76		76		0		0	No	C
1,1,2,2-Tetrachloroethane			2/27	7%	1-1.8	LSW-18-01	1-5	2.5	53	4	4	0.4	0.6	0	0	No	A
1,1,2-Trichloroethane			2/27	7%	1-1.3	LSW-18-01	1-5	2.5	730	16	16	0.1	0.2	0	0	No	A
1,1-Dichloroethane			1/26	4%	1-1	ISW-203	1-5	2.5	410		410	0	0	0	0	No	A
1,1-Dichloroethene			1/27	4%	1-1	ISW-203	1-5	2.5	130	7100	130	0	0	0	0	No	A
1,1-Dichloropropene			0/8	0%			5-5	2.5								No	B
1,2,3-Trichlorobenzene			0/18	0%			5-5	2.5	8		8		0.3		0	No	C
1,2,3-Trichloropropane			0/8	0%			5-5	2.5								No	B
1,2,4-Trichlorobenzene			0/18	0%			5-5	2.5	130	70	70		0		0	No	C
1,2,4-Trimethylbenzene			0/8	0%			5-5	2.5	15		15		0.2		0	No	C
1,2-Dibromo-3-chloropropane			0/18	0%			5-5	2.5								No	B
1,2-Dibromoethane			0/18	0%			5-5	2.5								No	B
1,2-Dichlorobenzene			0/18	0%			5-5	2.5	23	1300	23		0.1		0	No	C
1,2-Dichloroethane			0/26	0%			1-5	2.5	2000	37	37		0.1		0	No	C
1,2-Dichloropropane			2/27	7%	0.56-1	ISW-203	1-5	2.5	520	15	15	0.1	0.2	0	0	No	A
1,3,5-Trimethylbenzene			0/8	0%			5-5	2.5	26		26		0.1		0	No	C
1,3-Dichlorobenzene			0/18	0%			5-5	2.5	22	960	22		0.1		0	No	C
1,3-Dichloropropane			0/8	0%			5-5	2.5								No	B
1,3-Dichloropropene			0/2	0%			1-1	0.5		21						No	0
1,4-Dichlorobenzene			0/18	0%			5-5	2.5	9.4	190	9.4		0.3		0	No	C
2,2-Dichloropropane			0/8	0%			5-5	2.5								No	B
2-Butanone (MEK)			1/27	4%	5-5	ISW-203	2-100	50	22000		22000	0	0	0	0	No	A
2-Chlorotoluene			0/8	0%			5-5	2.5								No	B
2-Hexanone			3/27	11%	0.65-10	LSW-18-01	2-50	25	99		99	0.1	0.3	0	0	No	A
4-Chlorotoluene			0/8	0%			5-5	2.5								No	B
4-Methyl-2-pentanone			2/27	7%	0.61-5	LSW-17-01	2-50	25	170		170	0	0.1	0	0	No	A
Acetone			5/27	19%	5.5-10	LSW-17-01; LSW-18-01; LSW-19-01; LSW-22-01	2-100	50	1700		1700	0	0	0	0	No	A
Benzene			0/27	0%			1-5	2.5	160	51	51		0		0	No	C
Bromobenzene			0/8	0%			5-5	2.5								No	B
Bromochloromethane			0/18	0%			5-5	2.5								No	B
Bromoform			2/27	7%	0.94-1	ISW-203	1-5	2.5	230	140	140	0	0	0	0	No	A
Bromomethane			1/36	3%	1-1	ISW-203	0.49-10	5	16	1500	16	0.1	0.3	0	0	No	A
Carbon disulfide			5/27	19%	0.84-5	ISW-203	2-5	2.5	15		15	0.3	0.2	0	0	No	A
Carbon tetrachloride			0/27	0%			1-5	2.5	77	1.6	1.6		2		18	Yes	D
Chlorobenzene			1/27	4%	0.88-0.88	LSW-18-01	1-5	2.5	25	1600	25	0	0.1	0	0	No	A
Chloroethane			1/27	4%	1-1	ISW-203	1-10	5								Yes	G
Chloroform			0/27	0%			1-5	2.5	140	470	140		0		0	No	C
Chloromethane			1/25	4%	1-1	ISW-203	1-10	5								Yes	G
cis/trans1,2-Dichloroethene			5/9	56%	2.5-49	LSW-18-01	2-5	2.5								Yes	G
cis-1,2-Dichloroethene			5/27	19%	8.1-2000	SW-3	1.8-5	2.5	620		620	3	0	1	0	Yes	E
cis-1,3-Dichloropropene			1/27	4%	0.56-0.56	LSW-18-01	1-5	2.5	1.7		1.7	0.3	1	0	18	No	A

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
Cyclohexane			0/18	0%			5-10	5	158		158		0		0	No	C
Dibromochloromethane			0/27	0%			1-5	2.5	320	13	13		0.2		0	No	C
Dibromomethane			0/8	0%			5-5	2.5								No	B
Dichlorobromomethane			1/27	4%	1-1	ISW-203	1-5	2.5	340	17	17	0.1	0.1	0	0	No	A
Dichloromethane (Methylene chloride)			8/27	30%	5-10	LSW-17-01	5-5	2.5	1500	590	590	0	0	0	0	No	A
Ethyl benzene			1/27	4%	0.63-0.63	LSW-18-01	1-5	2.5	61	2100	61	0	0	0	0	No	A
Freon-11			0/18	0%			5-5	2.5								No	B
Freon-113			0/18	0%			5-10	5								No	B
Freon-12			0/18	0%			5-5	2.5								No	B
Isopropylbenzene			0/18	0%			5-5	2.5	4.8		4.8		0.5		0	No	C
m&p-Xylene			0/18	0%			5-10	5								No	B
Methyl acetate			0/18	0%			5-10	5								No	B
Methyl iodide			0/8	0%			5-5	2.5								No	B
Methyl tertbutyl ether (MTBE)			0/18	0%			5-5	2.5	730		730		0		0	No	C
Methylcyclohexane			0/18	0%			5-10	5	52		52		0.1		0	No	C
n-Butylbenzene			0/8	0%			5-5	2.5								No	B
n-Propylbenzene			0/8	0%			5-5	2.5								No	B
o-Xylene			0/18	0%			5-5	2.5								No	B
p-Isopropyltoluene			0/8	0%			5-5	2.5	16		16		0.2		0	No	C
sec-Butylbenzene			0/8	0%			5-5	2.5								No	B
Styrene			1/27	4%	0.83-0.83	LSW-18-01	1-5	2.5	32		32	0	0.1	0	0	No	A
Tentatively Identified Compounds			0/8	0%			5-5	2.5								No	B
tert-Butylbenzene			0/8	0%			5-5	2.5								No	B
Tetrachloroethene			1/26	4%	0.53-0.53	LSW-21-01	1-5	2.5	53	3.3	3.3	0.2	0.8	0	0	No	A
Toluene			1/27	4%	0.76-0.76	LSW-18-01	1-5	2.5	62	5980	62	0	0	0	0	No	A
trans-1,2-Dichloroethene			1/18	6%	9.2-9.2	SW-3	5-5	2.5	558	10000	558	0	0	0	0	No	A
trans-1,3-Dichloropropene			1/25	4%	0.52-0.52	LSW-18-01	1-5	2.5	1.7		1.7	0.3	1	0	18	No	A
trans-1,4-Dichloro-2-butene			0/8	0%			100-100	50								No	B
Trichloroethene			11/36	31%	1-1600	SW-3	0.42-5	2.5	220	30	30	53	0.1	7	0	Yes	E
Vinyl acetate			0/8	0%			50-50	25	16		16		2		8	Yes	D
Vinyl chloride			7/27	26%	1-140	SW-3	1-5	2.5	930	2.4	2.4	58	1	4	9	Yes	E
Xylenes (unspecified)			2/7	29%	0.73-5	LSW-18-01	1-1	0.5								Yes	G
Energetics																	
2,4-Dinitrotoluene			0/10	0%			5-5.6	2.8	44	3.4	3.4		0.8		0	No	C
2,6-Dinitrotoluene			0/10	0%			5-5.6	2.8	81		81		0		0	No	C
Acrylonitrile			0/8	0%			200-200	100	78	0.25	0.25		400		8	Yes	D

A: Max Detect HQ ≤ 1
B: Chemical lacks a screening value and was not detected
C: Surrogate HQ ≤ 1 for a chemical not detected in any sample
D: Surrogate HQ > 1 for a chemical not detected in any sample
E: Max Detect HQ > 1
F: Total concentration for a class of compounds is greater than the ESV for the class
G: Chemical is detected and no screening value is available
H: Chemical is detected and bioaccumulative with no wildlife ESV
I: Chemical is not detected and bioaccumulative with no wildlife ESV

BA: Bioaccumulative
DL: detection limit
ND: non-detect
Surrogate: 1/2 the maximum detection limit
ESV: ecological screening value
ISWQS: In-stream Water Quality Standard
HQ: hazard quotient
Max Detect HQ: max detected concentration / SSL
Max Surrogate HQ: max surrogate concentration / SSL
Screening Level: Lesser of Region 4 ESV and Georgia Instream Water Quality Standard.

APPENDIX A
Site Aerial Photography

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
= = = =	VEHICLE ACCESS
+-+-+-+	RAILWAY
|||||||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
)(	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 4. Former Macon Naval Ordnance Plant Landfill site, Landfill area, May 10, 1938. Approximate scale 1:4,320.

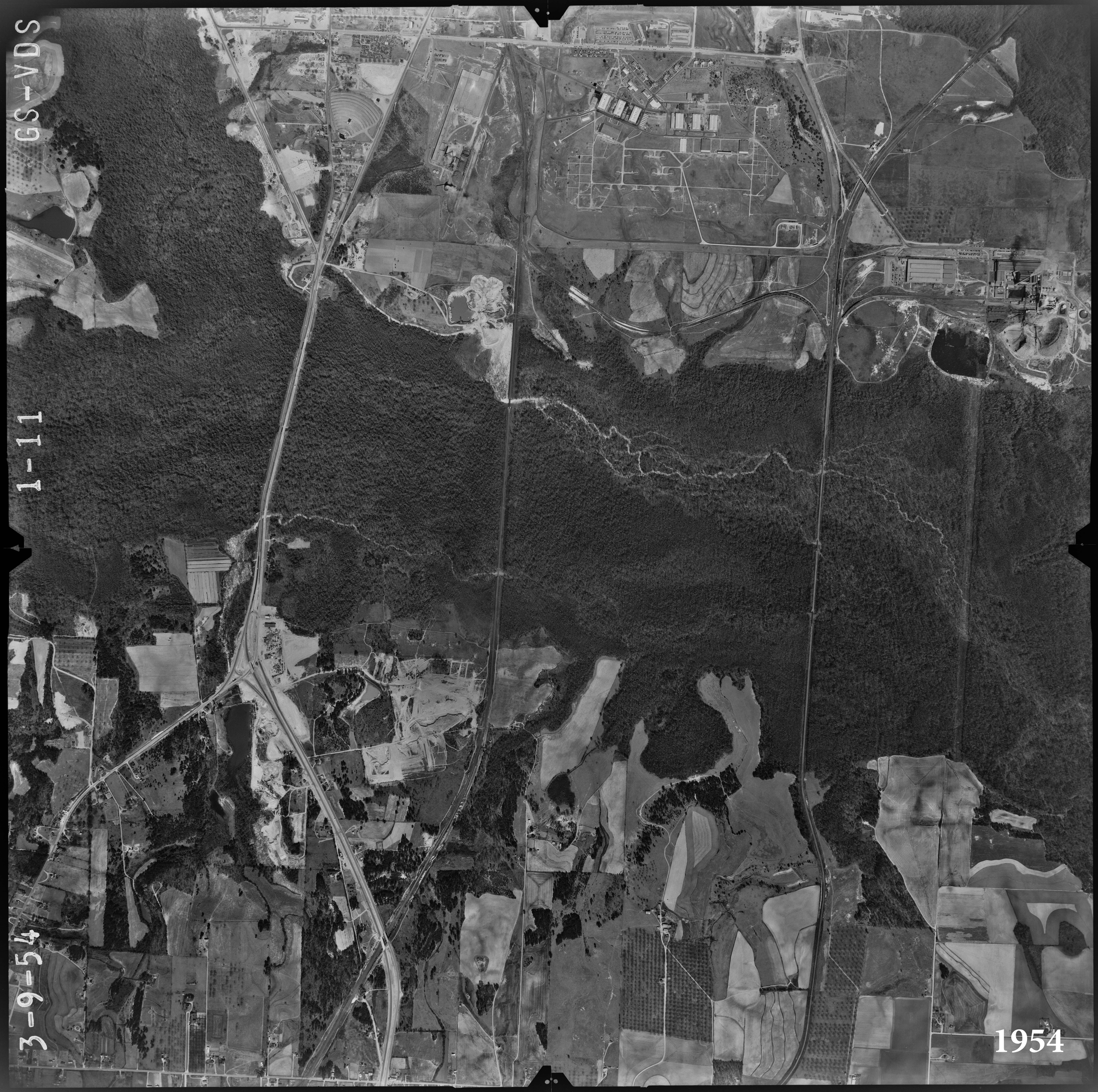
1938

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
====	VEHICLE ACCESS
+-+-+-	RAILWAY
|||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 6. Former Macon Naval Ordnance Plant Landfill site, Landfill area, February 3, 1951. Approximate scale 1:4,630.

1951



USGS
science for a changing world

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
= = = =	VEHICLE ACCESS
+-+-+-	RAILWAY
|||||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 8. Former Macon Naval Ordnance Plant Landfill site, Landfill area, March 24, 1955. Approximate scale 1:4,440.

1955

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
= = = =	VEHICLE ACCESS
+-+-+-+	RAILWAY
|||||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 10. Former Macon Naval Ordnance Plant Landfill site, Landfill area, October 11, 1958. Approximate scale 1:4,310.

1958

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
= = = =	VEHICLE ACCESS
+++++	RAILWAY
|||||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 12. Former Macon Naval Ordnance Plant Landfill site, Landfill area, February 3, 1966. Approximate scale 1:4,370.

1966

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
= = = =	VEHICLE ACCESS
+-+-+-	RAILWAY
|||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 14. Former Macon Naval Ordnance Plant Landfill site, Landfill area, March 9, 1972. Approximate scale 1:4,500.

1972

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
====	VEHICLE ACCESS
+-+-+-	RAILWAY
|||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 16. Former Macon Naval Ordnance Plant Landfill site, Landfill area, October 31, 1975. Approximate scale 1:4,370.

1975

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←— —	DRAINAGE
====	VEHICLE ACCESS
+-+-+-	RAILWAY
|||||||||	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 18. Former Macon Naval Ordnance Plant Landfill site, Landfill area, October 13, 1980. Approximate scale 1:4,440.

1980

1981

INTERPRETATION CODE

x—x—	FENCED SITE BOUNDARY
———	SITE BOUNDARY
x x x x x x	FENCE
←——	DRAINAGE
====	VEHICLE ACCESS
+++++	RAILWAY
	BERM/DIKE
	MOUNDED MATERIAL (EXTENSIVE)
	CULVERT
AB	ADMINISTRATION BUILDING
B	BUILDING
CA	CLEARED AREA
CR	CRATES
D	DEBRIS
DT	DARK-TONED
ECB	EARTH COVERED BUNKER
ESB	EAST STORAGE BUILDING
EX	EXCAVATION
FL	FILL
GS	GROUND SCAR
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
M	MATERIAL
MM	MOUNDED MATERIAL
NB	NEW BUILDING
OF	OUTFALL
RC	RAIL CAR
SL	STANDING LIQUID
ST	STAIN
SW	SOLID WASTE
VS	VEGETATION STRESS
WH	WAREHOUSE
WSB	WEST STORAGE BUILDING

Figure 20. Former Macon Naval Ordnance Plant Landfill site, Landfill area, February 24, 1988. Approximate scale 1:4,440.

1988

1993

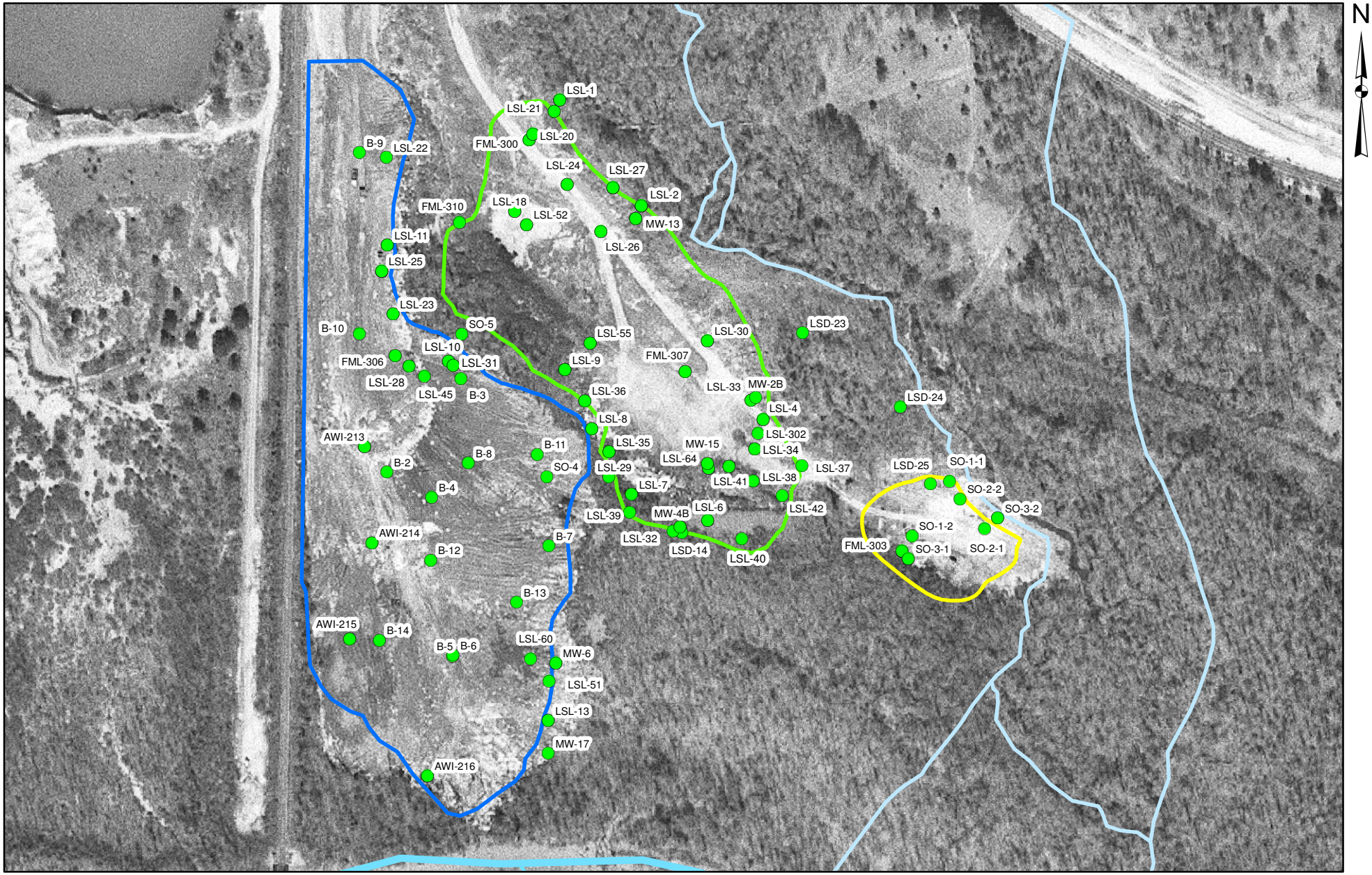
Untitled Map
Write a description for your map.
Legend
1999
Google Earth
Image U.S. Geological Survey
N
400 ft

2007

2010

2015

APPENDIX B
Historical Data

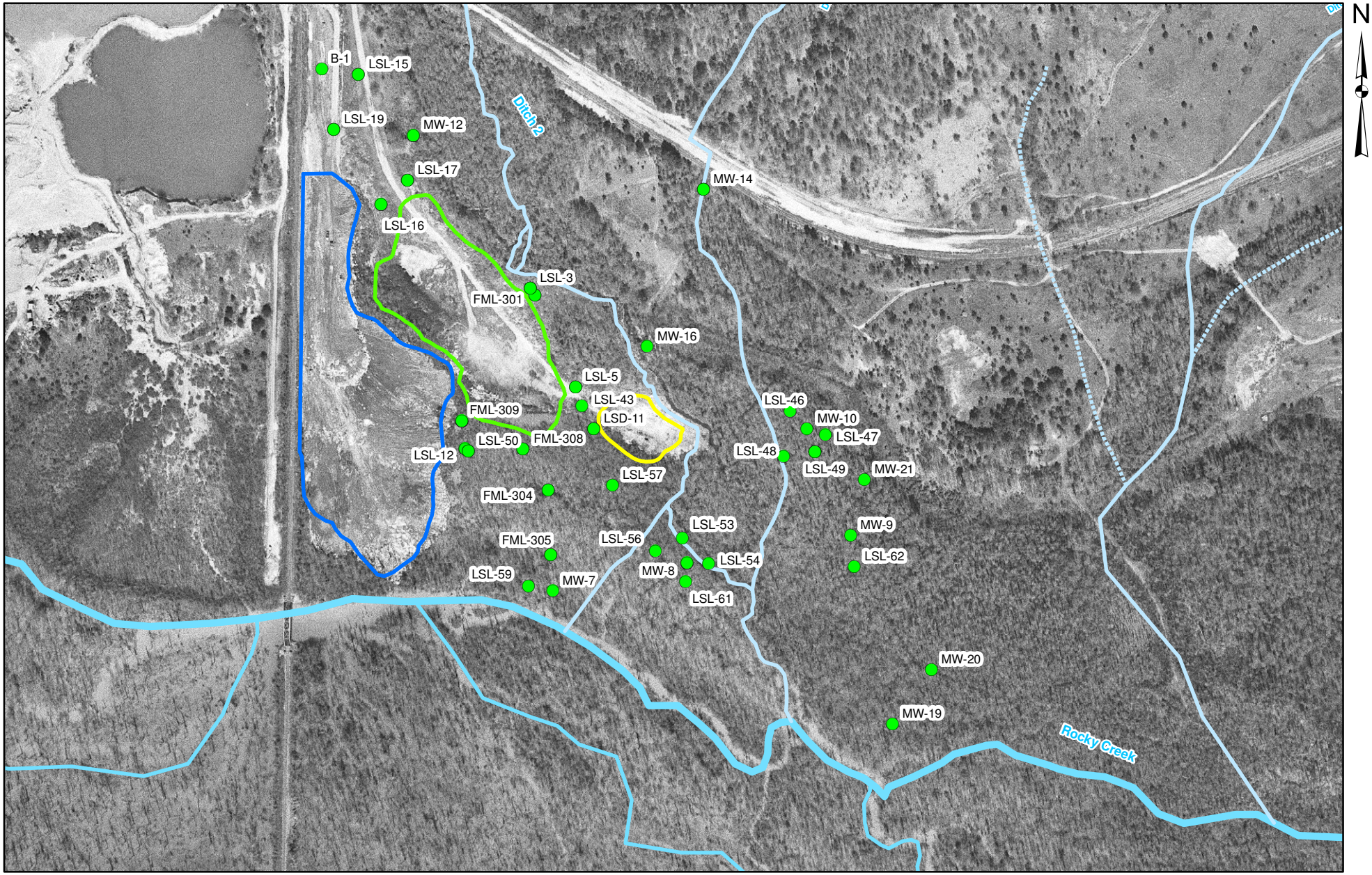


Historical Soil Sample Locations - Landfill Area

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig B 1A_Soil A.mxd

Figure No. B 1A



0 250 500 1,000
Feet

Legend

Soil Sample Locations

Landfills

FMNOL

Remote Landfill

Explosives Demo Area

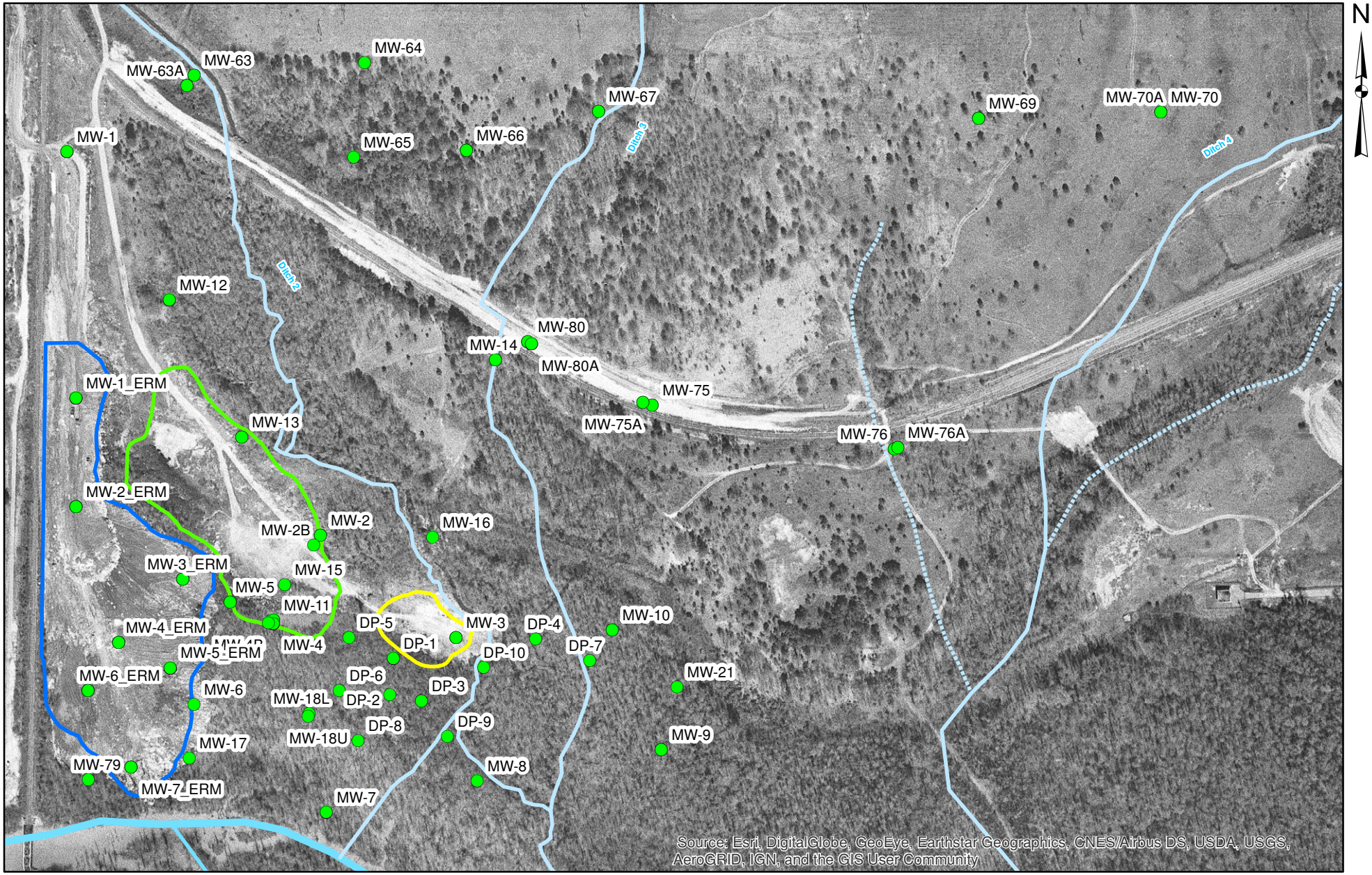
Aerial from 1975

Historical Soil Sample Locations - Outside Landfill Area

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig B 1B_Soil B.mxd

Figure No. B 1B



0 125 250 500
Feet

Legend

- Groundwater
- Explosives Demo Area
- FMNOL
- Remote Landfill

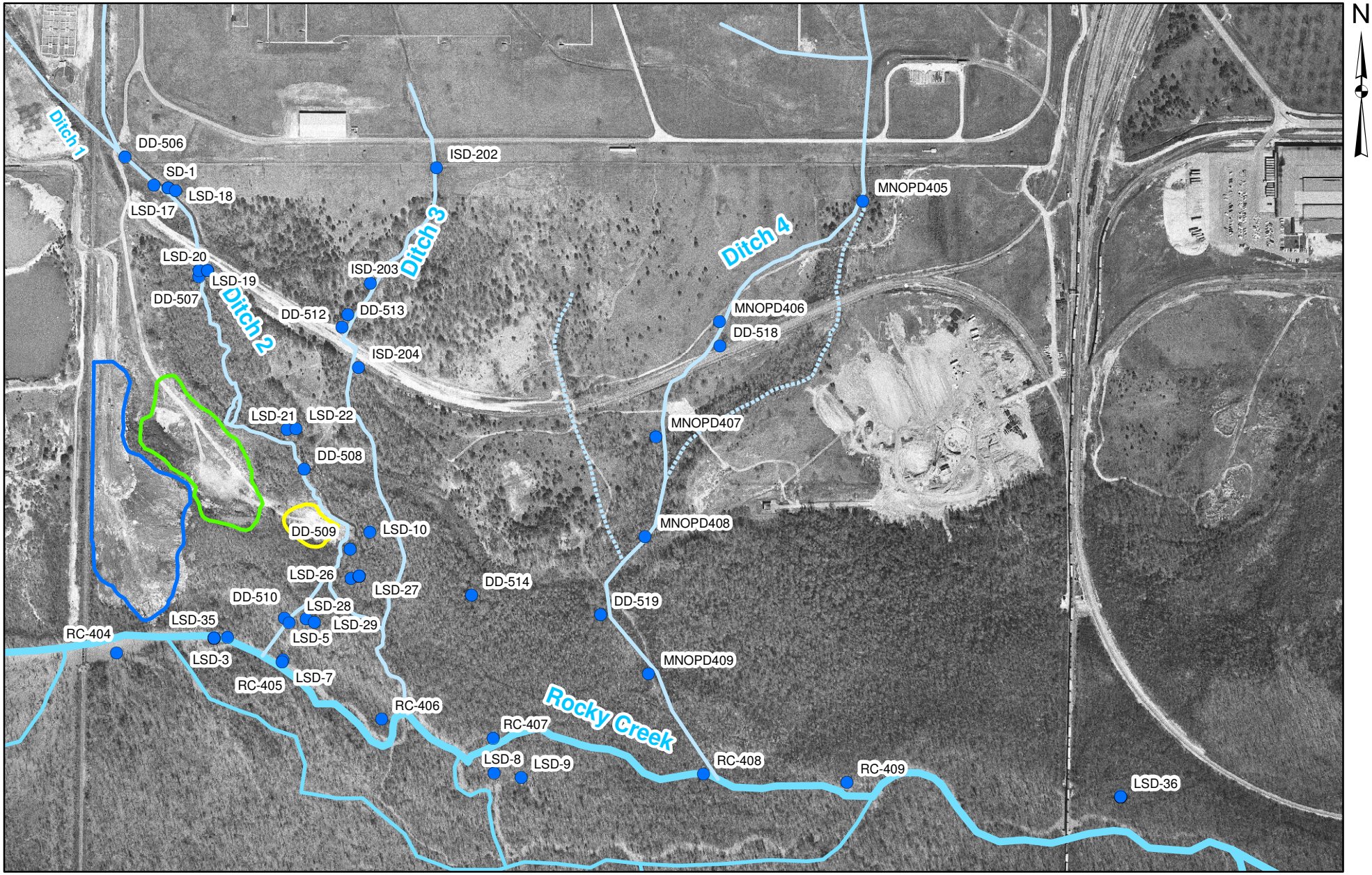
Aerial from 1975

Historical Groundwater Sample Locations

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\RIFS Work Plan\Fig B 2_GW.mxd

Figure No. B 2



0 250 500 1,000
Feet

Legend

- Sediment Sample Locations
- Explosives Demo Area
- FMNOL
- Remote Landfill

Aerial from 1975

Historical Sediment Sample Locations at OU2

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig B 3A_SedOU2.mxd

Figure No. B 3A

0 750 1,500 3,000
Feet

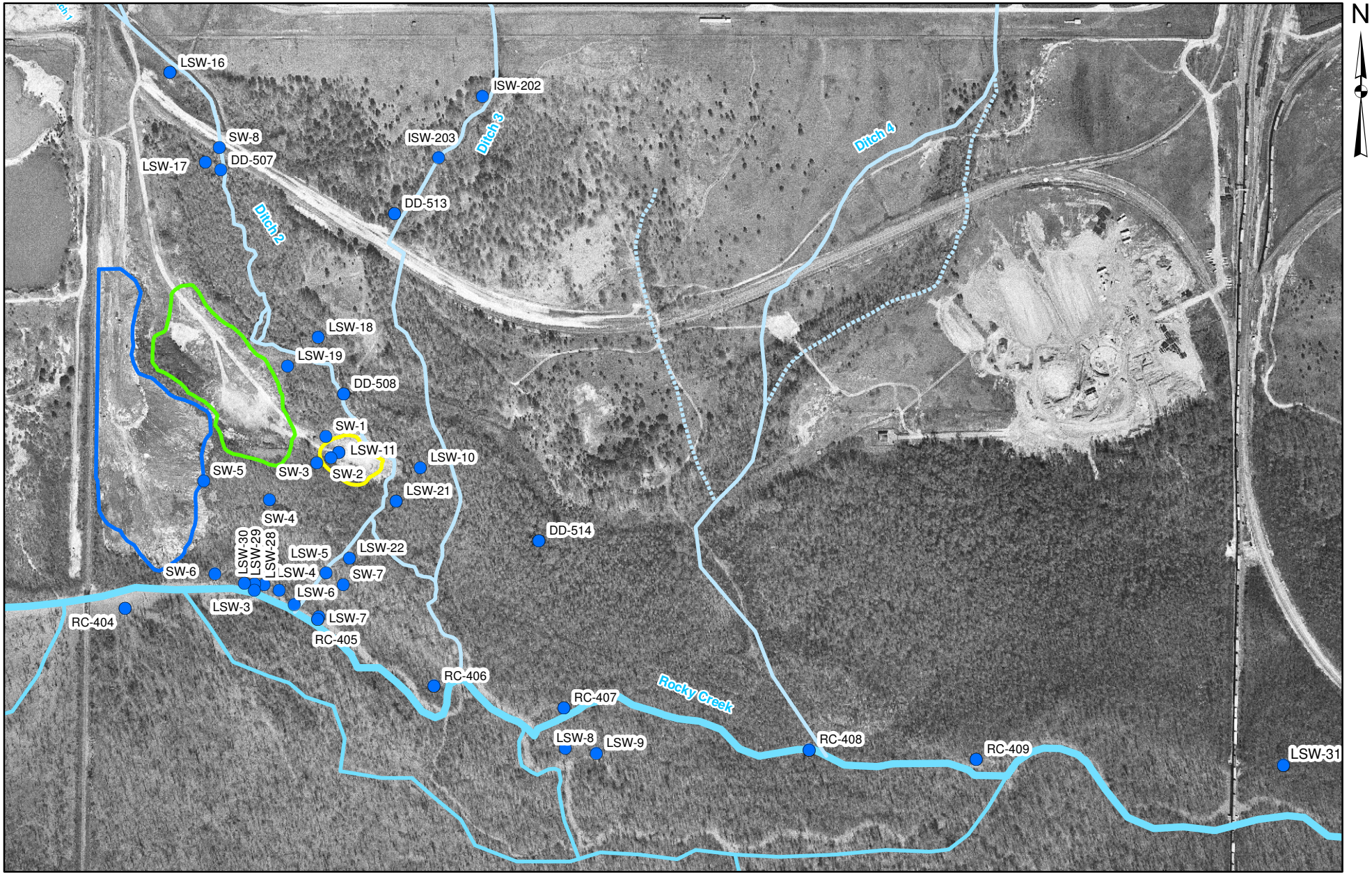
Legend

- Sediment Sample Locations
- Explosives Demo Area
- FMNOL
- Remote Landfill

Historical Sediment Sample Locations outside OU2

EPS
F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig B 3B_SedOut.mxd

Figure No. B 3B



0 250 500 1,000
Feet

Legend

- Surface Water Sample Location
- Explosives Demo Area
- FMNOL
- Remote Landfill

Aerial from 1975

Historical Surface Water Sample Locations at OU2

EPS

F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig B 4A_SWOU2.mxd

Figure No. B 4A

0 750 1,500 3,000
Feet

Legend

- Surface Water Sample Location
- Explosives Demo Area
- FMNOL
- Remote Landfill

Aerial from 1975

Historical Surface Water Sample Locations outside OU2

EPS
F:\AWI_Macon\Macon OU2\GIS\RIFS Work Plan\Fig B 4B_SWOut.mxd

Figure No. B 4B

APPENDIX C
COPC Memorandum

Environmental Planning Specialists, Inc.
400 Northridge Road, Suite 400
Sandy Springs, GA 30350
404.315.9113

TECHNICAL MEMORANDUM #1
CONSTITUENTS OF POTENTIAL CONCERN (COPC)
HUMAN AND ECOLOGICAL SCREENING

Date:	April 29, 2019
To:	Mr. Brian Farrier, U.S. EPA Region IV, Superfund Remedial Section C
From:	Joseph Nicolette

Executive Summary

This technical memorandum was prepared by Environmental Planning Specialists, Inc. (EPS) on behalf of the Respondents for the Armstrong World Industries Site Operable Unit 2 (Site) in Macon, Georgia. In preparation for the Remedial Investigation / Feasibility Study (RI/FS) process, the historical data collected at the Site were compiled into a relational database, evaluated, and screened against both human health and ecological screening values. The purpose of this screening was to develop a list of constituents of potential concern (COPCs) to take forward into the RI/FS process for further sampling and/or evaluation. The list of COPCs to take forward are listed below.

Medium	Inorganic List	HMW PAH	PCBs	Pesticides	SVOCs	VOCs	Energetics
Soil	X	X	X		BEHP	TCE	
Sediment	X	X	X				
Surface Water	X		X			PCE, TCE, cisDCE, VC	
Groundwater	X		X	Dieldrin	BEHP	PCE, TCE, cisDCE, VC, CT, 1,1-DCE	PETN, 2,4-DNT 1,3-DNB

Where:

Inorganic list: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron,lead, manganese, mercury, nickel, silver, thallium, vanadium, zinc

HMWPAH High Molecular Weight Polycyclic Aromatic Hydrocarbons): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, pyrene, perylene

PCBs (Polychlorinated Biphenyls): full suite of PCBs

SVOCs (Semivolatile Organic Compounds): BEHP: bis(2-ethylhexyl)phthalate

VOCs (Volatile Organic Compounds): PCE: tetrachloroethene; TCE: trichloroethene; 1,1-DCE: 1,1-dichloroethene; cisDCE: cis-1,2-dichloroethene; VC: vinyl chloride; CT: carbon tetrachloride

Energetics: PETN: Pentaerythritol tetranitrate; 2,4-DNT: 2,4-dinitrotoluene; 1,3-DNB: 1,3-dinitrobenzene

HUMAN HEALTH AND ECOLOGICAL RISK SCREENING
ARMSTRONG WORLD INDUSTRIES SUPERFUND SITE
Operable Unit 02
Macon, GA

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APPENDICES

Appendix A Pro UCL Output

ACRONYMS AND ABBREVIATIONS

1,1-DCE	1,1-Dichloroethene
1,3-DNB	1,3-Dinitrobenzene
2,4-DNT	2,4-Dinitrotoluene
AWI	Armstrong World Industries
BAF	Bioaccumulation Factor
BEHP	Bis(2-ethylhexyl)Phthalate
bgs	below ground surface
cis-DCE	cis-1,2-Dichloroethene
COPC	constituent of potential concern
CT	Carbon Tetrachloride
DNR	Georgia Department of Natural Resources
ELCR	Excess Lifetime Cancer Risk
EPC	Exposure Point Concentration
EPA	U.S. Environmental Protection Agency
EPS	Environmental Planning Specialists, Inc.
ERA	Ecological Risk Assessment
ESV	Ecological Screening Value
ERAGS	Ecological Risk Assessment Guidance for Superfund
EU	Exposure Unit
FDEP	Florida Department of Environmental Protection
Ft	foot or feet
HMWPAH	High Molecular Weight Polycyclic Armoatic Hydrocarbons
HQ	Hazard Quotient
HSRA	Hazardous Site Response Act
ISWQS	Georgia Instream Water Quality Standards
LOAEL	Low-Observed Adverse Effects Level
MNOP	Macon Naval Ordnance Plant
NOAEL	No-Observed Adverse Effects Level
PCBs	polychlorinated biphenyls
PAHs	polycyclic aromatic hydrocarbons
PCE	Tetrachloroethene
PCOPC	Preliminary Constituents of Potential Concern
PETN	Pentaerythritol tetranitrate
RI/FS	Remedial Investigation Feasibility Study
RSL	Regional Screening Level
RSV	Refined (ecological) Screening Value
SAIC	Science Applications International Corporation
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific/Management Decision Point
SOW	Statement of Work
SVOC	Semivolatile Organic Compound
TCE	Trichloroethene
TRV	Toxicity Reference Value
UCL	upper confidence limit
VC	Vinyl Chloride
VOC	Volatile Organic Compound
WQC	Water Quality Criteria

1 INTRODUCTION

EPS has prepared this technical memorandum on behalf of the Respondents for the Armstrong World Industries (AWI) Site Operable Unit 2 (Site) in Macon, Georgia. This memorandum is being submitted as an appendix to in the Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan). The goal of this memorandum is to present Constituents of Potential Concern (COPCs) for the Site to be incorporated into the RI/FS Work Plan. The purpose is twofold:

1. To establish constituents that may be analyzed in future sampling at the Site, and
2. To eliminate constituents from further consideration (*e.g.,* risk assessment) at the Site.

This process is being conducted as an element of the RI/FS Work Plan in order to ensure that the RI/FS focuses on constituents that contribute the greatest to overall risk (EPA, 1989). The selection of COPCs is based on both human health and ecological screening (Steps 1, 2 and 3a of an ecological risk assessment, (ERA).

This memorandum contains the following sections:

Section 2: Datasets Used in Screening
Summary of the data entered into the database and the subset of the data used in the evaluation.

Section 3: Human Health Screening
COPC screening analysis for human receptors.

Section 4: Screening Ecological Risk Assessment
Ecological risk screening, Steps 1, 2 and 3a of an ERA.

Section 5: RI/FS Constituents
List of COPCs for the Site, based upon the screening results from Sections 4 and 5.

Please refer to the main text of the RI/FS Work Plan for background information about the Site.

2 DATASETS USED IN SCREENING

2.1 Exposure Units

In risk assessments, large areas are divided into Exposure Units (EU) to represent areas over which receptors (*e.g.,* human or ecological) are expected to have routine exposure. During the evaluation process, the Site was divided into multiple EUs and the data were screened separately for each EU. It was determined that there was negligible difference between the resulting COPCs for each EU. Accordingly, in order to meet the intended purposes of this document, it was decided to treat the entire Site as one EU. The risk assessments to be conducted later may contain multiple EUs.

2.2 Media and Depth Considerations

Soils data records are selected on the basis of sample depth. Soil samples collected within the top 1 foot (ft) of soil are treated as surface soils. Soil samples collected below 1 ft below the ground surface (ft-bgs) are treated as subsurface soils. The ecological screening includes only surface soils.

Several samples that are designated as "sediments" are located in upland/wetland areas. These locations are in a low-lying bottomlands / backwater area that is susceptible to flooding and pockets of standing water. The area is not an aquatic setting; thus, it is appropriate to treat them as soils instead of sediments.

2.3 Data Evaluation and Selection

Historical data for the Site and neighboring properties (AWI and the Macon Naval Ordnance Plant (MNOP) located northwest and north of the Site, respectively) were compiled and reviewed in accordance with the Statement of Work (SOW). Historical data were assembled from various reports and entered into a relational database. The primary reports from which data were obtained and the method of data entry is shown below.

- Confirmation Study of the Former Macon Naval Ordnance Plant, Environmental Science & Engineering, Inc. (September 1990) – Hand entered
- Reportable Quantity Release Reporting: Response for Additional Information, Armstrong World Industries (August 1994) – Hand entered
- Delisting Status Report: Armstrong World Industries, ERM (June 1995) – Hand entered
- Final Site Investigation Report Former Macon Naval Ordnance Plant Landfill Site, Rust Environment & Infrastructure (September 1997) – Hand entered
- HSRA Compliance Status Report, SAIC (August 2000) – Electronic sediment and surface water data
- Phase 1 Remedial Investigation Report Former Macon Naval Ordnance Plant Landfill Site, SAIC (October 2000) – Hand entered

- Phase 1 Remedial Investigation Report Addendum Former Macon Naval Ordnance Plant Landfill Site, SAIC (October 2001) – Hand entered
- Monitoring Report for Post-Test Groundwater Sampling (October-November 2004), Science Applications International Corporation (January 2005) – Hand entered
- Former Macon Naval Ordnance Plant Surface Water Sampling Trip Report and Results, Georgia Environmental Protection Division (January 2006) – Hand entered
- Final Site Inspection Report Armstrong World Industries, Tetra Tech (September 2009) – EqUIS download
- Final Expanded Site Inspection Report Former Macon Naval Ordnance Landfill, Tetra Tech (September 2009) – EqUIS download
- Final Expanded Site Inspection Report Allied Industrial Park, Tetra Tech (September 2009) – EQuIS download
- June 2011 Supplemental Sampling Event, Tetra Tech (September 2011) – EQuIS download

All data records were selected from the database applicable to the exposure scenario evaluated, except for the following qualifiers outlined below:

- Only locations within the Site area were selected (*e.g.,* not in AWI, MNOP or upgradient)
- No records were extracted with an unknown coordinate position.
- Duplicate records (*e.g.*, blind sample duplicates) were excluded.

The sample IDs included in the dataset used for the screening are provided in Table 1. The locations of the soil, groundwater, sediment and surface water samples are provided in Figures 2 through 5, respectively.

The complete data sets, in Microsoft Excel format, are provided on a CD-ROM in Appendix B of the RI/FS Work Plan.

2.4 Data Screening

In order to ensure that the RI/FS focuses on constituents that contribute the greatest to the overall risk, the data sets are subjected to a "screening" process to identify COPCs. The data are screened against U.S. Environmental Protection Agency (EPA) published values, based on EPA Region 4 human health (EPA, 2018a) and ecological (EPA, 2018a) guidance.

4 HUMAN HEALTH SCREENING

4.1 Screening Values

EPA Region 4 guidance (EPA 2018b) is utilized in conducting the human health screening. EPA Regional Screening Levels (RSLs) (EPA 2018b) are the primary screening values used. RSLs are derived assuming long-term exposure of either residential or industrial receptors to the media at the Site. For surface soil and sediment, the screening values are the residential RSLs based on the lower of a 1 x 10^{-6} excess lifetime cancer risk (ELCR) or hazard quotient (HQ) of 0.1. Subsurface soil screening values are the industrial RSLs based on the lower of a 1 x 10^{-6} cancer risk or HQ of 0.1. Screening values for groundwater are the residential tapwater RSLs based on the lower of a 1 x 10^{-6} cancer risk or HQ of 0.1. Screening values for surface water data are the EPA Water Quality Criteria (WQC) (EPA 2019) for consumption of water and organisms. If a WQC is not available, tapwater RSLs are used.

4.2 Screening Process

4.2.1 Preliminary Screening

For each constituent in each medium, basic statistical information (such as the maximum detected concentration) is determined. These values are compared to the screening values to determine whether or not the constituent is a COPC based on the following:

1. elimination of constituents for which the maximum detected concentration did not exceed the applicable screening value;
2. elimination of five inorganic constituents (calcium, chloride, magnesium, potassium, and sodium) because they are considered essential human nutrients (EPA, 2018a);
3. elimination of constituents that were detected in fewer than 5% of the relevant samples, with the added provision that no more than 5% of the results for those constituents could have detection limits that exceed industrial RSL[1]; and
4. elimination of constituents with no RSL value and no proxy (surrogate) value is available for the constituent.

Several constituents detected in Site soils do not have EPA-derived toxicity values and, therefore, no RSL values. For some of these constituents, "proxy" RSLs are used in the COPC screening process.

The results of COPC screening for each medium are provided in Tables 2 through 5. Soil data are evaluated in three ways: the surface soils are compared to residential standards (Table 2a), the subsurface soils are compared to industrial standards (Table 2b) and a combined dataset of surface and subsurface soil is compared to residential standards (Table 2c).

[1] The only constituents that fall out of the screening due to detection frequency are specific polychlorinated biphenyls (PCBs) in soil. However, for consistency a full suite of PCB analysis will be conducted in all media. Thus, in the end no constituents are dropped due to detection frequency.

4.2.2 Refinement of COPC Screening

A refined screening is conducted for specific constituents that do not appear to be true COPCs. Constituents with a COPC status change during the refinement are noted on the tables. One example is naphthalene in soil. It is not a COPC in groundwater, sediment or surface water and is not a COPC for ecological receptors. Naphthalene was detected in only 7% of the 154 soil samples. Only two of those samples (4.08 mg/kg in surface soil and 55 mg/kg in subsurface soil) are above the residential RSL (3.8 mg/kg) and only one subsurface sample (55 mg/kg) was above the industrial RSL (17 mg/kg). The 95% upper confidence level (95% UCL) on the mean (using the ProUCL software) is 2.2 mg/kg, below the residential RSL. Furthermore, PAHs such as naphthalene are ubiquitous in the environmental owing to numerous anthropogenic and natural sources. Thus, naphthalene is not selected as a COPC in soil.

4.3 Human Health COPC Summary

A combined list of COPC screening results for all media is shown in Table 6.

5 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

5.1 Introduction

An ERA as outlined in the Ecological Risk Assessment Guidance for Superfund (ERAGS, EPA, 1997) consists of eight steps. The Screening Level Ecological Risk Assessment (SLERA) includes the first two steps of the ERAGS process. More specifically, Step 1 is a screening-level problem formulation and ecological effects evaluation and Step 2 is a screening-level exposure estimate and risk calculation. This report contains the SLERA along with a refined screening evaluation, which is Step 3a of the ERAGS process. Region 4 Ecological Risk Assessment Supplemental Guidance (EPA 2018a) was consulted in performing this evaluation.

5.2 Step 1 – Screening-level Problem Formulation and Ecological Effects Evaluation

5.2.1 Environmental Setting

The Site is in what is known as the Fall Line Hills Physiographic District, a sub-ecoregion of the Coastal Plain Physiographic Province. The topography of this area is referred to as the Sand Hills, which consists of gently rolling to swampy flatlands.

Generally, these soils are well drained, gently sloped, and acidic; and consist of sandy loams, sandy clay loams, and loamy sands. The surficial materials are saturated throughout the floodplain and is sufficiently thick to form a distinctive hydrogeologic feature in this area.

Along the northern border, the site consists of uplands with intermittent wetland areas. Further south the wetland areas become more prominent and are directly influenced by the floodplain of Rocky Creek. Several drainage ditches also flow north to south across the Site. Most of the Site is covered by dense vegetation: herbaceous plants, oaks, sweetgum, pines, holly, and privet. Evidence of deer, medium-sized mammals (raccoon, armadillo) and feral pigs are present throughout the site. Various species of birds (woodpeckers, mockingbird, warblers) and waterfowl inhabit the site. Fish species documented from Rocky Creek include: redfin pickerel, sunfish species, American eel, and bowfin. There is no documentation of surveys for herpetofauna and small mammals on the Site.

5.2.2 Potential Exposure Pathways

A complete exposure pathway is one in which constituents can be traced or expected to travel from the source to a receptor that can be affected by the constituents (EPA, 1997). Therefore, a constituent source, its release, and migration from the source along an exposure route to a receptor must be demonstrated before a potentially complete exposure pathway can be identified. In the absence of body burden data to document

constituent movement through the ecosystem, the pathways of constituent migration and interaction with receptors can only be inferred and extrapolated. Given the incomplete knowledge of the actual pathways, the pathways are considered "potentially complete" at this stage of the assessment.

Many constituents have been detected in soil, sediment and surface water at the Site. These constituents are likely present due to one or more of the following: materials deposited in the former landfills, materials exploded in the demolition area, or materials conveyed through water and sediment transport within ditches that originate upgradient of the Site. Constituents may migrate from these sources to Rocky Creek on the south end of the Site.

The table below illustrates the potentially complete exposure pathways that will be evaluated in the SLERA.

Identification of Potentially Complete Exposure Pathways	
Organism	**Possible Exposure Routes**
Benthic Plants/Invertebrates	Ingestion, surface contact, food web
Terrestrial Plants/Invertebrates	Ingestion, direct exposure
Upper Trophic Level Mammals and Birds	Ingestion, direct exposure, food web

5.2.3 Selection of Endpoints to Screen for Ecological Risk

According to the EPA (1998), an assessment endpoint is defined as "an explicit expression of the environmental value to be protected, operationally defined as an ecological entity and its attributes." Risk managers must choose from candidate endpoints as not all organisms or ecosystem features can be studied.

"For the SLERA, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments. Many of the ecotoxicity screening values are based on generic assessment endpoints (*e.g.*, protection of aquatic communities from changes in structure or function) and are assumed to be widely applicable to Sites around the United States" (EPA, 1997).

The selected assessment endpoints include protection of terrestrial and benthic invertebrates, terrestrial plant communities, and upper trophic level receptors (mammals and birds).

These species are identified at this Site for a number of reasons. The limnetic and benthic communities and plants provide an ecological service as the base of the ecological food web. Many middle to upper trophic level terrestrial and avian omnivores, carnivores, and piscivores serve roles in regulating the populations of other species through their grazing or predatory activities.

The primary ecological attributes that are of interest are abundance and diversity of populations of piscivorous/predatory birds and mammals and the ecological services provided by other organisms in the vicinity of the site including small mammals, plants, invertebrates, fish, reptiles and amphibians.

Measures of effects (also known as measurement endpoints) are measurable biological responses to a stressor that can be related to the valued characteristic chosen as the assessment endpoint (EPA 1997, 1998, 2003). Sometimes, the assessment endpoint encompasses too many species or species that are difficult to evaluate efficiently. In these cases, the measurement endpoints are different from the assessment endpoint, but can be used to make inferences about risks to the assessment endpoints.

The SLERA evaluates site media based on criteria that are protective of soil invertebrates, benthic invertebrates and other aquatic organisms, as these organisms are the base of the food web in the vicinity of the Site that supports avian and mammalian wildlife. The measurement endpoints are evaluated in the SLERA using HQs. An HQ is the ratio of a constituent concentration to an associated ecotoxicity screening value. An HQ below unity (1) implies there is no risk potential for the endpoint being considered, and above unity simply means further evaluation is warranted. The measurement endpoints primarily assess potential effects in invertebrates and fish, but are also likely to provide a conservative, albeit indirect, assessment of potential adverse effects to upper trophic level receptors.

Representative wildlife receptors must also be identified in order to perform necessary SLERA exposure estimates and risk calculations. These species are generally selected based on consideration of presence at the site as well as known or suspected sensitivity and exposure to the site-related constituents (EPA, 1997).

5.2.4 Threatened and Endangered Species

According to Georgia's Department of Natural Resources (DNR, 2013), twelve protected species have been documented in Macon-Bibb County. Atlantic Sturgeon, Fringed Campion, and Relict Trillium are listed as endangered under the Endangered Species Act and by the state of Georgia. The only other species with Federal Protection Status is the Gopher Tortoise, a candidate species for listing as endangered or threatened. All remaining threatened, rare, or unusual species are only provided state-level protection. The table below details the occurrences and status of threatened and endangered species known observed in Macon-Bibb County. It is worth noting that, although not documented within Macon-Bibb County, there are several other protected species known to occur in the Sand Hills eco-region.

Threatened and Endangered Species in Macon-Bibb County

Group	Common Name	Scientific Name	Federal Protection Status	State Protection Status	Occurrences
Birds	Bald Eagle	Haliaeetus leucocephalus		Threatened	266
Fishes	Atlantic Sturgeon	Acipenser oxyrinchus oxyrinchus	Endangered	Endangered	7
Fishes	Altamaha Shiner	Cyprinella xaenura		Threatened	71
Fishes	Goldstripe Darter	Etheostoma parvipinne		Rare	22
Mammals	Rafinesque's Big-eared Bat	Corynorhinus rafinesquii		Rare	39
Reptiles	Gopher Tortoise	Gopherus polyphemus	Candidate	Threatened	305
Reptiles	Southern Hognose Snake	Heterodon simus		Threatened	66
Plants	Yellow Flytrap	Sarracenia flava		Unusual	145
Plants	Gulf Sweet Pitcherplant	Sarracenia rubra ssp. gulfensis		Threatened	49
Plants	Ocmulgee Skullcap	Scutellaria ocmulgee		Threatened	23
Plants	Mountain Catchfly	Silene ovata		Rare	16
Plants	Fringed Campion	Silene polypetala	Endangered	Endangered	35
Plants	Relict Trillium	Trillium reliquum	Endangered	Endangered	56

5.2.5 Preliminary Effects Evaluation

The screening-level ecological effects evaluation involves the identification of appropriate ecotoxicity/ecological screening values (ESVs) for each medium. ESVs are constituent concentrations in

environmental media below which there is negligible risk to receptors exposed to those media (EPA, 2000). ESVs are published by EPA Region 4 (EPA, 2018a). The specific screening values by medium are as follows:

- Soil: Region 4 soil screening levels
- Sediment: Region 4 freshwater sediment ESVs
- Surface Water: The lower of Region 4 chronic freshwater screening values and Georgia Instream Water Quality Standards (ISWQS)

5.3 Step 2 - Preliminary Ecological Screening

The purpose of this step is to preliminarily determine constituents that need to be evaluated further. The constituents selected from this process are called Preliminary Constituents of Potential Concern (PCOPCs). Selection of constituents do not indicate that there is a known or actual risk. Risks are calculated in this SLERA by calculating HQs (dividing conservative chemical-specific exposure estimates by conservative chemical-specific ESVs). An HQ equal to or less than a value of 1 (to one significant figure) indicates that adverse impacts to wildlife are considered unlikely (EPA 1997, 2000). An HQ greater than 1 is an indication that further evaluation may be necessary to evaluate the potential for adverse impacts to wildlife, however this is not linearly scaled in terms of risk. The maximum concentration is divided by the screening level to obtain an HQ. For constituents that are not detected, a surrogate of one-half the maximum detection limit is used.

PCOPCs are selected based on the following criteria:

1. HQ > 1 based on a maximum detected concentration
2. Constituent detected, but no ESV available
3. Constituent not detected, but HQ > 1 using a surrogate of one-half the detection limit
4. Constituent is detected and bioaccumulative with no wildlife ESV

Preliminary ecological screening tables are presented for surface soil (Table 7), sediment (Table 8), and surface water (Table 9).

5.4 Step 3a – Refined Ecological Screening

5.4.1 Problem Formulation

Problem formulation (Step 3) is the initial step in the baseline ERA process. According to the EPA (2000):

> *"The Problem Formulation [i.e., Step 3] is commonly thought of in two parts: Step 3a and Step 3b. Step 3a serves to introduce information to refine the risk estimates from steps one and two. For the majority of sites, ecological risk assessment activities will cease after completion of Step 3a. At many Sites, a single deliverable document consisting of the reporting of results from Steps 1, 2 and 3a may be submitted. At those sites with greater ecological concerns, the additional problem formulation is called Step 3b. It is very important at this stage to perform a 'reality check.' Sites that do not warrant further study should not be carried forward."*

Step 3a of the ERA process is an opportunity for iterative refinement of potential risks using methods similar to those used in Steps 1 and 2 (EPA, 2000). Specifically, PCOPCs identified in the SLERA may be eliminated from further consideration based on the refinement of certain assumptions, such as reasonable constituent exposure estimates, background/reference location comparisons, and consideration of more realistic bioaccumulation potential. The refinements, applied to the Step 2 exposure estimates and risk characterization, are described in the section that follows.

5.4.2 Screening Refinement

Step 3 of the ERAGS process (Problem Formulation) starts with a refinement of the COPCs, which is referred to as Step 3a. The refinement of the PCOPCs identified in the SLERA is necessary to help focus further risk assessment activities on the constituents that potentially pose the greatest risk to ecological receptors. EPA guidance for this approach (EPA 1997, 2000, 2001) indicates that the refinement of PCOPCs in Step 3a streamlines the overall ERA process by using realistic criteria to focus the risk assessment. It is intended as an "incremental iteration of exposure, effects, and risk characterization" (EPA, 2001).

The refined screening is focused toward those PCOPCs identified in the SLERA. Only those constituents that are not eliminated in the conservative screening in the SLERA are carried through for the refined screening. The refined screening tables are presented in Table 10 (soil), Table 11 (sediment) and Table 12 (surface water).

In Step 3a the data are commonly compared to local background concentrations. Local background concentrations have not been evaluated yet for this Site, so this evaluation will be considered in the future ecological risk evaluation.

The assumptions used during the initial risk screen are very conservative; thus, during the refinement stage additional information is used to evaluate the data. Refinement ESVs (RSVs) are used as screening values, which include:

- Soil –Region 4 soil screening levels with the following hierarchy: mammalian, avian, plant, then invertebrate receptors. Priority was given to the upper trophic level receptors.
- Sediment – Region 4 freshwater sediment RSVs
- Surface Water – the lesser of Region 4 acute freshwater screening values and ISWQS
- If no RSV is available, the ESV from the SLERA is used.

The preliminary screening process identified a number of constituents for which no Region 4 ESVs exist. These constituents are excluded from further consideration under the refined screening protocol. This step is necessary in order to focus the subsequent evaluations on the most important COPCs at the Site. In general, ESVs are available for the constituents expected to present the greatest risks to ecological receptors. Thus, the elimination of constituents without ESVs as COPCs is consistent with maintaining the conservative character of this evaluation. Constituents detected in 5% or fewer of samples are also excluded as COPCs[2]. Essential nutrients (calcium, magnesium, sodium and potassium) are excluded as COPCs. For

[2] The only constituents dropped due to detection frequency include Aroclor 1242 in soil and cadmium, mercury, chloroethane and chloromethane in surface water. However, due to consistency with sampling protocols across media a full suite of PCBs, cadmium, and mercury are included in the list of constituents to take forward in the RI/FS process.

a more realistic evaluation of potential exposure, the 95% UCL is compared to the RSVs for the remaining constituents that had a maximum concentration above the RSV. The 95% UCL values are determined using the EPA ProUCL software. One half the detection limit is used for non-detected results. The input and output are included in Appendix B.

Constituents with an HQ less than or equal to 1 and constituents not detected and with 25% or fewer detection limits above the RSV are excluded as COPCs. Constituents that are not detected and have more than 25% of detection limits above the RSV are retained as PCOPCs.

The practical application of the above-identified criteria in the refined ecological screening for COPCs is detailed in Figure 6. Use of this process is based on "best professional judgement" (EPA, 1997) and, although in some cases arbitrary, is generally believed to be conservative in character. The sum toxic unit approach for PAHs was not utilized as the PAHs are selected as COPCs.

5.4.3 Food Chain Model

5.4.3.1 Purpose of Model

Certain constituents (selenium, low molecular weight PAHs, endosulfan II, endosulfan sulfate, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and pentachlorophenol) were identified as ecological COPCs that are not COPCs in soil, sediment or surface water for human health. To further assess these constituents to determine if they should remain as COPCs, a food-web model was conducted.

5.4.3.2 Receptors Evaluated

Potential ecological risks for COPCs in terrestrial areas are evaluated by comparing exposure and effects levels for the American robin (*Turdus migratorius*) and the southern short-tailed shrew (*Blarina carolinensis*). Based on much of the terrestrial area being a wetland or similar to a wetland, these two receptors are representative of feeding guilds that are likely to have the highest exposure to COPCs in soil and surface water.

- American robin – This receptor represents the avian omnivore guild, primarily feeding on soil invertebrates and terrestrial insects, with a smaller amount of intake from fruits.
- Short-tailed shrew – This receptor represents small omnivorous mammals, feeding primarily terrestrial insects and invertebrates but also on seeds and nuts.

Potential ecological risks for COPCs in the surface water features are evaluated by comparing exposure and effects levels for the green heron (*Butorides virescens*) and the raccoon (*Procyon lotor*). These two receptors are representative of feeding guilds that are likely to have the highest exposure to COPCs in sediment and surface water.

- Green heron – This receptor represents wading birds in the insectivore/piscivore guild, feeding primarily on benthic/aquatic invertebrates, small forage fish, and a lesser amount of amphibians and reptiles.
- Raccoon – This receptor represents piscivorous/omnivorous mammals feeding on berries, nuts, fish, invertebrates, amphibians and reptiles.

Chloroethane and chloromethane were only detected in one sample, do not have ESVs, and are not COPCs in other media or for human receptors. They will not be carried forward.

5.4.3.3 Measurement Endpoints

Measurement endpoints represent quantifiable ecological characteristics that can be measured, interpreted, and related to the valued ecological components chosen as the assessment endpoints (EPA, 1997 and 1998). The only measurement endpoint for the assessment endpoints identified above is the food chain hazard quotient (HQ).

Similar to the screening level HQs presented in the screening process, the food chain HQ is the ratio of the estimated direct and food chain exposure of a receptor to site COPCs to toxicity reference values (TRVs). These TRVs represent daily intake levels that are believed to be associated with either no, or minimal, adverse effects.

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

If the value of an HQ is less than or equal to unity, likelihood of an adverse effect in an exposed receptor is judged to be minimal, particularly when the toxicity benchmark is based on a no-observed adverse effects level (NOAEL). If an HQ exceeds unity, the likelihood of an adverse effect in an exposed receptor increases, particularly when the toxicity benchmark is based on a lowest-observed adverse effects level (LOAEL). The HQ is not truly a measure of "risk", that is, a probability that an adverse effect will occur (Tannenbaum 2003). In interpreting HQ values, it is always important to bear in mind that the values are predictions and are subject to the uncertainties that are inherent in both the estimates of exposure and the estimates of toxicity benchmarks. Therefore, HQ values should be interpreted as estimates rather than highly precise values and should be evaluated as part of the weight-of-evidence along with other relevant measurement endpoints.

5.4.3.4 Intake Equations

5.4.3.4.1 Terrestrial Receptors

The equation below calculates a daily intake of each COPC, in units of mg/kg-bw/day. For terrestrial receptors the daily intake accounts for exposure via ingestion of surface water, incidental ingestion of soil, ingestion of terrestrial plants, and ingestion of insects and soil dwelling invertebrates.

$$DI = [(C_{tp} \times I_{tp}) + (C_{ti} \times I_{ti}) + (C_s \times I_s) + (C_w \times I_w)] \times AUF / BW$$

Where:

DI	=	daily intake (mg/kg bw/day)
C_s	=	constituent concentration in soil (mg/kg-dw)
C_{tp}	=	constituent concentration in terrestrial plant (mg/kg-dw)
I_{tp}	=	daily terrestrial plant-matter intake rate (kg/day-dw)
C_{ti}	=	constituent concentration in terrestrial invertebrates (mg/kg-dw)
I_{ti}	=	daily terrestrial invertebrate intake rate (kg/day-dw)
I_s	=	daily soil ingestion rate (kg/day-dw)
C_w	=	constituent concentration surface water (mg/l)
I_w	=	daily surface water ingestion rate (l/day)
BW	=	body weight (kg)

AUF = area use factor (unitless)[3]

5.4.3.4.2 Aquatic Receptors

The equation shown below calculates a daily dose, in units of mg/kg of body weight (bw) per day on a dry weight (dw) basis for aquatic birds and mammals, and accounts for exposure via ingestion of surface water, incidental ingestion of sediment, and ingestion of plants, aquatic/benthic and terrestrial invertebrates, and fish[4].

$$DI = [(C_{ap} \times I_{ap}) + (C_{ai} \times I_{ai}) + (C_f \times I_f) + (C_s \times I_s) + (C_w \times I_w)] \times AUF / BW$$

Where:

DI	=	daily intake (mg/kg bw/day)
C_s	=	constituent concentration in sediment (mg/kg-dw)
C_{ap}	=	constituent concentration in aquatic plants (mg/kg-dw) (raccoon only)
I_{ap}	=	daily aquatic plant-matter intake rate (kg/day-dw) (raccoon only)
C_{ai}	=	constituent concentration in aquatic invertebrates (mg/kg-dw)
I_{ai}	=	daily aquatic invertebrate intake rate (kg/day-dw)
C_f	=	constituent concentration in forage fish (mg/kg-dw)
I_f	=	daily forage fish intake rate (kg/day-dw)
I_s	=	daily sediment ingestion rate (kg/day-dw)
C_w	=	constituent concentration in surface water (mg/l)
I_w	=	daily surface water ingestion rate (l/day)
BW	=	body weight (kg)
AUF	=	area use factor (unitless)

5.4.3.5 Intake Factors

The exposure parameters and factors required to calculate the intake estimates were generally obtained from a report entitled *Alternative Screening Values for Protection of Avian and Mammalian Ecological Receptors at Kennedy Space Center*, prepared by Ochoa and Roberts for the Florida Department of Environmental Protection (FDEP, 2004) and the associated letter by the authors (Ochoa and Roberts, 2003). This document provides a robust assortment of exposure parameters for terrestrial and avian wildlife, factors needed to estimate the transfer of COPCs from soil/sediment and surface water to biological tissue, and toxicity reference values. This report also utilizes research on species from the southeastern states, namely Florida. This is valuable as many animal traits (such was weight and habits) can vary with region of the country, and, thus, are better suited for this Site than the default values provided by the EPA. For example, body size is known to decrease with latitude for many species, thus it is important to base values on information collected from the southeast.

A summary of the specific intake factor values used to estimate the exposure of the terrestrial and aquatic receptors is provided in Table 13. The specific sources of information are indicated on the table.

[3] The AUF is a factor that accounts for the fraction of a receptor's foraging habitat that is accounted for by the site. It is shown here for completeness but to remain conservative that this stage of the risk assessment, it was not used (i.e., it was set equal to 1) for any of the receptor intake calculations presented in this report.

[4] Not all of the food categories are applicable to every receptor.

Because no recent site-specific COPC concentration data have been collected in biological organisms, a variety of chemical-specific fate and transport properties were used to model the potential for bioaccumulation of COPCs from abiotic media (i.e., soil, sediment, and surface water) into the biota consumed by upper trophic level wildlife. These bioaccumulation factors (BAFs) are unitless and are used to estimate the ratio between dry weight soil concentration and a dry weight tissue concentration. The chemical-specific BAFs for terrestrial receptors (estimating transfer from soil-to-plant and soil-to-terrestrial invertebrates) and aquatic receptors (estimating transfer from sediment to plants, sediment to aquatic or benthic insects, and surface water to forage fish) were obtained from FDEP (2004). For some organic COPCs without soil to plant uptake factors in FDEP (2004) (endosulfan II and endosulfan sulfate), the soil-to-plant factors were calculated using log octanal-water partitioning coefficients (logKow) obtained from the EPA's EPIWEB 4.1 Software and a regression equation from Travis and Arms (1988). A soil-to-terrestrial invertebrates BAF was not available for selenium, thus an equation from Sample (1999) was used to estimate the BAF. A summary of the constituent-specific fate and transport parameters used to estimate food chain exposure for terrestrial receptors is provided in Table 14.

5.4.3.6 Toxicity Reference Values

To evaluate the potential for adverse effects to wildlife exposed to chemical constituents in the environment, estimated exposures are compared to TRVs. In ecological risk assessments, it is common to include separate TRVs that are based on NOAELs and LOAELs associated with toxicological endpoints such as the impairment of growth and development and/or reproductive success that can be linked, at least conceptually, to maintaining healthy wildlife populations. As the purpose of this evaluation is to further refine the list of COPCs, NOAELs are used. If an HQ based on a NOAEL TRV is below unity, then there is a high degree of confidence that adverse effects to individual receptors are unlikely.

The TRVs are based on the following hierarchy of sources:

1. EPA's constituent-specific EcoSSL documents (EPA 2007)
2. Toxicological Benchmarks for Wildlife (Sample *et al.,* 1996)
3. Patton and Dieter (1980) for low molecular weight PAHs

A summary of the TRVs is presented in Table 15.

5.4.3.7 Calculated Intakes

Exposure point concentrations (EPC) are used to determine the intake for each receptor. EPCs in this analysis are based on "upper-bound" concentrations in soil, sediment and surface water. The upper-bound concentrations are generally 95% UCLs calculated using EPA's ProUCL software. These are the same values presented in the screening refinement tables. In cases where a UCL could not be calculated because of either too few samples or an insufficient number of detected results, or in cases where the calculated UCL exceeded the maximum detected concentrations, the maximum detected concentrations of those COPCs was used to represent the "upper-bound" concentration. The EPCs in each medium are provided in Table 16.

The upper-bound food chain intake estimates for the American robin and short-tailed shrew are provided in Tables 17 and 18, respectively. The upper-bound food chain intake estimates for the green heron and raccoon, are provided in Tables 19 and 20, respectively.

5.4.3.8 Risk Characterization

Risk characterization involves the integration of exposure and effects data to determine the likelihood of adverse effects. The risk calculation step integrates exposure and effect by using the results of the exposure estimate and the TRV to calculate an HQ for each COPC. An HQ is a ratio of the estimated daily COPC intake to the relevant TRV. An HQ less than or equal to 1 is indicative of no adverse effects. Actual magnitudes of effects and risk cannot necessarily be accurately inferred from the magnitude of the HQ value. For example, an HQ of 10 does not necessarily indicate that the risk of adverse effects is twice as high as the risk indicated by an HQ of 5.

The food chain HQs for each receptor are shown in Table 21. The HQ values for all constituents for all receptors are less than or equal to unity. Accordingly, these constituents do not pose an adverse risk to the receptors and are removed as COPCs.

5.5 Identification of Constituents of Potential Concern

A summary of the ecological COPCs and remaining PCOPCs is shown in Table 22. There are 15 COPCs and 25 remaining PCOPCs. The COPCs will be carried forward in the RI/FS process. The PCOPCs will not be carried forward as there is no indication that they pose a significant risk, especially as none of them had detected concentrations.

5.6 Uncertainty Evaluation for COPCs

An evaluation of uncertainties is a component of risk assessment (EPA, 1997). Steps 1-3a of an ERA are designed to provide estimates of the potential risks that may exist for wildlife and incorporates uncertainty in a conservative (*i.e.,* precautionary) manner. Uncertainty in an ERA is "the imperfect knowledge concerning the present or future state of the system under consideration; a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution" (EPA, 1997). Uncertainties that may lead to either an overestimation or an underestimation of risk are associated with each stage of risk assessment. There are several readily identifiable sources of uncertainty associated with the ecological screening process. In general, the process itself is designed to assist in the identification of significant sources of uncertainty.

- Elevated Detection Limits – Detection limits that exceed ESVs or RSVs are a significant source of uncertainty associated with the ecological screening process at this Site. Twenty-five of the constituents identified as PCOPC were not detected in any sample, yet because they have detection limits that exceed appropriate ESVs, they were retained as PCOPCs. Within the context of the ERA, where clearly important COPCs are readily identified, it is reasonable to conclude that the ecological risks related to constituents with elevated detection limits is unlikely to be significant relative to the major COPC.
- Age of the Data – The age of the sampling data is another source of uncertainty associated with measured concentrations of constituent constituents in the upland. Samples were collected on numerous occasions between 1989 and 2011.
- Absence of Site-Specific Background Concentrations – No site-specific background concentrations have been established for the Site. Without this type of data, it is not possible to determine with

confidence the extent to which measured concentrations are related to site activities vs. activities in surrounding areas and typical regional environmental concentrations. This uncertainty likely contributes to the identification of several naturally occurring inorganic constituents as COPCs. In addition, the lack of background data on environmentally ubiquitous organic compounds, such as metals and PAHs, could result in an overestimation of the magnitude of site-related risk from these constituents.

- Constituents without ESVs – Another major source of uncertainty relates to the numerous constituents for which ESVs are unavailable and were therefore eliminated from further consideration as COPC. As discussed previously, ESVs are generally available for the constituents expected to present the greatest risk to ecological receptors and several of the specific constituents missing ESVs were accounted for in screening values for larger constituent "groups." Therefore, it is reasonable to conclude that the exclusion of these constituents from further evaluation is consistent with the conservative nature of this evaluation.
- Toxicological and Ecological Uncertainties – There are uncertainties in many aspects of the toxicology relied upon for conducting ERAs (Newman 1998; Lovett Doust, *et al.* 1993). Only a limited number of species (mainly laboratory test species) are used to derive toxicity data and the data is obtained under laboratory conditions that are unlike natural conditions (Power 1996; Tannenbaum 2003).
- Data Uncertainties – The ecological screening is based on a limited number of samples, and these samples do not necessarily characterize the diverse areas of the Site. The majority of the samples were collected in a biased manner to characterize areas with suspected high concentrations.
- ProUCL – The use of EPA's ProUCL software to calculate UCLs on the mean concentration results in significant overestimation of exposure through direct contact with soil, sediment, and surface water, and to modeled concentrations in biota. This is because of the relatively small size of the datasets for many of the COPCs coupled with highly skewed distributions that reflect the spatially-limited nature of the impacts. Based on the conservative statistical algorithms employed by the ProUCL software, this often resulted in the recommendation to use a 97.5% or 99% UCL or the maximum detected concentration in many cases. The use of UCLs or maximum detected concentrations in these highly skewed datasets as the EPC to represent exposures in the risk assessment likely overestimates receptor exposures and risks, particularly because the samples associated with the maximum detected concentrations were intentionally biased, toward areas of contamination.

5.7 Scientific/Management Decision Point (SMDP)

SMDPs represent critical steps in the ERA process where risk management decision-making occurs. The first SMDP in the ERA process may occur either at the end of Step 2 or Step 3A (EPA, 2000). The purpose of the flexibility of the SMDP is so that additional evaluation of risks can occur and reporting can be streamlined into a single report. Generally, the following types of decisions are considered at this SMDP (EPA, 1997):

- There is adequate information to conclude that ecological risks are negligible and therefore no need for remediation on the basis of ecological risk.

- The information is not adequate to make a decision at this point, and the ecological risk assessment process will continue to Step 3.
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted.

The information is not adequate to make a decision at this point, and the ecological risk assessment process will continue to Step 3B. Subsequent activities associated with an ERA are warranted because the results of the screening indicate numerous COPCs, and because the Step 3A analysis is not adequate for remedial decision-making. Therefore, the risk assessment will proceed to Step 3B.

6 RI/FS CONSTITUENTS

The list of COPCs from the human health screening and the refined ecological screening are summarized on Table 23. This list was reviewed to determine the analytes and analytical suites to be taken forward in the RI/FS process for both future sampling and risk evaluation. The list (shown below) includes more constituents than are COPCs for consistency in analytical sampling and evaluation of results.

Medium	Inorganic List	HMW PAH	PCBs	Pesticides	SVOCs	VOCs	Energetics
Soil	X	X	X		BEHP	TCE	
Sediment	X	X	X				
Surface Water	X		X			PCE, TCE, cDCE, VC	
Groundwater	X		X	Dieldrin	BEHP	PCE, TCE, cDCE, VC, CT, 1,1-DCE	PETN, 2,4-DNT 1,3-DNB

Where:

Inorganic list: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, cyanide, iron,lead, manganese, mercury, nickel, silver, thallium, vanadium, zinc

HMWPAH: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, pyrene, perylene

PCBs: full suite of PCBs with the type (*e.g.,* aroclors, congeners) to be determined

SVOCs: BEHP: bis(2-ethylhexyl)phthalate

VOCs: PCE: tetrachloroethene; TCE: trichloroethene; 1,1-DCE: 1,1-dichloroethene; cDCE: cis-1,2-dichloroethene; VC: vinyl chloride; CT: carbon tetrachloride

Energetics: PETN: Pentaerythritol tetranitrate; 2,4-DNT: 2,4-dinitrotoluene; 1,3-DNB: 1,3-dinitrobenzene

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FIGURES

EPS
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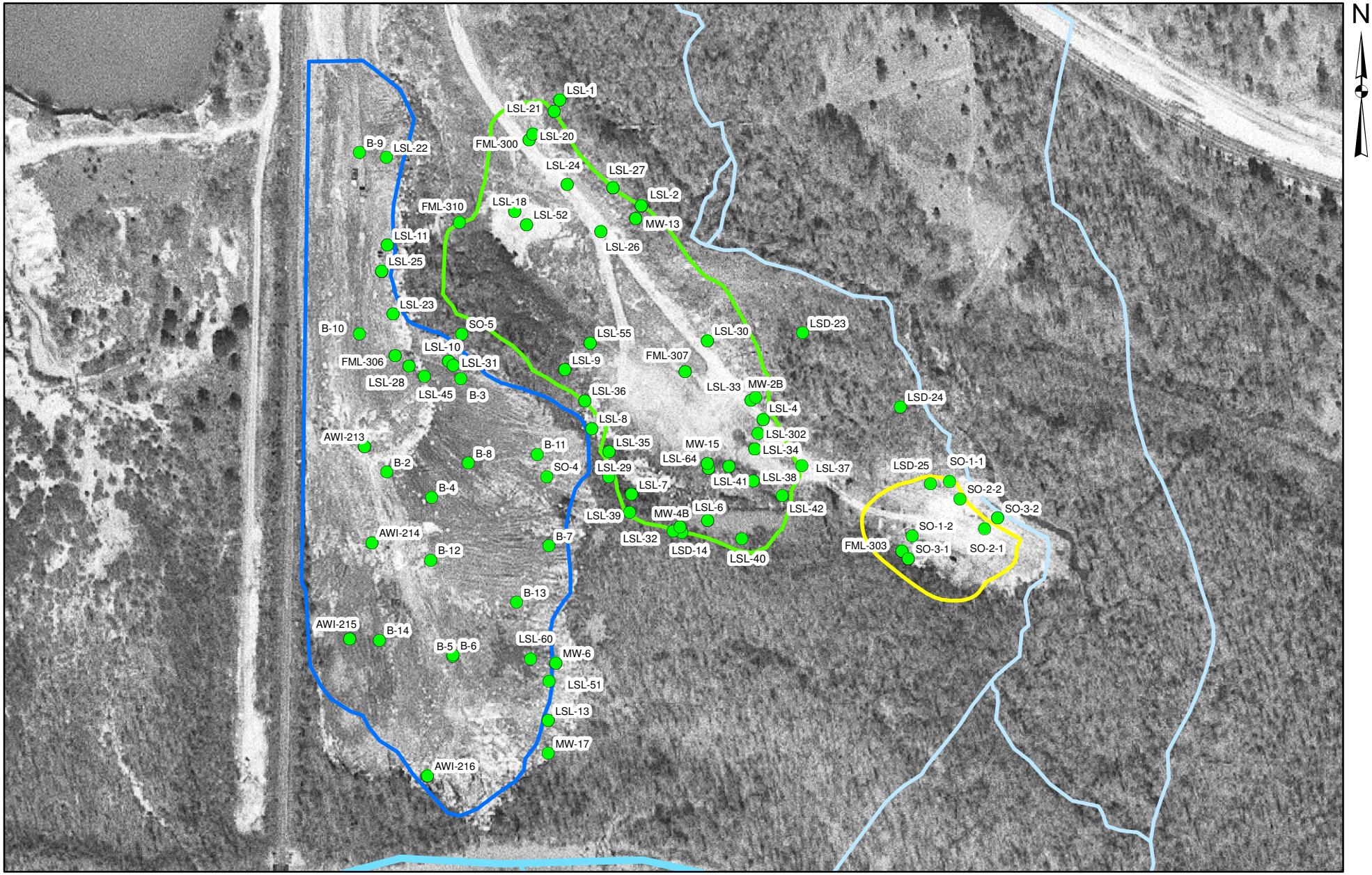
Site Map
Figure No. 1

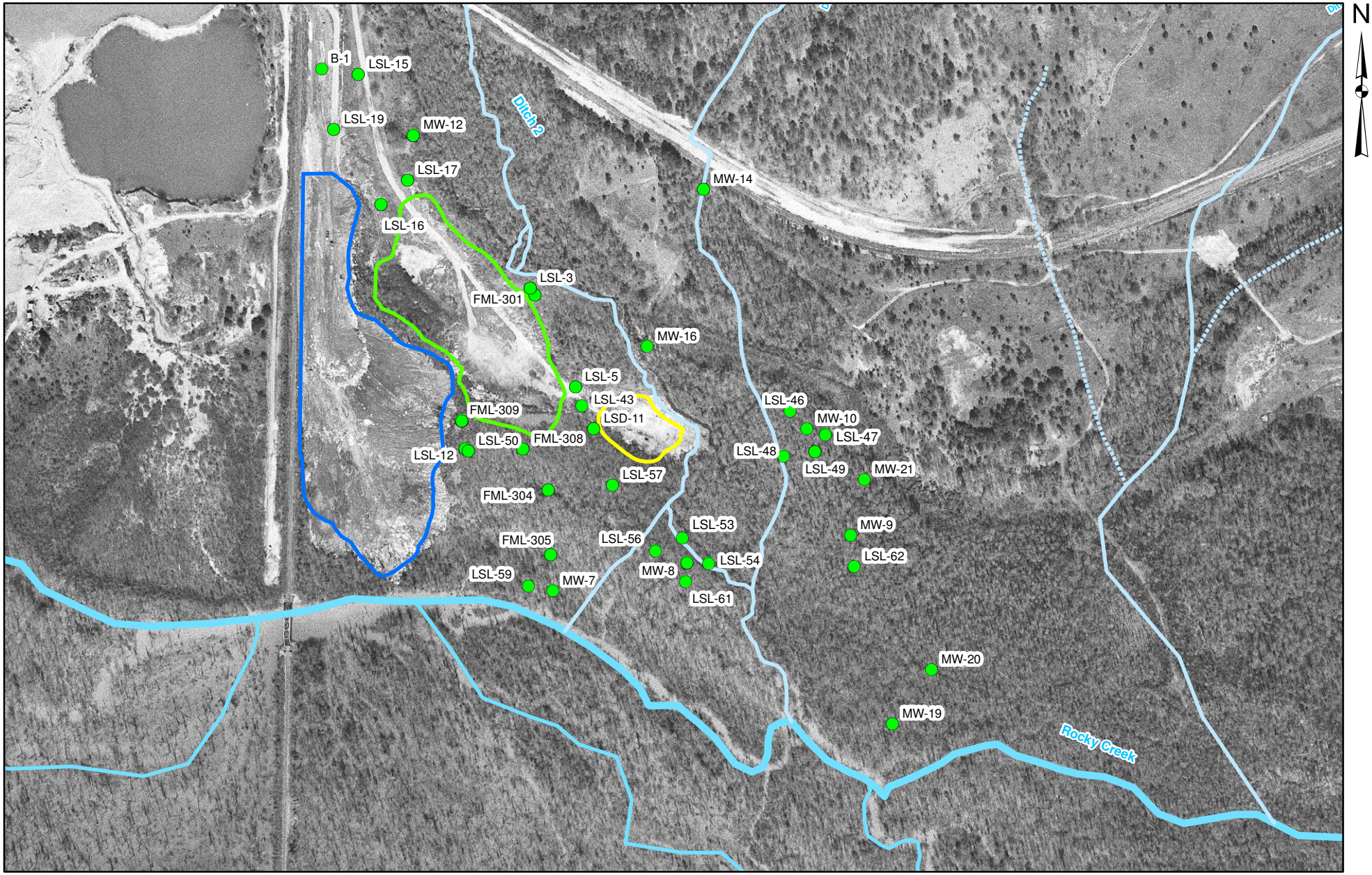


Historical Soil Sample Locations - Landfill Area

EPS

F:\AWI_Macon\Macon OU2\GIS\COPC\Soil.mxd

Figure No. 2A



0 250 500 1,000
Feet

Legend

Soil Sample Locations

Landfills

FMNOL

Remote Landfill

Explosives Demo Area

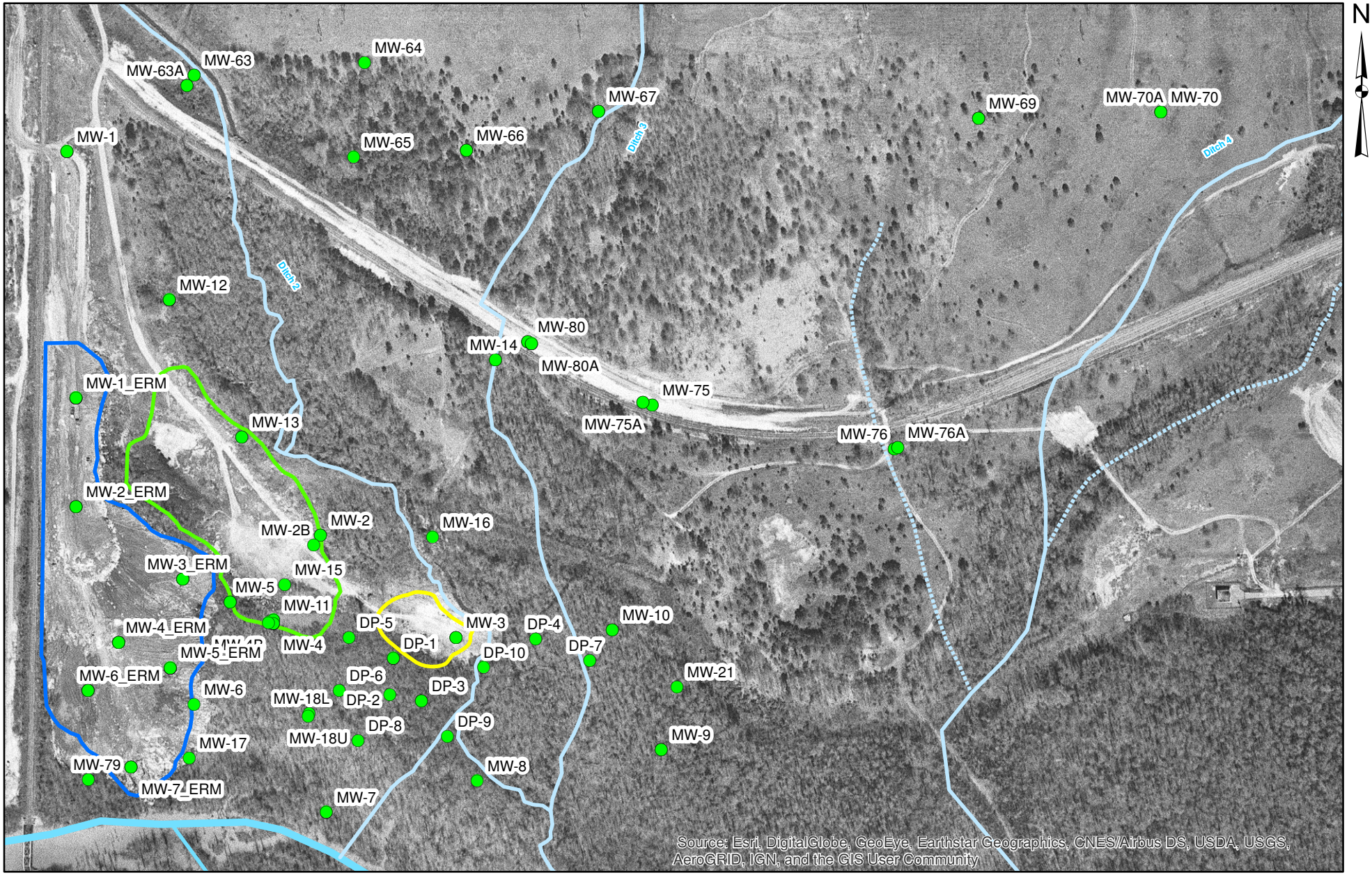
Aerial from 1975

Historical Soil Sample Locations - Outside Landfill Area

EPS

F:\AWI_Macon\Macon OU2\GIS\COPC\Soil.mxd

Figure No. 2B



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Feet

Legend

- Groundwater
- Explosives Demo Area
- FMNOL
- Remote Landfill

Aerial from 1975

Historical Groundwater Sample Locations

EPS
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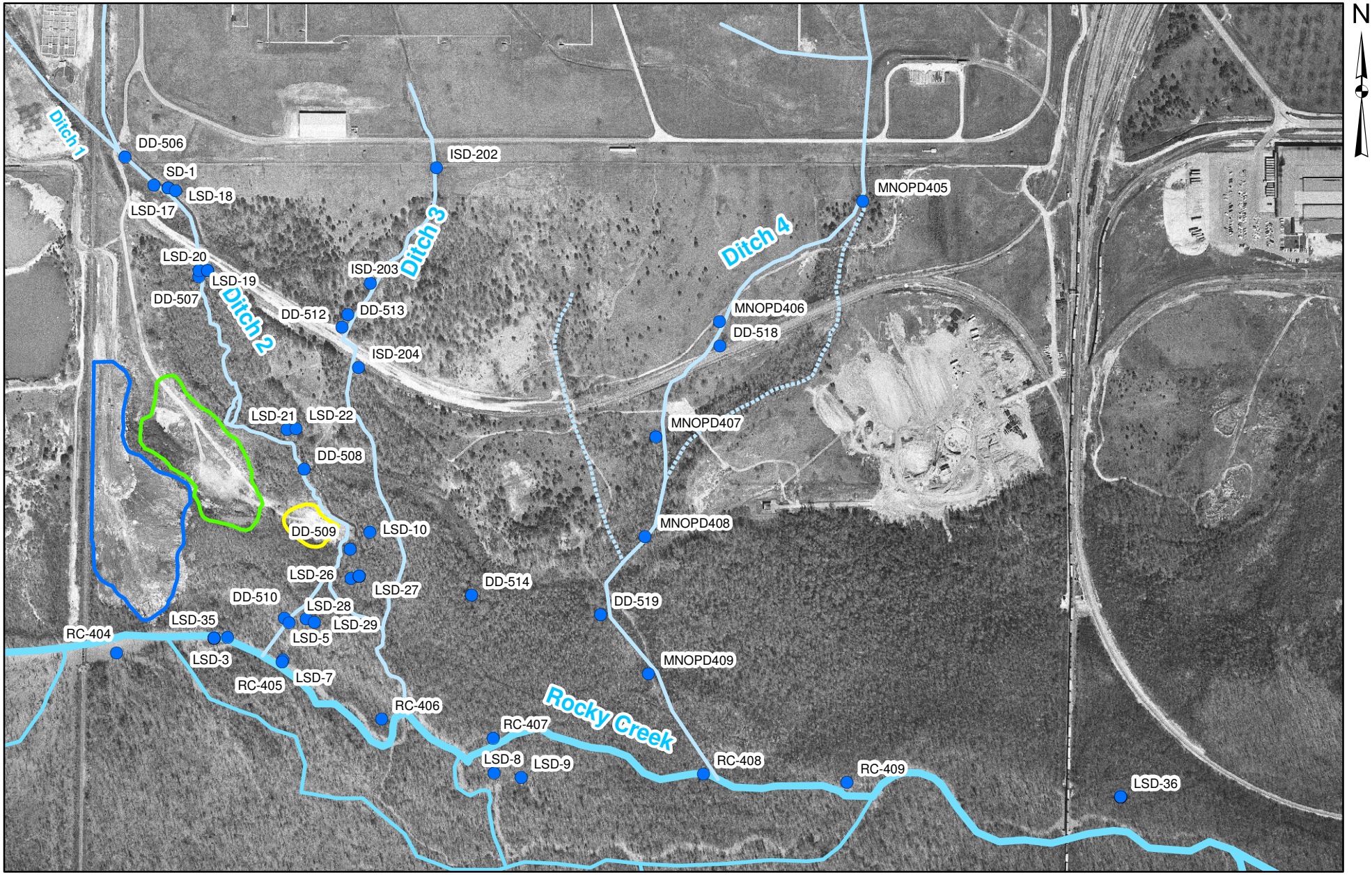
Figure No. 3



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Feet

Legend

- Sediment Sample Locations
- Explosives Demo Area
- FMNOL
- Remote Landfill

Aerial from 1975

Historical Sediment Sample Locations

EPS
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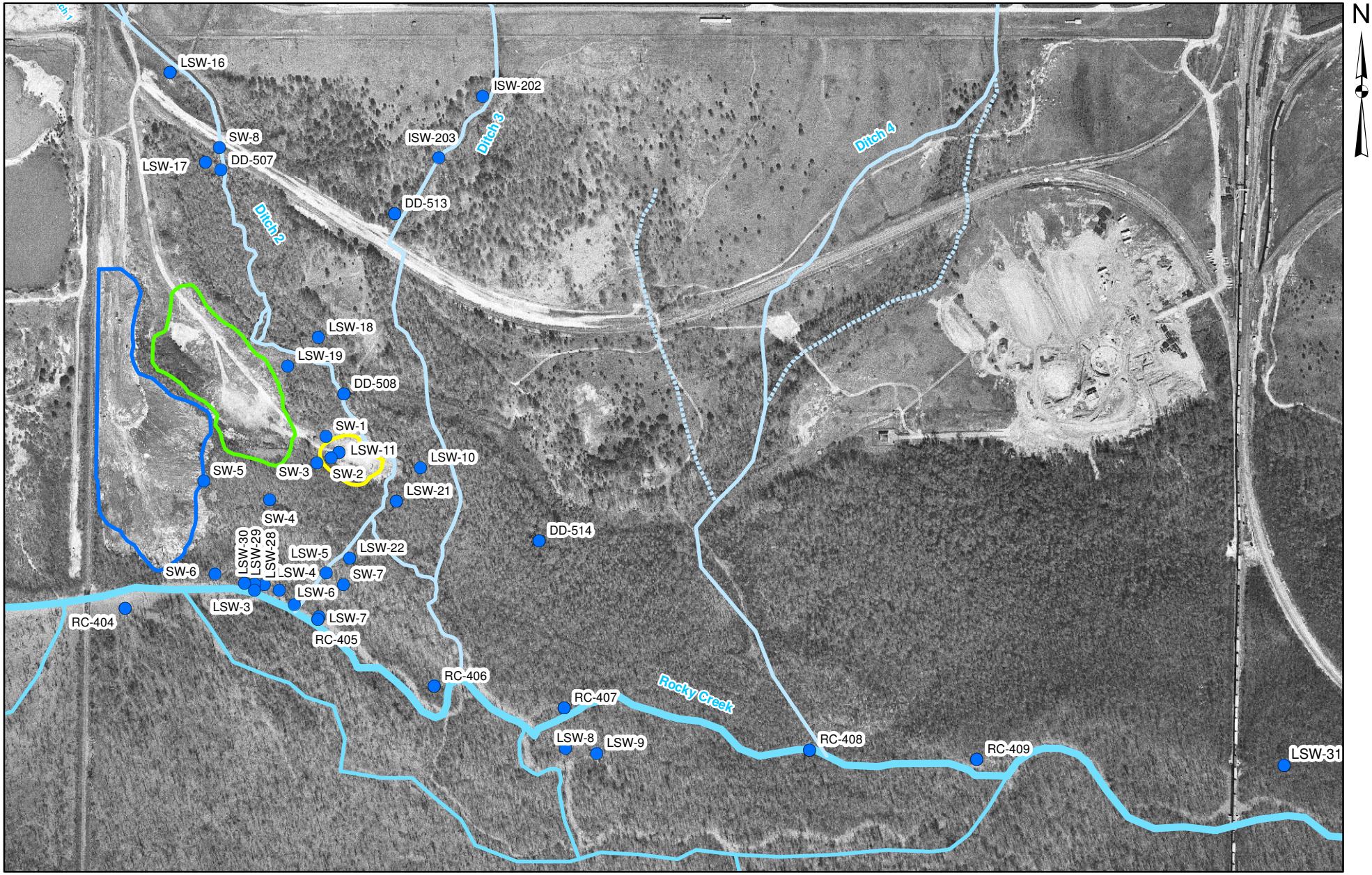
Figure No. 4



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Feet

Legend

- Surface Water Sample Location
- Explosives Demo Area
- FMNOL
- Remote Landfill

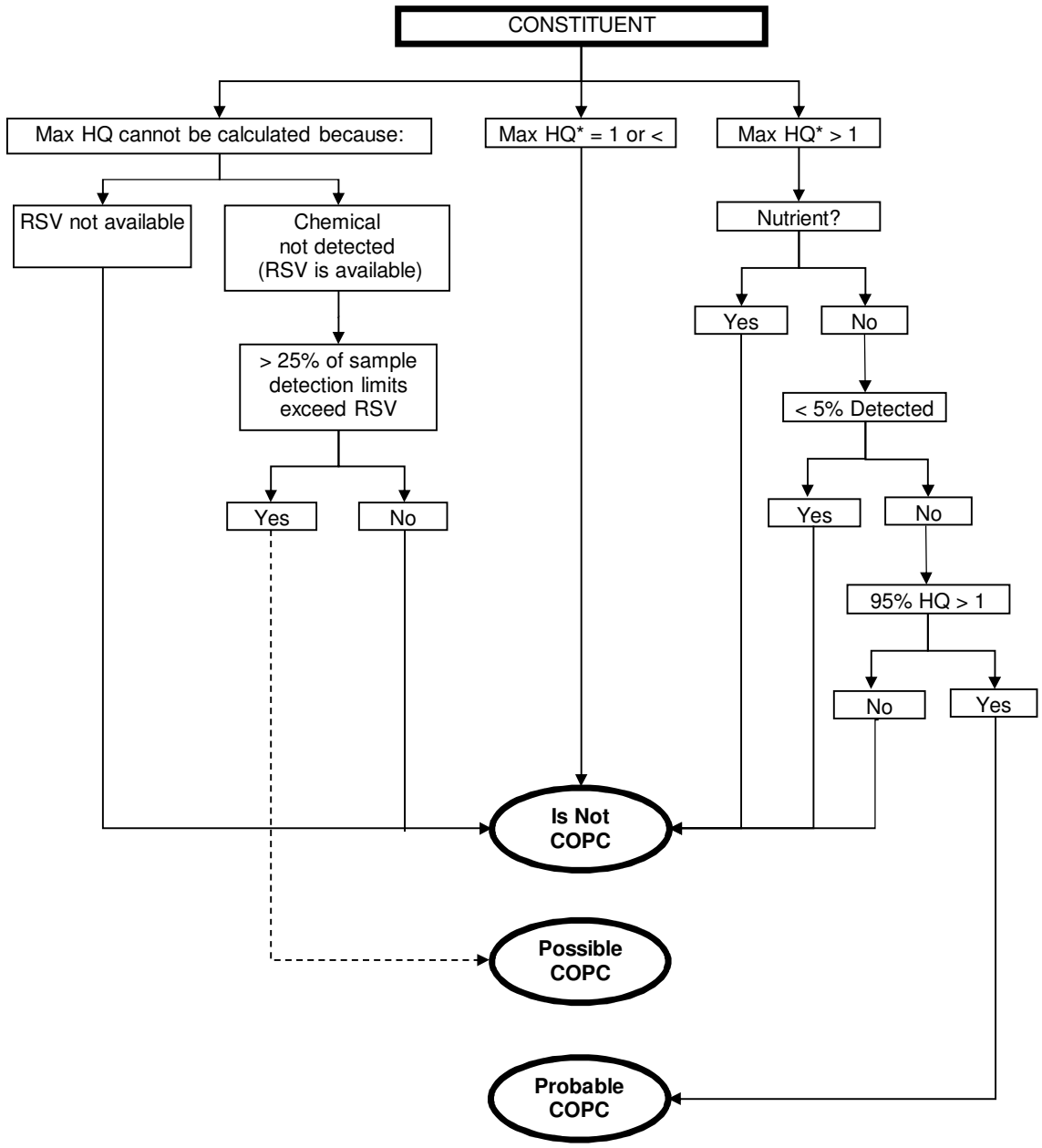
Aerial from 1975

Historical Surface Water Sample Locations

EPS
F:\AWI_Macon\Macon OU2\GIS\COPC\SW.mxd

Figure No. 5

Figure No. 6. Refined Ecological Screening Protocol



* Using Revised ESVs

TABLES

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Groundwater		DP-1	DP-1_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		DP-10	DP-10_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		DP-2	DP-2_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		DP-3	DP-3_1/16/1996	1/16/1996		1997 Rust Site Investigation
Groundwater		DP-4	DP-4_1/16/1996	1/16/1996		1997 Rust Site Investigation
Groundwater		DP-5	DP-5_1/16/1996	1/16/1996		1997 Rust Site Investigation
Groundwater		DP-6	DP-6_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		DP-7	DP-7_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		DP-8	DP-8_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		DP-9	DP-9_1/22/1996	1/22/1996		1997 Rust Site Investigation
Groundwater		MW-1	MW-1_2/1/1996	2/1/1996		1997 Rust Site Investigation
Groundwater		MW-1	MW-1_ESE_11/28/1989	11/28/1989		1990 Confirmation Study
Groundwater		MW-1_ERM	MW-1_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-1_ERM	MW-1_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-1_ERM	MW-1_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-1_ERM	MW-1_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-10	FML-314-MW	5/20/2009		2009 ESI
Groundwater		MW-10	MW-10_2/6/1996	2/6/1996		1997 Rust Site Investigation
Groundwater		MW-11	MW-11_1/26/1996	1/26/1996		1997 Rust Site Investigation
Groundwater		MW-11	MW11-GW1_11/13/1998	11/13/1998		2000 RIR
Groundwater		MW-12	MW-12-02_5/16/2001	5/16/2001		2001 RIR Addendum
Groundwater		MW-12	MW-12-02-F_5/16/2001	5/16/2001		2001 RIR Addendum
Groundwater		MW-12	MW12-GW1_11/12/1998	11/12/1998		2000 RIR
Groundwater		MW-13	MW-13-02_5/16/2001	5/16/2001		2001 RIR Addendum
Groundwater		MW-13	MW13-GW1_11/13/1998	11/13/1998		2000 RIR
Groundwater		MW-14	MW-14-02_5/18/2001	5/18/2001		2001 RIR Addendum
Groundwater		MW-14	MW14-GW1_11/17/1998	11/17/1998		2000 RIR
Groundwater		MW-15	MW15-GW1_11/16/1998	11/16/1998		2000 RIR
Groundwater		MW-16	MW16-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-17	MW17-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-18L	MW18L-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-18U	MW18U-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-19	FML-315-MW	5/19/2009		2009 ESI
Groundwater		MW-19	MW19-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-2	MW-2_2/1/1996	2/1/1996		1997 Rust Site Investigation
Groundwater		MW-2	MW-2_ESE_11/28/1989	11/28/1989		1990 Confirmation Study
Groundwater		MW-2_ERM	MW-2_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-2_ERM	MW-2_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-2_ERM	MW-2_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-2_ERM	MW-2_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-20	MW20-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-21	MW21-GW1_11/18/1998	11/18/1998		2000 RIR
Groundwater		MW-2B	MW2B-GW1_11/16/1998	11/16/1998		2000 RIR
Groundwater		MW-3	MW-3_2/1/1996	2/1/1996		1997 Rust Site Investigation
Groundwater		MW-3	MW-3_ESE_11/28/1989	11/28/1989		1990 Confirmation Study

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Groundwater		MW-3_ERM	MW-3_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-3_ERM	MW-3_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-3_ERM	MW-3_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-3_ERM	MW-3_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-4	MW-4_2/1/1996	2/1/1996		1997 Rust Site Investigation
Groundwater		MW-4	MW-4_ESE_11/28/1989	11/28/1989		1990 Confirmation Study
Groundwater		MW-4	MW4-GW1_11/13/1998	11/13/1998		2000 RIR
Groundwater		MW-4_ERM	MW-4_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-4_ERM	MW-4_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-4_ERM	MW-4_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-4_ERM	MW-4_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-4B	MW4B-GW1_11/16/1998	11/16/1998		2000 RIR
Groundwater		MW-5	MW-5_2/1/1996	2/1/1996		1997 Rust Site Investigation
Groundwater		MW-5	MW-5_ESE_11/28/1989	11/28/1989		1990 Confirmation Study
Groundwater		MW-5_ERM	MW-5_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-5_ERM	MW-5_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-5_ERM	MW-5_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-5_ERM	MW-5_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-6	MW-6_1/29/1996	1/29/1996		1997 Rust Site Investigation
Groundwater		MW-6_ERM	MW-6_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-6_ERM	MW-6_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-6_ERM	MW-6_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-6_ERM	MW-6_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-63	MW-63_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-63	MW-63-02_5/17/2001	5/17/2001		2001 RIR Addendum
Groundwater		MW-63A	MW-63A_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-63A	MW-63A-01_5/31/2001	5/31/2001		2001 RIR Addendum
Groundwater		MW-64	MW-64-02_5/17/2001	5/17/2001		2001 RIR Addendum
Groundwater		MW-65	MW-65-02_5/16/2001	5/16/2001		2001 RIR Addendum
Groundwater		MW-66	AIP-146-MW	5/17/2009		2009 ESI
Groundwater		MW-66	MW-66_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-66	MW-66-02_5/16/2001	5/16/2001		2001 RIR Addendum
Groundwater		MW-67	MW-67_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-67	MW-67-02_5/18/2001	5/18/2001		2001 RIR Addendum
Groundwater		MW-67	MW-67-02-F_5/18/2001	5/18/2001		2001 RIR Addendum
Groundwater		MW-69	MW-69_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-69	MW-69-02_5/23/2001	5/23/2001		2001 RIR Addendum
Groundwater		MW-69	MW-69-02-F_5/23/2001	5/23/2001		2001 RIR Addendum
Groundwater		MW-7	FML-312-MW	5/17/2009		2009 ESI
Groundwater		MW-7	MW-7_2/6/1996	2/6/1996		1997 Rust Site Investigation
Groundwater		MW-7_ERM	MW-7_ERM_1/22/1992	1/22/1992		1995 Delisting Report AWI
Groundwater		MW-7_ERM	MW-7_ERM_1/24/1995	1/24/1995		1995 Delisting Report AWI
Groundwater		MW-7_ERM	MW-7_ERM_10/24/1994	10/24/1994		1995 Delisting Report AWI
Groundwater		MW-7_ERM	MW-7_ERM_5/4/1995	5/4/1995		1995 Delisting Report AWI
Groundwater		MW-70	AIP-147-MW	5/17/2009		2009 ESI

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Groundwater		MW-70	MW-70_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-70A	MW-70A_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-75	MW-75_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-75	MW-75-01_5/31/2001	5/31/2001		2001 RIR Addendum
Groundwater		MW-75A	MW-75A_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-75A	MW-75A-01_6/1/2001	6/1/2001		2001 RIR Addendum
Groundwater		MW-76	MW-76_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-76	MW-76-01_5/30/2001	5/30/2001		2001 RIR Addendum
Groundwater		MW-76A	MW-76A_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-76A	MW-76A-01_5/29/2001	5/29/2001		2001 RIR Addendum
Groundwater		MW-79	MW-79-01_5/31/2001	5/31/2001		2001 RIR Addendum
Groundwater		MW-8	MW-8_2/8/1996	2/8/1996		1997 Rust Site Investigation
Groundwater		MW-80	AIP-149-MW	5/20/2009		2009 ESI
Groundwater		MW-80	MW-80_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-80	MW-80-01_5/30/2001	5/30/2001		2001 RIR Addendum
Groundwater		MW-80A	MW-80A_11/1/2004	11/1/2004		2005 GW AIP
Groundwater		MW-80A	MW-80A-01_5/30/2001	5/30/2001		2001 RIR Addendum
Groundwater		MW-9	FML-313-MW	5/20/2009		2009 ESI
Groundwater		MW-9	MW-9_2/7/1996	2/7/1996		1997 Rust Site Investigation
Sediment		DD-506	DD-506-SD	5/19/2009		2009 ESI
Sediment		DD-507	DD-507-SD	5/19/2009		2009 ESI
Sediment		DD-508	DD-508-SD	5/18/2009		2009 ESI
Sediment		DD-509	DD-509-SD	5/18/2009		2009 ESI
Sediment		DD-510	DD-510-SD	5/15/2009		2009 ESI
Sediment		DD-512	DD-512-SD	5/15/2009		2009 ESI
Sediment		DD-513	DD-513-SD	5/13/2009		2009 ESI
Sediment		DD-514	DD-514-SD	5/15/2009		2009 ESI
Sediment		DD-518	DD-518-SD	5/14/2009		2009 ESI
Sediment		DD-519	DD-519-SD	5/14/2009		2009 ESI
Sediment		ISD-202	ISD-202_3/10/2000	3/10/2000		2000 CSR
Sediment		ISD-203	ISD-203_3/9/2000	3/9/2000		2000 CSR
Sediment		ISD-204	ISD-204_3/10/2000	3/10/2000		2000 CSR
Sediment		LSD-10	LSD-10_6/1/1996	6/1/1996		1997 Rust Site Investigation
Sediment		LSD-17	LSD-17-01_5/26/1998	5/26/1998	0-0.5	2000 RIR
Sediment		LSD-18	LSD-18-01_5/26/1998	5/26/1998	0-0.5	2000 RIR
Sediment		LSD-19	LSD-19-01_5/22/1998	5/22/1998	0-0.5	2000 RIR
Sediment		LSD-20	LSD-20-01_5/22/1998	5/22/1998	0-0.5	2000 RIR
Sediment		LSD-21	LSD-21-01_5/22/1998	5/22/1998	0-0.5	2000 RIR
Sediment		LSD-22	LSD-22-01_5/22/1998	5/22/1998	0-0.5	2000 RIR
Sediment		LSD-26	LSD-26-01_5/21/1998	5/21/1998	0-0.5	2000 RIR
Sediment		LSD-27	LSD-27-01 _5/21/1998	5/21/1998	0-0.5	2000 RIR
Sediment		LSD-27	LSD-27-01_5/21/1998	5/21/1998	0-0.5	2000 RIR
Sediment		LSD-28	LSD-28-01_5/21/1998	5/21/1998	0-0.5	2000 RIR
Sediment		LSD-29	LSD-29-01_5/21/1998	5/21/1998	0-0.5	2000 RIR
Sediment		LSD-3	LSD-3_6/1/1996	6/1/1996		1997 Rust Site Investigation

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Sediment		LSD-35	LSD-35-01_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-35	LSD-35-02_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-35	LSD-35-03_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-35	LSD-35-04_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-35	LSD-35-05_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-36	LSD-36-01_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-36	LSD-36-02_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-36	LSD-36-03_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-36	LSD-36-04_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-36	LSD-36-05_5/27/1998	5/27/1998	0-0.5	2000 RIR
Sediment		LSD-5	LSD-5_6/1/1996	6/1/1996		1997 Rust Site Investigation
Sediment		LSD-7	LSD-7_6/1/1996	6/1/1996		1997 Rust Site Investigation
Sediment		LSD-8	LSD-8_6/1/1996	6/1/1996		1997 Rust Site Investigation
Sediment		LSD-9	LSD-9_6/1/1996	6/1/1996		1997 Rust Site Investigation
Sediment		MNOPD405	MNOP-D4-05-SD	6/30/2011		2009 ESI
Sediment		MNOPD406	MNOP-D4-06-SD	6/30/2011		2009 ESI
Sediment		MNOPD407	MNOP-D4-07-SD	6/30/2011		2009 ESI
Sediment		MNOPD408	MNOP-D4-W-08-SD	6/30/2011		2009 ESI
Sediment		MNOPD409	MNOP-D4-W-09-SD	6/30/2011		2009 ESI
Sediment		RC-404	RC-404-SD	5/15/2009		2009 ESI
Sediment		RC-405	RC-405-SD	5/15/2009		2009 ESI
Sediment		RC-406	RC-406-SD	5/18/2009		2009 ESI
Sediment		RC-407	RC-407-SD	5/19/2009		2009 ESI
Sediment		RC-408	RC-408-SD	5/12/2009		2009 ESI
Sediment		RC-409	RC-409-SD	5/12/2009		2009 ESI
Sediment		SD-1	SD-1_7/25/1990	7/25/1990	0-1	1990 Confirmation Study
Soil	SB	AWI-213	AWI-213-SB	5/13/2009	1-2	2009 ESI
Soil	SS	AWI-213	AWI-213-SF	5/13/2009	0-0.5	2009 ESI
Soil	SB	AWI-214	AWI-214-SB	5/13/2009	1-2	2009 ESI
Soil	SS	AWI-214	AWI-214-SF	5/13/2009	0-0.5	2009 ESI
Soil	SB	AWI-215	AWI-215-SB	5/13/2009	1-2	2009 ESI
Soil	SS	AWI-215	AWI-215-SF	5/13/2009	0-0.5	2009 ESI
Soil	SB	AWI-216	AWI-216-SB	5/13/2009	1-2	2009 ESI
Soil	SS	AWI-216	AWI-216-SF	5/13/2009	0-0.5	2009 ESI
Soil	SB	B-1	B-1_1/7/1992	1/7/1992	3.5-5.5	1995 Delisting Report AWI
Soil	SB	B-10	B-10_1/9/1992	1/9/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	B-11	B-11_1/9/1992	1/9/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	B-12	B-12_1/10/1992	1/10/1992	0-2	1995 Delisting Report AWI
Soil	SB	B-13	B-13_1/10/1992	1/10/1992	0-2	1995 Delisting Report AWI
Soil	SB	B-14	B-14_1/10/1992	1/10/1992	0-2	1995 Delisting Report AWI
Soil	SB	B-2	B-2_1/7/1992	1/7/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	B-3	B-3_1/7/1992	1/7/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	B-4	B-4_1/8/1992	1/8/1992	0-2	1995 Delisting Report AWI
Soil	SB	B-5	B-5_1/8/1992	1/8/1992	0-2	1995 Delisting Report AWI
Soil	SB	B-6	B-6_1/7/1992	1/7/1992	0-2	1995 Delisting Report AWI

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Soil	SB	B-7	B-7_1/8/1992	1/8/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	B-8	B-8_1/8/1992	1/8/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	B-9	B-9_1/9/1992	1/9/1992	0-5.5	1995 Delisting Report AWI
Soil	SB	FML-300	FML-300-SF	5/12/2009	0-0.5	2009 ESI
Soil	SS	FML-300	FML-300-SB	5/12/2009	1-2	2009 ESI
Soil	SB	FML-301	FML-301-SB	5/12/2009	1-2	2009 ESI
Soil	SS	FML-301	FML-301-SF	5/12/2009	0-0.5	2009 ESI
Soil	SB	FML-302	FML-302-SB	5/14/2009	1-2	2009 ESI
Soil	SS	FML-302	FML-302-SF	5/14/2009	0-0.5	2009 ESI
Soil	SB	FML-303	FML-303-SB	5/14/2009	1-2	2009 ESI
Soil	SS	FML-303	FML-303-SF	5/14/2009	0-0.5	2009 ESI
Soil	SB	FML-304	FML-304-SB	5/15/2009	1-2	2009 ESI
Soil	SS	FML-304	FML-304-SF	5/15/2009	0-0.5	2009 ESI
Soil	SB	FML-305	FML-305-SB	5/15/2009	1-2	2009 ESI
Soil	SS	FML-305	FML-305-SF	5/15/2009	0-0.5	2009 ESI
Soil	SB	FML-306	FML-306-SB	5/12/2009	1-2	2009 ESI
Soil	SS	FML-306	FML-306-SF	5/12/2009	0-0.5	2009 ESI
Soil	SB	FML-307	FML-307-SB	5/12/2009	1-2	2009 ESI
Soil	SS	FML-307	FML-307-SF	5/12/2009	0-0.5	2009 ESI
Soil	SB	FML-308	FML-308-SB	5/15/2009	1-2	2009 ESI
Soil	SS	FML-308	FML-308-SF	5/15/2009	0-0.5	2009 ESI
Soil	SB	FML-309	FML-309-SB	5/15/2009	1-2	2009 ESI
Soil	SS	FML-309	FML-309-SF	5/15/2009	0-0.5	2009 ESI
Soil	SS	FML-310	FML-310-SF	5/12/2009	0-0.5	2009 ESI
Soil *	SS	LSD-11	LSD-11_6/1/1996	6/1/1996		1997 Rust Site Investigation
Soil *	SS	LSD-14	LSD-14_6/1/1996	6/1/1996		1997 Rust Site Investigation
Soil *	SS	LSD-23	LSD-23-01_5/26/1998	5/26/1998	0-0.5	2000 RIR
Soil *	SS	LSD-24	LSD-24-01_5/26/1998	5/26/1998	0-0.5	2000 RIR
Soil *	SS	LSD-25	LSD-25-01_5/26/1998	5/26/1998	0-0.5	2000 RIR
Soil	SB	LSL-1	LSL-1 (0-2)_1/18/1996	1/18/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-1	LSL-1 (6-8)_1/18/1996	1/18/1996	6-8	1997 Rust Site Investigation
Soil	SB	LSL-10	LSL-10 (0-2)_1/24/1996	1/24/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-10	LSL-10 (8-10)_1/24/1996	1/24/1996	8-10	1997 Rust Site Investigation
Soil	SB	LSL-11	LSL-11 (0-2)_1/24/1996	1/24/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-11	LSL-11 (4-6)_1/24/1996	1/24/1996	4-6	1997 Rust Site Investigation
Soil	SB	LSL-12	LSL-12 (1-2)_4/25/1996	4/25/1996	1-2	1997 Rust Site Investigation
Soil	SB	LSL-12	LSL-12 (3-4)_4/25/1996	4/25/1996	3-4	1997 Rust Site Investigation
Soil	SB	LSL-13	LSL-13 (1-2)_4/25/1996	4/25/1996	1-2	1997 Rust Site Investigation
Soil	SB	LSL-13	LSL-13 (3-4)_4/25/1996	4/25/1996	3-4	1997 Rust Site Investigation
Soil	SB	LSL-15	LSL-15-01_6/17/1998	6/17/1998	0-2	2000 RIR
Soil	SB	LSL-15	LSL-15-02_6/17/1998	6/17/1998	5-7	2000 RIR
Soil	SB	LSL-16	LSL-16-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-16	LSL-16-02_6/22/1998	6/22/1998	5-7	2000 RIR
Soil	SB	LSL-17	LSL-17-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-17	LSL-17-02_6/22/1998	6/22/1998	4-6	2000 RIR

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Soil	SB	LSL-18	LSL-18-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-18	LSL-18-02_6/22/1998	6/22/1998	4-6	2000 RIR
Soil	SB	LSL-19	LSL-19-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-19	LSL-19-02_6/23/1998	6/23/1998	7-9	2000 RIR
Soil	SB	LSL-2	LSL-2 (0-2)_1/17/1996	1/17/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-2	LSL-2 (6-8)_1/17/1996	1/17/1996	6-8	1997 Rust Site Investigation
Soil	SB	LSL-20	LSL-20-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-20	LSL-20-02_6/22/1998	6/22/1998	5-7	2000 RIR
Soil	SB	LSL-21	LSL-21-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-21	LSL-21-02_6/22/1998	6/22/1998	4-6	2000 RIR
Soil	SB	LSL-22	LSL-22-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-23	LSL-23-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-23	LSL-23-02_6/23/1998	6/23/1998	7-9	2000 RIR
Soil	SB	LSL-24	LSL-24-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-24	LSL-24-02_6/22/1998	6/22/1998	4-6	2000 RIR
Soil	SB	LSL-25	LSL-25-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-25	LSL-25-02_6/23/1998	6/23/1998	6-8	2000 RIR
Soil	SB	LSL-26	LSL-26-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-26	LSL-26-02_6/22/1998	6/22/1998	3-5	2000 RIR
Soil	SB	LSL-27	LSL-27-01_6/22/1998	6/22/1998	0-2	2000 RIR
Soil	SB	LSL-27	LSL-27-02_6/22/1998	6/22/1998	4-6	2000 RIR
Soil	SB	LSL-28	LSL-28-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-28	LSL-28-02_6/23/1998	6/23/1998	8-10	2000 RIR
Soil	SB	LSL-29	LSL-29-01_6/24/1998	6/24/1998	0-2	2000 RIR
Soil	SB	LSL-3	LSL-3 (0-2)_1/17/1996	1/17/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-3	LSL-3 (6-8)_1/17/1996	1/17/1996	6-8	1997 Rust Site Investigation
Soil	SB	LSL-30	LSL-30-01_6/19/1998	6/19/1998	0-2	2000 RIR
Soil	SB	LSL-30	LSL-30-02_6/19/1998	6/19/1998	4-6	2000 RIR
Soil	SB	LSL-31	LSL-31-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-31	LSL-31-02_6/23/1998	6/23/1998	6-8	2000 RIR
Soil	SB	LSL-32	LSL-32-01_6/24/1998	6/24/1998	0-2	2000 RIR
Soil	SB	LSL-33	LSL-33-01_6/19/1998	6/19/1998	0-2	2000 RIR
Soil	SB	LSL-34	LSL-34-01_6/19/1998	6/19/1998	0-2	2000 RIR
Soil	SB	LSL-35	LSL-35-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-35	LSL-35-02_6/23/1998	6/23/1998	4-6	2000 RIR
Soil	SB	LSL-36	LSL-36-01_6/23/1998	6/23/1998	0-2	2000 RIR
Soil	SB	LSL-36	LSL-36-02_6/23/1998	6/23/1998	5-7	2000 RIR
Soil	SB	LSL-37	LSL-37-01_6/19/1998	6/19/1998	0-2	2000 RIR
Soil	SB	LSL-38	LSL-38-01_6/24/1998	6/24/1998	0-2	2000 RIR
Soil	SB	LSL-38	LSL-38-02_6/24/1998	6/24/1998	2-4	2000 RIR
Soil	SB	LSL-39	LSL-39-01_6/24/1998	6/24/1998	0-2	2000 RIR
Soil	SB	LSL-4	LSL-4 (0-2)_1/18/1996	1/18/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-4	LSL-4 (4-6)_1/18/1996	1/18/1996	4-6	1997 Rust Site Investigation
Soil	SB	LSL-40	LSL-40-01_6/24/1998	6/24/1998	0-2	2000 RIR
Soil	SB	LSL-41	LSL-41-01_6/24/1998	6/24/1998	0-2	2000 RIR

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Soil	SB	LSL-41	LSL-41-02_6/24/1998	6/24/1998	4-6	2000 RIR
Soil	SB	LSL-42	LSL-42-01_6/19/1998	6/19/1998	0-2	2000 RIR
Soil	SB	LSL-43	LSL-43-01_6/19/1998	6/19/1998	0-2	2000 RIR
Soil	SS	LSL-45	LSL-45_5/19/1998	5/19/1998	0-1	2000 RIR
Soil	SS	LSL-46	LSL-46_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-47	LSL-47_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-48	LSL-48_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-49	LSL-49 _5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-49	LSL-49_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SB	LSL-5	LSL-5 (0-2)_1/26/1996	1/26/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-5	LSL-5 (8-10)_1/26/1996	1/26/1996	8-10	1997 Rust Site Investigation
Soil	SS	LSL-50	LSL-50_5/19/1998	5/19/1998	0-1	2000 RIR
Soil	SS	LSL-51	LSL-51_5/19/1998	5/19/1998	0-1	2000 RIR
Soil	SB	LSL-52	LSL-52 0-2_5/19/1998	5/19/1998	0-2	2000 RIR
Soil	SB	LSL-52	LSL-52 2-4_5/19/1998	5/19/1998	2-4	2000 RIR
Soil	SS	LSL-53	LSL-53_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-54	LSL-54_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SB	LSL-55	LSL-55 0-2_5/19/1998	5/19/1998	0-2	2000 RIR
Soil	SB	LSL-55	LSL-55 2-4_5/19/1998	5/19/1998	2-4	2000 RIR
Soil	SS	LSL-56	LSL-56_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-57	LSL-57_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-59	LSL-59_5/19/1998	5/19/1998	0-1	2000 RIR
Soil	SB	LSL-6	LSL-6 (0-2)_1/19/1996	1/19/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-6	LSL-6 (6-8)_1/19/1996	1/19/1996	6-8	1997 Rust Site Investigation
Soil	SS	LSL-60	LSL-60_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-61	LSL-61_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SS	LSL-62	LSL-62_5/20/1998	5/20/1998	0-1	2000 RIR
Soil	SB	LSL-64	LSL-64 0-2_5/19/1998	5/19/1998	0-2	2000 RIR
Soil	SB	LSL-64	LSL-64 2-4_5/19/1998	5/19/1998	2-4	2000 RIR
Soil	SB	LSL-7	LSL-7 (0-2)_1/23/1996	1/23/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-7	LSL-7 (6-8)_1/23/1996	1/23/1996	6-8	1997 Rust Site Investigation
Soil	SB	LSL-8	LSL-8 (0-2)_1/18/1996	1/18/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-8	LSL-8 (4-5)_1/18/1996	1/18/1996	4-5	1997 Rust Site Investigation
Soil	SB	LSL-9	LSL-9 (0-2)_1/17/1996	1/17/1996	0-2	1997 Rust Site Investigation
Soil	SB	LSL-9	LSL-9 (6-8)_1/17/1996	1/17/1996	6-8	1997 Rust Site Investigation
Soil	SB	MW-10	MW-10 (0-2)_2/6/1996	2/6/1996	0-2	1997 Rust Site Investigation
Soil	SB	MW-12	MW-12-2_10/1/1998	10/1/1998	7-9	2000 RIR
Soil	SS	MW-12	MW-12-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SB	MW-13	MW-13-2_10/1/1998	10/1/1998	6-8	2000 RIR
Soil	SS	MW-13	MW-13-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SB	MW-14	MW-14-2_10/1/1998	10/1/1998	2-3	2000 RIR
Soil	SS	MW-14	MW-14-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SB	MW-15	MW-15-2_10/1/1998	10/1/1998	7-9	2000 RIR
Soil	SS	MW-15	MW-15-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SS	MW-16	MW-16-1_10/1/1998	10/1/1998	0-1	2000 RIR

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Soil	SS	MW-17	MW-17-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SS	MW-19	MW-19-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SS	MW-20	MW-20-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SS	MW-21	MW-21-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SS	MW-2B	MW-2B-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SB	MW-4B	MW-4B-2_10/1/1998	10/1/1998	2-3	2000 RIR
Soil	SS	MW-4B	MW-4B-1_10/1/1998	10/1/1998	0-1	2000 RIR
Soil	SB	MW-6	MW-6 (2-4)_1/29/1996	1/29/1996	2-4	1997 Rust Site Investigation
Soil	SB	MW-7	MW-7 (0-2)_2/6/1996	2/6/1996	0-2	1997 Rust Site Investigation
Soil	SB	MW-8	MW-8 (0-2)_2/8/1996	2/8/1996	0-2	1997 Rust Site Investigation
Soil	SB	MW-8	MW-8-1_2/8/1996	2/8/1996	0-2	1997 Rust Site Investigation
Soil	SB	MW-9	MW-9 (6-8)_2/7/1996	2/7/1996	6-8	1997 Rust Site Investigation
Soil	SB	SO-1-1	SO-1-1_11/29/1989	11/29/1989	0-3	1990 Confirmation Study
Soil	SB	SO-1-2	SO-1-2_7/26/1990	7/26/1990	0-3	1990 Confirmation Study
Soil	SB	SO-2-1	SO-2-1_11/29/1989	11/29/1989	0-3	1990 Confirmation Study
Soil	SB	SO-2-2	SO-2-2_7/26/1990	7/26/1990	0-3	1990 Confirmation Study
Soil	SB	SO-3-1	SO-3-1_11/29/1989	11/29/1989	0-3	1990 Confirmation Study
Soil	SB	SO-3-2	SO-3-2_7/26/1990	7/26/1990	0-3	1990 Confirmation Study
Soil	SB	SO-4	SO-4_11/29/1989	11/29/1989	0-3	1990 Confirmation Study
Soil *	SS	SO-5	SO-5_11/29/1989	11/29/1989	0-1	1990 Confirmation Study
Surface Water		DD-507	DD-507-SW	5/19/2009		2009 ESI
Surface Water		DD-508	DD-508-SW	5/18/2009		2009 ESI
Surface Water		DD-508	DD-508-SWF	5/18/2009		2009 ESI
Surface Water		DD-513	DD-513-SW	5/13/2009		2009 ESI
Surface Water		DD-513	DD-513-SWF	5/13/2009		2009 ESI
Surface Water		DD-514	DD-514-SW	5/15/2009		2009 ESI
Surface Water		DD-514	DD-514-SWF	5/15/2009		2009 ESI
Surface Water		ISW-202	ISW-202_3/10/2000	3/10/2000		2000 CSR
Surface Water		ISW-203	ISW-203_3/9/2000	3/9/2000		2000 CSR
Surface Water		LSW-10	LSW-10_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-11	LSW-11_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-16	LSW-16-01_5/26/1998	5/26/1998	0-1	2000 RIR
Surface Water		LSW-17	LSW-17-01_5/22/1998	5/22/1998	0-1	2000 RIR
Surface Water		LSW-18	LSW-18-01_5/22/1998	5/22/1998	0-1	2000 RIR
Surface Water		LSW-19	LSW-19-01_5/26/1998	5/26/1998	0-1	2000 RIR
Surface Water		LSW-20	LSW-20-01_5/26/1998	5/26/1998	0-1	2000 RIR
Surface Water		LSW-21	LSW-21-01_5/21/1998	5/21/1998	0-1	2000 RIR
Surface Water		LSW-22	LSW-22-01_5/21/1998	5/21/1998	0-1	2000 RIR
Surface Water		LSW-28	LSW-28-01_5/27/1998	5/27/1998	0-1	2000 RIR
Surface Water		LSW-29	LSW-29-01_5/27/1998	5/27/1998	0-1	2000 RIR
Surface Water		LSW-3	LSW-3_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-30	LSW-30-01_5/28/1998	5/28/1998	0-1	2000 RIR
Surface Water		LSW-31	LSW-31-01_5/27/1998	5/27/1998	0-1	2000 RIR
Surface Water		LSW-31	LSW-31-02_5/27/1998	5/27/1998	0-2	2000 RIR
Surface Water		LSW-4	LSW-4_6/1/1996	6/1/1996		1997 Rust Site Investigation

Table 1. Samples Included in COPC Selection

Matrix		Location	Sample ID	Date Sampled	Depth (ft)	Report
Surface Water		LSW-5	LSW-5_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-6	LSW-6_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-7	LSW-7_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-8	LSW-8_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		LSW-9	LSW-9_6/1/1996	6/1/1996		1997 Rust Site Investigation
Surface Water		RC-404	RC-404-SW	5/15/2009		2009 ESI
Surface Water		RC-404	RC-404-SWF	5/15/2009		2009 ESI
Surface Water		RC-405	RC-405-SW	5/15/2009		2009 ESI
Surface Water		RC-405	RC-405-SWF	5/15/2009		2009 ESI
Surface Water		RC-406	RC-406-SW	5/18/2009		2009 ESI
Surface Water		RC-406	RC-406-SWF	5/18/2009		2009 ESI
Surface Water		RC-407	RC-407-SW	5/19/2009		2009 ESI
Surface Water		RC-407	RC-407-SWF	5/19/2009		2009 ESI
Surface Water		RC-408	RC-408-SW	5/12/2009		2009 ESI
Surface Water		RC-408	RC-408-SWF	5/12/2009		2009 ESI
Surface Water		RC-409	RC-409-SW	5/12/2009		2009 ESI
Surface Water		RC-409	RC-409-SWF	5/12/2009		2009 ESI
Surface Water		SW-1	SW-1_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-2	SW-2_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-3	SW-3_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-4	SW-4_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-5	SW-5_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-6	SW-6_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-7	SW-7_11/10/2005	11/10/2005		2006 Water Sampling FMNOP
Surface Water		SW-8	SW-8_11/10/2005	11/10/2005		2006 Water Sampling FMNOP

* Sample designated as sediment, but treated as soil due to the area not always being inundated with water.
SS: Surface Soil (≤ 1 ft)
SB: Subsurface Soil (> 1 ft)

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Inorganics												
Aluminum		15/15	100%	2300-15000		7700	8	110000	0	0%	Yes	
Antimony		27/44	61%	0.3-30	0.27-34	3.1	8	47	0	0%	Yes	
Arsenic		44/45	98%	0.59-83	1.5-1.5	0.68	43	3	0	0%	Yes	
Barium		16/16	100%	11-400		1500	0	22000	0	0%	No	A
Beryllium		38/46	83%	0.13-1.5	0.54-2.8	16	0	230	0	0%	No	A
Cadmium		41/46	89%	0.46-160	0.13-0.8	7.1	23	98	0	0%	Yes	
Calcium		15/15	100%	210-43000							No	B
Chromium **		47/47	100%	0.24-340		12,000	0	180000	0	0%	No	A
Cobalt		3/15	20%	0.88-18	5.4-28	2.3	1	35	0	0%	Yes	
Copper		46/46	100%	3.5-4400		310	3	4700	0	0%	Yes	
Cyanide		1/15	7%	1.5-1.5	2.7-14	2.3	0	15	0	0%	No	A
Iron		15/15	100%	3200-31000		5500	12	82000	0	0%	Yes	
Lead		47/47	100%	5-2900		400	2	800	0	0%	Yes	
Magnesium		15/15	100%	46-8000							No	B
Manganese		15/15	100%	27-3600		180	13	2600			Yes	
Mercury		36/47	77%	0.04-3.9	0.047-0.59	1.1	11	4.6	0	0%	Yes	
Nickel		46/46	100%	0.23-490		150	2	2200	0	0%	Yes	
Potassium		13/15	87%	70-1700	540-560						No	B
Selenium		28/47	60%	0.56-7.2	0.14-20	39	0	580	0	0%	No	A
Silver		20/47	43%	0.23-160	0.22-5.6	39	1	580	0	0%	Yes	
Sodium		15/15	100%	3-390							No	B
Thallium		1/44	2%	0.51-0.51	0.44-14	0.078	1	1.2	20	45%	Yes	
Vanadium		15/15	100%	8.5-50		39	3	580	0	0%	Yes	
Zinc		45/46	98%	11.1-6600	6.5-6.5	2300	1	35000	0	0%	Yes	
High Molecular Weight PAHs												
Benzo(a)anthracene		13/45	29%	0.058-6.7	0.19-46	1.1	6	21	7	16%	Yes	
Benzo(a)pyrene		13/42	31%	0.061-12	0.19-46	0.11	11	2.1	21	50%	Yes	
Benzo(b)fluoranthene		13/47	28%	0.075-4.8	0.16-46	1.1	3	21	7	15%	Yes	
Benzo(g,h,i)perylene	Pyrene	15/47	32%	0.12-11	0.19-46	180	0	2300	0	0%	No	A
Benzo(k)fluoranthene		10/45	22%	0.059-9.3	0.19-46	11	0	210	0	0%	No	A
Chrysene		15/47	32%	0.067-10	0.19-46	110	0	2100	0	0%	No	A
Dibenzo(a,h)anthracene		7/45	16%	0.049-1.3	0.19-46	0.11	3	2.1	27	60%	Yes	
Fluoranthene		10/45	22%	0.12-13	0.19-46	240	0	3000	0	0%	No	A
Indeno(1,2,3-cd)pyrene		11/45	24%	0.043-1.6	0.19-46	1.1	1	21	7	16%	Yes	
Pyrene		11/47	23%	0.18-12	0.19-46	180	0	2300	0	0%	No	A
Benzo(e)pyrene		3/8	38%	0.3-1.4	0.23-30						No	D
Perylene		2/4	50%	0.6-1.1							No	D

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Low Molecular Weight PAHs												
2-Methylnaphthalene		0/15	0%		0.19-7.9	24		300	0	0%	No	E
Acenaphthene		0/45	0%		0.15-46	360		4500	0	0%	No	E
Acenaphthylene	Pyrene	1/45	2%	0.095-0.095	0.15-46	180	0	2300	0	0%	No	A
Anthracene		3/45	7%	0.051-0.32	0.19-46	1800	0	23000	0	0%	No	A
Fluorene		0/44	0%		0.15-46	240		3000	0	0%	No	E
Naphthalene		1/45	2%	4.08-4.1	0.15-46	3.8	1	17	7	16%	No	F *
Phenanthrene	Pyrene	9/47	19%	0.074-1	0.17-46	180	0	2300	0	0%	No	A
Pesticides												
Aldrin		0/15	0%		0.0019-0.01	0.039		0.18	0	0%	No	E
alpha-BHC		0/15	0%		0.0019-0.01	0.086		0.36	0	0%	No	E
alpha-Chlordane	Chlordane	5/15	33%	0.0011-0.0093	0.0019-0.01	1.7	0	7.7	0	0%	No	A
beta-BHC		1/15	7%	0.016-0.016	0.0019-0.01	0.3	0	1.3	0	0%	No	A
delta-BHC	alpha-BHC	0/15	0%		0.0019-0.01	0.086		0.36	0	0%	No	E
Dieldrin		2/15	13%	0.0011-0.003	0.0036-0.02	0.034	0	0.14	0	0%	No	A
Endosulfan I	Endosulfan	0/15	0%		0.0019-0.01	47		700	0	0%	No	E
Endosulfan II	Endosulfan	0/15	0%		0.0036-0.02	47		700	0	0%	No	E
Endosulfan sulfate	Endosulfan	2/15	13%	0.0024-0.045	0.0036-0.02	47	0	700	0	0%	No	A
Endrin		2/15	13%	0.001-0.0011	0.0036-0.02	1.9	0	25	0	0%	No	A
Endrin Aldehyde	Endrin	3/15	20%	0.0039-0.013	0.0036-0.02	1.9	0	25	0	0%	No	A
Endrin ketone	Endrin	1/15	7%	0.0032-0.0032	0.0036-0.02	1.9	0	25	0	0%	No	A
gamma-BHC (Lindane)		1/15	7%	0.0037-0.0037	0.0019-0.01						No	D
gamma-Chlordane	Chlordane	11/15	73%	0.0024-0.15	0.0019-0.01	1.7	0	7.7	0	0%	No	A
Heptachlor		1/15	7%	0.001-0.001	0.0019-0.01	0.13	0	0.63	0	0%	No	A
Heptachlor epoxide		2/15	13%	0.00049-0.0014	0.0019-0.01	0.07	0	0.33	0	0%	No	A
Methoxychlor		0/15	0%		0.019-0.1	32		410	0	0%	No	E
Toxaphene		0/15	0%		0.19-1	0.49		2.1	0	0%	No	E
DDD/DDE/DDT												
4,4'-DDD		2/15	13%	0.0034-0.0065	0.0036-0.02	0.19	0	2.5	0	0%	No	A
4,4'-DDE		6/15	40%	0.0018-0.081	0.0036-0.02	2	0	9.3	0	0%	No	A
4,4'-DDT		4/15	27%	0.0058-0.086	0.0036-0.02	1.9	0	8.5	0	0%	No	A

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
PCBs												
Aroclor 1016		2/44	5%	0.738-1.4	0.0018-1.5	0.41	2	5.1	0	0%	No	C
Aroclor 1221		0/44	0%		0.0017-1.4	0.2		0.83	1	2%	No	E
Aroclor 1232		2/44	5%	1.76-3.5	0.002-1.7	0.17	2	0.72	1	2%	No	C
Aroclor 1242		2/44	5%	1.91-2.8	0.0022-1.9	0.23	2	0.95	1	2%	No	C
Aroclor 1248		30/44	68%	0.011-43	0.0013-0.061	0.23	20	0.95	0	0%	Yes	
Aroclor 1254		12/44	27%	0.009-4	0.0013-1.1	0.12	10	0.97	1	2%	Yes	
Aroclor 1260		8/44	18%	0.018-1.1	0.0019-1.6	0.24	4	0.99	1	2%	Yes	
Aroclor 1262		0/15	0%		0.036-0.2						No	E
Aroclor 1268		0/15	0%		0.036-0.2						No	E
1,1'-Biphenyl, 2',3,4,5,5'-Pentachloro-		0/1	0%								No	E
1,1'-Biphenyl, 2,3',4',5-tetrachloro-		1/1	100%	0.5-0.5							No	D
1,1'-Biphenyl, 2,3',4',6-tetrachloro-		0/1	0%								No	E
1,1'-Biphenyl, 2',3,4-trichloro-		0/1	0%								No	E
1,1'-Biphenyl, 3,3',5,5'-tetrachloro-		0/1	0%								No	E
SVOCs												
(Z,Z)-9,12-Octadecadienoic acid		1/1	100%	0.3-0.3							No	D
6-methyl-Chrysene		1/1	100%	0.4-0.4							No	D
1,1-Biphenyl		0/15	0%		0.19-7.9	4.7		20	0	0%	No	E
1,2,3,4-Tetramethylbenzene		0/1	0%								No	E
1,2,3,5,6,8a-hexahydro-4,7-Naphthalene		1/1	100%	0.258-0.26							No	D
1,2,4,5-Tetrachlorobenzene		0/15	0%		0.19-7.9	2.3		35	0	0%	No	E
1,3-Diethyl-5-methylbenzene		0/1	0%								No	E
1,3-Dimethylpyrene		0/1	0%								No	E
1,4-Diethyl-2-methylbenzene		0/1	0%								No	E
1,4-Dioxane		0/15	0%		0.039-0.72	5.3		24	0	0%	No	E
1-chloro-Heptacosane		1/1	100%	0.7-0.7							No	D
1-Eicosanol		1/1	100%	0.21-0.21							No	D
1-methyl-7-(1-methylethyl)-Phenanthrene		0/1	0%								No	E
1-methyl-Chrysene		1/2	50%	4.16-4.2							No	D
1-methyl-Pyrene		0/1	0%								No	E
1-Tricosene		1/1	100%	0.3-0.3							No	D
2,3,3',4,4'-pentachloro-1,1'-biphenyl		0/1	0%								No	E
2,3,4,6-Tetrachlorophenol		0/15	0%		0.19-7.9	190		2500	0	0%	No	E
2,4,5-Trichlorophenol		0/16	0%		0.19-7.9	630		8200	0	0%	No	E
2,4,6-Trichlorophenol		0/16	0%		0.19-7.9	6.3		82	0	0%	No	E
2,4-Dichlorophenol		0/16	0%		0.19-7.9	19		250	0	0%	No	E
2,4-Dimethylphenol		0/16	0%		0.19-7.9	130		1600	0	0%	No	E
2,4-Dinitrophenol		0/15	0%		0.36-16	13		160	0	0%	No	E
2,4-Tricosanedione		0/3	0%								No	E
2,6,10,14-Tetramethylpentadecane		0/1	0%								No	E
2,6,10-Trimethyldodecane		0/1	0%								No	E
2,6-Dimethylheptane		0/1	0%								No	E

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
24-methyl-5-Cholestene-3-ol		1/1	100%	0.3-0.3							No	D
28-Nor-17.alpha.(H)-hopane		0/1	0%								No	E
2-Chloronaphthalene		0/45	0%		0.15-46	480		6000	0	0%	No	E
2-Chlorophenol		0/16	0%		0.19-7.9	39		580	0	0%	No	E
2-Methyl Decalin		1/2	50%	0.008-0.008							No	D
2-methyl-Chrysene		0/1	0%								No	E
2-Methyldecane		0/1	0%								No	E
2-Methylphenol		0/15	0%		0.19-7.9	320		4100	0	0%	No	E
2-methyl-Triphenylene		2/4	50%	0.4-0.7							No	D
2-Nitroaniline		0/15	0%		0.36-16	63		800	0	0%	No	E
2-Nitrophenol	2,4-Dinitrophenol	0/16	0%		0.19-7.9	13		160	0	0%	No	E
3,3'-Dichlorobenzidine		0/16	0%		0.19-7.9	1.2		5.1	3	19%	No	E
3-methyl-Benz[j]aceanthrylene		2/4	50%	0.4-5.1							No	D
3-Methyldecane		0/1	0%								No	E
3-Methylheptadecane		0/1	0%								No	E
3-methyl-Perylene		1/1	100%	0.3-0.3							No	D
3-Nitroaniline		0/15	0%		0.36-16						No	E
3-Nitrophthalic acid		1/1	100%	1.52-1.5							No	D
4,4'-Dinitrodiphenylsulphide		0/1	0%								No	E
4,6-Dinitro-2-methylphenol		0/16	0%		0.36-16	0.51		6.6	3	19%	No	E
4-Bromophenyl-phenylether		0/16	0%		0.19-7.9						No	E
4-Chloro-3-methylphenol		0/16	0%		0.19-7.9	630		8200	0	0%	No	E
4-Chloroaniline		0/15	0%		0.19-7.9	2.7		11	0	0%	No	E
4-Chlorophenyl-phenylether	2-Chlorophenol	0/16	0%		0.19-7.9	39		580	0	0%	No	E
4-Ethyl-o-xylene		0/1	0%								No	E
4-Nitroaniline		0/15	0%		0.36-16	25		110	0	0%	No	E
4-Nitrophenol	2,4-Dinitrophenol	0/16	0%		0.36-16	13		160	0	0%	No	E
5,12-Naphthacenedione		0/1	0%								No	E
5,8-dimethyl-Benzo[c]phenanthrene		1/3	33%	0.49-0.49							No	D
6,13-dihydro-Pentacene		1/1	100%	3-3							No	D
7H-Benz[de]anthracen-7-one		0/1	0%								No	E
7-methyl-Benz[a]anthracene		1/1	100%	4-4							No	D
Acetophenone		1/15	7%	0.082-0.082	0.19-7.9	780	0	12000	0	0%	No	A
Atrazine		0/15	0%		0.19-7.9	2.4		10	0	0%	No	E
Benzaldehyde		1/15	7%	0.16-0.16	0.19-7.9	170	0	820	0	0%	No	A
Benzo[b]naphtho[2,1-d]thiophene		0/1	0%								No	E
Benzo[b]naphtho[2,3-d]thiophene		0/1	0%								No	E
Bis(2-Chloro-1-methylethyl)Ether		0/16	0%		0.15-7.9						No	E
bis(2-Chloroethoxy) methane		0/16	0%		0.15-7.9	19		250	0	0%	No	E
bis(2-Chloroethyl) ether		0/16	0%		0.15-7.9	0.23		1	5	31%	No	E
bis(2-Ethylhexyl) phthalate		9/20	45%	0.31-83	0.19-5.7	39	2	160	0	0%	Yes	
Butylbenzylphthalate		0/16	0%		0.19-7.9	290		1200	0	0%	No	E
Campesterol		1/1	100%	0.3-0.3							No	D

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Caprolactam		0/15	0%		0.19-7.9	3100		40000	0	0%	No	E
Carbazole		0/15	0%		0.19-7.9						No	E
Cholesterol		1/1	100%	0.4-0.4							No	D
Cinnamyl cinnamate		2/2	100%	0.4-22							No	D
Copaene		1/1	100%	0.955-0.96							No	D
Cresols, Total		1/15	7%	3.4-3.4	0.19-7.9	630	0	8200	0	0%	No	A
Cyclopropanenonanoic acid, 2-[(2-butylcy		1/1	100%	6.45-6.5							No	D
Dibenz(a,h)anthracene, 5,6-dihydro-		0/1	0%								No	E
Dibenzofuran		0/15	0%		0.19-7.9	7.3		100	0	0%	No	E
Diethylphthalate		0/16	0%		0.15-7.9	5100		66000	0	0%	No	E
Dimethylphthalate		0/16	0%		0.15-7.9						No	E
Di-n-butylphthalate		0/18	0%		0.15-7.9	630		8200	0	0%	No	E
Di-n-octylphthalate		1/16	6%	0.2-0.2	0.19-7.9	63	0	820	0	0%	No	A
Dotriacontane		1/1	100%	0.228-0.23							No	D
Friedelan-3-one		2/2	100%	1-3							No	D
Gamma-Muurolene		1/1	100%	3.08-3.1							No	D
Glycocyanidine		0/1	0%								No	E
Heptadecanoic Acid		1/1	100%	0.4-0.4							No	D
Hexachlorobenzene		0/16	0%		0.19-7.9	0.21		0.96	6	38%	No	E
Hexachlorobutadiene		0/16	0%		0.19-7.9	1.2		5.3	3	19%	No	E
Hexachlorocyclopentadiene		0/15	0%		0.19-7.9	0.18		0.75	6	40%	No	E
Hexachloroethane		0/16	0%		0.19-7.9	1.8		8	0	0%	No	E
Hexadecanoic Acid		4/4	100%	0.2-4							No	D
Isophorone		0/16	0%		0.15-7.9	570		2400	0	0%	No	E
m-Terphenyl		1/1	100%	1-1							No	D
n-Amylcyclohexane		0/1	0%								No	E
n-Heptacosane		0/1	0%								No	E
Nitrobenzene		0/16	0%		0.19-7.9	5.1		22	0	0%	No	E
N-Nitroso-di-n-propylamine		0/16	0%		0.19-7.9	0.078		0.33	6	38%	No	E
N-Nitrosodiphenylamine/Diphenylamine		0/15	0%		0.19-7.9	110		470	0	0%	No	E
Nonadecane		1/2	50%	0.199-0.2							No	D
Octadecanoic Acid		2/2	100%	0.2-0.3							No	D
Oleic Acid		2/2	100%	0.5-0.9							No	D
o-Terphenyl		1/1	100%	0.4-0.4							No	D
Pentachlorophenol		0/16	0%		0.36-16	1		4	5	31%	No	E
Pentadecanoic acid		1/1	100%	0.8-0.8							No	D
Pentatriacontane		1/1	100%	0.173-0.17							No	D
Pentylcyclohexane		0/1	0%								No	E
Petroleum Hydrocarbons		1/1	100%	207-210							No	D
Phenol		0/16	0%		0.19-7.9	1900		25000	0	0%	No	E
p-Terphenyl		2/2	100%	0.7-3							No	D
Sitosterol		0/1	0%								No	E
Stigmast-4-en-3-one		2/2	100%	0.9-4							No	D

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Terpinolene		1/1	100%	0.253-0.25							No	D
trans-Decahydronaphthalene		0/1	0%								No	E
Z-11-Hexadecenoic acid		1/1	100%	0.6-0.6							No	D
VOCs												
1,1,1-Trichloroethane		0/42	0%		0.001-0.3	810		3600	0	0%	No	E
1,1,2,2-Tetrachloroethane		0/42	0%		0.001-0.36	0.6		2.7	0	0%	No	E
1,1,2-Trichloroethane		0/42	0%		0.001-0.23	0.15		0.63	0	0%	No	E
1,1-Dichloroethane		0/38	0%		0.001-0.15	3.6		16	0	0%	No	E
1,1-Dichloroethene		0/42	0%		0.001-0.5	23		100	0	0%	No	E
1,2,3-Trichlorobenzene		0/15	0%		0.002-0.036	6.3		93	0	0%	No	E
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	0/15	0%		0.002-0.036	5.8		26	0	0%	No	E
1,2,4-Trichlorobenzene		0/16	0%		0.002-0.21	5.8		26	0	0%	No	E
1,2,4-Trimethylbenzene		0/1	0%			30		180	0	0%	No	E
1,2,4-Trimethylbenzene Isomer		1/1	100%	0.0089-0.0089							No	D
1,2-Dibromo-3-chloropropane		0/15	0%		0.002-0.036	0.0053		0.064	0	0%	No	E
1,2-Dibromoethane		0/15	0%		0.002-0.036	0.036		0.16	0	0%	No	E
1,2-Dichlorobenzene		0/16	0%		0.002-0.15	180		930	0	0%	No	E
1,2-Dichloroethane		0/39	0%		0.001-0.36	0.46		2	0	0%	No	E
1,2-Dichloropropane		0/42	0%		0.001-0.13	1.6		6.6	0	0%	No	E
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/16	0%		0.002-0.15	180		930	0	0%	No	E
1,4-Dichlorobenzene		0/16	0%		0.002-0.15	2.6		11	0	0%	No	E
2-Butanone (MEK)		8/42	19%	0.0027-0.044	0.001-2.3	2700	0	19000	0	0%	No	A
2-Chloroethyl vinyl ether		0/1	0%		0.25-0.25						No	E
2-Hexanone		2/41	5%	0.0006-0.002	0.001-0.072	20	0	130	0	0%	No	A
3-Methylpentane		1/1	100%	0.0649-0.065							No	D
4-Methyl-2-pentanone		1/42	2%	0.0016-0.0016	0.001-0.68	3300	0	14000	0	0%	No	A
Acetone		12/41	29%	0.0034-0.07	0.001-0.072	6100	0	67000	0	0%	No	A
alpha-Pinene		1/1	100%	0.0741-0.074							No	D
Benzene		0/42	0%		0.001-0.21	1.2		5.1	0	0%	No	E
Benzene, 1-phenyl-4-(2-cyano-2-phenyleth		1/1	100%	0.0527-0.053							No	D
Bromochloromethane		0/15	0%		0.002-0.036	15		63	0	0%	No	E
Bromochloromethane	Bromodichloromethane	0/15	0%		0.002-0.036	0.29		1.3	0	0%	No	E
Bromoform		0/42	0%		0.001-0.23	19		86	0	0%	No	E
Bromomethane		0/44	0%		0.00092-0.61	0.68		3	0	0%	No	E
Camphene		2/2	100%	0.004-0.046							No	D
Carbon disulfide		4/42	10%	0.0038-0.11	0.001-0.5	77	0	350	0	0%	No	A
Carbon tetrachloride		0/42	0%		0.001-0.46	0.65		2.9	0	0%	No	E
Chlorobenzene		0/42	0%		0.001-0.34	28		130	0	0%	No	E
Chloroethane		0/41	0%		0.001-0.76	1400		5700	0	0%	No	E
Chloroform		2/42	5%	0.0143-0.015	0.001-0.23	0.32	0	1.4	0	0%	No	A
Chloromethane		1/39	3%	0.0357-0.036	0.001-0.65	11	0	46	0	0%	No	A
cis/trans1,2-Dichloroethene		1/25	4%	0.294-0.29	0.001-0.018						No	D
cis-1,2-Dichloroethene		1/17	6%	0.0081-0.0081	0.002-0.036	16	0	230	0	0%	No	A

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/42	0%		0.001-0.23	1.8		8.2	0	0%	No	E
Cyclohexane		0/15	0%		0.002-0.036	650		2700	0	0%	No	E
Dibromochloromethane		0/42	0%		0.001-0.23	8.3		39	0	0%	No	E
Dichlorobenzene		0/1	0%		0.72-0.72						No	E
Dichlorobromomethane		0/42	0%		0.001-0.13	0.29		1.3	0	0%	No	E
Dichloromethane (Methylene chloride)		10/42	24%	0.0076-0.024	0.001-1.5	35	0	320	0	0%	No	A
Diethyl ether		0/1	0%		0.3-0.3	1600		23000	0	0%	No	E
Ethyl benzene		2/42	5%	0.00035-0.24	0.001-0.49	5.8	0	25	0	0%	No	A
Ethyl-dimethylbenzene Isomer		1/1	100%	9.48-9.5							No	D
Freon-11		0/16	0%		0.002-0.63	2300		35000	0	0%	No	E
Freon-113		4/19	21%	0.0119-0.12	0.002-0.036	670	0	2800	0	0%	No	A
Freon-12		0/15	0%		0.002-0.036	8.7		37	0	0%	No	E
Isopropylbenzene		0/15	0%		0.002-0.036	190		990	0	0%	No	E
m&p-Xylene		0/15	0%		0.002-0.036						No	E
Methyl acetate		0/15	0%		0.002-0.036	7800		120000	0	0%	No	E
Methyl tertbutyl ether (MTBE)		0/15	0%		0.002-0.036	47		210	0	0%	No	E
Methylcyclohexane		0/15	0%		0.002-0.036						No	E
Methylcyclopentane		2/2	100%	0.0081-0.15							No	D
n-Hexane		3/3	100%	0.0444-0.063		61	0	250	0	0%	No	A
o-Xylene		0/17	0%		0.002-0.036	65		280	0	0%	No	E
p-Isopropyltoluene	Toluene	0/1	0%			490		4700	0	0%	No	E
sec-Butylbenzene		1/2	50%	0.019-0.019	0.0012-0.0012	780	0	12000	0	0%	No	A
sec-Butylbenzene	Cumene	1/2	50%	0.019-0.019	0.0012-0.0012	190	0	990	0	0%	No	A
Styrene		1/41	2%	0.0058-0.0058	0.001-0.036	600	0	3500	0	0%	No	A
Tentatively Identified Compounds		0/13	0%		0.002-0.04						No	E
tert-Butylbenzene		1/2	50%	0.015-0.015	0.001-0.001	780	0	12000	0	0%	No	A
tert-Butylbenzene	Cumene	1/2	50%	0.015-0.015	0.001-0.001	190	0	990	0	0%	No	A
Tetrachloroethene		0/41	0%		0.001-0.42	8.1		39	0	0%	No	E
Tetramethyl Benzene Isomer		1/1	100%	15.5-16							No	D
Toluene		1/42	2%	0.0015-0.0015	0.001-0.36	490	0	4700	0	0%	No	A
trans-1,2-Dichloroethene		1/18	6%	0.0034-0.0034	0.002-0.25	160	0	2300	0	0%	No	A
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/42	0%		0.001-0.15	1.8		8.2	0	0%	No	E
Trichloroethene		3/44	7%	0.0024-0.0042	0.001-0.25	0.41	0	1.9	0	0%	No	A
Vinyl chloride		1/44	2%	0.0059-0.0059	0.00089-0.74	0.059	0	1.7	0	0%	No	A
Xylenes (unspecified)		3/27	11%	0.0012-0.83	0.001-1.6						No	D

Table 2a. Human Health COPC Screening: Surface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Energetics												
Pentaerythritol tetranitrate		0/1	0%		8.44-8.4	13		160	0	0%	No	E
Trinitrophenylmethylnitramine		0/1	0%		1.54-1.5	16		230	0	0%	No	E
2,4-Dinitrotoluene		0/16	0%		0.19-7.9	1.7		7.4	1	6%	No	E
2,6-Dinitrotoluene		0/16	0%		0.19-7.9	0.36		1.5	5	31%	No	E
1,3,5-Trinitrobenzene		0/1	0%		1.03-1	220		3200	0	0%	No	E
1,3-Dinitrobenzene		0/1	0%		1.05-1	0.63		8.2	0	0%	No	E
2,4,6-Trinitrotoluene		0/1	0%		0.962-0.96	3.6		51	0	0%	No	E
Hexahydro-1,3,5-trinitro-1,3,5-triazine		0/1	0%		1.24-1.2	8.3		38	0	0%	No	E
HMX		0/1	0%		1.4-1.4	390		5700	0	0%	No	E
Nitroglycerin		0/1	0%		8.44-8.4	0.63		8.2	1	100%	No	E

A: Maximum detected concentration ≤ residential RSL
B: Nutrient
C: ≤ 5% detected and ≤ 5% of detection limits below industrial RSL
D: No RSL
E: Not detected
F: Removed during refinement of COPCs
* Only one detect, barely above residential RSL. Not a COPC in other media.
** RSL values shown are for Chromium III

DLs: Detection limits
ND: Non-detects
RSL: USEPA Regional Screening Level (November, 2018)
Ind: Industrial

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Inorganics													
Aluminum		14/14	100%	470-20000		7700	7	110000	0	0	0%	No	A
Antimony		75/105	71%	0.24-65	0.25-34	3.1	15	47	1	0	0%	Yes	
Arsenic		71/77	92%	0.38-24	0.4-1.3	0.68	57	3	19	0	0%	Yes	
Barium		18/18	100%	6.92-2600		1500	1	22000	0	0	0%	No	A
Beryllium		106/119	89%	0.018-2.2	0.01-2.8	16	0	230	0	0	0%	No	A
Cadmium		81/123	66%	0.11-370	0.11-0.83	7.1	30	98	9	0	0%	Yes	
Calcium		14/14	100%	59-50000								No	B
Chromium**		123/123	100%	2-6500		12000	0	180000	0	0	0%	No	A
Cobalt		2/14	14%	2.8-15	5.4-28	2.3	2	35	0	0	0%	No	A
Copper		118/119	99%	0.63-12000	2.7-2.7	310	20	4700	2	0	0%	Yes	
Cyanide		1/14	7%	0.91-0.91	2.7-14	2.3	0	15	0	0	0%	No	A
Iron		14/14	100%	930-25000		5500	10	82000	0	0	0%	No	A
Lead		120/123	98%	1.7-23000	1.3-4.8	400	13	800	6	0	0%	Yes	
Magnesium		13/14	93%	30-9300	640-640							No	B
Manganese		14/14	100%	23-1500		180	7	2600	0			No	A
Mercury		78/123	63%	0.01-43	0.02-0.6	1.1	10	4.6	4	0	0%	Yes	
Nickel		117/119	98%	0.32-820	1.4-2	150	6	2200	0	0	0%	No	A
Nitrate Nitrogen		13/14	93%	4.3-118	2-2	13000	0	190000	0	0	0%	No	A
Potassium		11/14	79%	140-1200	540-640							No	B
Selenium		49/109	45%	0.29-6.1	0.081-20	39	0	580	0	0	0%	No	A
Silver		33/109	30%	0.28-180	0.19-5.7	39	1	580	0	0	0%	No	A
Sodium		13/14	93%	4.6-880	540-540							No	B
Thallium		23/105	22%	0.36-170	0.087-17	0.078	23	1.2	9	15	14%	Yes	
Vanadium		13/14	93%	11-56	6.4-6.4	39	2	580	0	0	0%	No	A
Zinc		112/117	96%	0.87-7300	4.1-16	2300	6	35000	0	0	0%	No	A
High Molecular Weight PAHs													
Benzo(a)anthracene		21/109	19%	0.047-11	0.08-320	1.1	10	21	0	1	1%	No	A
Benzo(a)pyrene		29/107	27%	0.05-16	0.14-320	0.11	27	2.1	10	16	15%	Yes	
Benzo(b)fluoranthene		25/109	23%	0.082-19	0.09-320	1.1	12	21	0	1	1%	No	A
Benzo(g,h,i)perylene	Pyrene	24/109	22%	0.18-36	0.13-320	180	0	2300	0	0	0%	No	A
Benzo(k)fluoranthene		16/109	15%	0.0402-160	0.11-320	11	1	210	0	1	1%	No	A
Chrysene		24/109	22%	0.078-16	0.08-320	110	0	2100	0	0	0%	No	A
Dibenzo(a,h)anthracene		4/109	4%	0.25-0.87	0.14-320	0.11	3	2.1	0	25	23%	No	A
Fluoranthene		25/109	23%	0.0541-18	0.08-320	240	0	3000	0	0	0%	No	A
Indeno(1,2,3-cd)pyrene		17/109	16%	0.066-5.9	0.13-320	1.1	8	21	0	1	1%	No	A
Pyrene		24/109	22%	0.23-20	0.08-320	180	0	2300	0	0	0%	No	A
Benzo(e)pyrene		2/4	50%	0.442-23	0.19-7.6							No	D
Perylene		1/4	25%	0.342-0.34								No	D

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Low Molecular Weight PAHs													
2-Methylnaphthalene		3/45	7%	0.025-6.3	0.086-8.9	24	0	300	0	0	0%	No	A
Acenaphthene		3/109	3%	0.08-9.8	0.08-320	360	0	4500	0	0	0%	No	A
Acenaphthylene	Pyrene	2/109	2%	0.28-0.28	0.08-320	180	0	2300	0	0	0%	No	A
Anthracene		7/109	6%	0.029-5	0.08-320	1800	0	23000	0	0	0%	No	A
Fluorene		3/108	3%	0.072-8.1	0.08-320	240	0	3000	0	0	0%	No	A
Naphthalene		10/109	9%	0.00351-55	0.08-320	3.8	1	17	1	3	3%	No	F *
Phenanthrene	Pyrene	22/109	20%	0.061-32	0.08-320	180	0	2300	0	0	0%	No	A
Pesticides													
Aldrin		0/14	0%		0.0018-0.0089	0.039	0	0.18		0	0%	No	E
alpha-BHC		0/14	0%		0.0018-0.0089	0.086	0	0.36		0	0%	No	E
alpha-Chlordane	Chlordane	3/14	21%	0.00096-0.0081	0.0018-0.0089	1.7	0	7.7	0	0	0%	No	A
beta-BHC		1/14	7%	0.0011-0.0011	0.0018-0.0089	0.3	0	1.3	0	0	0%	No	A
delta-BHC	alpha-BHC	0/14	0%		0.0018-0.0089	0.086	0	0.36		0	0%	No	E
Dieldrin		2/14	14%	0.001-0.0031	0.0034-0.017	0.034	0	0.14	0	0	0%	No	A
Endosulfan I	Endosulfan	1/14	7%	0.014-0.014	0.0018-0.0089	47	0	700	0	0	0%	No	A
Endosulfan II	Endosulfan	2/14	14%	0.0024-0.014	0.0034-0.017	47	0	700	0	0	0%	No	A
Endosulfan sulfate	Endosulfan	5/14	36%	0.029-0.047	0.0034-0.0056	47	0	700	0	0	0%	No	A
Endrin		0/14	0%		0.0034-0.017	1.9	0	25		0	0%	No	E
Endrin Aldehyde	Endrin	0/14	0%		0.0034-0.017	1.9	0	25		0	0%	No	E
Endrin ketone	Endrin	0/14	0%		0.0034-0.017	1.9	0	25		0	0%	No	E
gamma-BHC (Lindane)		0/14	0%		0.0018-0.0089							No	E
gamma-Chlordane	Chlordane	12/14	86%	0.00075-0.17	0.0018-0.0019	1.7	0	7.7	0	0	0%	No	A
Heptachlor		0/14	0%		0.0018-0.0089	0.13	0	0.63		0	0%	No	E
Heptachlor epoxide		1/14	7%	0.00092-0.00092	0.0018-0.0089	0.07	0	0.33	0	0	0%	No	A
Methoxychlor		2/45	4%	0.01-0.2	0.0018-0.26	32	0	410	0	0	0%	No	A
Toxaphene		0/14	0%		0.18-0.89	0.49	0	2.1		0	0%	No	E
DDD/DDE/DDT													
4,4'-DDD		9/45	20%	0.0034-0.64	0.0028-0.41	0.19	1	2.5	0	0	0%	No	A
4,4'-DDE		20/45	44%	0.0014-0.29	0.00061-0.087	2	0	9.3	0	0	0%	No	A
4,4'-DDT		20/45	44%	0.0051-0.32	0.0011-0.16	1.9	0	8.5	0	0	0%	No	A

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
PCBs													
Aroclor 1016		0/73	0%		0.0015-0.85	0.41	0	5.1		0	0%	No	E
Aroclor 1221		0/73	0%		0.0014-0.81	0.2	0	0.83		0	0%	No	E
Aroclor 1232		1/73	1%	19.1-19	0.0017-0.97	0.17	1	0.72	1	1	1%	No	C
Aroclor 1242		1/73	1%	14-14	0.0018-1.1	0.23	1	0.95	1	1	1%	No	C
Aroclor 1248		36/103	35%	0.0333-23	0.001-0.61	0.23	23	0.95	12	0	0%	Yes	
Aroclor 1254		29/73	40%	0.0021-17	0.001-0.17	0.12	17	0.97	7	0	0%	Yes	
Aroclor 1260		26/104	25%	0.0023-21	0.0016-0.68	0.24	13	0.99	7	0	0%	Yes	
Aroclor 1262		0/14	0%		0.034-0.17							No	E
Aroclor 1268		0/14	0%		0.034-0.17							No	E
1,1'-Biphenyl, 2,2',6,6'-tetrachloro-		1/1	100%	0.3-0.3								No	D
1,1'-Biphenyl, 2,3,4',6-tetrachloro-		1/1	100%	1-1								No	D
1,1'-Biphenyl, 2,3',5,5'-tetrachloro-		1/1	100%	0.5-0.5								No	D
1,1'-Biphenyl, 2,4,4',6-tetrachloro-		1/1	100%	0.7-0.7								No	D
PCB congener 101		1/1	100%	0.2-0.2								No	D
PCB Congener 116		1/1	100%	0.2-0.2								No	D
PCB congener 28		1/1	100%	0.4-0.4								No	D
PCB congener 66		1/1	100%	0.4-0.4								No	D
SVOCs													
(E)-9-Octadecenoic acid		1/1	100%	1-1								No	D
6-methyl-Chrysene		1/1	100%	0.2-0.2								No	D
bis(1-methylethyl)-1,1'-Biphenyl		1/1	100%	2-2								No	D
(RH-)-14-Methyl-8-hexadecyn-1-ol		0/1	0%									No	E
1,12-dimethyl-Benz[a]anthracene		1/1	100%	0.2-0.2								No	D
1,1-Biphenyl		0/14	0%		0.18-8.9	4.7	0	20		0	0%	No	E
1,2,3,4-Tetramethylbenzene		0/1	0%									No	E
1,2,3,5,6,8a-hexahydro-4,7-Naphthalene		1/1	100%	0.397-0.4								No	D
1,2,3-Trimethylbenzene		0/1	0%			34	0	200		0	0%	No	E
1,2,4,5-Tetrachlorobenzene		1/15	7%	1.46-1.5	0.18-8.9	2.3	0	35	0	0	0%	No	A
1,3-Diethyl-5-methylbenzene		0/1	0%									No	E
1,4-Dioxane		0/14	0%		0.044-0.76	5.3	0	24		0	0%	No	E
11H-Indeno[2,1-a]phenanthrene		1/1	100%	0.4-0.4								No	D
13alpha-D-Homoe-5alpha-androstante		1/2	50%	9.11-9.1								No	D
18-Norabietane		1/1	100%	10-10								No	D
1-chloro-Heptacosane		1/1	100%	0.6-0.6								No	D
1-Chlorooctadecane		1/1	100%	14.8-15								No	D
1-Decene		1/1	100%	0.333-0.33								No	D
1-Docosene		1/1	100%	0.181-0.18								No	D
1-Eicosanol		1/1	100%	0.2-0.2								No	D
1-Isopropyl-2-methoxy-4-methylbenzene		1/1	100%	0.165-0.17								No	D

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
1-Methyl-3-Propylbenzene		1/2	50%	0.0322-0.032								No	D
1-methyl-7-(1-methylethyl)-Phenanthrene		0/1	0%									No	E
1-methyl-Benz[a]anthracene		2/2	100%	1-10								No	D
1-methyl-Chrysene		1/1	100%	2-2								No	D
1-Phenanthrenecarboxylic acid, 1,2,3,4,4		1/1	100%	2-2								No	D
2,2',3,3',4,4'-hexachloro-1,1'-biphenyl		0/1	0%									No	E
2,2',4,4',5,5'-hexachloro-1,1'-biphenyl		0/1	0%									No	E
2,2'-Methylenebis(6-tert-butyl-4-methylphenol)		1/1	100%	6.12-6.1								No	D
2,3,4,6-Tetrachlorophenol		0/14	0%		0.18-8.9	190	0	2500		0	0%	No	E
2,4,5,7-tetramethyl-Phenanthrene		1/2	50%	9-9								No	D
2,4,5-Trichlorophenol		0/18	0%		0.18-8.9	630	0	8200		0	0%	No	E
2,4,6-Trichlorophenol		0/18	0%		0.18-8.9	6.3	0	82		0	0%	No	E
2,4-Dichlorophenol		0/18	0%		0.15-8.9	19	0	250		0	0%	No	E
2,4-Dimethylphenol		0/18	0%		0.18-8.9	130	0	1600		0	0%	No	E
2,4-Dinitrophenol		0/14	0%		0.34-17	13	0	160		0	0%	No	E
2,6,10,14-Tetramethylpentadecane		0/2	0%									No	E
2,6,11,15-Tetramethylhexadecane		0/1	0%									No	E
2,6,11-Trimethyldodecane		1/1	100%	11.6-12								No	D
2,6-Dimethyloctane		1/1	100%	4.36-4.4								No	D
24-methyl-5-Cholestene-3-ol		1/1	100%	0.3-0.3								No	D
28-Nor-17 beta (H)-hopane		0/1	0%									No	E
28-Nor-17.alpha.(H)-hopane		1/1	100%	0.179-0.18								No	D
2-butyl-5-hexytoctahydro-1H-tndene		0/1	0%									No	E
2-Chloronaphthalene		0/78	0%		0.08-320	480	0	6000		0	0%	No	E
2-Chlorophenol		0/18	0%		0.15-8.9	39	0	580		0	0%	No	E
2-Methyl Decalin		1/2	50%	0.09-0.09								No	D
2-methyl-Chrysene		1/1	100%	8-8								No	D
2-Methyldecane		0/1	0%									No	E
2-Methylnonane		1/1	100%	14.9-15								No	D
2-Methylphenol		0/14	0%		0.18-8.9	320	0	4100		0	0%	No	E
2-methyl-Triphenylene		1/1	100%	0.3-0.3								No	D
2-Nitroaniline		0/14	0%		0.34-17	63	0	800		0	0%	No	E
2-Nitrophenol	2,4-Dinitrophenol	0/18	0%		0.15-8.9	13	0	160		0	0%	No	E
2-Oxooctadecanoic Acid Methyl Ester		1/1	100%	3.28-3.3								No	D
3,3'-Dichlorobenzidine		0/18	0%		0.18-8.9	1.2	0	5.1		3	17%	No	E
3-methyl-Benz[j]aceanthrylene		2/3	67%	0.6-0.8								No	D
3-Methyldecane		2/3	67%	0.0968-7.1								No	D
3-Methylnonane		2/3	67%	0.225-0.74								No	D
3-methyl-Perylene		3/3	100%	4-30								No	D
3-Nitroaniline		0/14	0%		0.34-17							No	E

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
3-Nitrophthalic acid		1/1	100%	3.47-3.5								No	D
4,4'-Dinitrodiphenylsulphide		0/1	0%									No	E
4,4'-Trimethylenebis(1-methylpiperidine)		0/1	0%									No	E
4,6-Dinitro-2-methylphenol		0/18	0%		0.34-17	0.51	0	6.6		3	17%	No	E
4-Bromophenyl-phenylether		0/18	0%		0.15-8.9							No	E
4-Chloro-3-methylphenol		0/18	0%		0.15-8.9	630	0	8200		0	0%	No	E
4-Chloroaniline		0/14	0%		0.18-8.9	2.7	0	11		0	0%	No	E
4-Chlorophenyl-phenylether	2-Chlorophenol	0/18	0%		0.11-8.9	39	0	580		0	0%	No	E
4-Ethyl-o-xylene		1/2	50%	24.2-24								No	D
4-Hexenoic acid,3-methyl-2,6-dioxo-		1/1	100%	2.53-2.5								No	D
4-methyl decane		1/1	100%	0.288-0.29								No	D
4-methyl-Benzo[ghi]perylene		4/4	100%	3-60								No	D
4-Methyldecane		1/2	50%	3.16-3.2								No	D
4-Nitroaniline		0/14	0%		0.34-17	25	0	110		0	0%	No	E
4-Nitrophenol	2,4-Dinitrophenol	0/18	0%		0.34-17	13	0	160		0	0%	No	E
5,8-dimethyl-Benzo[c]phenanthrene		0/1	0%									No	E
5-butyl-6-hexyloctahydro-1H-Indene		1/1	100%	5.26-5.3								No	D
9-Hexadecenoic Acid		1/1	100%	0.331-0.33								No	D
Acetaminde, N-methyl-N-(4-(4-methoxy-1-he		0/1	0%									No	E
Acetophenone		1/14	7%	0.085-0.085	0.18-8.9	780	0	12000	0	0	0%	No	A
alpha-Elemene		1/1	100%	0.282-0.28								No	D
Atrazine		0/14	0%		0.18-8.9	2.4	0	10		0	0%	No	E
Benzaldehyde		1/14	7%	0.057-0.057	0.18-8.9	170	0	820	0	0	0%	No	A
Benzene, 2,4-diethyl-1-methyl-		0/1	0%									No	E
Benzo[j]fluoranthene		1/1	100%	0.6-0.6		0.42	1	1.8	0	0	0%	No	A
Bis(2-Chloro-1-methylethyl)Ether		0/18	0%		0.08-8.9							No	E
bis(2-Chloroethoxy) methane		0/18	0%		0.08-8.9	19	0	250		0	0%	No	E
bis(2-Chloroethyl) ether		0/18	0%		0.08-8.9	0.23	0	1		6	33%	No	E
bis(2-Ethylhexyl) phthalate		16/70	23%	0.354-190	0.15-39	39	5	160	1	0	0%	Yes	
Bornyl cinnamate 2		1/1	100%	0.615-0.62								No	D
Butylbenzylphthalate		0/18	0%		0.11-8.9	290	0	1200		0	0%	No	E
Butylcyclohexane		0/1	0%									No	E
Caprolactam		0/14	0%		0.18-8.9	3100	0	40000		0	0%	No	E
Carbazole		1/14	7%	0.12-0.12	0.18-8.9							No	D
caryophyllene		1/1	100%	1.09-1.1								No	D
Cembrane		2/2	100%	0.192-16								No	D
Chloest-23-ene, (5.beta.)		0/2	0%									No	E
Cinnamyl cinnamate		3/3	100%	0.644-4.9								No	D
cis-11,14,17-Eicosatrienoic acid methyl ester		1/1	100%	0.636-0.64								No	D
Copaene		1/1	100%	0.488-0.49								No	D

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Cresols, Total		0/14	0%		0.18-8.9	630	0	8200		0	0%	No	E
Cubebene		1/1	100%	0.153-0.15								No	D
D:B-Friedo-18,19-secolup-19-ene, 3,10-ep		1/1	100%	0.483-0.48								No	D
Decane		3/4	75%	0.0163-24								No	D
D-Homoandrostane, (5.alpha., 13.alpha.)'		0/2	0%									No	E
Dibenzofuran		3/45	7%	0.058-5.9	0.13-8.9	7.3	0	100	0	0	0%	No	A
Diethylphthalate		0/18	0%		0.08-8.9	5100	0	66000		0	0%	No	E
Diethyltoluamide		1/1	100%	5-5								No	D
Dimethylphthalate		0/18	0%		0.08-8.9							No	E
Di-n-butylphthalate		14/50	28%	0.16-26	0.08-8.9	630	0	8200	0	0	0%	No	A
Di-n-octylphthalate		0/18	0%		0.15-8.9	63	0	820		0	0%	No	E
Dodecane		0/1	0%									No	E
Dotriacontane		1/1	100%	5.01-5								No	D
Eicosane		2/2	100%	1.65-13								No	D
Gamma-Muurolene		1/1	100%	0.189-0.19								No	D
Hexachlorobenzene		0/18	0%		0.11-8.9	0.21	0	0.96		6	33%	No	E
Hexachlorobutadiene		0/18	0%		0.15-8.9	1.2	0	5.3		3	17%	No	E
Hexachlorocyclopentadiene		0/14	0%		0.18-8.9	0.18	0	0.75		6	43%	No	E
Hexachloroethane		0/18	0%		0.11-8.9	1.8	0	8		1	6%	No	E
Hexadecanoic Acid		6/6	100%	0.159-1								No	D
Isodiospyrin		2/2	100%	2.58-47								No	D
Isophorone		0/18	0%		0.08-8.9	570	0	2400		0	0%	No	E
M-Ethyltoluene		0/1	0%									No	E
m-Terphenyl		2/2	100%	0.4-0.6								No	D
n-Heptadecane		1/1	100%	1.68-1.7								No	D
Nitrazepam		1/1	100%	0.2-0.2								No	D
Nitrobenzene		0/18	0%		0.18-8.9	5.1	0	22		0	0%	No	E
N-Nitroso-di-n-propylamine		0/18	0%		0.11-8.9	0.078	0	0.33		7	39%	No	E
N-Nitrosodiphenylamine/Diphenylamine		0/14	0%		0.18-8.9	110	0	470		0	0%	No	E
Nonadecane		1/1	100%	3.54-3.5								No	D
Nonane		0/1	0%			1.1	0	7.2		0	0%	No	E
Octadecane		1/1	100%	11.6-12								No	D
Octadecanoic Acid		1/1	100%	0.3-0.3								No	D
octahydro-4a-methyl 2(1H)-Naphthalenone		1/1	100%	0.818-0.82								No	D
o-Cymene		1/2	50%	9.08-9.1								No	D
Oleamide		1/1	100%	0.339-0.34								No	D
Oleic Acid		1/1	100%	0.23-0.23								No	D
Pentachlorophenol		3/18	17%	2.7-3.4	0.34-5.3	1	3	4	0	3	17%	No	A
Pentylcyclohexane		0/1	0%									No	E

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Petroleum Hydrocarbons		1/4	25%	1020-1000	27.6-29							No	D
Phenol		0/18	0%		0.15-8.9	1900	0	25000		0	0%	No	E
Phenols (Total)		12/14	86%	0.28-26	0.25-0.25							No	D
Sulfur		3/3	100%	0.6-220								No	D
Taraxeromethylether		1/1	100%	0.317-0.32								No	D
trans-Decahydronaphthalene		1/1	100%	0.196-0.2								No	D
Tri-m-cresyl Phosphate		1/1	100%	3.46-3.5								No	D
Triphenyl phosphate		1/1	100%	0.454-0.45								No	D
Tris(Ethylhexyl) Ester Phosphoric Acid		1/1	100%	1.35-1.4								No	D
Undecane		2/3	67%	6.94-18								No	D
VOCs													
1,1,1-Trichloroethane		0/81	0%		0.001-0.25	810	0	3600		0	0%	No	E
1,1,2,2-Tetrachloroethane		0/81	0%		0.001-0.31	0.6	0	2.7		0	0%	No	E
1,1,2,2-Tetrafluoropropane		1/1	100%	0.0236-0.024								No	D
1,1,2-Trichloroethane		0/95	0%		0.001-0.2	0.15	0	0.63		0	0%	No	E
1,1-Dichloroethane		0/77	0%		0.001-0.13	3.6	0	16		0	0%	No	E
1,1-Dichloroethene		0/81	0%		0.001-0.4	23	0	100		0	0%	No	E
1,2,3-Trichlorobenzene		0/14	0%		0.0022-0.038	6.3	0	93		0	0%	No	E
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	0/14	0%		0.0022-0.038	5.8	0	26		0	0%	No	E
1,2,4-Trichlorobenzene		0/18	0%		0.0022-0.36	5.8	0	26		0	0%	No	E
1,2,4-Trimethylbenzene		4/31	13%	0.00241-0.74	0.00061-0.0016	30	0	180	0	0	0%	No	A
1,2-Dibromo-3-chloropropane		0/14	0%		0.0022-0.038	0.0053	0	0.064		0	0%	No	E
1,2-Dibromoethane		0/14	0%		0.0022-0.038	0.036	0	0.16		0	0%	No	E
1,2-Dichlorobenzene		0/18	0%		0.0022-0.25	180	0	930		0	0%	No	E
1,2-Dichloroethane		3/88	3%	0.006-0.013	0.001-0.32	0.46	0	2	0	0	0%	No	A
1,2-Dichloropropane		3/95	3%	0.006-0.013	0.001-0.11	1.6	0	6.6	0	0	0%	No	A
1,3,5-Trimethylbenzene		2/31	6%	0.028-0.13	0.0006-0.0015	27	0	150	0	0	0%	No	A
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/18	0%		0.0022-0.25	180	0	930		0	0%	No	E
1,4-Dichlorobenzene		0/18	0%		0.0022-0.25	2.6	0	11		0	0%	No	E
1-Methyl-2-Propylcyclohexane		1/1	100%	0.277-0.28								No	D
2,2,3,3-Tetramethylbutane		1/1	100%	0.0138-0.014								No	D
2,3-Dihydro-1-methylindene		1/1	100%	0.152-0.15								No	D
2-Butanone (MEK)		8/81	10%	0.0014-0.086	0.001-2	2700	0	19000	0	0	0%	No	A
2-Chloroethyl vinyl ether		0/7	0%		0.13-0.22							No	E
2-Hexanone		0/74	0%		0.001-0.076	20	0	130		0	0%	No	E
2-Methylheptane		1/1	100%	0.83-0.83								No	D
2-Oxepanone		1/1	100%	1.26-1.3								No	D
3-Ethylhexane		1/1	100%	0.0265-0.027								No	D
4-Methyl-2-pentanone		1/81	1%	0.0053-0.0053	0.001-0.57	3300	0	14000	0	0	0%	No	A
Acetone		18/74	24%	0.0069-0.76	0.001-0.058	6100	0	67000	0	0	0%	No	A
alpha-Pinene		3/3	100%	0.0127-0.18								No	D
Azulene		1/1	100%	0.0246-0.025								No	D

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Benzene		3/81	4%	0.0018-0.0044	0.001-110	1.2	0	5.1	0	1	1%	No	A
beta-Pinene		1/1	100%	0.0293-0.029								No	D
Bromochloromethane		0/14	0%		0.0022-0.038	15	0	63		0	0%	No	E
Bromochloromethane	Bromodichloromethane	0/14	0%		0.0022-0.038	0.29	0	1.3		0	0%	No	E
Bromoform		0/81	0%		0.001-0.2	19	0	86		0	0%	No	E
Bromomethane		0/81	0%		0.001-0.52	0.68	0	3		0	0%	No	E
Butenamide, 2,2,3,3,4,4,4-heptafluoro-N-		1/1	100%	0.0459-0.046								No	D
Camphene		3/3	100%	0.0123-0.032								No	D
Carbon disulfide		7/80	9%	0.0016-0.058	0.001-0.4	77	0	350	0	0	0%	No	A
Carbon tetrachloride		0/81	0%		0.001-0.4	0.65	0	2.9		0	0%	No	E
Chlorobenzene		2/81	2%	0.0136-0.046	0.001-0.29	28	0	130	0	0	0%	No	A
Chloroethane		0/81	0%		0.001-0.65	1400	0	5700		0	0%	No	E
Chloroform		0/81	0%		0.001-0.2	0.32	0	1.4		0	0%	No	E
Chloromethane		0/77	0%		0.001-0.56	11	0	46		0	0%	No	E
cis/trans1,2-Dichloroethene		6/60	10%	0.0022-0.22	0.001-0.029							No	D
cis-1,2-Dichloroethene		2/45	4%	0.0053-0.042	0.0019-0.038	16	0	230	0	0	0%	No	A
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/81	0%		0.001-0.2	1.8	0	8.2		0	0%	No	E
Cyclohexane		0/14	0%		0.0022-0.038	650	0	2700		0	0%	No	E
Decahydro Naphthalene Isomer		1/1	100%	6.29-6.3								No	D
Dibromochloromethane		0/81	0%		0.001-0.2	8.3	0	39		0	0%	No	E
Dibromomethane		0/1	0%		0.0011-0.0011	2.4	0	9.9		0	0%	No	E
Dichlorobenzene		0/7	0%		0.37-0.61							No	E
Dichlorobromomethane		0/80	0%		0.001-0.11	0.29	0	1.3		0	0%	No	E
Dichloromethane (Methylene chloride)		40/95	42%	0.00078-0.75	0.001-1.3	35	0	320	0	0	0%	No	A
Diethyl Benzene Isomer		1/1	100%	0.21-0.21								No	D
Diethyl ether		0/7	0%		0.1-0.2	1600	0	23000		0	0%	No	E
Etheylmethyl Benzene Isomer		1/1	100%	0.0061-0.0061								No	D
Ethyl benzene		12/126	10%	0.00093-0.57	0.00082-0.41	5.8	0	25	0	0	0%	No	A
Ethyl dimethyl benzene Isomer		3/3	100%	0.0781-1.1								No	D
Ethyl Methyl Benzene Isomer		1/1	100%	0.0541-0.054								No	D
Freon-11		11/37	30%	0.00028-0.14	0.0022-0.54	2300	0	35000	0	0	0%	No	A
Freon-113		7/21	33%	0.0089-0.035	0.0022-0.038	670	0	2800	0	0	0%	No	A
Freon-12		0/14	0%		0.0022-0.038	8.7	0	37		0	0%	No	E
Hexamethylcyclotrisiloxane		1/1	100%	0.0059-0.0059								No	D
Isocamphane		2/2	100%	0.046-0.69								No	D
Isopropylbenzene		1/45	2%	0.012-0.012	0.00059-0.038	190	0	990	0	0	0%	No	A
m&p-Xylene		1/40	3%	0.029-0.029	0.0022-0.038							No	D
Methyl (Methylethyl) Benzene		1/1	100%	0.101-0.1								No	D
Methyl acetate		0/14	0%		0.0022-0.038	7800	0	120000		0	0%	No	E
Methyl Methylethyl Benzene isomer		2/2	100%	0.0575-0.15								No	D

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Methyl Methylethyl Cyclohexane		1/1	100%	0.0358-0.036								No	D
Methyl tertbutyl ether (MTBE)		0/14	0%		0.0022-0.038	47	0	210		0	0%	No	E
Methylcyclohexane		1/15	7%	0.0182-0.018	0.0022-0.038							No	D
Methylcyclopentane		1/1	100%	0.043-0.043								No	D
Methyl-propyl benzene isomer		2/2	100%	0.0414-0.67								No	D
n-Butanol		45/45	100%	0.0081-22		780	0	12000	0	0	0%	No	A
n-Butylbenzene		3/32	9%	0.036-0.14	0.00065-0.0017	390	0	5800	0	0	0%	No	A
n-Butylbenzene	Ethylbenzene	3/32	9%	0.036-0.14	0.00065-0.0017	5.8	0	25	0	0	0%	No	A
n-Hexane		9/9	100%	0.006-0.31		61	0	250	0	0	0%	No	A
n-Propylbenzene		1/31	3%	0.066-0.066	0.00068-0.0038	380	0	2400	0	0	0%	No	A
n-Propylbenzene	Ethylbenzene	1/31	3%	0.066-0.066	0.00068-0.0038	5.8	0	25	0	0	0%	No	A
Octamethylcyclotetrasiloxane		2/2	100%	0.0089-0.026								No	D
o-Xylene		1/45	2%	0.0026-0.0026	0.0016-0.038	65	0	280	0	0	0%	No	A
p-Isopropyltoluene	Toluene	3/31	10%	0.021-0.072	0.0007-0.0072	490	0	4700	0	0	0%	No	A
Propylcyclohexane		1/1	100%	0.0423-0.042								No	D
sec-Butylbenzene		1/31	3%	0.03-0.03	0.00069-0.0075	780	0	12000	0	0	0%	No	A
sec-Butylbenzene	Cumene	1/31	3%	0.03-0.03	0.00069-0.0075	190	0	990	0	0	0%	No	A
Styrene		2/74	3%	0.0007-0.00073	0.001-0.038	600	0	3500	0	0	0%	No	A
Tentatively Identified Compounds		0/11	0%		0.002-0.04							No	E
tert-Butylbenzene		1/31	3%	0.051-0.051	0.00064-0.0036	780	0	12000	0	0	0%	No	A
tert-Butylbenzene	Cumene	1/31	3%	0.051-0.051	0.00064-0.0036	190	0	990	0	0	0%	No	A
Tetrachloroethene		5/77	6%	0.00048-0.075	0.001-0.36	8.1	0	39	0	0	0%	No	A
Tetramethyl Benzene Isomer		5/5	100%	0.009-0.64								No	D
Toluene		12/126	10%	0.00084-0.018	0.00093-0.31	490	0	4700	0	0	0%	No	A
trans-1,2-Dichloroethene		1/21	5%	0.00058-0.00058	0.0022-0.22	160	0	2300	0	0	0%	No	A
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/81	0%		0.001-0.13	1.8	0	8.2		0	0%	No	E
trans-3,4,4-Trimethyl-2-pentene		2/2	100%	0.255-1.5								No	D
trans-3,4-dimethyl-2-hexene		2/2	100%	0.0367-0.17								No	D
Trichloro Trifluoro Ethane Isomer		1/1	100%	0.011-0.011								No	D
Trichloroethene		19/112	17%	0.00047-8.9	0.00046-0.22	0.41	1	1.9	1	0	0%	Yes	
Vinyl chloride		1/81	1%	0.0118-0.012	0.001-0.63	0.059	0	1.7	0	0	0%	No	A
Xylenes (unspecified)		13/67	19%	0.00098-0.62	0.001-1.4							No	D
Energetics													
Pentaerythritol tetranitrate		0/4	0%		4.41-7.2	13	0	160		0	0%	No	E
Trinitrophenylmethylnitramine		0/4	0%		0.806-1.3	16	0	230		0	0%	No	E
2,4-Dinitrotoluene		0/18	0%		0.18-8.9	1.7	0	7.4		2	11%	No	E
2,6-Dinitrotoluene		0/18	0%		0.18-8.9	0.36	0	1.5		6	33%	No	E
1,3,5-Trinitrobenzene		0/4	0%		0.538-0.88	220	0	3200		0	0%	No	E
1,3-Dinitrobenzene		0/4	0%		0.547-0.89	0.63	0	8.2		0	0%	No	E
2,4,6-Trinitrotoluene		0/4	0%		0.503-0.82	3.6	0	51		0	0%	No	E
Hexahydro-1,3,5-trinitro-1,3,5-triazine		0/4	0%		0.649-1	8.3	0	38		0	0%	No	E
HMX		0/4	0%		0.734-1.2	390	0	5700		0	0%	No	E

Table 2b. Human Health COPC Screening: Subsurface Soil

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Nitroglycerin		0/4	0%		4.41-7.2	0.63	0	8.2		0	0%	No	E

A: Maximum detected concentration ≤ residential RSL
B: Nutrient
C: ≤ 5% detected and ≤ 5% of detection limits below industrial RSL
D: No RSL
E: Not detected
F: Removed during refinement of COPCs
* Few detections. 95% UCL below residential RSL. Not a COPC in other media.
** RSL values shown are for Chromium III

DLs: Detection limits
ND: Non-detects
RSL: USEPA Regional Screening Level (November, 2018)
Ind: Industrial

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
Inorganics													
Aluminum		29/29	100%	470-20000		7700	15	110000	0	0	0%	Yes	
Antimony		102/149	68%	0.24-65	0.25-34	3.1	23	47	1	0	0%	Yes	
Arsenic		115/122	94%	0.38-83	0.4-1.5	0.68	100	3	43	0	0%	Yes	
Barium		34/34	100%	6.92-2600		1500	1	22000	0	0	0%	Yes	
Beryllium		144/165	87%	0.018-2.2	0.01-2.8	16	0	230	0	0	0%	No	A
Cadmium		122/169	72%	0.11-370	0.11-0.83	7.1	53	98	11	0	0%	Yes	
Calcium		29/29	100%	59-50000								No	B
Chromium ***		170/170	100%	0.24-6500		12000	0	180000	0	0	0%	No	A
Cobalt		5/29	17%	0.88-18	5.4-28	2.3	3	35	0	0	0%	Yes	
Copper		164/165	99%	0.63-12000	2.7-2.7	310	23	4700	2	0	0%	Yes	
Cyanide		2/29	7%	0.91-1.5	2.7-14	2.3	0	15	0	0	0%	No	A
Iron		29/29	100%	930-31000		5500	22	82000	0	0	0%	Yes	
Lead		167/170	98%	1.7-23000	1.3-4.8	400	15	800	7	0	0%	Yes	
Magnesium		28/29	97%	30-9300	640-640							No	B
Manganese		29/29	100%	23-3600		180	20	2600	2			Yes	
Mercury		114/170	67%	0.01-43	0.02-0.6	1.1	21	4.6	4	0	0%	Yes	
Nickel		163/165	99%	0.23-820	1.4-2	150	8	2200	0	0	0%	Yes	
Nitrate Nitrogen		13/14	93%	4.3-118	2-2	13000	0	190000	0	0	0%	No	A
Potassium		24/29	83%	70-1700	540-640							No	B
Selenium		77/156	49%	0.29-7.2	0.081-20	39	0	580	0	0	0%	No	A
Silver		53/156	34%	0.23-180	0.19-5.7	39	2	580	0	0	0%	Yes	
Sodium		28/29	97%	3-880	540-540							No	B
Thallium		24/149	16%	0.36-170	0.087-17	0.078	24	1.2	9	35	23%	Yes	
Vanadium		28/29	97%	8.5-56	6.4-6.4	39	5	580	0	0	0%	Yes	
Zinc		157/163	96%	0.87-7300	4.1-16	2300	7	35000	0	0	0%	Yes	
High Molecular Weight PAHs													
Benzo(a)anthracene		34/154	22%	0.047-11	0.08-320	1.1	16	21	0	8	5%	Yes	
Benzo(a)pyrene		42/149	28%	0.05-16	0.14-320	0.11	38	2.1	13	37	25%	Yes	
Benzo(b)fluoranthene		38/156	24%	0.075-19	0.09-320	1.1	15	21	0	8	5%	Yes	
Benzo(g,h,i)perylene	Pyrene	39/156	25%	0.12-36	0.13-320	180	0	2300	0	0	0%	No	A
Benzo(k)fluoranthene		26/154	17%	0.0402-160	0.11-320	11	1	210	0	1	1%	Yes	
Chrysene		39/156	25%	0.067-16	0.08-320	110	0	2100	0	0	0%	No	A
Dibenzo(a,h)anthracene		11/154	7%	0.049-1.3	0.14-320	0.11	6	2.1	0	52	34%	Yes	
Fluoranthene		35/154	23%	0.0541-18	0.08-320	240	0	3000	0	0	0%	No	A
Indeno(1,2,3-cd)pyrene		28/154	18%	0.043-5.9	0.13-320	1.1	9	21	0	8	5%	Yes	
Pyrene		35/156	22%	0.18-20	0.08-320	180	0	2300	0	0	0%	No	A
Benzo(e)pyrene		5/12	42%	0.3-23	0.19-30							No	D
Perylene		3/8	38%	0.342-1.1								No	D

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Low Molecular Weight PAHs														
2-Methylnaphthalene		3/60	5%	0.025-6.3	0.086-8.9	24	0	300	0	0	0%	No	A	
Acenaphthene		3/154	2%	0.08-9.8	0.08-320	360	0	4500	0	0	0%	No	A	
Acenaphthylene	Pyrene	3/154	2%	0.095-0.28	0.08-320	180	0	2300	0	0	0%	No	A	
Anthracene		10/154	6%	0.029-5	0.08-320	1800	0	23000	0	0	0%	No	A	
Fluorene		3/152	2%	0.072-8.1	0.08-320	240	0	3000	0	0	0%	No	A	
Naphthalene		11/154	7%	0.00351-55	0.08-320	3.8	2	17	1	10	6%	No	F	*
Phenanthrene	Pyrene	31/156	20%	0.061-32	0.08-320	180	0	2300	0	0	0%	No	A	
Pesticides														
Aldrin		0/29	0%		0.0018-0.01	0.039		0.18		0	0%	No	E	
alpha-BHC		0/29	0%		0.0018-0.01	0.086		0.36		0	0%	No	E	
alpha-Chlordane	Chlordane	8/29	28%	0.00096-0.0093	0.0018-0.01	1.7	0	7.7	0	0	0%	No	A	
beta-BHC		2/29	7%	0.0011-0.016	0.0018-0.01	0.3	0	1.3	0	0	0%	No	A	
delta-BHC	alpha-BHC	0/29	0%		0.0018-0.01	0.086		0.36		0	0%	No	E	
Dieldrin		4/29	14%	0.001-0.0031	0.0034-0.02	0.034	0	0.14	0	0	0%	No	A	
Endosulfan I	Endosulfan	1/29	3%	0.014-0.014	0.0018-0.01	47	0	700	0	0	0%	No	A	
Endosulfan II	Endosulfan	2/29	7%	0.0024-0.014	0.0034-0.02	47	0	700	0	0	0%	No	A	
Endosulfan sulfate	Endosulfan	7/29	24%	0.0024-0.047	0.0034-0.02	47	0	700	0	0	0%	No	A	
Endrin		2/29	7%	0.001-0.0011	0.0034-0.02	1.9	0	25	0	0	0%	No	A	
Endrin Aldehyde	Endrin	3/29	10%	0.0039-0.013	0.0034-0.02	1.9	0	25	0	0	0%	No	A	
Endrin ketone	Endrin	1/29	3%	0.0032-0.0032	0.0034-0.02	1.9	0	25	0	0	0%	No	A	
gamma-BHC (Lindane)		1/29	3%	0.0037-0.0037	0.0018-0.01							No	D	
gamma-Chlordane	Chlordane	23/29	79%	0.00075-0.17	0.0018-0.01	1.7	0	7.7	0	0	0%	No	A	
Heptachlor		1/29	3%	0.001-0.001	0.0018-0.01	0.13	0	0.63	0	0	0%	No	A	
Heptachlor epoxide		3/29	10%	0.00049-0.0014	0.0018-0.01	0.07	0	0.33	0	0	0%	No	A	
Methoxychlor		2/60	3%	0.01-0.2	0.0018-0.26	32	0	410	0	0	0%	No	A	
Toxaphene		0/29	0%		0.18-1	0.49		2.1		0	0%	No	E	
DDD/DDE/DDT														
4,4'-DDD		11/60	18%	0.0034-0.64	0.0028-0.41	0.19	1	2.5	0	0	0%	No	F	*
4,4'-DDE		26/60	43%	0.0014-0.29	0.00061-0.087	2	0	9.3	0	0	0%	No	A	
4,4'-DDT		24/60	40%	0.0051-0.32	0.0011-0.16	1.9	0	8.5	0	0	0%	No	A	

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
PCBs													
Aroclor 1016		2/117	2%	0.738-1.4	0.0015-1.5	0.41	2	5.1	0	0	0%	No	C
Aroclor 1221		0/117	0%		0.0014-1.4	0.2		0.83		1	1%	No	E
Aroclor 1232		3/117	3%	1.76-19	0.0017-1.7	0.17	3	0.72	3	2	2%	No	C
Aroclor 1242		3/117	3%	1.91-14	0.0018-1.9	0.23	3	0.95	3	2	2%	No	C
Aroclor 1248		66/147	45%	0.011-43	0.001-0.61	0.23	43	0.95	23	0	0%	Yes	
Aroclor 1254		41/117	35%	0.0021-17	0.001-1.1	0.12	27	0.97	12	1	1%	Yes	
Aroclor 1260		34/148	23%	0.0023-21	0.0016-1.6	0.24	17	0.99	8	1	1%	Yes	
Aroclor 1262		0/29	0%		0.034-0.2							No	E
Aroclor 1268		0/29	0%		0.034-0.2							No	E
1,1'-Biphenyl, 2,2',6,6'-tetrachloro-		1/1	100%	0.3-0.3								No	D
1,1'-Biphenyl, 2',3,4,5,5'-Pentachloro-		0/1	0%									No	E
1,1'-Biphenyl, 2,3',4',5-tetrachloro-		1/1	100%	0.5-0.5								No	D
1,1'-Biphenyl, 2,3',4',6-tetrachloro-		0/1	0%									No	E
1,1'-Biphenyl, 2,3,4',6-tetrachloro-		1/1	100%	1-1								No	D
1,1'-Biphenyl, 2',3,4-trichloro-		0/1	0%									No	E
1,1'-Biphenyl, 2,3',5,5'-tetrachloro-		1/1	100%	0.5-0.5								No	D
1,1'-Biphenyl, 2,4,4',6-tetrachloro-		1/1	100%	0.7-0.7								No	D
1,1'-Biphenyl, 3,3',5,5'-tetrachloro-		0/1	0%									No	E
PCB congener 101		1/1	100%	0.2-0.2								No	D
PCB Congener 116		1/1	100%	0.2-0.2								No	D
PCB congener 28		1/1	100%	0.4-0.4								No	D
PCB congener 66		1/1	100%	0.4-0.4								No	D
SVOCs													
(E)-9-Octadecenoic acid		1/1	100%	1-1								No	D
(Z,Z)-9,12-Octadecadienoic acid		1/1	100%	0.3-0.3								No	D
6-methyl-Chrysene		2/2	100%	0.2-0.4								No	D
bis(1-methylethyl)-1,1'-Biphenyl		1/1	100%	2-2								No	D
(RH-)-14-Methyl-8-hexadecyn-1-ol		0/1	0%									No	E
1,12-dimethyl-Benz[a]anthracene		1/1	100%	0.2-0.2								No	D
1,1-Biphenyl		0/29	0%		0.18-8.9	4.7		20		0	0%	No	E
1,2,3,4-Tetramethylbenzene		0/2	0%									No	E
1,2,3,5,6,8a-hexahydro-4,7-Naphthalene		2/2	100%	0.258-0.4								No	D
1,2,3-Trimethylbenzene		0/1	0%			34		200		0	0%	No	E
1,2,4,5-Tetrachlorobenzene		1/30	3%	1.46-1.5	0.18-8.9	2.3	0	35	0	0	0%	No	A
1,3-Diethyl-5-methylbenzene		0/2	0%									No	E
1,3-Dimethylpyrene		0/1	0%									No	E
1,4-Diethyl-2-methylbenzene		0/1	0%									No	E
1,4-Dioxane		0/29	0%		0.039-0.76	5.3		24		0	0%	No	E
11H-Indeno[2,1-a]phenanthrene		1/1	100%	0.4-0.4								No	D
13alpha-D-Homoe-5alpha-androstante		1/2	50%	9.11-9.1								No	D
18-Norabietane		1/1	100%	10-10								No	D
1-chloro-Heptacosane		2/2	100%	0.6-0.7								No	D

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
1-Chlorooctadecane		1/1	100%	14.8-15								No	D	
1-Decene		1/1	100%	0.333-0.33								No	D	
1-Docosene		1/1	100%	0.181-0.18								No	D	
1-Eicosanol		2/2	100%	0.2-0.21								No	D	
1-Isopropyl-2-methoxy-4-methylbenzene		1/1	100%	0.165-0.17								No	D	
1-Methyl-3-Propylbenzene		1/2	50%	0.0322-0.032								No	D	
1-methyl-7-(1-methylethyl)-Phenanthrene		0/2	0%									No	E	
1-methyl-Benz[a]anthracene		2/2	100%	1-10								No	D	
1-methyl-Chrysene		2/3	67%	2-4.2								No	D	
1-methyl-Pyrene		0/1	0%									No	E	
1-Phenanthrenecarboxylic acid, 1,2,3,4,4		1/1	100%	2-2								No	D	
1-Tricosene		1/1	100%	0.3-0.3								No	D	
2,2',3,3',4,4'-hexachloro-1,1'-biphenyl		0/1	0%									No	E	
2,2',4,4',5,5'-hexachloro-1,1'-biphenyl		0/1	0%									No	E	
2,2'-Methylenebis(6-tert-butyl-4-methylphenol)		1/1	100%	6.12-6.1								No	D	
2,3,3',4,4'-pentachloro-1,1'-biphenyl		0/1	0%									No	E	
2,3,4,6-Tetrachlorophenol		0/29	0%		0.18-8.9	190		2500		0	0%	No	E	
2,4,5,7-tetramethyl-Phenanthrene		1/2	50%	9-9								No	D	
2,4,5-Trichlorophenol		0/34	0%		0.18-8.9	630		8200		0	0%	No	E	
2,4,6-Trichlorophenol		0/34	0%		0.18-8.9	6.3		82		0	0%	No	E	
2,4-Dichlorophenol		0/34	0%		0.15-8.9	19		250		0	0%	No	E	
2,4-Dimethylphenol		0/34	0%		0.18-8.9	130		1600		0	0%	No	E	
2,4-Dinitrophenol		0/29	0%		0.34-17	13		160		0	0%	No	E	
2,4-Tricosanedione		0/3	0%									No	E	
2,6,10,14-Tetramethylpentadecane		0/3	0%									No	E	
2,6,10-Trimethyldodecane		0/1	0%									No	E	
2,6,11,15-Tetramethylhexadecane		0/1	0%									No	E	
2,6,11-Trimethyldodecane		1/1	100%	11.6-12								No	D	
2,6-Dimethylheptane		0/1	0%									No	E	
2,6-Dimethyloctane		1/1	100%	4.36-4.4								No	D	
24-methyl-5-Cholestene-3-ol		2/2	100%	0.3-0.3								No	D	
28-Nor-17 beta (H)-hopane		0/1	0%									No	E	
28-Nor-17.alpha.(H)-hopane		1/2	50%	0.179-0.18								No	D	
2-butyl-5-hexytoctahydro-1H-tndene		0/1	0%									No	E	
2-Chloronaphthalene		0/123	0%		0.08-320	480		6000		0	0%	No	E	
2-Chlorophenol		0/34	0%		0.15-8.9	39		580		0	0%	No	E	
2-Methyl Decalin		2/4	50%	0.008-0.09								No	D	
2-methyl-Chrysene		1/2	50%	8-8								No	D	
2-Methyldecane		0/2	0%									No	E	
2-Methylnonane		1/1	100%	14.9-15								No	D	
2-Methylphenol		0/29	0%		0.18-8.9	320		4100		0	0%	No	E	
2-methyl-Triphenylene		3/5	60%	0.3-0.7								No	D	

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
2-Nitroaniline		0/29	0%		0.34-17	63		800		0	0%	No	E	
2-Nitrophenol	2,4-Dinitrophenol	0/34	0%		0.15-8.9	13		160		0	0%	No	E	
2-Oxooctadecanoic Acid Methyl Ester		1/1	100%	3.28-3.3								No	D	
3,3'-Dichlorobenzidine		0/34	0%		0.18-8.9	1.2		5.1		6	18%	No	E	
3-methyl-Benz[j]aceanthrylene		4/7	57%	0.4-5.1								No	D	
3-Methyldecane		2/4	50%	0.0968-7.1								No	D	
3-Methylheptadecane		0/1	0%									No	E	
3-Methylnonane		2/3	67%	0.225-0.74								No	D	
3-methyl-Perylene		4/4	100%	0.3-30								No	D	
3-Nitroaniline		0/29	0%		0.34-17							No	E	
3-Nitrophthalic acid		2/2	100%	1.52-3.5								No	D	
4,4'-Dinitrodiphenylsulphide		0/2	0%									No	E	
4,4'-Trimethylenebis(1-methylpiperidine)		0/1	0%									No	E	
4,6-Dinitro-2-methylphenol		0/34	0%		0.34-17	0.51		6.6		6	18%	No	E	
4-Bromophenyl-phenylether		0/34	0%		0.15-8.9							No	E	
4-Chloro-3-methylphenol		0/34	0%		0.15-8.9	630		8200		0	0%	No	E	
4-Chloroaniline		0/29	0%		0.18-8.9	2.7		11		0	0%	No	E	
4-Chlorophenyl-phenylether	2-Chlorophenol	0/34	0%		0.11-8.9	39		580		0	0%	No	E	
4-Ethyl-o-xylene		1/3	33%	24.2-24								No	D	
4-Hexenoic acid,3-methyl-2,6-dioxo-		1/1	100%	2.53-2.5								No	D	
4-methyl decane		1/1	100%	0.288-0.29								No	D	
4-methyl-Benzo[ghi]perylene		4/4	100%	3-60								No	D	
4-Methyldecane		1/2	50%	3.16-3.2								No	D	
4-Nitroaniline		0/29	0%		0.34-17	25		110		0	0%	No	E	
4-Nitrophenol	2,4-Dinitrophenol	0/34	0%		0.34-17	13		160		0	0%	No	E	
5,12-Naphthacenedione		0/1	0%									No	E	
5,8-dimethyl-Benzo[c]phenanthrene		1/4	25%	0.49-0.49								No	D	
5-butyl-6-hexyloctahydro-1H-Indene		1/1	100%	5.26-5.3								No	D	
6,13-dihydro-Pentacene		1/1	100%	3-3								No	D	
7H-Benz[de]anthracen-7-one		0/1	0%									No	E	
7-methyl-Benz[a]anthracene		1/1	100%	4-4								No	D	
9-Hexadecenoic Acid		1/1	100%	0.331-0.33								No	D	
Acetaminde, N-methyl-N-(4-(4-methoxy-1-he		0/1	0%									No	E	
Acetophenone		2/29	7%	0.082-0.085	0.18-8.9	780	0	12000	0	0	0%	No	A	
alpha-Elemene		1/1	100%	0.282-0.28								No	D	
Atrazine		0/29	0%		0.18-8.9	2.4		10		0	0%	No	E	
Benzaldehyde		2/29	7%	0.057-0.16	0.18-8.9	170	0	820	0	0	0%	No	A	
Benzene, 2,4-diethyl-1-methyl-		0/1	0%									No	E	
Benzo[b]naphtho[2,1-d]thiophene		0/1	0%									No	E	
Benzo[b]naphtho[2,3-d]thiophene		0/1	0%									No	E	
Benzo[j]fluoranthene		1/1	100%	0.6-0.6		0.42	1	1.8	0	0	0%	No	F	**
Bis(2-Chloro-1-methylethyl)Ether		0/34	0%		0.08-8.9							No	E	

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
bis(2-Chloroethoxy) methane		0/34	0%		0.08-8.9	19		250		0	0%	No	E
bis(2-Chloroethyl) ether		0/34	0%		0.08-8.9	0.23		1		11	32%	No	E
bis(2-Ethylhexyl) phthalate		25/90	28%	0.31-190	0.15-39	39	7	160	1	0	0%	Yes	
Bornyl cinnamate 2		1/1	100%	0.615-0.62								No	D
Butylbenzylphthalate		0/34	0%		0.11-8.9	290		1200		0	0%	No	E
Butylcyclohexane		0/1	0%									No	E
Campesterol		1/1	100%	0.3-0.3								No	D
Caprolactam		0/29	0%		0.18-8.9	3100		40000		0	0%	No	E
Carbazole		1/29	3%	0.12-0.12	0.18-8.9							No	D
caryophyllene		1/1	100%	1.09-1.1								No	D
Cembrane		2/2	100%	0.192-16								No	D
Chloest-23-ene, (5.beta.)		0/2	0%									No	E
Cholesterol		1/1	100%	0.4-0.4								No	D
Cinnamyl cinnamate		5/5	100%	0.4-22								No	D
cis-11,14,17-Eicosatrienoic acid methyl ester		1/1	100%	0.636-0.64								No	D
Copaene		2/2	100%	0.488-0.96								No	D
Cresols, Total		1/29	3%	3.4-3.4	0.18-8.9	630	0	8200	0	0	0%	No	A
Cubebene		1/1	100%	0.153-0.15								No	D
Cyclopropanenonanoic acid, 2-[(2-butylcy		1/1	100%	6.45-6.5								No	D
D:B-Friedo-18,19-secolup-19-ene, 3,10-ep		1/1	100%	0.483-0.48								No	D
Decane		3/4	75%	0.0163-24								No	D
D-Homoandrostane, (5.alpha., 13.alpha.)'		0/2	0%									No	E
Dibenz(a,h)anthracene, 5,6-dihydro-		0/1	0%									No	E
Dibenzofuran		3/60	5%	0.058-5.9	0.13-8.9	7.3	0	100	0	0	0%	No	A
Diethylphthalate		0/34	0%		0.08-8.9	5100		66000		0	0%	No	E
Diethyltoluamide		1/1	100%	5-5								No	D
Dimethylphthalate		0/34	0%		0.08-8.9							No	E
Di-n-butylphthalate		14/68	21%	0.16-26	0.08-8.9	630	0	8200	0	0	0%	No	A
Di-n-octylphthalate		1/34	3%	0.2-0.2	0.15-8.9	63	0	820	0	0	0%	No	A
Dodecane		0/1	0%									No	E
Dotriacontane		2/2	100%	0.228-5								No	D
Eicosane		2/2	100%	1.65-13								No	D
Friedelan-3-one		2/2	100%	1-3								No	D
Gamma-Muurolene		2/2	100%	0.189-3.1								No	D
Glycocyanidine		0/1	0%									No	E
Heptadecanoic Acid		1/1	100%	0.4-0.4								No	D
Hexachlorobenzene		0/34	0%		0.11-8.9	0.21		0.96		12	35%	No	E
Hexachlorobutadiene		0/34	0%		0.15-8.9	1.2		5.3		6	18%	No	E
Hexachlorocyclopentadiene		0/29	0%		0.18-8.9	0.18		0.75		12	41%	No	E
Hexachloroethane		0/34	0%		0.11-8.9	1.8		8		1	3%	No	E
Hexadecanoic Acid		10/10	100%	0.159-4								No	D
Isodiospyrin		2/2	100%	2.58-47								No	D

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Isophorone		0/34	0%		0.08-8.9	570		2400		0	0%	No	E	
M-Ethyltoluene		0/1	0%									No	E	
m-Terphenyl		3/3	100%	0.4-1								No	D	
n-Amylcyclohexane		0/1	0%									No	E	
n-Heptacosane		0/1	0%									No	E	
n-Heptadecane		1/1	100%	1.68-1.7								No	D	
Nitrazepam		1/1	100%	0.2-0.2								No	D	
Nitrobenzene		0/34	0%		0.18-8.9	5.1		22		0	0%	No	E	
N-Nitroso-di-n-propylamine		0/34	0%		0.11-8.9	0.078		0.33		13	38%	No	E	
N-Nitrosodiphenylamine/Diphenylamine		0/29	0%		0.18-8.9	110		470		0	0%	No	E	
Nonadecane		2/3	67%	0.199-3.5								No	D	
Nonane		0/1	0%			1.1		7.2		0	0%	No	E	
Octadecane		1/1	100%	11.6-12								No	D	
Octadecanoic Acid		3/3	100%	0.2-0.3								No	D	
octahydro-4a-methyl 2(1H)-Naphthalenone		1/1	100%	0.818-0.82								No	D	
o-Cymene		1/2	50%	9.08-9.1								No	D	
Oleamide		1/1	100%	0.339-0.34								No	D	
Oleic Acid		3/3	100%	0.23-0.9								No	D	
o-Terphenyl		1/1	100%	0.4-0.4								No	D	
Pentachlorophenol		3/34	9%	2.7-3.4	0.34-16	1	3	4	0	8	24%	No	F	**
Pentadecanoic acid		1/1	100%	0.8-0.8								No	D	
Pentatriacontane		1/1	100%	0.173-0.17								No	D	
Pentylcyclohexane		0/2	0%									No	E	
Petroleum Hydrocarbons		2/5	40%	207-1000	27.6-29							No	D	
Phenol		0/34	0%		0.15-8.9	1900		25000		0	0%	No	E	
Phenols (Total)		12/14	86%	0.28-26	0.25-0.25							No	D	
p-Terphenyl		2/2	100%	0.7-3								No	D	
Sitosterol		0/1	0%									No	E	
Stigmast-4-en-3-one		2/2	100%	0.9-4								No	D	
Sulfur		3/3	100%	0.6-220								No	D	
Taraxeromethylether		1/1	100%	0.317-0.32								No	D	
Terpinolene		1/1	100%	0.253-0.25								No	D	
trans-Decahydronaphthalene		1/2	50%	0.196-0.2								No	D	
Tri-m-cresyl Phosphate		1/1	100%	3.46-3.5								No	D	
Triphenyl phosphate		1/1	100%	0.454-0.45								No	D	
Tris(Ethylhexyl) Ester Phosphoric Acid		1/1	100%	1.35-1.4								No	D	
Undecane		2/3	67%	6.94-18								No	D	
Z-11-Hexadecenoic acid		1/1	100%	0.6-0.6								No	D	
VOCs														
1,1,1-Trichloroethane		0/123	0%		0.001-0.3	810		3600		0	0%	No	E	
1,1,2,2-Tetrachloroethane		0/123	0%		0.001-0.36	0.6		2.7		0	0%	No	E	
1,1,2,2-Tetrafluoropropane		1/1	100%	0.0236-0.024								No	D	

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
1,1,2-Trichloroethane		0/137	0%		0.001-0.23	0.15		0.63		0	0%	No	E	
1,1-Dichloroethane		0/115	0%		0.001-0.15	3.6		16		0	0%	No	E	
1,1-Dichloroethene		0/123	0%		0.001-0.5	23		100		0	0%	No	E	
1,2,3-Trichlorobenzene		0/29	0%		0.002-0.038	6.3		93		0	0%	No	E	
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	0/29	0%		0.002-0.038	5.8		26		0	0%	No	E	
1,2,4-Trichlorobenzene		0/34	0%		0.002-0.36	5.8		26		0	0%	No	E	
1,2,4-Trimethylbenzene		4/32	13%	0.00241-0.74	0.00061-0.0016	30	0	180	0	0	0%	No	A	
1,2,4-Trimethylbenzene Isomer		1/1	100%	0.0089-0.0089								No	D	
1,2-Dibromo-3-chloropropane		0/29	0%		0.002-0.038	0.0053		0.064		0	0%	No	E	
1,2-Dibromoethane		0/29	0%		0.002-0.038	0.036		0.16		0	0%	No	E	
1,2-Dichlorobenzene		0/34	0%		0.002-0.25	180		930		0	0%	No	E	
1,2-Dichloroethane		3/127	2%	0.006-0.013	0.001-0.36	0.46	0	2	0	0	0%	No	A	
1,2-Dichloropropane		3/137	2%	0.006-0.013	0.001-0.13	1.6	0	6.6	0	0	0%	No	A	
1,3,5-Trimethylbenzene		2/31	6%	0.028-0.13	0.0006-0.0015	27	0	150	0	0	0%	No	A	
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/34	0%		0.002-0.25	180		930		0	0%	No	E	
1,4-Dichlorobenzene		0/34	0%		0.002-0.25	2.6		11		0	0%	No	E	
1-Methyl-2-Propylcyclohexane		1/1	100%	0.277-0.28								No	D	
2,2,3,3-Tetramethylbutane		1/1	100%	0.0138-0.014								No	D	
2,3-Dihydro-1-methylindene		1/1	100%	0.152-0.15								No	D	
2-Butanone (MEK)		16/123	13%	0.0014-0.086	0.001-2.3	2700	0	19000	0	0	0%	No	A	
2-Chloroethyl vinyl ether		0/8	0%		0.13-0.25							No	E	
2-Hexanone		2/115	2%	0.0006-0.002	0.001-0.076	20	0	130	0	0	0%	No	A	
2-Methylheptane		1/1	100%	0.83-0.83								No	D	
2-Oxepanone		1/1	100%	1.26-1.3								No	D	
3-Ethylhexane		1/1	100%	0.0265-0.027								No	D	
3-Methylpentane		1/1	100%	0.0649-0.065								No	D	
4-Methyl-2-pentanone		2/123	2%	0.0016-0.0053	0.001-0.68	3300	0	14000	0	0	0%	No	A	
Acetone		30/115	26%	0.0034-0.76	0.001-0.072	6100	0	67000	0	0	0%	No	A	
alpha-Pinene		4/4	100%	0.0127-0.18								No	D	
Azulene		1/1	100%	0.0246-0.025								No	D	
Benzene		3/123	2%	0.0018-0.0044	0.001-110	1.2	0	5.1	0	1	1%	No	A	
Benzene, 1-phenyl-4-(2-cyano-2-phenyleth		1/1	100%	0.0527-0.053								No	D	
beta-Pinene		1/1	100%	0.0293-0.029								No	D	
Bromochloromethane		0/29	0%		0.002-0.038	15		63		0	0%	No	E	
Bromochloromethane	Bromodichloromethane	0/29	0%		0.002-0.038	0.29		1.3		0	0%	No	E	
Bromoform		0/123	0%		0.001-0.23	19		86		0	0%	No	E	
Bromomethane		0/125	0%		0.00092-0.61	0.68		3		0	0%	No	E	
Butenamide, 2,2,3,3,4,4,4-heptafluoro-N-		1/1	100%	0.0459-0.046								No	D	
Camphene		5/5	100%	0.004-0.046								No	D	
Carbon disulfide		11/122	9%	0.0016-0.11	0.001-0.5	77	0	350	0	0	0%	No	A	

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Carbon tetrachloride		0/123	0%		0.001-0.46	0.65		2.9		0	0%	No	E	
Chlorobenzene		2/123	2%	0.0136-0.046	0.001-0.34	28	0	130	0	0	0%	No	A	
Chloroethane		0/122	0%		0.001-0.76	1400		5700		0	0%	No	E	
Chloroform		2/123	2%	0.0143-0.015	0.001-0.23	0.32	0	1.4	0	0	0%	No	A	
Chloromethane		1/116	1%	0.0357-0.036	0.001-0.65	11	0	46	0	0	0%	No	A	
cis/trans1,2-Dichloroethene		7/85	8%	0.0022-0.29	0.001-0.029							No	D	
cis-1,2-Dichloroethene		3/62	5%	0.0053-0.042	0.0019-0.038	16	0	230	0	0	0%	No	A	
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/123	0%		0.001-0.23	1.8		8.2		0	0%	No	E	
Cyclohexane		0/29	0%		0.002-0.038	650		2700		0	0%	No	E	
Decahydro Naphthalene Isomer		1/1	100%	6.29-6.3								No	D	
Dibromochloromethane		0/123	0%		0.001-0.23	8.3		39		0	0%	No	E	
Dibromomethane		0/1	0%		0.0011-0.0011	2.4		9.9		0	0%	No	E	
Dichlorobenzene		0/8	0%		0.37-0.72							No	E	
Dichlorobromomethane		0/122	0%		0.001-0.13	0.29		1.3		0	0%	No	E	
Dichloromethane (Methylene chloride)		50/137	36%	0.00078-0.75	0.001-1.5	35	0	320	0	0	0%	No	A	
Diethyl Benzene Isomer		1/1	100%	0.21-0.21								No	D	
Diethyl ether		0/8	0%		0.1-0.3	1600		23000		0	0%	No	E	
Etheylmethyl Benzene Isomer		1/1	100%	0.0061-0.0061								No	D	
Ethyl benzene		14/168	8%	0.00035-0.57	0.00082-0.49	5.8	0	25	0	0	0%	No	A	
Ethyl dimethyl benzene Isomer		3/3	100%	0.0781-1.1								No	D	
Ethyl Methyl Benzene Isomer		1/1	100%	0.0541-0.054								No	D	
Ethyl-dimethylbenzene Isomer		1/1	100%	9.48-9.5								No	D	
Freon-11		11/53	21%	0.00028-0.14	0.002-0.63	2300	0	35000	0	0	0%	No	A	
Freon-113		11/40	28%	0.0089-0.12	0.002-0.038	670	0	2800	0	0	0%	No	A	
Freon-12		0/29	0%		0.002-0.038	8.7		37		0	0%	No	E	
Hexamethylcyclotrisiloxane		1/1	100%	0.0059-0.0059								No	D	
Isocamphane		2/2	100%	0.046-0.69								No	D	
Isopropylbenzene		1/60	2%	0.012-0.012	0.00059-0.038	190	0	990	0	0	0%	No	A	
m&p-Xylene		1/55	2%	0.029-0.029	0.002-0.038							No	D	
Methyl (Methylethyl) Benzene		1/1	100%	0.101-0.1								No	D	
Methyl acetate		0/29	0%		0.002-0.038	7800		120000		0	0%	No	E	
Methyl Methylethyl Benzene isomer		2/2	100%	0.0575-0.15								No	D	
Methyl Methylethyl Cyclohexane		1/1	100%	0.0358-0.036								No	D	
Methyl tertbutyl ether (MTBE)		0/29	0%		0.002-0.038	47		210		0	0%	No	E	
Methylcyclohexane		1/30	3%	0.0182-0.018	0.002-0.038							No	D	
Methylcyclopentane		3/3	100%	0.0081-0.15								No	D	
Methyl-propyl benzene isomer		2/2	100%	0.0414-0.67								No	D	
n-Butanol		45/45	100%	0.0081-22		780	0	12000	0	#REF!	#REF!	No	A	
n-Butylbenzene		3/32	9%	0.036-0.14	0.00065-0.0017	390	0	5800	0	0	0%	No	A	
n-Butylbenzene	Ethylbenzene	3/32	9%	0.036-0.14	0.00065-0.0017	5.8	0	25	0	0	0%	No	A	
n-Hexane		12/12	100%	0.006-0.31		61	0	250	0	#REF!	#REF!	No	A	
n-Propylbenzene		1/31	3%	0.066-0.066	0.00068-0.0038	380	0	2400	0	0	0%	No	A	

Table 2c. Human Health COPC Screening: All Soil (Surface and Subsurface)

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# Detects > Ind RSL	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis
n-Propylbenzene	Ethylbenzene	1/31	3%	0.066-0.066	0.00068-0.0038	5.8	0	25	0	0	0%	No	A
Octamethylcyclotetrasiloxane		2/2	100%	0.0089-0.026								No	D
o-Xylene		1/62	2%	0.0026-0.0026	0.0016-0.038	65	0	280	0	0	0%	No	A
p-Isopropyltoluene	Toluene	3/32	9%	0.021-0.072	0.0007-0.0072	490	0	4700	0	0	0%	No	A
Propylcyclohexane		1/1	100%	0.0423-0.042								No	D
sec-Butylbenzene		2/33	6%	0.019-0.03	0.00069-0.0075	780	0	12000	0	0	0%	No	A
sec-Butylbenzene	Cumene	2/33	6%	0.019-0.03	0.00069-0.0075	190	0	990	0	0	0%	No	A
Styrene		3/115	3%	0.0007-0.0058	0.001-0.038	600	0	3500	0	0	0%	No	A
Tentatively Identified Compounds		0/24	0%		0.002-0.04							No	E
tert-Butylbenzene		2/33	6%	0.015-0.051	0.00064-0.0036	780	0	12000	0	0	0%	No	A
tert-Butylbenzene	Cumene	2/33	6%	0.015-0.051	0.00064-0.0036	190	0	990	0	0	0%	No	A
Tetrachloroethene		5/118	4%	0.00048-0.075	0.001-0.42	8.1	0	39	0	0	0%	No	A
Tetramethyl Benzene Isomer		6/6	100%	0.009-16								No	D
Toluene		13/168	8%	0.00084-0.018	0.00093-0.36	490	0	4700	0	0	0%	No	A
trans-1,2-Dichloroethene		2/39	5%	0.00058-0.0034	0.002-0.25	160	0	2300	0	0	0%	No	A
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/123	0%		0.001-0.15	1.8		8.2		0	0%	No	E
trans-3,4,4-Trimethyl-2-pentene		2/2	100%	0.255-1.5								No	D
trans-3,4-dimethyl-2-hexene		2/2	100%	0.0367-0.17								No	D
Trichloro Trifluoro Ethane Isomer		1/1	100%	0.011-0.011								No	D
Trichloroethene		22/156	14%	0.00047-8.9	0.00046-0.25	0.41	1	1.9	1	0	0%	Yes	
Vinyl chloride		2/125	2%	0.0059-0.012	0.00089-0.74	0.059	0	1.7	0	0	0%	No	A
Xylenes (unspecified)		16/94	17%	0.00098-0.83	0.001-1.6							No	D
Energetics													
Pentaerythritol tetranitrate		0/5	0%		4.41-8.4	13		160		0	0%	No	E
Trinitrophenylmethylnitramine		0/5	0%		0.806-1.5	16		230		0	0%	No	E
2,4-Dinitrotoluene		0/34	0%		0.18-8.9	1.7		7.4		3	9%	No	E
2,6-Dinitrotoluene		0/34	0%		0.18-8.9	0.36		1.5		11	32%	No	E
1,3,5-Trinitrobenzene		0/5	0%		0.538-1	220		3200		0	0%	No	E
1,3-Dinitrobenzene		0/5	0%		0.547-1	0.63		8.2		0	0%	No	E
2,4,6-Trinitrotoluene		0/5	0%		0.503-0.96	3.6		51		0	0%	No	E
Hexahydro-1,3,5-trinitro-1,3,5-triazine		0/5	0%		0.649-1.2	8.3		38		0	0%	No	E
HMX		0/5	0%		0.734-1.4	390		5700		0	0%	No	E
Nitroglycerin		0/5	0%		4.41-8.4	0.63		8.2		1	20%	No	E

A: Maximum detected concentration ≤ residential RSL
B: Nutrient
C: ≤ 5% detected and ≤ 5% of detection limits below industrial RSL
D: No RSL
E: Not detected
F: Removed during refinement of COPCs
* Few detections. 95% UCL below residential RSL. Not a COPC in other media.
** Not a COPC in surface soil or subsurface soil. The only residential RSL exceedance was in subsurface soil.
*** RSL values shown are for Chromium III

DLs: Detection limits
ND: Non-detects
RSL: USEPA Regional Screening Level (November, 2018)
Ind: Industrial

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Inorganics													
Aluminum		16/16	100%	1400-13000		7700	5	110000	0	0%	Yes		
Antimony		15/39	38%	0.31-6.2	0.24-32	3.1	2	47	0	0%	Yes		
Arsenic		29/40	73%	0.318-5	0.41-1.3	0.68	25	3	0	0%	Yes		
Barium		17/17	100%	11.2-300		1500	0	22000	0	0%	No	A	
Beryllium		33/44	75%	0.02-2	0.56-2.7	16	0	230	0	0%	No	A	
Cadmium		32/46	70%	0.33-15	0.09-0.98	7.1	7	98	0	0%	Yes		
Calcium		16/16	100%	72-11000							No	B	
Chromium ***		46/46	100%	0.43-61		12000	0	180000	0	0%	No	A	
Cobalt		7/16	44%	0.81-21	5.6-27	2.3	4	35	0	0%	Yes		
Copper		44/45	98%	0.18-110	0.9-0.9	310	0	4700	0	0%	No	A	
Cyanide		0/16	0%		2.5-14	2.3		15	0	0%	No	E	
Iron		16/16	100%	1400-35000		5500	10	82000	0	0%	Yes		
Lead		46/46	100%	0.81-110		400	0	800	0	0%	No	A	
Magnesium		16/16	100%	130-1700							No	B	
Manganese		16/16	100%	39-5800		180	9	2600			Yes		
Mercury		28/51	55%	0.027-3	0.01-0.58	1.1	3	4.6	0	0%	Yes		
Nickel		45/45	100%	0.24-19		150	0	2200	0	0%	No	A	
Potassium		16/16	100%	20-750							No	B	
Selenium		14/46	30%	0.38-4.2	0.09-19	39	0	580	0	0%	No	A	
Silver		3/46	7%	0.37-0.85	0.12-5.4	39	0	580	0	0%	No	A	
Sodium		16/16	100%	8.9-260							No	B	
Thallium		4/39	10%	1.2-2.2	0.28-14	0.078	4	1.2	16	41%	Yes		
Vanadium		15/16	94%	9.3-57	6.4-6.4	39	5	580	0	0%	Yes		
Zinc		45/45	100%	0.97-390		2300	0	35000	0	0%	No	A	
High Molecular Weight PAHs													
Benzo(a)anthracene		17/40	43%	0.033-2.7	0.0456-12	1.1	5	21	0	0%	Yes		
Benzo(a)pyrene		21/43	49%	0.047-6.6	0.0456-12	0.11	20	2.1	5	12%	Yes		
Benzo(b)fluoranthene		18/46	39%	0.043-3.1	0.0456-12	1.1	5	21	0	0%	Yes		
Benzo(g,h,i)perylene	Pyrene	22/46	48%	0.062-7.1	0.0456-12	180	0	2300	0	0%	No	A	
Benzo(k)fluoranthene		10/40	25%	0.031-0.83	0.0456-12	11	0	210	0	0%	No	A	
Chrysene		20/46	43%	0.045-4.8	0.0456-12	110	0	2100	0	0%	No	A	
Dibenzo(a,h)anthracene		9/40	23%	0.11-0.94	0.0456-12	0.11	9	2.1	9	23%	Yes		
Fluoranthene		13/40	33%	0.053-1.4	0.04-12	240	0	3000	0	0%	No	A	
Indeno(1,2,3-cd)pyrene		14/40	35%	0.034-1.8	0.0456-12	1.1	2	21	0	0%	Yes		
Pyrene		17/46	37%	0.051-4.5	0.04-12	180	0	2300	0	0%	No	A	
Benzo(e)pyrene		4/5	80%	1.59-6.3	0.19-0.19						No	D	
Perylene		4/4	100%	0.2-7							No	D	

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Low Molecular Weight PAHs													
2-Methylnaphthalene		0/16	0%		0.19-8.3	24		300	0	0%	No	E	
Acenaphthene		1/39	3%	0.056-0.056	0.04-12	360	0	4500	0	0%	No	A	
Acenaphthylene	Pyrene	2/40	5%	0.043-0.067	0.04-12	180	0	2300	0	0%	No	A	
Anthracene		5/40	13%	0.048-0.17	0.04-12	1800	0	23000	0	0%	No	A	
Fluorene		0/40	0%		0.04-12	240		3000	0	0%	No	E	
Naphthalene		0/40	0%		0.04-12	3.8		17	0	0%	No	E	
Phenanthrene	Pyrene	10/46	22%	0.028-0.72	0.04-12	180	0	2300	0	0%	No	A	
Pesticides													
Aldrin		0/16	0%		0.0019-0.0083	0.039		0.18	0	0%	No	E	
alpha-BHC		0/16	0%		0.0019-0.0083	0.086		0.36	0	0%	No	E	
alpha-Chlordane	Chlordane	4/16	25%	0.0028-0.027	0.0019-0.0083	1.7	0	7.7	0	0%	No	A	
beta-BHC		2/16	13%	0.0029-0.022	0.0019-0.0083	0.3	0	1.3	0	0%	No	A	
delta-BHC	alpha-BHC	0/16	0%		0.0019-0.0083	0.086		0.36	0	0%	No	E	
Dieldrin		1/16	6%	0.12-0.12	0.0037-0.016	0.034	1	0.14	0	0%	No	F	****
Endosulfan I	Endosulfan	0/16	0%		0.0019-0.0083	47		700	0	0%	No	E	
Endosulfan II	Endosulfan	1/16	6%	0.0021-0.0021	0.0037-0.016	47	0	700	0	0%	No	A	
Endosulfan sulfate	Endosulfan	1/16	6%	0.014-0.014	0.0037-0.016	47	0	700	0	0%	No	A	
Endrin		2/16	13%	0.0024-0.017	0.0037-0.016	1.9	0	25	0	0%	No	A	
Endrin Aldehyde	Endrin	0/16	0%		0.0037-0.016	1.9		25	0	0%	No	E	
Endrin ketone	Endrin	0/16	0%		0.0037-0.016	1.9		25	0	0%	No	E	
gamma-BHC (Lindane)		2/16	13%	0.0072-0.0085	0.0019-0.0065						No	D	
gamma-Chlordane	Chlordane	9/16	56%	0.01-0.094	0.0019-0.0065	1.7	0	7.7	0	0%	No	A	
Heptachlor		0/16	0%		0.0019-0.0083	0.13		0.63	0	0%	No	E	
Heptachlor epoxide		1/16	6%	0.00064-0.00064	0.0019-0.0083	0.07	0	0.33	0	0%	No	A	
Methoxychlor		4/16	25%	0.009-0.024	0.019-0.083	32	0	410	0	0%	No	A	
Toxaphene		0/16	0%		0.19-0.83	0.49		2.1	0	0%	No	E	
DDD/DDE/DDT													
4,4'-DDD		2/16	13%	0.0043-0.034	0.0037-0.016	0.19	0	2.5	0	0%	No	A	
4,4'-DDE		3/16	19%	0.0054-0.23	0.004-0.016	2	0	9.3	0	0%	No	A	
4,4'-DDT		5/16	31%	0.0088-0.21	0.0037-0.016	1.9	0	8.5	0	0%	No	A	

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
PCBs													
Aroclor 1016		0/39	0%		0.0015-0.26	0.41		5.1	0	0%	No	E	
Aroclor 1221		0/39	0%		0.0012-0.25	0.2		0.83	0	0%	No	E	
Aroclor 1232		0/39	0%		0.0012-0.3	0.17		0.72	0	0%	No	E	
Aroclor 1242		0/39	0%		0.0018-0.33	0.23		0.95	0	0%	No	E	
Aroclor 1248		25/39	64%	0.0777-14	0.001-0.06	0.23	22	0.95	0	0%	Yes		
Aroclor 1254		4/39	10%	0.14-2	0.001-0.19	0.12	4	0.97	0	0%	Yes		
Aroclor 1260		3/39	8%	0.23-0.75	0.0016-0.29	0.24	2	0.99	0	0%	Yes		
Aroclor 1262		0/16	0%		0.037-0.16						No	E	
Aroclor 1268		0/16	0%		0.037-0.16						No	E	
1,1'-Biphenyl, 2,2',3,4-tetrachloro-		1/1	100%	2-2							No	D	
1,1'-Biphenyl, 2,3',4',5-tetrachloro-		1/1	100%	2-2							No	D	
1,1'-Biphenyl, 2,3,4',6-tetrachloro-		2/2	100%	0.5-2							No	D	
1,1'-Biphenyl, 2,3',5,5'-tetrachloro-		2/2	100%	0.5-1							No	D	
PCB congener 28		1/1	100%	1-1							No	D	
SVOCs													
6-methyl-Chrysene		4/4	100%	0.4-6							No	D	
[(dodecyloxy)methyl]-Oxirane		1/1	100%	0.4-0.4							No	D	
1,1-Biphenyl		0/16	0%		0.19-8.3	4.7		20	0	0%	No	E	
1,2,4,5-Tetrachlorobenzene		0/16	0%		0.19-8.3	2.3		35	0	0%	No	E	
1,4-Dioxane		0/16	0%		0.06-0.62	5.3		24	0	0%	No	E	
1-[2-(hexadecyloxy)ethoxy]-Octadecane		1/1	100%	0.7-0.7							No	D	
11H-Indeno[2,1-a]phenanthrene		1/1	100%	2-2							No	D	
1-chloro-Heptacosane		1/1	100%	0.4-0.4							No	D	
1-Heneicosyl formate		1/1	100%	0.5-0.5							No	D	
1-Hexadecene		1/1	100%	0.2-0.2							No	D	
1-methyl-Benz[a]anthracene		3/3	100%	0.4-1							No	D	
1-methyl-Chrysene		4/4	100%	2-4							No	D	
1-methyl-Pyrene		2/2	100%	0.6-4							No	D	
2,3,4,6-Tetrachlorophenol		0/16	0%		0.19-8.3	190		2500	0	0%	No	E	
2,4,5-Trichlorophenol		0/17	0%		0.09-8.3	630		8200	0	0%	No	E	
2,4,6-Trichlorophenol		0/17	0%		0.09-8.3	6.3		82	0	0%	No	E	
2,4-Dichlorophenol		0/17	0%		0.09-8.3	19		250	0	0%	No	E	
2,4-Dimethylphenol		0/17	0%		0.09-8.3	130		1600	0	0%	No	E	
2,4-Dinitrophenol		0/16	0%		0.37-16	13		160	0	0%	No	E	
28-Nor-17.alpha.(H)-hopane		1/1	100%	3-3							No	D	
2-Chloronaphthalene		0/40	0%		0.04-12	480		6000	0	0%	No	E	
2-Chlorophenol		0/17	0%		0.09-8.3	39		580	0	0%	No	E	
2-methyl-Chrysene		2/2	100%	0.3-2.2							No	D	
2-Methylphenol		0/16	0%		0.19-8.3	320		4100	0	0%	No	E	
2-methyl-Triphenylene		3/3	100%	0.9-3							No	D	
2-Nitroaniline		0/16	0%		0.37-16	63		800	0	0%	No	E	
2-Nitrophenol	2,4-Dinitrophenol	0/17	0%		0.09-8.3	13		160	0	0%	No	E	

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
3,3'-Dichlorobenzidine		0/17	0%		0.16-8.3	1.2		5.1	1	6%	No	E	
3,4:8,9-Dibenzopyrene		1/1	100%	0.2-0.2							No	D	
3,6-dimethyl-Phenanthrene		1/1	100%	0.4-0.4							No	D	
3-methyl-Benz[j]aceanthrylene		1/1	100%	4-4							No	D	
3-methyl-Chrysene		1/1	100%	0.5-0.5							No	D	
3-methyl-Perylene		5/5	100%	2-8							No	D	
3-Nitroaniline		0/16	0%		0.37-16						No	E	
4,6-Dinitro-2-methylphenol		0/17	0%		0.37-16	0.51		6.6	3	18%	No	E	
4-Bromophenyl-phenylether		0/17	0%		0.04-8.3						No	E	
4-Chloro-3-methylphenol		0/17	0%		0.06-8.3	630		8200	0	0%	No	E	
4-Chloroaniline		0/16	0%		0.19-8.3	2.7		11	0	0%	No	E	
4-Chlorophenyl-phenylether	2-Chlorophenol	0/17	0%		0.04-8.3	39		580	0	0%	No	E	
4-methyl-Pyrene		1/1	100%	0.3-0.3							No	D	
4-Nitroaniline		0/16	0%		0.37-16	25		110	0	0%	No	E	
4-Nitrophenol	2,4-Dinitrophenol	0/17	0%		0.37-16	13		160	0	0%	No	E	
5,6-dihydro-Dibenz[a,h]anthracene		1/1	100%	5-5							No	D	
5,8-dimethyl-Benzo[c]phenanthrene		6/6	100%	1-8.6							No	D	
5-Methylchrysene		1/1	100%	4-4							No	D	
6,13-dihydro-Pentacene		1/1	100%	0.4-0.4							No	D	
7H-Benz[de]anthracen-7-one		1/1	100%	0.4-0.4							No	D	
9-methyl-Anthracene		1/1	100%	0.3-0.3							No	D	
Acetophenone		6/16	38%	0.047-0.5	0.19-8.3	780	0	12000	0	0%	No	A	
Atrazine		0/16	0%		0.19-8.3	2.4		10	0	0%	No	E	
Benzaldehyde		5/16	31%	0.033-1.3	0.19-8.3	170	0	820	0	0%	No	A	
Benzo[b]naphtho[2,3-d]furan		1/1	100%	0.5-0.5							No	D	
Benzo[j]fluoranthene		1/1	100%	2-2		0.42	1	1.8	0	0%	No	F	*
Bis(2-Chloro-1-methylethyl)Ether		0/17	0%		0.04-8.3						No	E	
bis(2-Chloroethoxy) methane		0/17	0%		0.04-8.3	19		250	0	0%	No	E	
bis(2-Chloroethyl) ether		0/17	0%		0.06-8.3	0.23		1	4	24%	No	E	
bis(2-Ethylhexyl) phthalate		7/23	30%	0.91-13	0.06-8.3	39	0	160	0	0%	No	A	
Butylbenzylphthalate		0/17	0%		0.04-8.3	290		1200	0	0%	No	E	
Campesterol		1/1	100%	0.5-0.5							No	D	
Caprolactam		0/16	0%		0.19-8.3	3100		40000	0	0%	No	E	
Carbazole		3/16	19%	0.04-0.12	0.19-8.3						No	D	
Cholesterol		2/2	100%	0.761-2							No	D	
Cinnamyl cinnamate		1/1	100%	0.6-0.6							No	D	
Cresols, Total		0/16	0%		0.19-8.3	630		8200	0	0%	No	E	
Dibenzofuran		0/16	0%		0.19-8.3	7.3		100	0	0%	No	E	
Diethylphthalate		0/17	0%		0.04-8.3	5100		66000	0	0%	No	E	
Diethyltoluamide		1/1	100%	3-3							No	D	
Diglycidyl Ether		0/1	0%								No	E	
Dimethylphthalate		0/17	0%		0.04-8.3						No	E	
Di-n-butylphthalate		0/23	0%		0.04-8.3	630		8200	0	0%	No	E	

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Di-n-octylphthalate		0/17	0%		0.06-8.3	63		820	0	0%	No	E	
Heneicosane		1/1	100%	1.12-1.1							No	D	
Hexachlorobenzene		0/17	0%		0.04-8.3	0.21		0.96	4	24%	No	E	
Hexachlorobutadiene		0/17	0%		0.09-8.3	1.2		5.3	1	6%	No	E	
Hexachlorocyclopentadiene		0/16	0%		0.19-8.3	0.18		0.75	4	25%	No	E	
Hexachloroethane		0/17	0%		0.04-8.3	1.8		8	1	6%	No	E	
Hexadecanoic Acid		1/1	100%	0.8-0.8							No	D	
Isophorone		0/17	0%		0.04-8.3	570		2400	0	0%	No	E	
m-Terphenyl		1/1	100%	0.5-0.5							No	D	
Nitrazepam		2/2	100%	0.5-2							No	D	
Nitrobenzene		0/17	0%		0.19-8.3	5.1		22	0	0%	No	E	
N-Nitroso-di-n-propylamine		0/17	0%		0.04-8.3	0.078		0.33	7	41%	No	E	
N-Nitrosodiphenylamine/Diphenylamine		0/16	0%		0.19-8.3	110		470	0	0%	No	E	
Pentachlorophenol		4/17	24%	0.057-3.3	0.37-16	1	3	4	2	12%	No	F	**
Petroleum Hydrocarbons		1/2	50%	4-4	33.1-33						No	D	
Phenol		0/17	0%		0.09-8.3	1900		25000	0	0%	No	E	
Tridecanoic acid		2/2	100%	0.6-2							No	D	
VOCs													
1,1,1-Trichloroethane		0/20	0%		0.0013-0.17	810		3600	0	0%	No	E	
1,1,2,2-Tetrachloroethane		0/20	0%		0.0013-0.21	0.6		2.7	0	0%	No	E	
1,1,2-Trichloroethane		0/20	0%		0.0013-0.13	0.15		0.63	0	0%	No	E	
1,1-Dichloroethane		0/20	0%		0.0013-0.09	3.6		16	0	0%	No	E	
1,1-Dichloroethene		0/20	0%		0.0013-0.3	23		100	0	0%	No	E	
1,2,3-Trichlorobenzene		0/16	0%		0.003-0.031	6.3		93	0	0%	No	E	
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	0/16	0%		0.003-0.031	5.8		26	0	0%	No	E	
1,2,4-Trichlorobenzene		0/17	0%		0.003-0.04	5.8		26	0	0%	No	E	
1,2-Dibromo-3-chloropropane		0/16	0%		0.003-0.031	0.0053		0.064	0	0%	No	E	
1,2-Dibromoethane		0/16	0%		0.003-0.031	0.036		0.16	0	0%	No	E	
1,2-Dichlorobenzene		0/17	0%		0.003-0.04	180		930	0	0%	No	E	
1,2-Dichloroethane		0/20	0%		0.0013-0.21	0.46		2	0	0%	No	E	
1,2-Dichloropropane		0/20	0%		0.0013-0.07	1.6		6.6	0	0%	No	E	
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/17	0%		0.003-0.04	180		930	0	0%	No	E	
1,3-Dichloropropene		0/1	0%		0.0014-0.0014	1.8		8.2	0	0%	No	E	
1,4-Dichlorobenzene		0/17	0%		0.003-0.04	2.6		11	0	0%	No	E	
2-Butanone (MEK)		2/20	10%	0.024-0.046	0.006-1.3	2700	0	19000	0	0%	No	A	
2-Chloroethyl vinyl ether		0/1	0%		0.15-0.15						No	E	
2-Hexanone		0/19	0%		0.006-0.062	20		130	0	0%	No	E	
4-Methyl-2-pentanone		1/20	5%	0.0064-0.0064	0.006-0.39	3300	0	14000	0	0%	No	A	
Acetone		5/19	26%	0.0258-0.25	0.006-0.062	6100	0	67000	0	0%	No	A	
Benzene		0/20	0%		0.0013-0.12	1.2		5.1	0	0%	No	E	
Bromochloromethane		0/16	0%		0.003-0.031	15		63	0	0%	No	E	
Bromochloromethane	Bromodichloromethane	0/16	0%		0.003-0.031	0.29		1.3	0	0%	No	E	
Bromoform		0/20	0%		0.0013-0.14	19		86	0	0%	No	E	

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Bromomethane		0/26	0%		0.00059-0.35	0.68		3	0	0%	No	E	
Carbon disulfide		0/20	0%		0.003-0.3	77		350	0	0%	No	E	
Carbon tetrachloride		0/20	0%		0.0013-0.27	0.65		2.9	0	0%	No	E	
Chlorobenzene		0/20	0%		0.0013-0.2	28		130	0	0%	No	E	
Chloroethane		0/20	0%		0.0013-0.44	1400		5700	0	0%	No	E	
Chloroform		0/20	0%		0.0013-0.13	0.32		1.4	0	0%	No	E	
Chloromethane		0/20	0%		0.0013-0.38	11		46	0	0%	No	E	
cis/trans1,2-Dichloroethene		0/3	0%		0.0026-0.0028						No	E	
cis-1,2-Dichloroethene		1/22	5%	0.0086-0.0086	0.0022-0.031	16	0	230	0	0%	No	A	
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/20	0%		0.0013-0.13	1.8		8.2	0	0%	No	E	
Cyclohexane		0/16	0%		0.003-0.031	650		2700	0	0%	No	E	
Dibromochloromethane		0/20	0%		0.0013-0.13	8.3		39	0	0%	No	E	
Dichlorobenzene		0/1	0%		0.41-0.41						No	E	
Dichlorobromomethane		0/20	0%		0.0013-0.07	0.29		1.3	0	0%	No	E	
Dichloromethane (Methylene chloride)		3/20	15%	0.0066-0.007	0.003-0.87	35	0	320	0	0%	No	A	
Diethyl ether		0/1	0%		0.1-0.1	1600		23000	0	0%	No	E	
dimethyldisulfide		1/1	100%	0.02-0.02							No	D	
Ethyl benzene		0/20	0%		0.0013-0.28	5.8		25	0	0%	No	E	
Freon-11		0/17	0%		0.003-0.37	2300		35000	0	0%	No	E	
Freon-113		0/16	0%		0.003-0.031	670		2800	0	0%	No	E	
Freon-12		0/16	0%		0.003-0.031	8.7		37	0	0%	No	E	
Isopropylbenzene		0/16	0%		0.003-0.031	190		990	0	0%	No	E	
m&p-Xylene		0/16	0%		0.003-0.031						No	E	
Methyl acetate		1/16	6%	0.0059-0.0059	0.003-0.031	7800	0	120000	0	0%	No	A	
Methyl tertbutyl ether (MTBE)		0/16	0%		0.003-0.031	47		210	0	0%	No	E	
Methylcyclohexane		1/16	6%	0.0036-0.0036	0.003-0.031						No	D	
o-Xylene		0/22	0%		0.0017-0.031	65		280	0	0%	No	E	
sec-Butylbenzene		0/6	0%		0.00076-0.0012	780		12000	0	0%	No	E	
sec-Butylbenzene	Cumene	0/6	0%		0.00076-0.0012	190		990	0	0%	No	E	
Styrene		0/19	0%		0.0013-0.031	600		3500	0	0%	No	E	
Tentatively Identified Compounds		0/11	0%		0.003-0.03						No	E	
tert-Butylbenzene		0/6	0%		0.00072-0.0011	780		12000	0	0%	No	E	
tert-Butylbenzene	Cumene	0/6	0%		0.00072-0.0011	190		990	0	0%	No	E	
Tetrachloroethene		1/20	5%	0.0051-0.0051	0.0013-0.24	8.1	0	39	0	0%	No	A	
Toluene		3/20	15%	0.0005-0.0007	0.003-0.21	490	0	4700	0	0%	No	A	
trans-1,2-Dichloroethene		0/23	0%		0.00067-0.15	160		2300	0	0%	No	E	
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/19	0%		0.0013-0.09	1.8		8.2	0	0%	No	E	
Trichloroethene		0/26	0%		0.00051-0.15	0.41		1.9	0	0%	No	E	
Vinyl chloride		1/26	4%	0.0033-0.0033	0.00057-0.43	0.059	0	1.7	0	0%	No	A	
Xylenes (unspecified)		0/1	0%		0.93-0.93						No	E	

Table 3. Human Health COPC Screening: Sediment

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (mg/kg)	Range of DLs for ND (mg/kg)	Residential RSL (mg/kg)	# Detects > Res RSL	Industrial RSL (mg/kg)	# DL > Ind RSL	% DL > Ind RSL	COPC?	Basis	
Energetics													
2,4-Dinitrotoluene		0/17	0%		0.19-8.3	1.7		7.4	1	6%	No	E	
2,6-Dinitrotoluene		0/17	0%		0.19-8.3	0.36		1.5	4	24%	No	E	
Pentaerythritol tetranitrate		0/1	0%		3.2-3.2	13		160	0	0%	No	E	
Trinitrophenylmethylnitramine		0/1	0%		0.321-0.32	16		230	0	0%	No	E	
1,3,5-Trinitrobenzene		0/1	0%		0.401-0.4	220		3200	0	0%	No	E	
1,3-Dinitrobenzene		0/1	0%		0.449-0.45	0.63		8.2	0	0%	No	E	
2,4,6-Trinitrotoluene		0/1	0%		0.369-0.37	3.6		51	0	0%	No	E	
Hexahydro-1,3,5-trinitro-1,3,5-triazine		0/1	0%		0.321-0.32	8.3		38	0	0%	No	E	
HMX		0/1	0%		0.353-0.35	390		5700	0	0%	No	E	
Nitroglycerin		0/1	0%		3.2-3.2	0.63		8.2	0	0%	No	E	

A: Maximum detected concentration ≤ residential RSL
B: Nutrient
C: ≤ 5% detected and ≤ 5% of detection limits below industrial RSL
D: No RSL
E: Not detected
F: Removed during refinement of COPCs
* Detection barely above the industrial RSL. Not commonly analyzed and not expected to be a COPC.
** Not a COPC in other media or for ecological receptors.
*** RSL values shown are for Chromium III
**** Only one detect, which is below industrial RSL. This detect is located in Ditch 4 upgradient of the abandoned rail line, which is to the east and upgradient of the Landfill Area.

DLs: Detection limits
ND: Non-detects
RSL: USEPA Regional Screening Level (November, 2018)
Ind: Industrial

Table 4. Human Health COPC Screening: Groundwater

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	Tapwater RSL (µg/L)	MCL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Tapwater RSL	% DL > Tapwater RSL	# Detects above MCL	COPC?	Basis
Inorganics														
Aluminum		6/6	100%	180-11000		2000		2000	3	0	0%		Yes	
Antimony		2/32	6%	0.86-290	2.45-60	0.78	6	0.78	2	29	91%	0	Yes	
Arsenic		9/37	24%	2.5-100	2.3-49	0.052	10	0.052	9	28	76%	9	Yes	
Barium		11/11	100%	34-130		380	2000	380	0	0	0%	8	No	A
Beryllium		9/60	15%	0.14-4	0.13-5	2.5	4	2.5	5	25	42%	0	Yes	
Beryllium Filtered		0/7	0%		4-4								No	E
Cadmium		11/44	25%	0.6-29	1.1-5	0.92	5	0.92	7	33	75%	2	Yes	
Calcium		6/6	100%	1400-53000									No	B
Chromium		42/65	65%	0.71-250	0.7-10		100	100				31	Yes	
Chromium Filtered		0/7	0%		10-10								No	E
Cobalt		0/6	0%		50-50	0.6		0.6		6	100%		No	E
Copper		25/39	64%	0.9-110	0.74-25	80	1300	80	3	0	0%	15	Yes	
Cyanide		6/18	33%	5-130	3-10	0.15	200	0.15	6	12	67%	5	Yes	
Iron		17/17	100%	3.78-21000		1400		1400	11	0	0%		Yes	
Lead		29/65	45%	2-2000	0.89-45	15	15	15	8	5	8%	22	Yes	
Lead Filtered		0/7	0%		3-3								No	E
Magnesium		6/6	100%	930-2500									No	B
Manganese		11/11	100%	27-590		43		43	9				Yes	
Mercury		12/44	27%	0.11-5	0.005-0.2	0.063	2	0.063	12	26	59%	1	Yes	
Nickel		21/39	54%	1.2-70	1.09-40	39		39	4	1	3%		Yes	
Nitrate Nitrogen		6/8	75%	0.1-1.8	0.1-0.1	3200	10000	3200	0	0	0%	0	No	A
Potassium		6/6	100%	650-2800									No	B
Selenium		5/37	14%	2.3-5.3	0.74-35	10	50	10	0	6	16%	0	No	A
Silver		0/26	0%		0.86-10	9.4		9.4		6	23%		No	E
Sodium		11/11	100%	7100-29000									No	B
Thallium		2/21	10%	2-5.1	3.97-25	0.02	2	0.02	2	19	90%	1	Yes	
Vanadium		4/6	67%	9.7-35	50-50	8.6		8.6	4	2	33%		Yes	
Zinc		21/39	54%	3.3-2100	0.86-60	600		600	1	0	0%		Yes	
High Molecular Weight PAHs														
Benzo(a)anthracene		0/9	0%		1-5.6	0.03		0.03		9	100%		No	E
Benzo(a)pyrene		0/9	0%		2-5.6	0.025	0.2	0.025		9	100%		No	E
Benzo(b)fluoranthene		0/9	0%		1.5-5.6	0.25		0.25		9	100%		No	E
Benzo(g,h,i)perylene	Pyrene	0/9	0%		2.5-5.6	12	0	0		0	0%		No	E
Benzo(k)fluoranthene		0/9	0%		1.5-5.6	2.5		2.5		4	44%		No	E
Chrysene		0/9	0%		1-5.6	25		25		0	0%		No	E
Dibenzo(a,h)anthracene		0/9	0%		2.5-5.6	0.025		0.025		9	100%		No	E
Fluoranthene		0/9	0%		1-5.6	80		80		0	0%		No	E
Indeno(1,2,3-cd)pyrene		0/9	0%		2.5-5.6	0.25		0.25		9	100%		No	E
Pyrene		0/9	0%		1-5.6	12		12		0	0%		No	E

Table 4. Human Health COPC Screening: Groundwater

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	Tapwater RSL (µg/L)	MCL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Tapwater RSL	% DL > Tapwater RSL	# Detects above MCL	COPC?	Basis
Low Molecular Weight PAHs														
2-Methylnaphthalene		0/4	0%		4.6-5.6	3.6		3.6		4	100%		No	E
Acenaphthene		0/9	0%		1-5.6	53		53		0	0%		No	E
Acenaphthylene	Pyrene	0/9	0%		1-5.6	12	0	0		0	0%		No	E
Anthracene		0/9	0%		1-5.6	180		180		0	0%		No	E
Fluorene		0/9	0%		1-5.6	29		29		0	0%		No	E
Naphthalene		0/26	0%		1-100	0.17		0.17		26	100%		No	E
Phenanthrene	Pyrene	0/9	0%		1-5.6	12	0	0		0	0%		No	E
Pesticides														
Aldrin		0/4	0%		0.05-0.054	0.00092		0.00092		4	100%		No	E
alpha-BHC		0/4	0%		0.05-0.054	0.0072		0.0072		4	100%		No	E
alpha-Chlordane	Chlordane	0/4	0%		0.05-0.054	0.02	0	0		4	100%		No	E
beta-BHC		0/4	0%		0.05-0.054	0.025		0.025		4	100%		No	E
delta-BHC	alpha-BHC	0/4	0%		0.05-0.054	0.0072	0	0		4	100%		No	E
Dieldrin		1/4	25%	0.081-0.081	0.1-0.11	0.0018		0.0018	1	3	75%		Yes	
Endosulfan I	Endosulfan	0/4	0%		0.05-0.054	10	0	0		0	0%		No	E
Endosulfan II	Endosulfan	0/4	0%		0.1-0.11	10	0	0		0	0%		No	E
Endosulfan sulfate	Endosulfan	0/4	0%		0.1-0.11	10	0	0		0	0%		No	E
Endrin		0/4	0%		0.1-0.11	0.23	2	0.23		0	0%		No	E
Endrin Aldehyde	Endrin	0/4	0%		0.1-0.11	0.23	0	0		0	0%		No	E
Endrin ketone	Endrin	0/4	0%		0.1-0.11	0.23	0	0		0	0%		No	E
gamma-BHC (Lindane)		0/4	0%		0.05-0.054								No	E
gamma-Chlordane	Chlordane	0/4	0%		0.05-0.054	0.02	0	0		4	100%		No	E
Heptachlor		0/4	0%		0.05-0.054	0.0014	0.4	0.0014		4	100%		No	E
Heptachlor epoxide		0/4	0%		0.05-0.054	0.0014	0.2	0.0014		4	100%		No	E
Methoxychlor		0/4	0%		0.5-0.54	3.7	40	3.7		0	0%		No	E
Toxaphene		0/4	0%		5-5.4	0.071	3	0.071		4	100%		No	E
DDD/DDE/DDT														
4,4'-DDD		0/4	0%		0.1-0.11	0.0063		0.0063		4	100%		No	E
4,4'-DDE		0/4	0%		0.1-0.11	0.046		0.046		4	100%		No	E
4,4'-DDT		0/4	0%		0.1-0.11	0.23		0.23		0	0%		No	E
PCBs														
Aroclor 1016		0/4	0%		1-1.1	0.14		0.14		4	100%		No	E
Aroclor 1221		0/4	0%		1-1.1	0.0047		0.0047		4	100%		No	E
Aroclor 1232		0/4	0%		1-1.1	0.0047		0.0047		4	100%		No	E
Aroclor 1242		0/4	0%		1-1.1	0.0078		0.0078		4	100%		No	E
Aroclor 1248		1/4	25%	0.3-0.3	1-1.1	0.0078		0.0078	1	3	75%		Yes	
Aroclor 1254		0/4	0%		1-1.1	0.0078		0.0078		4	100%		No	E
Aroclor 1260		0/4	0%		1-1.1	0.0078		0.0078		4	100%		No	E
Aroclor 1262		0/4	0%		1-1.1								No	E
Aroclor 1268		0/4	0%		1-1.1								No	E

Table 4. Human Health COPC Screening: Groundwater

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	Tapwater RSL (µg/L)	MCL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Tapwater RSL	% DL > Tapwater RSL	# Detects above MCL	COPC?	Basis	
SVOCs															
1,1-Biphenyl		0/4	0%		4.6-5.6	0.083		0.083		4	100%		No	E	
1,2,3-Trimethylbenzene		1/1	100%	31.9-32		5.5		5.5	1	0	0%		No	F	*
1,2,4,5-Tetrachlorobenzene		0/4	0%		4.6-5.6	0.17		0.17		4	100%		No	E	
1,4-Dioxane		0/7	0%		100-100	0.46		0.46		7	100%		No	E	
2,3,4,6-Tetrachlorophenol		0/4	0%		4.6-5.6	24		24		0	0%		No	E	
2,4,5-Trichlorophenol		0/9	0%		3-5.6	120		120		0	0%		No	E	
2,4,6-Trichlorophenol		0/9	0%		3-5.6	1.2		1.2		9	100%		No	E	
2,4-Dichlorophenol		0/9	0%		2-5.6	4.6		4.6		3	33%		No	E	
2,4-Dimethylphenol		0/9	0%		2-5.6	36		36		0	0%		No	E	
2,4-Dinitrophenol		0/9	0%		9.3-30	3.9		3.9		9	100%		No	E	
2-Chloronaphthalene		0/9	0%		1-5.6	75		75		0	0%		No	E	
2-Chlorophenol		0/9	0%		2-5.6	9.1		9.1		0	0%		No	E	
2-Methylphenol		0/4	0%		4.6-5.6	93		93		0	0%		No	E	
2-Nitroaniline		0/4	0%		9.3-11	19		19		0	0%		No	E	
2-Nitrophenol	2,4-Dinitrophenol	0/9	0%		2-5.6	3.9	0	0		4	44%		No	E	
3,3'-Dichlorobenzidine		0/9	0%		3-5.6	0.13		0.13		9	100%		No	E	
3-Nitroaniline		0/4	0%		9.3-11								No	E	
4,6-Dinitro-2-methylphenol		0/9	0%		9.3-20	0.15		0.15		9	100%		No	E	
4-Bromophenyl-phenylether		0/9	0%		2-5.6								No	E	
4-Chloro-3-methylphenol		0/9	0%		2-5.6	140		140		0	0%		No	E	
4-Chloroaniline		0/4	0%		4.6-5.6	0.37		0.37		4	100%		No	E	
4-Chlorophenyl-phenylether	2-Chlorophenol	0/9	0%		1.5-5.6	9.1	0	0		0	0%		No	E	
4-Nitroaniline		0/4	0%		9.3-11	3.8		3.8		4	100%		No	E	
4-Nitrophenol	2,4-Dinitrophenol	0/9	0%		9.3-11	3.9	0	0		9	100%		No	E	
Acetophenone		0/4	0%		4.6-5.6	190		190		0	0%		No	E	
Atrazine		0/4	0%		4.6-5.6	0.3	3	0.3		4	100%		No	E	
Benzaldehyde		0/4	0%		4.6-5.6	19		19		0	0%		No	E	
Bis(2-Chloro-1-methylethyl)Ether		0/9	0%		1-5.6								No	E	
bis(2-Chloroethoxy) methane		0/9	0%		1-5.6	5.9		5.9		0	0%		No	E	
bis(2-Chloroethyl) ether		0/9	0%		1-5.6	0.014		0.014		9	100%		No	E	
bis(2-Ethylhexyl) phthalate		5/9	56%	1.2-6.4	4.6-5.6	5.6	6	5.6	1	0	0%	1	Yes		
Butylbenzylphthalate		0/9	0%		1.5-5.6	16		16		0	0%		No	E	
Caprolactam		0/4	0%		4.6-5.6	990		990		0	0%		No	E	
Carbazole		0/4	0%		4.6-5.6								No	E	
Cresols, Total		0/4	0%		4.6-5.6	150		150		0	0%		No	E	
Dibenzofuran		0/4	0%		4.6-5.6	0.79		0.79		4	100%		No	E	
Diethylphthalate		0/9	0%		1-5.6	1500		1500		0	0%		No	E	
Dimethylphthalate		0/9	0%		1-5.6								No	E	
Di-n-butylphthalate		0/9	0%		1-5.6	90		90		0	0%		No	E	
Di-n-octylphthalate		0/9	0%		2-5.6	20		20		0	0%		No	E	
Hexachlorobenzene		0/9	0%		1-5.6	0.0098	1	0.0098		9	100%		No	E	

Table 4. Human Health COPC Screening: Groundwater

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	Tapwater RSL (µg/L)	MCL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Tapwater RSL	% DL > Tapwater RSL	# Detects above MCL	COPC?	Basis	
Hexachlorobutadiene		0/9	0%		2-5.6	0.14		0.14		9	100%		No	E	
Hexachlorocyclopentadiene		0/4	0%		4.6-5.6	0.041	50	0.041		4	100%		No	E	
Hexachloroethane		0/9	0%		1-5.6	0.33		0.33		9	100%		No	E	
Isophorone		0/9	0%		1-5.6	78		78		0	0%		No	E	
Nitrobenzene		0/9	0%		1-5.6	0.14		0.14		9	100%		No	E	
N-Nitroso-di-n-propylamine		0/9	0%		1-5.6	0.011		0.011		9	100%		No	E	
N-Nitrosodiphenylamine/Diphenylamine		0/9	0%		1-5.6	12		12		0	0%		No	E	
Pentachlorophenol		0/9	0%		9.3-11	0.041	1	0.041		9	100%		No	E	
Petroleum Hydrocarbons		0/5	0%		300-500								No	E	
Phenol		0/9	0%		2-5.6	580		580		0	0%		No	E	
Phenols (Total)		4/7	57%	6-11	5-6								No	D	
VOCs															
1,1,1-Trichloroethane		0/44	0%		1-250	800	200	200		0	0%		No	E	
1,1,2,2-Tetrachloroethane		0/44	0%		1-150	0.076		0.076		44	100%		No	E	
1,1,2-Trichloroethane		7/55	13%	0.66-3.3	1-280	0.041	5	0.041	7	48	87%	0	No	F	**
1,1-Dichloroethane		0/44	0%		1-250	2.8		2.8		28	64%		No	E	
1,1-Dichloroethene		10/55	18%	1.5-44	0.48-320	28	7	7	1	2	4%	2	Yes		
1,2,3-Trichlorobenzene		0/7	0%		5-5	0.7		0.7		7	100%		No	E	
1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	0/7	0%		5-5	0.4	0	0		7	100%		No	E	
1,2,4-Trichlorobenzene		0/12	0%		1-5	0.4	70	0.4		12	100%		No	E	
1,2-Dibromo-3-chloropropane		0/7	0%		5-5	0.00033	0.2	0.00033		7	100%		No	E	
1,2-Dibromoethane		0/7	0%		5-5	0.0075	0.05	0.0075		7	100%		No	E	
1,2-Dichlorobenzene		0/12	0%		1-5	30	600	30		0	0%		No	E	
1,2-Dichloroethane		0/50	0%		1-250	0.17	5	0.17		50	100%		No	E	
1,2-Dichloropropane		1/44	2%	5-5	1-200	0.82	5	0.82	1	43	98%	0	No	F	**
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/12	0%		1-5	30	0	0		0	0%		No	E	
1,4-Dichlorobenzene		0/12	0%		1-5	0.48	75	0.48		12	100%		No	E	
2-Butanone (MEK)		0/44	0%		2-530	560		560		0	0%		No	E	
2-Chloroethyl vinyl ether		0/5	0%		3.1-310								No	E	
2-Hexanone		0/38	0%		2-50	3.8		3.8		24	63%		No	E	
4-Methyl-2-pentanone		0/44	0%		2-400	630		630		0	0%		No	E	
Acetone		3/39	8%	2.5-12	2-60	1400		1400	0	0	0%		No	A	
Benzene		0/44	0%		1-220	0.46	5	0.46		44	100%		No	E	
Bromide		0/1	0%		1-1								No	E	
Bromochloromethane		0/7	0%		5-5	8.3		8.3		0	0%		No	E	
Bromochloromethane	Bromodichloromethane	0/7	0%		5-5	0.13	0	0		7	100%		No	E	
Bromoform		0/44	0%		1-260	3.3	80	3.3		27	61%		No	E	
Bromomethane		0/43	0%		1-350	0.75		0.75		43	100%		No	E	
Carbon disulfide		3/44	7%	1.4-5	2-250	81		81	0	2	5%		No	A	

Table 4. Human Health COPC Screening: Groundwater

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	Tapwater RSL (µg/L)	MCL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Tapwater RSL	% DL > Tapwater RSL	# Detects above MCL	COPC?	Basis	
Carbon tetrachloride		3/44	7%	0.64-1.9	1-260	0.46	5	0.46	3	41	93%	0	Yes		
Chlorobenzene		0/44	0%		1-140	7.8	100	7.8		5	11%		No	E	
Chloroethane		0/44	0%		1-360	2100		2100		0	0%		No	E	
Chloroform		9/62	15%	0.46-5	1-250	0.22	80	0.22	9	53	85%	0	No	F	**
Chloromethane		1/50	2%	2.1-2.1	1-440	19		19	0	5	10%		No	A	
cis/trans1,2-Dichloroethene		17/44	39%	0.48-8300	5-25								No	D	
cis-1,2-Dichloroethene		24/41	59%	0.77-6300	1.8-5	3.6	70	3.6	21	2	5%	3	Yes		
cis-1,3-Dichloropropene	1,3-Dichloropropene	0/44	0%		1-320	0.47	0	0		44	100%		No	E	
Cyclohexane		0/7	0%		5-5	1300		1300		0	0%		No	E	
Dibromochloromethane		0/44	0%		1-230	0.87	80	0.87		44	100%		No	E	
Dichlorobenzene		0/5	0%		1.6-160								No	E	
Dichlorobromomethane		0/51	0%		1-220	0.13	80	0.13		51	100%		No	E	
Dichloromethane (Methylene chloride)		7/44	16%	1.5-5	1-640	11	5	5	0	3	7%	0	No	A	
Diethyl ether		0/5	0%		2-200	390		390		0	0%		No	E	
Diiodomethane		1/1	100%	12.2-12									No	D	
Ethyl benzene		1/44	2%	0.92-0.92	1-130	1.5	700	1.5	0	27	61%	0	No	A	
Freon-11		0/12	0%		4.6-460	520		520		0	0%		No	E	
Freon-113		1/7	14%	3.7-3.7	5-5	1000		1000	0	0	0%		No	A	
Freon-12		0/7	0%		5-5	20		20		0	0%		No	E	
Isopropylbenzene		1/18	6%	4.4-4.4	0.54-5	45		45	0	0	0%		No	A	
m&p-Xylene		0/7	0%		5-5								No	E	
Methyl acetate		0/7	0%		5-5	2000		2000		0	0%		No	E	
Methyl tertbutyl ether (MTBE)		1/24	4%	64.4-64	5-50	14		14	1	3	13%		No	F	***
Methylcyclohexane		0/7	0%		5-5								No	E	
n-Hexane		3/3	100%	7.6-17		150		150	0	0	0%		No	A	
o-Xylene		0/7	0%		5-5	19		19		0	0%		No	E	
sec-Butylbenzene		2/12	17%	7.8-19	0.63-0.63	200		200	0	0	0%		No	A	
sec-Butylbenzene	Cumene	2/12	17%	7.8-19	0.63-0.63	45	0	0	0	0	0%	0	No	A	
Styrene		0/39	0%		1-25	120	100	100		0	0%		No	E	
Tentatively Identified Compounds		0/7	0%		5-5								No	E	
Tetrachloroethene		10/68	15%	0.41-6.4	0.49-190	4.1	5	4.1	3	24	35%	2	Yes		
Toluene		7/55	13%	0.29-5	0.85-170	110	1000	110	0	2	4%	3	No	A	
trans-1,2-Dichloroethene		8/36	22%	1.3-11	0.55-240	36	100	36	0	2	6%	4	No	A	
trans-1,3-Dichloropropene	1,3-Dichloropropene	0/44	0%		1-160	0.47	0	0		44	100%		No	E	
Trichloroethene		54/78	69%	0.67-20000	0.42-5	0.28	5	0.28	54	12	15%	9	Yes		
Vinyl chloride		23/77	30%	1.1-540	0.047-460	0.019	2	0.019	23	37	48%	13	Yes		
Xylenes (unspecified)		2/37	5%	0.7-2.9	1-370								No	D	
Total Petroleum Hydrocarbon (TPH)		5/7	71%	1000-2000	1000-1000								No	D	

Table 4. Human Health COPC Screening: Groundwater

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	Tapwater RSL (µg/L)	MCL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Tapwater RSL	% DL > Tapwater RSL	# Detects above MCL	COPC?	Basis
Energetics														
Pentaerythritol tetranitrate		2/12	17%	5.8-69	5-20	3.9		3.9	2	10	83%		Yes	
Trinitrophenylmethylnitramine		0/5	0%		0.6-0.6	3.9		3.9		0	0%		No	E
1,3,5-Trinitrobenzene		0/5	0%		0.626-0.63	59		59		0	0%		No	E
1,3-Dinitrobenzene		1/5	20%	1.18-1.2	0.52-0.52	0.2		0.2	1	4	80%		Yes	
2,4,6-Trinitrotoluene		0/5	0%		0.588-0.59	0.98		0.98		0	0%		No	E
2,4-Dinitrotoluene		1/9	11%	1.83-1.8	0.612-5.6	0.24		0.24	1	8	89%		Yes	
2,6-Dinitrotoluene		0/9	0%		1.15-5.6	0.049		0.049		9	100%		No	E
Hexahydro-1,3,5-trinitro-1,3,5-triazine		0/5	0%		2.11-2.1	0.97		0.97		5	100%		No	E
HMX		0/5	0%		1.65-1.6	100		100		0	0%		No	E

A: Maximum detected concentration ≤ screening value
B: Nutrient
C: ≤ 5% detected and ≤ 5% of detection limits below the RSL
D: No screening value
E: Not detected
F: Removed during refinement of COPCs

DLs: Detection limits
ND: Non-detects
RSL: USEPA Regional Screening Level (November, 2018)
Screening Level: Tapwater RSL unless MCL is lower. If no Tapwater RSL, then MCL.

* Only one sample collected. Uncommon constituent. Not detected in soil.
** All results below the MCL. Infrequently detected. Not a COPC in any other medium or for ecological receptors.
*** Only one detect. Not detected in soil. Not a COPC for any medium or for ecological receptors.

Table 5. Human Health COPC Screening: Surface Water

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	WQS (µg/L)	Tapwater RSL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Screening Value	% DL > Screening Value	COPC?	Basis
Inorganics													
Aluminum		9/19	47%	58-790	200-200		2000	2000	0	0	0%	No	A
Antimony		2/33	6%	2-3.2	2-60	5.6	0.78	5.6	0	19	58%	No	A
Arsenic		5/33	15%	2.1-4.4	2.1-10	0.018	0.052	0.018	5	28	85%	Yes	
Barium		19/19	100%	34-100		1000	380	1000	0	0	0%	No	A
Beryllium		1/33	3%	0.17-0.17	0.13-5		2.5	2.5	0	19	58%	No	A
Cadmium		2/42	5%	0.23-2.3	0.23-5		0.92	0.92	1	39	93%	Yes	
Calcium		19/19	100%	5100-130000								No	B
Chromium ****		14/42	33%	0.86-2.5	4.5-10		2200	2200	0	0	0%	No	A
Cobalt		0/19	0%		50-50		0.6	0.6		19	100%	No	E
Copper		20/42	48%	0.91-9.7	0.74-25	1300	80	1300	0	0	0%	No	A
Cyanide		0/10	0%		10-10	4	0.15	4		10	100%	No	E
Iron		18/19	95%	120-3400	100-100		1400	1400	8	0	0%	Yes	
Lead		11/42	26%	1.5-6.2	0.89-10		15	15	0	0	0%	No	A
Magnesium		19/19	100%	1600-4200								No	B
Manganese		19/19	100%	16-710		50		50	16	0	0%	Yes	
Mercury		1/42	2%	0.3-0.3	0.043-0.5		0.063	0.063	1	32	76%	Yes	
Nickel		10/42	24%	1.3-14	1.09-40	610	39	610	0	0	0%	No	A
Potassium		19/19	100%	2100-3200								No	B
Selenium		3/33	9%	2.1-3.3	2.1-35	170	10	170	0	0	0%	No	A
Silver		15/33	45%	2-7.9	1.1-10		9.4	9.4	0	17	52%	No	A
Sodium		19/19	100%	3200-29000								No	B
Thallium		2/33	6%	1.7-3.6	3.6-25	0.24	0.02	0.24	2	31	94%	Yes	
Vanadium		10/19	53%	1.2-13	50-50		8.6	8.6	2	9	47%	Yes	
Zinc		18/42	43%	7.7-120	16-60	7400	600	7400	0	0	0%	No	A
High Molecular Weight PAHs													
Benzo(a)anthracene		0/10	0%		5-5.6	0.0012	0.03	0.0012		10	100%	No	E
Benzo(a)pyrene		0/10	0%		5-5.6	0.0001	0.025	0.00012		10	100%	No	E
Benzo(b)fluoranthene		0/10	0%		5-5.6	0.0012	0.25	0.0012		10	100%	No	E
Benzo(g,h,i)perylene	Pyrene	0/10	0%		5-5.6		12	12		0	0%	No	E
Benzo(k)fluoranthene		0/10	0%		5-5.6	0.012	2.5	0.012		10	100%	No	E
Chrysene		0/10	0%		5-5.6	0.12	25	0.12		10	100%	No	E
Dibenzo(a,h)anthracene		0/10	0%		5-5.6	0.0001	0.025	0.00012		10	100%	No	E
Fluoranthene		0/10	0%		5-5.6	20	80	20		0	0%	No	E
Indeno(1,2,3-cd)pyrene		0/10	0%		5-5.6	0.0012	0.25	0.0012		10	100%	No	E
Pyrene		0/10	0%		5-5.6	20	12	20		0	0%	No	E

Table 5. Human Health COPC Screening: Surface Water

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	WQS (µg/L)	Tapwater RSL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Screening Value	% DL > Screening Value	COPC?	Basis	
Low Molecular Weight PAHs														
2-Methylnaphthalene		0/10	0%		5-5.6		3.6	3.6		10	100%	No	E	
Acenaphthene		0/10	0%		5-5.6	70	53	70		0	0%	No	E	
Acenaphthylene	Pyrene	0/10	0%		5-5.6		12	12		0	0%	No	E	
Anthracene		0/10	0%		5-5.6	300	180	300		0	0%	No	E	
Fluorene		0/10	0%		5-5.6	50	29	50		0	0%	No	E	
Naphthalene		0/18	0%		5-5.6		0.17	0.17		16	89%	No	E	
Phenanthrene	Pyrene	0/10	0%		5-5.6		12	12		0	0%	No	E	
Pesticides														
Aldrin		0/10	0%		0.05-0.05	8E-07	0.00092	7.7E-07		10	100%	No	E	
alpha-BHC		0/10	0%		0.05-0.05	0.0004	0.0072	0.00036		10	100%	No	E	
alpha-Chlordane	Chlordane	0/10	0%		0.05-0.05		0.02	0.02		10	100%	No	E	
beta-BHC		0/10	0%		0.05-0.05	0.008	0.025	0.008		10	100%	No	E	
delta-BHC	alpha-BHC	0/10	0%		0.05-0.05		0.0072	0.0072		10	100%	No	E	
Dieldrin		0/10	0%		0.1-0.1	1E-06	0.0018	1.2E-06		10	100%	No	E	
Endosulfan I	Endosulfan	0/10	0%		0.05-0.05	20	10	20		0	0%	No	E	
Endosulfan II	Endosulfan	0/10	0%		0.1-0.1	20	10	20		0	0%	No	E	
Endosulfan sulfate	Endosulfan	0/10	0%		0.1-0.1	20	10	20		0	0%	No	E	
Endrin		0/10	0%		0.1-0.1	0.03	0.23	0.03		10	100%	No	E	
Endrin Aldehyde	Endrin	0/10	0%		0.1-0.1	1	0.23	1		0	0%	No	E	
Endrin ketone	Endrin	0/10	0%		0.1-0.1		0.23	0.23		0	0%	No	E	
gamma-BHC (Lindane)		0/10	0%		0.05-0.05							No	E	
gamma-Chlordane	Chlordane	1/10	10%	0.15-0.15	0.05-0.05		0.02	0.02	1	9	90%	No	F	**
Heptachlor		0/10	0%		0.05-0.05	6E-06	0.0014	5.9E-06		10	100%	No	E	
Heptachlor epoxide		0/10	0%		0.05-0.05	3E-05	0.0014	0.000032		10	100%	No	E	
Methoxychlor		0/10	0%		0.5-0.5	0.02	3.7	0.02		10	100%	No	E	
Toxaphene		0/10	0%		5-5	0.0007	0.071	0.0007		10	100%	No	E	
DDD/DDE/DDT														
4,4'-DDD		0/10	0%		0.1-0.1	0.0001	0.0063	0.00012		10	100%	No	E	
4,4'-DDE		0/10	0%		0.1-0.1	2E-05	0.046	0.000018		10	100%	No	E	
4,4'-DDT		0/10	0%		0.1-0.1	3E-05	0.23	0.00003		10	100%	No	E	
PCBs														
Aroclor 1016		0/24	0%		0.04-1		0.14	0.14		10	42%	No	E	
Aroclor 1221		0/24	0%		0.04-1		0.0047	0.0047		24	100%	No	E	
Aroclor 1232		0/24	0%		0.05-1		0.0047	0.0047		24	100%	No	E	
Aroclor 1242		0/24	0%		0.05-1		0.0078	0.0078		24	100%	No	E	
Aroclor 1248		3/24	13%	0.08-2.2	0.03-1		0.0078	0.0078	3	18	75%	Yes		
Aroclor 1254		0/24	0%		0.03-1		0.0078	0.0078		24	100%	No	E	
Aroclor 1260		0/24	0%		0.05-1		0.0078	0.0078		24	100%	No	E	
Aroclor 1262		0/10	0%		1-1							No	E	
Aroclor 1268		0/10	0%		1-1							No	E	

Table 5. Human Health COPC Screening: Surface Water

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	WQS (µg/L)	Tapwater RSL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Screening Value	% DL > Screening Value	COPC?	Basis
SVOCs													
1,1-Biphenyl		0/10	0%		5-5.6		0.083	0.083		10	100%	No	E
1,2,4,5-Tetrachlorobenzene		0/10	0%		5-5.6	0.03	0.17	0.03		10	100%	No	E
1,4-Dioxane		0/10	0%		100-100		0.46	0.46		10	100%	No	E
2,3,4,6-Tetrachlorophenol		0/10	0%		5-5.6		24	24		0	0%	No	E
2,4,5-Trichlorophenol		0/10	0%		5-5.6	300	120	300		0	0%	No	E
2,4,6-Trichlorophenol		0/10	0%		5-5.6	1.5	1.2	1.5		10	100%	No	E
2,4-Dichlorophenol		0/10	0%		5-5.6	10	4.6	10		0	0%	No	E
2,4-Dimethylphenol		0/10	0%		5-5.6	100	36	100		0	0%	No	E
2,4-Dinitrophenol		0/10	0%		10-11	10	3.9	10		1	10%	No	E
2-Chloronaphthalene		0/10	0%		5-5.6	800	75	800		0	0%	No	E
2-Chlorophenol		0/10	0%		5-5.6	30	9.1	30		0	0%	No	E
2-Methylphenol		0/10	0%		5-5.6		93	93		0	0%	No	E
2-Nitroaniline		0/10	0%		10-11		19	19		0	0%	No	E
2-Nitrophenol	2,4-Dinitrophenol	0/10	0%		5-5.6		3.9	3.9		10	100%	No	E
3,3'-Dichlorobenzidine		0/10	0%		5-5.6	0.049	0.13	0.049		10	100%	No	E
3-Nitroaniline		0/10	0%		10-11							No	E
3-Penten-2-ol		1/1	100%	70-70								No	D
4,6-Dinitro-2-methylphenol		0/10	0%		10-11	2	0.15	2		10	100%	No	E
4-Bromophenyl-phenylether		0/10	0%		5-5.6							No	E
4-Chloro-3-methylphenol		0/10	0%		5-5.6	500	140	500		0	0%	No	E
4-Chloroaniline		0/10	0%		5-5.6		0.37	0.37		10	100%	No	E
4-Chlorophenyl-phenylether	2-Chlorophenol	0/10	0%		5-5.6		9.1	9.1		0	0%	No	E
4-Nitroaniline		0/10	0%		10-11		3.8	3.8		10	100%	No	E
4-Nitrophenol	2,4-Dinitrophenol	0/10	0%		10-11		3.9	3.9		10	100%	No	E
Acetophenone		0/10	0%		5-5.6		190	190		0	0%	No	E
Atrazine		0/10	0%		5-5.6		0.3	0.3		10	100%	No	E
Benzaldehyde		0/10	0%		5-5.6		19	19		0	0%	No	E
Bis(2-Chloro-1-methylethyl)Ether		0/10	0%		5-5.6							No	E
bis(2-Chloroethoxy) methane		0/10	0%		5-5.6		5.9	5.9		0	0%	No	E
bis(2-Chloroethyl) ether		0/10	0%		5-5.6	0.03	0.014	0.03		10	100%	No	E
bis(2-Ethylhexyl) phthalate		0/10	0%		5-5.6	0.32	5.6	0.32		10	100%	No	E
Butylbenzylphthalate		0/10	0%		5-5.6	0.1	16	0.1		10	100%	No	E
Caprolactam		0/10	0%		5-5.6		990	990		0	0%	No	E
Carbazole		0/10	0%		5-5.6							No	E
Cresols, Total		0/10	0%		5-5.6		150	150		0	0%	No	E
Dibenzofuran		0/10	0%		5-5.6		0.79	0.79		10	100%	No	E
Diethylphthalate		0/10	0%		5-5.6	600	1500	600		0	0%	No	E
Dimethylphthalate		0/10	0%		5-5.6	2000		2000		0	0%	No	E
Di-n-butylphthalate		0/10	0%		5-5.6	20	90	20		0	0%	No	E
Di-n-octylphthalate		0/10	0%		5-5.6		20	20		0	0%	No	E

Table 5. Human Health COPC Screening: Surface Water

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	WQS (µg/L)	Tapwater RSL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Screening Value	% DL > Screening Value	COPC?	Basis	
Hexachlorobenzene		0/10	0%		5-5.6	8E-05	0.0098	0.000079		10	100%	No	E	
Hexachlorobutadiene		0/18	0%		5-5.6	0.01	0.14	0.01		16	89%	No	E	
Hexachlorocyclopentadiene		0/10	0%		5-5.6	4	0.041	4		10	100%	No	E	
Hexachloroethane		0/10	0%		5-5.6	0.1	0.33	0.1		10	100%	No	E	
Isophorone		0/10	0%		5-5.6	34	78	34		0	0%	No	E	
Nitrobenzene		0/10	0%		5-5.6	10	0.14	10		0	0%	No	E	
N-Nitroso-di-n-propylamine		0/10	0%		5-5.6	0.005	0.011	0.005		10	100%	No	E	
N-Nitrosodiphenylamine/Diphenylamine		0/10	0%		5-5.6	3.3	12	3.3		10	100%	No	E	
Pentachlorophenol		0/10	0%		10-11	0.03	0.041	0.03		10	100%	No	E	
Phenol		0/10	0%		5-5.6	4000	580	4000		0	0%	No	E	
Prometon		2/2	100%	7-8			25	25	0	0	0%	No	A	
VOCs														
1,1,1,2-Tetrachloroethane		0/8	0%		5-5		0.57	0.57		8	100%	No	E	
1,1,1-Trichloroethane		0/27	0%		1-5	10000	800	10000		0	0%	No	E	
1,1,2,2-Tetrachloroethane		2/27	7%	1-1.8	1-5	0.2	0.076	0.2	2	25	93%	No	F	*
1,1,2-Trichloroethane		2/27	7%	1-1.3	1-5	0.55	0.041	0.55	2	25	93%	No	F	*
1,1-Dichloroethane		1/26	4%	1-1	1-5		2.8	2.8	0	18	69%	No	A	
1,1-Dichloroethene		1/27	4%	1-1	1-5	300	28	300	0	0	0%	No	A	
1,1-Dichloropropene	1,3-Dichloropropene	0/8	0%		5-5		0.47	0.47		8	100%	No	E	
1,2,3-Trichlorobenzene		0/18	0%		5-5		0.7	0.7		16	89%	No	E	
1,2,3-Trichloropropane		0/8	0%		5-5		0.00075	0.00075		8	100%	No	E	
1,2,4-Trichlorobenzene		0/18	0%		5-5	0.071	0.4	0.071		16	89%	No	E	
1,2,4-Trimethylbenzene		0/8	0%		5-5		5.6	5.6		0	0%	No	E	
1,2-Dibromo-3-chloropropane		0/18	0%		5-5		0.00033	0.00033		16	89%	No	E	
1,2-Dibromoethane		0/18	0%		5-5		0.0075	0.0075		18	100%	No	E	
1,2-Dichlorobenzene		0/18	0%		5-5	1000	30	1000		0	0%	No	E	
1,2-Dichloroethane		0/26	0%		1-5	9.9	0.17	9.9		0	0%	No	E	
1,2-Dichloropropane		2/27	7%	0.56-1	1-5	0.9	0.82	0.9	1	25	93%	No		*
1,3,5-Trimethylbenzene		0/8	0%		5-5		6	6		0	0%	No	E	
1,3-Dichlorobenzene	1,2-Dichlorobenzene	0/18	0%		5-5	7	30	7		0	0%	No	E	
1,3-Dichloropropane		0/8	0%		5-5		37	37		0	0%	No	E	
1,3-Dichloropropene		0/2	0%		1-1	0.27	0.47	0.27		2	100%	No	E	
1,4-Dichlorobenzene		0/18	0%		5-5	300	0.48	300		0	0%	No	E	
2,2-Dichloropropane		0/8	0%		5-5							No	E	
2-Butanone (MEK)		1/27	4%	5-5	2-100		560	560	0	0	0%	No	A	
2-Chlorotoluene		0/8	0%		5-5		24	24		0	0%	No	E	
2-Hexanone		3/27	11%	0.65-10	2-50		3.8	3.8	2	20	74%	No	F	**
4-Chlorotoluene		0/8	0%		5-5		25	25		0	0%	No	E	
4-Methyl-2-pentanone		2/27	7%	0.61-5	2-50		630	630	0	0	0%	No	A	
Acetone		5/27	19%	5.5-10	2-100		1400	1400	0	0	0%	No	A	

Table 5. Human Health COPC Screening: Surface Water

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	WQS (µg/L)	Tapwater RSL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Screening Value	% DL > Screening Value	COPC?	Basis	
Benzene		0/27	0%		1-5	2.1	0.46	2.1		18	67%	No	E	
Bromobenzene		0/8	0%		5-5		6.2	6.2		0	0%	No	E	
Bromochloromethane		0/18	0%		5-5		8.3	8.3		0	0%	No	E	
Bromoform		2/27	7%	0.94-1	1-5	7	3.3	7	0	0	0%	No	A	
Bromomethane		1/36	3%	1-1	0.49-10	100	0.75	100	0	0	0%	No	A	
Carbon disulfide		5/27	19%	0.84-5	2-5		81	81	0	0	0%	No	A	
Carbon tetrachloride		0/27	0%		1-5	0.4	0.46	0.4		27	100%	No	E	
Chlorobenzene		1/27	4%	0.88-0.88	1-5	100	7.8	100	0	0	0%	No	A	
Chloroethane		1/27	4%	1-1	1-10		2100	2100	0	0	0%	No	A	
Chloroform		0/27	0%		1-5	60	0.22	60		0	0%	No	E	
Chloromethane		1/25	4%	1-1	1-10		19	19	0	0	0%	No	A	
cis/trans1,2-Dichloroethene		5/9	56%	2.5-49	2-5							No	D	
cis-1,2-Dichloroethene		5/27	19%	8.1-2000	1.8-5		3.6	3.6	5	14	52%	Yes		
cis-1,3-Dichloropropene	1,3-Dichloropropene	1/27	4%	0.56-0.56	1-5		0.47	0.47	1	26	96%	No	F	***
Cyclohexane		0/18	0%		5-10		1300	1300		0	0%	No	E	
Dibromochloromethane		0/27	0%		1-5	0.8	0.87	0.8		27	100%	No	E	
Dibromomethane		0/8	0%		5-5		0.83	0.83		8	100%	No	E	
Dichlorobromomethane		1/27	4%	1-1	1-5	0.95	0.13	0.95	1	26	96%	No		*
Dichloromethane (Methylene chloride)		8/27	30%	5-10	5-5	20	11	20	0	0	0%	No	A	
Ethyl benzene		1/27	4%	0.63-0.63	1-5	68	1.5	68	0	0	0%	No	A	
Freon-11		0/18	0%		5-5		520	520		0	0%	No	E	
Freon-113		0/18	0%		5-10		1000	1000		0	0%	No	E	
Freon-12		0/18	0%		5-5		20	20		0	0%	No	E	
Isopropylbenzene		0/18	0%		5-5		45	45		0	0%	No	E	
m&p-Xylene		0/18	0%		5-10							No	E	
Methyl acetate		0/18	0%		5-10		2000	2000		0	0%	No	E	
Methyl iodide		0/8	0%		5-5							No	E	
Methyl tertbutyl ether (MTBE)		0/18	0%		5-5		14	14		0	0%	No	E	
Methylcyclohexane		0/18	0%		5-10							No	E	
n-Butylbenzene		0/8	0%		5-5		100	100		0	0%	No	E	
n-Propylbenzene		0/8	0%		5-5		66	66		0	0%	No	E	
o-Xylene		0/18	0%		5-5		19	19		0	0%	No	E	
p-Isopropyltoluene	Toluene	0/8	0%		5-5		110	110		0	0%	No	E	
sec-Butylbenzene		0/8	0%		5-5		200	200		0	0%	No	E	
sec-Butylbenzene	Cumene	0/8	0%		5-5		45	45		0	0%	No	E	
Styrene		1/27	4%	0.83-0.83	1-5		120	120	0	0	0%	No	A	
Tentatively Identified Compounds		0/8	0%		5-5							No	E	
tert-Butylbenzene		0/8	0%		5-5		69	69		0	0%	No	E	
Tetrachloroethene		1/26	4%	0.53-0.53	1-5	10	4.1	10	0	0	0%	No	A	
Toluene		1/27	4%	0.76-0.76	1-5	57	110	57	0	0	0%	No	A	
trans-1,2-Dichloroethene		1/18	6%	9.2-9.2	5-5	100	36	100	0	0	0%	No	A	

Table 5. Human Health COPC Screening: Surface Water

Parameter	Proxy	Detection Frequency	% Detects	Range of Detections (µg/L)	Range of DLs for ND (µg/L)	WQS (µg/L)	Tapwater RSL (µg/L)	Screening Value (µg/L)	# Detects above Screening Value	# DL > Screening Value	% DL > Screening Value	COPC?	Basis	
trans-1,3-Dichloropropene	1,3-Dichloropropene	1/25	4%	0.52-0.52	1-5		0.47	0.47	1	24	96%	No	F	***
trans-1,4-Dichloro-2-butene		0/8	0%		100-100		0.0013	0.0013		8	100%	No	E	
Trichloroethene		11/36	31%	1-1600	0.42-5	0.6	0.28	0.6	11	17	47%	Yes		
Vinyl acetate		0/8	0%		50-50		41	41		8	100%	No	E	
Vinyl chloride		7/27	26%	1-140	1-5	0.022	0.019	0.022	7	20	74%	Yes		
Xylenes (unspecified)		2/7	29%	0.73-5	1-1							No	D	
Energetics														
2,4-Dinitrotoluene		0/10	0%		5-5.6	0.049	0.24	0.049		10	100%	No	E	
2,6-Dinitrotoluene		0/10	0%		5-5.6		0.049	0.049		10	100%	No	E	
Acrylonitrile		0/8	0%		200-200	0.061	0.052	0.061		8	100%	No	E	

A: Maximum detected concentration ≤ screening value
B: Nutrient
C: ≤ 5% detected and ≤ 5% of detection limits below screening value
D: No RSL
E: Not detected
F: Removed during refinement of COPCs

DLs: Detection limits
ND: Non-detects
RSL: USEPA Regional Screening Level (November, 2018)
WQS: USEPA Water Quality Standard
Screening level: WQS; if not available then RSL

* Only one or two detections. Not a COPC in other media or for ecological receptors. Below Georgia's Instream Water Quality Standard.
** Few detections. Not a COPC in other media or for ecological receptors.
*** One detection barely above the screening level for a proxy constituent. Not a COPC in other media or for ecological receptors.
*** RSL values shown are for Chromium III

Table 6. Human Health COPC Summary

Constituent	Soil			Ground water	Sediment	Surface Water
	All Soil	SS	SB			
Inorganics						
Aluminum	**Yes**	**Yes**	No	**Yes**	**Yes**	No
Antimony	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No
Arsenic	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Barium	**Yes**	**Yes**				
Beryllium	No	No	No	**Yes**	No	No
Cadmium	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Chromium	No	No	No	**Yes**	No	No
Cobalt	**Yes**	**Yes**	No	No	**Yes**	No
Copper	**Yes**	**Yes**	**Yes**	**Yes**	No	No
Cyanide	No	No	No	**Yes**	No	No
Iron	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**
Lead	**Yes**	**Yes**	**Yes**	**Yes**	No	No
Manganese	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**
Mercury	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Nickel	**Yes**	**Yes**	No	**Yes**	No	No
Silver	**Yes**	**Yes**	No	No	No	No
Thallium	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Vanadium	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**
Zinc	**Yes**	**Yes**	No	**Yes**	No	No
PAHs						
High Molecular Weight						
Benzo(a)anthracene	**Yes**	**Yes**	No	No	**Yes**	No
Benzo(a)pyrene	**Yes**	**Yes**	**Yes**	No	**Yes**	No
Benzo(b)fluoranthene	**Yes**	**Yes**	No	No	**Yes**	No
Benzo(k)fluoranthene	**Yes**	No	No	No	No	No
Dibenzo(a,h)anthracene	**Yes**	**Yes**	No	No	**Yes**	No
Indeno(1,2,3-cd)pyrene	**Yes**	**Yes**	No	No	**Yes**	No
Pesticides						
Dieldrin	No	No	No	**Yes**	No	No
PCBs						
Aroclor 1248	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Aroclor 1254	**Yes**	**Yes**	**Yes**	No	**Yes**	No
Aroclor 1260	**Yes**	**Yes**	**Yes**	No	**Yes**	No
SVOCs						
bis(2-Ethylhexyl) phthalate	**Yes**	**Yes**	**Yes**	**Yes**	No	No
VOCs						
1,1-Dichloroethene	No	No	No	**Yes**	No	No
Carbon tetrachloride	No	No	No	**Yes**	No	No
cis-1,2-Dichloroethene	No	No	No	**Yes**	No	**Yes**
Tetrachloroethene	No	No	No	**Yes**	No	No
Trichloroethene	**Yes**	No	**Yes**	**Yes**	No	**Yes**
Vinyl chloride	No	No	No	**Yes**	No	**Yes**
Energetics						
Pentaerythritol tetranitrate	No	No	No	**Yes**	No	
2,4-Dinitrotoluene	No	No	No	**Yes**	No	No
1,3-Dinitrobenzene	No	No	No	**Yes**	No	

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
Inorganics														
Aluminum		15/15	100%	2300-15000	AWI-215-SF; AWI-216-SF								Yes	G
Antimony		27/44	61%	0.3-30	LSL-53	0.27-34	17	0.27	110	63	27	11	Yes	E
Arsenic		44/45	98%	0.59-83	MW-13-1	1.5-1.5	0.75	18	5	0	1	0	Yes	E
Barium		16/16	100%	11-400	AWI-215-SF			330	1		1	0	No	A
Beryllium		38/46	83%	0.13-1.5	AWI-214-SF; AWI-215-SF; AWI-216-SF	0.54-2.8	1.4	2.5	1	1	0	0	No	A
Cadmium		41/46	89%	0.46-160	MW-15-1	0.13-0.8	0.4	0.36	433	1	41	1	Yes	E
Calcium		15/15	100%	210-43000	AWI-215-SF								Yes	G
Chromium		47/47	100%	0.24-340	MW-4B-1			23	15		26	0	Yes	E
Cobalt		3/15	20%	0.88-18	FML-305-SF	5.4-28	14	13	1	1	1	1	No	A
Copper		46/46	100%	3.5-4400	MW-15-1			28	158		33	0	Yes	E
Cyanide		1/15	7%	1.5-1.5	AWI-216-SF	2.7-14	7	0.1	15	70	1	14	Yes	E
Iron		15/15	100%	3200-31000	FML-304-SF								Yes	G
Lead		47/47	100%	5-2900	MW-13-1			11	264		45	0	Yes	E
Magnesium		15/15	100%	46-8000	AWI-215-SF								Yes	G
Manganese		15/15	100%	27-3600	FML-305-SF			220	16		13	0	Yes	E
Mercury	Y	36/47	77%	0.04-3.9	LSL-61	0.047-0.59	0.3	0.013	300	23	36	11	Yes	H
Nickel		46/46	100%	0.23-490	LSL-47			38	13		3	0	Yes	E
Potassium		13/15	87%	70-1700	AWI-215-SF	540-560	280						Yes	G
Selenium	Y	28/47	60%	0.56-7.2	AWI-215-SF	0.14-20	10	0.52	14	19	28	11	Yes	H
Silver		20/47	43%	0.23-160	LSL-53	0.22-5.6	2.8	4.2	38	1	2	0	Yes	E
Sodium		15/15	100%	3-390	AWI-215-SF								Yes	G
Thallium		1/44	2%	0.51-0.51	MW-4B-1	0.44-14	7	0.05	10	140	1	43	Yes	E
Vanadium		15/15	100%	8.5-50	FML-304-SF			7.8	6		15	0	Yes	E
Zinc		45/46	98%	11.1-6600	MW-15-1	6.5-6.5	3.3	46	143	0.1	39	0	Yes	E
High Molecular Weight PAHs														
Benzo(a)anthracene		13/45	29%	0.058-6.7	LSL-53	0.19-46	23						Yes	G
Benzo(a)pyrene		13/42	31%	0.061-12	LSL-53	0.19-46	23						Yes	G
Benzo(b)fluoranthene		13/47	28%	0.075-4.8	MW-17-1	0.16-46	23						Yes	G
Benzo(g,h,i)perylene		15/47	32%	0.12-11	LSL-53	0.19-46	23						Yes	G
Benzo(k)fluoranthene		10/45	22%	0.059-9.3	LSL-56	0.19-46	23						Yes	G
Chrysene		15/47	32%	0.067-10	LSL-53	0.19-46	23						Yes	G
Dibenzo(a,h)anthracene		7/45	16%	0.049-1.3	AWI-215-SF	0.19-46	23						Yes	G
Fluoranthene		10/45	22%	0.12-13	MW-17-1	0.19-46	23						Yes	G
Indeno(1,2,3-cd)pyrene		11/45	24%	0.043-1.6	AWI-215-SF	0.19-46	23						Yes	G
Pyrene		11/47	23%	0.18-12	MW-17-1	0.19-46	23						Yes	G
Benzo(e)pyrene		3/8	38%	0.3-1.4	MW-13-1	0.23-30	15						Yes	G
Perylene		2/4	50%	0.6-1.1	MW-13-1								Yes	G
Total HMWPAHs	Y	19/47	40%		0.6 - 232		232	1.1		211	17	25	Yes	F

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
Low Molecular Weight PAHs														
2-Methylnaphthalene		0/15	0%			0.19-7.9	4						Yes	F
Acenaphthene		0/45	0%			0.15-46	23						Yes	F
Acenaphthylene		1/45	2%	0.095-0.095	FML-306-SF	0.15-46	23						Yes	G
Anthracene		3/45	7%	0.051-0.32	SO-5	0.19-46	23						Yes	G
Fluorene		0/44	0%			0.15-46	23						Yes	F
Naphthalene		1/45	2%	4.08-4.1	MW-15-1	0.15-46	23						Yes	G
Phenanthrene		9/47	19%	0.074-1	SO-5	0.17-46	23						Yes	G
Total LMWPAHs		10/47	21%	0.085 - 139			139	29		5	0	10	Yes	F
Pesticides														
Aldrin	Y	0/15	0%			0.0019-0.01	0.005	0.03		0.2		0	No	I
alpha-BHC	Y	0/15	0%			0.0019-0.01	0.005	0.0003		17		15	No	I
alpha-Chlordane	Y	5/15	33%	0.0011-0.0093	FML-301-SF	0.0019-0.01	0.005	0.0029	3	2	3	1	Yes	H
beta-BHC	Y	1/15	7%	0.016-0.016	FML-301-SF	0.0019-0.01	0.005	0.0003	53	17	1	14	Yes	H
delta-BHC		0/15	0%			0.0019-0.01	0.005						No	B
Dieldrin	Y	2/15	13%	0.0011-0.003	FML-310-SF	0.0036-0.02	0.01	0.0029	1	3	1	4	Yes	H
Endosulfan I		0/15	0%			0.0019-0.01	0.005	0.0009		6		15	Yes	D
Endosulfan II		0/15	0%			0.0036-0.02	0.01	0.0009		11		15	Yes	D
Endosulfan sulfate		2/15	13%	0.0024-0.045	AWI-216-SF	0.0036-0.02	0.01	0.0065	7	2	1	1	Yes	E
Endrin	Y	2/15	13%	0.001-0.0011	FML-310-SF	0.0036-0.02	0.01	0.0019	1	5	0	11	Yes	H
Endrin Aldehyde		3/15	20%	0.0039-0.013	FML-301-SF	0.0036-0.02	0.01						Yes	G
Endrin ketone		1/15	7%	0.0032-0.0032	FML-306-SF	0.0036-0.02	0.01						Yes	G
gamma-BHC (Lindane)		1/15	7%	0.0037-0.0037	FML-304-SF	0.0019-0.01	0.005	0.0031	1	2	1	1	No	A
gamma-Chlordane	Y	11/15	73%	0.0024-0.15	AWI-216-SF	0.0019-0.01	0.005	0.02	8	0.3	3	0	Yes	H
Heptachlor	Y	1/15	7%	0.001-0.001	FML-306-SF	0.0019-0.01	0.005	0.0016	1	3	0	4	Yes	H
Heptachlor epoxide		2/15	13%	0.00049-0.0014	FML-306-SF	0.0019-0.01	0.005	0.00015	9	33	2	13	Yes	E
Methoxychlor	Y	0/15	0%			0.019-0.1	0.05	0.0021		24		15	No	I
Toxaphene	Y	0/15	0%			0.19-1	0.5	0.00015		3333		15	No	I
DDD/DDE/DDT														
4,4'-DDD		2/15	13%	0.0034-0.0065	FML-304-SF	0.0036-0.02	0.01						Yes	G
4,4'-DDE		6/15	40%	0.0018-0.081	FML-310-SF	0.0036-0.02	0.01						Yes	G
4,4'-DDT		4/15	27%	0.0058-0.086	FML-310-SF	0.0036-0.02	0.01						Yes	G
Total DDD/DDE/DDT	Y	7/15	47%	0.0054 - 0.17			0.17	0.021		8	4	1	Yes	F

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
PCBs														
Aroclor 1016		2/44	5%	0.738-1.4	MW-16-1	0.0018-1.5	0.75						Yes	G
Aroclor 1221		0/44	0%			0.0017-1.4	0.72						Yes	F
Aroclor 1232		2/44	5%	1.76-3.5	MW-16-1	0.002-1.7	0.86						Yes	G
Aroclor 1242		2/44	5%	1.91-2.8	MW-16-1	0.0022-1.9	0.95						Yes	G
Aroclor 1248		30/44	68%	0.011-43	LSL-54	0.0013-0.061	0.031						Yes	G
Aroclor 1254		12/44	27%	0.009-4	AWI-216-SF	0.0013-1.1	0.54						Yes	G
Aroclor 1260		8/44	18%	0.018-1.1	MW-4B-1	0.0019-1.6	0.82						Yes	G
Aroclor 1262		0/15	0%			0.036-0.2	0.1						Yes	F
Aroclor 1268		0/15	0%			0.036-0.2	0.1						Yes	F
1,1'-Biphenyl, 2',3,4,5,5'-Pentachloro-		0/1	0%										Yes	F
1,1'-Biphenyl, 2,3',4',5-tetrachloro-		1/1	100%	0.5-0.5	FML-301-SF								Yes	G
1,1'-Biphenyl, 2,3',4',6-tetrachloro-		0/1	0%										Yes	F
1,1'-Biphenyl, 2',3,4-trichloro-		0/1	0%										Yes	F
1,1'-Biphenyl, 3,3',5,5'-tetrachloro-		0/1	0%										Yes	F
Total PCB	Y	37/44	84%		0.006 - 47		47	0.041		1146	36	3	Yes	F
SVOCs														
(Z,Z)-9,12-Octadecadienoic acid		1/1	100%	0.3-0.3	FML-306-SF								Yes	G
6-methyl-Chrysene		1/1	100%	0.4-0.4	FML-301-SF								Yes	G
1,1-Biphenyl		0/15	0%			0.19-7.9	4	0.2		20		6	Yes	D
1,2,3,4-Tetramethylbenzene		0/1	0%										No	B
1,2,3,5,6,8a-hexahydro-4,7-Naphthalene		1/1	100%	0.258-0.26	MW-14-1								Yes	G
1,2,4,5-Tetrachlorobenzene		0/15	0%			0.19-7.9	4	0.18		22		6	Yes	D
1,3-Diethyl-5-methylbenzene		0/1	0%										No	B
1,3-Dimethylpyrene		0/1	0%										No	B
1,4-Diethyl-2-methylbenzene		0/1	0%										No	B
1,4-Dioxane		0/15	0%			0.039-0.72	0.36						No	B
1-chloro-Heptacosane		1/1	100%	0.7-0.7	AWI-213-SF								Yes	G
1-Eicosanol		1/1	100%	0.21-0.21	MW-14-1								Yes	G
1-methyl-7-(1-methylethyl)-Phenanthrene		0/1	0%										No	B
1-methyl-Chrysene		1/2	50%	4.16-4.2	MW-19-1								Yes	G
1-methyl-Pyrene		0/1	0%										No	B
1-Tricosene		1/1	100%	0.3-0.3	FML-301-SF								Yes	G
2,3,3',4,4'-pentachloro-1,1'-biphenyl		0/1	0%										No	B
2,3,4,6-Tetrachlorophenol		0/15	0%			0.19-7.9	4	0.04		100		15	Yes	D
2,4,5-Trichlorophenol		0/16	0%			0.19-7.9	4	4		1		0	No	C
2,4,6-Trichlorophenol		0/16	0%			0.19-7.9	4	9.94		0.4		0	No	C
2,4-Dichlorophenol		0/16	0%			0.19-7.9	4	0.05		80		16	Yes	D
2,4-Dimethylphenol		0/16	0%			0.19-7.9	4	0.04		100		16	Yes	D
2,4-Dinitrophenol		0/15	0%			0.36-16	8	0.061		131		15	Yes	D
2,4-Tricosanedione		0/3	0%										No	B
2,6,10,14-Tetramethylpentadecane		0/1	0%										No	B

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
2,6,10-Trimethyldodecane		0/1	0%										No	B
2,6-Dimethylheptane		0/1	0%										No	B
24-methyl-5-Cholestene-3-ol		1/1	100%	0.3-0.3	LSL-62								Yes	G
28-Nor-17.alpha.(H)-hopane		0/1	0%										No	B
2-Chloronaphthalene		0/45	0%			0.15-46	23						No	B
2-Chlorophenol		0/16	0%			0.19-7.9	4	0.06		67		16	Yes	D
2-Methyl Decalin		1/2	50%	0.008-0.008	LSL-50								Yes	G
2-methyl-Chrysene		0/1	0%										No	B
2-Methyldecane		0/1	0%										No	B
2-Methylphenol		0/15	0%			0.19-7.9	4	0.1		40		11	Yes	D
2-methyl-Triphenylene		2/4	50%	0.4-0.7	MW-2B-1								Yes	G
2-Nitroaniline		0/15	0%			0.36-16	8	0.02		400		15	Yes	D
2-Nitrophenol		0/16	0%			0.19-7.9	4						No	B
3,3'-Dichlorobenzidine		0/16	0%			0.19-7.9	4	0.03		133		16	Yes	D
3-methyl-Benz[j]aceanthrylene		2/4	50%	0.4-5.1	MW-19-1								Yes	G
3-Methyldecane		0/1	0%										No	B
3-Methylheptadecane		0/1	0%										No	B
3-methyl-Perylene		1/1	100%	0.3-0.3	AWI-214-SF								Yes	G
3-Nitroaniline		0/15	0%			0.36-16	8						No	B
3-Nitrophthalic acid		1/1	100%	1.52-1.5	MW-2B-1								Yes	G
4,4'-Dinitrodiphenylsulphide		0/1	0%										No	B
4,6-Dinitro-2-methylphenol		0/16	0%			0.36-16	8						No	B
4-Bromophenyl-phenylether		0/16	0%			0.19-7.9	4						No	B
4-Chloro-3-methylphenol		0/16	0%			0.19-7.9	4						No	B
4-Chloroaniline		0/15	0%			0.19-7.9	4	1		4		5	Yes	D
4-Chlorophenyl-phenylether		0/16	0%			0.19-7.9	4						No	B
4-Ethyl-o-xylene		0/1	0%										No	B
4-Nitroaniline		0/15	0%			0.36-16	8						No	B
4-Nitrophenol		0/16	0%			0.36-16	8	5.12		2		3	Yes	D
5,12-Naphthacenedione		0/1	0%										No	B
5,8-dimethyl-Benzo[c]phenanthrene		1/3	33%	0.49-0.49	MW-19-1								Yes	G
6,13-dihydro-Pentacene		1/1	100%	3-3	AWI-215-SF								Yes	G
7H-Benz[de]anthracen-7-one		0/1	0%										No	B
7-methyl-Benz[a]anthracene		1/1	100%	4-4	AWI-215-SF								Yes	G
Acetophenone		1/15	7%	0.082-0.082	FML-301-SF	0.19-7.9	4						Yes	G
Atrazine		0/15	0%			0.19-7.9	4	0.00005		80000		15	Yes	D
Benzaldehyde		1/15	7%	0.16-0.16	FML-309-SF	0.19-7.9	4						Yes	G
Benzo[b]naphtho[2,1-d]thiophene		0/1	0%										No	B
Benzo[b]naphtho[2,3-d]thiophene		0/1	0%										No	B
Bis(2-Chloro-1-methylethyl)Ether		0/16	0%			0.15-7.9	4						No	B
bis(2-Chloroethoxy) methane		0/16	0%			0.15-7.9	4						No	B
bis(2-Chloroethyl) ether		0/16	0%			0.15-7.9	4						No	B

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
bis(2-Ethylhexyl) phthalate	Y	9/20	45%	0.31-83	AWI-213-SF	0.19-5.7	2.9	0.02	4150	145	9	9	Yes	H
Butylbenzylphthalate		0/16	0%			0.19-7.9	4	0.59		7		5	Yes	D
Campesterol		1/1	100%	0.3-0.3	FML-303-SF								Yes	G
Caprolactam		0/15	0%			0.19-7.9	4						No	B
Carbazole		0/15	0%			0.19-7.9	4	0.07		57		15	Yes	D
Cholesterol		1/1	100%	0.4-0.4	FML-303-SF								Yes	G
Cinnamyl cinnamate		2/2	100%	0.4-22	MW-14-1								Yes	G
Copaene		1/1	100%	0.955-0.96	MW-14-1								Yes	G
Cresols, Total		1/15	7%	3.4-3.4	FML-309-SF	0.19-7.9	4						Yes	G
Cyclopropanenonanoic acid, 2-[(2-butylcy		1/1	100%	6.45-6.5	MW-19-1								Yes	G
Dibenz(a,h)anthracene, 5,6-dihydro-		0/1	0%										No	B
Dibenzofuran		0/15	0%			0.19-7.9	4	0.15		27		6	Yes	D
Diethylphthalate		0/16	0%			0.15-7.9	4	0.25		16		6	Yes	D
Dimethylphthalate		0/16	0%			0.15-7.9	4	0.35		11		6	Yes	D
Di-n-butylphthalate		0/18	0%			0.15-7.9	4	0.011		364		18	Yes	D
Di-n-octylphthalate		1/16	6%	0.2-0.2	FML-310-SF	0.19-7.9	4	0.91	0.2	4	0	5	No	A
Dotriacontane		1/1	100%	0.228-0.23	MW-12-1								Yes	G
Friedelan-3-one		2/2	100%	1-3	FML-309-SF								Yes	G
Gamma-Muurolene		1/1	100%	3.08-3.1	MW-13-1								Yes	G
Glycocyanidine		0/1	0%										No	B
Heptadecanoic Acid		1/1	100%	0.4-0.4	FML-306-SF								Yes	G
Hexachlorobenzene	Y	0/16	0%			0.19-7.9	4	0.079		51		16	No	I
Hexachlorobutadiene	Y	0/16	0%			0.19-7.9	4	0.009		444		16	No	I
Hexachlorocyclopentadiene		0/15	0%			0.19-7.9	4	0.0064		625		15	Yes	D
Hexachloroethane		0/16	0%			0.19-7.9	4	0.024		167		16	Yes	D
Hexadecanoic Acid		4/4	100%	0.2-4	FML-306-SF								Yes	G
Isophorone		0/16	0%			0.15-7.9	4						No	B
m-Terphenyl		1/1	100%	1-1	AWI-214-SF								Yes	G
n-Amylcyclohexane		0/1	0%										No	B
n-Heptacosane		0/1	0%										No	B
Nitrobenzene		0/16	0%			0.19-7.9	4	2.2		2		4	Yes	D
N-Nitroso-di-n-propylamine		0/16	0%			0.19-7.9	4						No	B
N-Nitrosodiphenylamine/Diphenylamine		0/15	0%			0.19-7.9	4	0.545		7		5	Yes	D
Nonadecane		1/2	50%	0.199-0.2	MW-2B-1								Yes	G
Octadecanoic Acid		2/2	100%	0.2-0.3	FML-306-SF								Yes	G
Oleic Acid		2/2	100%	0.5-0.9	FML-306-SF								Yes	G
o-Terphenyl		1/1	100%	0.4-0.4	AWI-214-SF								Yes	G
Pentachlorophenol	Y	0/16	0%			0.36-16	8	2.1		4		5	No	I
Pentadecanoic acid		1/1	100%	0.8-0.8	FML-306-SF								Yes	G
Pentatriacontane		1/1	100%	0.173-0.17	MW-12-1								Yes	G
Pentylcyclohexane		0/1	0%										No	B
Petroleum Hydrocarbons		1/1	100%	207-210	SO-5								Yes	G

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
Phenol		0/16	0%			0.19-7.9	4	0.79		5		5	Yes	D
p-Terphenyl		2/2	100%	0.7-3	AWI-215-SF								Yes	G
Sitosterol		0/1	0%										No	B
Stigmast-4-en-3-one		2/2	100%	0.9-4	FML-309-SF								Yes	G
Terpinolene		1/1	100%	0.253-0.25	MW-14-1								Yes	G
trans-Decahydronaphthalene		0/1	0%										No	B
Z-11-Hexadecenoic acid		1/1	100%	0.6-0.6	FML-306-SF								Yes	G
VOCs														
1,1,1-Trichloroethane		0/42	0%			0.001-0.3	0.15	0.04		4		1	Yes	D
1,1,2,2-Tetrachloroethane		0/42	0%			0.001-0.36	0.18	0.127		1		1	No	C
1,1,2-Trichloroethane		0/42	0%			0.001-0.23	0.12	0.32		0.4		0	No	C
1,1-Dichloroethane		0/38	0%			0.001-0.15	0.075	0.14		1		0	No	C
1,1-Dichloroethene		0/42	0%			0.001-0.5	0.25	0.04		6		1	Yes	D
1,2,3-Trichlorobenzene		0/15	0%			0.002-0.036	0.018	20		0		0	No	C
1,2,4-Trichlorobenzene		0/16	0%			0.002-0.21	0.11	0.27		0.4		0	No	C
1,2,4-Trimethylbenzene		0/1	0%					0.09				0	No	C
1,2,4-Trimethylbenzene Isomer		1/1	100%	0.0089-0.0089	MW-12-1								Yes	G
1,2-Dibromo-3-chloropropane		0/15	0%			0.002-0.036	0.018						No	B
1,2-Dibromoethane		0/15	0%			0.002-0.036	0.018						No	B
1,2-Dichlorobenzene		0/16	0%			0.002-0.15	0.075	0.09		1		0	No	C
1,2-Dichloroethane		0/39	0%			0.001-0.36	0.18	0.4		0.5		0	No	C
1,2-Dichloropropane		0/42	0%			0.001-0.13	0.065	0.28		0.2		0	No	C
1,3-Dichlorobenzene		0/16	0%			0.002-0.15	0.075	0.08		1		0	No	C
1,4-Dichlorobenzene		0/16	0%			0.002-0.15	0.075	0.88		0.1		0	No	C
2-Butanone (MEK)		8/42	19%	0.0027-0.044	LSL-51	0.001-2.3	1.2	1	0	1	0	1	No	A
2-Chloroethyl vinyl ether		0/1	0%			0.25-0.25	0.13						No	B
2-Hexanone		2/41	5%	0.0006-0.002	LSL-62	0.001-0.072	0.036	0.36	0	0.1	0	0	No	A
3-Methylpentane		1/1	100%	0.0649-0.065	LSL-46								Yes	G
4-Methyl-2-pentanone		1/42	2%	0.0016-0.0016	LSL-62	0.001-0.68	0.34						Yes	G
Acetone		12/41	29%	0.0034-0.07	LSL-15	0.001-0.072	0.036	1.2	0.1	0	0	0	No	A
alpha-Pinene		1/1	100%	0.0741-0.074	LSL-62								Yes	G
Benzene		0/42	0%			0.001-0.21	0.11	0.12		1		0	No	C
Benzene, 1-phenyl-4-(2-cyano-2-phenyleth		1/1	100%	0.0527-0.053	LSL-57								Yes	G
Bromochloromethane		0/15	0%			0.002-0.036	0.018						No	B
Bromoform		0/42	0%			0.001-0.23	0.12	0.07		2		1	Yes	D
Bromomethane		0/44	0%			0.00092-0.61	0.31	0.002		155		10	Yes	D
Camphene		2/2	100%	0.004-0.046	LSL-51								Yes	G
Carbon disulfide		4/42	10%	0.0038-0.11	MW-15-1	0.001-0.5	0.25	0.005	21	50	2	7	Yes	E
Carbon tetrachloride		0/42	0%			0.001-0.46	0.23	0.05		5		1	Yes	D
Chlorobenzene		0/42	0%			0.001-0.34	0.17	2.4		0.1		0	No	C
Chloroethane		0/41	0%			0.001-0.76	0.38						No	B
Chloroform		2/42	5%	0.0143-0.015	MW-20-1	0.001-0.23	0.12	0.05	0.3	2	0	1	No	A

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
Chloromethane		1/39	3%	0.0357-0.036	LSL-51	0.001-0.65	0.33						Yes	G
cis/trans1,2-Dichloroethene		1/25	4%	0.294-0.29	MW-15-1	0.001-0.018	0.0089	0.04	7	0.2	1	0	Yes	E
cis-1,2-Dichloroethene		1/17	6%	0.0081-0.0081	LSD-11	0.002-0.036	0.018	0.04	0.2	0.5	0	0	No	A
cis-1,3-Dichloropropene		0/42	0%			0.001-0.23	0.12						No	B
Cyclohexane		0/15	0%			0.002-0.036	0.018						No	B
Dibromochloromethane		0/42	0%			0.001-0.23	0.12						No	B
Dichlorobenzene		0/1	0%			0.72-0.72	0.36						No	B
Dichlorobromomethane		0/42	0%			0.001-0.13	0.065						No	B
Dichloromethane (Methylene chloride)		10/42	24%	0.0076-0.024	LSL-51	0.001-1.5	0.75	0.21	0.1	4	0	1	No	A
Diethyl ether		0/1	0%			0.3-0.3	0.15						No	B
Ethyl benzene		2/42	5%	0.00035-0.24	MW-15-1	0.001-0.49	0.25	0.27	1	1	0	0	No	A
Ethyl-dimethylbenzene Isomer		1/1	100%	9.48-9.5	MW-15-1								Yes	G
Freon-11		0/16	0%			0.002-0.63	0.32	16.4		0		0	No	C
Freon-113		4/19	21%	0.0119-0.12	LSL-57	0.002-0.036	0.018						Yes	G
Freon-12		0/15	0%			0.002-0.036	0.018						No	B
Isopropylbenzene		0/15	0%			0.002-0.036	0.018	0.04		0.5		0	No	C
m&p-Xylene		0/15	0%			0.002-0.036	0.018						No	B
Methyl acetate		0/15	0%			0.002-0.036	0.018						No	B
Methyl tertbutyl ether (MTBE)		0/15	0%			0.002-0.036	0.018						No	B
Methylcyclohexane		0/15	0%			0.002-0.036	0.018						No	B
Methylcyclopentane		2/2	100%	0.0081-0.15	LSL-46								Yes	G
n-Hexane		3/3	100%	0.0444-0.063	LSL-45			0.007	9		3	0	Yes	E
o-Xylene		0/17	0%			0.002-0.036	0.018						No	B
p-Isopropyltoluene		0/1	0%					0.18				0	No	C
sec-Butylbenzene		1/2	50%	0.019-0.019	LSD-14	0.0012-0.0012	0.0006						Yes	G
Styrene		1/41	2%	0.0058-0.0058	MW-13-1	0.001-0.036	0.018	1.2	0	0	0	0	No	A
Tentatively Identified Compounds		0/13	0%			0.002-0.04	0.02						No	B
tert-Butylbenzene		1/2	50%	0.015-0.015	LSD-14	0.001-0.001	0.0005						Yes	G
Tetrachloroethene		0/41	0%			0.001-0.42	0.21	0.06		4		1	Yes	D
Tetramethyl Benzene Isomer		1/1	100%	15.5-16	MW-15-1								Yes	G
Toluene		1/42	2%	0.0015-0.0015	LSL-62	0.001-0.36	0.18	0.15	0	1	0	1	No	A
trans-1,2-Dichloroethene		1/18	6%	0.0034-0.0034	LSD-11	0.002-0.25	0.13	0.04	0.1	3	0	1	No	A
trans-1,3-Dichloropropene		0/42	0%			0.001-0.15	0.075						No	B
Trichloroethene		3/44	7%	0.0024-0.0042	LSD-11	0.001-0.25	0.13	0.06	0.1	2	0	1	No	A
Vinyl chloride		1/44	2%	0.0059-0.0059	LSL-56	0.00089-0.74	0.37	0.03	0.2	12	0	1	No	A
Xylenes (unspecified)		3/27	11%	0.0012-0.83	MW-15-1	0.001-1.6	0.8						Yes	G

Table 7. Preliminary Ecological PCOPC Screening: Soil

Parameter	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Surrogate for ND (mg/kg)	Region 4 SSL (mg/kg)	Max Detect HQ	Max Surrogate HQ	# Detects > SSL	# Surrogate > SSL	PCOPC?	Basis
Energetics														
2,4-Dinitrotoluene		0/16	0%			0.19-7.9	4	6		1		0	No	C
2,6-Dinitrotoluene		0/16	0%			0.19-7.9	4	4		1		0	No	C
Pentaerythritol tetranitrate		0/1	0%			8.44-8.4	4.2	2.2		2		1	Yes	D
Trinitrophenylmethylnitramine		0/1	0%			1.54-1.5	0.77	0.018		43		1	Yes	D
1,3,5-Trinitrobenzene		0/1	0%			1.03-1	0.52	0.3		2		1	Yes	D
1,3-Dinitrobenzene		0/1	0%			1.05-1	0.53	0.034		16		1	Yes	D
2,4,6-Trinitrotoluene		0/1	0%			0.962-0.96	0.48	7.5		0.1		0	No	C
Hexahydro-1,3,5-trinitro-1,3,5-triazine		0/1	0%			1.24-1.2	0.62	2.3		0.3		0	No	C
HMX		0/1	0%			1.4-1.4	0.7	16		0		0	No	C
Nitroglycerin		0/1	0%			8.44-8.4	4.2	13		0.3		0	No	C

A: Max Detect HQ ≤ 1
B: Chemical lacks a screening value and was not detected
C: Surrogate HQ ≤ 1 for a chemical not detected in any sample
D: Surrogate HQ > 1 for a chemical not detected in any sample
E: Max Detect HQ > 1
F: Total concentration for a class of compounds is greater than the ESV for the class
G: Chemical is detected and no screening value is available
H: Chemical is detected and bioaccumulative with no wildlife ESV
I: Chemical is not detected and bioaccumulative with no wildlife ESV

BA: Bioaccumulative
DL: detection limit
ND: non-detect
Surrogate: 1/2 the maximum detection limit
SSL: soil screening level
HQ: hazard quotient
Max Detect HQ: max detected concentration / SSL
Max Surrogate HQ: max surrogate concentration / SSL

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
Inorganics															
Aluminum			16/16	100%	1400-13000	RC-402-SD; RC-404-SD			25000	1		0	0	No	A
Antimony			15/39	38%	0.31-6.2	LSD-26-01	0.24-32	16	2	3	8	3	10	Yes	E
Arsenic			29/40	73%	0.318-5	RC-408-SD	0.41-1.3	0.65	9.8	1	0.1	0	0	No	A
Barium			17/17	100%	11.2-300	RC-404-SD			20	15		14	0	Yes	E
Beryllium			33/44	75%	0.02-2	LSD-36-05	0.56-2.7	1.35						Yes	G
Cadmium			32/46	70%	0.33-15	RC-408-SD	0.09-0.98	0.49	1	15	0.5	19	0	Yes	E
Calcium			16/16	100%	72-11000	DD-514-SD								Yes	G
Chromium			46/46	100%	0.43-61	LSD-36-05			43.4	1		1	0	No	A
Cobalt			7/16	44%	0.81-21	RC-402-SD; RC-404-SD	5.6-27	13.5	50	0.4	0.3	0	0	No	A
Copper			44/45	98%	0.18-110	LSD-35-05	0.9-0.9	0.45	31.6	3	0	10	0	Yes	E
Cyanide			0/16	0%			2.5-14	7						No	B
Iron			16/16	100%	1400-35000	RC-404-SD			20000	2		2	0	Yes	E
Lead			46/46	100%	0.81-110	DD-508-SD; DD-514-SD			35.8	3		16	0	Yes	E
Magnesium			16/16	100%	130-1700	DD-509-SD								Yes	G
Manganese			16/16	100%	39-5800	RC-404-SD			460	13		6	0	Yes	E
Mercury	Aquatic	Y	28/51	55%	0.027-3	LSD-29-01	0.01-0.58	0.29	0.18	17	2	14	1	Yes	E
Mercury	Wildlife	Y	28/51	55%	0.027-3	LSD-29-01	0.01-0.58	0.29	0.17	18	2	14	2	Yes	E
Nickel			45/45	100%	0.24-19	LSD-36-05			22.7	1		0	0	No	A
Potassium			16/16	100%	20-750	RC-404-SD								Yes	G
Selenium	Aquatic	Y	14/46	30%	0.38-4.2	LSD-36-05	0.09-19	9.5	0.72	6	13	9	16	Yes	E
Selenium	Wildlife	Y	14/46	30%	0.38-4.2	LSD-36-05	0.09-19	9.5	0.8	5	12	9	16	Yes	E
Silver			3/46	7%	0.37-0.85	LSD-28-01	0.12-5.4	2.7	1	1	3	0	5	No	A
Sodium			16/16	100%	8.9-260	DD-514-SD								Yes	G
Thallium			4/39	10%	1.2-2.2	LSD-36-01	0.28-14	7						Yes	G
Vanadium			15/16	94%	9.3-57	RC-404-SD	6.4-6.4	3.2						Yes	G
Zinc			45/45	100%	0.97-390	DD-508-SD; LSD-34-01			121	3		4	0	Yes	E
High Molecular Weight PAHs															
Benzo(a)anthracene		Y	17/40	43%	0.033-2.7	LSD-36-03	0.0456-12	5.95	0.108	25	55	14	14	Yes	H
Benzo(a)pyrene		Y	21/43	49%	0.047-6.6	DD-501-SD; RC-408-SD	0.0456-12	5.95	0.15	44	40	19	10	Yes	H
Benzo(b)fluoranthene		Y	18/46	39%	0.043-3.1	LSD-36-03	0.0456-12	5.95	0.19	16	31	15	12	Yes	H
Benzo(g,h,i)perylene		Y	22/46	48%	0.062-7.1	DD-510-SD	0.0456-12	5.95	0.17	42	35	20	10	Yes	H
Benzo(k)fluoranthene		Y	10/40	25%	0.031-0.83	LSD-36-03	0.0456-12	5.95	0.24	3	25	8	16	Yes	H
Chrysene		Y	20/46	43%	0.045-4.8	LSD-36-03	0.0456-12	5.95	0.166	29	36	17	12	Yes	H
Dibenzo(a,h)anthracene		Y	9/40	23%	0.11-0.94	LSD-36-03	0.0456-12	5.95	0.033	29	180	9	29	Yes	H
Fluoranthene		Y	13/40	33%	0.053-1.4	LSD-36-03	0.04-12	5.95	0.423	3	14	5	14	Yes	H
Indeno(1,2,3-cd)pyrene		Y	14/40	35%	0.034-1.8	DD-510-SD	0.0456-12	5.95	0.2	9	30	11	13	Yes	H

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
Pyrene			17/46	37%	0.051-4.5	LSD-36-03	0.04-12	5.95	0.195	23	31	13	14	Yes	E
Benzo(e)pyrene			4/5	80%	1.59-6.3	LSD-36-03	0.19-0.19	0.095						Yes	G
Perylene			4/4	100%	0.2-7	RC-409-SD								Yes	G
Total HMWPAH		Y	24/47	51%	0.228 - 60			60	1		60		19	Yes	F
Low Molecular Weight PAHs															
2-Methylnaphthalene			0/16	0%			0.19-8.3	4.15	0.0202		205		16	Yes	D
Acenaphthene			1/39	3%	0.056-0.056	DD-509-SD	0.04-12	5.95	0.0067	8	888	1	38	Yes	E
Acenaphthylene			2/40	5%	0.043-0.067	DD-518-SD	0.04-12	5.95	0.0059	11	1008	2	38	Yes	E
Anthracene			5/40	13%	0.048-0.17	DD-518-SD	0.04-12	5.95	0.057	3	104	3	32	Yes	E
Fluorene			0/40	0%			0.04-12	5.95	0.077		77		37	Yes	D
Naphthalene			0/40	0%			0.04-12	5.95	0.176		34		21	Yes	D
Phenanthrene		Y	10/46	22%	0.028-0.72	RC-408-SD	0.04-12	5.95	0.204	4	29	9	15	Yes	H
Total LMWPAH			11/46	24%	0.055 - 35.7			35.7	0.6		35.7	3	25	Yes	F
Pesticides															
Aldrin	Aquatic	Y	0/16	0%			0.0019-0.0083	0.00415	0.029		0.1		0	No	C
Aldrin	Wildlife	Y	0/16	0%			0.0019-0.0083	0.00415	0.042		0.1		0	No	C
alpha-BHC		Y	0/16	0%			0.0019-0.0083	0.00415	0.0003		14		16	Yes	D
alpha-Chlordane			4/16	25%	0.0028-0.027	DD-508-SD	0.0019-0.0083	0.00415	0.0032	8	1	3	2	Yes	E
beta-BHC	Aquatic	Y	2/16	13%	0.0029-0.022	DD-509-SD	0.0019-0.0083	0.00415	0.005	4	1	1	0	Yes	E
beta-BHC	Wildlife	Y	2/16	13%	0.0029-0.022	DD-509-SD	0.0019-0.0083	0.00415	0.3	0.1	0	0	0	No	A
delta-BHC			0/16	0%			0.0019-0.0083	0.00415						No	B
Dieldrin	Aquatic	Y	1/16	6%	0.12-0.12	DD-518-SD	0.0037-0.016	0.008	0.0019	63	4	1	14	Yes	E
Dieldrin	Wildlife	Y	1/16	6%	0.12-0.12	DD-518-SD	0.0037-0.016	0.008	0.0077	16	1	1	1	Yes	E
Endosulfan I			0/16	0%			0.0019-0.0083	0.00415	0.00001		415		16	Yes	D
Endosulfan II			1/16	6%	0.0021-0.0021	RC-409-SD	0.0037-0.016	0.008	0.0009	2	9	1	15	Yes	E
Endosulfan sulfate			1/16	6%	0.014-0.014	DD-506-SD	0.0037-0.016	0.008	0.0007	20	11	1	15	Yes	E
Endrin	Aquatic	Y	2/16	13%	0.0024-0.017	DD-509-SD	0.0037-0.016	0.008	0.0022	8	4	2	11	Yes	E
Endrin	Wildlife	Y	2/16	13%	0.0024-0.017	DD-509-SD	0.0037-0.016	0.008	0.008	2	1	1	0	Yes	E
Endrin Aldehyde			0/16	0%			0.0037-0.016	0.008	0.0022		4		12	Yes	D
Endrin ketone			0/16	0%			0.0037-0.016	0.008	0.0022		4		12	Yes	D
gamma-BHC (Lindane)			2/16	13%	0.0072-0.0085	DD-514-SD	0.0019-0.0065	0.00325						Yes	G
gamma-Chlordane			9/16	56%	0.01-0.094	RC-408-SD	0.0019-0.0065	0.00325	0.0032	29	1	9	1	Yes	E
Heptachlor		Y	0/16	0%			0.0019-0.0083	0.00415	0.0006		7		16	Yes	D
Heptachlor epoxide			1/16	6%	0.00064-0.0006	DD-518-SD	0.0019-0.0083	0.00415	0.0025	0.3	2	0	4	No	A
Methoxychlor		Y	4/16	25%	0.009-0.024	DD-508-SD	0.019-0.083	0.0415	0.03	1	1	0	2	Yes	H
Toxaphene		Y	0/16	0%			0.19-0.83	0.415	0.0001		4150		16	Yes	D
DDD/DDE/DDT															
4,4'-DDD		Y	2/16	13%	0.0043-0.034	DD-508-SD	0.0037-0.016	0.008	0.0035	10	2	2	4	Yes	H
4,4'-DDE		Y	3/16	19%	0.0054-0.23	DD-508-SD	0.004-0.016	0.008	0.0014	164	6	3	13	Yes	H
4,4'-DDT		Y	5/16	31%	0.0088-0.21	DD-508-SD	0.0037-0.016	0.008	0.001	210	8	5	11	Yes	H
Total DDD/DDE/DDT		Y	6/16	38%	0.006 - 0.474			0.474	0.0053		89	6	0	Yes	F

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
PCBs															
Aroclor 1016			0/39	0%			0.0015-0.26	0.132						No	B
Aroclor 1221			0/39	0%			0.0012-0.25	0.126						No	B
Aroclor 1232			0/39	0%			0.0012-0.3	0.1505						No	B
Aroclor 1242			0/39	0%			0.0018-0.33	0.166						No	B
Aroclor 1248			25/39	64%	0.0777-14	DD-508-SD	0.001-0.06	0.03						Yes	G
Aroclor 1254			4/39	10%	0.14-2	DD-513-SD	0.001-0.19	0.095						Yes	G
Aroclor 1260			3/39	8%	0.23-0.75	DD-508-SD	0.0016-0.29	0.1445						Yes	G
Aroclor 1262			0/16	0%			0.037-0.16	0.08						No	B
Aroclor 1268			0/16	0%			0.037-0.16	0.08						No	B
1,1'-Biphenyl, 2,2',3,4-tetrachloro-			1/1	100%	2-2	DD-508-SD								Yes	G
1,1'-Biphenyl, 2,3',4',5-tetrachloro-			1/1	100%	2-2	RC-408-SD								Yes	G
1,1'-Biphenyl, 2,3,4',6-tetrachloro-			2/2	100%	0.5-2	DD-508-SD								Yes	G
1,1'-Biphenyl, 2,3',5,5'-tetrachloro-			2/2	100%	0.5-1	DD-508-SD								Yes	G
PCB congener 28			1/1	100%	1-1	DD-508-SD								Yes	G
Total PCBs			26/39	67%		0.005 - 21		21	0.0598		351	28	0	Yes	F
Total PCBs	Wildlife		26/39	67%		0.005 - 21		21	0.014		1500	33	0	Yes	F
SVOCs															
6-methyl-Chrysene			4/4	100%	0.4-6	RC-408-SD								Yes	G
[(dodecyloxy)methyl]-Oxirane			1/1	100%	0.4-0.4	RC-406-SD								Yes	G
1,1-Biphenyl			0/16	0%			0.19-8.3	4.15	0.198		21		7	Yes	D
1,2,4,5-Tetrachlorobenzene			0/16	0%			0.19-8.3	4.15	0.187		22		7	Yes	D
1,4-Dioxane			0/16	0%			0.06-0.62	0.31						No	B
1-[2-(hexadecyloxy)ethoxy]-Octadecane			1/1	100%	0.7-0.7	DD-519-SD								Yes	G
11H-Indeno[2,1-a]phenanthrene			1/1	100%	2-2	RC-409-SD								Yes	G
1-chloro-Heptacosane			1/1	100%	0.4-0.4	DD-509-SD								Yes	G
1-Heneicosyl formate			1/1	100%	0.5-0.5	DD-518-SD								Yes	G
1-Hexadecene			1/1	100%	0.2-0.2	RC-406-SD								Yes	G
1-methyl-Benz[a]anthracene			3/3	100%	0.4-1	DD-508-SD; DD-519-SD								Yes	G
1-methyl-Chrysene			4/4	100%	2-4	DD-510-SD; RC-407-SD								Yes	G
1-methyl-Pyrene			2/2	100%	0.6-4	RC-408-SD								Yes	G
2,3,4,6-Tetrachlorophenol			0/16	0%			0.19-8.3	4.15	0.03		138		16	Yes	D
2,4,5-Trichlorophenol			0/17	0%			0.09-8.3	4.15	0.034		122		17	Yes	D
2,4,6-Trichlorophenol			0/17	0%			0.09-8.3	4.15	0.089		47		16	Yes	D
2,4-Dichlorophenol			0/17	0%			0.09-8.3	4.15	0.057		73		16	Yes	D
2,4-Dimethylphenol			0/17	0%			0.09-8.3	4.15	0.039		106		17	Yes	D
2,4-Dinitrophenol			0/16	0%			0.37-16	8	0.223		36		12	Yes	D
28-Nor-17.alpha.(H)-hopane			1/1	100%	3-3	DD-508-SD								Yes	G
2-Chloronaphthalene			0/40	0%			0.04-12	5.95						No	B
2-Chlorophenol			0/17	0%			0.09-8.3	4.15	0.055		75		16	Yes	D

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
2-methyl-Chrysene			2/2	100%	0.3-2.2	LSD-36-03								Yes	G
2-Methylphenol			0/16	0%			0.19-8.3	4.15	0.119		35		10	Yes	D
2-methyl-Triphenylene			3/3	100%	0.9-3	RC-409-SD								Yes	G
2-Nitroaniline			0/16	0%			0.37-16	8						No	B
2-Nitrophenol			0/17	0%			0.09-8.3	4.15	0.168		25		7	Yes	D
3,3'-Dichlorobenzidine			0/17	0%			0.16-8.3	4.15	0.031		134		17	Yes	D
3,4:8,9-Dibenzopyrene			1/1	100%	0.2-0.2	DD-507-SD								Yes	G
3,6-dimethyl-Phenanthrene			1/1	100%	0.4-0.4	DD-513-SD								Yes	G
3-methyl-Benz[j]aceanthrylene			1/1	100%	4-4	RC-408-SD								Yes	G
3-methyl-Chrysene			1/1	100%	0.5-0.5	DD-509-SD								Yes	G
3-methyl-Perylene			5/5	100%	2-8	RC-408-SD								Yes	G
3-Nitroaniline			0/16	0%			0.37-16	8						No	B
4,6-Dinitro-2-methylphenol			0/17	0%			0.37-16	8	1.477		5		4	Yes	D
4-Bromophenyl-phenylether			0/17	0%			0.04-8.3	4.15	0.047		88		16	Yes	D
4-Chloro-3-methylphenol			0/17	0%			0.06-8.3	4.15	0.005		830		17	Yes	D
4-Chloroaniline			0/16	0%			0.19-8.3	4.15	0.0009		4611		16	Yes	D
4-Chlorophenyl-phenylether			0/17	0%			0.04-8.3	4.15	0.055		75		16	Yes	D
4-methyl-Pyrene			1/1	100%	0.3-0.3	DD-513-SD								Yes	G
4-Nitroaniline			0/16	0%			0.37-16	8						No	B
4-Nitrophenol			0/17	0%			0.37-16	8	0.153		52		17	Yes	D
5,6-dihydro-Dibenz[a,h]anthracene			1/1	100%	5-5	RC-408-SD								Yes	G
5,8-dimethyl-Benzo[c]phenanthrene			6/6	100%	1-8.6	LSD-36-03								Yes	G
5-Methylchrysene			1/1	100%	4-4	LSD-36-03								Yes	G
6,13-dihydro-Pentacene			1/1	100%	0.4-0.4	DD-513-SD								Yes	G
7H-Benz[de]anthracen-7-one			1/1	100%	0.4-0.4	DD-509-SD								Yes	G
9-methyl-Anthracene			1/1	100%	0.3-0.3	DD-513-SD								Yes	G
Acetophenone			6/16	38%	0.047-0.5	RC-408-SD	0.19-8.3	4.15						Yes	G
Atrazine			0/16	0%			0.19-8.3	4.15	0.0003		13833		16	Yes	D
Benzaldehyde			5/16	31%	0.033-1.3	RC-408-SD	0.19-8.3	4.15	0.059	22	70	4	11	Yes	E
Benzo[b]naphtho[2,3-d]furan			1/1	100%	0.5-0.5	DD-509-SD								Yes	G
Benzo[j]fluoranthene			1/1	100%	2-2	DD-519-SD								Yes	G
Bis(2-Chloro-1-methylethyl)Ether			0/17	0%			0.04-8.3	4.15						No	B
bis(2-Chloroethoxy) methane			0/17	0%			0.04-8.3	4.15						No	B
bis(2-Chloroethyl) ether			0/17	0%			0.06-8.3	4.15	4.761		1		0	No	C
bis(2-Ethylhexyl) phthalate		Y	7/23	30%	0.91-13	RC-408-SD	0.06-8.3	4.15	0.18	72	23	7	8	Yes	H
Butylbenzylphthalate			0/17	0%			0.04-8.3	4.15	0.1		42		14	Yes	D
Campesterol			1/1	100%	0.5-0.5	DD-518-SD								Yes	G
Caprolactam			0/16	0%			0.19-8.3	4.15						No	B
Carbazole			3/16	19%	0.04-0.12	DD-509-SD	0.19-8.3	4.15	0.069	2	60	1	13	Yes	E
Cholesterol			2/2	100%	0.761-2	LSD-21-01								Yes	G
Cinnamyl cinnamate			1/1	100%	0.6-0.6	DD-518-SD								Yes	G
Cresols, Total			0/16	0%			0.19-8.3	4.15						No	B

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
Dibenzofuran			0/16	0%			0.19-8.3	4.15	0.51		8		4	Yes	D
Diethylphthalate			0/17	0%			0.04-8.3	4.15	0.32		13		5	Yes	D
Diethyltoluamide			1/1	100%	3-3	DD-519-SD								Yes	G
Diglycidyl Ether			0/1	0%										No	B
Dimethylphthalate			0/17	0%			0.04-8.3	4.15	0.678		6		4	Yes	D
Di-n-butylphthalate			0/23	0%			0.04-8.3	4.15	0.011		377		23	Yes	D
Di-n-octylphthalate			0/17	0%			0.06-8.3	4.15	0.039		106		16	Yes	D
Heneicosane			1/1	100%	1.12-1.1	LSD-36-02								Yes	G
Hexachlorobenzene		Y	0/17	0%			0.04-8.3	4.15	0.02		208		16	Yes	D
Hexachlorobutadiene		Y	0/17	0%			0.09-8.3	4.15	0.0007		5929		17	Yes	D
Hexachlorocyclopentadiene	Aquatic		0/16	0%			0.19-8.3	4.15	0.0065		638		16	Yes	D
Hexachlorocyclopentadiene	Wildlife		0/16	0%			0.19-8.3	4.15	0.069		60		16	Yes	D
Hexachloroethane			0/17	0%			0.04-8.3	4.15	0.027		154		16	Yes	D
Hexadecanoic Acid			1/1	100%	0.8-0.8	RC-406-SD								Yes	G
Isophorone			0/17	0%			0.04-8.3	4.15	0.876		5		3	Yes	D
m-Terphenyl			1/1	100%	0.5-0.5	DD-509-SD								Yes	G
Nitrazepam			2/2	100%	0.5-2	RC-409-SD								Yes	G
Nitrobenzene			0/17	0%			0.19-8.3	4.15	0.407		10		4	Yes	D
N-Nitroso-di-n-propylamine			0/17	0%			0.04-8.3	4.15						No	B
N-Nitrosodiphenylamine/Diphenylamine			0/16	0%			0.19-8.3	4.15	0.11		38		12	Yes	D
Pentachlorophenol	Aquatic	Y	4/17	24%	0.057-3.3	RC-408-SD	0.37-16	8	0.01	330	800	4	13	Yes	E
Pentachlorophenol	Wildlife	Y	4/17	24%	0.057-3.3	RC-408-SD	0.37-16	8	0.065	51	123	3	13	Yes	E
Petroleum Hydrocarbons			1/2	50%	4-4	RC-409-SD	33.1-33	16.55						Yes	G
Phenol			0/17	0%			0.09-8.3	4.15	0.175		24		7	Yes	D
Tridecanoic acid			2/2	100%	0.6-2	DD-519-SD								Yes	G
VOCs															
1,1,1-Trichloroethane			0/20	0%			0.0013-0.17	0.085	0.07		1		1	No	C
1,1,2,2-Tetrachloroethane			0/20	0%			0.0013-0.21	0.105	0.25		0.4		0	No	C
1,1,2-Trichloroethane			0/20	0%			0.0013-0.13	0.065	0.538		0.1		0	No	C
1,1-Dichloroethane			0/20	0%			0.0013-0.09	0.045	0.131		0.3		0	No	C
1,1-Dichloroethene			0/20	0%			0.0013-0.3	0.15	0.1		2		1	Yes	D
1,2,3-Trichlorobenzene			0/16	0%			0.003-0.031	0.0155	0.113		0.1		0	No	C
1,2,4-Trichlorobenzene			0/17	0%			0.003-0.04	0.02	0.011		2		2	Yes	D
1,2-Dibromo-3-chloropropane			0/16	0%			0.003-0.031	0.0155						No	B
1,2-Dibromoethane			0/16	0%			0.003-0.031	0.0155						No	B
1,2-Dichlorobenzene			0/17	0%			0.003-0.04	0.02	0.095		0.2		0	No	C
1,2-Dichloroethane			0/20	0%			0.0013-0.21	0.105	0.986		0.1		0	No	C
1,2-Dichloropropane			0/20	0%			0.0013-0.07	0.035	0.428		0.1		0	No	C
1,3-Dichlorobenzene			0/17	0%			0.003-0.04	0.02	0.089		0.2		0	No	C
1,3-Dichloropropene			0/1	0%			0.0014-0.0014	0.0007	0.0015		0.5		0	No	0
1,4-Dichlorobenzene			0/17	0%			0.003-0.04	0.02	0.03		1		0	No	C
2-Butanone (MEK)			2/20	10%	0.024-0.046	DD-519-SD	0.006-1.3	0.65	7.604	0	0.1	0	0	No	A

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
2-Chloroethyl vinyl ether			0/1	0%			0.15-0.15	0.075						No	B
2-Hexanone			0/19	0%			0.006-0.062	0.031	0.045		1		0	No	C
4-Methyl-2-pentanone			1/20	5%	0.0064-0.0064	ISD-204	0.006-0.39	0.195	0.073	0.1	3	0	1	No	A
Acetone			5/19	26%	0.0258-0.25	DD-518-SD	0.006-0.062	0.031	0.065	4	0.5	2	0	Yes	E
Benzene			0/20	0%			0.0013-0.12	0.061	0.01		6		2	Yes	D
Bromochloromethane			0/16	0%			0.003-0.031	0.0155						No	B
Bromoform			0/20	0%			0.0013-0.14	0.068	0.142		0.5		0	No	C
Bromomethane			0/26	0%			0.00059-0.35	0.175	0.0065		27		4	Yes	D
Carbon disulfide			0/20	0%			0.003-0.3	0.15	0.0078		19		4	Yes	D
Carbon tetrachloride			0/20	0%			0.0013-0.27	0.135	0.057		2		1	Yes	D
Chlorobenzene			0/20	0%			0.0013-0.2	0.1	0.03		3		1	Yes	D
Chloroethane			0/20	0%			0.0013-0.44	0.22						No	B
Chloroform			0/20	0%			0.0013-0.13	0.065	0.087		1		0	No	C
Chloromethane			0/20	0%			0.0013-0.38	0.19						No	B
cis/trans1,2-Dichloroethene			0/3	0%			0.0026-0.0028	0.0014	0.338		0		0	No	0
cis-1,2-Dichloroethene			1/22	5%	0.0086-0.0086	LSD-10	0.0022-0.031	0.0155	0.432	0	0	0	0	No	A
cis-1,3-Dichloropropene			0/20	0%			0.0013-0.13	0.065	0.0015		43		16	Yes	D
Cyclohexane			0/16	0%			0.003-0.031	0.0155						No	B
Dibromochloromethane			0/20	0%			0.0013-0.13	0.065	0.198		0.3		0	No	C
Dichlorobenzene			0/1	0%			0.41-0.41	0.205						No	B
Dichlorobromomethane			0/20	0%			0.0013-0.07	0.035	0.21		0.2		0	No	C
Dichloromethane (Methylene chloride)			3/20	15%	0.0066-0.007	ISD-204	0.003-0.87	0.435	0.018	0.4	24	0	1	No	A
Diethyl ether			0/1	0%			0.1-0.1	0.05						No	B
dimethyldisulfide			1/1	100%	0.02-0.02	DD-508-SD								Yes	G
Ethyl benzene			0/20	0%			0.0013-0.28	0.14	0.29		0.5		0	No	C
Freon-11			0/17	0%			0.003-0.37	0.185						No	B
Freon-113			0/16	0%			0.003-0.031	0.0155						No	B
Freon-12			0/16	0%			0.003-0.031	0.0155						No	B
Isopropylbenzene			0/16	0%			0.003-0.031	0.0155	0.035		0.4		0	No	C
m&p-Xylene			0/16	0%			0.003-0.031	0.0155						No	B
Methyl acetate			1/16	6%	0.0059-0.0059	DD-518-SD	0.003-0.031	0.0155						Yes	G
Methyl tertbutyl ether (MTBE)			0/16	0%			0.003-0.031	0.0155	0.304		0.1		0	No	C
Methylcyclohexane			1/16	6%	0.0036-0.0036	DD-519-SD	0.003-0.031	0.0155						Yes	G
o-Xylene			0/22	0%			0.0017-0.031	0.0155						No	B
sec-Butylbenzene			0/6	0%			0.00076-0.001	0.0006						No	B
Styrene			0/19	0%			0.0013-0.031	0.0155	0.126		0.1		0	No	C
Tentatively Identified Compounds			0/11	0%			0.003-0.03	0.015						No	B
tert-Butylbenzene			0/6	0%			0.00072-0.001	0.00055						No	B
Tetrachloroethene			1/20	5%	0.0051-0.0051	DD-519-SD	0.0013-0.24	0.12	0.05	0.1	2	0	1	No	A
Toluene			3/20	15%	0.0005-0.0007	ISD-202; ISD-204	0.003-0.21	0.105	0.01	0.1	11	0	2	No	A
trans-1,2-Dichloroethene			0/23	0%			0.00067-0.15	0.075	0.389		0.2		0	No	C

Table 8. Preliminary Ecological PCOPC Screening: Sediment

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (mg/kg)	Location of Max Detect	Range of DLs for ND (mg/kg)	Max Surrogate for ND (mg/kg)	Region 4 ESV (mg/kg)	Max Detected HQ	Max Surrogate HQ	# Detects > ESV	# Surrogate > ESV	PCOPC?	Basis
trans-1,3-Dichloropropene			0/19	0%			0.0013-0.09	0.045	0.0015		30		16	Yes	D
Trichloroethene			0/26	0%			0.00051-0.15	0.075	0.134		1		0	No	C
Vinyl chloride			1/26	4%	0.0033-0.0033	LSD-10	0.00057-0.43	0.215	0.482	0	0.4	0	0	No	A
Xylenes (unspecified)			0/1	0%			0.93-0.93	0.465						No	B
Energetics															
2,4-Dinitrotoluene			0/17	0%			0.19-8.3	4.15	0.29		14		6	Yes	D
2,6-Dinitrotoluene			0/17	0%			0.19-8.3	4.15	0.296		14		6	Yes	D
Pentaerythritol tetranitrate			0/1	0%			3.2-3.2	1.6						No	B
Trinitrophenylmethylnitramine			0/1	0%			0.321-0.32	0.1605						No	B
1,3,5-Trinitrobenzene			0/1	0%			0.401-0.4	0.2005	0.015		13		1	Yes	D
1,3-Dinitrobenzene			0/1	0%			0.449-0.45	0.2245	0.04		6		1	Yes	D
2,4,6-Trinitrotoluene			0/1	0%			0.369-0.37	0.1845	0.027		7		1	Yes	D
Hexahydro-1,3,5-trinitro-1,3,5-triazine			0/1	0%			0.321-0.32	0.1605	0.065		2		1	Yes	D
HMX			0/1	0%			0.353-0.35	0.1765	0.108		2		1	Yes	D
Nitroglycerin			0/1	0%			3.2-3.2	1.6	0.01		160		1	Yes	D

A: Max Detect HQ ≤ 1
B: Chemical lacks a screening value and was not detected
C: Surrogate HQ ≤ 1 for a chemical not detected in any sample
D: Surrogate HQ > 1 for a chemical not detected in any sample
E: Max Detect HQ > 1
F: Total concentration for a class of compounds is greater than the ESV for the class
G: Chemical is detected and no screening value is available
H: Chemical is detected and bioaccumulative with no wildlife ESV
I: Chemical is not detected and bioaccumulative with no wildlife ESV

BA: Bioaccumulative
DL: detection limit
ND: non-detect
Surrogate: 1/2 the maximum detection limit
ESV: ecological screening value
HQ: hazard quotient
Max Detect HQ: max detected concentration / SSL
Max Surrogate HQ: max surrogate concentration / SSL

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
Inorganics																	
Aluminum			9/19	47%	58-790	DD-514-SW	200-200	100	87		87	9	1	7	10	Yes	E
Antimony			2/33	6%	2-3.2	LSW-17-01	2-60	30	190	640	190	0	0.2	0	0	No	A
Arsenic			5/33	15%	2.1-4.4	DD-508-SW	2.1-10	5	150	50	50	0.1	0.1	0	0	No	A
Barium			19/19	100%	34-100	DD-508-SW			220		220	0.5		0	0	No	A
Beryllium			1/33	3%	0.17-0.17	ISW-203	0.13-5	2.5	11		11	0	0.2	0	0	No	A
Cadmium			2/42	5%	0.23-2.3	LSW-10	0.23-5	2.5	0.45		0.45	5	6	1	39	Yes	E
Calcium			19/19	100%	5100-130000	DD-513-SW			116000		116000	1		3	0	No	A
Chromium			14/42	33%	0.86-2.5	LSW-16-01	4.5-10	5								Yes	G
Cobalt			0/19	0%			50-50	25	19		19		1		19	No	C
Copper			20/42	48%	0.91-9.7	LSW-11	0.74-25	12.5	4.95		4.95	2	3	1	6	Yes	E
Cyanide			0/10	0%			10-10	5	5.2		5.2		1		0	No	C
Iron			18/19	95%	120-3400	DD-508-SW	100-100	50	1000		1000	3	0.1	11	0	Yes	E
Lead			11/42	26%	1.5-6.2	DD-514-SW	0.89-10	5	1.25		1.25	5	4	11	16	Yes	E
Magnesium			19/19	100%	1600-4200	DD-513-SW			82000		82000	0.1		0	0	No	A
Manganese			19/19	100%	16-710	RC-504-SW			93		93	8		16	0	Yes	E
Mercury	Aquatic	Y	1/42	2%	0.3-0.3	LSW-11	0.043-0.5	0.25	0.77		0.77	0.4	0.3	0	0	No	A
Mercury	Wildlife	Y	1/42	2%	0.3-0.3	LSW-11	0.043-0.5	0.25	0.0013		0.0013	231	192	1	41	Yes	E
Nickel			10/42	24%	1.3-14	LSW-6	1.09-40	20	28.9		28.9	0.5	0.7	0	0	No	A
Potassium			19/19	100%	2100-3200	DD-508-SW			53000		53000	0.1		0	0	No	A
Selenium		Y	3/33	9%	2.1-3.3	LSW-30	2.1-35	17.5	5		5	0.7	4	0	19	Yes	H
Silver			15/33	45%	2-7.9	LSW-29	1.1-10	5	0.06		0.06	132	83	15	18	Yes	E
Sodium			19/19	100%	3200-29000	DD-507-SW			680000		680000	0		0	0	No	A
Thallium			2/33	6%	1.7-3.6	ISW-203	3.6-25	12.5	6	0.47	0.47	8	27	2	31	Yes	E
Vanadium			10/19	53%	1.2-13	DD-513-SW	50-50	25	27		27	0.5	0.9	0	0	No	A
Zinc			18/42	43%	7.7-120	DD-508-SW	16-60	30	66		66	2	0.5	3	0	Yes	E
High Molecular Weight PAHs																	
Benzo(a)anthracene		Y	0/10	0%			5-5.6	2.8	4.7	0.018	0.018		156		10	No	I
Benzo(a)pyrene		Y	0/10	0%			5-5.6	2.8	0.06	0.018	0.018		156		10	No	I
Benzo(b)fluoranthene		Y	0/10	0%			5-5.6	2.8	2.6	0.018	0.018		156		10	No	I
Benzo(g,h,i)perylene		Y	0/10	0%			5-5.6	2.8	0.012		0.012		233		10	No	I
Benzo(k)fluoranthene		Y	0/10	0%			5-5.6	2.8	0.06	0.018	0.018		156		10	No	I
Chrysene		Y	0/10	0%			5-5.6	2.8	4.7	0.018	0.018		156		10	No	I
Dibenzo(a,h)anthracene		Y	0/10	0%			5-5.6	2.8	0.012	0.018	0.012		233		10	No	I
Fluoranthene		Y	0/10	0%			5-5.6	2.8	0.8	140	0.8		4		10	No	I
Indeno(1,2,3-cd)pyrene		Y	0/10	0%			5-5.6	2.8	0.012	0.018	0.012		233		10	No	I
Pyrene			0/10	0%			5-5.6	2.8	4.6	4000	4.6		0.6		0	No	C
Low Molecular Weight PAHs																	
2-Methylnaphthalene			0/10	0%			5-5.6	2.8	4.7		4.7		0.6		0	No	C
Acenaphthene			0/10	0%			5-5.6	2.8	15	900	15		0.2		0	No	C
Acenaphthylene			0/10	0%			5-5.6	2.8	13		13		0.2		0	No	C
Anthracene			0/10	0%			5-5.6	2.8	0.02	40000	0.02		140		10	Yes	D
Fluorene			0/10	0%			5-5.6	2.8	19	5300	19		0.1		0	No	C
Naphthalene			0/18	0%			5-5.6	2.8	21		21		0.1		0	No	C
Phenanthrene		Y	0/10	0%			5-5.6	2.8	2.3		2.3		1		10	No	I

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
Pesticides																	
Aldrin		Y	0/10	0%			0.05-0.05	0.025	0.04	0.00005	0.00005		500		10	No	I
alpha-BHC		Y	0/10	0%			0.05-0.05	0.025	0.01	0.0049	0.0049		5		10	No	I
alpha-Chlordane			0/10	0%			0.05-0.05	0.025								No	B
beta-BHC		Y	0/10	0%			0.05-0.05	0.025	0.01	0.017	0.01		3		10	No	I
delta-BHC			0/10	0%			0.05-0.05	0.025								No	B
Dieldrin	Aquatic	Y	0/10	0%			0.1-0.1	0.05	0.06	5.4E-05	0.000054		926		10	Yes	D
Dieldrin	Wildlife	Y	0/10	0%			0.1-0.1	0.05	0.06	5.4E-05	0.000054		926		10	Yes	D
Endosulfan I			0/10	0%			0.05-0.05	0.025	0.06	89	0.06		0.4		0	No	C
Endosulfan II			0/10	0%			0.1-0.1	0.05	0.06	89	0.06		0.8		0	No	C
Endosulfan sulfate			0/10	0%			0.1-0.1	0.05	0.06	89	0.06		0.8		0	No	C
Endrin		Y	0/10	0%			0.1-0.1	0.05	0.04	0.06	0.04		1		10	No	I
Endrin Aldehyde			0/10	0%			0.1-0.1	0.05		0.3						No	B
Endrin ketone			0/10	0%			0.1-0.1	0.05								No	B
gamma-BHC (Lindane)			0/10	0%			0.05-0.05	0.025								No	B
gamma-Chlordane			1/10	10%	0.15-0.15	DD-514-SW	0.05-0.05	0.025								Yes	G
Heptachlor		Y	0/10	0%			0.05-0.05	0.025	0.004	7.9E-05	0.000079		316		10	No	I
Heptachlor epoxide			0/10	0%			0.05-0.05	0.025	0.004	3.9E-05	0.000039		641		10	Yes	D
Methoxychlor		Y	0/10	0%			0.5-0.5	0.25	0.03	0.03	0.03		8		10	No	I
Toxaphene		Y	0/10	0%			5-5	2.5	0.0002	0.00028	0.0002		12500		10	No	I
DDD/DDE/DDT																	
4,4'-DDD		Y	0/10	0%			0.1-0.1	0.05	0.01	0.00031	0.00031		161		10	No	I
4,4'-DDE		Y	0/10	0%			0.1-0.1	0.05	0.3	0.00022	0.00022		227		10	No	I
4,4'-DDT	Aquatic	Y	0/10	0%			0.1-0.1	0.05	0.001	0.00022	0.00022		227		10	Yes	D
4,4'-DDT	Wildlife	Y	0/10	0%			0.1-0.1	0.05	0.001	0.00022	0.00022		227		10	Yes	D
PCBs																	
Aroclor 1016			0/24	0%			0.04-1	0.5								Yes	F
Aroclor 1221			0/24	0%			0.04-1	0.5								Yes	F
Aroclor 1232			0/24	0%			0.05-1	0.5								Yes	F
Aroclor 1242			0/24	0%			0.05-1	0.5								Yes	F
Aroclor 1248			3/24	13%	0.08-2.2		0.03-1	0.5								Yes	F
Aroclor 1254			0/24	0%			0.03-1	0.5								Yes	F
Aroclor 1260			0/24	0%			0.05-1	0.5								Yes	F
Aroclor 1262			0/10	0%			1-1	0.5								Yes	F
Aroclor 1268			0/10	0%			1-1	0.5								Yes	F
Total PCB		Y	3/24	13%		0.13 - 6.2		6.2	0.014		0.014		443	3	21	Yes	F
Total PCB	WIldlife	Y	3/24	13%		0.13 - 6.2		6.2	0.00012		0.00012		51667	3	24	Yes	F
SVOCs																	
1,1-Biphenyl			0/10	0%			5-5.6	2.8	6.5		6.5		0.4		0	No	C
1,2,4,5-Tetrachlorobenzene			0/10	0%			5-5.6	2.8	8.3		8.3		0.3		0	No	C
1,4-Dioxane			0/10	0%			100-100	50	2.2E+07		22000000		0		0	No	C
2,3,4,6-Tetrachlorophenol			0/10	0%			5-5.6	2.8	1		1		3		10	Yes	D
2,4,5-Trichlorophenol			0/10	0%			5-5.6	2.8	1.9		1.9		1		10	No	C
2,4,6-Trichlorophenol			0/10	0%			5-5.6	2.8	4.9	2.4	2.4		1		10	No	C
2,4-Dichlorophenol			0/10	0%			5-5.6	2.8	11	290	11		0.3		0	No	C
2,4-Dimethylphenol			0/10	0%			5-5.6	2.8	15	850	15		0.2		0	No	C

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
2,4-Dinitrophenol			0/10	0%			10-11	5.5	71	5300	71		0.1		0	No	C
2-Chloronaphthalene			0/10	0%			5-5.6	2.8		1600						No	B
2-Chlorophenol			0/10	0%			5-5.6	2.8	18	150	18		0.2		0	No	C
2-Methylphenol			0/10	0%			5-5.6	2.8	67		67		0		0	No	C
2-Nitroaniline			0/10	0%			10-11	5.5	17		17		0.3		0	No	C
2-Nitrophenol			0/10	0%			5-5.6	2.8	73		73		0		0	No	C
3,3'-Dichlorobenzidine			0/10	0%			5-5.6	2.8	4.5	0.028	0.028		100		10	Yes	D
3-Nitroaniline			0/10	0%			10-11	5.5								No	B
4,6-Dinitro-2-methylphenol			0/10	0%			10-11	5.5		280						No	B
4-Bromophenyl-phenylether			0/10	0%			5-5.6	2.8	1.5		1.5		2		10	Yes	D
4-Chloro-3-methylphenol			0/10	0%			5-5.6	2.8								No	B
4-Chloroaniline			0/10	0%			5-5.6	2.8	0.8		0.8		4		10	Yes	D
4-Chlorophenyl-phenylether			0/10	0%			5-5.6	2.8								No	B
4-Nitroaniline			0/10	0%			10-11	5.5								No	B
4-Nitrophenol			0/10	0%			10-11	5.5	58		58		0.1		0	No	C
Acetophenone			0/10	0%			5-5.6	2.8								No	B
Atrazine			0/10	0%			5-5.6	2.8	0.03		0.03		93		10	Yes	D
Benzaldehyde			0/10	0%			5-5.6	2.8	143		143		0		0	No	C
Bis(2-Chloro-1-methylethyl)Ether			0/10	0%			5-5.6	2.8		65000						No	B
bis(2-Chloroethoxy) methane			0/10	0%			5-5.6	2.8								No	B
bis(2-Chloroethyl) ether			0/10	0%			5-5.6	2.8		0.53						No	B
bis(2-Ethylhexyl) phthalate		Y	0/10	0%			5-5.6	2.8	8	2.2	2.2		1		10	No	I
Butylbenzylphthalate			0/10	0%			5-5.6	2.8	23	1900	23		0.1		0	No	C
Caprolactam			0/10	0%			5-5.6	2.8								No	B
Carbazole			0/10	0%			5-5.6	2.8	4		4		0.7		0	No	C
Dibenzofuran			0/10	0%			5-5.6	2.8	4		4		0.7		0	No	C
Diethylphthalate			0/10	0%			5-5.6	2.8	220	44000	220		0		0	No	C
Dimethylphthalate			0/10	0%			5-5.6	2.8	1100	1100000	1100		0		0	No	C
Di-n-butylphthalate			0/10	0%			5-5.6	2.8	19	4500	19		0.1		0	No	C
Di-n-octylphthalate			0/10	0%			5-5.6	2.8	215		215		0		0	No	C
Hexachlorobenzene	Aquatic	Y	0/10	0%			5-5.6	2.8	0.15	0.00029	0.00029		9655		10	Yes	D
Hexachlorobenzene	Wildlife	Y	0/10	0%			5-5.6	2.8	0.0003	0.00029	0.00029		9655		10	Yes	D
Hexachlorobutadiene	Aquatic	Y	0/18	0%			5-5.6	2.8	1	18	1		3		16	Yes	D
Hexachlorobutadiene	Wildlife	Y	0/18	0%			5-5.6	2.8	1	18	1		3		16	Yes	D
Hexachlorocyclopentadiene			0/10	0%			5-5.6	2.8	0.45	1100	0.45		6		10	Yes	D
Hexachloroethane			0/10	0%			5-5.6	2.8	12	3.3	3.3		0.8		0	No	C
Isophorone			0/10	0%			5-5.6	2.8	920	960	920		0		0	No	C
Nitrobenzene			0/10	0%			5-5.6	2.8	230	690	230		0		0	No	C
N-Nitroso-di-n-propylamine			0/10	0%			5-5.6	2.8								No	B
N-Nitrosodiphenylamine/Diphenylamine			0/10	0%			5-5.6	2.8	25	0.51	0.51		5		10	Yes	D
Pentachlorophenol		Y	0/10	0%			10-11	5.5	15	3	3		2		10	No	I
Phenol			0/10	0%			5-5.6	2.8	160	857000	160		0		0	No	C
3-Penten-2-ol			1/1	100%	70-70	DD-507-SW										Yes	G
Cresols, Total			0/10	0%			5-5.6	2.8								No	B
Prometon			2/2	100%	7-8	DD-507-SW										Yes	G

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
VOCs																	
1,1,1,2-Tetrachloroethane			0/8	0%			5-5	2.5	85		85		0		0	No	C
1,1,1-Trichloroethane			0/27	0%			1-5	2.5	76		76		0		0	No	C
1,1,2,2-Tetrachloroethane			2/27	7%	1-1.8	LSW-18-01	1-5	2.5	53	4	4	0.4	0.6	0	0	No	A
1,1,2-Trichloroethane			2/27	7%	1-1.3	LSW-18-01	1-5	2.5	730	16	16	0.1	0.2	0	0	No	A
1,1-Dichloroethane			1/26	4%	1-1	ISW-203	1-5	2.5	410		410	0	0	0	0	No	A
1,1-Dichloroethene			1/27	4%	1-1	ISW-203	1-5	2.5	130	7100	130	0	0	0	0	No	A
1,1-Dichloropropene			0/8	0%			5-5	2.5								No	B
1,2,3-Trichlorobenzene			0/18	0%			5-5	2.5	8		8		0.3		0	No	C
1,2,3-Trichloropropane			0/8	0%			5-5	2.5								No	B
1,2,4-Trichlorobenzene			0/18	0%			5-5	2.5	130	70	70		0		0	No	C
1,2,4-Trimethylbenzene			0/8	0%			5-5	2.5	15		15		0.2		0	No	C
1,2-Dibromo-3-chloropropane			0/18	0%			5-5	2.5								No	B
1,2-Dibromoethane			0/18	0%			5-5	2.5								No	B
1,2-Dichlorobenzene			0/18	0%			5-5	2.5	23	1300	23		0.1		0	No	C
1,2-Dichloroethane			0/26	0%			1-5	2.5	2000	37	37		0.1		0	No	C
1,2-Dichloropropane			2/27	7%	0.56-1	ISW-203	1-5	2.5	520	15	15	0.1	0.2	0	0	No	A
1,3,5-Trimethylbenzene			0/8	0%			5-5	2.5	26		26		0.1		0	No	C
1,3-Dichlorobenzene			0/18	0%			5-5	2.5	22	960	22		0.1		0	No	C
1,3-Dichloropropane			0/8	0%			5-5	2.5								No	B
1,3-Dichloropropene			0/2	0%			1-1	0.5		21						No	0
1,4-Dichlorobenzene			0/18	0%			5-5	2.5	9.4	190	9.4		0.3		0	No	C
2,2-Dichloropropane			0/8	0%			5-5	2.5								No	B
2-Butanone (MEK)			1/27	4%	5-5	ISW-203	2-100	50	22000		22000	0	0	0	0	No	A
2-Chlorotoluene			0/8	0%			5-5	2.5								No	B
2-Hexanone			3/27	11%	0.65-10	LSW-18-01	2-50	25	99		99	0.1	0.3	0	0	No	A
4-Chlorotoluene			0/8	0%			5-5	2.5								No	B
4-Methyl-2-pentanone			2/27	7%	0.61-5	LSW-17-01	2-50	25	170		170	0	0.1	0	0	No	A
Acetone			5/27	19%	5.5-10	LSW-17-01; LSW-18-01; LSW-19-01; LSW-22-01	2-100	50	1700		1700	0	0	0	0	No	A
Benzene			0/27	0%			1-5	2.5	160	51	51		0		0	No	C
Bromobenzene			0/8	0%			5-5	2.5								No	B
Bromochloromethane			0/18	0%			5-5	2.5								No	B
Bromoform			2/27	7%	0.94-1	ISW-203	1-5	2.5	230	140	140	0	0	0	0	No	A
Bromomethane			1/36	3%	1-1	ISW-203	0.49-10	5	16	1500	16	0.1	0.3	0	0	No	A
Carbon disulfide			5/27	19%	0.84-5	ISW-203	2-5	2.5	15		15	0.3	0.2	0	0	No	A
Carbon tetrachloride			0/27	0%			1-5	2.5	77	1.6	1.6		2		18	Yes	D
Chlorobenzene			1/27	4%	0.88-0.88	LSW-18-01	1-5	2.5	25	1600	25	0	0.1	0	0	No	A
Chloroethane			1/27	4%	1-1	ISW-203	1-10	5								Yes	G
Chloroform			0/27	0%			1-5	2.5	140	470	140		0		0	No	C
Chloromethane			1/25	4%	1-1	ISW-203	1-10	5								Yes	G
cis/trans1,2-Dichloroethene			5/9	56%	2.5-49	LSW-18-01	2-5	2.5								Yes	G
cis-1,2-Dichloroethene			5/27	19%	8.1-2000	SW-3	1.8-5	2.5	620		620	3	0	1	0	Yes	E
cis-1,3-Dichloropropene			1/27	4%	0.56-0.56	LSW-18-01	1-5	2.5	1.7		1.7	0.3	1	0	18	No	A

Table 9. Preliminary Ecological PCOPC Screening: Surface Water

Parameter	Note	BA	Detection Frequency	% Detects	Range of Detections (µg/L)	Location of Max Detect	Range of DLs for ND (µg/L)	Surrogate for ND (µg/L)	Region 4 ESV (µg/L)	Georgia ISWQS (µg/L)	Screening Level (µg/L)	Max Detected HQ	Max Surrogate HQ	# Detects > Screening Level	# Surrogate > Screening Level	PCOPC?	Basis
Cyclohexane			0/18	0%			5-10	5	158		158		0		0	No	C
Dibromochloromethane			0/27	0%			1-5	2.5	320	13	13		0.2		0	No	C
Dibromomethane			0/8	0%			5-5	2.5								No	B
Dichlorobromomethane			1/27	4%	1-1	ISW-203	1-5	2.5	340	17	17	0.1	0.1	0	0	No	A
Dichloromethane (Methylene chloride)			8/27	30%	5-10	LSW-17-01	5-5	2.5	1500	590	590	0	0	0	0	No	A
Ethyl benzene			1/27	4%	0.63-0.63	LSW-18-01	1-5	2.5	61	2100	61	0	0	0	0	No	A
Freon-11			0/18	0%			5-5	2.5								No	B
Freon-113			0/18	0%			5-10	5								No	B
Freon-12			0/18	0%			5-5	2.5								No	B
Isopropylbenzene			0/18	0%			5-5	2.5	4.8		4.8		0.5		0	No	C
m&p-Xylene			0/18	0%			5-10	5								No	B
Methyl acetate			0/18	0%			5-10	5								No	B
Methyl iodide			0/8	0%			5-5	2.5								No	B
Methyl tertbutyl ether (MTBE)			0/18	0%			5-5	2.5	730		730		0		0	No	C
Methylcyclohexane			0/18	0%			5-10	5	52		52		0.1		0	No	C
n-Butylbenzene			0/8	0%			5-5	2.5								No	B
n-Propylbenzene			0/8	0%			5-5	2.5								No	B
o-Xylene			0/18	0%			5-5	2.5								No	B
p-Isopropyltoluene			0/8	0%			5-5	2.5	16		16		0.2		0	No	C
sec-Butylbenzene			0/8	0%			5-5	2.5								No	B
Styrene			1/27	4%	0.83-0.83	LSW-18-01	1-5	2.5	32		32	0	0.1	0	0	No	A
Tentatively Identified Compounds			0/8	0%			5-5	2.5								No	B
tert-Butylbenzene			0/8	0%			5-5	2.5								No	B
Tetrachloroethene			1/26	4%	0.53-0.53	LSW-21-01	1-5	2.5	53	3.3	3.3	0.2	0.8	0	0	No	A
Toluene			1/27	4%	0.76-0.76	LSW-18-01	1-5	2.5	62	5980	62	0	0	0	0	No	A
trans-1,2-Dichloroethene			1/18	6%	9.2-9.2	SW-3	5-5	2.5	558	10000	558	0	0	0	0	No	A
trans-1,3-Dichloropropene			1/25	4%	0.52-0.52	LSW-18-01	1-5	2.5	1.7		1.7	0.3	1	0	18	No	A
trans-1,4-Dichloro-2-butene			0/8	0%			100-100	50								No	B
Trichloroethene			11/36	31%	1-1600	SW-3	0.42-5	2.5	220	30	30	53	0.1	7	0	Yes	E
Vinyl acetate			0/8	0%			50-50	25	16		16		2		8	Yes	D
Vinyl chloride			7/27	26%	1-140	SW-3	1-5	2.5	930	2.4	2.4	58	1	4	9	Yes	E
Xylenes (unspecified)			2/7	29%	0.73-5	LSW-18-01	1-1	0.5								Yes	G
Energetics																	
2,4-Dinitrotoluene			0/10	0%			5-5.6	2.8	44	3.4	3.4		0.8		0	No	C
2,6-Dinitrotoluene			0/10	0%			5-5.6	2.8	81		81		0		0	No	C
Acrylonitrile			0/8	0%			200-200	100	78	0.25	0.25		400		8	Yes	D

A: Max Detect HQ ≤ 1
B: Chemical lacks a screening value and was not detected
C: Surrogate HQ ≤ 1 for a chemical not detected in any sample
D: Surrogate HQ > 1 for a chemical not detected in any sample
E: Max Detect HQ > 1
F: Total concentration for a class of compounds is greater than the ESV for the class
G: Chemical is detected and no screening value is available
H: Chemical is detected and bioaccumulative with no wildlife ESV
I: Chemical is not detected and bioaccumulative with no wildlife ESV

BA: Bioaccumulative
DL: detection limit
ND: non-detect
Surrogate: 1/2 the maximum detection limit
ESV: ecological screening value
ISWQS: In-stream Water Quality Standard
HQ: hazard quotient
Max Detect HQ: max detected concentration / SSL
Max Surrogate HQ: max surrogate concentration / SSL
Screening Level: Lesser of Region 4 ESV and Georgia Instream Water Quality Standard.

Table 10. Refined Ecological COPC Screening: Soil

Parameter	BA	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Soil Mammalian Screening Level (mg/kg)	Soil Avian Screening Level (mg/kg)	Soil Plants Screening Level (mg/kg)	Soil Inverte-brates Screening Level (mg/kg)	RSV (mg/kg)	RSV Source	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis	
Inorganics																		
Aluminum		100%	15/15	15000												N	A	
Antimony		61%	27/44	29.6	0.27		5	78	0.27	Mammal	27/44	110	25%	3.8	14	COPC	H	
Arsenic		98%	44/45	83.4	46	43	18	6.8	46	Mammal	1/45	2	0%	6.2	0.1	N	G	
Cadmium		89%	41/46	156	0.36	0.77	32	140	0.36	Mammal	41/46	433	2%	90	250	COPC	H	
Calcium		100%	15/15	43000												N	A	
Chromium		100%	47/47	337	63	23			63	Mammal	5/47	5	0%	76	1	N	G	
Copper		100%	46/46	4420	49	28	70	80	49	Mammal	24/46	90	0%	641	13	COPC	H	
Cyanide		7%	1/15	1.5	330	0.098			330	Mammal	0/15	0	0%			N	D	
Iron		100%	15/15	31000												N	A	
Lead		100%	47/47	2900	56	11	120	1700	56	Mammal	29/47	52	0%	226	4	COPC	H	
Magnesium		100%	15/15	8000												N	A	
Manganese		100%	15/15	3600	4000	4300	220	450	4000	Mammal	0/15	1	0%			N	D	
Mercury	Y	77%	36/47	3.9	1.7	0.013	0.3	0.05	1.7	Mammal	8/47	2	0%	1.1	1	N	G	
Nickel		100%	46/46	490	130	210	38	280	130	Mammal	2/46	4	0%	77	1	N	G	
Potassium		87%	13/15	1700												N	A	
Selenium	Y	60%	28/47	7.2	0.63	1.2	0.52	4.1	0.63	Mammal	23/47	11	23%	1.7	3	COPC	H	
Silver		43%	20/47	160	14	4.2	560		14	Mammal	1/47	11	0%	19	1	N	G	
Sodium		100%	15/15	390												N	A	
Thallium		2%	1/44	0.51	0.42	4.5	0.05		0.42	Mammal	1/44	1	64%			N	D	
Vanadium		100%	15/15	50	280	7.8	60		280	Mammal	0/15	0.2	0%			N	D	
Zinc		98%	45/46	6580	79	46	160	120	79	Mammal	37/46	83	0%	547	7	COPC	H	
High Molecular Weight PAHs																		
Benzo(a)anthracene		29%	13/45	6.69	3.4	0.73	18	4.69	3.4	Mammal	2/45	2	29%	1.3	0.4	N	G	
Benzo(a)pyrene		31%	13/42	11.6	62			0.13	62	Mammal	0/42	0.2	0%			N	D	
Benzo(b)fluoranthene		28%	13/47	4.78	44		18	2.7	44	Mammal	0/47	0.1	0%			N	D	
Benzo(g,h,i)perylene		32%	15/47	11.4	25			0.07	25	Mammal	0/47	0.5	0%			N	D	
Benzo(k)fluoranthene		22%	10/45	9.26	71			0.13	71	Mammal	0/45	0.1	0%			N	D	
Chrysene		32%	15/47	10.2	3.1			5.18	3.1	Mammal	3/47	3	28%	1.8	1	N	G	
Dibenzo(a,h)anthracene		16%	7/45	1.3	14			0.06	14	Mammal	0/45	0.1	11%			N	D	
Fluoranthene		22%	10/45	12.6	22			10	22	Mammal	0/45	1	2%			N	D	
Indeno(1,2,3-cd)pyrene		24%	11/45	1.6	71			0.08	71	Mammal	0/45	0	0%			N	D	
Pyrene		23%	11/47	12.1	22	34		10	22	Mammal	0/47	1	2%			N	D	
Benzo(e)pyrene		38%	3/8	1.43				0.25	0.25	Invertebrates	3/8	6	25%	1.2	5	COPC	H	
Perylene		50%	2/4	1.07				0.17	0.17	Invertebrates	2/4	6	0%	1.07	6	COPC	H	*
Total HMWPAH		19%	19/47	232	1.1			18	1.1	Mammal	17/47	211	53%	14	13	COPC	H	
Low Molecular Weight PAHs																		
2-Methylnaphthalene		0%	0/15		16			0.11	16	Mammal			0%			N	C	
Acenaphthene		0%	0/45		120		0.25	0.38	120	Mammal			0%			N	C	
Acenaphthylene		2%	1/45	0.095	120			0.34	120	Mammal	0/45	0	0%			N	D	
Anthracene		7%	3/45	0.32	210		6.8	0.0015	210	Mammal	0/45	0	0%			N	D	
Fluorene		0%	0/44		250			3.7	250	Mammal			0%			N	C	
Naphthalene		2%	1/45	4.08	9.7	5.7	1	0.16	9.7	Mammal	0/45	0.4	16%			N	D	
Phenanthrene		19%	9/47	1	11			5.5	11	Mammal	0/47	0.1	13%			N	D	
Total LMWPAH		21%	10/47	139	100			29	100	Mammal	0/47	1	4%			N	D	

Table 10. Refined Ecological COPC Screening: Soil

Parameter	BA	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Soil Mammalian Screening Level (mg/kg)	Soil Avian Screening Level (mg/kg)	Soil Plants Screening Level (mg/kg)	Soil Inverte-brates Screening Level (mg/kg)	RSV (mg/kg)	RSV Source	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
Pesticides																	
alpha-Chlordane	Y	33%	5/15	0.0093	0.27	0.27	2.2	0.0029	0.27	Avian	0/15	0	0%			N	D
beta-BHC	Y	7%	1/15	0.016	0.27			0.0003	0.27	Mammal	0/15	0.1	0%			N	D
Dieldrin	Y	13%	2/15	0.003	0.0049	0.022	10	0.0029	0.0049	Mammal	0/15	1	20%			N	D
Endosulfan I		0%	0/15		0.119			0.0009	0.119	Mammal			0%			N	C
Endosulfan II		0%	0/15		0.64	15		0.0009	0.64	Mammal			0%			N	C
Endosulfan sulfate		13%	2/15	0.045	0.036			0.0007	0.036	Mammal	1/15	1	0%			N	D
Endrin	Y	13%	2/15	0.0011	0.023	0.0014	0.0034	0.0019	0.023	Mammal	0/15	0	0%			N	D
Endrin Aldehyde		20%	3/15	0.013												N	A
Endrin ketone		7%	1/15	0.0032												N	A
gamma-Chlordane	Y	73%	11/15	0.15	2.3	2.2	2.2	0.02	2.3	Mammal	0/15	0.1	0%			N	D
Heptachlor	Y	7%	1/15	0.001	0.059	0.3	0.4	0.0016	0.059	Mammal	0/15	0	0%			N	D
Heptachlor epoxide		13%	2/15	0.0014	0.152			0.00015	0.152	Mammal	0/15	0	0%			N	D
DDD/DDE/DDT																	
4,4'-DDD		13%	2/15	0.0065	0.044	0.36			0.044	Mammal	0/15	0.1	0%			N	D
4,4'-DDE		40%	6/15	0.081	3.7	0.11			3.7	Mammal	0/15	0	0%			N	D
4,4'-DDT		27%	4/15	0.086	4.1	0.0063			4.1	Mammal	0/15	0	0%			N	D
Total DDD/DDE/DDT		47%	7/15	0.17	0.021	0.093			0.021	Mammal	4/15	8	7%	0.051	2	COPC	H
PCBs																	
Aroclor 1016		5%	2/44	1.38	1				1	Mammal	1/44	1	0%			N	D
Aroclor 1221		0%	0/44													N	A
Aroclor 1232		5%	2/44	3.54												N	A
Aroclor 1242		5%	2/44	2.76	0.38	0.041			0.38	Mammal	2/44	7	2%			N	F
Aroclor 1248		68%	30/44	42.7	0.0072	0.041			0.0072	Mammal	30/44	5931	23%	7.2	1000	COPC	H
Aroclor 1254		27%	12/44	4	0.44	0.041			0.44	Mammal	7/44	9	2%	0.62	1	N	G
Aroclor 1260		18%	8/44	1.08	10	0.88			10	Mammal	0/44	0.1	0%			N	D
Aroclor 1262		0%	0/15													N	A
Aroclor 1268		0%	0/15													N	A
1,1'-Biphenyl, 2',3,4,5,5'-Pentachloro-		0%	0/1													N	A
1,1'-Biphenyl, 2,3',4',5-tetrachloro-		100%	1/1	0.5												N	A
1,1'-Biphenyl, 2,3',4',6-tetrachloro-		0%	0/1													N	A
1,1'-Biphenyl, 2',3,4-trichloro-		0%	0/1													N	A
1,1'-Biphenyl, 3,3',5,5'-tetrachloro-		0%	0/1													N	A
Total PCBs		84%	37/44	47	0.371	0.041	40	0.33	0.371	Mammal	23/44	127	0/44	8.7	23	COPC	H
SVOCs																	
(Z,Z)-9,12-Octadecadienoic acid		100%	1/1	0.3												N	A
6-methyl-Chrysene		100%	1/1	0.4												N	A
1,1-Biphenyl		0%	0/15				60	0.2	60	Plants			0%			N	C
1,2,3,5,6,8a-hexahydro-4,7-Naphthalene		100%	1/1	0.258												N	A
1,2,4,5-Tetrachlorobenzene		0%	0/15		2.02			0.18	2.02	Mammal			20%			N	C
1-chloro-Heptacosane		100%	1/1	0.7												N	A
1-Eicosanol		100%	1/1	0.21												N	A
1-methyl-Chrysene		50%	1/2	4.16												N	A
1-Tricosene		100%	1/1	0.3												N	A
2,3,4,6-Tetrachlorophenol		0%	0/15		0.2			0.04	0.2	Mammal			40%			PCOPC	B

Table 10. Refined Ecological COPC Screening: Soil

Parameter	BA	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Soil Mammalian Screening Level (mg/kg)	Soil Avian Screening Level (mg/kg)	Soil Plants Screening Level (mg/kg)	Soil Inverte-brates Screening Level (mg/kg)	RSV (mg/kg)	RSV Source	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
2,4-Dichlorophenol		0%	0/16		87.5			0.05	87.5	Mammal			0%			N	C
2,4-Dimethylphenol		0%	0/16					0.04	0.04	Invertebrates			100%			PCOPC	B
2,4-Dinitrophenol		0%	0/15		0.061		20	0.15	0.061	Mammal			100%			PCOPC	B
24-methyl-5-Cholestene-3-ol		100%	1/1	0.3												N	A
2-Chlorophenol		0%	0/16		0.54	0.39		0.06	0.54	Mammal			31%			PCOPC	B
2-Methyl Decalin		50%	1/2	0.008												N	A
2-Methylphenol		0%	0/15		580		0.67	0.1	580	Mammal			0%			N	C
2-methyl-Triphenylene		50%	2/4	0.704												N	A
2-Nitroaniline		0%	0/15		5.3			0.02	5.3	Mammal			20%			N	C
3,3'-Dichlorobenzidine		0%	0/16		0.646			0.03	0.646	Mammal			31%			PCOPC	B
3-methyl-Benz[j]aceanthrylene		50%	2/4	5.08												N	A
3-methyl-Perylene		100%	1/1	0.3												N	A
3-Nitrophthalic acid		100%	1/1	1.52												N	A
4-Chloroaniline		0%	0/15		1.1		1	1.8	1.1	Mammal			33%			PCOPC	B
4-Nitrophenol		0%	0/16		5.12			7	5.12	Mammal			19%			N	C
5,8-dimethyl-Benzo[c]phenanthrene		33%	1/3	0.49												N	A
6,13-dihydro-Pentacene		100%	1/1	3												N	A
7-methyl-Benz[a]anthracene		100%	1/1	4												N	A
Acetophenone		7%	1/15	0.082												N	A
Atrazine		0%	0/15					0.00005	0.00005	Invertebrates			100%			PCOPC	B
Benzaldehyde		7%	1/15	0.16												N	A
bis(2-Ethylhexyl) phthalate	Y	45%	9/20	83	0.6	0.02		8.4	0.6	Mammal	8/20	138	20%	28	47	COPC	H
Butylbenzylphthalate		0%	0/16		90			0.59	90	Mammal			0%			N	C
Campesterol		100%	1/1	0.3												N	A
Carbazole		0%	0/15		79			0.07	79	Mammal			0%			N	C
Cholesterol		100%	1/1	0.4												N	A
Cinnamyl cinnamate		100%	2/2	22.1												N	A
Copaene		100%	1/1	0.955												N	A
Cresols, Total		7%	1/15	3.4												N	A
Cyclopropanenonanoic acid, 2-[(2-butylcy		100%	1/1	6.45												N	A
Dibenzofuran		0%	0/15				6.1	0.15	6.1	Plants			0%			N	C
Diethylphthalate		0%	0/16		3600		100	0.25	3600	Mammal			0%			N	C
Dimethylphthalate		0%	0/16		38			10	38	Mammal			0%			N	C
Di-n-butylphthalate		0%	0/18		180	0.011	160	0.22	180	Mammal			0%			N	C
Dotriacontane		100%	1/1	0.228												N	A
Friedelan-3-one		100%	2/2	3												N	A
Gamma-Muurolene		100%	1/1	3.08												N	A
Heptadecanoic Acid		100%	1/1	0.4												N	A
Hexachlorocyclopentadiene		0%	0/15		0.755		10	0.001	0.755	Mammal			33%			PCOPC	B
Hexachloroethane		0%	0/16		0.6			0.024	0.6	Mammal			31%			PCOPC	B
Hexadecanoic Acid		100%	4/4	4												N	A
m-Terphenyl		100%	1/1	1												N	A
Nitrobenzene		0%	0/16		4.8			2.2	4.8	Mammal			0%			N	C
N-Nitrosodiphenylamine/Diphenylamine		0%	0/15		0.545			20	0.545	Mammal			33%			PCOPC	B
Nonadecane		50%	1/2	0.199												N	A
Octadecanoic Acid		100%	2/2	0.3												N	A

Table 10. Refined Ecological COPC Screening: Soil

Parameter	BA	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Soil Mammalian Screening Level (mg/kg)	Soil Avian Screening Level (mg/kg)	Soil Plants Screening Level (mg/kg)	Soil Inverte-brates Screening Level (mg/kg)	RSV (mg/kg)	RSV Source	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
Oleic Acid		100%	2/2	0.9												N	A
o-Terphenyl		100%	1/1	0.4												N	A
Pentadecanoic acid		100%	1/1	0.8												N	A
Pentatriacontane		100%	1/1	0.173												N	A
Petroleum Hydrocarbons		100%	1/1	207												N	A
Phenol		0%	0/16		37		0.79	1.8	37	Mammal			0%			N	C
p-Terphenyl		100%	2/2	3												N	A
Stigmast-4-en-3-one		100%	2/2	4												N	A
Terpinolene		100%	1/1	0.253												N	A
Z-11-Hexadecenoic acid		100%	1/1	0.6												N	A
VOCs																	
1,1,1-Trichloroethane		0%	0/42		260			0.04	260	Mammal			0%			N	C
1,1-Dichloroethene		0%	0/42		11			0.04	11	Mammal			0%			N	C
1,2,4-Trimethylbenzene Isomer		100%	1/1	0.0089												N	A
3-Methylpentane		100%	1/1	0.0649												N	A
4-Methyl-2-pentanone		2%	1/42	0.0016												N	A
alpha-Pinene		100%	1/1	0.0741												N	A
Benzene, 1-phenyl-4-(2-cyano-2-phenyleth		100%	1/1	0.0527												N	A
Bromoform		0%	0/42		15.9			0.07	15.9	Mammal			0%			N	C
Bromomethane		0%	0/44		0.24			0.002	0.24	Mammal			2%			N	C
Camphene		100%	2/2	0.0458												N	A
Carbon disulfide		10%	4/42	0.105	0.81			0.005	0.81	Mammal	0/42	0.1	0%			N	D
Carbon tetrachloride		0%	0/42		2.98			0.05	2.98	Mammal			0%			N	C
Chloromethane		3%	1/39	0.0357												N	A
cis/trans1,2-Dichloroethene		4%	1/25	0.294	24			0.04	24	Mammal	0/25	0	0%			N	D
Ethyl-dimethylbenzene Isomer		100%	1/1	9.48												N	A
Freon-113		21%	4/19	0.115												N	A
Methylcyclopentane		100%	2/2	0.153												N	A
n-Hexane		100%	3/3	0.0632				0.007	0.007	Invertebrates	3/3	9	0%			N	J
sec-Butylbenzene		50%	1/2	0.019												N	A
tert-Butylbenzene		50%	1/2	0.015												N	A
Tetrachloroethene		0%	0/41		0.18		10	0.06	0.18	Mammal			2%			N	C
Tetramethyl Benzene Isomer		100%	1/1	15.5												N	A
Xylenes (unspecified)		11%	3/27	0.834												N	A

Table 10. Refined Ecological COPC Screening: Soil

Parameter	BA	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Soil Mammalian Screening Level (mg/kg)	Soil Avian Screening Level (mg/kg)	Soil Plants Screening Level (mg/kg)	Soil Inverte-brates Screening Level (mg/kg)	RSV (mg/kg)	RSV Source	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
Energetics																	
Pentaerythritol tetranitrate		0%	0/1		100			2.2	100	Mammal			0%			N	C
Trinitrophenylmethylnitramine		0%	0/1		1.5		25	0.018	1.5	Mammal			0%			N	C
1,3,5-Trinitrobenzene		0%	0/1				0.3	10	0.3	Plants			100%			PCOPC	B
1,3-Dinitrobenzene		0%	0/1		0.072	0.079		0.034	0.072	Mammal			100%			PCOPC	B

A: No RSV
B: Not detected and > 25% detection limits above the RSV
C: Not detected and ≤ 25 % detection limits above the RSV
D: Max HQ < RSV
E: Nutrient
F: ≤ 5% detected
G: 95% UCL HQ ≤ 1
H: 95% UCL HQ > 1
I: Part of a group
J: Eliminated as COPC. Not a COPC in other media or for human health. Only 3 samples collected. Very few soil benchmarks are available for n-Hexane.

BA: bioaccumulative
DL: detection limit ND: non-detect
RSV: Refinement ecological screening value
RSV hierarchy: Mammal, Avian, Plants, Invertebrates
Max Detect HQ: max detected concentration / RSV
95%UCL: recommended value from ProUCL
95%UCL: 95%UCL / RSV
* Used maximum detected concentration instead of 95% UCL either due to small number of detects or 95% UCL being higher than the maximum

Table 11. Refined Ecological COPC Screening: Sediment

Parameter	Note	Bio-accumulative	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Region 4 RSV (mg/kg)	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
Inorganics													
Antimony			38%	15/39	6.2	25	0/39	0.2	0%			N	D
Barium			100%	17/17	300	60	10/17	5	0%	129	2	COPC	H
Beryllium			75%	33/44	2							N	A
Cadmium			70%	32/46	15	5	13/46	3	0%	5.9	1	N	G
Calcium			100%	16/16	11000							N	A
Copper			98%	44/45	107	149	0/45	1	0%			N	D
Iron			100%	16/16	35000	40000	0/16	1	0%			N	D
Lead			100%	46/46	110	128	0/46	1	0%			N	D
Magnesium			100%	16/16	1700							N	A
Manganese			100%	16/16	5800	1100	5/16	5	0%	5093	5	COPC	H
Mercury	Aquatic	Y	55%	28/51	3	1.1	4/51	3	0%	0.66	1	N	G
Mercury	Wildlife	Y	55%	28/51	3	0.17	14/51	18	4%	0.66	4	COPC	H
Potassium			100%	16/16	750							N	A
Selenium	Aquatic	Y	30%	14/46	4.2	2.9	2/46	1	17%	1	0.3	N	D
Selenium	Wildlife	Y	30%	14/46	4.2	1.2	6/46	4	35%	1	1	N	G
Sodium			100%	16/16	260							N	A
Thallium			10%	4/39	2.2							N	A
Vanadium			94%	15/16	57							N	A
Zinc			100%	45/45	390	459	0/45	1	0%			N	D
High Molecular Weight PAHs													
Benzo(a)anthracene		Y	43%	17/40	2.68							N	A
Benzo(a)pyrene		Y	49%	21/43	6.6							N	A
Benzo(b)fluoranthene		Y	39%	18/46	3.11							N	A
Benzo(g,h,i)perylene		Y	48%	22/46	7.1							N	A
Benzo(k)fluoranthene		Y	25%	10/40	0.831							N	A
Chrysene		Y	43%	20/46	4.82							N	A
Dibenzo(a,h)anthracene		Y	23%	9/40	0.943							N	A
Fluoranthene		Y	33%	13/40	1.39							N	A
Indeno(1,2,3-cd)pyrene		Y	35%	14/40	1.8							N	A
Pyrene			37%	17/46	4.45							N	A
Benzo(e)pyrene			80%	4/5	6.34	0.967	4/5	7	0%	4.9	5	COPC	H
Perylene			100%	4/4	7	0.967	2/4	7	0%	6.1	6	COPC	H
Total HMWPAH			51%	24/47	60	1	19/47	60	23%	9.5	10	COPC	I
Low Molecular Weight PAHs													
2-Methylnaphthalene			0%	0/16								N	A
Acenaphthene			3%	1/39	0.056							N	A
Acenaphthylene			5%	2/40	0.067							N	A
Anthracene			13%	5/40	0.17							N	A
Fluorene			0%	0/40								N	A
Naphthalene			0%	0/40								N	A
Phenanthrene		Y	22%	10/46	0.72							N	A
Total LMWPAH			24%	11/46	36	0.6	3/46	60	46%	2.2	4	COPC	H

Table 11. Refined Ecological COPC Screening: Sediment

Parameter	Note	Bio-accumulative	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Region 4 RSV (mg/kg)	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis	
Pesticides														
alpha-BHC		Y	0%	0/16		0.006			0%			N	C	
alpha-Chlordane			25%	4/16	0.027							N	A	
beta-BHC	Aquatic	Y	13%	2/16	0.022	0.0072	1/16	3	0%	0.01	1	N	G	
beta-BHC	Wildlife		13%	2/16	0.022	1.5	0/16	0	0%			N	D	
Dieldrin		Y	6%	1/16	0.12	0.062	1/16	2	0%	0.12	2	N	J	*
Dieldrin	Wildlife	Y	6%	1/16	0.12	0.01	1/16	12	0%	0.12	12	N	J	*
Endosulfan I			0%	0/16		0.001			88%			PCOPC	B	
Endosulfan II			6%	1/16	0.0021	0.0009	1/16	2	94%	0.0021	2	COPC	H	*
Endosulfan sulfate			6%	1/16	0.014	0.0007	1/16	20	94%	0.014	20	COPC	H	*
Endrin		Y	13%	2/16	0.017	0.207	0/16	0.1	0%			N	D	
Endrin	Wildlife	Y	13%	2/16	0.017	0.018	0/16	1	0%			N	D	
Endrin Aldehyde			0%	0/16								N	A	
Endrin ketone			0%	0/16								N	A	
gamma-BHC (Lindane)			13%	2/16	0.0085							N	A	
gamma-Chlordane			56%	9/16	0.094							N	A	
Heptachlor		Y	0%	0/16		0.075			0%			N	C	
Methoxychlor		Y	25%	4/16	0.024	0.059	0/16	0.4	0%			N	D	
Toxaphene		Y	0%	0/16		0.032			100%			PCOPC	B	
DDD/DDE/DDT														
4,4'-DDD		Y	13%	2/16	0.034	0.0085	1/16	4	0%	0.016	2	COPC	H	
4,4'-DDE		Y	19%	3/16	0.23	0.0068	2/16	34	6%	0.053	8	COPC	H	
4,4'-DDT		Y	31%	5/16	0.21	0.007	5/16	30	6%	0.05	7	COPC	H	
Total DDD/DDE/DDT			38%	6/16	0.47	0.572	0/16	1	0%	0.21	0.4	N	D	
PCBs														
Aroclor 1016			0%	0/39								N	A	
Aroclor 1221			0%	0/39								N	A	
Aroclor 1232			0%	0/39								N	A	
Aroclor 1242			0%	0/39								N	A	
Aroclor 1248			64%	25/39	14							N	A	
Aroclor 1254			10%	4/39	2							N	A	
Aroclor 1260			8%	3/39	0.75							N	A	
Aroclor 1262			0%	0/16								N	A	
Aroclor 1268			0%	0/16								N	A	
1,1'-Biphenyl, 2,2',3,4-tetrachloro-			100%	1/1	2							N	A	
1,1'-Biphenyl, 2,3',4',5-tetrachloro-			100%	1/1	2							N	A	
1,1'-Biphenyl, 2,3,4',6-tetrachloro-			100%	2/2	2							N	A	
1,1'-Biphenyl, 2,3',5,5'-tetrachloro-			100%	2/2	1							N	A	
PCB congener 28			100%	1/1	1							N	A	
Total PCBs			67%	26/39	21	0.0598	26/39	351	8%	4	67	COPC	I	
Total PCBs	Wildlife		67%	26/39	21	0.014	26/39	1500	8%	4	286	COPC	I	

Table 11. Refined Ecological COPC Screening: Sediment

Parameter	Note	Bio-accumulative	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Region 4 RSV (mg/kg)	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
SVOCs													
6-methyl-Chrysene			100%	4/4	6							N	A
[(dodecyloxy)methyl]-Oxirane			100%	1/1	0.4							N	A
1,1-Biphenyl			0%	0/16		1.494			19%			N	C
1,2,4,5-Tetrachlorobenzene			0%	0/16		0.135			63%			PCOPC	B
1-[2-(hexadecyloxy)ethoxy]-Octadecane			100%	1/1	0.7							N	A
11H-Indeno[2,1-a]phenanthrene			100%	1/1	2							N	A
1-chloro-Heptacosane			100%	1/1	0.4							N	A
1-Heneicosyl formate			100%	1/1	0.5							N	A
1-Hexadecene			100%	1/1	0.2							N	A
1-methyl-Benz[a]anthracene			100%	3/3	1							N	A
1-methyl-Chrysene			100%	4/4	4							N	A
1-methyl-Pyrene			100%	2/2	4							N	A
2,3,4,6-Tetrachlorophenol			0%	0/16		0.948			19%			N	C
2,4,5-Trichlorophenol			0%	0/17		1.964			6%			N	C
2,4,6-Trichlorophenol			0%	0/17		1.964			6%			N	C
2,4-Dichlorophenol			0%	0/17		1.886			12%			N	C
2,4-Dimethylphenol			0%	0/17		1.437			18%			N	C
2,4-Dinitrophenol			0%	0/16		2.961			19%			N	C
28-Nor-17.alpha.(H)-hopane			100%	1/1	3							N	A
2-Chlorophenol			0%	0/17		0.55			24%			N	C
2-methyl-Chrysene			100%	2/2	2.16							N	A
2-Methylphenol			0%	0/16		1.773			19%			N	C
2-methyl-Triphenylene			100%	3/3	3							N	A
2-Nitrophenol			0%	0/17		3.589			6%			N	C
3,3'-Dichlorobenzidine			0%	0/17		0.09			94%			PCOPC	B
3,4:8,9-Dibenzopyrene			100%	1/1	0.2							N	A
3,6-dimethyl-Phenanthrene			100%	1/1	0.4							N	A
3-methyl-Benz[j]aceanthrylene			100%	1/1	4							N	A
3-methyl-Chrysene			100%	1/1	0.5							N	A
3-methyl-Perylene			100%	5/5	8							N	A
4,6-Dinitro-2-methylphenol			0%	0/17		2.304			18%			N	C
4-Bromophenyl-phenylether			0%	0/17		0.062			94%			PCOPC	B
4-Chloro-3-methylphenol			0%	0/17		2.035			6%			N	C
4-Chloroaniline			0%	0/16		0.021			100%			PCOPC	B
4-Chlorophenyl-phenylether			0%	0/17								N	A
4-methyl-Pyrene			100%	1/1	0.3							N	A
4-Nitrophenol			0%	0/17		4.105			6%			N	C
5,6-dihydro-Dibenz[a,h]anthracene			100%	1/1	5							N	A
5,8-dimethyl-Benzo[c]phenanthrene			100%	6/6	8.55							N	A
5-Methylchrysene			100%	1/1	4							N	A
6,13-dihydro-Pentacene			100%	1/1	0.4							N	A
7H-Benz[de]anthracen-7-one			100%	1/1	0.4							N	A

Table 11. Refined Ecological COPC Screening: Sediment

Parameter	Note	Bio-accumulative	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Region 4 RSV (mg/kg)	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis	
9-methyl-Anthracene			100%	1/1	0.3							N	A	
Acetophenone			38%	6/16	0.5							N	A	
Atrazine			0%	0/16		0.089			100%			PCOPC	B	
Benzaldehyde			31%	5/16	1.3	0.58	2/16	2	19%	0.42	1	N	G	
Benzo[b]naphtho[2,3-d]furan			100%	1/1	0.5							N	A	
Benzo[j]fluoranthene			100%	1/1	2							N	A	
bis(2-Ethylhexyl) phthalate		Y	30%	7/23	13	2.6	3/23	5	4%	3.4	1	N	G	
Butylbenzylphthalate			0%	0/17		0.481			24%			N	C	
Campesterol			100%	1/1	0.5							N	A	
Carbazole			19%	3/16	0.12	4.561	0/16	0	0%	0.12	0	N	D	X
Cholesterol			100%	2/2	2.02							N	A	
Cinnamyl cinnamate			100%	1/1	0.6							N	A	
Dibenzofuran			0%	0/16		2.313			6%			N	C	
Diethylphthalate			0%	0/17		1.105			18%			N	C	
Diethyltoluamide			100%	1/1	3							N	A	
Dimethylphthalate			0%	0/17		2.031			6%			N	C	
Di-n-butylphthalate			0%	0/23		0.319			22%			N	C	
Di-n-octylphthalate			0%	0/17		1.1			18%			N	C	
Heneicosane			100%	1/1	1.12							N	A	
Hexachlorobenzene		Y	0%	0/17		0.24			41%			PCOPC	B	
Hexachlorobutadiene		Y	0%	0/17								N	A	
Hexachlorocyclopentadiene	Aquatic		0%	0/16		0.81			19%			N	C	
Hexachlorocyclopentadiene	Wildlife		0%	0/16		0.069			100%			PCOPC	B	
Hexachloroethane			0%	0/17		0.075			94%			PCOPC	B	
Hexadecanoic Acid			100%	1/1	0.8							N	A	
Isophorone			0%	0/17		0.948			18%			N	C	
m-Terphenyl			100%	1/1	0.5							N	A	
Nitrazepam			100%	2/2	2							N	A	
Nitrobenzene			0%	0/17		9.007			0%			N	C	
N-Nitrosodiphenylamine/Diphenylamine			0%	0/16		0.377			25%			N	C	
Pentachlorophenol	Aquatic	Y	24%	4/17	3.3	1.2	3/17	3	12%	0.93	1	N	G	*
Pentachlorophenol	Wildlife	Y	24%	4/17	3.3	0.065	3/17	51	76%	0.93	14	COPC	H	*
Petroleum Hydrocarbons			50%	1/2	4							N	A	
Phenol			0%	0/17		0.21			41%			PCOPC	B	
Tridecanoic acid			100%	2/2	2							N	A	
VOCs														
1,1-Dichloroethene			0%	0/20		0.753			0%			N	C	
1,2,4-Trichlorobenzene			0%	0/17		0.485			0%			N	C	
Acetone			26%	5/19	0.25	38.133	0/19	0	0%	0.06	0	N	D	
Benzene			0%	0/20		2.185			0%			N	C	
Bromomethane			0%	0/26		0.0065			15%			N	C	
Carbon disulfide			0%	0/20		1.58			0%			N	C	
Carbon tetrachloride			0%	0/20		0.706			0%			N	C	

Table 11. Refined Ecological COPC Screening: Sediment

Parameter	Note	Bio-accumulative	% Detects	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Region 4 RSV (mg/kg)	Frequency of Detects > RSV	Max Detect HQ	% DL > RSV	95% UCL (mg/kg)	95% UCL HQ	COPC?	Basis
Chlorobenzene			0%	0/20		0.939			0%			N	C
cis-1,3-Dichloropropene			0%	0/20		0.075			0%			N	C
dimethyldisulfide			100%	1/1	0.02							N	A
Methyl acetate			6%	1/16	0.0059							N	A
Methylcyclohexane			6%	1/16	0.0036							N	A
trans-1,3-Dichloropropene			0%	0/19		0.075			0%			N	C
Energetics													
2,4-Dinitrotoluene			0%	0/17		2.9			6%			N	C
2,6-Dinitrotoluene			0%	0/17		0.131			65%			PCOPC	B
1,3,5-Trinitrobenzene			0%	0/1		0.116			100%			PCOPC	B
1,3-Dinitrobenzene			0%	0/1		0.105			100%			PCOPC	B
2,4,6-Trinitrotoluene			0%	0/1		0.112			100%			PCOPC	B
Hexahydro-1,3,5-trinitro-1,3,5-triazine			0%	0/1		0.312			0%			N	C
HMX			0%	0/1		64.709			0%			N	C
Nitroglycerin			0%	0/1		12.704			0%			N	C

A: No RSV
B: Not detected and > 25% detection limits above the RSV
C: Not detected and ≤ 25 % detection limits above the RSV
D: Max HQ < RSV
E: Nutrient
F: ≤ 5% detected
G: 95% UCL HQ ≤ 1
H: 95% UCL HQ > 1
I: Part of a group

DL: detection limit
ND: non-detect
RSV: Refinement ecological screening value
Max Detect HQ: max detected concentration / RSV
95%UCL: recommended value from ProUCL
95%UCL: 95%UCL / RSV

* Used max detected concentration instead of 95% UCL either due to small number of detects or 95% UCL being higher than max

Table 12. Refined Ecological COPC Screening: Surface Water

Parameter	Note	Bio-accumulative	% Detect	Frequency of Detection	Maximum Detected Concentration (µg/L)	Region 4 RSV (µg/L)	ISWQS (µg/L)	Screening Value (µg/L)	Basis	Frequency of Detects > Screening Value	Max Detect HQ	% DL > Screening Val	95% UCL (µg/L)	95% UCL HQ	COPC?	Basis
Inorganics																
Aluminum			47%	9/19	790	750		750	Reg 4 RESV	1/19	1	0%			N	D
Cadmium			5%	2/42	2.3	0.94		0.94	Reg 4 RESV	1/42	2	64%			N	F
Chromium			33%	14/42	2.5										N	A
Copper			48%	20/42	9.7	7		7	Reg 4 RESV	1/42	1	14%			N	D
Iron			95%	18/19	3400	1000		1000	Reg 4 RESV	11/19	3	0%	1954	2	COPC	H
Lead			26%	11/42	6.2	30.1		30.1	Reg 4 RESV	0/42	0.2	0%			N	D
Manganese			100%	19/19	710	1680		1680	Reg 4 RESV	0/19	0.4	0%			N	D
Mercury	Aquatic	Y	2%	1/42	0.3	1.4		1.4	Reg 4 RESV	0/42	0.2	0%			N	D
Mercury	Wildlife		2%	1/42	0.3	0.012		0.012	Reg 4 RESV	1/42	25	98%			N	F
Selenium		Y	9%	3/33	3.3	20		20	Reg 4 RESV	0/33	0.2	0%			N	D
Silver			45%	15/33	7.9	0.98		0.98	Reg 4 RESV	15/33	8	52%	6.6	7	COPC	H
Thallium			6%	2/33	3.6	54	0.47	0.47	ISWQS	2/33	8	94%			N	G
Zinc			43%	18/42	120	66		66	Reg 4 RESV	3/42	2	0%	28	0.4	N	G
Low Molecular Weight PAHs																
Anthracene			0%	0/10		0.18	40000	0.18	Reg 4 RESV			100%			PCOPC	B
Pesticides																
Dieldrin	Aquatic	Y	0%	0/10		0.24	0.000054	0.000054	ISWQS			100%			PCOPC	B
Dieldrin	Wildlife	Y	0%	0/10		0.24	0.000054	0.000054	ISWQS			100%			PCOPC	B
gamma-Chlordane			10%	1/10	0.15	2.4		2.4	Reg 4 RESV	0/10	0.1	0%			N	D
Heptachlor epoxide			0%	0/10		0.5	0.000039	0.000039	ISWQS			100%			PCOPC	B
DDD/DDE/DDT																
4,4'-DDT	Aquatic	Y	0%	0/10		1.1	0.00022	0.00022	ISWQS			100%			PCOPC	B
4,4'-DDT	Wildlife	Y	0%	0/10		1.1	0.00022	0.00022	ISWQS			100%			PCOPC	B
PCBs																
Aroclor 1016			0%	0/24											N	A
Aroclor 1221			0%	0/24											N	A
Aroclor 1232			0%	0/24											N	A
Aroclor 1242			0%	0/24											N	A
Aroclor 1248			13%	3/24	2.2										N	A
Aroclor 1254			0%	0/24											N	A
Aroclor 1260			0%	0/24											N	A
Aroclor 1262			0%	0/10											N	A
Aroclor 1268			0%	0/10											N	A
Total PCB	Acute		13%	3/24	6.2	0.014		0.014	Reg 4 RESV	3/22	443	88%	0.93	66	COPC	H
Total PCB	Wildlife		13%	3/24	6.2	0.00012		0.00012	Reg 4 RESV	3/22	51667	100%	0.93	7750	COPC	H

Table 12. Refined Ecological COPC Screening: Surface Water

Parameter	Note	Bio-accumulative	% Detect	Frequency of Detection	Maximum Detected Concentration (µg/L)	Region 4 RSV (µg/L)	ISWQS (µg/L)	Screening Value (µg/L)	Basis	Frequency of Detects > Screening Value	Max Detect HQ	% DL > Screening Val	95% UCL (µg/L)	95% UCL HQ	COPC?	Basis
SVOCs																
2,3,4,6-Tetrachlorophenol			0%	0/10		11		11	Reg 4 RESV			0%			N	C
3,3'-Dichlorobenzidine			0%	0/10		41	0.028	0.028	ISWQS			100%			PCOPC	B
3-Penten-2-ol			100%	1/1	70										N	A
4-Bromophenyl-phenylether			0%	0/10		12		12	Reg 4 RESV			0%			N	C
4-Chloroaniline			0%	0/10		24		24	Reg 4 RESV			0%			N	C
Atrazine			0%	0/10		0.05		0.05	Reg 4 RESV			100%			PCOPC	B
Hexachlorobenzene	Aquatic	Y	0%	0/10		2.8	0.00029	0.00029	ISWQS			100%			PCOPC	B
Hexachlorobenzene	Wildlife	Y	0%	0/10		0.0003	0.00029	0.00029	ISWQS			100%			PCOPC	B
Hexachlorobutadiene	Aquatic	Y	0%	0/18		10	18	10	Reg 4 RESV			0%			N	C
Hexachlorobutadiene	Wildlife	Y	0%	0/18		10	18	10	Reg 4 RESV			0%			N	C
Hexachlorocyclopentadiene			0%	0/10		4.5	1100	4.5	Reg 4 RESV			0%			N	C
N-Nitrosodiphenylamine/Diph			0%	0/10		220	0.51	0.51	ISWQS			100%			PCOPC	B
Prometon			100%	2/2	8										N	A
VOCs																
Carbon tetrachloride			0%	0/27		0.014		0.014	Reg 4 RESV			0%			N	C
Chloroethane			4%	1/27	1										N	F
Chloromethane			4%	1/25	1										N	F
cis/trans1,2-Dichloroethene			56%	5/9	49.1										N	A
cis-1,2-Dichloroethene			19%	5/27	2000	5500		5500	Reg 4 RESV	0/27	0.4	0%			N	D
Trichloroethene			31%	11/36	1600	2000	30	30	ISWQS	7/36	53	0%	281	9	COPC	H
Vinyl acetate			0%	0/8		280		280	Reg 4 RESV			0%			N	C
Vinyl chloride			26%	7/27	140	8400	2.4	2.4	ISWQS	4/27	58	33%	35	15	COPC	H
Xylenes (unspecified)			29%	2/7	5										N	A
Energetics																
Acrylonitrile			0%	0/8		650	0.25	0.25	ISWQS			100%			PCOPC	B

A: No RSV
B: Not detected and > 25% detection limits above the RSV
C: Not detected and ≤ 25 % detection limits above the RSV
D: Max HQ < RSV
E: Nutrient
F: ≤ 5% detected
G: 95% UCL HQ ≤ 1
H: 95% UCL HQ > 1
I: Part of a group

DL: detection limit
ND: non-detect
RSV: Refinement ecological screening value
ISWQS: Georgia in-stream water quality standard
Max Detect HQ: max detected concentration / RSV
95%UCL: recommended value from ProUCL
95%UCL: 95%UCL / RSV

Screening value: Lesser of Region 4 RSV and ISWQS

Table 13. Intake Parameters

Receptor	Primary Diet	Body Weight [1] (kg)	AUF [2]	Ingestion Rate [3] (kg/d)	Dietary Composition [4]			Dietary Breakdown [5]			Soil/ Sediment [6] (kg/day)	Surface Water (L/day)
					Fish	Plants	Animals/ Invertebrates	Fish (kg/day)	Plant (kg/day)	Animal/ Invertebrates (kg/day)		
Terrestrial Receptors												
American Robin	Insects, fruits	0.077	1	0.019		0.62	0.38		0.012	0.0072	0.00057	0.01
Short-tail Shrew	Insects, invertebrates, seeds and nuts	0.0080	1	0.0011		0.05	0.95		0.000	0.0010	0.00004	0.001
Aquatic Receptors												
Green Heron	Small fish, insects, small reptiles and amphibians	0.212	1	0.031	0.9	0	0.1	0.028	0	0.003	0.00016	0.02
Raccoon	Fruits, seeds, nuts, fish, molluscs, insects	6.0	1	0.30	0.19	0.58	0.24	0.057	0.17	0.07	0.0282	0.497

Notes:

1) Body weights for robin, shrew and heron from Dunning (1993) and Silva and Downing (1995) as reported by FDEP (2004).
   Body weight for raccoon based on the mean of the range (5-7 kg) of 10 adults from FL and GA from Whitaker and Hamilton 1998.
2) AUF: Area use factor: a djustment factor (from 0 to 1) based upon an organism's total time of exposure to unit-based contaminants.
   For this preliminary risk evaluation stage, a factor of 1 was assigned to each receptor, even though the foraging area may be greater than the size of the Site.
3) Ingestion rate for robin, shrew and heron from (Ochoa and Roberts, 2003) based on Nagy et al. (1999).
   Ingestion rate for racoon based on allometric equation from Nagy 1987 (as referenced in EPA 1993). FIR (kg-dw/day) = $0.0687*BW^{0.822}$(kg)
4) Dietary composition for robin from EPA (1993) as referenced in Ochoa and Roberts (2003).
   Dietary composition for shrew from Whitaker and Hamilton (1998) as referenced in Ochoa and Roberts (2003).
   Dietary composition for heron from Kale and Maehr (1990) as referenced in Ochoa and Roberts (2003).
   Dietary composition for racoon based upon the spring diet of raccoons from Tennessee reported in EPA (1993).
   - All vertebrate prey (frogs, fish, birds, mammals and other) in Table 16 were combined for the fish category. The invertebrate category includes both insects and crayfish.
5) Dietary breakdown = Dietary Compsition x Ingestion Rate
6) Soil/sediment ingestion rate for robin (3%), shrew (4%) and heron (0.5%) from Ochoa and Roberts (2003).
   Sediment ingestion rate for racoon (9.4%) from Beyer et al. (2002).
7) Water intake based on allometric equation from Calder and Braun 1983. WIR (l/day) = $0.059*BW^{0.67}$(kg)
   Robin: WIR (l/day) = $0.059*BW^{0.67}$(kg)
   Shrew: WIR (l/day) = $0.099*BW^{0.90}$(kg)
   Heron: WIR (l/day) = $0.059*BW^{0.67}$(kg)
   Racoon: WIR (l/day) = $0.099*BW^{0.90}$(kg)

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Table 14. Bioaccumulation Factors

Constituent	logKow [1]	Plant		Terrestrial Invertebrates		Aquatic Invertebrates		Fish	
Selenium	0.24	0.5	2	eqn	4	4.8	2	0.24	2
LMWPAH		0.20	5	0.21	5	5.2	5	0.65	5
Endosulfan II	3.5	0.37	3	0.0415	7	1.08	8	0.135	8
Endosulfan sulfate	3.64	0.30	3	0.0415	7	1.08	8	0.135	8
DDD	5.87	0.016	2	0.48	6	7.53	2	0.942	2
DDE	6	0.019	2	1.29	6	18	2	2.24	2
DDT	6.79	0.0078	2	1.98	6	25.3	2	3.16	2
Pentachlorophenol	4.74	0.014	2	3.58	6	27.4	2	3.43	2

Notes:

1) logKow values from EPIWEB 4.1
2) FDEP 2004
3) 10^(1.588-(0.578*logKow)) from Travis and Arms (1988)
4) 10^(-0.075 + 0.73*ln(Soil Concentration)) from Sample (1999)
5) FDEP 2004 - average of individual values for LMWPAH constituents
6) FDEP 2004 - average of earthworm and other invertebrates
7) FDEP 2004 - average of earthworm and other invertebrates (surrogate Endosulfan I)
8) FDEP 2004 (surrogate Endosulfan I)
9) FDEP 2004 equation with current values from EPIWEB

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Table 15. Toxicity Reference Values

Constituent	Avian			
	TRV (mg/kg/d)	Species	Basis	Source
Selenium	0.29	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproductive endpoints	Eco-SSL
LMWPAH	22.8	Mallard duck	Organ weight	Patton and Dieter, 1980
Endosulfan II	10	gray partidge	NOAEL, diet, 4 weeks, reproduction (surrogate: endosulfan)	Sample et al. 1996
Endosulfan sulfate	10	gray partidge	NOAEL, diet, 4 weeks, reproduction (surrogate: endosulfan)	Sample et al. 1996
DDD	0.23	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproduction	Eco-SSL
DDE	0.23	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproduction	Eco-SSL
DDT	0.23	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproduction	Eco-SSL
Pentachlorophenol	6.73	various	Lowest NOAEL value for reproduction, growth or survival	Eco-SSL

Constituent	Mammalian			
	TRV (mg/kg/d)	Species	Basis	Source
Selenium	0.14	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproductive endpoints	Eco-SSL
LMWPAH	65.6	various	Highest bounded NOAEL lower than the lowest bounded LOAEL value for reproduction, growth or survival	Eco-SSL
Endosulfan II	0.15	shrew	NOAEL, oral intubation, 30 day (subchronic), reproduction (surrogate: endosulfan)	Sample et al. 1996
Endosulfan sulfate	0.15	shrew	NOAEL, oral intubation, 30 day (subchronic), reproduction (surrogate: endosulfan)	Sample et al. 1996
DDD	0.15	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproductive endpoints	Eco-SSL
DDE	0.15	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproductive endpoints	Eco-SSL
DDT	0.15	various	Highest bounded NOAEL below lowest bounded LOAEL for growth and reproductive endpoints	Eco-SSL
Pentachlorophenol	8.42	various	Geometric mean of NOAEL values for reproduction and growth	Eco-SSL

References:

Eco-SSL: EPA. 2007. Ecological Soil Screening Levels. https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents

Patton, J.F. and M.P. Dieter. 1980. Effects of Petroleum Hydrocarbons on Hepatic Function in the Duck. *Comparative Biochemistry and Physiology Part C: Comparative Pharmacology* . 65:1:33-36.

Sample, B.E., D.M. Opresko, and G.W. Suter. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision.

Table 16. Exposure Point Concentrations

Constituent	Soil (mg/kg)		Sediment (mg/kg)		Surface Water (µg/L)	
Selenium	1.7		1		3.3	*
LMWPAH	139	*	2.2		0	**
Endosulfan II	0	**	0.0021	*	0	**
Endosulfan sulfate	0.045	*	0.014	*	0	**
DDD	0.0065	*	0.016		0	**
DDE	0.081	*	0.053		0	**
DDT	0.086	*	0.05		0	**
Pentachlorophenol	0	**	0.93		0	**

Recommended UCLs from ProUCL software

* Maximum value used instead of UCL used due to limited number of detections

** Not detected

Table 17. Intake for American Robin

Constituent	BAFs		Concentrations				American Robin Intake (mg/kg/day) [3]
	Invertebrate	Plant	Surface Water EPC (mg/L)	Soil EPC (mg/kg)	Invertebrate Tissue Conc. (mg/kg-dw) [1]	Plant Tissue Conc. (mg/kg-dw) [2]	
Selenium	Eqn [4]	0.5	0.0033	1.7	0.94	0.85	0.23
LMWPAH	0.21	0.20	0	139	29	27	7.9
Endosulfan II	0.0415	0.37	0	0	0	0	0
Endosulfan sulfate	0.0415	0.30	0	0.045	0.0019	0.014	0.0026
DDD	0.481	0.016	0	0.0065	0.0031	0.00010	0.00036
DDE	1.285	0.019	0	0.081	0.10	0.0015	0.011
DDT	1.98	0.0078	0	0.086	0.17	0.00067	0.017
Pentachlorophenol	3.58	0.014	0	0	0	0	0

1) Cinvert = Soil EPC x Invertebrate BAF
2) Cplant = Soil EPC x Plant BAF
3) DI = [(Cinvert x Ia) + (Cplant x Ip) + (Cs x Is) + (Cw x Iw)] * AUF / BW

Animal Ingestion, Ia	0.00722	kg/d
Plant Ingestion, Ip	0.01178	kg/d
Soil Ingestion, Is	0.00057	kg/d
Water Ingestion, Iw	0.01	L/d
AUF	1.00	
Body Weight, BW	0.08	kg

4) 10^(-0.075 + 0.73*ln(Soil Concentration))

Table 18. Intake for Short-Tailed Shrew

Constituent	BAFs		Concentrations				Short-Tailed Shrew Intake (mg/kg/day) [3]
	Invertebrate	Plant	Surface Water EPC (mg/L)	Soil EPC (mg/kg)	Invertebrate Tissue Conc. (mg/kg-dw) [1]	Plant Tissue Conc. (mg/kg-dw) [2]	
Selenium	Eqn [4]	0.5	0.0033	1.7	0.94	0.85	0.14
LMWPAH	0.21	0.20	0	139	29	27	4.7
Endosulfan II	0.0415	0.37	0	0	0	0	0
Endosulfan sulfate	0.0415	0.30	0	0.045	0.0019	0.014	0.00059
DDD	0.48	0.016	0	0.0065	0.0031	0.00010	0.00044
DDE	1.29	0.019	0	0.081	0.10	0.0015	0.014
DDT	1.98	0.0078	0	0.086	0.17	0.00067	0.023
Pentachlorophenol	3.58	0.014	0	0	0	0	0

1) Cinvert = Soil EPC x Invertebrate BAF
2) Cplant = Soil EPC x Plant BAF
3) DI = [(Cinvert * Ia) + (Cplant * Ip) + (Cs * Is) + (Cw * Iw)] * AUF / BW

Animal Ingestion, Ia	0.001045	kg/d
Plant Ingestion, Ip	0.000055	kg/d
Soil Ingestion, Is	0.000044	kg/d
Water Ingestion, Iw	0.00	L/d
AUF	1.00	
Body Weight, BW	0.01	kg

4) 10^(-0.075 + 0.73*ln(Soil Concentration))

Table 19. Intake for the Green Heron

Constituent	BAFs		Concentrations				Green Heron Intake (mg/kg/day) [3]
	Fish	Invertebrates	Surface Water EPC (mg/L)	Sediment EPC (mg/kg)	Fish Tissue Conc. (mg/kg-dw) [1]	Invertebrate Tissue Conc. (mg/kg-dw) [2]	
Selenium	0.24	4.8	0.0033	1	0.00079	4.8	0.071
LMWPAH	0.65	5.2	0	2.2	0	12	0.17
Endosulfan II	0.135	1.08	0	0.0021	0	0.0023	0.000035
Endosulfan sulfate	0.135	1.08	0	0.014	0	0.015	0.00023
DDD	0.942	7.53	0	0.016	0	0.12	0.0018
DDE	2.24	18	0	0.053	0	0.95	0.014
DDT	3.16	25.3	0	0.05	0	1.3	0.019
Pentachlorophenol	3.43	27.4	0	0.93	0	25	0.4

1) Cfish = SW EPC * Fish BAF
2) Cinvert = Sediment EPC x Invertebrate BAF
3) DI = [(Cfish * If) + (Cinvert * Ii) + (Cs * Is) + (Cw * Iw)] * AUF / BW

Fish Ingestion, If	0.02785	kg/d
Invertebrate Ingestion, Ii	0.0031	
Plant Ingestion, Ip	0	kg/d
Sediment Ingestion, Is	0.000155	kg/d
Water Ingestion, Iw	0.02	L/d
AUF	1.00	
Body Weight, BW	0.21	kg

Table 20. Intake for the Racoon

Constituent	BAFs			Concentrations					Raccoon Intake (mg/kg/day) [4]
	Fish	Invertebrates	Plants	Surface Water EPC (mg/L)	Sediment EPC (mg/kg)	Fish Tissue Conc. (mg/kg-dw) [1]	Invertebrate Tissue Conc. (mg/kg-dw) [2]	Plant Tissue Conc. (mg/kg-dw) [3]	
Selenium	0.24	4.8	0.5	0.0033	1	0.00079	4.8	0.50	0.077
LMWPAH	0.65	5.2	0.20	0	2.2	0	12	0.44	0.16
Endosulfan II	0.135	1.08	0.37	0	0.0021	0	0.0023	0.00077	0.000059
Endosulfan sulfate	0.135	1.08	0.30	0	0.014	0	0.015	0.0043	0.00037
DDD	0.942	7.53	0.016	0	0.016	0	0.12	0.00026	0.0015
DDE	2.24	18	0.019	0	0.053	0	0.95	0.0010	0.012
DDT	3.16	25.3	0.0078	0	0.05	0	1.3	0.00039	0.015
Pentachlorophenol	3.43	27.4	0.014	0	0.93	0	25	0.013	0.3

1) Cfish = SW EPC * Fish BAF
2) Cinvert = Sediment EPC * Invertebrate BAF
3) Cplant = Sediment EPC * Plant BAF
4) DI = [(Cfish * If) + (Cinvert * Ii) + (Cplant * Ip) + (Cs * Is) + (Cw * Iw)] AUF / BW

Fish Ingestion, If	0.057	kg/d
Invertebrate Ingestion, Ii	0.072	
Plant Ingestion, Ip	0.17	kg/d
Sediment Ingestion, Is	0.028	kg/d
Water Ingestion, Iw	0.50	L/d
AUF	1	
Body Weight, BW	6.0	kg

Table 21. Food Chain Risk Evaluation

Constituent	American Robin			Short-tailed Shrew			Great Heron			Raccoon		
	Exposure (mg/kg/d)	TRV (mg dw/kg bw/d)	HQ	Exposure (mg/kg/d)	TRV (mg dw/kg bw/d)	HQ	Exposure (mg/kg/d)	TRV (mg dw/kg bw/d)	HQ	Exposure (mg/kg/d)	TRV (mg dw/kg bw/d)	HQ
Selenium	0.23	0.29	0.8	0.14	0.14	1	0.071	0.29	0.2	0.077	0.14	0.5
LMWPAH	7.9	22.8	0.3	4.7	65.6	0.1	0.17	22.8	0.007	0.16	65.6	0.002
Endosulfan II	0	10	0	0	0.15	0	3.47E-05	10	0.000003	5.938E-05	0.15	0.0004
Endosulfan sulfate	0.0026	10	0.0003	0.00059	0.15	0.00	0.00023	10	0.00002	0.00037	0.15	0.002
DDD	0.00036	0.23	0.002	0.00044	0.15	0.003	0.0018	0.23	0.008	0.0015	0.15	0.01
DDE	0.011	0.23	0.05	0.014	0.15	0.09	0.014	0.23	0.06	0.012	0.15	0.1
DDT	0.017	0.23	0.07	0.023	0.15	0.2	0.019	0.23	0.08	0.015	0.15	0.1
Pentachlorophenol	0	6.73	0	0	8.42	0	0.4	6.73	0.1	0.3	8.42	0.0

HQ = Exposure / TRV

Table 22. Refined Ecological COPC/PCOPC Summary

Parameter	Soil	Sediment	SW
Inorganics			
Antimony	**COPC**		
Barium		**COPC**	
Cadmium	**COPC**		
Copper	**COPC**		
Iron			**COPC**
Lead	**COPC**		
Manganese		**COPC**	
Mercury		**COPC**	
Silver			**COPC**
Zinc	**COPC**		
High Molecular Weight PAHs			
Benzo(e)pyrene	**COPC**	**COPC**	
Perylene	**COPC**	**COPC**	
Total HMWPAH	**COPC**	**COPC**	
Low Molecular Weight PAHs			
Anthracene			PCOPC
Pesticides			
Dieldrin			PCOPC
Endosulfan I		PCOPC	
Heptachlor epoxide			PCOPC
Toxaphene		PCOPC	
DDD/DDE/DDT			
4,4'-DDT			PCOPC
PCBs			
Aroclor 1248	**COPC**		
Total PCBs	**COPC**	**COPC**	**COPC**
SVOCs			
1,2,4,5-Tetrachlorobenzene		PCOPC	
2,3,4,6-Tetrachlorophenol	PCOPC		
2,4-Dimethylphenol	PCOPC		
2,4-Dinitrophenol	PCOPC		
2-Chlorophenol	PCOPC		
3,3'-Dichlorobenzidine	PCOPC	PCOPC	PCOPC
4-Bromophenyl-phenylether		PCOPC	
4-Chloroaniline	PCOPC	PCOPC	
Atrazine	PCOPC	PCOPC	PCOPC
bis(2-Ethylhexyl) phthalate	**COPC**		
Hexachlorobenzene		PCOPC	PCOPC
Hexachlorocyclopentadiene	PCOPC	PCOPC	
Hexachloroethane	PCOPC	PCOPC	
N-Nitrosodiphenylamine/Diphenyla	PCOPC		PCOPC
Phenol		PCOPC	
VOCs			
Trichloroethene			**COPC**
Vinyl chloride			**COPC**
Energetics			
2,6-Dinitrotoluene		PCOPC	
1,3,5-Trinitrobenzene	PCOPC	PCOPC	
1,3-Dinitrobenzene	PCOPC	PCOPC	
2,4,6-Trinitrotoluene		PCOPC	
Acrylonitrile			PCOPC

Table 23. Summary of COPCs

Parameter	Soil				Groundwater	Sediment		Surface Water	
		Human Health			Human		Human		Human
	Ecological	All	SS	SB	Health	Ecological	Health	Ecological	Health
Inorganics									
Aluminum		X	X		X		X		
Antimony	X	X	X	X	X		X		
Arsenic		X	X	X	X		X		X
Barium		X				X			
Beryllium					X				
Cadmium	X	X	X	X	X		X		X
Chromium					X				
Cobalt		X	X				X		
Copper	X	X	X	X	X				
Cyanide					X				
Iron		X	X		X		X	X	X
Lead	X	X	X	X	X				
Manganese		X	X	X	X	X	X		X
Mercury		X	X	X	X	X	X		X
Nickel		X	X		X				
Silver		X	X					X	
Thallium		X	X	X	X		X		X
Vanadium		X	X		X		X		X
Zinc	X	X	X		X				
High Molecular Weight PAHs									
Total HMWPAHs	X					X			
Benzo(a)anthracene		X	X				X		
Benzo(a)pyrene		X	X	X			X		
Benzo(b)fluoranthene		X	X				X		
Benzo(e)pyrene	X					X			
Benzo(k)fluoranthene		X							
Chrysene									
Dibenzo(a,h)anthracene		X	X				X		
Indeno(1,2,3-cd)pyrene		X	X				X		
Perylene	X					X			
Pesticides									
Dieldrin					X				
PCBs									
Total PCBs	X					X		X	
Aroclor 1248	X	X	X	X	X		X		X
Aroclor 1254		X	X	X			X		
Aroclor 1260		X	X	X			X		
SVOCs									
bis(2-Ethylhexyl) phthalate	X	X	X	X	X				
VOCs									
1,1-Dichloroethene					X				
Carbon tetrachloride					X				
cis-1,2-Dichloroethene					X				X
Tetrachloroethene					X				
Trichloroethene		X		X	X			X	X
Vinyl chloride					X			X	X
Energetics									
Pentaerythritol tetranitrate					X				
2,4-Dinitrotoluene					X				
1,3-Dinitrobenzene					X				

APPENDIX A
ProUCL

Soil - Antimony

Parameter	Sample ID	Val	D_Val
Antimony	FML-308-SF	0.95	1
Antimony	MW-17-1_10/1/1998	0.32	0
Antimony	LSL-45_5/19/1998	0.35	1
Antimony	LSL-49_5/20/1998	0.55	1
Antimony	LSL-48_5/20/1998	0.46	1
Antimony	LSL-47_5/20/1998	0.41	1
Antimony	LSL-46_5/20/1998	0.43	1
Antimony	LSL-53_5/20/1998	29.6	1
Antimony	LSL-51_5/19/1998	0.92	1
Antimony	LSL-54_5/20/1998	11.3	1
Antimony	FML-305-SF	12	0
Antimony	FML-304-SF	20	0
Antimony	FML-301-SF	0.3	1
Antimony	LSD-25-01_5/26/1998	1.09	0
Antimony	LSL-60_5/20/1998	0.55	1
Antimony	LSD-24-01_5/26/1998	1.1	0
Antimony	LSD-23-01_5/26/1998	1.09	0
Antimony	FML-309-SF	34	0
Antimony	MW-14-1_10/1/1998	0.32	0
Antimony	AWI-213-SF	3.5	1
Antimony	AWI-214-SF	2.4	1
Antimony	AWI-215-SF	9.1	1
Antimony	MW-21-1_10/1/1998	0.69	0
Antimony	MW-20-1_10/1/1998	0.86	1
Antimony	MW-19-1_10/1/1998	0.7	0
Antimony	LSL-59_5/19/1998	0.31	1
Antimony	AWI-216-SF	1.2	1
Antimony	LSL-50_5/19/1998	2.8	1
Antimony	MW-12-1_10/1/1998	0.28	0
Antimony	LSL-62_5/20/1998	2.1	1
Antimony	LSL-61_5/20/1998	1	1
Antimony	FML-303-SF	3.3	1
Antimony	FML-306-SF	0.32	1
Antimony	LSL-57_5/20/1998	14	1
Antimony	LSL-56_5/20/1998	24.3	1
Antimony	MW-16-1_10/1/1998	0.35	0
Antimony	MW-15-1_10/1/1998	0.27	0
Antimony	FML-307-SF	6.5	0
Antimony	FML-310-SF	6.8	0
Antimony	MW-4B-1_10/1/1998	3.4	1
Antimony	MW-13-1_10/1/1998	0.73	1
Antimony	FML-302-SF	0.41	1
Antimony	FML-300-SB	6.7	0
Antimony	MW-2B-1_10/1/1998	0.27	0

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:05:25 PM
From File	Soils.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	44	Number of Distinct Observations	37
Number of Detects	27	Number of Non-Detects	17
Number of Distinct Detects	25	Number of Distinct Non-Detects	14
Minimum Detect	0.3	Minimum Non-Detect	0.27
Maximum Detect	29.6	Maximum Non-Detect	34
Variance Detects	55.33	Percent Non-Detects	38.64%
Mean Detects	4.28	SD Detects	7.438
Median Detects	0.95	CV Detects	1.738
Skewness Detects	2.504	Kurtosis Detects	5.907
Mean of Logged Detects	0.392	SD of Logged Detects	1.402

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.588	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.357	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	2.915	KM Standard Error of Mean	0.952
KM SD	6.089	95% KM (BCA) UCL	4.725
95% KM (t) UCL	4.515	95% KM (Percentile Bootstrap) UCL	4.627
95% KM (z) UCL	4.481	95% KM Bootstrap t UCL	5.967
90% KM Chebyshev UCL	5.771	95% KM Chebyshev UCL	7.064
97.5% KM Chebyshev UCL	8.859	99% KM Chebyshev UCL	12.39

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.935	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.799	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.177	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.584	k star (bias corrected MLE)	0.544
Theta hat (MLE)	7.325	Theta star (bias corrected MLE)	7.867
nu hat (MLE)	31.55	nu star (bias corrected)	29.38
Mean (detects)	4.28		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	2.63
Maximum	29.6	Median	0.41
SD	6.154	CV	2.34
k hat (MLE)	0.279	k star (bias corrected MLE)	0.275
Theta hat (MLE)	9.442	Theta star (bias corrected MLE)	9.574
nu hat (MLE)	24.51	nu star (bias corrected)	24.17
Adjusted Level of Significance (β)	0.0445		

Approximate Chi Square Value (24.17, α)	13.98	Adjusted Chi Square Value (24.17, β)	13.72
95% Gamma Approximate UCL (use when n>=50)	4.547	95% Gamma Adjusted UCL (use when n<50)	4.635

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.915	SD (KM)	6.089
Variance (KM)	37.07	SE of Mean (KM)	0.952
k hat (KM)	0.229	k star (KM)	0.229
nu hat (KM)	20.17	nu star (KM)	20.13
theta hat (KM)	12.72	theta star (KM)	12.74
80% gamma percentile (KM)	4.092	90% gamma percentile (KM)	8.795
95% gamma percentile (KM)	14.48	99% gamma percentile (KM)	29.81

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (20.13, α)	10.95	Adjusted Chi Square Value (20.13, β)	10.72
95% Gamma Approximate KM-UCL (use when n>=50)	5.361	95% Gamma Adjusted KM-UCL (use when n<50)	5.476

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.166	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.753	Mean in Log Scale	-0.325
SD in Original Scale	6.104	SD in Log Scale	1.536
95% t UCL (assumes normality of ROS data)	4.3	95% Percentile Bootstrap UCL	4.358
95% BCA Bootstrap UCL	4.955	95% Bootstrap t UCL	5.839
95% H-UCL (Log ROS)	4.784		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0876	KM Geo Mean	0.916
KM SD (logged)	1.322	95% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.214	95% H-UCL (KM -Log)	3.826
KM SD (logged)	1.322	95% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.214		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.677	Mean in Log Scale	0.132
SD in Original Scale	6.466	SD in Log Scale	1.528
95% t UCL (Assumes normality)	5.316	95% H-Stat UCL	7.403

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	3.826

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Arsenic

Parameter	Sample ID	Val	D_Val
Arsenic	FML-301-SF	4.8	1
Arsenic	MW-14-1_10/1/1998	1.9	1
Arsenic	FML-309-SF	3.6	1
Arsenic	FML-307-SF	0.69	1
Arsenic	FML-308-SF	4.6	1
Arsenic	FML-310-SF	2.7	1
Arsenic	FML-305-SF	4.2	1
Arsenic	FML-302-SF	1.2	1
Arsenic	MW-13-1_10/1/1998	83.4	1
Arsenic	LSL-47_5/20/1998	2.7	1
Arsenic	LSD-25-01_5/26/1998	3.8	1
Arsenic	MW-15-1_10/1/1998	8.3	1
Arsenic	LSD-24-01_5/26/1998	6.3	1
Arsenic	MW-2B-1_10/1/1998	2	1
Arsenic	LSD-23-01_5/26/1998	9.4	1
Arsenic	SO-5_11/29/1989	4.83	1
Arsenic	MW-4B-1_10/1/1998	9.5	1
Arsenic	FML-304-SF	6.5	1
Arsenic	LSL-57_5/20/1998	5.3	1
Arsenic	MW-20-1_10/1/1998	7.4	1
Arsenic	MW-19-1_10/1/1998	4.7	1
Arsenic	MW-16-1_10/1/1998	2.3	1
Arsenic	LSL-50_5/19/1998	3.8	1
Arsenic	MW-12-1_10/1/1998	1.4	1
Arsenic	LSL-62_5/20/1998	5.9	1
Arsenic	LSL-46_5/20/1998	4.2	1
Arsenic	LSL-59_5/19/1998	2.2	1
Arsenic	MW-21-1_10/1/1998	7	1
Arsenic	LSL-56_5/20/1998	3.9	1
Arsenic	LSL-54_5/20/1998	4	1
Arsenic	LSL-53_5/20/1998	5.6	1
Arsenic	FML-303-SF	1.6	1
Arsenic	LSL-49_5/20/1998	4.4	1
Arsenic	FML-300-SB	1	1
Arsenic	LSL-48_5/20/1998	2.5	1
Arsenic	LSL-61_5/20/1998	2.9	1
Arsenic	AWI-214-SF	0.59	1
Arsenic	AWI-213-SF	0.96	1
Arsenic	MW-17-1_10/1/1998	2.8	1
Arsenic	LSL-60_5/20/1998	2.4	1
Arsenic	FML-306-SF	2	1
Arsenic	AWI-216-SF	1.9	1
Arsenic	AWI-215-SF	1.5	0
Arsenic	LSL-51_5/19/1998	5.5	1
Arsenic	LSL-45_5/19/1998	2.6	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:04:18 PM
From File	Soils_c.xls
Full Precision	OFF
Confidence Coefficient	95%

Number of Bootstrap Operations 2000

Val

General Statistics

Total Number of Observations	45	Number of Distinct Observations	40
Number of Detects	44	Number of Non-Detects	1
Number of Distinct Detects	39	Number of Distinct Non-Detects	1
Minimum Detect	0.59	Minimum Non-Detect	1.5
Maximum Detect	83.4	Maximum Non-Detect	1.5
Variance Detects	148.9	Percent Non-Detects	2.222%
Mean Detects	5.665	SD Detects	12.2
Median Detects	3.8	CV Detects	2.154
Skewness Detects	6.285	Kurtosis Detects	40.83
Mean of Logged Detects	1.227	SD of Logged Detects	0.834

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.3	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.944	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.354	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	5.561	KM Standard Error of Mean	1.802
KM SD	11.95	95% KM (BCA) UCL	9.017
95% KM (t) UCL	8.588	95% KM (Percentile Bootstrap) UCL	8.952
95% KM (z) UCL	8.524	95% KM Bootstrap t UCL	18.27
90% KM Chebyshev UCL	10.97	95% KM Chebyshev UCL	13.41
97.5% KM Chebyshev UCL	16.81	99% KM Chebyshev UCL	23.49

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.744	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.775	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.185	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.137	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.123	k star (bias corrected MLE)	1.062
Theta hat (MLE)	5.043	Theta star (bias corrected MLE)	5.335
nu hat (MLE)	98.85	nu star (bias corrected)	93.44
Mean (detects)	5.665		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	5.54
Maximum	83.4	Median	3.8
SD	12.09	CV	2.183
k hat (MLE)	0.946	k star (bias corrected MLE)	0.898
Theta hat (MLE)	5.857	Theta star (bias corrected MLE)	6.171
nu hat (MLE)	85.13	nu star (bias corrected)	80.79

Adjusted Level of Significance (β)	0.0447		
Approximate Chi Square Value (80.79, α)	61.08	Adjusted Chi Square Value (80.79, β)	60.51
95% Gamma Approximate UCL (use when n>=50)	7.327	95% Gamma Adjusted UCL (use when n<50)	7.396

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.561	SD (KM)	11.95
Variance (KM)	142.7	SE of Mean (KM)	1.802
k hat (KM)	0.217	k star (KM)	0.217
nu hat (KM)	19.5	nu star (KM)	19.53
theta hat (KM)	25.67	theta star (KM)	25.63
80% gamma percentile (KM)	7.627	90% gamma percentile (KM)	16.81
95% gamma percentile (KM)	28.03	99% gamma percentile (KM)	58.55

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (19.53, α)	10.51	Adjusted Chi Square Value (19.53, β)	10.29
95% Gamma Approximate KM-UCL (use when n>=50)	10.34	95% Gamma Adjusted KM-UCL (use when n<50)	10.56

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.944	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0869	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.132	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.561	Mean in Log Scale	1.2
SD in Original Scale	12.08	SD in Log Scale	0.844
95% t UCL (assumes normality of ROS data)	8.588	95% Percentile Bootstrap UCL	9.165
95% BCA Bootstrap UCL	11.03	95% Bootstrap t UCL	18.03
95% H-UCL (Log ROS)	6.278		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.198	KM Geo Mean	3.315
KM SD (logged)	0.838	95% Critical H Value (KM-Log)	2.199
KM Standard Error of Mean (logged)	0.127	95% H-UCL (KM -Log)	6.219
KM SD (logged)	0.838	95% Critical H Value (KM-Log)	2.199
KM Standard Error of Mean (logged)	0.127		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	5.556	Mean in Log Scale	1.194
SD in Original Scale	12.08	SD in Log Scale	0.855
95% t UCL (Assumes normality)	8.583	95% H-Stat UCL	6.322

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	6.219

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

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

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

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

Soil - Cadmium

Parameter	Sample ID	Val	D_Val
Cadmium	MW-13-1_10/1/1998	4.8	1
Cadmium	LSL-61_5/20/1998	79.4	1
Cadmium	MW-20-1_10/1/1998	27.9	1
Cadmium	FML-309-SF	4.6	1
Cadmium	FML-310-SF	0.57	0
Cadmium	LSL-46_5/20/1998	15.8	1
Cadmium	LSL-48_5/20/1998	19.1	1
Cadmium	FML-308-SF	7.8	1
Cadmium	MW-19-1_10/1/1998	16.7	1
Cadmium	MW-15-1_10/1/1998	156	1
Cadmium	LSL-54_5/20/1998	53.9	1
Cadmium	FML-300-SB	0.46	1
Cadmium	LSL-50_5/19/1998	45.8	1
Cadmium	FML-303-SF	13	1
Cadmium	LSL-62_5/20/1998	17.9	1
Cadmium	AWI-213-SF	0.93	1
Cadmium	LSL-47_5/20/1998	9.3	1
Cadmium	MW-12-1_10/1/1998	0.13	0
Cadmium	LSL-59_5/19/1998	0.15	0
Cadmium	LSL-49_5/20/1998	19.5	1
Cadmium	AWI-216-SF	2.3	1
Cadmium	LSL-45_5/19/1998	0.49	1
Cadmium	LSL-51_5/19/1998	15.4	1
Cadmium	MW-4B-1_10/1/1998	90.9	1
Cadmium	AWI-214-SF	2.6	1
Cadmium	MW-16-1_10/1/1998	6.3	1
Cadmium	MW-21-1_10/1/1998	14.6	1
Cadmium	MW-2B-1_10/1/1998	2.5	1
Cadmium	LSD-24-01_5/26/1998	6.3	1
Cadmium	FML-305-SF	1.6	1
Cadmium	LSD-23-01_5/26/1998	12.3	1
Cadmium	LSD-25-01_5/26/1998	4.9	1
Cadmium	LSL-57_5/20/1998	44.1	1
Cadmium	LSD-14_6/1/1996	17	1
Cadmium	LSL-60_5/20/1998	5.3	1
Cadmium	MW-17-1_10/1/1998	2.2	1
Cadmium	LSD-11_6/1/1996	8.91	1
Cadmium	LSL-56_5/20/1998	55.8	1
Cadmium	FML-306-SF	0.57	1
Cadmium	FML-304-SF	6.2	1
Cadmium	AWI-215-SF	140	1
Cadmium	FML-302-SF	2.7	1
Cadmium	FML-301-SF	4.5	1
Cadmium	FML-307-SF	0.54	0
Cadmium	SO-5_11/29/1989	0.801	0
Cadmium	LSL-53_5/20/1998	63.1	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:02:57 PM
From File	Soils_f.xls
Full Precision	OFF

Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	46	Number of Distinct Observations	44
Number of Detects	41	Number of Non-Detects	5
Number of Distinct Detects	40	Number of Distinct Non-Detects	5
Minimum Detect	0.46	Minimum Non-Detect	0.13
Maximum Detect	156	Maximum Non-Detect	0.801
Variance Detects	1298	Percent Non-Detects	10.87%
Mean Detects	24.47	SD Detects	36.03
Median Detects	9.3	CV Detects	1.472
Skewness Detects	2.368	Kurtosis Detects	5.631
Mean of Logged Detects	2.252	SD of Logged Detects	1.499

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.666	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.311	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.137	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	21.84	KM Standard Error of Mean	5.14
KM SD	34.43	95% KM (BCA) UCL	31.2
95% KM (t) UCL	30.47	95% KM (Percentile Bootstrap) UCL	30.73
95% KM (z) UCL	30.29	95% KM Bootstrap t UCL	33.41
90% KM Chebyshev UCL	37.26	95% KM Chebyshev UCL	44.24
97.5% KM Chebyshev UCL	53.94	99% KM Chebyshev UCL	72.98

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.833	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.799	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.158	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.144	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.646	k star (bias corrected MLE)	0.615
Theta hat (MLE)	37.86	Theta star (bias corrected MLE)	39.77
nu hat (MLE)	53.01	nu star (bias corrected)	50.46
Mean (detects)	24.47		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	21.82
Maximum	156	Median	7.05
SD	34.83	CV	1.596
k hat (MLE)	0.415	k star (bias corrected MLE)	0.403
Theta hat (MLE)	52.56	Theta star (bias corrected MLE)	54.2

nu hat (MLE)	38.19	nu star (bias corrected)	37.03
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (37.03, α)	24.1	Adjusted Chi Square Value (37.03, β)	23.76
95% Gamma Approximate UCL (use when n>=50)	33.52	95% Gamma Adjusted UCL (use when n<50)	34

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	21.84	SD (KM)	34.43
Variance (KM)	1185	SE of Mean (KM)	5.14
k hat (KM)	0.402	k star (KM)	0.391
nu hat (KM)	37.02	nu star (KM)	35.94
theta hat (KM)	54.28	theta star (KM)	55.91
80% gamma percentile (KM)	35.15	90% gamma percentile (KM)	61.95
95% gamma percentile (KM)	91.49	99% gamma percentile (KM)	166

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (35.94, α)	23.22	Adjusted Chi Square Value (35.94, β)	22.89
95% Gamma Approximate KM-UCL (use when n>=50)	33.8	95% Gamma Adjusted KM-UCL (use when n<50)	34.29

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.072	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.137	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	21.86	Mean in Log Scale	1.902
SD in Original Scale	34.8	SD in Log Scale	1.742
95% t UCL (assumes normality of ROS data)	30.48	95% Percentile Bootstrap UCL	30.51
95% BCA Bootstrap UCL	32.44	95% Bootstrap t UCL	34.57
95% H-UCL (Log ROS)	70.74		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.83	KM Geo Mean	6.236
KM SD (logged)	1.858	95% Critical H Value (KM-Log)	3.386
KM Standard Error of Mean (logged)	0.279	95% H-UCL (KM -Log)	89.51
KM SD (logged)	1.858	95% Critical H Value (KM-Log)	3.386
KM Standard Error of Mean (logged)	0.279		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	21.84	Mean in Log Scale	1.816
SD in Original Scale	34.81	SD in Log Scale	1.911
95% t UCL (Assumes normality)	30.46	95% H-Stat UCL	102.4

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	89.51

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Chromium

Parameter	Sample ID	Val	D_Val
Chromium	LSL-57_5/20/1998	54.1	1
Chromium	FML-301-SF	15	1
Chromium	FML-305-SF	19	1
Chromium	MW-14-1_10/1/1998	0.24	1
Chromium	LSL-49_5/20/1998	24.6	1
Chromium	MW-2B-1_10/1/1998	16.1	1
Chromium	LSL-54_5/20/1998	61.2	1
Chromium	LSD-23-01_5/26/1998	51.3	1
Chromium	LSL-47_5/20/1998	23.7	1
Chromium	FML-303-SF	30	1
Chromium	LSL-51_5/19/1998	37.1	1
Chromium	MW-12-1_10/1/1998	4.3	1
Chromium	AWI-216-SF	19	1
Chromium	LSL-53_5/20/1998	76.3	1
Chromium	AWI-213-SF	13	1
Chromium	LSL-56_5/20/1998	96.6	1
Chromium	SO-5_11/29/1989	29.6	1
Chromium	LSL-60_5/20/1998	24.3	1
Chromium	FML-306-SF	23	1
Chromium	LSL-62_5/20/1998	48.5	1
Chromium	LSL-45_5/19/1998	33	1
Chromium	MW-21-1_10/1/1998	41.5	1
Chromium	FML-307-SF	4.2	1
Chromium	AWI-215-SF	61	1
Chromium	LSL-48_5/20/1998	21.4	1
Chromium	FML-309-SF	17	1
Chromium	LSD-25-01_5/26/1998	16.6	1
Chromium	MW-17-1_10/1/1998	15.8	1
Chromium	LSL-59_5/19/1998	15.4	1
Chromium	MW-20-1_10/1/1998	47.6	1
Chromium	MW-4B-1_10/1/1998	337	1
Chromium	FML-302-SF	9.1	1
Chromium	MW-16-1_10/1/1998	17.1	1
Chromium	FML-304-SF	24	1
Chromium	MW-15-1_10/1/1998	211	1
Chromium	MW-13-1_10/1/1998	31.1	1
Chromium	FML-308-SF	23	1
Chromium	LSL-46_5/20/1998	35.2	1
Chromium	FML-300-SB	4.8	1
Chromium	MW-19-1_10/1/1998	41.3	1
Chromium	LSL-61_5/20/1998	47.2	1
Chromium	LSD-11_6/1/1996	19.3	1
Chromium	FML-310-SF	20	1
Chromium	LSD-14_6/1/1996	15.8	1
Chromium	LSD-24-01_5/26/1998	36.4	1
Chromium	LSL-50_5/19/1998	72.8	1
Chromium	AWI-214-SF	25	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 5:02:37 PM
From File	Soils_g.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	0.24	Mean	40.65
Maximum	337	Median	24.3
SD	55.23	Std. Error of Mean	8.056
Coefficient of Variation	1.359	Skewness	4.149

Normal GOF Test

Shapiro Wilk Test Statistic	0.537	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.255	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.128	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	54.17	95% Adjusted-CLT UCL (Chen-1995)	59.11
		95% Modified-t UCL (Johnson-1978)	54.99

Gamma GOF Test

A-D Test Statistic	1.625	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.775	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.164	k star (bias corrected MLE)	1.104
Theta hat (MLE)	34.92	Theta star (bias corrected MLE)	36.82
nu hat (MLE)	109.4	nu star (bias corrected)	103.8
MLE Mean (bias corrected)	40.65	MLE Sd (bias corrected)	38.69
		Approximate Chi Square Value (0.05)	81.26
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	80.63

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	51.91	95% Adjusted Gamma UCL (use when n<50)	52.31

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.884	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.192	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.128	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.427	Mean of logged Data	3.217
Maximum of Logged Data	5.82	SD of logged Data	1.089

Assuming Lognormal Distribution

95% H-UCL	66.68	90% Chebyshev (MVUE) UCL	69.6
95% Chebyshev (MVUE) UCL	81.06	97.5% Chebyshev (MVUE) UCL	96.97
99% Chebyshev (MVUE) UCL	128.2		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	53.9	95% Jackknife UCL	54.17
95% Standard Bootstrap UCL	53.97	95% Bootstrap-t UCL	74.43
95% Hall's Bootstrap UCL	118.9	95% Percentile Bootstrap UCL	55.1
95% BCA Bootstrap UCL	61.23		
90% Chebyshev(Mean, Sd) UCL	64.82	95% Chebyshev(Mean, Sd) UCL	75.76
97.5% Chebyshev(Mean, Sd) UCL	90.96	99% Chebyshev(Mean, Sd) UCL	120.8

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	75.76

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Copper

Parameter	Sample ID	Val	D_Val
Copper	LSD-24-01_5/26/1998	49.7	1
Copper	FML-309-SF	73	1
Copper	LSL-46_5/20/1998	34.1	1
Copper	LSL-51_5/19/1998	26.1	1
Copper	FML-305-SF	14	1
Copper	LSL-49_5/20/1998	33.5	1
Copper	LSL-53_5/20/1998	79.8	1
Copper	LSL-48_5/20/1998	24.3	1
Copper	LSL-45_5/19/1998	37	1
Copper	LSL-50_5/19/1998	91.8	1
Copper	FML-304-SF	53	1
Copper	FML-308-SF	47	1
Copper	FML-301-SF	49	1
Copper	LSD-25-01_5/26/1998	24.7	1
Copper	FML-310-SF	9.6	1
Copper	MW-12-1_10/1/1998	3.5	1
Copper	LSL-54_5/20/1998	73.2	1
Copper	LSL-47_5/20/1998	24.8	1
Copper	MW-14-1_10/1/1998	6.7	1
Copper	MW-2B-1_10/1/1998	49.5	1
Copper	MW-16-1_10/1/1998	19.2	1
Copper	MW-15-1_10/1/1998	4420	1
Copper	MW-19-1_10/1/1998	39.2	1
Copper	AWI-216-SF	99	1
Copper	MW-20-1_10/1/1998	62.5	1
Copper	MW-4B-1_10/1/1998	1730	1
Copper	AWI-215-SF	100	1
Copper	MW-21-1_10/1/1998	50.6	1
Copper	FML-307-SF	6.5	1
Copper	FML-302-SF	47	1
Copper	FML-300-SB	28	1
Copper	AWI-214-SF	110	1
Copper	FML-303-SF	710	1
Copper	AWI-213-SF	78	1
Copper	MW-13-1_10/1/1998	84.2	1
Copper	FML-306-SF	39	1
Copper	LSL-57_5/20/1998	136	1
Copper	LSL-61_5/20/1998	52.6	1
Copper	LSD-23-01_5/26/1998	76.5	1
Copper	MW-17-1_10/1/1998	6.9	1
Copper	LSL-59_5/19/1998	5.1	1
Copper	LSD-11_6/1/1996	48.8	1
Copper	LSL-62_5/20/1998	55	1
Copper	LSL-60_5/20/1998	116	1
Copper	LSD-14_6/1/1996	73.7	1
Copper	LSL-56_5/20/1998	91.7	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:01:59 PM
From File	Soils_i.xls
Full Precision	OFF

Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	46	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	3.5	Mean	197.6
Maximum	4420	Median	49.6
SD	689.6	Std. Error of Mean	101.7
Coefficient of Variation	3.49	Skewness	5.587

Normal GOF Test

Shapiro Wilk Test Statistic	0.278	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.47	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	368.4	95% Adjusted-CLT UCL (Chen-1995)	454.3
		95% Modified-t UCL (Johnson-1978)	382.3

Gamma GOF Test

A-D Test Statistic	6.366	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.823	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.344	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.463	k star (bias corrected MLE)	0.447
Theta hat (MLE)	426.6	Theta star (bias corrected MLE)	441.6
nu hat (MLE)	42.61	nu star (bias corrected)	41.17
MLE Mean (bias corrected)	197.6	MLE Sd (bias corrected)	295.4
		Approximate Chi Square Value (0.05)	27.46
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	27.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	296.2	95% Adjusted Gamma UCL (use when n<50)	300.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.17	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.253	Mean of logged Data	3.898
Maximum of Logged Data	8.394	SD of logged Data	1.313

Assuming Lognormal Distribution

95% H-UCL	197.3	90% Chebyshev (MVUE) UCL	195.8
95% Chebyshev (MVUE) UCL	233.3	97.5% Chebyshev (MVUE) UCL	285.4
99% Chebyshev (MVUE) UCL	387.7		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	364.8	95% Jackknife UCL	368.4
95% Standard Bootstrap UCL	367.3	95% Bootstrap-t UCL	1134
95% Hall's Bootstrap UCL	1188	95% Percentile Bootstrap UCL	382.4
95% BCA Bootstrap UCL	536.9		
90% Chebyshev(Mean, Sd) UCL	502.6	95% Chebyshev(Mean, Sd) UCL	640.8
97.5% Chebyshev(Mean, Sd) UCL	832.6	99% Chebyshev(Mean, Sd) UCL	1209

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	640.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Lead

Parameter	Sample ID	Val	D_Val
Lead	SO-5_11/29/1989	39.3	1
Lead	LSD-25-01_5/26/1998	91.4	1
Lead	FML-302-SF	25	1
Lead	FML-307-SF	5	1
Lead	FML-300-SB	20	1
Lead	LSD-14_6/1/1996	41.6	1
Lead	LSD-24-01_5/26/1998	189	1
Lead	FML-303-SF	560	1
Lead	LSD-23-01_5/26/1998	280	1
Lead	FML-309-SF	57	1
Lead	LSL-60_5/20/1998	63.5	1
Lead	FML-305-SF	35	1
Lead	FML-310-SF	17	1
Lead	MW-13-1_10/1/1998	2900	1
Lead	LSD-11_6/1/1996	52.2	1
Lead	MW-15-1_10/1/1998	395	1
Lead	FML-301-SF	150	1
Lead	LSL-51_5/19/1998	61.2	1
Lead	MW-2B-1_10/1/1998	47.1	1
Lead	LSL-46_5/20/1998	156	1
Lead	MW-4B-1_10/1/1998	382	1
Lead	MW-17-1_10/1/1998	26.5	1
Lead	FML-304-SF	90	1
Lead	FML-308-SF	90	1
Lead	LSL-50_5/19/1998	100	1
Lead	LSL-59_5/19/1998	12.4	1
Lead	MW-16-1_10/1/1998	70.4	1
Lead	LSL-57_5/20/1998	190	1
Lead	MW-19-1_10/1/1998	83.1	1
Lead	LSL-61_5/20/1998	55.1	1
Lead	MW-12-1_10/1/1998	5.7	1
Lead	LSL-56_5/20/1998	183	1
Lead	LSL-62_5/20/1998	183	1
Lead	MW-14-1_10/1/1998	12	1
Lead	MW-20-1_10/1/1998	222	1
Lead	LSL-48_5/20/1998	51.2	1
Lead	AWI-214-SF	87	1
Lead	MW-21-1_10/1/1998	203	1
Lead	LSL-54_5/20/1998	184	1
Lead	FML-306-SF	37	1
Lead	AWI-216-SF	57	1
Lead	LSL-47_5/20/1998	73.4	1
Lead	LSL-45_5/19/1998	57.8	1
Lead	LSL-49_5/20/1998	73.7	1
Lead	AWI-215-SF	54	1
Lead	AWI-213-SF	51	1
Lead	LSL-53_5/20/1998	133	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 5:01:35 PM
From File	Soils_j.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	5	Mean	169.2
Maximum	2900	Median	70.4
SD	422	Std. Error of Mean	61.56
Coefficient of Variation	2.494	Skewness	6.158

Normal GOF Test

Shapiro Wilk Test Statistic	0.33	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.349	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.128	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	272.5	95% Adjusted-CLT UCL (Chen-1995)	329.5
		95% Modified-t UCL (Johnson-1978)	281.8

Gamma GOF Test

A-D Test Statistic	2.331	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.792	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.188	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.134	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.736	k star (bias corrected MLE)	0.703
Theta hat (MLE)	229.9	Theta star (bias corrected MLE)	240.7
nu hat (MLE)	69.17	nu star (bias corrected)	66.09
MLE Mean (bias corrected)	169.2	MLE Sd (bias corrected)	201.8
		Approximate Chi Square Value (0.05)	48.38
Adjusted Level of Significance	0.0449	Adjusted Chi Square Value	47.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	231.1	95% Adjusted Gamma UCL (use when n<50)	233.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.946	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0941	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.128	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.609	Mean of logged Data	4.316
Maximum of Logged Data	7.972	SD of logged Data	1.163

Assuming Lognormal Distribution

95% H-UCL	226.3	90% Chebyshev (MVUE) UCL	233.1
95% Chebyshev (MVUE) UCL	273.6	97.5% Chebyshev (MVUE) UCL	329.8
99% Chebyshev (MVUE) UCL	440.1		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	270.5	95% Jackknife UCL	272.5
95% Standard Bootstrap UCL	267.3	95% Bootstrap-t UCL	532.4
95% Hall's Bootstrap UCL	638.7	95% Percentile Bootstrap UCL	289.2
95% BCA Bootstrap UCL	376.7		
90% Chebyshev(Mean, Sd) UCL	353.9	95% Chebyshev(Mean, Sd) UCL	437.5
97.5% Chebyshev(Mean, Sd) UCL	553.6	99% Chebyshev(Mean, Sd) UCL	781.7

Suggested UCL to Use

95% H-UCL	226.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Soil - Mercury

Parameter	Sample ID	Val	D_Val
Mercury	LSL-60_5/20/1998	0.16	1
Mercury	MW-17-1_10/1/1998	0.04	1
Mercury	LSL-45_5/19/1998	0.06	1
Mercury	LSL-59_5/19/1998	0.07	1
Mercury	LSL-47_5/20/1998	0.63	1
Mercury	LSD-11_6/1/1996	0.047	0
Mercury	LSL-57_5/20/1998	1.5	1
Mercury	LSD-14_6/1/1996	0.11	0
Mercury	LSL-56_5/20/1998	2.5	1
Mercury	LSD-23-01_5/26/1998	2.8	1
Mercury	LSL-54_5/20/1998	0.68	1
Mercury	FML-306-SF	0.13	0
Mercury	LSD-24-01_5/26/1998	0.35	1
Mercury	LSL-53_5/20/1998	1.8	1
Mercury	SO-5_11/29/1989	0.1895	0
Mercury	MW-19-1_10/1/1998	1.1	1
Mercury	AWI-213-SF	0.086	1
Mercury	FML-303-SF	0.47	1
Mercury	AWI-214-SF	0.29	1
Mercury	FML-300-SB	0.11	0
Mercury	FML-302-SF	0.69	1
Mercury	MW-21-1_10/1/1998	1.2	1
Mercury	FML-307-SF	0.11	0
Mercury	MW-20-1_10/1/1998	3.7	1
Mercury	LSL-62_5/20/1998	1.7	1
Mercury	AWI-215-SF	0.25	1
Mercury	LSL-61_5/20/1998	3.9	1
Mercury	MW-13-1_10/1/1998	0.44	1
Mercury	MW-15-1_10/1/1998	0.07	1
Mercury	MW-16-1_10/1/1998	0.21	1
Mercury	MW-2B-1_10/1/1998	0.17	1
Mercury	MW-14-1_10/1/1998	0.08	1
Mercury	MW-4B-1_10/1/1998	0.91	1
Mercury	MW-12-1_10/1/1998	0.04	1
Mercury	LSD-25-01_5/26/1998	0.36	1
Mercury	AWI-216-SF	0.17	0
Mercury	FML-310-SF	0.11	0
Mercury	LSL-49_5/20/1998	1.7	1
Mercury	FML-301-SF	0.14	0
Mercury	FML-308-SF	1.2	1
Mercury	LSL-50_5/19/1998	2.2	1
Mercury	LSL-48_5/20/1998	0.57	1
Mercury	LSL-46_5/20/1998	0.84	1
Mercury	LSL-51_5/19/1998	0.48	1
Mercury	FML-304-SF	0.32	0
Mercury	FML-305-SF	0.51	1
Mercury	FML-309-SF	0.59	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 5:01:14 PM
From File	Soils_k.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	39
Number of Detects	36	Number of Non-Detects	11
Number of Distinct Detects	32	Number of Distinct Non-Detects	8
Minimum Detect	0.04	Minimum Non-Detect	0.047
Maximum Detect	3.9	Maximum Non-Detect	0.59
Variance Detects	1.033	Percent Non-Detects	23.4%
Mean Detects	0.938	SD Detects	1.017
Median Detects	0.54	CV Detects	1.084
Skewness Detects	1.544	Kurtosis Detects	1.904
Mean of Logged Detects	-0.737	SD of Logged Detects	1.315

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.806	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.145	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.736	KM Standard Error of Mean	0.141
KM SD	0.951	95% KM (BCA) UCL	0.997
95% KM (t) UCL	0.972	95% KM (Percentile Bootstrap) UCL	0.974
95% KM (z) UCL	0.967	95% KM Bootstrap t UCL	1.045
90% KM Chebyshev UCL	1.158	95% KM Chebyshev UCL	1.349
97.5% KM Chebyshev UCL	1.615	99% KM Chebyshev UCL	2.136

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.28	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.782	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0828	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.152	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.873	k star (bias corrected MLE)	0.819
Theta hat (MLE)	1.074	Theta star (bias corrected MLE)	1.146
nu hat (MLE)	62.84	nu star (bias corrected)	58.94
Mean (detects)	0.938		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.722
Maximum	3.9	Median	0.35
SD	0.971	CV	1.345
k hat (MLE)	0.498	k star (bias corrected MLE)	0.481

Theta hat (MLE)	1.448	Theta star (bias corrected MLE)	1.501
nu hat (MLE)	46.85	nu star (bias corrected)	45.19
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (45.19, α)	30.77	Adjusted Chi Square Value (45.19, β)	30.39
95% Gamma Approximate UCL (use when n>=50)	1.06	95% Gamma Adjusted UCL (use when n<50)	1.073

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.736	SD (KM)	0.951
Variance (KM)	0.904	SE of Mean (KM)	0.141
k hat (KM)	0.599	k star (KM)	0.575
nu hat (KM)	56.31	nu star (KM)	54.05
theta hat (KM)	1.228	theta star (KM)	1.28
80% gamma percentile (KM)	1.213	90% gamma percentile (KM)	1.932
95% gamma percentile (KM)	2.689	99% gamma percentile (KM)	4.526

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (54.05, α)	38.16	Adjusted Chi Square Value (54.05, β)	37.73
95% Gamma Approximate KM-UCL (use when n>=50)	1.042	95% Gamma Adjusted KM-UCL (use when n<50)	1.054

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.935	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0986	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.145	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.738	Mean in Log Scale	-1.168
SD in Original Scale	0.959	SD in Log Scale	1.411
95% t UCL (assumes normality of ROS data)	0.973	95% Percentile Bootstrap UCL	0.967
95% BCA Bootstrap UCL	1.035	95% Bootstrap t UCL	1.04
95% H-UCL (Log ROS)	1.508		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.212	KM Geo Mean	0.298
KM SD (logged)	1.445	95% Critical H Value (KM-Log)	2.851
KM Standard Error of Mean (logged)	0.217	95% H-UCL (KM -Log)	1.551
KM SD (logged)	1.445	95% Critical H Value (KM-Log)	2.851
KM Standard Error of Mean (logged)	0.217		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.74	Mean in Log Scale	-1.173
SD in Original Scale	0.958	SD in Log Scale	1.43
95% t UCL (Assumes normality)	0.974	95% H-Stat UCL	1.563

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	1.054

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

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

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

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

Soil - Nickel

Parameter	Sample ID	Val	D_Val
Nickel	MW-12-1_10/1/1998	3.4	1
Nickel	MW-4B-1_10/1/1998	118	1
Nickel	LSL-62_5/20/1998	12.5	1
Nickel	LSL-61_5/20/1998	8.1	1
Nickel	FML-308-SF	8.2	1
Nickel	AWI-216-SF	9.7	1
Nickel	MW-17-1_10/1/1998	4.4	1
Nickel	LSL-59_5/19/1998	3	1
Nickel	LSL-49_5/20/1998	5.8	1
Nickel	LSL-60_5/20/1998	10.3	1
Nickel	LSD-11_6/1/1996	8.18	1
Nickel	LSL-57_5/20/1998	16.1	1
Nickel	FML-305-SF	5	1
Nickel	MW-20-1_10/1/1998	11.7	1
Nickel	AWI-213-SF	5.1	1
Nickel	FML-303-SF	14	1
Nickel	LSL-46_5/20/1998	8.8	1
Nickel	AWI-214-SF	12	1
Nickel	FML-300-SB	1.7	1
Nickel	LSL-47_5/20/1998	490	1
Nickel	FML-302-SF	3.1	1
Nickel	MW-21-1_10/1/1998	10.3	1
Nickel	MW-14-1_10/1/1998	2.7	1
Nickel	FML-307-SF	0.23	1
Nickel	LSD-14_6/1/1996	10	1
Nickel	FML-309-SF	9.5	1
Nickel	FML-310-SF	1.6	1
Nickel	MW-19-1_10/1/1998	9.8	1
Nickel	MW-13-1_10/1/1998	12.9	1
Nickel	AWI-215-SF	9.9	1
Nickel	MW-15-1_10/1/1998	236	1
Nickel	MW-16-1_10/1/1998	5.1	1
Nickel	LSL-48_5/20/1998	16.2	1
Nickel	MW-2B-1_10/1/1998	3.9	1
Nickel	LSL-45_5/19/1998	8.9	1
Nickel	FML-306-SF	6.1	1
Nickel	LSD-23-01_5/26/1998	17.7	1
Nickel	LSL-53_5/20/1998	11.6	1
Nickel	LSL-54_5/20/1998	14.2	1
Nickel	FML-304-SF	7.5	1
Nickel	LSL-50_5/19/1998	8.7	1
Nickel	LSD-25-01_5/26/1998	5.9	1
Nickel	LSL-56_5/20/1998	16.6	1
Nickel	LSL-51_5/19/1998	9.4	1
Nickel	FML-301-SF	5	1
Nickel	LSD-24-01_5/26/1998	11.4	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 4:55:53 PM
From File	Soils_m.xls
Full Precision	OFF

Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	46	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	0.23	Mean	26.31
Maximum	490	Median	9.15
SD	79.14	Std. Error of Mean	11.67
Coefficient of Variation	3.008	Skewness	5.129

Normal GOF Test

Shapiro Wilk Test Statistic	0.305	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.478	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	45.9	95% Adjusted-CLT UCL (Chen-1995)	54.93
		95% Modified-t UCL (Johnson-1978)	47.37

Gamma GOF Test

A-D Test Statistic	6.949	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.808	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.364	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.137	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.565	k star (bias corrected MLE)	0.543
Theta hat (MLE)	46.56	Theta star (bias corrected MLE)	48.48
nu hat (MLE)	51.98	nu star (bias corrected)	49.93
MLE Mean (bias corrected)	26.31	MLE Sd (bias corrected)	35.71
		Approximate Chi Square Value (0.05)	34.7
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	34.29

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	37.85	95% Adjusted Gamma UCL (use when n<50)	38.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.854	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.945	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.21	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.129	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.47	Mean of logged Data	2.167
Maximum of Logged Data	6.194	SD of logged Data	1.181

Assuming Lognormal Distribution

95% H-UCL	27.37	90% Chebyshev (MVUE) UCL	28.07
95% Chebyshev (MVUE) UCL	33.03	97.5% Chebyshev (MVUE) UCL	39.92
99% Chebyshev (MVUE) UCL	53.45		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	45.5	95% Jackknife UCL	45.9
95% Standard Bootstrap UCL	45.02	95% Bootstrap-t UCL	102.6
95% Hall's Bootstrap UCL	110.8	95% Percentile Bootstrap UCL	46.81
95% BCA Bootstrap UCL	57.59		
90% Chebyshev(Mean, Sd) UCL	61.31	95% Chebyshev(Mean, Sd) UCL	77.17
97.5% Chebyshev(Mean, Sd) UCL	99.17	99% Chebyshev(Mean, Sd) UCL	142.4

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	77.17

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Selenium

Parameter	Sample ID	Val	D_Val
Selenium	MW-19-1_10/1/1998	2.3	1
Selenium	LSD-24-01_5/26/1998	1.8	1
Selenium	FML-302-SF	4.1	0
Selenium	LSL-61_5/20/1998	0.92	1
Selenium	LSL-62_5/20/1998	0.61	0
Selenium	LSL-51_5/19/1998	1.5	1
Selenium	LSL-48_5/20/1998	0.59	1
Selenium	MW-12-1_10/1/1998	0.27	0
Selenium	LSD-25-01_5/26/1998	1.9	1
Selenium	FML-305-SF	6.7	0
Selenium	MW-13-1_10/1/1998	0.96	1
Selenium	LSL-47_5/20/1998	0.4	0
Selenium	FML-301-SF	5	0
Selenium	FML-300-SB	3.9	0
Selenium	LSL-50_5/19/1998	0.92	0
Selenium	AWI-215-SF	7.2	1
Selenium	MW-14-1_10/1/1998	0.63	1
Selenium	MW-16-1_10/1/1998	0.59	1
Selenium	MW-2B-1_10/1/1998	0.56	1
Selenium	FML-308-SF	12	0
Selenium	AWI-214-SF	4.6	0
Selenium	MW-15-1_10/1/1998	2.5	1
Selenium	LSD-23-01_5/26/1998	3.5	1
Selenium	FML-304-SF	12	0
Selenium	LSL-46_5/20/1998	0.73	1
Selenium	FML-306-SF	1.2	1
Selenium	FML-303-SF	0.92	1
Selenium	MW-20-1_10/1/1998	2.2	1
Selenium	LSL-56_5/20/1998	2	1
Selenium	LSL-54_5/20/1998	1.7	1
Selenium	MW-4B-1_10/1/1998	2.5	1
Selenium	FML-307-SF	3.8	0
Selenium	LSL-57_5/20/1998	1.6	1
Selenium	LSD-11_6/1/1996	0.14	0
Selenium	LSL-49_5/20/1998	0.85	1
Selenium	LSL-60_5/20/1998	0.71	1
Selenium	SO-5_11/29/1989	0.286	0
Selenium	LSL-59_5/19/1998	0.31	0
Selenium	LSL-53_5/20/1998	2.3	1
Selenium	MW-17-1_10/1/1998	1.2	1
Selenium	MW-21-1_10/1/1998	2.9	1
Selenium	FML-310-SF	4	0
Selenium	LSL-45_5/19/1998	0.62	1
Selenium	LSD-14_6/1/1996	0.33	0
Selenium	AWI-213-SF	4.6	0
Selenium	AWI-216-SF	1.7	1
Selenium	FML-309-SF	20	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 4:55:04 PM
From File	Soils_o.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	38
Number of Detects	28	Number of Non-Detects	19
Number of Distinct Detects	22	Number of Distinct Non-Detects	17
Minimum Detect	0.56	Minimum Non-Detect	0.14
Maximum Detect	7.2	Maximum Non-Detect	20
Variance Detects	1.791	Percent Non-Detects	40.43%
Mean Detects	1.717	SD Detects	1.338
Median Detects	1.55	CV Detects	0.779
Skewness Detects	2.701	Kurtosis Detects	10.03
Mean of Logged Detects	0.329	SD of Logged Detects	0.642

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.737	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.164	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	1.348	KM Standard Error of Mean	0.204
KM SD	1.257	95% KM (BCA) UCL	1.747
95% KM (t) UCL	1.691	95% KM (Percentile Bootstrap) UCL	1.725
95% KM (z) UCL	1.684	95% KM Bootstrap t UCL	1.759
90% KM Chebyshev UCL	1.96	95% KM Chebyshev UCL	2.238
97.5% KM Chebyshev UCL	2.622	99% KM Chebyshev UCL	3.378

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.564	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.125	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.167	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.512	k star (bias corrected MLE)	2.266
Theta hat (MLE)	0.684	Theta star (bias corrected MLE)	0.758
nu hat (MLE)	140.7	nu star (bias corrected)	126.9
Mean (detects)	1.717		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	1.263
Maximum	7.2	Median	0.975
SD	1.218	CV	0.964
k hat (MLE)	0.772	k star (bias corrected MLE)	0.737

Theta hat (MLE)	1.637	Theta star (bias corrected MLE)	1.715
nu hat (MLE)	72.53	nu star (bias corrected)	69.23
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (69.23, α)	51.08	Adjusted Chi Square Value (69.23, β)	50.59
95% Gamma Approximate UCL (use when n>=50)	1.712	95% Gamma Adjusted UCL (use when n<50)	1.729

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.348	SD (KM)	1.257
Variance (KM)	1.581	SE of Mean (KM)	0.204
k hat (KM)	1.15	k star (KM)	1.091
nu hat (KM)	108.1	nu star (KM)	102.5
theta hat (KM)	1.173	theta star (KM)	1.236
80% gamma percentile (KM)	2.154	90% gamma percentile (KM)	3.039
95% gamma percentile (KM)	3.918	99% gamma percentile (KM)	5.946

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (102.53, α)	80.16	Adjusted Chi Square Value (102.53, β)	79.54
95% Gamma Approximate KM-UCL (use when n>=50)	1.725	95% Gamma Adjusted KM-UCL (use when n<50)	1.738

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.164	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.325	Mean in Log Scale	0.0256
SD in Original Scale	1.156	SD in Log Scale	0.702
95% t UCL (assumes normality of ROS data)	1.608	95% Percentile Bootstrap UCL	1.625
95% BCA Bootstrap UCL	1.683	95% Bootstrap t UCL	1.748
95% H-UCL (Log ROS)	1.62		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.155	KM Geo Mean	0.856
KM SD (logged)	1.06	95% Critical H Value (KM-Log)	2.396
KM Standard Error of Mean (logged)	0.181	95% H-UCL (KM -Log)	2.183
KM SD (logged)	1.06	95% Critical H Value (KM-Log)	2.396
KM Standard Error of Mean (logged)	0.181		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.916	Mean in Log Scale	0.165
SD in Original Scale	1.947	SD in Log Scale	1.106
95% t UCL (Assumes normality)	2.393	95% H-Stat UCL	3.242

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	1.738	95% GROS Adjusted Gamma UCL	1.729

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

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

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

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

Soil - Silver

Parameter	Sample ID	Val	D_Val
Silver	FML-301-SF	1.4	0
Silver	FML-307-SF	1.1	0
Silver	MW-16-1_10/1/1998	0.3	0
Silver	MW-15-1_10/1/1998	0.35	1
Silver	MW-21-1_10/1/1998	0.56	0
Silver	MW-20-1_10/1/1998	0.57	0
Silver	MW-13-1_10/1/1998	0.23	1
Silver	LSD-24-01_5/26/1998	0.92	0
Silver	FML-309-SF	5.6	0
Silver	LSL-47_5/20/1998	0.81	1
Silver	LSL-51_5/19/1998	1.3	1
Silver	FML-310-SF	1.1	0
Silver	MW-19-1_10/1/1998	0.59	0
Silver	FML-302-SF	1.2	0
Silver	LSL-45_5/19/1998	0.56	1
Silver	LSL-49_5/20/1998	0.63	1
Silver	LSL-54_5/20/1998	1.2	1
Silver	LSD-25-01_5/26/1998	0.9	0
Silver	AWI-213-SF	1.3	0
Silver	LSL-59_5/19/1998	0.42	1
Silver	MW-17-1_10/1/1998	0.28	0
Silver	SO-5_11/29/1989	1.36	0
Silver	FML-305-SF	1.9	0
Silver	LSL-60_5/20/1998	0.97	1
Silver	LSL-61_5/20/1998	1.2	1
Silver	AWI-216-SF	1.7	0
Silver	LSL-57_5/20/1998	0.81	1
Silver	LSL-56_5/20/1998	2.2	1
Silver	LSD-11_6/1/1996	1.7	1
Silver	LSL-46_5/20/1998	0.96	1
Silver	LSL-50_5/19/1998	1.9	1
Silver	FML-304-SF	3.4	0
Silver	FML-303-SF	1.3	0
Silver	LSD-23-01_5/26/1998	0.89	0
Silver	LSD-14_6/1/1996	0.86	0
Silver	FML-308-SF	3.4	0
Silver	AWI-215-SF	1.5	0
Silver	AWI-214-SF	1.3	0
Silver	LSL-53_5/20/1998	160	1
Silver	MW-2B-1_10/1/1998	0.37	1
Silver	FML-300-SB	1.1	0
Silver	LSL-48_5/20/1998	0.8	1
Silver	MW-4B-1_10/1/1998	5.7	1
Silver	MW-12-1_10/1/1998	0.22	0
Silver	FML-306-SF	1.4	0
Silver	LSL-62_5/20/1998	1.3	1
Silver	MW-14-1_10/1/1998	0.28	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 4:53:54 PM
From File	Soils_p.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	32
Number of Detects	20	Number of Non-Detects	27
Number of Distinct Detects	17	Number of Distinct Non-Detects	20
Minimum Detect	0.23	Minimum Non-Detect	0.22
Maximum Detect	160	Maximum Non-Detect	5.6
Variance Detects	1262	Percent Non-Detects	57.45%
Mean Detects	9.17	SD Detects	35.52
Median Detects	0.965	CV Detects	3.873
Skewness Detects	4.464	Kurtosis Detects	19.95
Mean of Logged Detects	0.176	SD of Logged Detects	1.365

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.257	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.489	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	4.167	KM Standard Error of Mean	3.441
KM SD	22.99	95% KM (BCA) UCL	11.04
95% KM (t) UCL	9.944	95% KM (Percentile Bootstrap) UCL	10.91
95% KM (z) UCL	9.827	95% KM Bootstrap t UCL	151.3
90% KM Chebyshev UCL	14.49	95% KM Chebyshev UCL	19.17
97.5% KM Chebyshev UCL	25.66	99% KM Chebyshev UCL	38.41

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.546	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.838	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.426	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.209	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.332	k star (bias corrected MLE)	0.316
Theta hat (MLE)	27.58	Theta star (bias corrected MLE)	29.03
nu hat (MLE)	13.3	nu star (bias corrected)	12.64
Mean (detects)	9.17		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	3.908
Maximum	160	Median	0.01
SD	23.28	CV	5.958
k hat (MLE)	0.189	k star (bias corrected MLE)	0.191

Theta hat (MLE)	20.7	Theta star (bias corrected MLE)	20.47
nu hat (MLE)	17.74	nu star (bias corrected)	17.95
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (17.95, α)	9.351	Adjusted Chi Square Value (17.95, β)	9.154
95% Gamma Approximate UCL (use when n>=50)	7.5	95% Gamma Adjusted UCL (use when n<50)	7.661

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.167	SD (KM)	22.99
Variance (KM)	528.7	SE of Mean (KM)	3.441
k hat (KM)	0.0328	k star (KM)	0.0449
nu hat (KM)	3.087	nu star (KM)	4.223
theta hat (KM)	126.9	theta star (KM)	92.74
80% gamma percentile (KM)	0.378	90% gamma percentile (KM)	5.471
95% gamma percentile (KM)	21.22	99% gamma percentile (KM)	94.44

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.22, α)	0.812	Adjusted Chi Square Value (4.22, β)	0.768
95% Gamma Approximate KM-UCL (use when n>=50)	21.68	95% Gamma Adjusted KM-UCL (use when n<50)	22.93

95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.748	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.078	Mean in Log Scale	-0.72
SD in Original Scale	23.26	SD in Log Scale	1.277
95% t UCL (assumes normality of ROS data)	9.772	95% Percentile Bootstrap UCL	10.83
95% BCA Bootstrap UCL	17.54	95% Bootstrap t UCL	175.8
95% H-UCL (Log ROS)	1.809		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.483	KM Geo Mean	0.617
KM SD (logged)	1.131	95% Critical H Value (KM-Log)	2.474
KM Standard Error of Mean (logged)	0.189	95% H-UCL (KM -Log)	1.766
KM SD (logged)	1.131	95% Critical H Value (KM-Log)	2.474
KM Standard Error of Mean (logged)	0.189		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.29	Mean in Log Scale	-0.311
SD in Original Scale	23.22	SD in Log Scale	1.132
95% t UCL (Assumes normality)	9.977	95% H-Stat UCL	2.105

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

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	19.17

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.

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

Soil - Zinc

Parameter	Sample ID	Val	D_Val
Zinc	MW-21-1_10/1/1998	314	1
Zinc	FML-308-SF	210	1
Zinc	FML-302-SF	100	1
Zinc	FML-303-SF	1300	1
Zinc	AWI-213-SF	93	1
Zinc	FML-300-SB	32	1
Zinc	LSD-25-01_5/26/1998	240	1
Zinc	LSL-50_5/19/1998	90.5	1
Zinc	LSL-46_5/20/1998	207	1
Zinc	AWI-214-SF	120	1
Zinc	AWI-216-SF	120	1
Zinc	MW-15-1_10/1/1998	6580	1
Zinc	LSL-48_5/20/1998	74.2	1
Zinc	FML-305-SF	75	1
Zinc	LSL-61_5/20/1998	106	1
Zinc	LSL-54_5/20/1998	301	1
Zinc	LSL-59_5/19/1998	16.1	1
Zinc	MW-4B-1_10/1/1998	1500	1
Zinc	LSL-60_5/20/1998	140	1
Zinc	LSD-23-01_5/26/1998	566	1
Zinc	LSL-57_5/20/1998	566	1
Zinc	LSL-49_5/20/1998	115	1
Zinc	LSD-11_6/1/1996	136	1
Zinc	LSL-56_5/20/1998	247	1
Zinc	FML-306-SF	130	1
Zinc	FML-304-SF	270	1
Zinc	LSD-14_6/1/1996	230	1
Zinc	MW-17-1_10/1/1998	41.3	1
Zinc	MW-16-1_10/1/1998	130	1
Zinc	FML-309-SF	260	1
Zinc	FML-307-SF	6.5	0
Zinc	LSL-51_5/19/1998	103	1
Zinc	FML-310-SF	26	1
Zinc	MW-19-1_10/1/1998	162	1
Zinc	LSD-24-01_5/26/1998	431	1
Zinc	LSL-62_5/20/1998	222	1
Zinc	MW-13-1_10/1/1998	891	1
Zinc	MW-20-1_10/1/1998	412	1
Zinc	LSL-45_5/19/1998	99.7	1
Zinc	FML-301-SF	190	1
Zinc	AWI-215-SF	220	1
Zinc	MW-14-1_10/1/1998	14.8	1
Zinc	MW-2B-1_10/1/1998	111	1
Zinc	LSL-53_5/20/1998	243	1
Zinc	MW-12-1_10/1/1998	11.1	1
Zinc	LSL-47_5/20/1998	135	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 4:59:49 PM
From File	Soils_q.xls
Full Precision	OFF

Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	46	Number of Distinct Observations	43
Number of Detects	45	Number of Non-Detects	1
Number of Distinct Detects	42	Number of Distinct Non-Detects	1
Minimum Detect	11.1	Minimum Non-Detect	6.5
Maximum Detect	6580	Maximum Non-Detect	6.5
Variance Detects	981425	Percent Non-Detects	2.174%
Mean Detects	390.7	SD Detects	990.7
Median Detects	140	CV Detects	2.536
Skewness Detects	5.837	Kurtosis Detects	36.54
Mean of Logged Detects	5.093	SD of Logged Detects	1.192

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.34	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	382.4	KM Standard Error of Mean	144.7
KM SD	970.5	95% KM (BCA) UCL	651
95% KM (t) UCL	625.4	95% KM (Percentile Bootstrap) UCL	644.6
95% KM (z) UCL	620.4	95% KM Bootstrap t UCL	1237
90% KM Chebyshev UCL	816.5	95% KM Chebyshev UCL	1013
97.5% KM Chebyshev UCL	1286	99% KM Chebyshev UCL	1822

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.93	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.795	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.229	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.138	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.692	k star (bias corrected MLE)	0.661
Theta hat (MLE)	564.6	Theta star (bias corrected MLE)	591.3
nu hat (MLE)	62.28	nu star (bias corrected)	59.46
Mean (detects)	390.7		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	382.2
Maximum	6580	Median	138
SD	981.3	CV	2.567
k hat (MLE)	0.583	k star (bias corrected MLE)	0.56
Theta hat (MLE)	655.2	Theta star (bias corrected MLE)	682.7

nu hat (MLE)	53.67	nu star (bias corrected)	51.5
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (51.50, α)	36.02	Adjusted Chi Square Value (51.50, β)	35.6
95% Gamma Approximate UCL (use when n>=50)	546.5	95% Gamma Adjusted UCL (use when n<50)	552.9

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	382.4	SD (KM)	970.5
Variance (KM)	941894	SE of Mean (KM)	144.7
k hat (KM)	0.155	k star (KM)	0.16
nu hat (KM)	14.28	nu star (KM)	14.68
theta hat (KM)	2463	theta star (KM)	2396
80% gamma percentile (KM)	436.9	90% gamma percentile (KM)	1142
95% gamma percentile (KM)	2078	99% gamma percentile (KM)	4760

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (14.68, α)	7.041	Adjusted Chi Square Value (14.68, β)	6.869
95% Gamma Approximate KM-UCL (use when n>=50)	797.3	95% Gamma Adjusted KM-UCL (use when n<50)	817.2

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.945	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.131	Detected Data Not Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	382.4	Mean in Log Scale	5.028
SD in Original Scale	981.2	SD in Log Scale	1.259
95% t UCL (assumes normality of ROS data)	625.4	95% Percentile Bootstrap UCL	651.7
95% BCA Bootstrap UCL	827.3	95% Bootstrap t UCL	1217
95% H-UCL (Log ROS)	551.5		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	5.023	KM Geo Mean	151.9
KM SD (logged)	1.257	95% Critical H Value (KM-Log)	2.616
KM Standard Error of Mean (logged)	0.187	95% H-UCL (KM -Log)	546.6
KM SD (logged)	1.257	95% Critical H Value (KM-Log)	2.616
KM Standard Error of Mean (logged)	0.187		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	382.3	Mean in Log Scale	5.008
SD in Original Scale	981.3	SD in Log Scale	1.313
95% t UCL (Assumes normality)	625.3	95% H-Stat UCL	598.6

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	546.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Benzo(a)anthracene

Parameter	Sample ID	Val	D_Val
Benzo(a)anthracene	LSD-25-01_5/26/1998	30.3	0
Benzo(a)anthracene	FML-301-SF	0.35	1
Benzo(a)anthracene	FML-304-SF	5.5	0
Benzo(a)anthracene	FML-305-SF	3.3	0
Benzo(a)anthracene	FML-308-SF	5.7	0
Benzo(a)anthracene	FML-309-SF	1	0
Benzo(a)anthracene	LSL-45_5/19/1998	2.5	0
Benzo(a)anthracene	LSL-47_5/20/1998	2.9	0
Benzo(a)anthracene	LSL-48_5/20/1998	3.4	0
Benzo(a)anthracene	LSL-49_5/20/1998	16.3	0
Benzo(a)anthracene	LSL-50_5/19/1998	26.7	0
Benzo(a)anthracene	LSL-53_5/20/1998	6.690001	1
Benzo(a)anthracene	LSL-54_5/20/1998	7.1	0
Benzo(a)anthracene	LSL-56_5/20/1998	4.6	0
Benzo(a)anthracene	LSL-57_5/20/1998	21.5	0
Benzo(a)anthracene	LSL-59_5/19/1998	0.23	0
Benzo(a)anthracene	LSL-46_5/20/1998	3	0
Benzo(a)anthracene	AWI-215-SF	1.2	1
Benzo(a)anthracene	MW-13-1_10/1/1998	1.3	1
Benzo(a)anthracene	FML-310-SF	0.061	1
Benzo(a)anthracene	FML-307-SF	0.19	0
Benzo(a)anthracene	MW-15-1_10/1/1998	7.78	0
Benzo(a)anthracene	FML-302-SF	0.058	1
Benzo(a)anthracene	MW-2B-1_10/1/1998	0.4	0
Benzo(a)anthracene	FML-300-SB	0.19	0
Benzo(a)anthracene	SO-5_11/29/1989	1.4	1
Benzo(a)anthracene	MW-4B-1_10/1/1998	4.1	0
Benzo(a)anthracene	LSD-24-01_5/26/1998	31.7	0
Benzo(a)anthracene	AWI-216-SF	7.900001	0
Benzo(a)anthracene	FML-306-SF	0.41	1
Benzo(a)anthracene	AWI-214-SF	0.2	1
Benzo(a)anthracene	LSL-51_5/19/1998	6	0
Benzo(a)anthracene	AWI-213-SF	0.13	1
Benzo(a)anthracene	LSL-60_5/20/1998	15.5	0
Benzo(a)anthracene	LSL-61_5/20/1998	4.9	0
Benzo(a)anthracene	LSD-23-01_5/26/1998	31.7	0
Benzo(a)anthracene	FML-303-SF	0.13	1
Benzo(a)anthracene	MW-16-1_10/1/1998	4.98	0
Benzo(a)anthracene	LSL-62_5/20/1998	46.3	0
Benzo(a)anthracene	MW-17-1_10/1/1998	4.35	1
Benzo(a)anthracene	MW-20-1_10/1/1998	9.77	0
Benzo(a)anthracene	MW-12-1_10/1/1998	0.409	0
Benzo(a)anthracene	MW-14-1_10/1/1998	0.463	0
Benzo(a)anthracene	MW-19-1_10/1/1998	1.67	1
Benzo(a)anthracene	MW-21-1_10/1/1998	38	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:03:52 PM
From File	Soils_d.xls
Full Precision	OFF
Confidence Coefficient	95%

Number of Bootstrap Operations 2000

Val

General Statistics

Total Number of Observations	45	Number of Distinct Observations	42
Number of Detects	13	Number of Non-Detects	32
Number of Distinct Detects	12	Number of Distinct Non-Detects	30
Minimum Detect	0.058	Minimum Non-Detect	0.19
Maximum Detect	6.69	Maximum Non-Detect	46.3
Variance Detects	3.929	Percent Non-Detects	71.11%
Mean Detects	1.381	SD Detects	1.982
Median Detects	0.41	CV Detects	1.436
Skewness Detects	2.07	Kurtosis Detects	3.998
Mean of Logged Detects	-0.662	SD of Logged Detects	1.562

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.698	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.288	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.781	KM Standard Error of Mean	0.277
KM SD	1.399	95% KM (BCA) UCL	1.239
95% KM (t) UCL	1.246	95% KM (Percentile Bootstrap) UCL	1.295
95% KM (z) UCL	1.237	95% KM Bootstrap t UCL	1.721
90% KM Chebyshev UCL	1.612	95% KM Chebyshev UCL	1.989
97.5% KM Chebyshev UCL	2.512	99% KM Chebyshev UCL	3.539

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.463	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.78	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.248	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.624	k star (bias corrected MLE)	0.531
Theta hat (MLE)	2.214	Theta star (bias corrected MLE)	2.6
nu hat (MLE)	16.22	nu star (bias corrected)	13.81
Mean (detects)	1.381		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.474
Maximum	6.69	Median	0.13
SD	1.194	CV	2.52
k hat (MLE)	0.451	k star (bias corrected MLE)	0.436
Theta hat (MLE)	1.05	Theta star (bias corrected MLE)	1.086
nu hat (MLE)	40.62	nu star (bias corrected)	39.25

Adjusted Level of Significance (β)	0.0447		
Approximate Chi Square Value (39.25, α)	25.9	Adjusted Chi Square Value (39.25, β)	25.54
95% Gamma Approximate UCL (use when n>=50)	0.718	95% Gamma Adjusted UCL (use when n<50)	0.728

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.781	SD (KM)	1.399
Variance (KM)	1.957	SE of Mean (KM)	0.277
k hat (KM)	0.311	k star (KM)	0.305
nu hat (KM)	28.02	nu star (KM)	27.48
theta hat (KM)	2.507	theta star (KM)	2.556
80% gamma percentile (KM)	1.202	90% gamma percentile (KM)	2.297
95% gamma percentile (KM)	3.551	99% gamma percentile (KM)	6.8

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (27.48, α)	16.53	Adjusted Chi Square Value (27.48, β)	16.25
95% Gamma Approximate KM-UCL (use when n>=50)	1.298	95% Gamma Adjusted KM-UCL (use when n<50)	1.321

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.167	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.559	Mean in Log Scale	-1.295
SD in Original Scale	1.165	SD in Log Scale	0.967
95% t UCL (assumes normality of ROS data)	0.851	95% Percentile Bootstrap UCL	0.862
95% BCA Bootstrap UCL	0.975	95% Bootstrap t UCL	1.387
95% H-UCL (Log ROS)	0.615		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.312	KM Geo Mean	0.269
KM SD (logged)	1.383	95% Critical H Value (KM-Log)	2.835
KM Standard Error of Mean (logged)	0.326	95% H-UCL (KM -Log)	1.265
KM SD (logged)	1.383	95% Critical H Value (KM-Log)	2.835
KM Standard Error of Mean (logged)	0.326		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.225	Mean in Log Scale	0.372
SD in Original Scale	5.728	SD in Log Scale	1.714
95% t UCL (Assumes normality)	5.659	95% H-Stat UCL	14.73

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	1.321

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

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

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

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

Soil - Chrysene

Parameter	Sample ID	Val	D_Val
Chrysene	AWI-213-SF	0.21	1
Chrysene	MW-13-1_10/1/1998	1.4	1
Chrysene	MW-2B-1_10/1/1998	0.4	0
Chrysene	MW-15-1_10/1/1998	7.78	0
Chrysene	MW-4B-1_10/1/1998	4.1	0
Chrysene	LSL-59_5/19/1998	0.23	0
Chrysene	FML-310-SF	0.067	1
Chrysene	FML-308-SF	5.7	0
Chrysene	LSL-46_5/20/1998	3	0
Chrysene	LSL-47_5/20/1998	2.9	0
Chrysene	LSL-48_5/20/1998	3.4	0
Chrysene	LSL-49_5/20/1998	16.3	0
Chrysene	LSL-50_5/19/1998	26.7	0
Chrysene	LSL-53_5/20/1998	10.2	1
Chrysene	LSL-54_5/20/1998	7.1	0
Chrysene	FML-304-SF	0.69	1
Chrysene	LSL-57_5/20/1998	21.5	0
Chrysene	FML-305-SF	3.3	0
Chrysene	LSL-61_5/20/1998	4.9	0
Chrysene	LSL-62_5/20/1998	46.3	0
Chrysene	MW-12-1_10/1/1998	0.409	0
Chrysene	MW-14-1_10/1/1998	0.463	0
Chrysene	MW-16-1_10/1/1998	4.98	0
Chrysene	MW-19-1_10/1/1998	3.1	1
Chrysene	MW-20-1_10/1/1998	9.77	0
Chrysene	MW-21-1_10/1/1998	38	0
Chrysene	LSL-60_5/20/1998	15.5	0
Chrysene	MW-17-1_10/1/1998	7.2	1
Chrysene	LSL-56_5/20/1998	4.6	0
Chrysene	LSD-11_6/1/1996	0.3	0
Chrysene	FML-300-SB	0.19	0
Chrysene	FML-301-SF	0.56	1
Chrysene	AWI-216-SF	7.900001	0
Chrysene	LSL-45_5/19/1998	2.5	0
Chrysene	AWI-214-SF	0.38	1
Chrysene	AWI-215-SF	2.3	1
Chrysene	FML-309-SF	0.15	1
Chrysene	FML-302-SF	0.082	1
Chrysene	LSL-51_5/19/1998	6	0
Chrysene	LSD-14_6/1/1996	0.71	0
Chrysene	SO-5_11/29/1989	0.95	1
Chrysene	FML-303-SF	0.2	1
Chrysene	LSD-23-01_5/26/1998	31.7	0
Chrysene	LSD-24-01_5/26/1998	31.7	0
Chrysene	FML-307-SF	0.19	0
Chrysene	LSD-25-01_5/26/1998	30.3	0
Chrysene	FML-306-SF	0.5	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 5:02:17 PM
From File	Soils_h.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	45
Number of Detects	15	Number of Non-Detects	32
Number of Distinct Detects	15	Number of Distinct Non-Detects	30
Minimum Detect	0.067	Minimum Non-Detect	0.19
Maximum Detect	10.2	Maximum Non-Detect	46.3
Variance Detects	8.766	Percent Non-Detects	68.09%
Mean Detects	1.866	SD Detects	2.961
Median Detects	0.56	CV Detects	1.587
Skewness Detects	2.211	Kurtosis Detects	4.375
Mean of Logged Detects	-0.422	SD of Logged Detects	1.53

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.649	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.22	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.988	KM Standard Error of Mean	0.357
KM SD	2.016	95% KM (BCA) UCL	1.664
95% KM (t) UCL	1.587	95% KM (Percentile Bootstrap) UCL	1.627
95% KM (z) UCL	1.575	95% KM Bootstrap t UCL	2.302
90% KM Chebyshev UCL	2.058	95% KM Chebyshev UCL	2.542
97.5% KM Chebyshev UCL	3.215	99% KM Chebyshev UCL	4.536

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.597	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.786	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.179	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.232	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.592	k star (bias corrected MLE)	0.518
Theta hat (MLE)	3.153	Theta star (bias corrected MLE)	3.603
nu hat (MLE)	17.75	nu star (bias corrected)	15.54
Mean (detects)	1.866		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.619
Maximum	10.2	Median	0.01
SD	1.851	CV	2.99
k hat (MLE)	0.261	k star (bias corrected MLE)	0.259

Theta hat (MLE)	2.367	Theta star (bias corrected MLE)	2.39
nu hat (MLE)	24.57	nu star (bias corrected)	24.34
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (24.34, α)	14.11	Adjusted Chi Square Value (24.34, β)	13.86
95% Gamma Approximate UCL (use when n>=50)	1.068	95% Gamma Adjusted UCL (use when n<50)	1.087

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.988	SD (KM)	2.016
Variance (KM)	4.064	SE of Mean (KM)	0.357
k hat (KM)	0.24	k star (KM)	0.239
nu hat (KM)	22.59	nu star (KM)	22.48
theta hat (KM)	4.112	theta star (KM)	4.132
80% gamma percentile (KM)	1.412	90% gamma percentile (KM)	2.975
95% gamma percentile (KM)	4.846	99% gamma percentile (KM)	9.86

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.48, α)	12.7	Adjusted Chi Square Value (22.48, β)	12.47
95% Gamma Approximate KM-UCL (use when n>=50)	1.749	95% Gamma Adjusted KM-UCL (use when n<50)	1.782

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.968	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.105	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.22	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.763	Mean in Log Scale	-1.147
SD in Original Scale	1.805	SD in Log Scale	1.049
95% t UCL (assumes normality of ROS data)	1.205	95% Percentile Bootstrap UCL	1.219
95% BCA Bootstrap UCL	1.418	95% Bootstrap t UCL	2.189
95% H-UCL (Log ROS)	0.796		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.134	KM Geo Mean	0.322
KM SD (logged)	1.365	95% Critical H Value (KM-Log)	2.752
KM Standard Error of Mean (logged)	0.294	95% H-UCL (KM -Log)	1.423
KM SD (logged)	1.365	95% Critical H Value (KM-Log)	2.752
KM Standard Error of Mean (logged)	0.294		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.2	Mean in Log Scale	0.335
SD in Original Scale	5.735	SD in Log Scale	1.706
95% t UCL (Assumes normality)	5.604	95% H-Stat UCL	13.37

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	1.782

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

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

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

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

Soil - Benzo(e)pyrene

Parameter	Sample ID	Val	D_Val
Benzo(e)pyrene	MW-13-1_10/1/1998	1.43	1
Benzo(e)pyrene	FML-303-SF	0.3	1
Benzo(e)pyrene	LSL-49_5/20/1998	16.3	0
Benzo(e)pyrene	LSL-54_5/20/1998		0
Benzo(e)pyrene	LSL-59_5/19/1998	0.23	0
Benzo(e)pyrene	LSD-25-01_5/26/1998	30.3	0
Benzo(e)pyrene	MW-16-1_10/1/1998		0
Benzo(e)pyrene	FML-306-SF	0.3	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:03:17 PM
From File	Soils_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	2
Number of Detects	3	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.3	Minimum Non-Detect	0.23
Maximum Detect	1.43	Maximum Non-Detect	30.3
Variance Detects	0.426	Percent Non-Detects	50%
Mean Detects	0.677	SD Detects	0.652
Median Detects	0.3	CV Detects	0.964
Skewness Detects	1.732	Kurtosis Detects	N/A
Mean of Logged Detects	-0.683	SD of Logged Detects	0.902

Warning: Data set has only 3 Detected Values.

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

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	0.565	KM Standard Error of Mean	0.306
KM SD	0.5	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.182	95% KM (Percentile Bootstrap) UCL	N/A

95% KM (z) UCL	1.069	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.484	95% KM Chebyshev UCL	1.9
97.5% KM Chebyshev UCL	2.478	99% KM Chebyshev UCL	3.613

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.857	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.364	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.14	nu star (bias corrected)	N/A
Mean (detects)	0.677		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.428
Maximum	1.43	Median	0.283
SD	0.503	CV	1.174
k hat (MLE)	0.838	k star (bias corrected MLE)	0.53
Theta hat (MLE)	0.511	Theta star (bias corrected MLE)	0.808
nu hat (MLE)	10.06	nu star (bias corrected)	6.361
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (6.36, α)	1.827	Adjusted Chi Square Value (6.36, β)	1.083
95% Gamma Approximate UCL (use when n>=50)	1.491	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.565	SD (KM)	0.5
Variance (KM)	0.25	SE of Mean (KM)	0.306
k hat (KM)	1.276	k star (KM)	0.749
nu hat (KM)	15.31	nu star (KM)	8.988
theta hat (KM)	0.443	theta star (KM)	0.754
80% gamma percentile (KM)	0.926	90% gamma percentile (KM)	1.396
95% gamma percentile (KM)	1.877	99% gamma percentile (KM)	3.019

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.99, α)	3.32	Adjusted Chi Square Value (8.99, β)	2.204
95% Gamma Approximate KM-UCL (use when n>=50)	1.53	95% Gamma Adjusted KM-UCL (use when n<50)	2.304

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.385	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.445	Mean in Log Scale	-1.246
SD in Original Scale	0.493	SD in Log Scale	1.059
95% t UCL (assumes normality of ROS data)	0.85	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	3.922		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.88	KM Geo Mean	0.415
KM SD (logged)	0.723	95% Critical H Value (KM-Log)	3.239
KM Standard Error of Mean (logged)	0.443	95% H-UCL (KM -Log)	1.534
KM SD (logged)	0.723	95% Critical H Value (KM-Log)	3.239
KM Standard Error of Mean (logged)	0.443		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.241	Mean in Log Scale	0.1
SD in Original Scale	6.169	SD in Log Scale	1.971
95% t UCL (Assumes normality)	9.316	95% H-Stat UCL	6255

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.182

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Soil - High Molecular Weight PAHs (Total)

SubGroup	Sample ID	Val	D_Val
HMWPAH	AWI-213-SF	1.827	1
HMWPAH	AWI-214-SF	2.889	1
HMWPAH	AWI-215-SF	20.38	1
HMWPAH	AWI-216-SF	39.5	0
HMWPAH	FML-300-SB	0.95	0
HMWPAH	FML-301-SF	4.329	1
HMWPAH	FML-302-SF	0.816	1
HMWPAH	FML-303-SF	2.049	1
HMWPAH	FML-304-SF	22.13	1
HMWPAH	FML-305-SF	14.34	1
HMWPAH	FML-306-SF	4.449	1
HMWPAH	FML-307-SF	0.95	0
HMWPAH	FML-308-SF	26.61	1
HMWPAH	FML-309-SF	4.47	1
HMWPAH	FML-310-SF	0.812	1
HMWPAH	LSD-11_6/1/1996	0.599	0
HMWPAH	LSD-14_6/1/1996	1.38	0
HMWPAH	LSD-23-01_5/26/1998	158.5	0
HMWPAH	LSD-24-01_5/26/1998	158.5	0
HMWPAH	LSD-25-01_5/26/1998	151.5	0
HMWPAH	LSL-45_5/19/1998	12.5	0
HMWPAH	LSL-46_5/20/1998	15	0
HMWPAH	LSL-47_5/20/1998	14.5	0
HMWPAH	LSL-48_5/20/1998	17	0
HMWPAH	LSL-49_5/20/1998	81.50001	0
HMWPAH	LSL-50_5/19/1998	133.5	0
HMWPAH	LSL-51_5/19/1998	30	0
HMWPAH	LSL-53_5/20/1998	55.97	1
HMWPAH	LSL-54_5/20/1998	35.5	0
HMWPAH	LSL-56_5/20/1998	29.96	1
HMWPAH	LSL-57_5/20/1998	107.5	0
HMWPAH	LSL-59_5/19/1998	1.15	0
HMWPAH	LSL-60_5/20/1998	77.5	0
HMWPAH	LSL-61_5/20/1998	28.8	1
HMWPAH	LSL-62_5/20/1998	231.5	0
HMWPAH	MW-12-1_10/1/1998	2.045	0
HMWPAH	MW-13-1_10/1/1998	12.98	1
HMWPAH	MW-14-1_10/1/1998	2.315	0
HMWPAH	MW-15-1_10/1/1998	38.9	0
HMWPAH	MW-16-1_10/1/1998	22.41	0
HMWPAH	MW-17-1_10/1/1998	52.755	1
HMWPAH	MW-19-1_10/1/1998	27.753	1
HMWPAH	MW-20-1_10/1/1998	48.85	0
HMWPAH	MW-21-1_10/1/1998	190	0
HMWPAH	MW-2B-1_10/1/1998	1.8	0
HMWPAH	MW-4B-1_10/1/1998	20.5	0
HMWPAH	SO-5_11/29/1989	10.17	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 4:58:51 PM
From File	Soils_s.xls

Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	45
Number of Detects	19	Number of Non-Detects	28
Number of Distinct Detects	19	Number of Distinct Non-Detects	26
Minimum Detect	0.812	Minimum Non-Detect	0.599
Maximum Detect	55.97	Maximum Non-Detect	231.5
Variance Detects	281.8	Percent Non-Detects	59.57%
Mean Detects	17.03	SD Detects	16.79
Median Detects	12.98	CV Detects	0.986
Skewness Detects	1.131	Kurtosis Detects	0.689
Mean of Logged Detects	2.181	SD of Logged Detects	1.347

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	10.26	KM Standard Error of Mean	2.468
KM SD	14.12	95% KM (BCA) UCL	14.22
95% KM (t) UCL	14.4	95% KM (Percentile Bootstrap) UCL	14.33
95% KM (z) UCL	14.32	95% KM Bootstrap t UCL	15.43
90% KM Chebyshev UCL	17.67	95% KM Chebyshev UCL	21.02
97.5% KM Chebyshev UCL	25.68	99% KM Chebyshev UCL	34.82

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.414	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.773	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.165	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.895	k star (bias corrected MLE)	0.789
Theta hat (MLE)	19.03	Theta star (bias corrected MLE)	21.59
nu hat (MLE)	34	nu star (bias corrected)	29.97
Mean (detects)	17.03		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	8.262
Maximum	55.97	Median	3.511
SD	12.93	CV	1.565
k hat (MLE)	0.381	k star (bias corrected MLE)	0.371

Theta hat (MLE)	21.7	Theta star (bias corrected MLE)	22.29
nu hat (MLE)	35.78	nu star (bias corrected)	34.83
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (34.83, α)	22.33	Adjusted Chi Square Value (34.83, β)	22.01
95% Gamma Approximate UCL (use when n>=50)	12.89	95% Gamma Adjusted UCL (use when n<50)	13.07

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	10.26	SD (KM)	14.12
Variance (KM)	199.3	SE of Mean (KM)	2.468
k hat (KM)	0.528	k star (KM)	0.509
nu hat (KM)	49.66	nu star (KM)	47.83
theta hat (KM)	19.42	theta star (KM)	20.17
80% gamma percentile (KM)	16.86	90% gamma percentile (KM)	27.66
95% gamma percentile (KM)	39.17	99% gamma percentile (KM)	67.43

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (47.83, α)	32.95	Adjusted Chi Square Value (47.83, β)	32.56
95% Gamma Approximate KM-UCL (use when n>=50)	14.89	95% Gamma Adjusted KM-UCL (use when n<50)	15.07

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8.254	Mean in Log Scale	1.253
SD in Original Scale	12.83	SD in Log Scale	1.272
95% t UCL (assumes normality of ROS data)	11.4	95% Percentile Bootstrap UCL	11.55
95% BCA Bootstrap UCL	11.96	95% Bootstrap t UCL	12.55
95% H-UCL (Log ROS)	12.91		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.271	KM Geo Mean	3.566
KM SD (logged)	1.525	95% Critical H Value (KM-Log)	2.954
KM Standard Error of Mean (logged)	0.288	95% H-UCL (KM -Log)	22.18
KM SD (logged)	1.525	95% Critical H Value (KM-Log)	2.954
KM Standard Error of Mean (logged)	0.288		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	23.86	Mean in Log Scale	2.197
SD in Original Scale	28.52	SD in Log Scale	1.687
95% t UCL (Assumes normality)	30.84	95% H-Stat UCL	81.94

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	14.4

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Soil - DDD/DDE/DDT Total

SubGroup	Sample ID	Val	D_Val
DDD/DDE/DDT	AWI-213-SF	0.0066	0
DDD/DDE/DDT	AWI-214-SF	0.00645	0
DDD/DDE/DDT	AWI-215-SF	0.00765	0
DDD/DDE/DDT	AWI-216-SF	0.0084	0
DDD/DDE/DDT	FML-300-SB	0.0094	1
DDD/DDE/DDT	FML-301-SF	0.0664	1
DDD/DDE/DDT	FML-302-SF	0.008	1
DDD/DDE/DDT	FML-303-SF	0.0276	1
DDD/DDE/DDT	FML-304-SF	0.0175	1
DDD/DDE/DDT	FML-305-SF	0.00945	0
DDD/DDE/DDT	FML-306-SF	0.0865	1
DDD/DDE/DDT	FML-307-SF	0.0054	0
DDD/DDE/DDT	FML-308-SF	0.0165	0
DDD/DDE/DDT	FML-309-SF	0.03	0
DDD/DDE/DDT	FML-310-SF	0.1704	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 4:59:23 PM
From File	Soils_r.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	15	Number of Distinct Observations	15
Number of Detects	7	Number of Non-Detects	8
Number of Distinct Detects	7	Number of Distinct Non-Detects	8
Minimum Detect	0.008	Minimum Non-Detect	0.0054
Maximum Detect	0.17	Maximum Non-Detect	0.03
Variance Detects	0.00348	Percent Non-Detects	53.33%
Mean Detects	0.0551	SD Detects	0.059
Median Detects	0.0276	CV Detects	1.07
Skewness Detects	1.466	Kurtosis Detects	1.899
Mean of Logged Detects	-3.437	SD of Logged Detects	1.164

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.827	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.251	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.029	KM Standard Error of Mean	0.0125
KM SD	0.0446	95% KM (BCA) UCL	0.0505
95% KM (t) UCL	0.051	95% KM (Percentile Bootstrap) UCL	0.0511
95% KM (z) UCL	0.0495	95% KM Bootstrap t UCL	0.0718
90% KM Chebyshev UCL	0.0664	95% KM Chebyshev UCL	0.0833
97.5% KM Chebyshev UCL	0.107	99% KM Chebyshev UCL	0.153

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.301	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.319	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.064	k star (bias corrected MLE)	0.703
Theta hat (MLE)	0.0518	Theta star (bias corrected MLE)	0.0784
nu hat (MLE)	14.89	nu star (bias corrected)	9.843
Mean (detects)	0.0551		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.008	Mean	0.0311
Maximum	0.17	Median	0.01
SD	0.0451	CV	1.453
k hat (MLE)	0.984	k star (bias corrected MLE)	0.831
Theta hat (MLE)	0.0316	Theta star (bias corrected MLE)	0.0374
nu hat (MLE)	29.51	nu star (bias corrected)	24.94
Adjusted Level of Significance (β)	0.0324		
Approximate Chi Square Value (24.94, α)	14.56	Adjusted Chi Square Value (24.94, β)	13.59
95% Gamma Approximate UCL (use when n>=50)	0.0532	95% Gamma Adjusted UCL (use when n<50)	0.057

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.029	SD (KM)	0.0446
Variance (KM)	0.00199	SE of Mean (KM)	0.0125
k hat (KM)	0.423	k star (KM)	0.383
nu hat (KM)	12.7	nu star (KM)	11.49
theta hat (KM)	0.0686	theta star (KM)	0.0758
80% gamma percentile (KM)	0.0466	90% gamma percentile (KM)	0.0826
95% gamma percentile (KM)	0.122	99% gamma percentile (KM)	0.223

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.49, α)	4.893	Adjusted Chi Square Value (11.49, β)	4.375
95% Gamma Approximate KM-UCL (use when n>=50)	0.0682	95% Gamma Adjusted KM-UCL (use when n<50)	0.0763

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0269	Mean in Log Scale	-4.91
SD in Original Scale	0.0473	SD in Log Scale	1.64
95% t UCL (assumes normality of ROS data)	0.0484	95% Percentile Bootstrap UCL	0.0489
95% BCA Bootstrap UCL	0.0572	95% Bootstrap t UCL	0.0786
95% H-UCL (Log ROS)	0.155		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.339	KM Geo Mean	0.0131
KM SD (logged)	1.135	95% Critical H Value (KM-Log)	2.965
KM Standard Error of Mean (logged)	0.321	95% H-UCL (KM -Log)	0.0611
KM SD (logged)	1.135	95% Critical H Value (KM-Log)	2.965
KM Standard Error of Mean (logged)	0.321		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0287	Mean in Log Scale	-4.454
SD in Original Scale	0.0464	SD in Log Scale	1.309
95% t UCL (Assumes normality)	0.0498	95% H-Stat UCL	0.0859

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.051

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

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

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

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

Soil - Aroclor 1248

Parameter	Sample ID	Val	D_Val
Aroclor 1248	MW-21-1_10/1/1998	2.08	1
Aroclor 1248	AWI-214-SF	0.043	0
Aroclor 1248	MW-20-1_10/1/1998	8.190001	1
Aroclor 1248	AWI-216-SF	0.056	0
Aroclor 1248	AWI-213-SF	0.044	0
Aroclor 1248	LSL-49_5/20/1998	0.183	1
Aroclor 1248	MW-16-1_10/1/1998	3.73	1
Aroclor 1248	MW-14-1_10/1/1998	0.0014	0
Aroclor 1248	MW-12-1_10/1/1998	0.0013	0
Aroclor 1248	LSL-46_5/20/1998	0.554	1
Aroclor 1248	LSD-23-01_5/26/1998	0.434	1
Aroclor 1248	FML-309-SF	0.091	1
Aroclor 1248	FML-308-SF	0.47	1
Aroclor 1248	MW-17-1_10/1/1998	0.0014	0
Aroclor 1248	FML-305-SF	0.24	1
Aroclor 1248	FML-304-SF	1.2	1
Aroclor 1248	FML-301-SF	2	1
Aroclor 1248	AWI-215-SF	0.051	0
Aroclor 1248	LSD-24-01_5/26/1998	0.453	1
Aroclor 1248	MW-19-1_10/1/1998	2.35	1
Aroclor 1248	LSL-60_5/20/1998	0.148	1
Aroclor 1248	LSL-47_5/20/1998	0.102	1
Aroclor 1248	LSL-51_5/19/1998	0.0891	1
Aroclor 1248	LSL-48_5/20/1998	0.0692	1
Aroclor 1248	LSL-45_5/19/1998	0.0015	0
Aroclor 1248	FML-303-SF	0.18	1
Aroclor 1248	FML-306-SF	0.05	0
Aroclor 1248	LSD-25-01_5/26/1998	0.891	1
Aroclor 1248	LSL-57_5/20/1998	2.44	1
Aroclor 1248	FML-310-SF	0.038	0
Aroclor 1248	MW-15-1_10/1/1998	0.0613	0
Aroclor 1248	MW-2B-1_10/1/1998	0.668	1
Aroclor 1248	FML-307-SF	0.011	1
Aroclor 1248	LSL-56_5/20/1998	11.3	1
Aroclor 1248	LSL-53_5/20/1998	21	1
Aroclor 1248	MW-4B-1_10/1/1998	0.0254	0
Aroclor 1248	LSL-54_5/20/1998	42.7	1
Aroclor 1248	FML-302-SF	0.1	1
Aroclor 1248	LSL-62_5/20/1998	0.444	1
Aroclor 1248	LSL-59_5/19/1998	0.0222	1
Aroclor 1248	FML-300-SB	0.036	0
Aroclor 1248	LSL-61_5/20/1998	0.885	1
Aroclor 1248	LSL-50_5/19/1998	1.91	1
Aroclor 1248	MW-13-1_10/1/1998	0.0242	0

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:04:56 PM
From File	Soils_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	44	Number of Distinct Observations	43
Number of Detects	30	Number of Non-Detects	14
Number of Distinct Detects	30	Number of Distinct Non-Detects	13
Minimum Detect	0.011	Minimum Non-Detect	0.0013
Maximum Detect	42.7	Maximum Non-Detect	0.0613
Variance Detects	73.59	Percent Non-Detects	31.82%
Mean Detects	3.498	SD Detects	8.579
Median Detects	0.512	CV Detects	2.453
Skewness Detects	3.835	Kurtosis Detects	15.95
Mean of Logged Detects	-0.497	SD of Logged Detects	1.944

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.448	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.382	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.159	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	2.386	KM Standard Error of Mean	1.097
KM SD	7.152	95% KM (BCA) UCL	4.301
95% KM (t) UCL	4.23	95% KM (Percentile Bootstrap) UCL	4.374
95% KM (z) UCL	4.19	95% KM Bootstrap t UCL	8.484
90% KM Chebyshev UCL	5.676	95% KM Chebyshev UCL	7.167
97.5% KM Chebyshev UCL	9.235	99% KM Chebyshev UCL	13.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.562	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.836	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.2	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.172	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.379	k star (bias corrected MLE)	0.364
Theta hat (MLE)	9.22	Theta star (bias corrected MLE)	9.619
nu hat (MLE)	22.76	nu star (bias corrected)	21.82
Mean (detects)	3.498		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	2.388
Maximum	42.7	Median	0.164
SD	7.234	CV	3.029
k hat (MLE)	0.263	k star (bias corrected MLE)	0.261
Theta hat (MLE)	9.069	Theta star (bias corrected MLE)	9.166
nu hat (MLE)	23.17	nu star (bias corrected)	22.93
Adjusted Level of Significance (β)	0.0445		
Approximate Chi Square Value (22.93, α)	13.03	Adjusted Chi Square Value (22.93, β)	12.78
95% Gamma Approximate UCL (use when n>=50)	4.2	95% Gamma Adjusted UCL (use when n<50)	4.284

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.386	SD (KM)	7.152
Variance (KM)	51.15	SE of Mean (KM)	1.097
k hat (KM)	0.111	k star (KM)	0.119
nu hat (KM)	9.798	nu star (KM)	10.46
theta hat (KM)	21.43	theta star (KM)	20.07
80% gamma percentile (KM)	2.071	90% gamma percentile (KM)	6.744
95% gamma percentile (KM)	13.63	99% gamma percentile (KM)	34.71

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.46, α)	4.233	Adjusted Chi Square Value (10.46, β)	4.099
95% Gamma Approximate KM-UCL (use when n>=50)	5.898	95% Gamma Adjusted KM-UCL (use when n<50)	6.092

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0708	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.159	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.388	Mean in Log Scale	-1.883
SD in Original Scale	7.234	SD in Log Scale	2.611
95% t UCL (assumes normality of ROS data)	4.221	95% Percentile Bootstrap UCL	4.32
95% BCA Bootstrap UCL	5.374	95% Bootstrap t UCL	7.892
95% H-UCL (Log ROS)	28.51		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.265	KM Geo Mean	0.104
KM SD (logged)	3.091	95% Critical H Value (KM-Log)	5.313
KM Standard Error of Mean (logged)	0.495	95% H-UCL (KM -Log)	151
KM SD (logged)	3.091	95% Critical H Value (KM-Log)	5.313
KM Standard Error of Mean (logged)	0.495		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.39	Mean in Log Scale	-1.882
SD in Original Scale	7.233	SD in Log Scale	2.745
95% t UCL (Assumes normality)	4.223	95% H-Stat UCL	48.84

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	7.167

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

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

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

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

Soil - Aroclor 1254

Parameter	Sample ID	Val	D_Val
Aroclor 1254	MW-13-1_10/1/1998	0.0242	0
Aroclor 1254	LSL-46_5/20/1998	0.0184	0
Aroclor 1254	LSL-51_5/19/1998	0.0036	0
Aroclor 1254	FML-310-SF	0.038	0
Aroclor 1254	LSD-23-01_5/26/1998	0.0098	0
Aroclor 1254	LSL-47_5/20/1998	0.0181	0
Aroclor 1254	LSL-60_5/20/1998	0.0024	0
Aroclor 1254	LSD-24-01_5/26/1998	0.0097	0
Aroclor 1254	LSD-25-01_5/26/1998	0.0235	0
Aroclor 1254	FML-301-SF	1.5	1
Aroclor 1254	FML-302-SF	0.061	1
Aroclor 1254	FML-304-SF	0.11	0
Aroclor 1254	FML-305-SF	0.063	0
Aroclor 1254	FML-300-SB	0.036	0
Aroclor 1254	FML-308-SF	0.11	0
Aroclor 1254	FML-303-SF	0.18	1
Aroclor 1254	FML-309-SF	0.2	0
Aroclor 1254	FML-307-SF	0.009	1
Aroclor 1254	MW-20-1_10/1/1998	0.304	0
Aroclor 1254	LSL-62_5/20/1998	0.0284	0
Aroclor 1254	LSL-61_5/20/1998	0.003	0
Aroclor 1254	MW-12-1_10/1/1998	0.0013	0
Aroclor 1254	LSL-59_5/19/1998	0.0014	0
Aroclor 1254	MW-14-1_10/1/1998	0.0014	0
Aroclor 1254	LSL-57_5/20/1998	0.066	0
Aroclor 1254	MW-16-1_10/1/1998	2.23	1
Aroclor 1254	FML-306-SF	0.05	0
Aroclor 1254	LSL-56_5/20/1998	0.282	0
Aroclor 1254	MW-19-1_10/1/1998	1.32	1
Aroclor 1254	LSL-48_5/20/1998	0.0042	0
Aroclor 1254	LSL-54_5/20/1998	1.08	0
Aroclor 1254	LSL-50_5/19/1998	0.0412	0
Aroclor 1254	AWI-214-SF	0.26	1
Aroclor 1254	LSL-53_5/20/1998	0.404	0
Aroclor 1254	AWI-215-SF	0.44	1
Aroclor 1254	MW-21-1_10/1/1998	0.059	0
Aroclor 1254	MW-4B-1_10/1/1998	0.994	1
Aroclor 1254	LSL-49_5/20/1998	0.005	0
Aroclor 1254	AWI-216-SF	4	1
Aroclor 1254	MW-2B-1_10/1/1998	0.459	1
Aroclor 1254	MW-17-1_10/1/1998	0.0014	0
Aroclor 1254	MW-15-1_10/1/1998	0.0613	0
Aroclor 1254	LSL-45_5/19/1998	0.0015	0
Aroclor 1254	AWI-213-SF	0.34	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:04:38 PM
From File	Soils_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	44	Number of Distinct Observations	41
Number of Detects	12	Number of Non-Detects	32
Number of Distinct Detects	12	Number of Distinct Non-Detects	29
Minimum Detect	0.009	Minimum Non-Detect	0.0013
Maximum Detect	4	Maximum Non-Detect	1.08
Variance Detects	1.362	Percent Non-Detects	72.73%
Mean Detects	0.983	SD Detects	1.167
Median Detects	0.45	CV Detects	1.188
Skewness Detects	1.812	Kurtosis Detects	3.439
Mean of Logged Detects	-0.865	SD of Logged Detects	1.68

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.792	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.273	KM Standard Error of Mean	0.115
KM SD	0.729	95% KM (BCA) UCL	0.497
95% KM (t) UCL	0.466	95% KM (Percentile Bootstrap) UCL	0.464
95% KM (z) UCL	0.462	95% KM Bootstrap t UCL	0.636
90% KM Chebyshev UCL	0.617	95% KM Chebyshev UCL	0.773
97.5% KM Chebyshev UCL	0.99	99% KM Chebyshev UCL	1.416

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.143	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.769	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.255	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.711	k star (bias corrected MLE)	0.589
Theta hat (MLE)	1.382	Theta star (bias corrected MLE)	1.669
nu hat (MLE)	17.07	nu star (bias corrected)	14.14
Mean (detects)	0.983		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.009	Mean	0.275
Maximum	4	Median	0.01
SD	0.735	CV	2.671
k hat (MLE)	0.3	k star (bias corrected MLE)	0.295
Theta hat (MLE)	0.917	Theta star (bias corrected MLE)	0.933
nu hat (MLE)	26.43	nu star (bias corrected)	25.96
Adjusted Level of Significance (β)	0.0445		

Approximate Chi Square Value (25.96, α)	15.35	Adjusted Chi Square Value (25.96, β)	15.07
95% Gamma Approximate UCL (use when n>=50)	0.466	95% Gamma Adjusted UCL (use when n<50)	0.474

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.273	SD (KM)	0.729
Variance (KM)	0.531	SE of Mean (KM)	0.115
k hat (KM)	0.14	k star (KM)	0.146
nu hat (KM)	12.33	nu star (KM)	12.82
theta hat (KM)	1.947	theta star (KM)	1.872
80% gamma percentile (KM)	0.29	90% gamma percentile (KM)	0.805
95% gamma percentile (KM)	1.509	99% gamma percentile (KM)	3.565

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.82, α)	5.772	Adjusted Chi Square Value (12.82, β)	5.612
95% Gamma Approximate KM-UCL (use when n>=50)	0.606	95% Gamma Adjusted KM-UCL (use when n<50)	0.623

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.243	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.271	Mean in Log Scale	-4.414
SD in Original Scale	0.737	SD in Log Scale	2.402
95% t UCL (assumes normality of ROS data)	0.457	95% Percentile Bootstrap UCL	0.465
95% BCA Bootstrap UCL	0.532	95% Bootstrap t UCL	0.688
95% H-UCL (Log ROS)	1.035		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.899	KM Geo Mean	0.00745
KM SD (logged)	2.709	95% Critical H Value (KM-Log)	4.728
KM Standard Error of Mean (logged)	0.45	95% H-UCL (KM -Log)	2.057
KM SD (logged)	2.709	95% Critical H Value (KM-Log)	4.728
KM Standard Error of Mean (logged)	0.45		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.303	Mean in Log Scale	-3.526
SD in Original Scale	0.73	SD in Log Scale	2.447
95% t UCL (Assumes normality)	0.488	95% H-Stat UCL	2.956

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	0.623

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - Total PCBs

SubGroup	Sample ID	Val	D_Val
PCB	AWI-213-SF	0.516	1
PCB	AWI-214-SF	0.432	1
PCB	AWI-215-SF	0.644	1
PCB	AWI-216-SF	4.224	1
PCB	FML-300-SB	0.162	1
PCB	FML-301-SF	4.402	1
PCB	FML-302-SF	0.299	1
PCB	FML-303-SF	0.567	1
PCB	FML-304-SF	1.64	1
PCB	FML-305-SF	0.492	1
PCB	FML-306-SF	0.225	0
PCB	FML-307-SF	0.146	1
PCB	FML-308-SF	0.91	1
PCB	FML-309-SF	0.891	1
PCB	FML-310-SF	0.242	1
PCB	LSD-23-01_5/26/1998	0.47595	1
PCB	LSD-24-01_5/26/1998	0.4944	1
PCB	LSD-25-01_5/26/1998	0.9914	1
PCB	LSL-45_5/19/1998	0.00725	0
PCB	LSL-46_5/20/1998	0.6325	1
PCB	LSL-47_5/20/1998	0.1793	1
PCB	LSL-48_5/20/1998	0.08705	1
PCB	LSL-49_5/20/1998	0.2043	1
PCB	LSL-50_5/19/1998	2.08605	1
PCB	LSL-51_5/19/1998	0.10455	1
PCB	LSL-53_5/20/1998	22.726	1
PCB	LSL-54_5/20/1998	47.325	1
PCB	LSL-56_5/20/1998	12.5065	1
PCB	LSL-57_5/20/1998	2.72195	1
PCB	LSL-59_5/19/1998	0.0281	1
PCB	LSL-60_5/20/1998	0.15825	1
PCB	LSL-61_5/20/1998	0.8977	1
PCB	LSL-62_5/20/1998	0.56545	1
PCB	MW-12-1_10/1/1998	0.0061	0
PCB	MW-13-1_10/1/1998	0.1146	0
PCB	MW-14-1_10/1/1998	0.0067	0
PCB	MW-15-1_10/1/1998	0.29275	0
PCB	MW-16-1_10/1/1998	14.336	1
PCB	MW-17-1_10/1/1998	0.00685	0
PCB	MW-19-1_10/1/1998	8.53355	1
PCB	MW-20-1_10/1/1998	9.489001	1
PCB	MW-21-1_10/1/1998	2.3324	1
PCB	MW-2B-1_10/1/1998	1.2206	1
PCB	MW-4B-1_10/1/1998	2.1634	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 4:58:31 PM
From File	Soils_t.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	44	Number of Distinct Observations	44
Number of Detects	37	Number of Non-Detects	7
Number of Distinct Detects	37	Number of Distinct Non-Detects	7
Minimum Detect	0.0281	Minimum Non-Detect	0.0061
Maximum Detect	47.33	Maximum Non-Detect	0.293
Variance Detects	77.11	Percent Non-Detects	15.91%
Mean Detects	3.941	SD Detects	8.781
Median Detects	0.644	CV Detects	2.228
Skewness Detects	3.871	Kurtosis Detects	17.1
Mean of Logged Detects	-0.0615	SD of Logged Detects	1.683

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.487	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.936	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.339	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.144	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	3.32	KM Standard Error of Mean	1.233
KM SD	8.07	95% KM (BCA) UCL	5.641
95% KM (t) UCL	5.393	95% KM (Percentile Bootstrap) UCL	5.39
95% KM (z) UCL	5.349	95% KM Bootstrap t UCL	7.564
90% KM Chebyshev UCL	7.02	95% KM Chebyshev UCL	8.696
97.5% KM Chebyshev UCL	11.02	99% KM Chebyshev UCL	15.59

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.086	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.824	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.213	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.154	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.451	k star (bias corrected MLE)	0.432
Theta hat (MLE)	8.748	Theta star (bias corrected MLE)	9.122
nu hat (MLE)	33.34	nu star (bias corrected)	31.97
Mean (detects)	3.941		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	3.316
Maximum	47.33	Median	0.541
SD	8.165	CV	2.462
k hat (MLE)	0.341	k star (bias corrected MLE)	0.333
Theta hat (MLE)	9.735	Theta star (bias corrected MLE)	9.972
nu hat (MLE)	29.97	nu star (bias corrected)	29.26
Adjusted Level of Significance (β)	0.0445		

Approximate Chi Square Value (29.26, α)	17.91	Adjusted Chi Square Value (29.26, β)	17.61
95% Gamma Approximate UCL (use when n>=50)	5.416	95% Gamma Adjusted UCL (use when n<50)	5.509

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.32	SD (KM)	8.07
Variance (KM)	65.13	SE of Mean (KM)	1.233
k hat (KM)	0.169	k star (KM)	0.173
nu hat (KM)	14.89	nu star (KM)	15.21
theta hat (KM)	19.62	theta star (KM)	19.21
80% gamma percentile (KM)	4.013	90% gamma percentile (KM)	9.988
95% gamma percentile (KM)	17.73	99% gamma percentile (KM)	39.59

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (15.21, α)	7.407	Adjusted Chi Square Value (15.21, β)	7.222
95% Gamma Approximate KM-UCL (use when n>=50)	6.816	95% Gamma Adjusted KM-UCL (use when n<50)	6.991

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.936	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.109	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.144	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.32	Mean in Log Scale	-0.606
SD in Original Scale	8.163	SD in Log Scale	2.009
95% t UCL (assumes normality of ROS data)	5.389	95% Percentile Bootstrap UCL	5.542
95% BCA Bootstrap UCL	6.239	95% Bootstrap t UCL	8.328
95% H-UCL (Log ROS)	12.68		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.751	KM Geo Mean	0.472
KM SD (logged)	2.255	95% Critical H Value (KM-Log)	4.046
KM Standard Error of Mean (logged)	0.35	95% H-UCL (KM -Log)	24.13
KM SD (logged)	2.255	95% Critical H Value (KM-Log)	4.046
KM Standard Error of Mean (logged)	0.35		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.322	Mean in Log Scale	-0.728
SD in Original Scale	8.163	SD in Log Scale	2.289
95% t UCL (Assumes normality)	5.39	95% H-Stat UCL	27.71

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	8.696

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Soil - bis(2-Ethylhexyl)Phthalate

Parameter	Sample ID	Val	D_Val
bis(2-Ethylhexyl) phthalate	FML-300-SB	0.19	0
bis(2-Ethylhexyl) phthalate	FML-302-SF	0.2	0
bis(2-Ethylhexyl) phthalate	FML-303-SF	2.6	1
bis(2-Ethylhexyl) phthalate	FML-307-SF	0.19	0
bis(2-Ethylhexyl) phthalate	FML-310-SF	1.2	1
bis(2-Ethylhexyl) phthalate	FML-301-SF	0.31	1
bis(2-Ethylhexyl) phthalate	FML-304-SF	5.5	0
bis(2-Ethylhexyl) phthalate	FML-305-SF	3.3	0
bis(2-Ethylhexyl) phthalate	FML-308-SF	5.7	0
bis(2-Ethylhexyl) phthalate	FML-309-SF	1	0
bis(2-Ethylhexyl) phthalate	LSD-11_6/1/1996	2.3	1
bis(2-Ethylhexyl) phthalate	LSD-14_6/1/1996	3.8	0
bis(2-Ethylhexyl) phthalate	LSL-54_5/20/1998		0
bis(2-Ethylhexyl) phthalate	SO-5_11/29/1989	0.3	0
bis(2-Ethylhexyl) phthalate	AWI-213-SF	83.00001	1
bis(2-Ethylhexyl) phthalate	AWI-214-SF	43	1
bis(2-Ethylhexyl) phthalate	AWI-215-SF	6.2	1
bis(2-Ethylhexyl) phthalate	AWI-216-SF	36	1
bis(2-Ethylhexyl) phthalate	FML-306-SF	25	1
bis(2-Ethylhexyl) phthalate	LSL-45_5/19/1998		0

UCL Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation	ProUCL 5.11/23/2019 5:05:48 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
		Number of Missing Observations	1
Minimum	0.19	Mean	12.21
Maximum	83	Median	2.95
SD	21.85	Std. Error of Mean	5.15
Coefficient of Variation	1.789	Skewness	2.437

Normal GOF Test

Shapiro Wilk Test Statistic	0.612	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.386	Lilliefors GOF Test
5% Lilliefors Critical Value	0.202	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	21.17	95% Adjusted-CLT UCL (Chen-1995)	23.84
		95% Modified-t UCL (Johnson-1978)	21.66

Sediment - Barium

Parameter	Sample ID	Val	D_Val
Barium	DD-513-SD	69	1
Barium	DD-518-SD	60	1
Barium	DD-512-SD	22	1
Barium	RC-406-SD	110	1
Barium	RC-405-SD	38	1
Barium	RC-407-SD	170	1
Barium	DD-519-SD	110	1
Barium	DD-507-SD	15	1
Barium	DD-510-SD	140	1
Barium	DD-509-SD	100	1
Barium	RC-404-SD	300	1
Barium	RC-409-SD	160	1
Barium	DD-506-SD	13	1
Barium	SD-1_7/25/1990	11.2	1
Barium	DD-514-SD	110	1
Barium	RC-408-SD	160	1
Barium	DD-508-SD	57	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:49:22 PM
From File	Sed_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	17	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	11.2	Mean	96.78
Maximum	300	Median	100
SD	75.35	Std. Error of Mean	18.27
Coefficient of Variation	0.779	Skewness	1.136

Normal GOF Test

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.136	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.207	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	128.7	95% Adjusted-CLT UCL (Chen-1995)	132.2
		95% Modified-t UCL (Johnson-1978)	129.5

Gamma GOF Test

A-D Test Statistic	0.388	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.153	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.213	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	1.493	k star (bias corrected MLE)	1.269
Theta hat (MLE)	64.81	Theta star (bias corrected MLE)	76.27
nu hat (MLE)	50.77	nu star (bias corrected)	43.14
MLE Mean (bias corrected)	96.78	MLE Sd (bias corrected)	85.91
		Approximate Chi Square Value (0.05)	29.08
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	27.88

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	143.6	95% Adjusted Gamma UCL (use when n<50)	149.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.892	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.187	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.207	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	2.416	Mean of logged Data	4.202
Maximum of Logged Data	5.704	SD of logged Data	0.994

Assuming Lognormal Distribution

95% H-UCL	211.9	90% Chebyshev (MVUE) UCL	189
95% Chebyshev (MVUE) UCL	227	97.5% Chebyshev (MVUE) UCL	279.7
99% Chebyshev (MVUE) UCL	383.3		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	126.8	95% Jackknife UCL	128.7
95% Standard Bootstrap UCL	125.9	95% Bootstrap-t UCL	136.8
95% Hall's Bootstrap UCL	142	95% Percentile Bootstrap UCL	127.8
95% BCA Bootstrap UCL	132.3		
90% Chebyshev(Mean, Sd) UCL	151.6	95% Chebyshev(Mean, Sd) UCL	176.4
97.5% Chebyshev(Mean, Sd) UCL	210.9	99% Chebyshev(Mean, Sd) UCL	278.6

Suggested UCL to Use

95% Student's-t UCL	128.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - Cadmium

Parameter	Sample ID			Val	D_Val
Cadmium	RC-408-SD			15	1
Cadmium	DD-507-SD			0.9	1
Cadmium	RC-406-SD			0.61	0
Cadmium	LSD-36-01_5/27/1998			0.99	1
Cadmium	LSD-35-05_5/27/1998			0.12	0
Cadmium	DD-518-SD			0.67	0
Cadmium	LSD-35-04_5/27/1998			0.11	0
Cadmium	DD-519-SD			11	1
Cadmium	LSD-35-03_5/27/1998			0.13	0
Cadmium	DD-513-SD			5.8	1
Cadmium	LSD-3_6/1/1996			0.49	1
Cadmium	LSD-35-02_5/27/1998			0.14	0
Cadmium	LSD-35-01_5/27/1998			0.12	0
Cadmium	DD-514-SD			12	1
Cadmium	RC-407-SD			6	1
Cadmium	RC-409-SD			6.2	1
Cadmium	DD-506-SD			0.94	1
Cadmium	DD-512-SD			0.56	0
Cadmium	SD-1_7/25/1990			0.564	1
Cadmium	LSD-7_6/1/1996			0.23	0
Cadmium	LSD-21-01_5/22/1998			0.89	1
Cadmium	LSD-20-01_5/22/1998			0.68	1
Cadmium	LSD-19-01_5/22/1998			0.47	1
Cadmium	LSD-36-04_5/27/1998			1.2	1
Cadmium	LSD-18-01_5/26/1998			0.43	1
Cadmium	LSD-17-01_5/26/1998			0.33	1
Cadmium	LSD-22-01_5/22/1998			1.8	1
Cadmium	LSD-36-05_5/27/1998			12.2	1
Cadmium	DD-510-SD			4.5	1
Cadmium	LSD-8_6/1/1996			0.65	1
Cadmium	DD-509-SD			12	1
Cadmium	LSD-9_6/1/1996			4.88	1
Cadmium	RC-404-SD			0.98	0
Cadmium	DD-508-SD			8.4	1
Cadmium	RC-405-SD			0.67	0
Cadmium	LSD-10_6/1/1996			9.87	1
Cadmium	LSD-36-03_5/27/1998			4.9	1
Cadmium	LSD-27-01_5/21/1998			1	1
Cadmium	LSD-28-01_5/21/1998			5.2	1
Cadmium	LSD-26-01_5/21/1998			5	1
Cadmium	LSD-29-01_5/21/1998			6.2	1
Cadmium	LSD-5_6/1/1996			5.09	1
Cadmium	LSD-36-02_5/27/1998			0.37	1
Cadmium	ISD-202_3/10/2000			0.1	0
Cadmium	ISD-203_3/9/2000			0.09	0
Cadmium	ISD-204_3/10/2000			0.09	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.12/15/2019 6:46:57 PM
From File	WorkSheet.xls
Full Precision	OFF

Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	46	Number of Distinct Observations	41
Number of Detects	32	Number of Non-Detects	14
Number of Distinct Detects	30	Number of Distinct Non-Detects	11
Minimum Detect	0.33	Minimum Non-Detect	0.09
Maximum Detect	15	Maximum Non-Detect	0.98
Variance Detects	19	Percent Non-Detects	30.43%
Mean Detects	4.561	SD Detects	4.359
Median Detects	4.69	CV Detects	0.956
Skewness Detects	0.856	Kurtosis Detects	-0.343
Mean of Logged Detects	0.888	SD of Logged Detects	1.264

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	3.218	KM Standard Error of Mean	0.616
KM SD	4.115	95% KM (BCA) UCL	4.263
95% KM (t) UCL	4.254	95% KM (Percentile Bootstrap) UCL	4.296
95% KM (z) UCL	4.232	95% KM Bootstrap t UCL	4.366
90% KM Chebyshev UCL	5.068	95% KM Chebyshev UCL	5.906
97.5% KM Chebyshev UCL	7.068	99% KM Chebyshev UCL	9.352

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.304	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.779	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.192	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.161	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.926	k star (bias corrected MLE)	0.86
Theta hat (MLE)	4.925	Theta star (bias corrected MLE)	5.303
nu hat (MLE)	59.27	nu star (bias corrected)	55.04
Mean (detects)	4.561		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	3.176
Maximum	15	Median	0.895
SD	4.192	CV	1.32
k hat (MLE)	0.349	k star (bias corrected MLE)	0.34
Theta hat (MLE)	9.112	Theta star (bias corrected MLE)	9.333

nu hat (MLE)	32.06	nu star (bias corrected)	31.31
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (31.31, α)	19.52	Adjusted Chi Square Value (31.31, β)	19.22
95% Gamma Approximate UCL (use when n>=50)	5.093	95% Gamma Adjusted UCL (use when n<50)	5.173

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.218	SD (KM)	4.115
Variance (KM)	16.93	SE of Mean (KM)	0.616
k hat (KM)	0.612	k star (KM)	0.586
nu hat (KM)	56.29	nu star (KM)	53.95
theta hat (KM)	5.26	theta star (KM)	5.488
80% gamma percentile (KM)	5.305	90% gamma percentile (KM)	8.414
95% gamma percentile (KM)	11.68	99% gamma percentile (KM)	19.59

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (53.95, α)	38.08	Adjusted Chi Square Value (53.95, β)	37.64
95% Gamma Approximate KM-UCL (use when n>=50)	4.56	95% Gamma Adjusted KM-UCL (use when n<50)	4.613

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.884	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.154	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.233	Mean in Log Scale	0.0971
SD in Original Scale	4.148	SD in Log Scale	1.618
95% t UCL (assumes normality of ROS data)	4.26	95% Percentile Bootstrap UCL	4.248
95% BCA Bootstrap UCL	4.444	95% Bootstrap t UCL	4.43
95% H-UCL (Log ROS)	8.556		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0381	KM Geo Mean	0.963
KM SD (logged)	1.774	95% Critical H Value (KM-Log)	3.274
KM Standard Error of Mean (logged)	0.27	95% H-UCL (KM -Log)	11.05
KM SD (logged)	1.774	95% Critical H Value (KM-Log)	3.274
KM Standard Error of Mean (logged)	0.27		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.223	Mean in Log Scale	-0.0481
SD in Original Scale	4.157	SD in Log Scale	1.839
95% t UCL (Assumes normality)	4.252	95% H-Stat UCL	13

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

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	5.906

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - Manganese

Parameter	Sample ID		Val	D_Val
Manganese	DD-514-SD		220	1
Manganese	DD-510-SD		960	1
Manganese	RC-405-SD		120	1
Manganese	DD-512-SD		140	1
Manganese	DD-507-SD		42	1
Manganese	RC-406-SD		2000	1
Manganese	RC-409-SD		2700	1
Manganese	DD-508-SD		67	1
Manganese	DD-509-SD		180	1
Manganese	DD-518-SD		150	1
Manganese	RC-408-SD		1900	1
Manganese	RC-407-SD		2900	1
Manganese	RC-404-SD		5800	1
Manganese	DD-519-SD		320	1
Manganese	DD-506-SD		39	1
Manganese	DD-513-SD		210	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:44:53 PM
From File	Sed_n.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	39	Mean	1109
Maximum	5800	Median	215
SD	1602	Std. Error of Mean	400.4
Coefficient of Variation	1.444	Skewness	1.95

Normal GOF Test

Shapiro Wilk Test Statistic	0.71	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.314	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1811	95% Adjusted-CLT UCL (Chen-1995)	1976
		95% Modified-t UCL (Johnson-1978)	1844

Gamma GOF Test

A-D Test Statistic	0.879	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.79	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.25	**Kolmogorov-Smirnov Gamma GOF Test**

5% K-S Critical Value	0.226	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.567	k star (bias corrected MLE)	0.502
Theta hat (MLE)	1956	Theta star (bias corrected MLE)	2208
nu hat (MLE)	18.15	nu star (bias corrected)	16.08
MLE Mean (bias corrected)	1109	MLE Sd (bias corrected)	1565
		Approximate Chi Square Value (0.05)	8.018
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	7.377

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2224	95% Adjusted Gamma UCL (use when n<50)	2418

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.189	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.664	Mean of logged Data	5.913
Maximum of Logged Data	8.666	SD of logged Data	1.614

Assuming Lognormal Distribution

95% H-UCL	6487	90% Chebyshev (MVUE) UCL	2797
95% Chebyshev (MVUE) UCL	3537	97.5% Chebyshev (MVUE) UCL	4564
99% Chebyshev (MVUE) UCL	6582		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	1768	95% Jackknife UCL	1811
95% Standard Bootstrap UCL	1752	95% Bootstrap-t UCL	2321
95% Hall's Bootstrap UCL	2164	95% Percentile Bootstrap UCL	1780
95% BCA Bootstrap UCL	1959		
90% Chebyshev(Mean, Sd) UCL	2310	95% Chebyshev(Mean, Sd) UCL	2855
97.5% Chebyshev(Mean, Sd) UCL	3610	99% Chebyshev(Mean, Sd) UCL	5093

Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL	5093

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - Mercury

Parameter	Sample ID			Val	D_Val
Mercury	LSD-7_6/1/1996			0.038	0
Mercury	RC-409-SD			0.77	1
Mercury	LSD-28-01_5/21/1998			0.85	1
Mercury	LSD-29-01_5/21/1998			3	1
Mercury	LSD-36-02_5/27/1998			0.12	1
Mercury	LSD-9_6/1/1996			0.077	0
Mercury	LSD-36-03_5/27/1998			0.24	1
Mercury	DD-507-SD			0.13	0
Mercury	LSD-22-01_5/22/1998			0.11	1
Mercury	LSD-35-03_5/27/1998			0.02	0
Mercury	LSD-27-01_5/21/1998			0.13	1
Mercury	LSD-35-04_5/27/1998			0.01	0
Mercury	LSD-35-05_5/27/1998			0.02	0
Mercury	LSD-36-01_5/27/1998			0.07	1
Mercury	MNOP-D4-W-09-SD			1.1	1
Mercury	SD-1_7/25/1990			0.1009	0
Mercury	RC-408-SD			1.9	1
Mercury	DD-506-SD			0.027	1
Mercury	LSD-5_6/1/1996			0.975	1
Mercury	DD-509-SD			0.16	0
Mercury	LSD-8_6/1/1996			0.15	1
Mercury	LSD-26-01_5/21/1998			0.14	1
Mercury	DD-513-SD			0.18	0
Mercury	LSD-36-04_5/27/1998			0.06	1
Mercury	LSD-10_6/1/1996			0.036	0
Mercury	LSD-3_6/1/1996			0.058	1
Mercury	RC-405-SD			0.13	0
Mercury	MNOP-D4-06-SD			0.05	0
Mercury	MNOP-D4-05-SD			0.05	0
Mercury	DD-510-SD			0.24	0
Mercury	LSD-18-01_5/26/1998			0.87	1
Mercury	DD-519-SD			0.35	0
Mercury	DD-512-SD			0.11	0
Mercury	MNOP-D4-07-SD			0.46	1
Mercury	RC-404-SD			0.21	0
Mercury	RC-406-SD			0.13	0
Mercury	LSD-17-01_5/26/1998			0.03	1
Mercury	DD-518-SD			0.13	0
Mercury	LSD-21-01_5/22/1998			0.23	1
Mercury	LSD-36-05_5/27/1998			2.5	1
Mercury	LSD-35-02_5/27/1998			0.02	0
Mercury	LSD-20-01_5/22/1998			0.28	1
Mercury	LSD-35-01_5/27/1998			0.01	0
Mercury	DD-508-SD			0.15	0
Mercury	DD-514-SD			0.58	0
Mercury	LSD-19-01_5/22/1998			0.07	1
Mercury	RC-407-SD			0.94	1
Mercury	MNOP-D4-W-08-SD			0.19	1
Mercury	ISD-202_3/10/2000			0.07	1
Mercury	ISD-203_3/9/2000			0.04	1
Mercury	ISD-204_3/10/2000			0.08	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 6:50:50 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	51	Number of Distinct Observations	38
Number of Detects	28	Number of Non-Detects	23
Number of Distinct Detects	26	Number of Distinct Non-Detects	16
Minimum Detect	0.027	Minimum Non-Detect	0.01
Maximum Detect	3	Maximum Non-Detect	0.58
Variance Detects	0.592	Percent Non-Detects	45.10%
Mean Detects	0.552	SD Detects	0.77
Median Detects	0.17	CV Detects	1.394
Skewness Detects	2.035	Kurtosis Detects	3.824
Mean of Logged Detects	-1.473	SD of Logged Detects	1.379

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.696	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.164	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.319	KM Standard Error of Mean	0.0881
KM SD	0.617	95% KM (BCA) UCL	0.481
95% KM (t) UCL	0.466	95% KM (Percentile Bootstrap) UCL	0.465
95% KM (z) UCL	0.464	95% KM Bootstrap t UCL	0.566
90% KM Chebyshev UCL	0.583	95% KM Chebyshev UCL	0.703
97.5% KM Chebyshev UCL	0.869	99% KM Chebyshev UCL	1.195

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.128	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.791	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.173	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.689	k star (bias corrected MLE)	0.639
Theta hat (MLE)	0.801	Theta star (bias corrected MLE)	0.864
nu hat (MLE)	38.59	nu star (bias corrected)	35.79
Mean (detects)	0.552		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.308
Maximum	3	Median	0.04

SD	0.628	CV	2.041
k hat (MLE)	0.388	k star (bias corrected MLE)	0.378
Theta hat (MLE)	0.794	Theta star (bias corrected MLE)	0.814
nu hat (MLE)	39.53	nu star (bias corrected)	38.54
Adjusted Level of Significance (β)	0.0453		
Approximate Chi Square Value (38.54, α)	25.32	Adjusted Chi Square Value (38.54, β)	25.01
95% Gamma Approximate UCL (use when n>=50)	0.468	95% Gamma Adjusted UCL (use when n<50)	0.474

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.319	SD (KM)	0.617
Variance (KM)	0.381	SE of Mean (KM)	0.0881
k hat (KM)	0.267	k star (KM)	0.264
nu hat (KM)	27.23	nu star (KM)	26.96
theta hat (KM)	1.194	theta star (KM)	1.206
80% gamma percentile (KM)	0.472	90% gamma percentile (KM)	0.953
95% gamma percentile (KM)	1.517	99% gamma percentile (KM)	3.009

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (26.96, α)	16.12	Adjusted Chi Square Value (26.96, β)	15.87
95% Gamma Approximate KM-UCL (use when n>=50)	0.533	95% Gamma Adjusted KM-UCL (use when n<50)	0.541

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.924	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.132	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.164	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.314	Mean in Log Scale	-2.598
SD in Original Scale	0.625	SD in Log Scale	1.697
95% t UCL (assumes normality of ROS data)	0.461	95% Percentile Bootstrap UCL	0.468
95% BCA Bootstrap UCL	0.505	95% Bootstrap t UCL	0.54
95% H-UCL (Log ROS)	0.666		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.549	KM Geo Mean	0.0782
KM SD (logged)	1.676	95% Critical H Value (KM-Log)	3.103
KM Standard Error of Mean (logged)	0.259	95% H-UCL (KM -Log)	0.664
KM SD (logged)	1.676	95% Critical H Value (KM-Log)	3.103
KM Standard Error of Mean (logged)	0.259		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.332	Mean in Log Scale	-2.274
SD in Original Scale	0.618	SD in Log Scale	1.537
95% t UCL (Assumes normality)	0.477	95% H-Stat UCL	0.633

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.664

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

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

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

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

Sediment - Selenium

Parameter	Sample ID	Val	D_Val
Selenium	LSD-36-05_5/27/1998	4.2	1
Selenium	RC-404-SD	6.8	0
Selenium	DD-510-SD	8	0
Selenium	DD-508-SD	5.1	0
Selenium	DD-509-SD	5.8	0
Selenium	LSD-9_6/1/1996	0.57	1
Selenium	LSD-8_6/1/1996	0.69	1
Selenium	RC-409-SD	6.5	0
Selenium	LSD-7_6/1/1996	0.09	0
Selenium	DD-507-SD	4.5	0
Selenium	LSD-35-05_5/27/1998	0.25	0
Selenium	RC-405-SD	4.7	0
Selenium	LSD-35-01_5/27/1998	0.26	0
Selenium	SD-1_7/25/1990	0.197	0
Selenium	LSD-3_6/1/1996	0.61	1
Selenium	LSD-35-02_5/27/1998	0.3	0
Selenium	LSD-35-03_5/27/1998	0.27	0
Selenium	RC-408-SD	11	0
Selenium	DD-506-SD	4.6	0
Selenium	DD-519-SD	12	0
Selenium	DD-518-SD	4.7	0
Selenium	RC-406-SD	4.2	0
Selenium	DD-513-SD	5.9	0
Selenium	RC-407-SD	7.9	0
Selenium	LSD-35-04_5/27/1998	0.24	0
Selenium	DD-512-SD	3.9	0
Selenium	DD-514-SD	19	0
Selenium	LSD-18-01_5/26/1998	0.31	0
Selenium	LSD-21-01_5/22/1998	0.3	0
Selenium	LSD-36-03_5/27/1998	1.3	1
Selenium	LSD-20-01_5/22/1998	0.31	0
Selenium	LSD-19-01_5/22/1998	0.31	0
Selenium	LSD-26-01_5/21/1998	1.1	1
Selenium	LSD-17-01_5/26/1998	0.42	1
Selenium	LSD-10_6/1/1996	0.11	0
Selenium	LSD-36-04_5/27/1998	0.9	1
Selenium	LSD-36-02_5/27/1998	2	1
Selenium	LSD-36-01_5/27/1998	3.3	1
Selenium	LSD-5_6/1/1996	0.9	1
Selenium	LSD-22-01_5/22/1998	0.38	1
Selenium	LSD-29-01_5/21/1998	2.1	1
Selenium	LSD-28-01_5/21/1998	2	1
Selenium	LSD-27-01_5/21/1998	0.31	0
Selenium	ISD-202_3/10/2000	0.55	0
Selenium	ISD-203_3/9/2000	0.49	0
Selenium	ISD-204_3/10/2000	0.49	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.12/15/2019 6:53:20 PM
From File	WorkSheet.xls

Sediment - Benzo(e)pyrene

Parameter	Sample ID		Val	D_Val
Benzo(e)pyrene	LSD-36-03_5/27/1998		6.34	1
Benzo(e)pyrene	LSD-36-01_5/27/1998		1.84	1
Benzo(e)pyrene	LSD-36-04_5/27/1998		1.59	1
Benzo(e)pyrene	DD-508-SD		3	1
Benzo(e)pyrene	LSD-35-01_5/27/1998		0.19	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:48:35 PM
From File	Sed_f.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.59	Minimum Non-Detect	0.19
Maximum Detect	6.34	Maximum Non-Detect	0.19
Variance Detects	4.78	Percent Non-Detects	20%
Mean Detects	3.193	SD Detects	2.186
Median Detects	2.42	CV Detects	0.685
Skewness Detects	1.568	Kurtosis Detects	2.266
Mean of Logged Detects	1.005	SD of Logged Detects	0.624

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.285	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	2.592	KM Standard Error of Mean	1.072
KM SD	2.076	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.878	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.356	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	5.808	95% KM Chebyshev UCL	7.265
97.5% KM Chebyshev UCL	9.288	99% KM Chebyshev UCL	13.26

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.38	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	**Kolmogorov-Smirnov GOF**

5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.361	k star (bias corrected MLE)	1.007
Theta hat (MLE)	0.95	Theta star (bias corrected MLE)	3.17
nu hat (MLE)	26.89	nu star (bias corrected)	8.056
Mean (detects)	3.193		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	2.556
Maximum	6.34	Median	1.84
SD	2.369	CV	0.927
k hat (MLE)	0.587	k star (bias corrected MLE)	0.368
Theta hat (MLE)	4.353	Theta star (bias corrected MLE)	6.942
nu hat (MLE)	5.872	nu star (bias corrected)	3.682
Adjusted Level of Significance (β)	0.0086		
Approximate Chi Square Value (3.68, α)	0.6	Adjusted Chi Square Value (3.68, β)	0.238
95% Gamma Approximate UCL (use when n>=50)	15.68	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.592	SD (KM)	2.076
Variance (KM)	4.311	SE of Mean (KM)	1.072
k hat (KM)	1.559	k star (KM)	0.757
nu hat (KM)	15.59	nu star (KM)	7.568
theta hat (KM)	1.663	theta star (KM)	3.425
80% gamma percentile (KM)	4.248	90% gamma percentile (KM)	6.387
95% gamma percentile (KM)	8.578	99% gamma percentile (KM)	13.77

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.57, α)	2.487	Adjusted Chi Square Value (7.57, β)	1.406
95% Gamma Approximate KM-UCL (use when n>=50)	7.886	95% Gamma Adjusted KM-UCL (use when n<50)	13.95

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.659	Mean in Log Scale	0.675
SD in Original Scale	2.238	SD in Log Scale	0.914
95% t UCL (assumes normality of ROS data)	4.793	95% Percentile Bootstrap UCL	4.277
95% BCA Bootstrap UCL	4.722	95% Bootstrap t UCL	7.501
95% H-UCL (Log ROS)	23.66		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.472	KM Geo Mean	1.603
KM SD (logged)	1.171	95% Critical H Value (KM-Log)	5.648
KM Standard Error of Mean (logged)	0.604	95% H-UCL (KM -Log)	86.69

KM SD (logged)	1.171	95% Critical H Value (KM-Log)	5.648
KM Standard Error of Mean (logged)	0.604		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.573	Mean in Log Scale	0.333
SD in Original Scale	2.346	SD in Log Scale	1.596
95% t UCL (Assumes normality)	4.81	95% H-Stat UCL	2070

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	4.878

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

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

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

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

Sediment - Perylene

Parameter	Sample ID	Val	D_Val
Perylene	DD-509-SD	2	1
Perylene	RC-409-SD	7	1
Perylene	DD-507-SD	0.2	1
Perylene	DD-518-SD	0.4	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:43:38 PM
From File	Sed_q.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.2	Mean	2.4
Maximum	7	Median	1.2
SD	3.171	Std. Error of Mean	1.585
Coefficient of Variation	1.321	Skewness	1.644

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.81	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	6.131	95% Adjusted-CLT UCL (Chen-1995)	6.4
		95% Modified-t UCL (Johnson-1978)	6.348

Gamma GOF Test

A-D Test Statistic	0.301	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.672	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.271	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.406	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.712	k star (bias corrected MLE)	0.345
Theta hat (MLE)	3.372	Theta star (bias corrected MLE)	6.965
nu hat (MLE)	5.694	nu star (bias corrected)	2.757

MLE Mean (bias corrected)	2.4	MLE Sd (bias corrected)	4.088
		Approximate Chi Square Value (0.05)	0.304
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	21.75	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.609	Mean of logged Data	0.0283
Maximum of Logged Data	1.946	SD of logged Data	1.601

Assuming Lognormal Distribution

95% H-UCL	62651	90% Chebyshev (MVUE) UCL	7.051
95% Chebyshev (MVUE) UCL	9.183	97.5% Chebyshev (MVUE) UCL	12.14
99% Chebyshev (MVUE) UCL	17.95		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5.008	95% Jackknife UCL	6.131
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.156	95% Chebyshev(Mean, Sd) UCL	9.31
97.5% Chebyshev(Mean, Sd) UCL	12.3	99% Chebyshev(Mean, Sd) UCL	18.17

Suggested UCL to Use

95% Student's-t UCL	6.131

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - High Molecular Weight PAHs

SubGroup	Sample ID	Val	D_Val
HMWPAH	DD-506-SD	0.51	1
HMWPAH	DD-507-SD	4.98	1
HMWPAH	DD-508-SD	10.89	1
HMWPAH	DD-509-SD	11.22	1
HMWPAH	DD-510-SD	24.75	1
HMWPAH	DD-512-SD	0.95	0
HMWPAH	DD-513-SD	7.87	1
HMWPAH	DD-514-SD	34.95	1
HMWPAH	DD-518-SD	3.18	1
HMWPAH	DD-519-SD	3.865	1
HMWPAH	LSD-10_6/1/1996	2.99	1
HMWPAH	LSD-17-01_5/26/1998	4.05	0
HMWPAH	LSD-18-01_5/26/1998	8.9	0
HMWPAH	LSD-19-01_5/22/1998	4.45	0
HMWPAH	LSD-20-01_5/22/1998	22.5	0
HMWPAH	LSD-21-01_5/22/1998	4.125	1
HMWPAH	LSD-22-01_5/22/1998	4.55	0
HMWPAH	LSD-26-01_5/21/1998	11.5	0
HMWPAH	LSD-27-01 _5/21/1998	1.1	0
HMWPAH	LSD-27-01_5/21/1998	9.9	0
HMWPAH	LSD-28-01_5/21/1998	59.5	0
HMWPAH	LSD-29-01_5/21/1998	55	0
HMWPAH	LSD-3_6/1/1996	0.45	0
HMWPAH	LSD-35-01_5/27/1998	0.95	0
HMWPAH	LSD-35-02_5/27/1998	1.1	0
HMWPAH	LSD-35-03_5/27/1998	1	0
HMWPAH	LSD-35-04_5/27/1998	0.85	0
HMWPAH	LSD-35-05_5/27/1998	0.9	0
HMWPAH	LSD-36-01_5/27/1998	10.228	1
HMWPAH	LSD-36-02_5/27/1998	1.869	1
HMWPAH	LSD-36-03_5/27/1998	36.254	1
HMWPAH	LSD-36-04_5/27/1998	8.903	1
HMWPAH	LSD-36-05_5/27/1998	12.062	1
HMWPAH	LSD-5_6/1/1996	2.685	1
HMWPAH	LSD-7_6/1/1996	0.385	0
HMWPAH	LSD-8_6/1/1996	0.525	0
HMWPAH	LSD-9_6/1/1996	2.91	1
HMWPAH	RC-404-SD	1.412	1
HMWPAH	RC-405-SD	1.101	1
HMWPAH	RC-406-SD	1.449	1
HMWPAH	RC-407-SD	20.02	1
HMWPAH	RC-408-SD	25.31	1
HMWPAH	RC-409-SD	26.49	1
HMWPAH	SD-1_7/25/1990	0.385	0
HMWPAH	ISD-202_3/10/2000	0.2625	0
HMWPAH	ISD-203_3/9/2000	0.92	0
HMWPAH	ISD-204_3/10/2000	0.228	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.12/15/2019 6:55:50 PM

From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	47	Number of Distinct Observations	44
Number of Detects	24	Number of Non-Detects	23
Number of Distinct Detects	24	Number of Distinct Non-Detects	20
Minimum Detect	0.51	Minimum Non-Detect	0.228
Maximum Detect	36.25	Maximum Non-Detect	59.5
Variance Detects	122.2	Percent Non-Detects	48.94%
Mean Detects	10.83	SD Detects	11.05
Median Detects	6.425	CV Detects	1.02
Skewness Detects	1.178	Kurtosis Detects	0.225
Mean of Logged Detects	1.799	SD of Logged Detects	1.192

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.816	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.177	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	6.135	KM Standard Error of Mean	1.445
KM SD	9.434	95% KM (BCA) UCL	8.689
95% KM (t) UCL	8.561	95% KM (Percentile Bootstrap) UCL	8.483
95% KM (z) UCL	8.513	95% KM Bootstrap t UCL	9.258
90% KM Chebyshev UCL	10.47	95% KM Chebyshev UCL	12.43
97.5% KM Chebyshev UCL	15.16	99% KM Chebyshev UCL	20.52

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.482	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.772	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.14	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.183	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.99	k star (bias corrected MLE)	0.894
Theta hat (MLE)	10.94	Theta star (bias corrected MLE)	12.12
nu hat (MLE)	47.52	nu star (bias corrected)	42.91
Mean (detects)	10.83		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	5.575
Maximum	36.25	Median	0.898
SD	9.52	CV	1.708

k hat (MLE)	0.248	k star (bias corrected MLE)	0.247
Theta hat (MLE)	22.44	Theta star (bias corrected MLE)	22.59
nu hat (MLE)	23.35	nu star (bias corrected)	23.2
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (23.20, α)	13.24	Adjusted Chi Square Value (23.20, β)	13
95% Gamma Approximate UCL (use when n>=50)	9.768	95% Gamma Adjusted UCL (use when n<50)	9.948

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.135	SD (KM)	9.434
Variance (KM)	88.99	SE of Mean (KM)	1.445
k hat (KM)	0.423	k star (KM)	0.41
nu hat (KM)	39.76	nu star (KM)	38.56
theta hat (KM)	14.5	theta star (KM)	14.96
80% gamma percentile (KM)	9.93	90% gamma percentile (KM)	17.25
95% gamma percentile (KM)	25.27	99% gamma percentile (KM)	45.38

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (38.56, α)	25.34	Adjusted Chi Square Value (38.56, β)	25
95% Gamma Approximate KM-UCL (use when n>=50)	9.337	95% Gamma Adjusted KM-UCL (use when n<50)	9.464

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0925	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.177	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.888	Mean in Log Scale	0.667
SD in Original Scale	9.343	SD in Log Scale	1.506
95% t UCL (assumes normality of ROS data)	8.176	95% Percentile Bootstrap UCL	8.228
95% BCA Bootstrap UCL	8.5	95% Bootstrap t UCL	8.735
95% H-UCL (Log ROS)	11.6		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.483	KM Geo Mean	1.622
KM SD (logged)	1.764	95% Critical H Value (KM-Log)	3.268
KM Standard Error of Mean (logged)	0.284	95% H-UCL (KM -Log)	17.99
KM SD (logged)	1.764	95% Critical H Value (KM-Log)	3.268
KM Standard Error of Mean (logged)	0.284		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	7.557	Mean in Log Scale	0.922
SD in Original Scale	10.22	SD in Log Scale	1.687
95% t UCL (Assumes normality)	10.06	95% H-Stat UCL	22.94

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1) 9.464

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

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

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

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

Sediment - Low Molecular Weight PAHs

SubGroup	Sample ID	Val	D_Val
LMWPAH	DD-506-SD	0.688	1
LMWPAH	DD-507-SD	0.721	1
LMWPAH	DD-508-SD	1.95	1
LMWPAH	DD-509-SD	1.166	1
LMWPAH	DD-510-SD	11.47	1
LMWPAH	DD-512-SD	0.665	0
LMWPAH	DD-513-SD	1.148	1
LMWPAH	DD-514-SD	29.05	0
LMWPAH	DD-518-SD	0.812	1
LMWPAH	DD-519-SD	2.275	0
LMWPAH	LSD-10_6/1/1996	0.065	0
LMWPAH	LSD-17-01_5/26/1998	2.7	0
LMWPAH	LSD-18-01_5/26/1998	5.34	0
LMWPAH	LSD-19-01_5/22/1998	2.67	0
LMWPAH	LSD-20-01_5/22/1998	13.5	0
LMWPAH	LSD-21-01_5/22/1998	2.67	0
LMWPAH	LSD-22-01_5/22/1998	2.73	0
LMWPAH	LSD-26-01_5/21/1998	6.9	0
LMWPAH	LSD-27-01_5/21/1998	6.6	0
LMWPAH	LSD-28-01_5/21/1998	35.7	0
LMWPAH	LSD-29-01_5/21/1998	33	0
LMWPAH	LSD-3_6/1/1996	0.065	0
LMWPAH	LSD-35-01_5/27/1998	0.57	0
LMWPAH	LSD-35-02_5/27/1998	0.66	0
LMWPAH	LSD-35-03_5/27/1998	0.6	0
LMWPAH	LSD-35-04_5/27/1998	0.51	0
LMWPAH	LSD-35-05_5/27/1998	0.54	0
LMWPAH	LSD-36-01_5/27/1998	2.859	1
LMWPAH	LSD-36-02_5/27/1998	0.9	0
LMWPAH	LSD-36-03_5/27/1998	6.3	0
LMWPAH	LSD-36-04_5/27/1998	4.5	0
LMWPAH	LSD-36-05_5/27/1998	7.5	0
LMWPAH	LSD-5_6/1/1996	0.175	0
LMWPAH	LSD-7_6/1/1996	0.055	0
LMWPAH	LSD-8_6/1/1996	0.075	0
LMWPAH	LSD-9_6/1/1996	0.08	0
LMWPAH	RC-404-SD	1.085	0
LMWPAH	RC-405-SD	0.805	0
LMWPAH	RC-406-SD	1.015	0
LMWPAH	RC-407-SD	11.94	1
LMWPAH	RC-408-SD	5.22	1
LMWPAH	RC-409-SD	2.225	1
LMWPAH	SD-1_7/25/1990	0.12	0
LMWPAH	ISD-202_3/10/2000	0.1575	0
LMWPAH	ISD-203_3/9/2000	0.552	0
LMWPAH	ISD-204_3/10/2000	0.1368	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options
Date/Time of Computation ProUCL 5.12/15/2019 6:58:13 PM
From File WorkSheet.xls

Sediment - beta-BHC

Parameter	Sample ID		Val	D_Val
beta-BHC	DD-519-SD		0.0065	0
beta-BHC	RC-405-SD		0.0023	0
beta-BHC	DD-509-SD		0.022	1
beta-BHC	DD-508-SD		0.0053	0
beta-BHC	DD-513-SD		0.0028	0
beta-BHC	DD-512-SD		0.0019	0
beta-BHC	DD-518-SD		0.0023	0
beta-BHC	DD-514-SD		0.0083	0
beta-BHC	DD-510-SD		0.0037	0
beta-BHC	DD-507-SD		0.002	0
beta-BHC	DD-506-SD		0.0022	0
beta-BHC	RC-407-SD		0.0039	0
beta-BHC	RC-408-SD		0.0052	0
beta-BHC	RC-404-SD		0.0031	0
beta-BHC	RC-406-SD		0.0029	1
beta-BHC	RC-409-SD		0.003	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/7/2019 1:37:39 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	2	Number of Non-Detects	14
Number of Distinct Detects	2	Number of Distinct Non-Detects	13
Minimum Detect	0.0029	Minimum Non-Detect	0.0019
Maximum Detect	0.022	Maximum Non-Detect	0.0083
Variance Detects	1.82E-04	Percent Non-Detects	87.50%
Mean Detects	0.0125	SD Detects	0.0135
Median Detects	0.0125	CV Detects	1.085
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-4.83	SD of Logged Detects	1.433

Warning: Data set has only 2 Detected Values.

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

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

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

KM Mean	0.00329	KM Standard Error of Mean	0.00172
KM SD	0.00484	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0063	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00611	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00844	95% KM Chebyshev UCL	0.0108
97.5% KM Chebyshev UCL	0.014	99% KM Chebyshev UCL	0.0204

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.267	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00982	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	5.069	nu star (bias corrected)	N/A
Mean (detects)	0.0125		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00329	SD (KM)	0.00484
Variance (KM)	2.35E-05	SE of Mean (KM)	0.00172
k hat (KM)	0.462	k star (KM)	0.417
nu hat (KM)	14.77	nu star (KM)	13.33
theta hat (KM)	0.00713	theta star (KM)	0.0079
80% gamma percentile (KM)	0.00533	90% gamma percentile (KM)	0.00923
95% gamma percentile (KM)	0.0135	99% gamma percentile (KM)	0.0241

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0335
Approximate Chi Square Value (13.33, α)	6.119	Adjusted Chi Square Value (13.33, β)	5.57
95% Gamma Approximate KM-UCL (use when n>=50)	0.00717	95% Gamma Adjusted KM-UCL (use when n<50)	0.00788

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00164	Mean in Log Scale	-8.816
SD in Original Scale	0.00548	SD in Log Scale	1.655
95% t UCL (assumes normality of ROS data)	0.00404	95% Percentile Bootstrap UCL	0.00437
95% BCA Bootstrap UCL	0.00575	95% Bootstrap t UCL	0.299
95% H-UCL (Log ROS)	0.00299		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.056	KM Geo Mean	0.00234
KM SD (logged)	0.596	95% Critical H Value (KM-Log)	2.155
KM Standard Error of Mean (logged)	0.217	95% H-UCL (KM -Log)	0.0039
KM SD (logged)	0.596	95% Critical H Value (KM-Log)	2.155
KM Standard Error of Mean (logged)	0.217		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0032	Mean in Log Scale	-6.191
SD in Original Scale	0.0051	**SD in Log Scale**	0.778
95% t UCL (Assumes normality)	0.00543	95% H-Stat UCL	0.00447

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

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.0108

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

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

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

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

Sediment - 4,4'-DDD

Parameter	Sample ID	Val	D_Val
4,4'-DDD	RC-409-SD	0.0059	0
4,4'-DDD	DD-506-SD	0.0043	0
4,4'-DDD	DD-519-SD	0.0043	1
4,4'-DDD	DD-518-SD	0.0045	0
4,4'-DDD	DD-514-SD	0.016	0
4,4'-DDD	DD-508-SD	0.034	1
4,4'-DDD	DD-510-SD	0.0071	0
4,4'-DDD	RC-404-SD	0.006	0
4,4'-DDD	DD-513-SD	0.0055	0
4,4'-DDD	DD-507-SD	0.004	0
4,4'-DDD	RC-406-SD	0.0057	0
4,4'-DDD	RC-408-SD	0.01	0
4,4'-DDD	RC-407-SD	0.0075	0
4,4'-DDD	DD-509-SD	0.0041	0
4,4'-DDD	RC-405-SD	0.0045	0
4,4'-DDD	DD-512-SD	0.0037	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:50:41 PM
From File	Sed.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	0.0037	Mean	0.00794
Maximum	0.034	Median	0.0056
SD	0.0076	Std. Error of Mean	0.0019
Coefficient of Variation	0.957	Skewness	3.09

Normal GOF Test		
Shapiro Wilk Test Statistic	0.559	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	**0.336**	**Lilliefors GOF Test**
5% Lilliefors Critical Value	**0.213**	**Data Not Normal at 5% Significance Level**
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	**0.0113**	**95% Adjusted-CLT UCL (Chen-1995)**	**0.0126**
		95% Modified-t UCL (Johnson-1978)	**0.0115**

Gamma GOF Test		
A-D Test Statistic	1.716	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.217	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	**2.414**	**k star (bias corrected MLE)**	**2.003**
Theta hat (MLE)	**0.00329**	**Theta star (bias corrected MLE)**	**0.00397**
nu hat (MLE)	**77.26**	**nu star (bias corrected)**	**64.1**
MLE Mean (bias corrected)	0.00794	MLE Sd (bias corrected)	0.00561
		Approximate Chi Square Value (0.05)	46.68
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	44.99
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	**0.0109**	**95% Adjusted Gamma UCL (use when n<50)**	**0.0113**
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.213	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	**-5.599**	Mean of logged Data	-5.057
Maximum of Logged Data	-3.381	SD of logged Data	0.588
Assuming Lognormal Distribution			
95% H-UCL	**0.0105**	**90% Chebyshev (MVUE) UCL**	**0.0109**
95% Chebyshev (MVUE) UCL	**0.0125**	**97.5% Chebyshev (MVUE) UCL**	**0.0146**
99% Chebyshev (MVUE) UCL	**0.0189**		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0111	95% Jackknife UCL	0.0113
95% Standard Bootstrap UCL	**0.011**	**95% Bootstrap-t UCL**	**0.0207**
95% Hall's Bootstrap UCL	**0.0237**	**95% Percentile Bootstrap UCL**	**0.0113**
95% BCA Bootstrap UCL	0.0134		
90% Chebyshev(Mean, Sd) UCL	0.0136	95% Chebyshev(Mean, Sd) UCL	0.0162
97.5% Chebyshev(Mean, Sd) UCL	0.0198	99% Chebyshev(Mean, Sd) UCL	0.0269
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	**0.0162**		

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

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

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

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

Sediment - 4,4'-DDE

Parameter	Sample ID	Val	D_Val
4,4'-DDE	DD-518-SD	0.0045	0
4,4'-DDE	DD-506-SD	0.0043	0
4,4'-DDE	DD-508-SD	0.23	1
4,4'-DDE	RC-407-SD	0.0075	0
4,4'-DDE	DD-519-SD	0.013	0
4,4'-DDE	DD-512-SD	0.0054	1
4,4'-DDE	RC-409-SD	0.0059	0
4,4'-DDE	DD-510-SD	0.0071	0
4,4'-DDE	DD-507-SD	0.004	0
4,4'-DDE	DD-513-SD	0.0055	0
4,4'-DDE	RC-405-SD	0.0045	0
4,4'-DDE	RC-404-SD	0.006	0
4,4'-DDE	DD-514-SD	0.016	0
4,4'-DDE	RC-408-SD	0.077	1
4,4'-DDE	RC-406-SD	0.0057	0
4,4'-DDE	DD-509-SD	0.0041	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:50:24 PM
From File	Sed_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	3	Number of Non-Detects	13
Number of Distinct Detects	3	Number of Distinct Non-Detects	12
Minimum Detect	0.0054	Minimum Non-Detect	0.004
Maximum Detect	0.23	Maximum Non-Detect	0.016
Variance Detects	0.0132	Percent Non-Detects	81.25%
Mean Detects	0.104	SD Detects	0.115
Median Detects	0.077	CV Detects	1.102
Skewness Detects	1.005	Kurtosis Detects	N/A
Mean of Logged Detects	-3.085	SD of Logged Detects	1.929

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.26	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.0229	KM Standard Error of Mean	0.0172

KM SD	0.0563	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0531	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0512	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0746	95% KM Chebyshev UCL	0.098
97.5% KM Chebyshev UCL	0.131	99% KM Chebyshev UCL	0.194

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.73	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.143	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4.381	nu star (bias corrected)	N/A
Mean (detects)	0.104		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.0054	Mean	0.0277
Maximum	0.23	Median	0.01
SD	0.0565	CV	2.044
k hat (MLE)	0.81	k star (bias corrected MLE)	0.699
Theta hat (MLE)	0.0342	Theta star (bias corrected MLE)	0.0395
nu hat (MLE)	25.9	nu star (bias corrected)	22.38
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (22.38, α)	12.62	Adjusted Chi Square Value (22.38, β)	11.8
95% Gamma Approximate UCL (use when n>=50)	0.049	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0229	SD (KM)	0.0563
Variance (KM)	0.00317	SE of Mean (KM)	0.0172
k hat (KM)	0.165	k star (KM)	0.176
nu hat (KM)	5.292	nu star (KM)	5.633
theta hat (KM)	0.138	theta star (KM)	0.13
80% gamma percentile (KM)	0.028	90% gamma percentile (KM)	0.069
95% gamma percentile (KM)	0.122	99% gamma percentile (KM)	0.27

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.63, α)	1.455	Adjusted Chi Square Value (5.63, β)	1.229
95% Gamma Approximate KM-UCL (use when n>=50)	0.0886	95% Gamma Adjusted KM-UCL (use when n<50)	0.105

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.273	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0196	Mean in Log Scale	-8.529
SD in Original Scale	0.0593	SD in Log Scale	2.866
95% t UCL (assumes normality of ROS data)	0.0456	95% Percentile Bootstrap UCL	0.0442
95% BCA Bootstrap UCL	0.063	95% Bootstrap t UCL	0.872

95% H-UCL (Log ROS)	1.14

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.04	KM Geo Mean	0.00648
KM SD (logged)	1.163	95% Critical H Value (KM-Log)	2.964
KM Standard Error of Mean (logged)	0.358	95% H-UCL (KM -Log)	0.031
KM SD (logged)	1.163	95% Critical H Value (KM-Log)	2.964
KM Standard Error of Mean (logged)	0.358		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0223	Mean in Log Scale	-5.28
SD in Original Scale	0.0584	SD in Log Scale	1.353
95% t UCL (Assumes normality)	0.0479	95% H-Stat UCL	0.0401

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0531

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - 4,4'-DDT

Parameter	Sample ID	Val	D_Val
4,4'-DDT	RC-409-SD	0.025	1
4,4'-DDT	DD-510-SD	0.0071	0
4,4'-DDT	DD-518-SD	0.0045	0
4,4'-DDT	DD-507-SD	0.004	0
4,4'-DDT	RC-404-SD	0.006	0
4,4'-DDT	DD-508-SD	0.21	1
4,4'-DDT	RC-405-SD	0.0045	0
4,4'-DDT	DD-509-SD	0.0041	0
4,4'-DDT	RC-408-SD	0.072	1
4,4'-DDT	DD-512-SD	0.0037	0
4,4'-DDT	DD-513-SD	0.0055	0
4,4'-DDT	RC-407-SD	0.0075	0
4,4'-DDT	DD-519-SD	0.025	1
4,4'-DDT	DD-506-SD	0.0043	0
4,4'-DDT	DD-514-SD	0.016	0
4,4'-DDT	RC-406-SD	0.0088	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:50:04 PM
From File	Sed_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
Number of Detects	5	Number of Non-Detects	11
Number of Distinct Detects	4	Number of Distinct Non-Detects	10
Minimum Detect	0.0088	Minimum Non-Detect	0.0037
Maximum Detect	0.21	Maximum Non-Detect	0.016
Variance Detects	0.00685	Percent Non-Detects	68.75%
Mean Detects	0.0682	SD Detects	0.0827
Median Detects	0.025	CV Detects	1.214
Skewness Detects	1.827	Kurtosis Detects	3.313
Mean of Logged Detects	-3.26	SD of Logged Detects	1.206

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.768	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.0239	KM Standard Error of Mean	0.0143
KM SD	0.051	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0489	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0473	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0667	95% KM Chebyshev UCL	0.086

97.5% KM Chebyshev UCL	0.113	99% KM Chebyshev UCL	0.166

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.359	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.691	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.294	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.364	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.004	k star (bias corrected MLE)	0.535
Theta hat (MLE)	0.0679	Theta star (bias corrected MLE)	0.127
nu hat (MLE)	10.04	nu star (bias corrected)	5.35
Mean (detects)	0.0682		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.0088	Mean	0.0282
Maximum	0.21	Median	0.01
SD	0.051	CV	1.81
k hat (MLE)	0.944	k star (bias corrected MLE)	0.809
Theta hat (MLE)	0.0298	Theta star (bias corrected MLE)	0.0348
nu hat (MLE)	30.21	nu star (bias corrected)	25.88
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (25.88, α)	15.29	Adjusted Chi Square Value (25.88, β)	14.36
95% Gamma Approximate UCL (use when n>=50)	0.0477	95% Gamma Adjusted UCL (use when n<50)	0.0508

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0239	SD (KM)	0.051
Variance (KM)	0.0026	SE of Mean (KM)	0.0143
k hat (KM)	0.219	k star (KM)	0.22
nu hat (KM)	7.006	nu star (KM)	7.026
theta hat (KM)	0.109	theta star (KM)	0.109
80% gamma percentile (KM)	0.0329	90% gamma percentile (KM)	0.0721
95% gamma percentile (KM)	0.12	99% gamma percentile (KM)	0.25

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.03, α)	2.185	Adjusted Chi Square Value (7.03, β)	1.891
95% Gamma Approximate KM-UCL (use when n>=50)	0.0768	95% Gamma Adjusted KM-UCL (use when n<50)	0.0887

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.239	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0217	Mean in Log Scale	-6.201
SD in Original Scale	0.0536	SD in Log Scale	2.167
95% t UCL (assumes normality of ROS data)	0.0452	95% Percentile Bootstrap UCL	0.046
95% BCA Bootstrap UCL	0.0604	95% Bootstrap t UCL	0.134

95% H-UCL (Log ROS)	0.31

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.864	KM Geo Mean	0.00772
KM SD (logged)	1.239	95% Critical H Value (KM-Log)	3.091
KM Standard Error of Mean (logged)	0.347	95% H-UCL (KM -Log)	0.0448
KM SD (logged)	1.239	95% Critical H Value (KM-Log)	3.091
KM Standard Error of Mean (logged)	0.347		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0234	Mean in Log Scale	-5.068
SD in Original Scale	0.0529	SD in Log Scale	1.447
95% t UCL (Assumes normality)	0.0466	95% H-Stat UCL	0.065

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0489

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - DDD/DDE/DDT

SubGroup	Sample ID	Val	D_Val
DDD/DDE/DDT	DD-506-SD	0.00645	0
DDD/DDE/DDT	DD-507-SD	0.006	0
DDD/DDE/DDT	DD-508-SD	0.474	1
DDD/DDE/DDT	DD-509-SD	0.00615	0
DDD/DDE/DDT	DD-510-SD	0.01065	0
DDD/DDE/DDT	DD-512-SD	0.0091	1
DDD/DDE/DDT	DD-513-SD	0.00825	0
DDD/DDE/DDT	DD-514-SD	0.024	0
DDD/DDE/DDT	DD-518-SD	0.00675	0
DDD/DDE/DDT	DD-519-SD	0.0358	1
DDD/DDE/DDT	RC-404-SD	0.009	0
DDD/DDE/DDT	RC-405-SD	0.00675	0
DDD/DDE/DDT	RC-406-SD	0.0145	1
DDD/DDE/DDT	RC-407-SD	0.01125	0
DDD/DDE/DDT	RC-408-SD	0.154	1
DDD/DDE/DDT	RC-409-SD	0.0309	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:42:46 PM
From File	Sed_s.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	6	Number of Non-Detects	10
Number of Distinct Detects	6	Number of Distinct Non-Detects	9
Minimum Detect	0.0091	Minimum Non-Detect	0.006
Maximum Detect	0.474	Maximum Non-Detect	0.024
Variance Detects	0.033	Percent Non-Detects	62.5%
Mean Detects	0.12	SD Detects	0.182
Median Detects	0.0334	CV Detects	1.517
Skewness Detects	2.038	Kurtosis Detects	4.134
Mean of Logged Detects	-3.06	SD of Logged Detects	1.489

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.695	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0488	KM Standard Error of Mean	0.0316
KM SD	0.115	95% KM (BCA) UCL	0.112
95% KM (t) UCL	0.104	95% KM (Percentile Bootstrap) UCL	0.104
95% KM (z) UCL	0.101	95% KM Bootstrap t UCL	0.466
90% KM Chebyshev UCL	0.144	95% KM Chebyshev UCL	0.187

97.5% KM Chebyshev UCL	0.246	99% KM Chebyshev UCL	0.363

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.471	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.312	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.345	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.652	k star (bias corrected MLE)	0.437
Theta hat (MLE)	0.184	Theta star (bias corrected MLE)	0.274
nu hat (MLE)	7.819	nu star (bias corrected)	5.243
Mean (detects)	0.12		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.0091	Mean	0.0511
Maximum	0.474	Median	0.01
SD	0.118	CV	2.314
k hat (MLE)	0.589	k star (bias corrected MLE)	0.52
Theta hat (MLE)	0.0869	Theta star (bias corrected MLE)	0.0984
nu hat (MLE)	18.84	nu star (bias corrected)	16.64
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (16.64, α)	8.416	Adjusted Chi Square Value (16.64, β)	7.757
95% Gamma Approximate UCL (use when n>=50)	0.101	95% Gamma Adjusted UCL (use when n<50)	0.11

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0488	SD (KM)	0.115
Variance (KM)	0.0133	SE of Mean (KM)	0.0316
k hat (KM)	0.178	k star (KM)	0.187
nu hat (KM)	5.708	nu star (KM)	5.971
theta hat (KM)	0.273	theta star (KM)	0.261
80% gamma percentile (KM)	0.0618	90% gamma percentile (KM)	0.147
95% gamma percentile (KM)	0.256	99% gamma percentile (KM)	0.558

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.97, α)	1.625	Adjusted Chi Square Value (5.97, β)	1.382
95% Gamma Approximate KM-UCL (use when n>=50)	0.179	95% Gamma Adjusted KM-UCL (use when n<50)	0.211

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.239	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0453	Mean in Log Scale	-5.864
SD in Original Scale	0.121	SD in Log Scale	2.433
95% t UCL (assumes normality of ROS data)	0.0981	95% Percentile Bootstrap UCL	0.101
95% BCA Bootstrap UCL	0.129	95% Bootstrap t UCL	0.461

95% H-UCL (Log ROS)	1.532

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.33	KM Geo Mean	0.0132
KM SD (logged)	1.292	95% Critical H Value (KM-Log)	3.18
KM Standard Error of Mean (logged)	0.355	95% H-UCL (KM -Log)	0.0876
KM SD (logged)	1.292	95% Critical H Value (KM-Log)	3.18
KM Standard Error of Mean (logged)	0.355		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0479	Mean in Log Scale	-4.55
SD in Original Scale	0.12	SD in Log Scale	1.506
95% t UCL (Assumes normality)	0.1	95% H-Stat UCL	0.131

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	0.211

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

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

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

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

Sediment - PCBs

SubGroup	Sample ID	Val	D_Val
PCB	DD-506-SD	0.532	1
PCB	DD-507-SD	0.71	1
PCB	DD-508-SD	21.1	1
PCB	DD-509-SD	5.3135	1
PCB	DD-510-SD	2.084	1
PCB	DD-512-SD	0.1665	0
PCB	DD-513-SD	2.22	1
PCB	DD-514-SD	3.04	1
PCB	DD-518-SD	0.2025	0
PCB	DD-519-SD	2.53	1
PCB	ISD-202_3/10/2000	0.0182	0
PCB	ISD-203_3/9/2000	0.0161	0
PCB	ISD-204_3/10/2000	0.0161	0
PCB	LSD-17-01_5/26/1998	0.81675	1
PCB	LSD-18-01_5/26/1998	0.0836	1
PCB	LSD-19-01_5/22/1998	0.01305	0
PCB	LSD-20-01_5/22/1998	0.1589	1
PCB	LSD-21-01_5/22/1998	0.309	1
PCB	LSD-22-01_5/22/1998	0.34675	1
PCB	LSD-26-01_5/21/1998	1.67395	1
PCB	LSD-27-01_5/21/1998	1.00635	1
PCB	LSD-28-01_5/21/1998	1.9603	1
PCB	LSD-29-01_5/21/1998	5.5335	1
PCB	LSD-35-01_5/27/1998	0.00555	0
PCB	LSD-35-02_5/27/1998	0.0066	0
PCB	LSD-35-03_5/27/1998	0.00615	0
PCB	LSD-35-04_5/27/1998	0.00495	0
PCB	LSD-35-05_5/27/1998	0.0053	0
PCB	LSD-36-01_5/27/1998	1.0412	1
PCB	LSD-36-02_5/27/1998	0.1052	1
PCB	LSD-36-03_5/27/1998	10.914	1
PCB	LSD-36-04_5/27/1998	3.29725	1
PCB	LSD-36-05_5/27/1998	0.01815	0
PCB	RC-404-SD	0.27	0
PCB	RC-405-SD	0.55	1
PCB	RC-406-SD	0.6295	1
PCB	RC-407-SD	3.8	1
PCB	RC-408-SD	10.2	1
PCB	RC-409-SD	5.236	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:02:29 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	39	Number of Distinct Observations	38
Number of Detects	26	Number of Non-Detects	13
Number of Distinct Detects	26	Number of Distinct Non-Detects	12
Minimum Detect	8.36E-02	Minimum Non-Detect	4.95E-03
Maximum Detect	21.1	Maximum Non-Detect	0.27
Variance Detects	21.47	Percent Non-Detects	33.33%
Mean Detects	3.277	SD Detects	4.634
Median Detects	1.817	CV Detects	1.414
Skewness Detects	2.698	Kurtosis Detects	8.453
Mean of Logged Detects	0.35	SD of Logged Detects	1.43

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.672	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	2.188	KM Standard Error of Mean	0.656
KM SD	4.017	95% KM (BCA) UCL	3.423
95% KM (t) UCL	3.294	95% KM (Percentile Bootstrap) UCL	3.286
95% KM (z) UCL	3.267	95% KM Bootstrap t UCL	4.12
90% KM Chebyshev UCL	4.156	95% KM Chebyshev UCL	5.047
97.5% KM Chebyshev UCL	6.285	99% KM Chebyshev UCL	8.715

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.335	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.787	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.116	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.178	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.719	k star (bias corrected MLE)	0.662
Theta hat (MLE)	4.556	Theta star (bias corrected MLE)	4.951
nu hat (MLE)	37.4	nu star (bias corrected)	34.41
Mean (detects)	3.277		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	1.00E-02	Mean	2.188
Maximum	21.1	Median	0.55
SD	4.07	CV	1.86
k hat (MLE)	0.326	k star (bias corrected MLE)	0.318
Theta hat (MLE)	6.706	Theta star (bias corrected MLE)	6.874
nu hat (MLE)	25.45	nu star (bias corrected)	24.82
Adjusted Level of Significance (β)	0.0437		
Approximate Chi Square Value (24.82, α)	14.48	Adjusted Chi Square Value (24.82, β)	14.16
95% Gamma Approximate UCL (use when n>=50)	3.751	95% Gamma Adjusted UCL (use when n<50)	3.834

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.188	SD (KM)	4.017
Variance (KM)	16.14	SE of Mean (KM)	0.656
k hat (KM)	0.297	k star (KM)	0.291
nu hat (KM)	23.14	nu star (KM)	22.69
theta hat (KM)	7.375	theta star (KM)	7.52
80% gamma percentile (KM)	3.329	90% gamma percentile (KM)	6.476
95% gamma percentile (KM)	10.11	99% gamma percentile (KM)	19.58

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.69, α)	12.86	Adjusted Chi Square Value (22.69, β)	12.57
95% Gamma Approximate KM-UCL (use when n>=50)	3.861	95% Gamma Adjusted KM-UCL (use when n<50)	3.951

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0895	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.203	Mean in Log Scale	-0.733
SD in Original Scale	4.061	SD in Log Scale	1.942
95% t UCL (assumes normality of ROS data)	3.3	95% Percentile Bootstrap UCL	3.344
95% BCA Bootstrap UCL	3.648	95% Bootstrap t UCL	4.152
95% H-UCL (Log ROS)	10.09		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.481	KM Geo Mean	0.227
KM SD (logged)	2.86	95% Critical H Value (KM-Log)	5.082
KM Standard Error of Mean (logged)	0.472	95% H-UCL (KM -Log)	143.4
KM SD (logged)	2.86	95% Critical H Value (KM-Log)	5.082
KM Standard Error of Mean (logged)	0.472		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.194	Mean in Log Scale	-1.31
SD in Original Scale	4.066	SD in Log Scale	2.766
95% t UCL (Assumes normality)	3.292	95% H-Stat UCL	113.5

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	3.951

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - Benzaldehyde

Parameter	Sample ID		Val	D_Val
Benzaldehyde	RC-406-SD		0.29	0
Benzaldehyde	DD-518-SD		0.23	0
Benzaldehyde	RC-408-SD		1.3	1
Benzaldehyde	DD-509-SD		0.21	0
Benzaldehyde	DD-514-SD		8.3	0
Benzaldehyde	RC-409-SD		0.59	1
Benzaldehyde	DD-507-SD		0.2	0
Benzaldehyde	DD-512-SD		0.19	0
Benzaldehyde	DD-513-SD		0.29	0
Benzaldehyde	DD-506-SD		0.22	0
Benzaldehyde	DD-510-SD		3.7	0
Benzaldehyde	DD-519-SD		0.32	1
Benzaldehyde	DD-508-SD		0.12	1
Benzaldehyde	RC-407-SD		3.8	0
Benzaldehyde	RC-404-SD		0.31	0
Benzaldehyde	RC-405-SD		0.033	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:48:59 PM
From File	Sed_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	5	Number of Non-Detects	11
Number of Distinct Detects	5	Number of Distinct Non-Detects	10
Minimum Detect	0.033	Minimum Non-Detect	0.19
Maximum Detect	1.3	Maximum Non-Detect	8.3
Variance Detects	0.26	Percent Non-Detects	68.75%
Mean Detects	0.473	SD Detects	0.51
Median Detects	0.32	CV Detects	1.079
Skewness Detects	1.371	Kurtosis Detects	1.67
Mean of Logged Detects	-1.387	SD of Logged Detects	1.428

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.229	KM Standard Error of Mean	0.109
KM SD	0.344	95% KM (BCA) UCL	0.451
95% KM (t) UCL	0.42	95% KM (Percentile Bootstrap) UCL	0.432
95% KM (z) UCL	0.408	95% KM Bootstrap t UCL	0.598
90% KM Chebyshev UCL	0.557	95% KM Chebyshev UCL	0.705

97.5% KM Chebyshev UCL	0.911	99% KM Chebyshev UCL	1.316

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.165	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.694	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.365	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.915	k star (bias corrected MLE)	0.499
Theta hat (MLE)	0.517	Theta star (bias corrected MLE)	0.947
nu hat (MLE)	9.148	nu star (bias corrected)	4.993
Mean (detects)	0.473		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.173
Maximum	1.3	Median	0.0572
SD	0.337	CV	1.948
k hat (MLE)	0.486	k star (bias corrected MLE)	0.436
Theta hat (MLE)	0.356	Theta star (bias corrected MLE)	0.397
nu hat (MLE)	15.54	nu star (bias corrected)	13.96
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (13.96, α)	6.546	Adjusted Chi Square Value (13.96, β)	5.976
95% Gamma Approximate UCL (use when n>=50)	0.369	95% Gamma Adjusted UCL (use when n<50)	0.405

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.229	SD (KM)	0.344
Variance (KM)	0.118	SE of Mean (KM)	0.109
k hat (KM)	0.443	k star (KM)	0.402
nu hat (KM)	14.17	nu star (KM)	12.85
theta hat (KM)	0.517	theta star (KM)	0.57
80% gamma percentile (KM)	0.37	90% gamma percentile (KM)	0.646
95% gamma percentile (KM)	0.95	99% gamma percentile (KM)	1.713

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.85, α)	5.791	Adjusted Chi Square Value (12.85, β)	5.26
95% Gamma Approximate KM-UCL (use when n>=50)	0.508	95% Gamma Adjusted KM-UCL (use when n<50)	0.559

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.169	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.197	Mean in Log Scale	-2.28
SD in Original Scale	0.326	SD in Log Scale	1
95% t UCL (assumes normality of ROS data)	0.34	95% Percentile Bootstrap UCL	0.343
95% BCA Bootstrap UCL	0.414	95% Bootstrap t UCL	0.743

95% H-UCL (Log ROS)	0.339

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.236	KM Geo Mean	0.107
KM SD (logged)	1.155	95% Critical H Value (KM-Log)	2.95
KM Standard Error of Mean (logged)	0.501	95% H-UCL (KM -Log)	0.502
KM SD (logged)	1.155	95% Critical H Value (KM-Log)	2.95
KM Standard Error of Mean (logged)	0.501		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.702	Mean in Log Scale	-1.329
SD in Original Scale	1.115	SD in Log Scale	1.384
95% t UCL (Assumes normality)	1.191	95% H-Stat UCL	2.276

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.42

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - bis(2-Ethylhexyl)phthalate

Parameter	Sample ID	Val	D_Val
bis(2-Ethylhexyl) phthalate	LSD-3_6/1/1996	1.3	0
bis(2-Ethylhexyl) phthalate	SD-1_7/25/1990	0.06	0
bis(2-Ethylhexyl) phthalate	RC-405-SD	0.23	0
bis(2-Ethylhexyl) phthalate	LSD-5_6/1/1996	3.4	0
bis(2-Ethylhexyl) phthalate	DD-507-SD	0.2	0
bis(2-Ethylhexyl) phthalate	RC-408-SD	13	1
bis(2-Ethylhexyl) phthalate	DD-506-SD	0.22	0
bis(2-Ethylhexyl) phthalate	RC-409-SD	3.1	1
bis(2-Ethylhexyl) phthalate	DD-514-SD	8.3	0
bis(2-Ethylhexyl) phthalate	DD-518-SD	0.23	0
bis(2-Ethylhexyl) phthalate	LSD-7_6/1/1996	1.1	0
bis(2-Ethylhexyl) phthalate	DD-510-SD	3.7	0
bis(2-Ethylhexyl) phthalate	LSD-10_6/1/1996	1.6	1
bis(2-Ethylhexyl) phthalate	DD-509-SD	2.5	1
bis(2-Ethylhexyl) phthalate	DD-512-SD	0.19	0
bis(2-Ethylhexyl) phthalate	DD-513-SD	0.91	1
bis(2-Ethylhexyl) phthalate	RC-404-SD	0.31	0
bis(2-Ethylhexyl) phthalate	LSD-9_6/1/1996	1.5	0
bis(2-Ethylhexyl) phthalate	RC-407-SD	3.8	0
bis(2-Ethylhexyl) phthalate	DD-519-SD	3.4	1
bis(2-Ethylhexyl) phthalate	DD-508-SD	2.2	1
bis(2-Ethylhexyl) phthalate	RC-406-SD	0.29	0
bis(2-Ethylhexyl) phthalate	LSD-8_6/1/1996	1.5	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:47:50 PM
From File	Sed_h.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	23	Number of Distinct Observations	20
Number of Detects	7	Number of Non-Detects	16
Number of Distinct Detects	7	Number of Distinct Non-Detects	14
Minimum Detect	0.91	Minimum Non-Detect	0.06
Maximum Detect	13	Maximum Non-Detect	8.3
Variance Detects	17.12	Percent Non-Detects	69.57%
Mean Detects	3.816	SD Detects	4.138
Median Detects	2.5	CV Detects	1.084
Skewness Detects	2.412	Kurtosis Detects	6.094
Mean of Logged Detects	1	SD of Logged Detects	0.821

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.397	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	1.344	KM Standard Error of Mean	0.626
KM SD	2.725	95% KM (BCA) UCL	2.554
95% KM (t) UCL	2.419	95% KM (Percentile Bootstrap) UCL	2.476
95% KM (z) UCL	2.373	95% KM Bootstrap t UCL	3.12
90% KM Chebyshev UCL	3.221	95% KM Chebyshev UCL	4.071
97.5% KM Chebyshev UCL	5.251	99% KM Chebyshev UCL	7.568

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.604	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.308	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.317	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.621	k star (bias corrected MLE)	1.022
Theta hat (MLE)	2.353	Theta star (bias corrected MLE)	3.735
nu hat (MLE)	22.7	nu star (bias corrected)	14.3
Mean (detects)	3.816		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	1.168
Maximum	13	Median	0.01
SD	2.806	CV	2.402
k hat (MLE)	0.235	k star (bias corrected MLE)	0.233
Theta hat (MLE)	4.974	Theta star (bias corrected MLE)	5.009
nu hat (MLE)	10.8	nu star (bias corrected)	10.73
Adjusted Level of Significance (β)	0.0389		
Approximate Chi Square Value (10.73, α)	4.402	Adjusted Chi Square Value (10.73, β)	4.111
95% Gamma Approximate UCL (use when n>=50)	2.847	95% Gamma Adjusted UCL (use when n<50)	3.049

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.344	SD (KM)	2.725
Variance (KM)	7.428	SE of Mean (KM)	0.626
k hat (KM)	0.243	k star (KM)	0.241
nu hat (KM)	11.19	nu star (KM)	11.07
theta hat (KM)	5.525	theta star (KM)	5.588
80% gamma percentile (KM)	1.925	90% gamma percentile (KM)	4.046
95% gamma percentile (KM)	6.582	99% gamma percentile (KM)	13.37

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.07, α)	4.619	Adjusted Chi Square Value (11.07, β)	4.32
95% Gamma Approximate KM-UCL (use when n>=50)	3.221	95% Gamma Adjusted KM-UCL (use when n<50)	3.444

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.423	Mean in Log Scale	-0.415
SD in Original Scale	2.702	SD in Log Scale	1.088
95% t UCL (assumes normality of ROS data)	2.391	95% Percentile Bootstrap UCL	2.448
95% BCA Bootstrap UCL	3.108	95% Bootstrap t UCL	4.248
95% H-UCL (Log ROS)	2.204		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.391	KM Geo Mean	0.249
KM SD (logged)	1.86	95% Critical H Value (KM-Log)	3.822
KM Standard Error of Mean (logged)	0.469	95% H-UCL (KM -Log)	6.395
KM SD (logged)	1.86	95% Critical H Value (KM-Log)	3.822
KM Standard Error of Mean (logged)	0.469		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.734	Mean in Log Scale	-0.43
SD in Original Scale	2.735	SD in Log Scale	1.584
95% t UCL (Assumes normality)	2.713	95% H-Stat UCL	7.134

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	3.444	95% GROS Adjusted Gamma UCL	3.049

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - Carbazole

Parameter	Sample ID	Val	D_Val
Carbazole	DD-514-SD	8.3	0
Carbazole	RC-404-SD	0.31	0
Carbazole	RC-409-SD	0.61	0
Carbazole	DD-518-SD	0.23	0
Carbazole	DD-512-SD	0.19	0
Carbazole	DD-509-SD	0.12	1
Carbazole	DD-519-SD	0.65	0
Carbazole	DD-513-SD	0.059	1
Carbazole	RC-407-SD	3.8	0
Carbazole	DD-510-SD	3.7	0
Carbazole	RC-406-SD	0.29	0
Carbazole	DD-507-SD	0.04	1
Carbazole	RC-405-SD	0.23	0
Carbazole	DD-508-SD	0.53	0
Carbazole	RC-408-SD	1.5	0
Carbazole	DD-506-SD	0.22	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 6:46:57 PM
From File	Sed_j.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	3	Number of Non-Detects	13
Number of Distinct Detects	3	Number of Distinct Non-Detects	12
Minimum Detect	0.04	Minimum Non-Detect	0.19
Maximum Detect	0.12	Maximum Non-Detect	8.3
Variance Detects	0.00175	Percent Non-Detects	81.25%
Mean Detects	0.073	SD Detects	0.0418
Median Detects	0.059	CV Detects	0.573
Skewness Detects	1.338	Kurtosis Detects	N/A
Mean of Logged Detects	-2.723	SD of Logged Detects	0.557

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.073	KM Standard Error of Mean	0.0241

KM SD	0.0341	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.115	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.113	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.145	95% KM Chebyshev UCL	0.178
97.5% KM Chebyshev UCL	0.224	99% KM Chebyshev UCL	0.313

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	4.885	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0149	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	29.31	nu star (bias corrected)	N/A
Mean (detects)	0.073		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.04	Mean	0.0709
Maximum	0.12	Median	0.0702
SD	0.018	CV	0.254
k hat (MLE)	17.62	k star (bias corrected MLE)	14.36
Theta hat (MLE)	0.00402	Theta star (bias corrected MLE)	0.00494
nu hat (MLE)	563.9	nu star (bias corrected)	459.5
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (459.52, α)	410.8	Adjusted Chi Square Value (459.52, β)	405.6
95% Gamma Approximate UCL (use when n>=50)	0.0793	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.073	SD (KM)	0.0341
Variance (KM)	0.00116	SE of Mean (KM)	0.0241
k hat (KM)	4.576	k star (KM)	3.759
nu hat (KM)	146.4	nu star (KM)	120.3
theta hat (KM)	0.016	theta star (KM)	0.0194
80% gamma percentile (KM)	0.101	90% gamma percentile (KM)	0.123
95% gamma percentile (KM)	0.144	99% gamma percentile (KM)	0.188

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (120.30, α)	95.97	Adjusted Chi Square Value (120.30, β)	93.5
95% Gamma Approximate KM-UCL (use when n>=50)	0.0915	95% Gamma Adjusted KM-UCL (use when n<50)	0.0939

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0676	Mean in Log Scale	-2.723
SD in Original Scale	0.0178	SD in Log Scale	0.24
95% t UCL (assumes normality of ROS data)	0.0753	95% Percentile Bootstrap UCL	0.0752
95% BCA Bootstrap UCL	0.0764	95% Bootstrap t UCL	0.0806

95% H-UCL (Log ROS)	0.0757

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.723	KM Geo Mean	0.0657
KM SD (logged)	0.455	95% Critical H Value (KM-Log)	2.005
KM Standard Error of Mean (logged)	0.322	95% H-UCL (KM -Log)	0.0922
KM SD (logged)	0.455	95% Critical H Value (KM-Log)	2.005
KM Standard Error of Mean (logged)	0.322		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.656	Mean in Log Scale	-1.381
SD in Original Scale	1.105	SD in Log Scale	1.333
95% t UCL (Assumes normality)	1.14	95% H-Stat UCL	1.87

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.115

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sediment - Pentachlorophenol

Parameter	Sample ID	Val	D_Val
Pentachlorophenol	DD-506-SD	0.43	0
Pentachlorophenol	DD-507-SD	0.4	0
Pentachlorophenol	DD-508-SD	1	0
Pentachlorophenol	DD-509-SD	0.41	0
Pentachlorophenol	DD-510-SD	1.6	1
Pentachlorophenol	DD-512-SD	0.37	0
Pentachlorophenol	DD-513-SD	0.057	1
Pentachlorophenol	DD-514-SD	16	0
Pentachlorophenol	DD-518-SD	0.45	0
Pentachlorophenol	DD-519-SD	1.3	0
Pentachlorophenol	RC-404-SD	0.6	0
Pentachlorophenol	RC-405-SD	0.45	0
Pentachlorophenol	RC-406-SD	0.57	0
Pentachlorophenol	RC-407-SD	7.5	0
Pentachlorophenol	RC-408-SD	3.3	1
Pentachlorophenol	RC-409-SD	1.3	1
Pentachlorophenol	SD-1_7/25/1990	0.61	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/16/2019 3:42:01 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	17	Number of Distinct Observations	15
Number of Detects	4	Number of Non-Detects	13
Number of Distinct Detects	4	Number of Distinct Non-Detects	12
Minimum Detect	0.057	Minimum Non-Detect	0.37
Maximum Detect	3.3	Maximum Non-Detect	16
Variance Detects	1.785	Percent Non-Detects	76.47%
Mean Detects	1.564	SD Detects	1.336
Median Detects	1.45	CV Detects	0.854
Skewness Detects	0.499	Kurtosis Detects	1.397
Mean of Logged Detects	-0.235	SD of Logged Detects	1.798

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.239	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.459	KM Standard Error of Mean	0.267
KM SD	0.895	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.925	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.898	95% KM Bootstrap t UCL	N/A

90% KM Chebyshev UCL	1.26	95% KM Chebyshev UCL	1.622
97.5% KM Chebyshev UCL	2.126	99% KM Chebyshev UCL	3.114

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.403	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.669	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.33	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.404	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.862	k star (bias corrected MLE)	0.382
Theta hat (MLE)	1.815	Theta star (bias corrected MLE)	4.093
nu hat (MLE)	6.895	nu star (bias corrected)	3.057
Mean (detects)	1.564		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.388
Maximum	3.3	Median	0.01
SD	0.888	CV	2.288
k hat (MLE)	0.302	k star (bias corrected MLE)	0.288
Theta hat (MLE)	1.285	Theta star (bias corrected MLE)	1.348
nu hat (MLE)	10.26	nu star (bias corrected)	9.785
Adjusted Level of Significance (β)	0.0346		
Approximate Chi Square Value (9.79, α)	3.808	Adjusted Chi Square Value (9.79, β)	3.426
95% Gamma Approximate UCL (use when n>=50)	0.997	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.459	SD (KM)	0.895
Variance (KM)	0.801	SE of Mean (KM)	0.267
k hat (KM)	0.263	k star (KM)	0.256
nu hat (KM)	8.937	nu star (KM)	8.693
theta hat (KM)	1.746	theta star (KM)	1.795
80% gamma percentile (KM)	0.672	90% gamma percentile (KM)	1.375
95% gamma percentile (KM)	2.207	99% gamma percentile (KM)	4.413

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.69, α)	3.143	Adjusted Chi Square Value (8.69, β)	2.802
95% Gamma Approximate KM-UCL (use when n>=50)	1.269	95% Gamma Adjusted KM-UCL (use when n<50)	1.424

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	**Detected Data appear Lognormal at 5% Significance Level**
Lilliefors Test Statistic	0.359	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	**Detected Data appear Lognormal at 5% Significance Level**

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.422	Mean in Log Scale	-2.131
SD in Original Scale	0.873	SD in Log Scale	1.374
95% t UCL (assumes normality of ROS data)	0.792	95% Percentile Bootstrap UCL	0.794

95% BCA Bootstrap UCL	0.921	95% Bootstrap t UCL	1.251
95% H-UCL (Log ROS)	0.938		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.163	KM Geo Mean	0.115
KM SD (logged)	1.414	95% Critical H Value (KM-Log)	3.336
KM Standard Error of Mean (logged)	0.422	95% H-UCL (KM -Log)	1.016
KM SD (logged)	1.414	95% Critical H Value (KM-Log)	3.336
KM Standard Error of Mean (logged)	0.422		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.253	**Mean in Log Scale**	-0.689
SD in Original Scale	2.057	SD in Log Scale	1.318
95% t UCL (Assumes normality)	2.124	95% H-Stat UCL	3.405

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.925

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

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

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

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

Sediment - Acetone

Parameter	Sample ID	Val	D_Val
Acetone	DD-513-SD	0.025	0
Acetone	DD-514-SD	0.062	0
Acetone	RC-407-SD	0.024	0
Acetone	DD-512-SD	0.016	0
Acetone	DD-510-SD	0.031	0
Acetone	DD-508-SD	0.017	0
Acetone	RC-405-SD	0.015	0
Acetone	DD-509-SD	0.006	0
Acetone	RC-406-SD	0.018	0
Acetone	RC-404-SD	0.024	0
Acetone	DD-507-SD	0.012	0
Acetone	DD-519-SD	0.18	1
Acetone	RC-408-SD	0.018	0
Acetone	DD-506-SD	0.013	0
Acetone	DD-518-SD	0.25	1
Acetone	RC-409-SD	0.016	0
Acetone	ISD-202_3/10/2000	0.0258	1
Acetone	ISD-203_3/9/2000	0.0351	1
Acetone	ISD-204_3/10/2000	0.0337	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:05:09 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	19	Number of Distinct Observations	16
Number of Detects	5	Number of Non-Detects	14
Number of Distinct Detects	5	Number of Distinct Non-Detects	11
Minimum Detect	0.0258	Minimum Non-Detect	0.006
Maximum Detect	0.25	Maximum Non-Detect	0.062
Variance Detects	0.0107	Percent Non-Detects	73.68%
Mean Detects	0.105	SD Detects	0.104
Median Detects	0.0351	CV Detects	0.987
Skewness Detects	0.856	Kurtosis Detects	-1.874
Mean of Logged Detects	-2.7	SD of Logged Detects	1.062

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.35	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data Not Normal at 5% Significance Level
Detected Data appear Approximate Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.0324	KM Standard Error of Mean	0.0165
KM SD	0.0644	95% KM (BCA) UCL	0.0698

95% KM (t) UCL	0.061	95% KM (Percentile Bootstrap) UCL	0.0621
95% KM (z) UCL	0.0596	95% KM Bootstrap t UCL	0.124
90% KM Chebyshev UCL	0.082	95% KM Chebyshev UCL	0.104
97.5% KM Chebyshev UCL	0.136	99% KM Chebyshev UCL	0.197

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.638	Anderson-Darling GOF Test
5% A-D Critical Value	0.689	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.365	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.363	Detected Data Not Gamma Distributed at 5% Significance Level

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

Gamma Statistics on Detected Data Only

k hat (MLE)	1.264	k star (bias corrected MLE)	0.639
Theta hat (MLE)	0.083	Theta star (bias corrected MLE)	0.164
nu hat (MLE)	12.64	nu star (bias corrected)	6.389
Mean (detects)	0.105		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.035
Maximum	0.25	Median	0.01
SD	0.065	CV	1.859
k hat (MLE)	0.792	k star (bias corrected MLE)	0.702
Theta hat (MLE)	0.0442	Theta star (bias corrected MLE)	0.0498
nu hat (MLE)	30.08	nu star (bias corrected)	26.67
Adjusted Level of Significance (β)	0.0369		
Approximate Chi Square Value (26.67, α)	15.89	Adjusted Chi Square Value (26.67, β)	15.17
95% Gamma Approximate UCL (use when n>=50)	0.0587	95% Gamma Adjusted UCL (use when n<50)	0.0615

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0324	SD (KM)	0.0644
Variance (KM)	0.00415	SE of Mean (KM)	0.0165
k hat (KM)	0.253	k star (KM)	0.248
nu hat (KM)	9.604	nu star (KM)	9.421
theta hat (KM)	0.128	theta star (KM)	0.131
80% gamma percentile (KM)	0.0469	90% gamma percentile (KM)	0.0972
95% gamma percentile (KM)	0.157	99% gamma percentile (KM)	0.317

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.42, α)	3.583	Adjusted Chi Square Value (9.42, β)	3.274
95% Gamma Approximate KM-UCL (use when n>=50)	0.0851	95% Gamma Adjusted KM-UCL (use when n<50)	0.0931

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.812	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.33	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0293	Mean in Log Scale	-5.268

SD in Original Scale	0.0674	SD in Log Scale	1.715
95% t UCL (assumes normality of ROS data)	0.0561	95% Percentile Bootstrap UCL	0.056
95% BCA Bootstrap UCL	0.0657	95% Bootstrap t UCL	0.182
95% H-UCL (Log ROS)	0.102		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.458	KM Geo Mean	0.0116
KM SD (logged)	1.173	95% Critical H Value (KM-Log)	2.866
KM Standard Error of Mean (logged)	0.305	95% H-UCL (KM -Log)	0.051
KM SD (logged)	1.173	95% Critical H Value (KM-Log)	2.866
KM Standard Error of Mean (logged)	0.305		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0354	Mean in Log Scale	-4.161
SD in Original Scale	0.0651	SD in Log Scale	1.121
95% t UCL (Assumes normality)	0.0613	95% H-Stat UCL	0.0611

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.061

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Surface Water - Iron

Parameter	Sample ID	Val	D_Val
Iron	RC-409-SW	2500	1
Iron	RC-408-SWF	1000	1
Iron	RC-408-SW	2100	1
Iron	DD-513-SWF	100	0
Iron	RC-409-SWF	1100	1
Iron	RC-404-SWF	1100	1
Iron	DD-507-SW	140	1
Iron	DD-514-SW	3200	1
Iron	RC-407-SW	2900	1
Iron	RC-407-SWF	930	1
Iron	RC-406-SWF	810	1
Iron	DD-508-SW	3400	1
Iron	RC-406-SW	3000	1
Iron	RC-405-SW	2200	1
Iron	RC-404-SW	2200	1
Iron	DD-508-SWF	220	1
Iron	RC-405-SWF	1100	1
Iron	DD-513-SW	120	1
Iron	DD-514-SWF	430	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.11/23/2019 5:17:44 PM
From File	SW.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	19	Number of Distinct Observations	16
Number of Detects	18	Number of Non-Detects	1
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	120	Minimum Non-Detect	100
Maximum Detect	3400	Maximum Non-Detect	100
Variance Detects	1235382	Percent Non-Detects	5.263%
Mean Detects	1581	SD Detects	1111
Median Detects	1100	CV Detects	0.703
Skewness Detects	0.261	Kurtosis Detects	-1.369
Mean of Logged Detects	6.982	SD of Logged Detects	1.062

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.223	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data Not Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	1503	KM Standard Error of Mean	260.2
KM SD	1102	95% KM (BCA) UCL	1929
95% KM (t) UCL	1954	95% KM (Percentile Bootstrap) UCL	1938
95% KM (z) UCL	1931	95% KM Bootstrap t UCL	1981
90% KM Chebyshev UCL	2283	95% KM Chebyshev UCL	2637
97.5% KM Chebyshev UCL	3127	99% KM Chebyshev UCL	4091

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.58	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.207	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.449	k star (bias corrected MLE)	1.245
Theta hat (MLE)	1091	Theta star (bias corrected MLE)	1270
nu hat (MLE)	52.17	nu star (bias corrected)	44.81
Mean (detects)	1581		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	120	Mean	1504
Maximum	3400	Median	1100
SD	1130	CV	0.751
k hat (MLE)	1.268	k star (bias corrected MLE)	1.103
Theta hat (MLE)	1186	Theta star (bias corrected MLE)	1364
nu hat (MLE)	48.19	nu star (bias corrected)	41.92
Adjusted Level of Significance (β)	0.0369		
Approximate Chi Square Value (41.92, α)	28.08	Adjusted Chi Square Value (41.92, β)	27.09
95% Gamma Approximate UCL (use when n>=50)	2246	95% Gamma Adjusted UCL (use when n<50)	2328

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1503	SD (KM)	1102
Variance (KM)	1214640	SE of Mean (KM)	260.2
k hat (KM)	1.859	k star (KM)	1.6
nu hat (KM)	70.64	nu star (KM)	60.82
theta hat (KM)	808.3	theta star (KM)	938.9
80% gamma percentile (KM)	2308	90% gamma percentile (KM)	3082
95% gamma percentile (KM)	3831	99% gamma percentile (KM)	5514

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (60.82, α)	43.88	Adjusted Chi Square Value (60.82, β)	42.63
95% Gamma Approximate KM-UCL (use when n>=50)	2083	95% Gamma Adjusted KM-UCL (use when n<50)	2144

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.871	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1502	Mean in Log Scale	6.853
SD in Original Scale	1133	SD in Log Scale	1.177
95% t UCL (assumes normality of ROS data)	1953	95% Percentile Bootstrap UCL	1929
95% BCA Bootstrap UCL	1958	95% Bootstrap t UCL	1959
95% H-UCL (Log ROS)	4192		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	6.857	KM Geo Mean	950.8
KM SD (logged)	1.136	95% Critical H Value (KM-Log)	2.809
KM Standard Error of Mean (logged)	0.268	95% H-UCL (KM -Log)	3846
KM SD (logged)	1.136	95% Critical H Value (KM-Log)	2.809
KM Standard Error of Mean (logged)	0.268		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1500	Mean in Log Scale	6.821
SD in Original Scale	1136	SD in Log Scale	1.249
95% t UCL (Assumes normality)	1952	95% H-Stat UCL	4816

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1954

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Surface Water - Silver

Parameter	Sample ID	Val	D_Val
Silver	RC-409-SW	10	0
Silver	DD-513-SWF	10	0
Silver	RC-408-SWF	10	0
Silver	LSW-28-01_5/27/199	7.3	1
Silver	LSW-29-01_5/27/199	7.9	1
Silver	RC-408-SW	10	0
Silver	RC-407-SWF	10	0
Silver	LSW-31-01_5/27/199	7.5	1
Silver	LSW-31-02_5/27/199	7.8	1
Silver	RC-407-SW	10	0
Silver	RC-406-SWF	10	0
Silver	RC-406-SW	10	0
Silver	RC-405-SWF	10	0
Silver	RC-405-SW	10	0
Silver	LSW-30-01_5/28/199	3.9	1
Silver	LSW-16-01_5/26/199	7.3	1
Silver	DD-508-SW	10	0
Silver	DD-508-SWF	2.8	1
Silver	LSW-20-01_5/26/199	7.3	1
Silver	LSW-21-01_5/21/199	4.3	1
Silver	LSW-19-01_5/26/199	7.4	1
Silver	LSW-22-01_5/21/199	4.2	1
Silver	DD-513-SW	2.9	1
Silver	DD-507-SW	10	0
Silver	RC-409-SWF	10	0
Silver	LSW-17-01_5/22/199	7.3	1
Silver	LSW-18-01_5/22/199	7.8	1
Silver	DD-514-SWF	10	0
Silver	DD-514-SW	10	0
Silver	RC-404-SWF	10	0
Silver	RC-404-SW	10	0
Silver	ISW-202_3/10/2000	1.1	0
Silver	ISW-203_3/9/2000	2	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:10:53 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	33	Number of Distinct Observations	13
Number of Detects	15	Number of Non-Detects	18
Number of Distinct Detects	11	Number of Distinct Non-Detects	2
Minimum Detect	2	Minimum Non-Detect	1.1
Maximum Detect	7.9	Maximum Non-Detect	10
Variance Detects	4.793	Percent Non-Detects	54.55%

Mean Detects	5.847	SD Detects	2.189
Median Detects	7.3	CV Detects	0.374
Skewness Detects	-0.646	Kurtosis Detects	-1.444
Mean of Logged Detects	1.679	SD of Logged Detects	0.464

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.347	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.22	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	5.55	KM Standard Error of Mean	0.608
KM SD	2.348	95% KM (BCA) UCL	6.492
95% KM (t) UCL	6.579	95% KM (Percentile Bootstrap) UCL	6.54
95% KM (z) UCL	6.549	95% KM Bootstrap t UCL	6.468
90% KM Chebyshev UCL	7.373	95% KM Chebyshev UCL	8.199
97.5% KM Chebyshev UCL	9.345	99% KM Chebyshev UCL	11.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.518	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.738	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.357	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.222	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.918	k star (bias corrected MLE)	4.779
Theta hat (MLE)	0.988	Theta star (bias corrected MLE)	1.223
nu hat (MLE)	177.5	nu star (bias corrected)	143.4
Mean (detects)	5.847		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	2	Mean	5.632
Maximum	9.787	Median	5.729
SD	2.107	CV	0.374
k hat (MLE)	6.399	k star (bias corrected MLE)	5.838
Theta hat (MLE)	0.88	Theta star (bias corrected MLE)	0.965
nu hat (MLE)	422.3	nu star (bias corrected)	385.3
Adjusted Level of Significance (β)	0.0419		
Approximate Chi Square Value (385.28, α)	340.8	Adjusted Chi Square Value (385.28, β)	338.6
95% Gamma Approximate UCL (use when n>=50)	6.367	95% Gamma Adjusted UCL (use when n<50)	6.407

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.55	SD (KM)	2.348
Variance (KM)	5.514	SE of Mean (KM)	0.608
k hat (KM)	5.586	k star (KM)	5.099
nu hat (KM)	368.7	nu star (KM)	336.5
theta hat (KM)	0.993	theta star (KM)	1.088

80% gamma percentile (KM)	7.444	90% gamma percentile (KM)	8.84
95% gamma percentile (KM)	10.11	99% gamma percentile (KM)	12.8

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (336.52, α)	295	Adjusted Chi Square Value (336.52, β)	293
95% Gamma Approximate KM-UCL (use when n>=50)	6.331	95% Gamma Adjusted KM-UCL (use when n<50)	6.374

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.787	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.347	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.22	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.585	Mean in Log Scale	1.619
SD in Original Scale	2.395	SD in Log Scale	0.476
95% t UCL (assumes normality of ROS data)	6.292	95% Percentile Bootstrap UCL	6.268
95% BCA Bootstrap UCL	6.309	95% Bootstrap t UCL	6.35
95% H-UCL (Log ROS)	6.642		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.58	KM Geo Mean	4.855
KM SD (logged)	0.579	95% Critical H Value (KM-Log)	2
KM Standard Error of Mean (logged)	0.15	95% H-UCL (KM -Log)	7.045
KM SD (logged)	0.579	95% Critical H Value (KM-Log)	2
KM Standard Error of Mean (logged)	0.15		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	5.25	Mean in Log Scale	1.574
SD in Original Scale	1.728	SD in Log Scale	0.497
95% t UCL (Assumes normality)	5.76	95% H-Stat UCL	6.474

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

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	6.579	KM H-UCL	7.045
95% KM (BCA) UCL	6.492		

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

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

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

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

Surface Water - Zinc

Parameter	Sample ID	Val	D_Val
Zinc	LSW-5_6/1/1996	19	0
Zinc	LSW-11_6/1/1996	107	1
Zinc	LSW-22-01_5/21/199	9.3	1
Zinc	LSW-4_6/1/1996	18	0
Zinc	RC-406-SWF	60	0
Zinc	LSW-6_6/1/1996	47.9	0
Zinc	LSW-21-01_5/21/199	19.8	1
Zinc	RC-406-SW	60	0
Zinc	LSW-31-02_5/27/199	7.7	1
Zinc	LSW-10_6/1/1996	57.4	1
Zinc	LSW-19-01_5/26/199	17.4	1
Zinc	DD-508-SWF	98	1
Zinc	LSW-9_6/1/1996	16	0
Zinc	DD-508-SW	120	1
Zinc	RC-405-SWF	60	0
Zinc	LSW-20-01_5/26/199	16.2	1
Zinc	RC-405-SW	60	0
Zinc	LSW-7_6/1/1996	19	0
Zinc	LSW-17-01_5/22/199	23.6	1
Zinc	RC-409-SWF	60	0
Zinc	DD-514-SW	60	0
Zinc	RC-409-SW	60	0
Zinc	RC-404-SW	60	0
Zinc	LSW-8_6/1/1996	18	0
Zinc	DD-513-SW	60	0
Zinc	LSW-18-01_5/22/199	19.4	1
Zinc	RC-408-SWF	60	0
Zinc	LSW-31-01_5/27/199	14.4	1
Zinc	RC-408-SW	60	0
Zinc	RC-404-SWF	60	0
Zinc	LSW-28-01_5/27/199	10	1
Zinc	LSW-29-01_5/27/199	9.1	1
Zinc	LSW-16-01_5/26/199	19.1	1
Zinc	LSW-3_6/1/1996	20	0
Zinc	RC-407-SWF	60	0
Zinc	LSW-30-01_5/28/199	8.2	1
Zinc	DD-507-SW	60	0
Zinc	DD-514-SWF	60	0
Zinc	RC-407-SW	60	0
Zinc	DD-513-SWF	60	0
Zinc	ISW-202_3/10/2000	28.6	1
Zinc	ISW-203_3/9/2000	34.6	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:12:28 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	42	Number of Distinct Observations	24
Number of Detects	18	Number of Non-Detects	24
Number of Distinct Detects	18	Number of Distinct Non-Detects	6
Minimum Detect	7.7	Minimum Non-Detect	16
Maximum Detect	120	Maximum Non-Detect	60
Variance Detects	1311	Percent Non-Detects	57.14%
Mean Detects	34.43	SD Detects	36.2
Median Detects	19.25	CV Detects	1.051
Skewness Detects	1.622	Kurtosis Detects	1.298
Mean of Logged Detects	3.125	SD of Logged Detects	0.887

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.71	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	23.7	KM Standard Error of Mean	4.436
KM SD	25.99	95% KM (BCA) UCL	31.81
95% KM (t) UCL	31.16	95% KM (Percentile Bootstrap) UCL	30.87
95% KM (z) UCL	30.99	95% KM Bootstrap t UCL	34.27
90% KM Chebyshev UCL	37	95% KM Chebyshev UCL	43.03
97.5% KM Chebyshev UCL	51.4	99% KM Chebyshev UCL	67.83

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.142	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.759	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.208	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.35	k star (bias corrected MLE)	1.162
Theta hat (MLE)	25.51	Theta star (bias corrected MLE)	29.63
nu hat (MLE)	48.6	nu star (bias corrected)	41.83
Mean (detects)	34.43		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	22.96
Maximum	120	Median	13.82
SD	28.1	CV	1.224
k hat (MLE)	0.473	k star (bias corrected MLE)	0.456
Theta hat (MLE)	48.5	Theta star (bias corrected MLE)	50.41
nu hat (MLE)	39.77	nu star (bias corrected)	38.27
Adjusted Level of Significance (β)	0.0443		

Approximate Chi Square Value (38.27, α)	25.1	Adjusted Chi Square Value (38.27, β)	24.72
95% Gamma Approximate UCL (use when n>=50)	35.01	95% Gamma Adjusted UCL (use when n<50)	35.55

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	23.7	SD (KM)	25.99
Variance (KM)	675.3	SE of Mean (KM)	4.436
k hat (KM)	0.831	k star (KM)	0.788
nu hat (KM)	69.84	nu star (KM)	66.19
theta hat (KM)	28.5	theta star (KM)	30.07
80% gamma percentile (KM)	38.76	90% gamma percentile (KM)	57.83
95% gamma percentile (KM)	77.29	99% gamma percentile (KM)	123.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (66.19, α)	48.47	Adjusted Chi Square Value (66.19, β)	47.93
95% Gamma Approximate KM-UCL (use when n>=50)	32.36	95% Gamma Adjusted KM-UCL (use when n<50)	32.73

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	24.09	Mean in Log Scale	2.842
SD in Original Scale	26.13	SD in Log Scale	0.76
95% t UCL (assumes normality of ROS data)	30.88	95% Percentile Bootstrap UCL	30.96
95% BCA Bootstrap UCL	32.95	95% Bootstrap t UCL	34.93
95% H-UCL (Log ROS)	29.42		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.829	KM Geo Mean	16.94
KM SD (logged)	0.725	95% Critical H Value (KM-Log)	2.082
KM Standard Error of Mean (logged)	0.143	95% H-UCL (KM -Log)	27.87
KM SD (logged)	0.725	95% Critical H Value (KM-Log)	2.082
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	28.78	Mean in Log Scale	3.108
SD in Original Scale	24.8	SD in Log Scale	0.693
95% t UCL (Assumes normality)	35.22	95% H-Stat UCL	35.52

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	27.87

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Surface Water - Total PCBs

SubGroup	Sample ID	Val	D_Val
PCB	DD-507-SW	4.5	0
PCB	DD-508-SW	4.5	0
PCB	DD-513-SW	4.5	0
PCB	RC-404-SW	4.5	0
PCB	RC-405-SW	4.5	0
PCB	RC-406-SW	4.5	0
PCB	RC-407-SW	4.5	0
PCB	RC-408-SW	4.5	0
PCB	RC-409-SW	4.5	0
PCB	LSW-20-01_5/26/1998	0.19	0
PCB	LSW-31-01_5/27/1998	0.16	0
PCB	LSW-22-01_5/21/1998	0.155	0
PCB	LSW-28-01_5/27/1998	0.155	0
PCB	LSW-30-01_5/28/1998	0.155	0
PCB	LSW-29-01_5/27/1998	0.15	0
PCB	LSW-31-02_5/27/1998	0.145	0
PCB	LSW-18-01_5/22/1998	0.14	0
PCB	LSW-16-01_5/26/1998	0.135	0
PCB	LSW-17-01_5/22/1998	0.135	0
PCB	DD-514-SW	6.2	1
PCB	LSW-19-01_5/26/1998	0.3	1
PCB	LSW-21-01_5/21/1998	0.215	1
PCB	ISW-202_3/10/2000	0.35	0
PCB	ISW-203_3/9/2000	0.35	0

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:18:39 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	24	Number of Distinct Observations	12
Number of Detects	3	Number of Non-Detects	21
Number of Distinct Detects	3	Number of Distinct Non-Detects	9
Minimum Detect	0.215	Minimum Non-Detect	0.135
Maximum Detect	6.2	Maximum Non-Detect	4.5
Variance Detects	11.77	Percent Non-Detects	87.50%
Mean Detects	2.238	SD Detects	3.431
Median Detects	0.3	CV Detects	1.533
Skewness Detects	1.731	Kurtosis Detects	N/A
Mean of Logged Detects	-0.306	SD of Logged Detects	1.852

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.761	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.381	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	0.407	KM Standard Error of Mean	0.302
KM SD	1.209	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.926	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.905	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.315	95% KM Chebyshev UCL	1.725
97.5% KM Chebyshev UCL	2.296	99% KM Chebyshev UCL	3.416

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.562	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.986	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3.369	nu star (bias corrected)	N/A
Mean (detects)	2.238		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	0.289
Maximum	6.2	Median	0.01
SD	1.261	CV	4.371
k hat (MLE)	0.251	k star (bias corrected MLE)	0.248
Theta hat (MLE)	1.148	Theta star (bias corrected MLE)	1.165
nu hat (MLE)	12.06	nu star (bias corrected)	11.89
Adjusted Level of Significance (β)	0.0392		
Approximate Chi Square Value (11.89, α)	5.152	Adjusted Chi Square Value (11.89, β)	4.842
95% Gamma Approximate UCL (use when n>=50)	0.666	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.407	SD (KM)	1.209
Variance (KM)	1.461	SE of Mean (KM)	0.302
k hat (KM)	0.114	k star (KM)	0.127
nu hat (KM)	5.449	nu star (KM)	6.101
theta hat (KM)	3.588	theta star (KM)	3.204
80% gamma percentile (KM)	0.38	90% gamma percentile (KM)	1.171
95% gamma percentile (KM)	2.306	99% gamma percentile (KM)	5.722

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.10, α)	1.692	Adjusted Chi Square Value (6.10, β)	1.534
95% Gamma Approximate KM-UCL (use when n>=50)	1.469	95% Gamma Adjusted KM-UCL (use when n<50)	1.619

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.293	Mean in Log Scale	-5.363
SD in Original Scale	1.261	SD in Log Scale	2.738
95% t UCL (assumes normality of ROS data)	0.734	95% Percentile Bootstrap UCL	0.803
95% BCA Bootstrap UCL	1.082	95% Bootstrap t UCL	7.942
95% H-UCL (Log ROS)	4.256		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.742	KM Geo Mean	0.175
KM SD (logged)	0.781	95% Critical H Value (KM-Log)	2.269
KM Standard Error of Mean (logged)	0.204	95% H-UCL (KM -Log)	0.344
KM SD (logged)	0.781	95% Critical H Value (KM-Log)	2.269
KM Standard Error of Mean (logged)	0.204		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.17	Mean in Log Scale	-0.955
SD in Original Scale	1.495	SD in Log Scale	1.668
95% t UCL (Assumes normality)	1.693	95% H-Stat UCL	5.3

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.926

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Surface Water - Trichloroethene

Parameter	Sample ID	Val	D_Val
Trichloroethene	RC-405-SW	5	0
Trichloroethene	DD-508-SW	5	0
Trichloroethene	DD-513-SW	1	1
Trichloroethene	LSW-9_6/1/1996	0.42	0
Trichloroethene	LSW-10_6/1/1996	380	1
Trichloroethene	LSW-8_6/1/1996	0.42	0
Trichloroethene	LSW-21-01_5/21/199	81.6	1
Trichloroethene	LSW-7_6/1/1996	0.42	0
Trichloroethene	DD-507-SW	5	0
Trichloroethene	LSW-6_6/1/1996	0.42	0
Trichloroethene	LSW-3_6/1/1996	0.42	0
Trichloroethene	LSW-22-01_5/21/199	1	0
Trichloroethene	LSW-5_6/1/1996	0.42	0
Trichloroethene	LSW-4_6/1/1996	0.42	0
Trichloroethene	SW-8_11/10/2005	5	0
Trichloroethene	LSW-16-01_5/26/199	1.1	1
Trichloroethene	LSW-18-01_5/22/199	160	1
Trichloroethene	LSW-17-01_5/22/199	1	0
Trichloroethene	DD-514-SW	3.6	1
Trichloroethene	SW-2_11/10/2005	51	1
Trichloroethene	RC-408-SW	5	0
Trichloroethene	RC-404-SW	5	0
Trichloroethene	SW-3_11/10/2005	1600	1
Trichloroethene	SW-1_11/10/2005	5	0
Trichloroethene	SW-7_11/10/2005	5	0
Trichloroethene	LSW-11_6/1/1996	0.42	0
Trichloroethene	SW-4_11/10/2005	5	0
Trichloroethene	RC-409-SW	5	0
Trichloroethene	SW-6_11/10/2005	5	0
Trichloroethene	LSW-19-01_5/26/199	104	1
Trichloroethene	RC-406-SW	5	0
Trichloroethene	LSW-20-01_5/26/199	97.8	1
Trichloroethene	SW-5_11/10/2005	5	0
Trichloroethene	RC-407-SW	5	0
Trichloroethene	ISW-202_3/10/2000	1	0
Trichloroethene	ISW-203_3/9/2000	1	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:16:31 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	36	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	25

Number of Distinct Detects	10	Number of Distinct Non-Detects	3
Minimum Detect	1	Minimum Non-Detect	0.42
Maximum Detect	1600	Maximum Non-Detect	5
Variance Detects	220003	Percent Non-Detects	69.44%
Mean Detects	225.6	SD Detects	469
Median Detects	81.6	CV Detects	2.08
Skewness Detects	3.012	Kurtosis Detects	9.398
Mean of Logged Detects	3.394	SD of Logged Detects	2.605

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.525	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.374	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	69.34	KM Standard Error of Mean	46.86
KM SD	268	95% KM (BCA) UCL	162.8
95% KM (t) UCL	148.5	95% KM (Percentile Bootstrap) UCL	149.7
95% KM (z) UCL	146.4	95% KM Bootstrap t UCL	541.9
90% KM Chebyshev UCL	209.9	95% KM Chebyshev UCL	273.6
97.5% KM Chebyshev UCL	362	99% KM Chebyshev UCL	535.5

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.492	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.813	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.169	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.275	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.335	k star (bias corrected MLE)	0.304
Theta hat (MLE)	674.2	Theta star (bias corrected MLE)	742.2
nu hat (MLE)	7.36	nu star (bias corrected)	6.686
Mean (detects)	225.6		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	68.93
Maximum	1600	Median	0.01
SD	272	CV	3.946
k hat (MLE)	0.124	k star (bias corrected MLE)	0.132
Theta hat (MLE)	557.9	Theta star (bias corrected MLE)	523.1
nu hat (MLE)	8.895	nu star (bias corrected)	9.487
Adjusted Level of Significance (β)	0.0428		
Approximate Chi Square Value (9.49, α)	3.624	Adjusted Chi Square Value (9.49, β)	3.46
95% Gamma Approximate UCL (use when n>=50)	180.5	95% Gamma Adjusted UCL (use when n<50)	189

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	69.34	SD (KM)	268

Variance (KM)	71849	SE of Mean (KM)	46.86
k hat (KM)	0.0669	k star (KM)	0.0799
nu hat (KM)	4.818	nu star (KM)	5.75
theta hat (KM)	1036	theta star (KM)	868.3
80% gamma percentile (KM)	32.89	90% gamma percentile (KM)	164.2
95% gamma percentile (KM)	403.2	99% gamma percentile (KM)	1229

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.75, α)	1.514	Adjusted Chi Square Value (5.75, β)	1.418
95% Gamma Approximate KM-UCL (use when n>=50)	263.4	95% Gamma Adjusted KM-UCL (use when n<50)	281.2

95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	69.18	Mean in Log Scale	-1.694
SD in Original Scale	271.9	SD in Log Scale	4.447
95% t UCL (assumes normality of ROS data)	145.7	95% Percentile Bootstrap UCL	153.7
95% BCA Bootstrap UCL	217.9	95% Bootstrap t UCL	504.3
95% H-UCL (Log ROS)	1041317		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.56	KM Geo Mean	1.751
KM SD (logged)	2.362	95% Critical H Value (KM-Log)	4.252
KM Standard Error of Mean (logged)	0.423	95% H-UCL (KM -Log)	155.4
KM SD (logged)	2.362	95% Critical H Value (KM-Log)	4.252
KM Standard Error of Mean (logged)	0.423		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	69.98	Mean in Log Scale	0.989
SD in Original Scale	271.7	SD in Log Scale	2.342
95% t UCL (Assumes normality)	146.5	95% H-Stat UCL	222.3

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1) 281.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Surface Water - Vinyl Chloride

Parameter	Sample ID	Val	D_Val
Vinyl chloride	SW-1_11/10/2005	2	0
Vinyl chloride	SW-8_11/10/2005	2	0
Vinyl chloride	RC-405-SW	5	0
Vinyl chloride	LSW-18-01_5/22/199	3	1
Vinyl chloride	DD-514-SW	7.9	1
Vinyl chloride	RC-404-SW	5	0
Vinyl chloride	SW-3_11/10/2005	140	1
Vinyl chloride	LSW-17-01_5/22/199	1	0
Vinyl chloride	SW-4_11/10/2005	2	0
Vinyl chloride	LSW-16-01_5/26/199	1	0
Vinyl chloride	DD-507-SW	5	0
Vinyl chloride	SW-7_11/10/2005	2	0
Vinyl chloride	LSW-22-01_5/21/199	1	0
Vinyl chloride	SW-2_11/10/2005	14	1
Vinyl chloride	LSW-21-01_5/21/199	1	0
Vinyl chloride	LSW-19-01_5/26/199	2	1
Vinyl chloride	LSW-20-01_5/26/199	1.7	1
Vinyl chloride	DD-508-SW	5	0
Vinyl chloride	SW-6_11/10/2005	2	0
Vinyl chloride	RC-406-SW	5	0
Vinyl chloride	RC-409-SW	5	0
Vinyl chloride	DD-513-SW	5	0
Vinyl chloride	SW-5_11/10/2005	2	0
Vinyl chloride	RC-407-SW	5	0
Vinyl chloride	RC-408-SW	5	0
Vinyl chloride	ISW-202_3/10/2000	1	0
Vinyl chloride	ISW-203_3/9/2000	1	1

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/15/2019 7:14:42 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Val

General Statistics

Total Number of Observations	27	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	20
Number of Distinct Detects	7	Number of Distinct Non-Detects	3
Minimum Detect	1	Minimum Non-Detect	1
Maximum Detect	140	Maximum Non-Detect	5
Variance Detects	2628	Percent Non-Detects	74.07%
Mean Detects	24.23	SD Detects	51.26
Median Detects	3	CV Detects	2.116
Skewness Detects	2.601	Kurtosis Detects	6.814
Mean of Logged Detects	1.71	SD of Logged Detects	1.691

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.527	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.436	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

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

KM Mean	7.14	KM Standard Error of Mean	5.446
KM SD	26.2	95% KM (BCA) UCL	17.66
95% KM (t) UCL	16.43	95% KM (Percentile Bootstrap) UCL	17.43
95% KM (z) UCL	16.1	95% KM Bootstrap t UCL	107.2
90% KM Chebyshev UCL	23.48	95% KM Chebyshev UCL	30.88
97.5% KM Chebyshev UCL	41.15	99% KM Chebyshev UCL	61.33

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.842	Anderson-Darling GOF Test
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.283	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.33	Detected data appear Gamma Distributed at 5% Significance Level
Detected data follow Appr. Gamma Distribution at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	0.439	k star (bias corrected MLE)	0.346
Theta hat (MLE)	55.21	Theta star (bias corrected MLE)	70.03
nu hat (MLE)	6.143	nu star (bias corrected)	4.844
Mean (detects)	24.23		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	0.01	Mean	6.361
Maximum	140	Median	0.01
SD	26.88	CV	4.226
k hat (MLE)	0.164	k star (bias corrected MLE)	0.171
Theta hat (MLE)	38.77	Theta star (bias corrected MLE)	37.3
nu hat (MLE)	8.861	nu star (bias corrected)	9.209
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (9.21, α)	3.454	Adjusted Chi Square Value (9.21, β)	3.231
95% Gamma Approximate UCL (use when n>=50)	16.96	95% Gamma Adjusted UCL (use when n<50)	18.13

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	7.14	SD (KM)	26.2
Variance (KM)	686.3	SE of Mean (KM)	5.446
k hat (KM)	0.0743	k star (KM)	0.0907
nu hat (KM)	4.011	nu star (KM)	4.899
theta hat (KM)	96.12	theta star (KM)	78.7
80% gamma percentile (KM)	4.26	90% gamma percentile (KM)	18.17
95% gamma percentile (KM)	41.59	99% gamma percentile (KM)	119

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.90, α)	1.106	Adjusted Chi Square Value (4.90, β)	0.997

95% Gamma Approximate KM-UCL (use when n>=50)	31.63	95% Gamma Adjusted KM-UCL (use when n<50)	35.08

95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.213	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.555	Mean in Log Scale	-1.215
SD in Original Scale	26.84	SD in Log Scale	2.439
95% t UCL (assumes normality of ROS data)	15.36	95% Percentile Bootstrap UCL	16.58
95% BCA Bootstrap UCL	22.73	95% Bootstrap t UCL	100.3
95% H-UCL (Log ROS)	57.07		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.522	KM Geo Mean	1.685
KM SD (logged)	1.086	95% Critical H Value (KM-Log)	2.635
KM Standard Error of Mean (logged)	0.235	95% H-UCL (KM -Log)	5.326
KM SD (logged)	1.086	95% Critical H Value (KM-Log)	2.635
KM Standard Error of Mean (logged)	0.235		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	7.43	Mean in Log Scale	0.62
SD in Original Scale	26.64	SD in Log Scale	1.196
95% t UCL (Assumes normality)	16.17	95% H-Stat UCL	7.311

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1) 35.08

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

APPENDIX D
Photo Log

Photo 1 *Abandoned drums in wetlands surrounding the AWI remote and FMNOP landfills. 12/6/2018*

Photo 2 *Animal burrow with abandoned drum and general refuse atop AWI remote landfill. 12/6/2018*

EPS
a Montrose Environmental Group company

Photo 3 *Former pond between AWI remote and FMNOP landfills. 12/6/2018*

Photo 4 *Main drainage entering from the northwest corner of OU2 site. 12/6/2018*

EPS
a Montrose Environmental Group company

Photo 5 *Small mammal burrow atop AWI remote landfill. 1/15/2019*

Photo 6 *Breach in fencing surrounding the AWI remote landfill. 1/15/2019*

EPS
a Montrose Environmental Group company

Photo 7 *Deer and raccoon tracks at breach in fencing. 1/15/2019*

Photo 8 *Groundwater seep near explosive demolition area. 1/15/2019*

EPS
a Montrose Environmental Group company

Photo 9 *Wetland area with various channels with defined flow. 1/15/2019*

Photo 10 *Inside the former excavation pit. 1/16/2019*

EPS a Montrose Environmental Group company

Photo 11 *Coyote or feral dog tracks. 1/16/2019*

Photo 12 *Floodplain inundated with flows from Rocky Creek. 1/17/2019*

APPENDIX E
Database Management Plan

DATABASE MANAGEMENT PLAN

DESCRIPTION OF DATA

The EPS database currently contains the historical data for the Site and neighboring properties (Section 3 of the Work Plan), and will be augmented with chemical records from various environmental media (soil, groundwater, sediment, surface water) and biota (fish tissue), physical properties of landfill waste material, and other field records (*e.g.*, water quality parameters, depth to groundwater, etc.) obtained from execution of the proposed work scope (Section 8 of the Work Plan). The data may occur in a variety of formats: hand written field notes, hard copies of laboratory data, Electronic Data Deliverables, and published papers.

RELATIONAL DATABASE FUNDAMENTALS

The EPS database is an MS Access normalized relational database. A database is defined as a large collection of data organized especially for rapid search and retrieval. Data are organized into standardized, structured tables that are specifically related to one another. MS Access is an industry-standard relational application for small to medium databases.

Normalization in general terms means to put something in a standard state. Through normalization, a database is designed to contain all data necessary for the purpose the database is to serve, have as little redundancy of records as possible, permit efficient updates of the data, and avoid losing data unknowingly. In the case of the EPS database, structured tables are created to store every piece of data. Each table is made up of columns or fields, which only store a certain data type. In other words, a field can only store either a number, a piece of text, or a date. The specific structure of these tables is illustrated in Figure 1 and is described in detail in Section 4.2.

A relational database is one in which multiple tables are used in order to store unique information only once. Each table is linked or related to another by a common field. For example, the Location table stores coordinates; the Sample ID table contains information about the sampling parameters (*e.g.,* sample identifiers, date of collection); and the Data table contains results of chemical or other analyses. The Location table is linked to the Sample ID table by the location, which is linked to the Data table by the sample ID. This eliminates redundancy and reduces potential for errors.

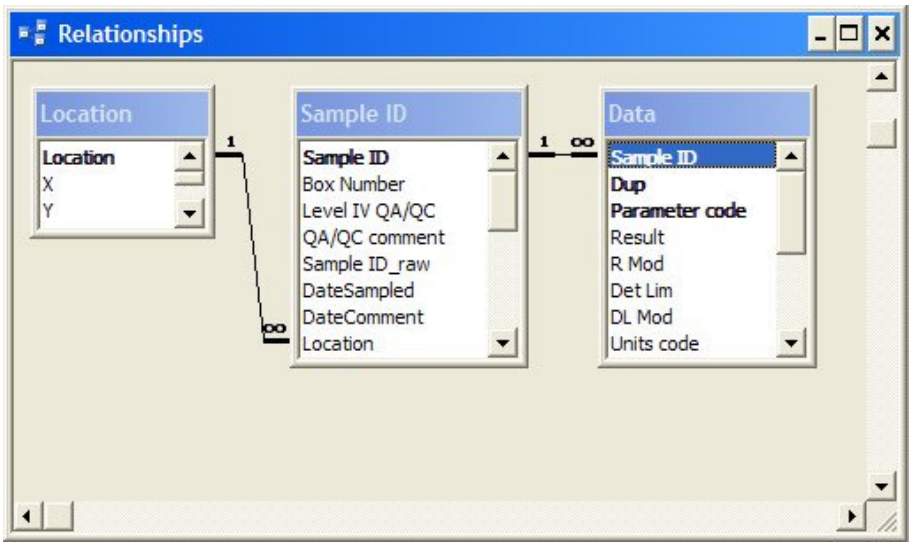

Figure 1 – Table Relationships

Another important aspect of a relational database is the need to avoid duplicate record entries. In order to prevent a duplicate entry, each table is given a key field or set of fields that define a unique record. This key field serves as an index for the database. When each table has a key field, a "one-to-many" relationship is used to link information across multiple tables. For example, the location "B-12" can only have one X and one Y value in the Location table, but it can be found several times in the Sample ID table.

DATABASE MANAGEMENT

Databases need to be properly managed to ensure proper input of data, to avoid duplicate or missing entries, to prevent corruption of data (both accidental and malicious), and to maintain ease of use and operability. EPS has adopted a database management strategy that addresses this need for accuracy, security, and flexibility.

Security and Redundancy

The database is designed for use by two classes of users: the Database Manager (DM) and the End-User. A DM designs and maintains the structure of the database, appropriately prepares data for entry (outside of Access), correctly executes validation tests within Access during data entry, and informs end-users of any limitations to the dataset. An End-User queries data for day-to-day work (analysis, reports, thought

experiments, etc.) and links data to outside applications (Geographic Information System (GIS), outside databases). There is one DM and any number of End-Users.

The database is not simply one database, but rather a collection of three separate databases: Build, Master, and Main. The Build database links directly to the Master database and is used exclusively by the DM to validate, format, and finally enter data into the Master database. The Master database stores all the data and is managed only by the DM. The Main database is an exact replicate of the Master database that is linked to by End-Users for day-to-day work. When changes are made to the Master database it is copied over to the Main database. This procedure, known as "compacting", ensures that the Main database always has the most up to date records, and that there is separation between the original records and those used on a daily basis. The overall organizational and management structure of the database is illustrated in Figure 2.

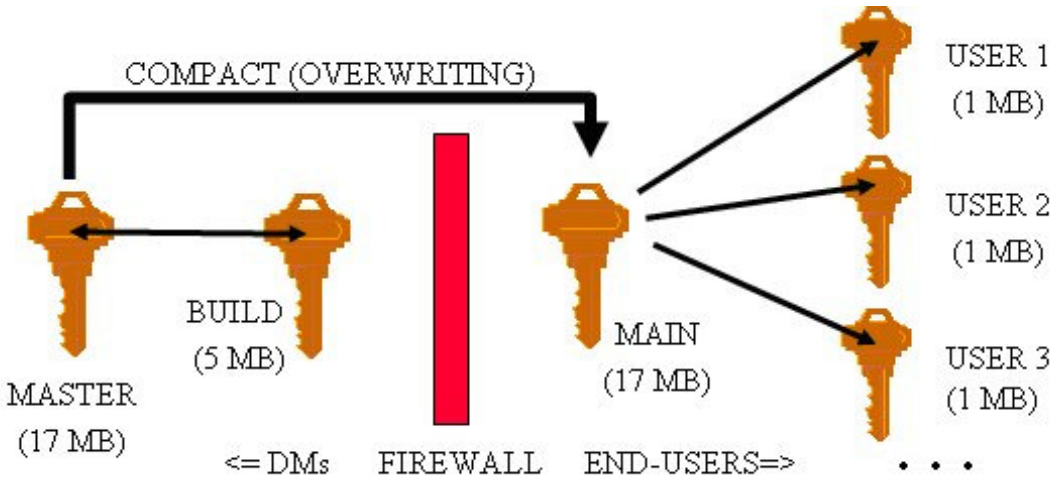

Figure 2 – Build, Master, Main – Database Management Strategy

Database Structure

The following section describes the table structure of the database. Figure 3 presents each table's fields as well as relationships between tables. Fundamentally, there are two types of tables in the database: Record tables, that store data itself, and Key tables, which store codes. Record tables tend to be large in size and often have several fields that are encoded using codes stored in Key tables. Key tables tend to be smaller in size and are designed to encode one element of the database at a time. Two types of Key

tables are used in this database: Direct keys, in which there is a direct relationship between data stored in a Record table and the code in a Key table, and Check Sum keys, where the data store in a Record table is a sum of multiple independent codes in a Key table. Individual tables are described in greater detail in the following sections.

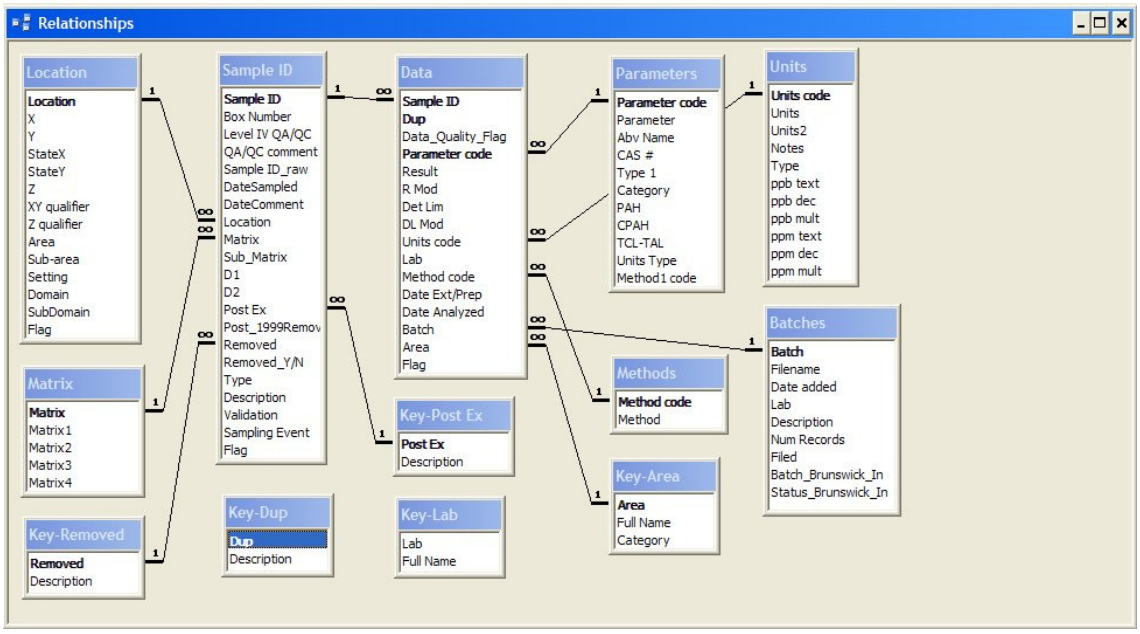

Figure 3 – Database Table Structure

Description of Record Tables:

- Batches – Tracks data entry events, cataloging the electronic filename of the raw data, how many records where entered, when, and from what lab.
- Data – Stores the individual Sample ID and Parameter result pairs, results modifiers, detection limits, units, laboratory name, analysis method, area, and batch number.
- Location - Stores geographic coordinates for Sample IDs, as well as setting (for example on-site/off-site) and domain (for example clean up domain areas).
- Sample ID - Stores date, sample type, location, depth, associated sampling event, reported matrix, for each of the samples in the database. It also stores flags for removal status, whether or not the sample has a Level 4 QA/QC data package from a laboratory associated with it. The Sample ID nomenclature is standardized to account for naming inconsistencies.

Description of Key Tables:

- Key-Data Quality Flag – A Direct key table that stores information regarding the quality and completeness of data records.
- Key-Dup – A Check Sum key table that stores Dup code values. The database is designed to store all duplicate records that often are the result of multiple analysis methods and lab replicates. Original values are given a Dup code of 0. Duplicate records are given values that are the sum their duplicate characteristics. Characteristic codes are listed below:

  1 - Duplicate sample sent to the same lab (often with a different Sample ID)

  2 - Split sample sent to different lab: generally with the same Sample ID

  4 - A duplicate analysis by the same lab generally by another method

  8 - A duplicate due to reporting both the diluted and undiluted result

  16 - Miscellaneous
- Key-Lab – A Direct key table that stores laboratory names.
- Matrix - A key table that stores matrix types (*i.e.,* soil, surface water, sediment, biota type, etc.)
- Methods - A key table that stores EPA Methods (*i.e.,* EPA 8260, EPA 8150)
- ATLParameters – A Direct key that stores parameter codes, type, and parameter category (*i.e,* VOC, SVOC, metals etc.). The purpose of this table is to minimize spelling errors due to differing names for identical parameters as well as to enable grouping of similar parameters by type.
- Units – A Direct key that stores unit codes as well as conversion factors. In order to maintain historical accuracy, the unit field of the Data table stores the units in which the data was originally recorded. This table is used to convert results in order to view records in a consistent unit type.

ELECTRONIC DATA ENTRY AND VALIDATION

This section describes how new data records are validated and added to the Master database. New records are added by the DM exclusively in the Build database, which stores all temporary tables and queries used to validate electronic records, in order to

prevent addition of data to the Master database that has not been "cleaned". The cleaning process is similar to an assembly line: Raw or "dirty" electronic data is imported by the DM into the Build database and placed into a temporary table, thoroughly inspected to meet quality control criteria, encoded, inspected again, and finally added to the Master database. The goal of the validation process is to catch any errors or inconsistencies within the data itself and to ensure proper encoding of values in order to maintain a standard format.

The work necessary to validate raw data is performed in queries. A query in its basic form allows the user to select fields for a table or multiple tables. Queries can also perform statistical calculations, replace values, add and remove records, create and delete tables. Because of the heterogeneity of the raw data, DMs modify queries and update key fields in order to maintain proper encoding. The following is a step by step process used to "clean" raw data:

- Raw data is imported into a temporary table that has the same structure as the Master database's Data table.
- Each set of raw data is assigned a batch number in order to track its addition.
- Raw data is checked for duplicate records. If duplicate records exist, they are assigned the proper Dup code.
- The parameter name is checked for spelling to ensure proper encoding.
- Units and Methods are checked to ensure proper encoding.
- In order to maintain database consistency, non-detected values are assigned a "0" Result and a "U" Result Modifier. This is necessary because different analytical laboratories use dissimilar codes for non-detected values.
- Missing values are checked in order to prevent errors of omission.
- Sample ID / Date pairs are checked.
- Sample IDs in the raw data are cross-checked with existing locations. New locations are added when necessary.
- All raw records are checked against the Master database's Data table to prevent duplicate entries.
- "Clean" data is added to the Master database.
- All temporary tables are deleted.

While the term "cleaning" can sometimes imply that "dirty" data is removed, this is not the case in the database. No "dirty" data is excluded. Instead of being thrown out, all data is categorized to allow database End-Users flexibility in analyzing data: Records are given Dup codes, data quality flags, matrix codes, area designations, etc. Because the database is a living database, DMs often have to modify table structures and add keys to key tables to input new sources of data in order to categorize additional records. These modifications do not change existing records, but instead build upon them. The database is both inclusive and dynamic.

LINK TO GIS

End-Users may generate standard database files (.dbf) through MS Access, organizing data in an array data type with multiple records and fields. These data may be visualized in GIS should the database file contain coordinate information from the Location data table. Database files may be linked to the database allowing GIS maps to remain up-to-date with the most recent data.