1883251

HUMAN HEALTH RISK ASSESSMENT FOR THE SMURFIT-STONE/FRENCHTOWN MILL OPERABLE UNIT 1 SITE LOCATED IN MISSOULA COUNTY, MONTANA

02/27/2017

Prepared by:
U.S. Environmental Protection Agency
Region 8
1595 Wynkoop Street
Denver, CO 80202

With technical assistance from:
SRC, Inc.
999 18th Street, Suite 1380
Denver, Colorado 80202

This page intentionally left blank to facilitate double-sided printing

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 PURPOSE 1
1.2 ORGANIZATION 1

2.0 SITE CHARACTERIZATION 2

2.1 SITE OVERVIEW 2
2.2 LAND USE 3
2.3 BASIS FOR POTENTIAL HUMAN HEALTH CONCERN 4
2.4 SITE INVESTIGATIONS 4
2.5 DATA OVERVIEW 4

3.0 EXPOSURE ASSESSMENT 6

3.1 SITE CONCEPTUAL MODEL 6
3.2 EXPOSURE PATHWAYS OF CHIEF CONCERN 8
3.2.1 Exposures to Soil 9
3.2.2 Exposures to Groundwater 10
3.2.3 Exposures to Sediment 11
3.2.4 Exposures to Surface Water 12
3.2.5 Exposures to Food Items 12
3.3 SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN 13
3.3.1 COPC Selection Process 13
3.3.2 Source of Risk-Based Screening Level Values 14
3.3.3 Evaluation of Beneficial Minerals 15
3.3.4 Background Screen 15

4.0 TOXICITY ASSESSMENT 17

5.0 RESULTS 18

5.1 RISK-BASED SCREEN 18
5.2 BACKGROUND SCREEN 18
5.3 SUMMARY 18

6.0 RISK CHARACTERIZATION 19

6.1 RISKS FROM EXPOSURES TO OU1 SOILS 19
6.2 RISKS FROM EXPOSURES TO SEDIMENTS AND SURFACE WATER IN O'KEEFE AND LAVALLE CREEKS 19
6.3 RISKS FROM EXPOSURES TO OU1 GROUNDWATER 19

7.0 UNCERTAINTY ASSESSMENT 21

8.0 REFERENCES 23

APPENDICES

Appendix A OU1 Data
Appendix B Screening Level Evaluations
Appendix C ProUCL Output Comparing Site and Background Data

LIST OF TABLES

Table 2-1 Data Summary for OU1
Table 2-2 OU1 Surface Soil Summary Statistics
Table 2-3 OU1 Groundwater Summary Statistics
Table 2-4 OU1 Sediment Summary Statistics
Table 2-5 OU1 Surface Water Summary Statistics

Table 3-1 Exposure Parameters for a Resident
Table 3-2 List of Background Samples
Table 3-3 Background Surface Soil Summary Statistics
Table 3-4 Background Groundwater Summary Statistics
Table 3-5 Background Sediment Summary Statistics
Table 3-6 Background Surface Water Summary Statistics

Table 4-1 COPC Screening for OU1 Surface Soil
Table 4-2 COPC Screening for OU1 Groundwater
Table 4-3 COPC Screening for Sediment in O'Keefe and Lavalle Creeks
Table 4-4 COPC Screening for Surface Water in O'Keefe and Lavalle Creeks

LIST OF FIGURES

Figure 2-1 Site Location Map (adapted from Newfields 2015)
Figure 2-2 Operable Unit Site Map (adapted from Newfields 2015)
Figure 2-3 Groundwater Well Sampling Locations Map (adapted from Newfields 2016)
Figure 2-4 Sediment and Surface Water Sampling Locations Map (adapted from Newfields 2016)

Figure 3-1 Conceptual Site Model (CSM)
Figure 3-2 COPC Selection Procedure

Figure 6-1 Manganese in OU1 Groundwater

LIST OF ACRONYMS AND ABBREVIATIONS

CFR	Clark Fork River
COPC	Contaminant of Potential Concern
DI	Daily Intake
DRI	Daily Reference Intake
EPD	Effective Predictive Domain
FSP	Field Sampling Plan
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
Kow	Octanol/Water Partition Coefficient
MDEQ	Montana Department of Environmental Quality
MW	Molecular Weight
NPL	National Priorities List
OU	Operable Unit
PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
RBC	Risk-based Concentration
RIWP	Remedial Investigation Work Plan
RME	Reasonably Maximum Exposure
RSL	Regional Screening Level
SI	Site Investigation
SL	Screening Level
SVOC	Semi-volatile Organic Compound
USEPA	United States Environmental Protection Agency
WMW	Wilcoxon-Mann-Whitney

1.0 INTRODUCTION

1.1 Purpose

This document is a human health risk assessment (HHRA) for the Smurfit-Stone/Frenchtown Mill Operable Unit 1 site (hereafter referred to as "the OU1 site") located in Montana. The purpose of this document is to evaluate potential risks to humans, both now and in the future, from site-related contaminants that are present at the OU1 site, assuming that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media.

The results of this assessment are intended to help inform risk managers and the public about current and potential future health risks to humans that may occur as a result of exposure to site-related contaminants, and to help determine if there is a need for further evaluation to protect public health at the OU1 site. The methods used to evaluate risks in this assessment are consistent with current guidelines for human health risk assessment provided by the U.S. Environmental Protection Agency (USEPA) for use at Superfund sites (USEPA 1989; 1991a; 1991b; 1991c; 1992; 2002; 2014).

1.2 Organization

In addition to this introduction, this report is organized into the following sections:

Section 2 This section provides a description of the site and a review of data that have been collected to characterize the nature and extent of environmental contamination at the site.

Section 3 This section identifies human exposure scenarios of potential concern at the OU1 Site and describes the approach for identifying contaminants of potential concern (COPCs) for each exposure medium.

Section 4 This section summarizes the results of the COPC selection process.

Section 5 This section provides a summary of the findings presented in this report.

Section 6 This section provides full citations for USEPA guidance documents, site-related documents, and scientific publications referenced in this report.

All tables, figures, and appendices cited in the text are provided at the end of the report.

2.0 SITE CHARACTERIZATION

A detailed description of the Smurfit-Stone/Frenchtown Mill site and its history is provided in the Remedial Investigation Work Plan (RIWP) report for the site (Newfields 2015). Site information is also provided on EPA's Superfund Page for the site[1]. Pertinent information derived from these sources is summarized in the following subsections.

2.1 Site Overview

The Smurfit-Stone/Frenchtown Mill site is in Missoula County, Montana and is located 11 miles northwest of Missoula, Montana (Figure 2-1; adapted from Newfields 2015). The entire site encompasses approximately 3,150 acres.

Historically, a pulp and paper mill operated on site from 1957 to 2010. Wood was chipped, and the chips were washed and digested to create a wood fiber pulp. Beginning in 1990, pulp was also created from recycling old corrugated containers at a recycled fiber plant on site. Waste bark and wood (hog fuel) generated as part of the on-site chipping of logs was conveyed to a storage yard on site and burned in a boiler. Most of the pulp was used to produce un-bleached linerboard, but some of the total pulp produced from 1960-1999 was used to create white linerboard or sold as bleached pulp.

The core industrial footprint of the site includes the former mill, recycling plant, a wood chipping staging area, the hog fuel area, and various equipment storage areas. During the pulp and paper production, high usage of water and energy resulted in large amounts of waste generation like wastewater, solid waste (e.g., treatment sludges, boiler ash, wood processing residuals, lime kiln grits, inert materials, and general refuse) and air emissions. The paper making process at the site was designed to recover and recycle contaminants utilized in the washing and digesting processes. Stack emissions from recovery boilers, power boilers, and lime kilns were controlled, monitored and releases to the atmosphere were consistent with regulatory permitting. The Mill included a wastewater treatment system that consisted of a clarifier and settling ponds (primary treatment), sludge dewatering plant, aeration basins (secondary treatment), polishing ponds, a color removal plant (tertiary treatment) and a series of unlined holding ponds used to store treated effluent prior to discharge. When holding ponds were at capacity, treated wastewater was moved to infiltration basins and infiltrated to groundwater. Treated wastewater was discharged to the Clark Fork River (CFR) between 2010 and 2011 when river flow and temperature conditions were within permit limits.

[1] Smurfit-Stone Mill Frenchtown, Missoula, MT webpage: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0802850

The Smurfit-Stone/Frenchtown Mill site was proposed to be added to the National Priority List (NPL) on December 12, 2013. Although the site has not been added to the NPL, an agreement was reached in November 2015 between the USEPA and the Respondents to conduct a site investigation. USEPA has been in consultation with the Montana Department of Environmental Quality (MDEQ) throughout the process including in the development of this agreement; however, it should be noted that MDEQ is not a signatory party to the agreement between USEPA and the Respondents. For assessment and management purposes, the USEPA, MDEQ and the Respondents have agreed to divide the site into three operable units (OUs) based on historic use and the nature of the potential environmental concerns, as follows (Figure 2-2; adapted from Newfields 2015):

> **OU1** encompasses about 1,200 acres of the site. This area has been and continues to be used largely for agricultural purposes, including grasslands for cattle grazing and cropland irrigated for alfafa and grain crops.
>
> **OU2** encompasses approximately 255 acres of the site and includes the former industrial area. This area includes the former buildings and process areas for the Mill.
>
> **OU3** encompasses approximately 1,700 acres of the site and includes areas of the site where solid and aqueous wastes were treated and stored. This area includes the wastewater treatment system (settling ponds, aeration basins, polishing ponds, solid waste basins, spoils basins, holding ponds, and infiltration basins).

This assessment focuses on OU1.

2.2 Land Use

Historical land use of OU1 included agriculture, open space, and well fields to produce groundwater for Mill operations. As shown in Figure 2-2, there are 12 platted parcels of land within OU1. Nine of the parcels (AG1-AG9) are used for farming, ranching, equipment storage, and production well fields (water supply), one parcel is used as an office for a few employees of the current property owners (M2Green), and two native forest parcels are located west of the Clark Fork River (CFR) (WR1 and WR2). Portions of two parcels (AG8 and AG9) include floodplain upstream of the treated water holding ponds. O'Keefe Creek and Lavalle Creek are tributaries to the CFR that flow through the OU1 site.

OU1 was not used for industrial purposes or for waste or wastewater treatment and storage. OU1 continues to be used largely for agricultural purposes, including grasslands for cattle

grazing and cropland irrigated for alfalfa and grain crops. Information provided to USEPA by the Missoula County Planner indicated that OU1 is not currently zoned for a specific land use.

2.3 Basis for Potential Human Health Concern

Mill operations (predominantly the pulping and bleaching processes) used or produced various hazardous contaminants on site, including semi-volatile organic compounds (SVOCs), heavy metals, and bleaching chemicals. The use of chlorine for the bleaching of pulp produces chlorinated organic compounds, including dioxins and furans. Site activities and waste disposal practices may have contaminated soil, sediment, surface water and groundwater. Excess exposures to the contaminants used or produced by mill operations may cause a range of non-cancer and cancer effects in humans, so humans who reside and/or work at, and/or visit the OU1 site could be at risk of adverse health effects if excessive exposure to contaminated environmental media were to occur.

2.4 Site Investigations

As described in the 2015 RIWP, numerous environmental studies and compliance monitoring events have been conducted at the site (Newfields 2015). The USEPA conducted a site investigation (SI) in 2011 to support evaluation of the site for possible NPL listing (USEPA 2012). This investigation was focused on the former wastewater treatment and storage area (currently designated as operable unit 3), O'Keefe Creek, and the CFR. In April 2014, the Potential Responsible Party (PRP) for the site commissioned the collection of environmental samples from areas that were not investigated by the USEPA in 2011. Follow-up sampling was conducted in accordance with the USEPA approved RIWP and associated Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) (Newfields 2015) in November and December 2015.

For this assessment, attention was focused on data collected from 2014 and 2015. This is because more recent data are likely to be more representative of current site conditions than older data.

2.5 Data Overview

The environmental data for the OU1 site considered in this assessment include surface soil, groundwater, sediment, and surface water samples collected by Newfields during the 2014 and 2015 site investigations (see Table 2-1). All of these data have been validated and are considered to be appropriate for use in this assessment.

Groundwater wells in OU1 that were included in this assessment are NFWM21, RE289, SMW2, SMW20, SMW3 and SMW4 (see Figure 2-3). Data on concentrations in surface water for OU1 are limited to two samples, one collected in Lavalle Creek (SW9-LV) and one collected in O'Keefe Creek (SW10-OK). As shown in Figure 2-4, SW10-OK is located upstream of the mill site boundary. In the absence of additional data, this sample is included in the OU1 site dataset for surface water along with the co-located sediment sample (SE21-OK-SA). Excel files containing the data are provided in electronic format in Appendix A, and summary statistics are provided in Tables 2-2 to 2-5.

3.0 EXPOSURE ASSESSMENT

Exposure is the process by which humans come in to contact with contaminants in the environment. In general, humans can be exposed to contaminants in a variety of environmental media (e.g., soil, sediment, water, air, food), and these exposures can occur through several pathways (e.g., ingestion, dermal contact, inhalation).

3.1 Site Conceptual Model

Figure 3-1 presents a Conceptual Site Model (CSM) for OU1 that summarizes USEPA's current understanding of how contaminants that have been released to the environment at the OU1 site might result in exposure of human receptors. This CSM is based on the most current understanding of expected land use now and in the future. The main features of this CSM are discussed below.

Primary Sources of Contamination

As noted above, Mill operations used or produced various hazardous contaminants on site, including dioxins/furans, SVOCs, and heavy metals. These contaminants were generated or released mainly in OU2 and OU3.

Transport in the Environment

Contaminants generated and/or released from historic Mill operations in OU2 and OU3 may migrate in the environment by several processes:

- Fine-grained soil particulates may be released into air as a consequence either of wind erosion and/or human disturbances. In 2014, the USEPA identified the potential for the migration of dust from the wastewater treatment system ponds to OU1 (Newfields 2015). Furthermore, transport of contaminants emitted to the air from boiler emissions can result in direct deposition of contaminants in OU1 surface soils.

- Runoff (from rain or snowmelt) from surface soils into area streams may result in contamination of both surface water and stream sediments.

- Contaminants in soil may be dissolved by water (rain or snowmelt) and infiltrate into subsurface soils and downward into groundwater.

Populations of Chief Concern

Humans who are most likely to be exposed to site-related contaminants include the following.

Current and Hypothetical Future Agricultural Workers (Farmers/Ranchers)

As noted previously, land within OU1 is currently predominantly used for farming and ranching, mainly for the production of livestock forage and grazing land for cattle. Future land use is expected to be similar. Therefore, the agricultural worker population includes farmers/ranchers who may be exposed while tending to their crops and/or livestock within the OU1 site.

Current and Hypothetical Future Residents

At the time of this assessment, there was a person living within a ranch property located within OU1. However, verbal correspondence between the Respondents and the tenant has indicated that the tenant will be vacating in the near future and the building will likely be demolished. Consequently, current residential exposure of ranchers, farmers, or renters was not evaluated in this assessment.

As noted above, OU1 is not currently zoned and there are no restrictions in place to prohibit development of OU1 for residential use in the future. On this basis, the CSM includes a hypothetical future residential receptor.

Current and Hypothetical Future Commercial/Industrial Workers

As noted above, one parcel within OU1 is currently used as an office for a few employees of M2Green (the current land owner). Also, additional changes in land use to support commercial development within OU1 in the future are anticipated. At present, future development of industrial facilities (e.g., large scale manufacturing plants) are not anticipated within OU1. On this basis, the worker population represents current and hypothetical future commercial workers who may be exposed to site contamination while working at locations within the OU1 site.

Hypothetical Future Construction Workers

With commercial development, future construction activities at the OU1 site are anticipated. These activities would involve soil excavation and construction. The

hypothetical future construction worker population represents construction workers who may be exposed to site contamination during such activities.

Hypothetical Future Recreational Visitors

As noted above, OU1 includes two native forest parcels (WR1 and WR2) and Lavalle Creek and O'Keefe Creek flow through the site. Additionally, future land use of other parcels within OU1 could support recreational activities by site visitors or by hypothetical future residents. Recreational activities in the areas of the OU1 site may include hiking and wading/playing and/or swimming in the creeks. Activities that involve motorized vehicles (e.g., all-terrain vehicles) are not anticipated.

On this basis, the recreational visitor population represents individuals (adults and children aged 0-6 years) who may walk and/or hike through the OU1 site and who may play, wade or swim in Lavalle Creek or O'Keefe Creek.

3.2 Exposure Pathways of Chief Concern

Not all of the potential exposure routes to these populations of receptors are likely to be of equal concern. First, in order to be of concern, an exposure pathway must be "complete". That is, there must be contact between a human receptor and a contaminated environmental medium. Exposure pathways that are not complete are indicated in Figure 3-1 by open boxes. For pathways that are complete, the relative importance of one to another is related to the amount of contaminant taken into the body by each pathway. Exposure scenarios that are likely to result in the highest level of exposure are shown in Figure 3-1 by boxes containing a solid circle (●). Greatest attention is focused on quantification of exposure from these pathways in order to determine if the pathway contributes significant risk. Pathways that are complete but which are judged to contribute only minor exposures, at least in comparison to other pathways, are shown by boxes with an open circle (❍). Because of their minor contribution, these pathways are not evaluated quantitatively.

The following sections present a more detailed description of these pathways and an analysis of their relative importance for human exposure.

3.2.1 Exposures to Soil

Exposures to Surface Soil

Incidental Ingestion of Surface Soil

Even though few people intentionally ingest soil, anyone who has direct contact with contaminated surface soil may incidentally ingest small amounts that adhere to their hands during outdoor activities. Incidental ingestion of soil is often one of the most important routes of human exposure, so ingestion of surface soil is evaluated for all receptors.

Dermal Contact with Surface Soil

Humans who come into contact with contaminated soils may get some of the material on their skin. As such, dermal exposure to surface soil is considered a complete exposure pathway and is evaluated quantitatively for all receptors.

Inhalation of Airborne Soil Particulates

Whenever contaminated soils are exposed at the surface, fine-grained particles may become suspended in air by wind and/or human activity, and humans in the area could inhale those particles. In cases where the soil is disturbed only by wind or light human activity (e.g., walking/hiking), the amount of particulate material inhaled from air is generally quite small compared to the amount that is typically assumed for incidental ingestion. Therefore, inhalation of soil particulates generated by wind erosion or walking is considered a minor pathway for all potential human receptors. Appendix B presents screening level calculations to support this designation.

When surface soil is disturbed by mechanical forces such as farming or construction equipment, dust levels in air may be significant and intake of soil from inhalation of airborne dusts may become similar to or even higher than the ingestion pathway. Thus, inhalation of soil particulates generated through the use of farming or construction equipment is evaluated quantitatively for agriculture workers and hypothetical future construction workers.

Inhalation of Vapors Emitted from Surface Soils

Whenever contaminated soils are exposed at the surface, volatile contaminants may volatilize into the air and humans in the area could inhale those vapors. Volatile organic compounds

(VOCs) are not expected in OU1 soils. Volatilization of the SVOCs expected in OU1 soils (dioxins/furans and PAHs) is not expected to be significant given the relatively low volatility of these contaminants and the absence of a continuous source. Also, the amount of vapor inhaled from air is generally quite small compared to the amount that is typically assumed for incidental ingestion. Therefore, inhalation of vapors emitted from surface soils is considered a minor pathway for all potential human receptors. Appendix B presents screening level calculations to support this designation.

Exposures to Subsurface Soil

Due to the nature of the work, construction workers may be exposed via direct contact to subsurface soil (i.e., depths of 0 to 10 feet). Construction workers who have direct contact with contaminated soils may get subsurface soils on their skin and incidentally ingest small amounts that adhere to their hands during construction activities. On this basis, incidental ingestion of and dermal contact with subsurface soils are considered complete exposure pathways for hypothetical future construction workers.

3.2.2 Exposures to Groundwater

Available site information suggests that there is a low tendency for site-related contaminants to migrate downward into the groundwater at this site (Newfields 2015). Groundwater is not currently used as a drinking water source in OU1. Therefore, exposure of current workers to groundwater is not evaluated quantitatively. It is possible that groundwater from OU1 could be used within future residences and/or commercial buildings. There are three primary pathways by which a hypothetical future resident or commercial worker may be exposed to groundwater as described below.

Ingestion of Drinking Water

Hypothetical future residents or commercial workers may ingest site groundwater as drinking water.

Dermal Contact with Groundwater

If site groundwater were used in residential homes in the future, dermal exposure by residents would primarily be the result of showering/bathing. If site groundwater were used in commercial buildings in the future, dermal exposure by workers would primarily be the result of hand washing. Metals and dioxins/furans have been detected in OU1 groundwater samples.

USEPA guidance recommends against quantifying exposure and risk based on dermal contact with 2,3,7,8-TCDD in water because the molecular weight (MW) and octanol/water partition coefficient (Kow) are outside of the effective predictive domain (EPD) (USEPA 2004). Uptake of metals across the skin from contact with water is usually a minor exposure pathway due to the relatively low tendency of metals to cross the skin even when contact does occur. Furthermore, risk associated with dermal contact to metals in water is expected to be relatively small compared to the amount that is typically assumed for ingestion of drinking water (see Appendix B). Thus, dermal exposure to groundwater by hypothetical future residents and workers is considered a minor pathway and was not evaluated quantitatively in this assessment.

Inhalation of Vapors Released from Water

Volatile contaminants in water can be released to indoor air by two pathways: 1) vaporization to indoor air through standard indoor water uses, and 2) vapor intrusion in which vapors rise from the groundwater through the soil underlying a building foundation and get into the building through cracks in the foundation. Although these pathways may be complete at future residences and/or commercial buildings within the OU1 site, the contaminants detected in OU1 groundwater (dioxins/furans, metals) are not considered to be of sufficient volatility to expect significant exposures via these pathways. Therefore, these pathways were not evaluated quantitatively in this assessment.

3.2.3 Exposures to Sediment

Incidental Ingestion of Sediment

People recreating along O'Keefe and Lavalle Creeks within the OU1 site are unlikely to intentionally ingest sediment, but as described above for surface soil, anyone who has direct contact with contaminated sediments may incidentally ingest small amounts that adhere to their hands during recreational activities at area creeks. Thus, incidental ingestion of sediment is evaluated quantitatively for recreational visitors.

Dermal Contact with Sediment

Recreational visitors who come into contact with contaminated sediments may get some of the material on their skin during recreational activities at area creeks. As such, dermal exposure to sediments is considered a complete exposure pathway and is evaluated quantitatively for recreational visitors.

3.2.4 Exposures to Surface Water

Incidental Ingestion of Surface Water

People recreating along O'Keefe and Lavalle Creeks within the OU1 site are unlikely to intentionally ingest surface water as drinking water, but may incidentally ingest small amounts while recreating at area creeks. Therefore, this exposure pathway is considered complete for recreational visitors and is evaluated quantitatively.

Dermal Contact with Surface Water

Humans visiting site creeks for recreational purposes may have occasional dermal contact with surface water while playing along or wading/swimming in the creeks. Therefore, this exposure pathway is considered complete for recreational visitors and is evaluated quantitatively.

3.2.5 Exposures to Food Items

Ingestion of Crops Grown in Contaminated Soil

As noted above, currently OU1 is predominantly used to grow alfalfa and grain crops for livestock. Although crops intended for human consumption are not currently grown on site, they could be grown in the future. Humans eating crops grown in contaminated soil may be exposed to certain contaminants that may be taken up by the plant. Therefore, ingestion of crops grown on site in the future is considered a complete exposure pathway and is evaluated quantitatively.

Ingestion of Cattle Grazed On-Site

Grasslands within OU1 are currently used for cattle grazing. Cattle grazing on the site may take up contaminants either from eating vegetation grown in contaminated soils and/or by direct ingestion of soil while feeding. It is assumed that ranchers may consume meat from these cattle as part of their diet. On this basis, ingestion of cattle is considered a complete exposure pathway and is evaluated quantitatively.

Ingestion of Fish from Area Creeks

At present, MDEQ and PRP representatives indicate that there are no edible fish in Lavalle or O'Keefe Creeks. Therefore, exposure of humans by ingestion of fish caught from these water bodies is not evaluated in this assessment.

3.3 Selection of Contaminants of Potential Concern

COPCs are contaminants which exist in the environment at concentration levels that might be of potential health concern to humans and which are or might be derived, at least in part, from site-related sources.

3.3.1 COPC Selection Process

The procedure used to identify COPCs for the evaluation of risks to human receptors from contaminated environmental media (soil, surface water, groundwater, and sediment) is shown in Figure 3-2. It is important to note that this COPC selection procedure is intended to be conservative. That is, it is expected that some contaminants may be identified as COPCs that are actually of little or no concern, but that no contaminants of authentic concern will be overlooked.

The COPC selection procedure includes two primary steps:

(1) Comparison of site data to risk-based concentrations,
(2) Comparison of site data to background data.

In brief, the COPC selection procedure classifies each contaminant into one of three categories:

- COPC
- Not a COPC
- Source of Uncertainty

In Step 1, the process begins by determining if the contaminant has a risk-based concentration (RBC) that can be used to evaluate potential risk. An RBC is a concentration of a contaminant in a medium that is believed to pose negligible health risk to a specified population of human receptors. For carcinogens, this is a concentration that corresponds to a cancer risk of 1E-06. For non-carcinogens, this is a concentration that corresponds to a Hazard Quotient (HQ) of 0.1.

If an RBC is available, the next step is to evaluate the detection frequency. If a contaminant was detected in 5% or more of the site samples, the maximum detected concentration for each contaminant in each medium is compared to the RBC. If the maximum detected concentration exceeds the RBC, the contaminant moves into Step 2, the background comparison. If the maximum detected concentration does not exceed the RBC, it may be concluded that the contaminant does not pose a significant risk to humans and may be excluded as a COPC.

If the contaminant was detected in fewer than 5% of the site samples, or if the contaminant was not detected, then the detection limit is evaluated. If the detection limit is lower than the RBC, then it is very unlikely that the contaminant will pose a significant risk to human health and may be excluded as a COPC. However, if the detection limit is above the RBC, this is identified as a source of uncertainty.

If a contaminant does not have an RBC, this is identified as a source of uncertainty unless the contaminant is a beneficial nutrient and the expected average intake from site media is similar to the range that is considered healthful.

In Step 2, site data for contaminants identified as having a maximum detected concentration above an available RBC value are compared to appropriate background concentrations.

If the measured level of a contaminant is not statistically (based on an alpha of 0.05, see section 3.3.4) higher than the level that would be expected for that contaminant based on background levels, then it may be concluded that the site-related contribution for that contaminant is sufficiently minor and further quantitative evaluation is not needed. If the contaminant is observed to be present at a level higher than would otherwise be expected, then that contaminant is retained for quantitative risk evaluation.

In summary, a contaminant is identified as a COPC if the maximum detected concentration exceeds an available RBC, and site concentrations for that contaminant are significantly higher than background concentrations.

3.3.2 Source of Risk-Based Screening Level Values

Risk-based screening levels (SLs or RBCs) used in this assessment are selected based on the human receptor identified in the CSM (Figure 3-1) who is expected to receive the highest exposure. In general for OU1, this is the hypothetical future resident. Therefore, RBC values for use in the COPC selection protocol were derived from USEPA's Regional Screening Level (RSL) Tables (USEPA, 2016), using values that are protective of residents. USEPA's RSL Tables include generic SLs for a resident exposed to soil or drinking water calculated assuming default exposure parameters that represent Reasonable Maximum Exposure (RME) conditions for chronic exposures via the oral, dermal and inhalation pathways (see Table 3-1).

3.3.3 Evaluation of Beneficial Minerals

A number of metals are beneficial minerals, and a certain level of intake is required to maintain good health. This includes calcium, chromium (III), copper, iron, magnesium, manganese, molybdenum, potassium, selenium, sodium, and zinc. However, excess intake of these minerals may cause adverse effects. If a SL was available for such minerals in USEPA's RSL Tables, they were evaluated as described above. Because of their low toxicity (even at high doses), USEPA has not derived RBC values for some minerals, including calcium, magnesium, potassium, and sodium. These four contaminants were evaluated by calculating an effective RBC as follows:

Effective RBC (beneficial) = DRI / DI

Where:

DRI = Daily Reference Intake by an adult (mg/day), derived from the Food and Nutrition Board (FNB 2013)

DI = Daily intake of site medium (kg/day of soil or sediment; L/day of water)

3.3.4 Background Screen

Concentrations of a contaminant in the environment are characterized by distributions, whereby a comparison between site data and background data must be based on sound statistical techniques. For the purposes of this assessment, USEPA's ProUCL Software (v 5.0) was used to compare available site data to available background data (USEPA 2013). This was done using the Wilcoxon-Mann-Whitney (WMW) two sample hypothesis test in ProUCL for the null hypothesis site >= background at a confidence coefficient of 95%. If ProUCL concludes that the Form 2 null hypothesis can not be rejected, the WMW two sample hypothesis test is conducted for the null hypothesis site = background at a confidence coefficient of 95%. The Gehan test was used when multiple detection limits are present as prompted by the ProUCL output based on the WMW test.

Background soil data considered in this assessment are based on data collected by the MDEQ for dioxins/furans and inorganics (MDEQ, 2013; 2011). Background data for groundwater, sediment, and surface water include data collected during RI sampling from unimpacted areas/areas upstream of the Smurfit Stone/Frenchtown Mill site (Table 3-2). Table 3-2 presents

the list of background samples considered in this assessment. Tables 3-3 to 3-6 present summary statistics for the background data used in this assessment.

Four wells (CountyMW, SMW1, SMW5, and SMW6) were identified as background groundwater locations for OU1. Inorganics data from these wells are limited for total recoverable metals to a single sample collected from the County well. The limited available background data restricts the use of ProUCL or other robust statistical methods for comparing site groundwater data for total recoverable metals to background. However, data for dissolved metals are available from each of the four background wells (n=5). In the absence of additional background data on total recoverable metals, the dissolved metals data from the four background wells were utilized for comparison to dissolved metal concentrations in site samples.

4.0 TOXICITY ASSESSMENT

The basic objective of a toxicity assessment is to identify what adverse health effects a contaminant causes, and how the appearance of these adverse effects depends on exposure level. In addition, the toxic effects of a contaminant frequently depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure (subchronic, chronic, or lifetime). Thus, a full description of the toxic effects of a contaminant includes a listing of what adverse health effects the contaminant may cause, and how the occurrence of these effects depends upon dose, route, and duration of exposure.

The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the non-cancer effects of the contaminant, while the second addresses the cancer effects of the contaminant. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and non-cancer effects. The relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population forms the basis for a quantitative dose-response relationship. Toxicity values (e.g, reference doses and slope factors) are derived based on such dose-response relationships.

The SLs included in USEPA's RSL Tables and utilized in the COPC screening procedure in this assessment are derived based on toxicity values chosen following USEPA's Superfund hierarchy of human health toxicity values (USEPA 2003).

5.0 RESULTS

Tables 4-1 to 4-4 present the application of the COPC selection process described above. The results of the COPC selection process are described in further detail below.

5.1 Risk-based Screen

As seen in Tables 4-1 to 4-4, maximum detected concentrations were below respective RBCs across media for all contaminants except the following:

- Aluminum, arsenic, chromium (hexavalent), cobalt, iron, manganese and thallium in soil.
- TEQ, arsenic, chromium (hexavalent), cobalt, and manganese in groundwater.
- Aluminum, arsenic, chromium (hexavalent), cobalt, iron, and manganese in sediment.
- TEQ, arsenic, and chromium (hexavalent) in surface water.

5.2 Background Screen

Of the contaminants listed above with maximum detected concentrations above respective RBCs, only manganese in groundwater was identified in the background screening process as being present at the OU1 site above background concentrations. Appendix C includes the ProUCL output for the background comparisons for these contaminants.

5.3 Summary

Following screening of the available data for OU1 in accordance with the COPC selection procedure outlined in Figure 3-1, the only COPC identified for OU1 is manganese in groundwater.

6.0 RISK CHARACTERIZATION

6.1 Risks from Exposures to OU1 Soils

Most contaminants in OU1 surface soils were found to be present at concentrations below RBCs for the receptor in the CSM expected to receive the highest exposure (hypothetical future residents). None of the contaminants identified as being detected at concentrations above the residential SLs were found to be present above background concentrations. On this basis, risks to potential receptors exposed to surface soil is expected to be within or below acceptable risk limits. The available soil data for OU1 are restricted to samples collected at the surface (roughly 0-0.5 ft below surface); no data are currently available for subsurface soils. As noted above, contamination of subsurface soils is anticipated to occur primarily through infiltration of surface soils. On this basis, contaminant concentrations in subsurface soils are expected to be similar or less than concentrations observed in surface soils. Given that concentrations in surface soils do not exceed the available conservative screening levels for a resident, it is concluded that risks to construction workers from exposures to subsurface soils will also be within or below acceptable risk limits (non-cancer hazards below 1.0 and cancer risks between 1E-04 and 1E-06).

6.2 Risks from Exposures to Sediments and Surface Water in O'Keefe and Lavalle Creeks

Contaminants in surface waters and sediments of O'Keefe and Lavalle Creeks are present at concentrations either below conservative RBCs or comparable to background concentrations. On this basis, risks to potential recreational visitors exposed in these Creeks is expected to be within or below acceptable risk limits.

6.3 Risks from Exposures to OU1 Groundwater

Except for manganese, all contaminants measured in groundwater collected from wells within OU1 are present at concentrations that are either below conservative RBCs or are comparable to background concentrations.

In general, when evaluating risks to humans consuming groundwater as drinking water, the exposure evaluation is performed on a well-by-well basis. This is because wells in different areas and screened at different depths may draw water with differing levels of contamination. Accordingly, Figure 6-1 summarizes the available data for both dissolved and total manganese by well, and compares the measured values to the concentration corresponding to a HQ of 1.0 for both residents and workers.

As shown, levels of manganese (either dissolved or total) do not exceed an HQ of 1 for workers at any well.

For hypothetical future residents, levels of dissolved manganese exceed an HQ of 1 at two wells, RE289 and SMW4. One sample of total manganese also exceeds an HQ of 1 at well SMW4.

The source of the elevated manganese in these two wells is not clear. These two wells are not located close to each other (see Figure 2-3), and measured levels of manganese in intervening wells are below a level of concern. Also, as described in Section 3.1 above, releases of site-related contaminants to OU1 are expected to have occurred mainly by deposition of contaminants into site surface soils, and levels of manganese in OU1 soils do not appear to be elevated above background (see Table 4-1 and Appendix C). Consequently, it is possible that the elevated manganese levels observed in wells RE289 and SMW4 are attributable to natural variations rather than site related releases, but further investigations would be needed to evaluate this possibility.

7.0 UNCERTAINTY ASSESSMENT

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with contaminated media, and the true dose-response curves for non-cancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment.

The main sources of uncertainty in the exposure assessment and risk characterization presented in this assessment include uncertainties from exposure pathways not evaluated, as well as uncertainties in the exposure parameters and toxicity values used to derive screening levels as described in further detail below.

Uncertainties in Data

Surface water samples collected from O'Keefe and Lavalle Creeks are limited (n=2). Such small sample sizes increases the uncertainty in the statistical comparisons between site and background concentrations. However, the screening process included in this assessment is conservative assuming residential SLs that account for direct ingestion of surface water as drinking water. It is anticipated that exposures to surface water in O'Keefe and Lavalle Creeks will primarily occur during recreational activities that will be of short and intermittent durations, and direct consumption of surface water as drinking water is unlikely.

Uncertainties in Exposure Pathways Not Evaluated

Omission of exposure pathways believed to be minor compared to one or more other pathways that were evaluated may result in a small underestimation of exposure and risk, but the magnitude of this underestimation is not expected to be significant.

Uncertainties in Human Exposure Parameters

Accurate calculation of exposures requires accurate estimates of the level of human exposure that is occurring. The SLs used in this assessment are based on conservative exposure assumptions whereby estimates of exposure are more likely to overestimate than underestimate actual exposure.

Uncertainties in Toxicity Values

Toxicity information for many contaminants is often limited. Consequently, there are varying degrees of uncertainty associated with toxicity values (i.e., oral SF, RfD, RfC, inhalation UR). For example, uncertainties can arise from the following sources:

- Extrapolation from animal studies to humans
- Extrapolation from high dose to low dose
- Extrapolation from continuous exposure to intermittent exposure
- Limited or inconsistent toxicity studies

In general, uncertainty in toxicity factors is one of the largest sources of uncertainty in risk estimates at a site. Because of the conservative methods USEPA uses in dealing with these uncertainties, it is much more likely that the uncertainty will result in an overestimation rather than an underestimation of risk.

8.0 REFERENCES

FNB 2013. Dietary Reference Intakes (DRIs): Estimated Average Requirements. Food and Nutrition Board, Institute of Medicine, National Academies of Science.

MDEQ. (2011). Montana Dioxin Background Investigation Report. Montana Department of Environmental Quality. April 2011.

MDEQ. (2013). Background Concentrations of Inorganic Constituents in Montana Surface Soils. Montana Department of Environmental Quality. September 2013.

Newfields. 2015. Remedial Investigation Work Plan. Smurfit Stone/Frenchtown Mill Missoula County, Montana. November.

New Fields 2016. Preliminary Data Summary Report, Smurfit Stone/Frenchtown Mill, Missoula County, Montana. Prepared for International Paper Company, M2Green Redevelopment, LLC, and West Rock CP, LLC. June 2016.

USEPA. 1989. Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part A).

USEPA. 1991a. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." Washington, DC. OSWER Directive 9285.6-03.

USEPA. 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

USEPA. 1991c. Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). Washington, DC. OSWER Directive 9285.7-01B.

USEPA. 1992. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication 9285.7-081.

USEPA. 1994. Evaluating and Identifying Contaminants of Concern for Human Health. Region 8 Superfund Technical Guidance. RA-03. September.

USEPA. 1998. Toxicological Review of Hexavalent Chromium. Integrated Risk Information System (IRIS). August.

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

USEPA. 2003. Human Health Toxicity Values in Superfund Risk Assessments. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. OSWER Directive 9285.7-53. December 2003.

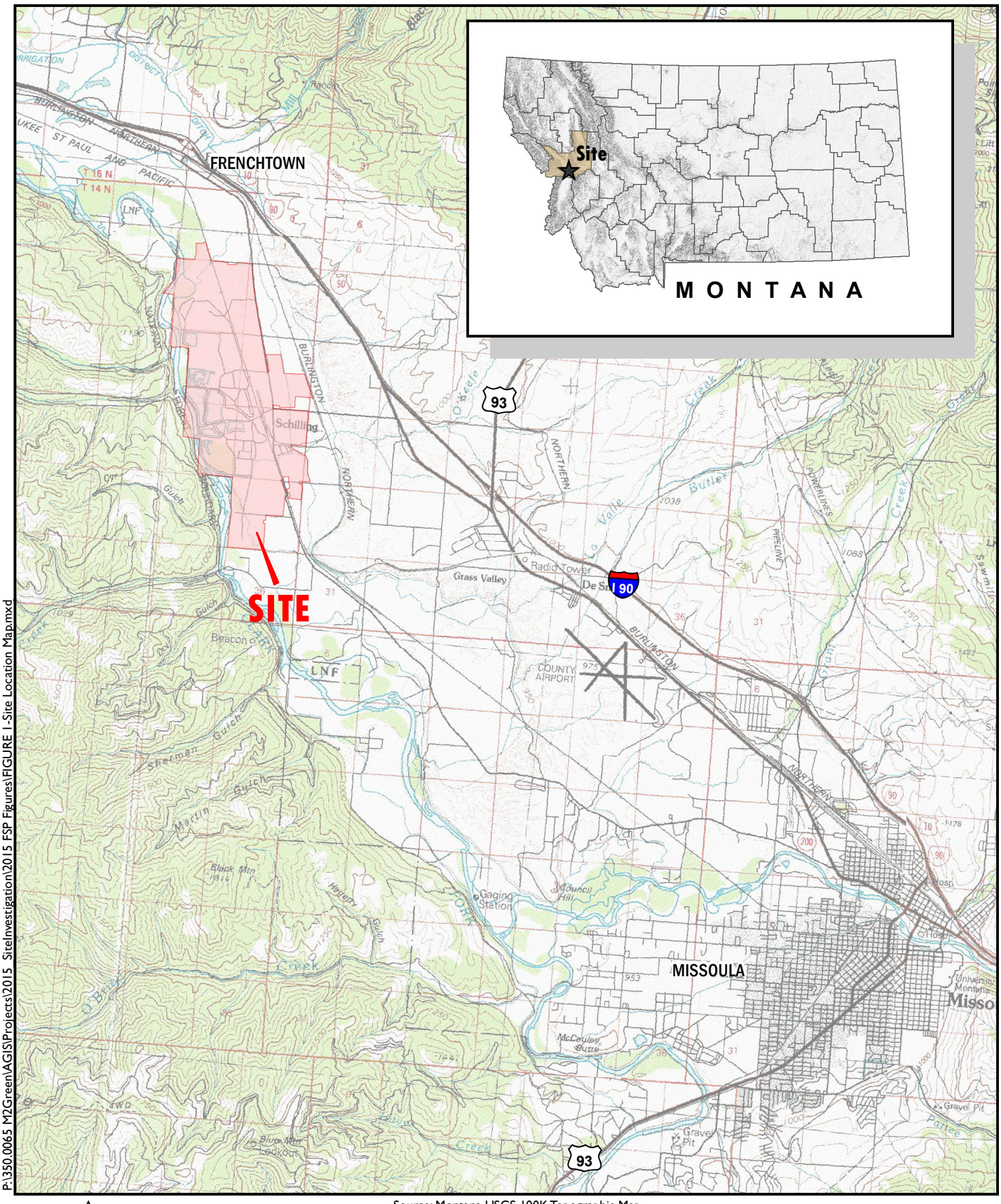
USEPA. 2012. Analytical Results Report for a Combined Site Inspection and Removal Assessment. Smurfit-Stone Mill, near Missoula, Missoula County, MT.

USEPA. 2013. ProUCL Version 5.0.00 User Guide. Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041.September.

USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: "Update of Standard Default Exposure Factors." OSWER Directive 9200.1-120.

USEPA. 2016. Regional Screening Levels. U.S. Environmental Protection Agency. Last updated May 2016. Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls

FIGURES



P:\350.0065 M2Green\AGIS\Projects\2015 SiteInvestigation\2015 FSP Figures\FIGURE 1-Site Location Map.mxd

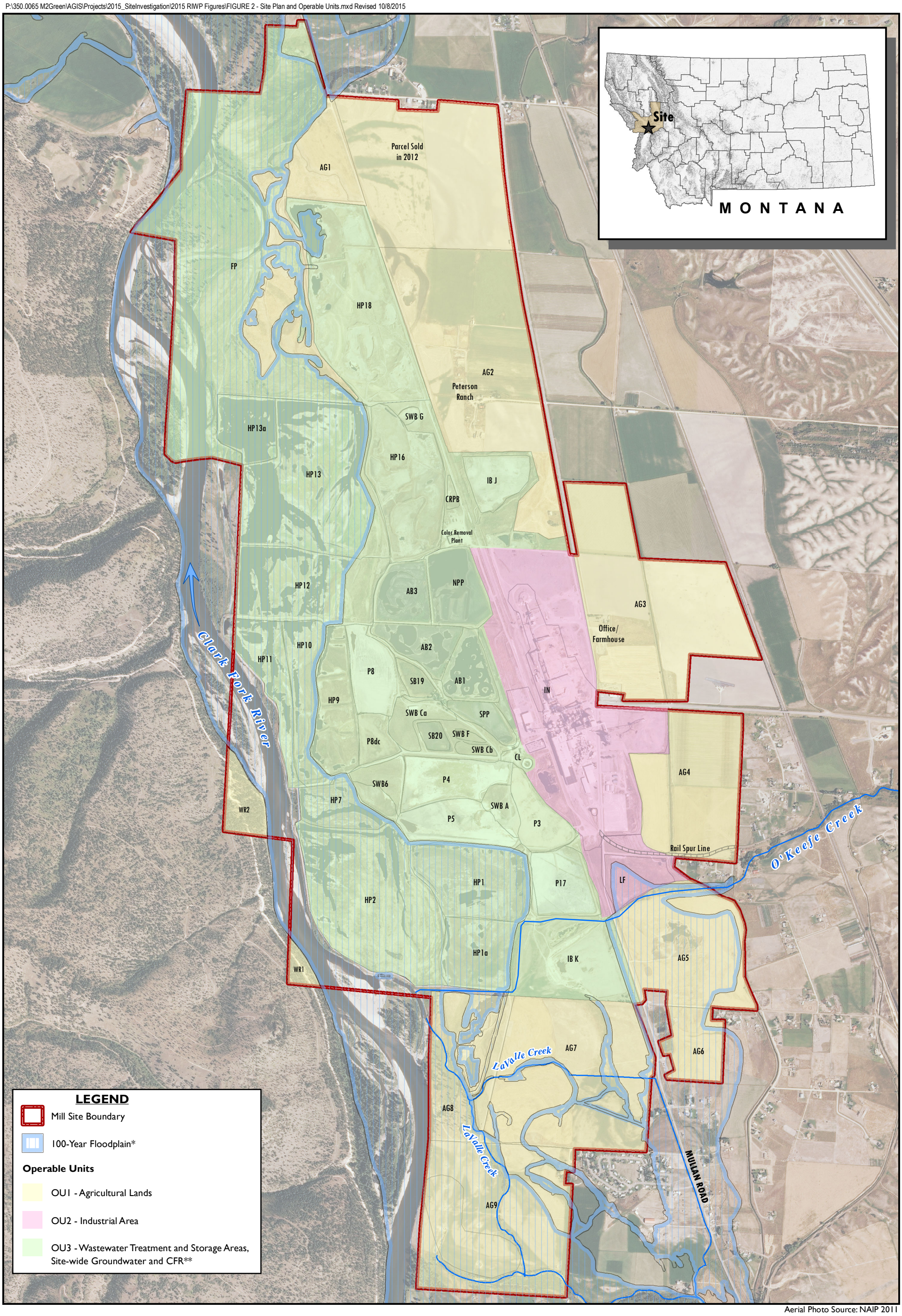
Source: Montana USGS 100K Topographic Map

0 Feet 10,000

NewFields

Site Location Map
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-1

P:\350.0065 M2Green\AGIS\Projects\2015_SiteInvestigation\2015 RIWP Figures\FIGURE 2 - Site Plan and Operable Units.mxd Revised 10/8/2015



Aerial Photo Source: NAIP 2011

0 Feet 1,600

NewFields

*Floodplain Source:
As defined by the Federal Emergency Management Agency (FEMA) 2013 Digital Flood Insurance Rate Map (DFIRM). (NFIP 2013)

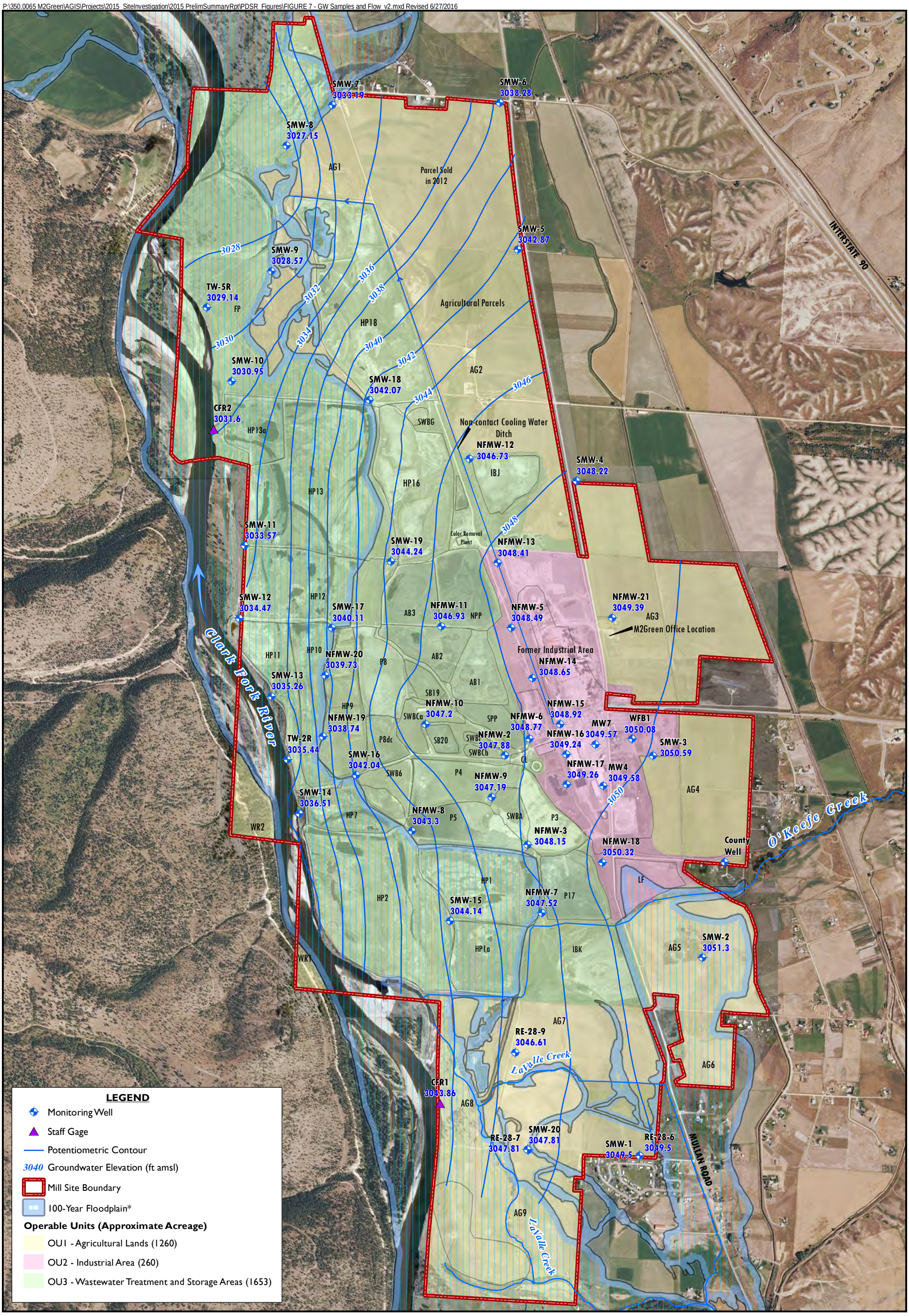
**Where Contaminant of Potential Concern from the Site have come to be located in the CFR

Notes

AG - Agricultural Land
AB - Aeration Stabilization Basin
CFR - Clark Fork River
CRPB - Color Removal Plant Basin
CL - Clarifier
FP - Floodplain Area
HP - Holding or Storage Pond
IB - Rapid Infiltration Basin
LF - Land farm
IN - Industrial Area
NPP - North Polishing Pond
OU - Operable Unit
P - Settling Pond
SB - Spoils Basin
SPP - South Polishing Pond
SWB - Solid Waste Basin
WR - West of the Clark Fork River

Site Plan and Operable Units
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-2

P:\350.0065 M2Green\AGIS\Projects\2015_SiteInvestigation\2015 PrelimSummaryRpt\PDSR_Figures\FIGURE 7 - GW Samples and Flow_v2.mxd Revised 6/27/2016



LEGEND

- Monitoring Well
- Staff Gage
- Potentiometric Contour
- *3040* Groundwater Elevation (ft amsl)
- Mill Site Boundary
- 100-Year Floodplain*

Operable Units (Approximate Acreage)

- OU1 - Agricultural Lands (1260)
- OU2 - Industrial Area (260)
- OU3 - Wastewater Treatment and Storage Areas (1653)

N

0 Feet 1,600

Aerial Photo Source: NAIP 2011 and Newfields 2016 (Within Site Boundary)

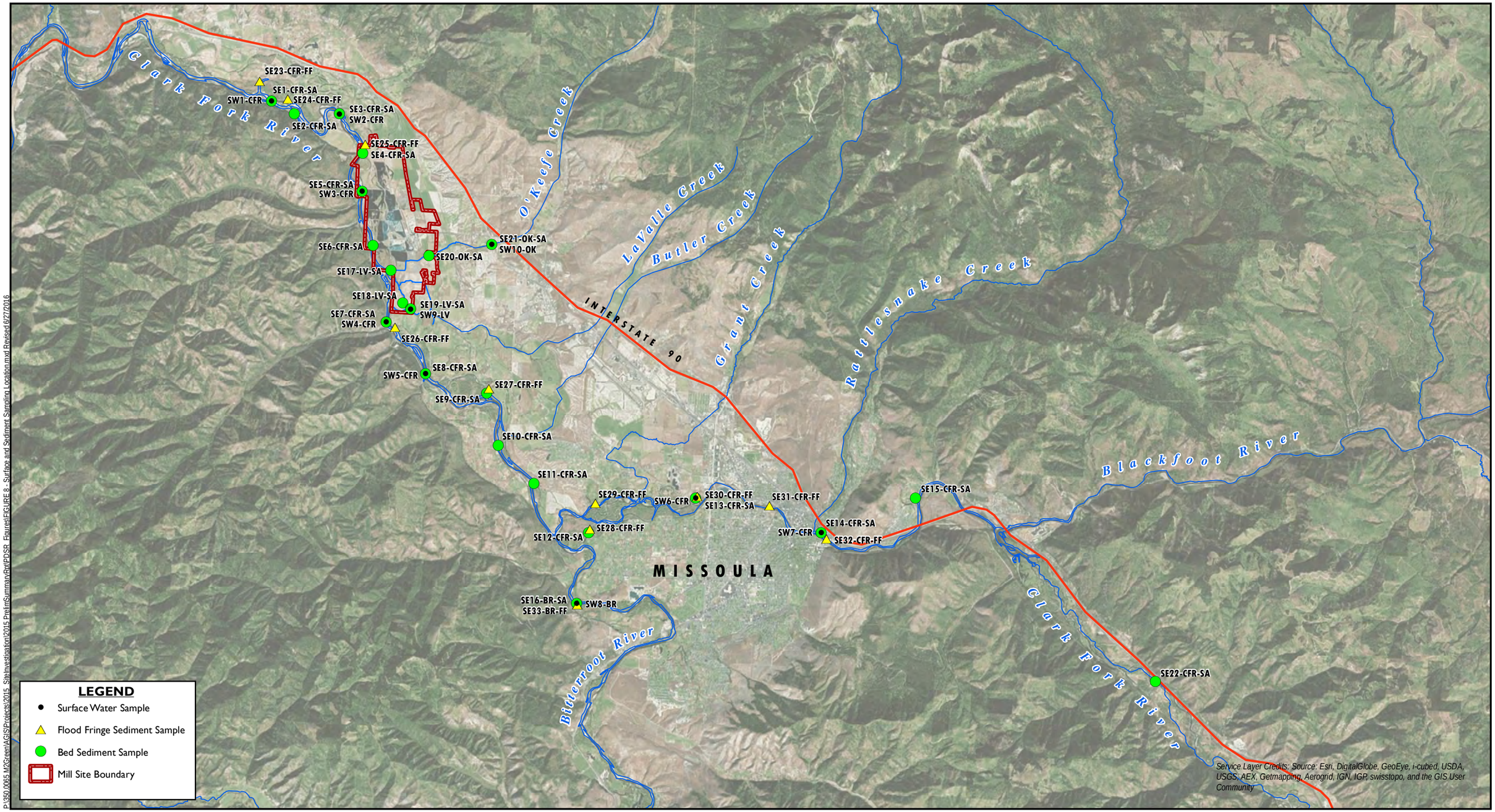
*Floodplain Source:
As defined by the Federal Emergency Management Agency (FEMA) 2013 Digital Flood Insurance Rate Map (DFIRM). (NFIP 2013)

Notes

AG - Agricultural Land
AB - Aeration Stabilization Basin
CFR - Clark Fork River
CL - Clarifier
FP - Flood Plain
HP - Holding or Storage Pond
IB - Rapid Infiltration Basin
NPP - North Polishing Pond
P - Settling Pond
SB - Spoils Basin
SPP - South Polishing Pond
SWB - Solid Waste Basin
WR - West of River
amsl - above mean sea level

NewFields

Groundwater Sample Locations and Flow Map
December 2015
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-3



P:\350\0065 M2Green\AGIS\Projects\2015_SiteInvestigation\2015 PreFinSummaryRpt\PDSR_Figures\FIGURE 8 - Surface and Sediment Sampling Location.mxd Revised 6/27/2016

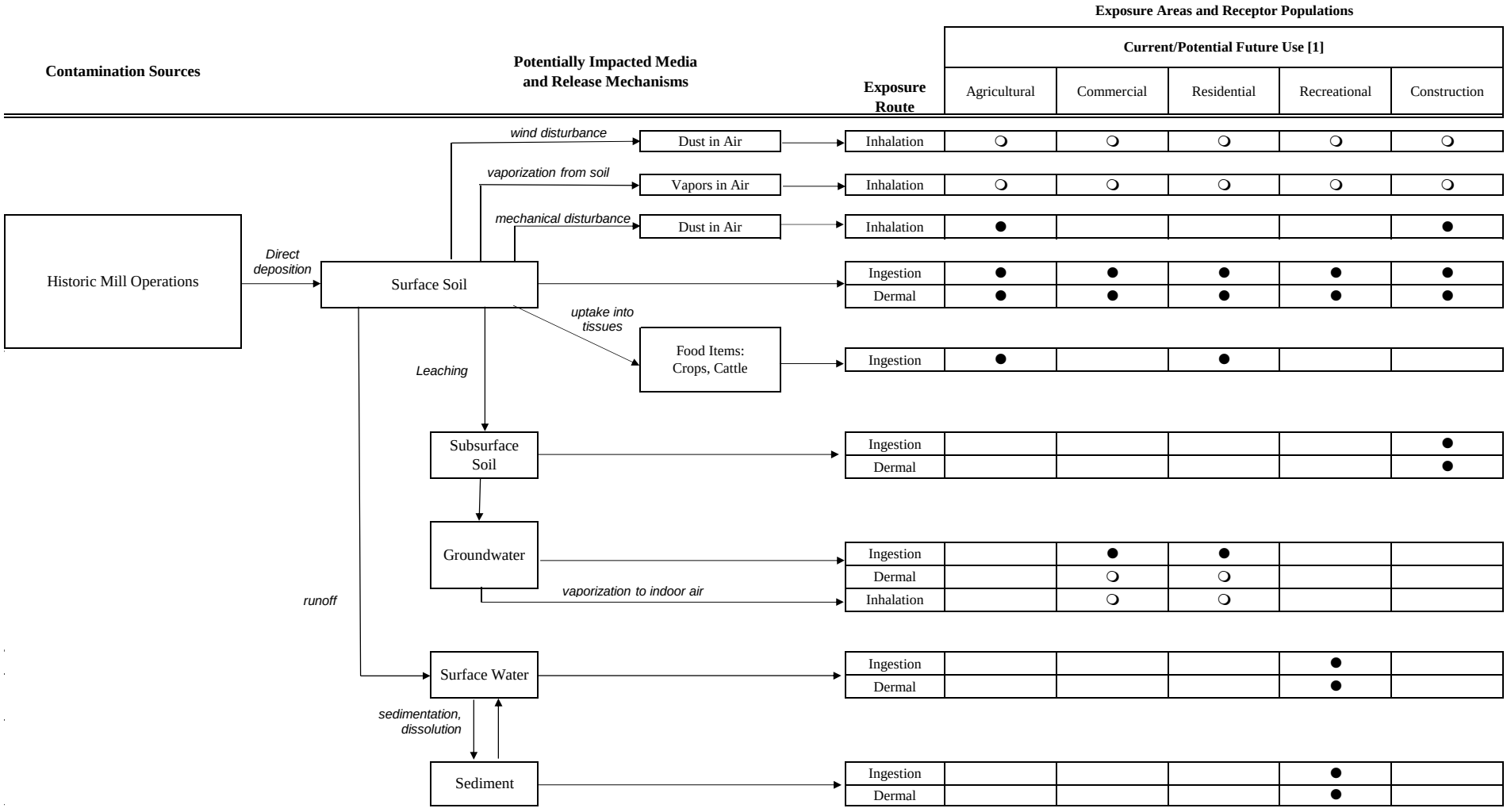
N

0 Feet 12,000

NewFields

Surface Water and Sediment
Sampling Locations
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-4

Figure 3-1. Conceptual Site Model for Human Exposure at OU1 - Agricultural Area Soils



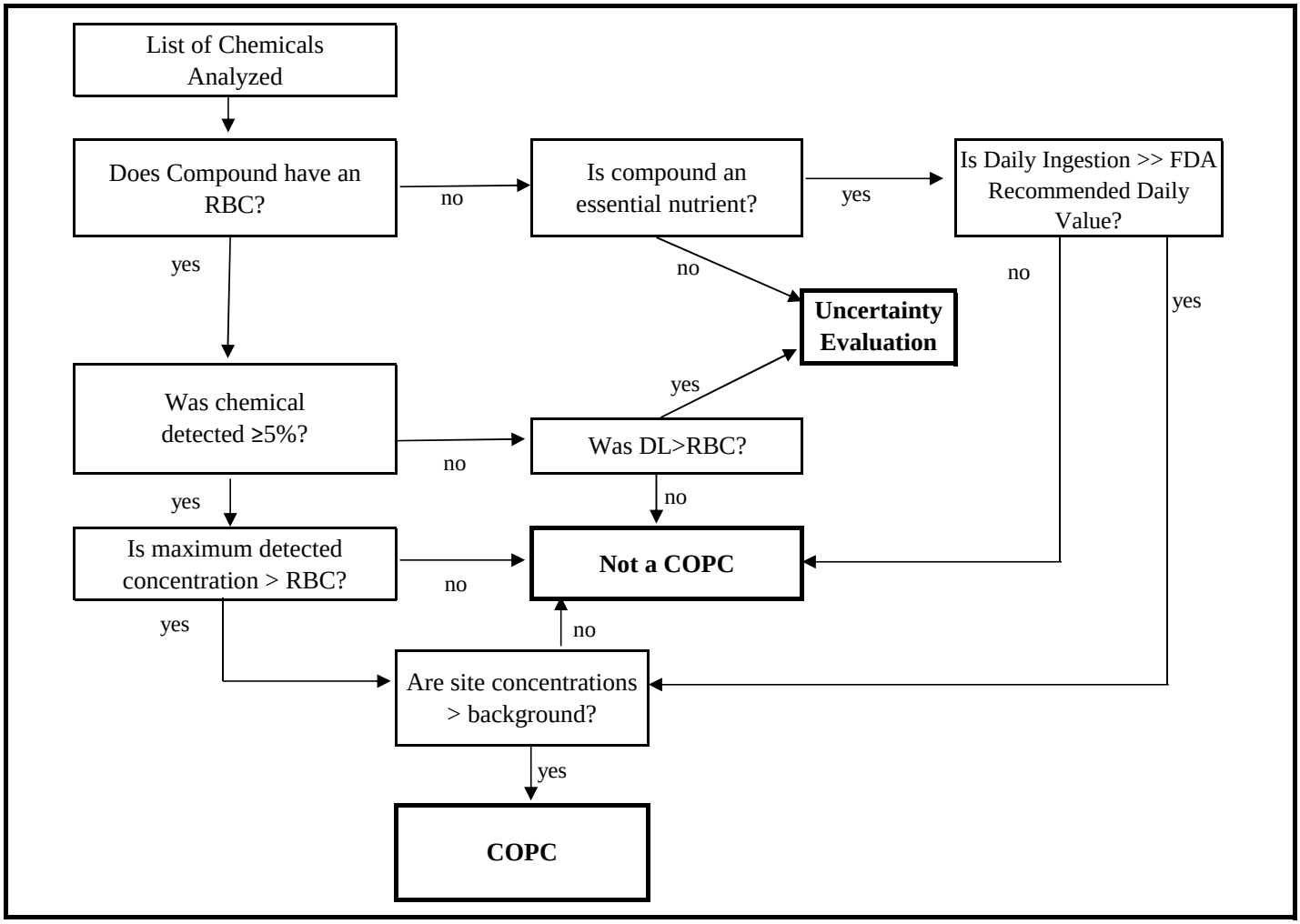
LEGEND

●	Pathway is complete and might be significant; quantitative evaluation.
❍	Pathway is complete, but is relatively minor; semi-quantitative evaluation.
	Pathway is not complete; no evaluation required.

Notes:

[1] Future land use is expected to be consistent with current and past use, although OU1 is currently not zoned for a specific land use.

Figure 3-2. COPC Selection Procedure for Human Health



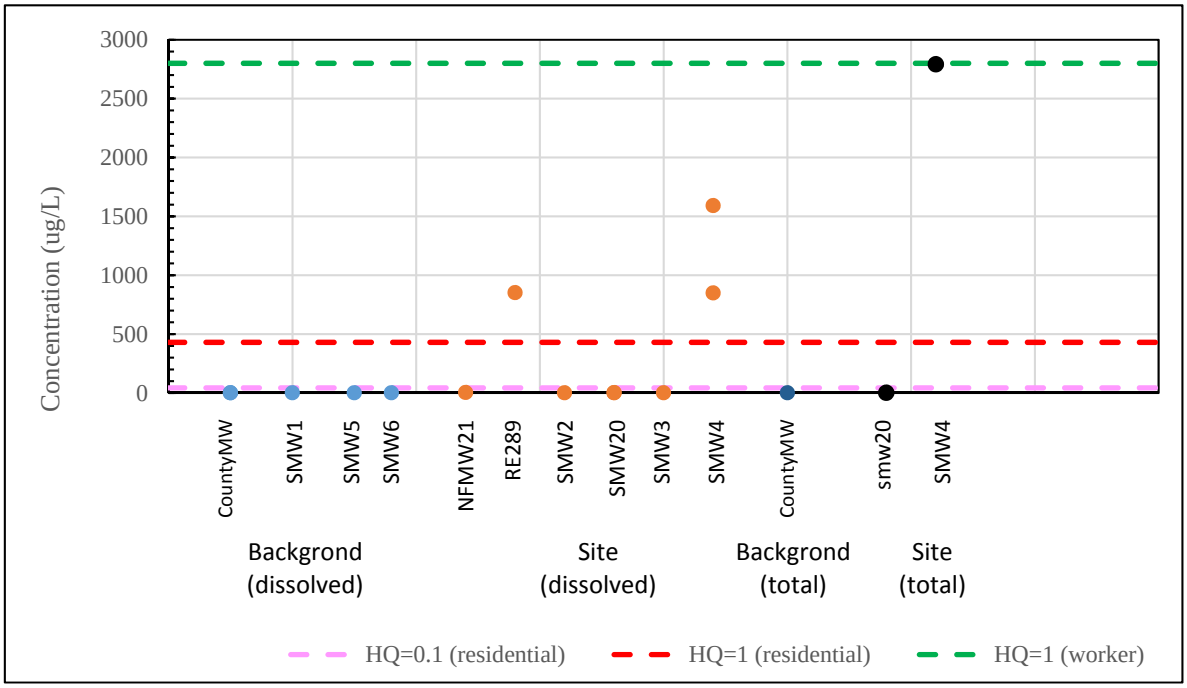
Notes:

RBC = Risk-based concentration (HQ = 0.1, Cancer risk = 1E-06)

COPC = chemical of potential concern

DL = detection limit

Figure 6-1. Manganese in OU1 Groundwater



TABLES

Table 2-1. Data Summary for OU1

Media	Sample Date	Sample Description	Analysis
Soil	April 2014	Surface (0-2.4 inches) soil samples were collected from 18 locations (n=18).	TAL metals, dioxins and furans.
	November 2015	Surface soil samples were collected from 0-2 inch and 5-7 inch depth intervals at 39 locations (n=78).	TAL metals, PAHs, dioxins and furans.
Groundwater	April 2014	Four wells sampled (n=4).	Aroclors, total and dissolved TAL metals, dioxins and furans.
	November 2015	Six wells sampled (n=6). These included the same four wells sampled in 2014.	Total and dissolved TAL metals, dioxins and furans.
Sediment	November 2015	Sediment samples were collected from 0-0.34 feet at three locations in Lavalle Creek and two locations on O'Keefe Creek.	Aroclors, TAL metals, dioxins and furans.
Surface water	November 2015	Two surface water samples were collected; one from Lavalle Creek and one from O'Keefe Creek.	Aroclors, total and dissolved TAL metals, SVOCs, dioxins and furans.

Table 2-2. OU1 Surface Soil Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (mg/kg)	Standard Deviation[a] (mg/kg)	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	96	96	100	1.7E-07	2.3E-07	1.2E-06	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	96	96	100	2.0E-07	2.3E-07	1.2E-06	--
	Toxicity Equivalence Dioxins (ND=MDL)	96	96	100	2.4E-07	2.2E-07	1.3E-06	--
Metals	Aluminum	96	96	100	1.3E+04	6.4E+03	3.1E+04	5.7E+00
	Antimony	18	14	78	1.3E-01	5.8E-02	2.4E-01	9.3E-02
	Arsenic	96	96	100	4.2E+00	1.5E+00	7.9E+00	1.3E-01
	Barium	96	96	100	2.0E+02	8.6E+01	4.3E+02	8.7E-02
	Beryllium	18	18	100	7.4E-01	3.5E-01	1.2E+00	8.4E-02
	Cadmium	96	91	95	1.5E-01	6.0E-02	2.8E-01	3.1E-02
	Calcium	18	18	100	1.8E+04	5.0E+04	2.2E+05	4.2E+01
	Chromium	96	91	95	1.0E+01	4.2E+00	1.9E+01	2.1E-01
	Cobalt	96	96	100	5.5E+00	2.2E+00	1.0E+01	2.5E-01
	Copper	96	94	98	1.9E+01	7.3E+00	3.4E+01	3.7E-01
	Iron	96	96	100	1.3E+04	4.9E+03	2.2E+04	2.8E+01
	Lead	96	96	100	1.0E+01	3.4E+00	2.1E+01	5.6E-02
	Magnesium	18	18	100	1.3E+04	2.6E+04	1.2E+05	1.5E+01
	Manganese	96	96	100	3.3E+02	1.4E+02	7.3E+02	2.3E-01
	Mercury	96	21	22	9.3E-03	1.3E-02	8.0E-02	8.0E-03
	Nickel	96	92	96	9.3E+00	4.0E+00	1.6E+01	1.5E-01
	Potassium	18	18	100	3.0E+03	1.2E+03	4.9E+03	8.3E+01
	Selenium	18	16	89	8.9E-01	4.9E-01	1.8E+00	3.0E-01
	Silver	96	0	0	7.4E-02	3.7E-02	--	1.5E-01
	Sodium	18	18	100	9.4E+01	4.0E+01	1.7E+02	2.9E+01
	Thallium	96	86	90	1.4E-01	5.7E-02	2.6E-01	3.8E-02
	Vanadium	96	96	100	1.4E+01	4.1E+00	2.2E+01	2.6E-01
	Zinc	96	96	100	5.3E+01	1.8E+01	9.1E+01	1.3E+00
SVOCs	Acenaphthene	78	0	0	2.3E-04	1.6E-05	--	4.5E-04
	Acenaphthylene	78	0	0	2.1E-04	1.5E-05	--	4.3E-04
	Anthracene	78	0	0	1.9E-04	1.3E-05	--	3.9E-04
	Benzo(a)anthracene	78	0	0	1.2E-04	7.9E-06	--	2.3E-04
	Benzo(a)pyrene	78	0	0	1.2E-04	8.8E-06	--	2.5E-04
	Benzo(b)fluoranthene	78	1	1	3.8E-04	1.4E-03	1.3E-02	4.4E-04
	Benzo(g,h,i)perylene	78	0	0	2.2E-04	1.5E-05	--	4.5E-04
	Benzo(k)fluoranthene	78	0	0	2.5E-04	1.7E-05	--	5.1E-04
	Chrysene	78	0	0	1.6E-04	1.1E-05	--	3.1E-04
	Dibenzo(a,h)anthracene	78	0	0	2.7E-04	1.9E-05	--	5.4E-04
	Fluoranthene	78	1	1	5.1E-04	3.2E-03	2.9E-02	2.8E-04
	Fluorene	78	0	0	2.0E-04	1.3E-05	--	3.9E-04
	Indeno(1,2,3-cd)pyrene	78	0	0	2.4E-04	1.7E-05	--	4.9E-04
	Naphthalene	78	0	0	2.3E-04	1.6E-05	--	4.7E-04
	Phenanthrene	78	1	1	3.3E-04	1.5E-03	1.4E-02	3.1E-04
	Pyrene	78	1	1	4.5E-04	2.7E-03	2.4E-02	3.0E-04

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a] Non-detects evaluated at 1/2 the MDL.

[b] Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 2-3. OU1 Groundwater Summary Statistics [a]

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[b] (ug/L)	Standard Deviation[b] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
Aroclors	Aroclor-1016	2	0	0	2.0E-02	3.5E-04	--	4.0E-02
	Aroclor-1221	2	0	0	1.6E-02	3.5E-04	--	3.3E-02
	Aroclor-1232	2	0	0	2.4E-02	3.5E-04	--	4.9E-02
	Aroclor-1242	2	0	0	2.5E-02	3.5E-04	--	5.1E-02
	Aroclor-1248	2	0	0	1.6E-02	3.5E-04	--	3.2E-02
	Aroclor-1254	2	0	0	2.3E-02	3.5E-04	--	4.6E-02
	Aroclor-1260	2	0	0	1.4E-02	3.5E-04	--	2.8E-02
	Aroclor-1262	2	0	0	1.4E-02	3.5E-04	--	2.9E-02
	Aroclor-1268	2	0	0	1.6E-02	0.0E+00	--	3.2E-02
TEQ[c]	Toxicity Equivalence Dioxins (ND=0)	8	2	25	3.3E-08	7.9E-08	2.3E-07	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	8	2	25	3.9E-07	6.5E-08	5.4E-07	--
	Toxicity Equivalence Dioxins (ND=MDL)	8	2	25	7.4E-07	5.5E-08	8.5E-07	--
Total Metals	Aluminum	2	1	50	3.6E+00	4.2E+00	6.5E+00	1.2E+00
	Antimony	2	1	50	2.4E-01	1.7E-01	3.6E-01	2.5E-01
	Arsenic	2	2	100	3.1E+00	2.4E+00	4.8E+00	2.5E-01
	Barium	2	2	100	2.3E+02	3.3E+01	2.6E+02	1.4E-01
	Beryllium	2	0	0	3.3E-02	0.0E+00	--	6.6E-02
	Cadmium	2	1	50	4.3E-02	3.8E-02	7.0E-02	3.3E-02
	Calcium	2	2	100	5.2E+04	1.1E+04	6.0E+04	2.5E+02
	Chromium	2	1	50	2.2E-01	1.6E-01	3.3E-01	2.2E-01
	Cobalt	2	1	50	8.6E-01	1.0E+00	1.6E+00	2.5E-01
	Copper	2	2	100	5.5E+00	5.8E+00	9.6E+00	2.2E-01
	Iron	2	0	0	4.0E+00	0.0E+00	--	8.0E+00
	Lead	2	0	0	2.3E-02	0.0E+00	--	4.6E-02
	Magnesium	2	2	100	1.9E+04	3.8E+03	2.1E+04	2.5E+02
	Manganese	2	2	100	1.4E+03	2.0E+03	2.8E+03	3.5E+00
	Mercury	2	0	0	1.3E-02	0.0E+00	0.0E+00	2.6E-02
	Nickel	2	2	100	2.1E+00	2.5E+00	3.8E+00	2.3E-01
	Potassium	2	2	100	3.6E+03	5.1E+02	3.9E+03	1.3E+03
	Selenium	2	0	0	1.3E-01	0.0E+00	--	2.5E-01
	Silver	2	0	0	2.8E-02	0.0E+00	--	5.6E-02
	Sodium	2	2	100	1.7E+04	1.2E+04	2.5E+04	5.0E+02
	Thallium	2	0	0	1.3E-02	0.0E+00	--	2.5E-02
	Vanadium	2	2	100	1.7E+00	1.3E+00	2.6E+00	2.1E-01
	Zinc	2	2	100	3.5E+00	4.9E-01	3.8E+00	2.5E+00
Dissolved Metals	Aluminum	8	2	25	3.0E+00	4.2E+00	1.3E+01	2.6E+00
	Antimony	2	0	0	1.3E-01	0.0E+00	--	2.5E-01
	Arsenic	8	8	100	2.3E+00	1.6E+00	5.0E+00	1.5E-01
	Barium	8	8	100	1.9E+02	6.8E+01	2.9E+02	9.6E-02
	Beryllium	2	0	0	3.3E-02	0.0E+00	--	6.6E-02
	Cadmium	8	1	13	1.6E-02	1.1E-02	4.3E-02	2.6E-02
	Calcium	8	8	100	4.9E+04	6.9E+03	6.2E+04	1.1E+02
	Chromium	8	7	88	1.9E+00	3.2E+00	9.7E+00	1.8E-01
	Cobalt	8	3	38	4.3E-01	5.6E-01	1.6E+00	1.6E-01
	Copper	8	5	63	1.6E+00	2.2E+00	6.7E+00	2.1E-01
	Iron	8	2	25	1.3E+01	1.6E+01	5.2E+01	1.2E+01
	Lead	8	0	0	2.3E-02	3.5E-10	0.0E+00	4.6E-02
	Magnesium	8	8	100	1.7E+04	2.4E+03	2.0E+04	7.8E+01
	Manganese	8	6	75	4.1E+02	6.1E+02	1.6E+03	7.6E-01
	Mercury	8	0	0	1.2E-02	9.3E-04	--	2.3E-02
	Nickel	8	5	63	1.3E+00	1.7E+00	4.8E+00	1.8E-01
	Potassium	8	7	88	2.8E+03	1.2E+03	3.9E+03	4.1E+02
	Selenium	2	0	0	1.3E-01	0.0E+00	--	2.5E-01
	Silver	8	0	0	6.3E-02	2.2E-02	--	1.3E-01
	Sodium	8	8	100	1.2E+04	5.5E+03	2.4E+04	1.5E+02
	Thallium	8	0	0	8.8E-03	2.3E-03	--	1.8E-02
	Vanadium	8	6	75	1.0E+00	6.3E-01	1.7E+00	2.6E-01
	Zinc	8	3	38	2.6E+00	2.0E+00	5.6E+00	2.4E+00

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a]Groundwater data based on samples collected from NFMW21, RE289, SMW2, SMW20, SMW3, SMW4.

[b]Non-detects evaluated at 1/2 the MDL.

[c]Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 2-4. OU1 Sediment Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (mg/kg)	Standard Deviation[a] (mg/kg)	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
Aroclors	Aroclor-1016	5	0	0	6.8E-03	3.0E-03	--	1.4E-02
	Aroclor-1221	5	0	0	1.6E-02	7.1E-03	--	3.2E-02
	Aroclor-1232	5	0	0	7.0E-03	3.2E-03	--	1.4E-02
	Aroclor-1242	5	0	0	1.8E-02	8.1E-03	--	3.6E-02
	Aroclor-1248	5	0	0	1.2E-02	5.2E-03	--	2.3E-02
	Aroclor-1254	5	0	0	4.4E-03	2.0E-03	--	8.8E-03
	Aroclor-1260	5	0	0	4.5E-03	2.0E-03	--	9.0E-03
	Aroclor-1262	5	0	0	5.9E-03	2.7E-03	--	1.2E-02
	Aroclor-1268	5	0	0	4.1E-03	1.8E-03	--	8.2E-03
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	5	5	100	9.8E-07	1.2E-06	3.1E-06	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	5	5	100	1.0E-06	1.2E-06	3.1E-06	--
	Toxicity Equivalence Dioxins (ND=MDL)	5	5	100	1.0E-06	1.2E-06	3.1E-06	--
Metals	Aluminum	5	5	100	9.8E+03	3.2E+03	1.4E+04	7.8E+00
	Arsenic	5	5	100	7.4E+00	5.0E+00	1.3E+01	2.3E-01
	Barium	5	5	100	2.1E+02	7.9E+01	3.2E+02	1.5E-01
	Cadmium	5	2	40	2.0E-01	2.9E-01	6.8E-01	5.2E-02
	Chromium	5	5	100	1.1E+01	2.5E+00	1.4E+01	3.6E-01
	Cobalt	5	5	100	7.2E+00	3.8E+00	1.3E+01	4.6E-01
	Copper	5	5	100	4.6E+01	4.2E+01	1.2E+02	6.2E-01
	Iron	5	5	100	1.4E+04	6.4E+03	2.5E+04	4.7E+01
	Lead	5	5	100	1.7E+01	6.4E+00	2.3E+01	8.1E-02
	Manganese	5	5	100	2.6E+02	1.7E+02	4.8E+02	2.6E-01
	Mercury	5	1	20	3.6E-02	6.4E-02	1.5E-01	1.5E-02
	Nickel	5	5	100	1.0E+01	3.1E+00	1.5E+01	2.9E-01
	Silver	5	0	0	1.1E-01	4.7E-02	--	2.2E-01
	Thallium	5	0	0	4.1E-02	1.7E-02	--	8.1E-02
	Vanadium	5	5	100	1.6E+01	3.5E+00	2.1E+01	5.2E-01
	Zinc	5	5	100	9.7E+01	8.7E+01	2.5E+02	2.5E+00
SVOCs	1,2,4-Trichlorobenzene-SVOC	5	0	0	6.4E-02	2.9E-02	--	1.3E-01
	1,2-Dichlorobenzene-SVOC	5	0	0	2.5E-02	1.1E-02	--	5.0E-02
	1,2-Diphenylhydrazine	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	1,3-Dichlorobenzene-SVOC	5	0	0	2.4E-02	1.1E-02	--	4.9E-02
	1,4-Dichlorobenzene-SVOC	5	0	0	2.6E-02	1.2E-02	--	5.1E-02
	1-Methylnaphthalene	5	0	0	6.7E-02	3.0E-02	--	1.3E-01
	2,4,5-Trichlorophenol	5	0	0	4.6E-02	2.1E-02	--	9.2E-02
	2,4,6-Trichlorophenol	5	0	0	5.0E-02	2.3E-02	--	9.9E-02
	2,4-Dichlorophenol	5	0	0	7.3E-02	3.3E-02	--	1.5E-01
	2,4-Dimethylphenol	5	0	0	7.2E-02	3.3E-02	--	1.4E-01
	2,4-Dinitrophenol	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	2,4-Dinitrotoluene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	2,6-Dinitrotoluene	5	0	0	3.3E-02	1.5E-02	--	6.6E-02
	2-Chloronaphthalene	5	0	0	6.0E-02	2.7E-02	--	1.2E-01
	2-Chlorophenol	5	0	0	9.0E-02	4.1E-02	--	1.8E-01
	2-Methylnaphthalene	5	0	0	6.9E-02	3.1E-02	--	1.4E-01
	2-Nitroaniline	5	0	0	4.2E-02	1.9E-02	--	8.4E-02
	2-Nitrophenol	5	0	0	6.6E-02	3.0E-02	--	1.3E-01
	3,3`-Dichlorobenzidine	5	0	0	5.4E-02	2.4E-02	--	1.1E-01
	3-Nitroaniline	5	0	0	3.9E-02	1.8E-02	--	7.9E-02
	4,6-Dinitro-o-cresol	5	0	0	7.7E-02	3.5E-02	--	1.5E-01
	4-Bromophenyl phenyl ether	5	0	0	4.1E-02	1.9E-02	--	8.2E-02
	4-Chloro-3-methylphenol	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	4-Chlorophenyl phenyl ether	5	0	0	4.4E-02	2.0E-02	--	8.9E-02
	4-Nitroaniline	5	0	0	3.4E-02	1.5E-02	--	6.8E-02
	4-Nitrophenol	5	0	0	4.1E-02	1.8E-02	--	8.1E-02
	Acenaphthene	5	0	0	4.5E-02	2.0E-02	--	8.9E-02
	Acenaphthylene	5	0	0	5.1E-02	2.3E-02	--	1.0E-01
	Anthracene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Benzo(a)anthracene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Benzo(a)pyrene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Benzo(b)fluoranthene	5	0	0	4.9E-02	2.2E-02	--	9.8E-02
	Benzo(g,h,i)perylene	5	0	0	4.7E-02	2.1E-02	--	9.4E-02
	Benzo(k)fluoranthene	5	0	0	4.9E-02	2.2E-02	--	9.9E-02
	bis(2-chloroethoxy)methane	5	0	0	7.5E-02	3.4E-02	--	1.5E-01
	bis(2-chloroethyl)ether	5	0	0	2.7E-02	1.2E-02	--	5.4E-02

Table 2-4. OU1 Sediment Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (mg/kg)	Standard Deviation[a] (mg/kg)	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
SVOCs	Bis(2-chloroisopropyl)ether	5	0	0	8.9E-02	4.0E-02	--	1.8E-01
	Bis(2-ethylhexyl)phthalate	5	0	0	6.6E-02	3.0E-02	--	1.3E-01
	Butyl benzyl phthalate	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Carbazole	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Chrysene	5	0	0	5.2E-02	2.3E-02	--	1.0E-01
	Dibenzo(a,h)anthracene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Dibenzofuran	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Dibutyl phthalate	5	0	0	5.4E-02	2.4E-02	--	1.1E-01
	Diethyl phthalate	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Dimethyl phthalate	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Di-n-octyl phthalate	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Fluoranthene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Fluorene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Hexachlorobenzene	5	0	0	5.1E-02	2.3E-02	--	1.0E-01
	Hexachlorobutadiene-SVOC	5	0	0	3.2E-02	1.5E-02	--	6.5E-02
	Hexachloroethane	5	0	0	2.5E-02	1.1E-02	--	4.9E-02
	Indeno(1,2,3-cd)pyrene	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Isophorone	5	0	0	6.2E-02	2.8E-02	--	1.2E-01
	m & p-cresols	5	0	0	7.7E-02	3.5E-02	--	1.5E-01
	Naphthalene-SVOC	5	0	0	7.2E-02	3.3E-02	--	1.4E-01
	Nitrobenzene	5	0	0	7.8E-02	3.5E-02	--	1.6E-01
	N-Nitrosodimethylamine	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	N-Nitrosodi-n-propylamine	5	0	0	5.3E-02	2.4E-02	--	1.1E-01
	N-Nitrosodiphenylamine	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	o-Cresol	5	0	0	8.4E-02	3.8E-02	--	1.7E-01
	p-Chloroaniline	5	0	0	5.9E-02	2.7E-02	--	1.2E-01
	Pentachlorophenol	5	0	0	1.9E-01	8.7E-02	--	3.9E-01
	Phenanthrene	5	0	0	5.5E-02	2.5E-02	--	1.1E-01
	Phenol	5	0	0	8.4E-02	3.8E-02	--	1.7E-01
	Pyrene	5	0	0	4.9E-02	2.2E-02	--	9.7E-02

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a]Non-detects evaluated at 1/2 the MDL

[b]Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 2-5. OU1 Surface Water Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
Aroclors	Aroclor-1016	2	0	0	2.3E-02	3.5E-04	--	4.6E-02
	Aroclor-1221	2	0	0	9.8E-03	3.5E-04	--	2.0E-02
	Aroclor-1232	2	0	0	1.8E-02	3.5E-04	--	3.7E-02
	Aroclor-1242	2	0	0	1.4E-02	0.0E+00	--	2.8E-02
	Aroclor-1248	2	0	0	6.3E-03	3.5E-04	--	1.3E-02
	Aroclor-1254	2	0	0	7.8E-03	3.5E-04	--	1.6E-02
	Aroclor-1260	2	0	0	7.3E-03	3.5E-04	--	1.5E-02
	Aroclor-1262	2	0	0	2.1E-02	3.5E-04	--	4.2E-02
	Aroclor-1268	2	0	0	1.1E-02	3.5E-04	--	2.3E-02
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	2	2	100	6.6E-08	3.7E-08	9.2E-08	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	2	2	100	3.9E-07	3.7E-08	4.2E-07	--
	Toxicity Equivalence Dioxins (ND=MDL)	2	2	100	7.1E-07	3.6E-08	7.4E-07	--
Total Metals	Aluminum	2	2	100	8.0E+02	7.4E+02	1.3E+03	3.0E+00
	Arsenic	2	2	100	1.7E+00	7.1E-02	1.7E+00	1.1E-01
	Barium	2	2	100	2.6E+02	8.5E+00	2.6E+02	8.1E-02
	Cadmium	2	0	0	1.2E-02	0.0E+00	--	2.4E-02
	Chromium	2	1	50	6.4E-01	7.9E-01	1.2E+00	1.7E-01
	Cobalt	2	1	50	2.3E-01	2.4E-01	4.0E-01	1.3E-01
	Copper	2	2	100	1.5E+00	8.3E-01	2.1E+00	2.1E-01
	Iron	2	2	100	6.4E+02	5.3E+02	1.0E+03	1.4E+01
	Lead	2	2	100	5.0E-01	2.2E-01	6.5E-01	4.6E-02
	Manganese	2	2	100	1.4E+01	8.9E+00	2.0E+01	2.4E-01
	Mercury	2	2	100	3.0E-02	0.0E+00	3.0E-02	2.2E-02
	Nickel	2	2	100	6.6E-01	4.8E-01	1.0E+00	1.6E-01
	Silver	2	0	0	7.5E-02	0.0E+00	--	1.5E-01
	Thallium	2	0	0	7.5E-03	0.0E+00	--	1.5E-02
	Vanadium	2	2	100	1.4E+00	2.1E-01	1.5E+00	2.8E-01
	Zinc	2	1	50	3.1E+00	2.7E+00	5.0E+00	2.4E+00
Dissolved Metals	Aluminum	2	1	50	2.2E+01	2.9E+01	4.2E+01	3.0E+00
	Arsenic	2	2	100	1.4E+00	7.1E-02	1.4E+00	1.1E-01
	Barium	2	2	100	2.3E+02	1.8E+01	2.4E+02	8.1E-02
	Cadmium	2	0	0	1.2E-02	0.0E+00	--	2.4E-02
	Calcium	2	2	100	4.1E+04	1.7E+04	5.2E+04	6.7E+01
	Chromium	2	0	0	8.5E-02	0.0E+00	--	1.7E-01
	Cobalt	2	2	100	9.5E-01	4.2E-02	9.8E-01	1.3E-01
	Copper	2	2	100	5.4E-01	3.6E-01	7.9E-01	2.1E-01
	Iron	2	1	50	2.2E+01	2.2E+01	3.7E+01	1.4E+01
	Lead	2	1	50	4.0E-02	2.4E-02	5.7E-02	4.6E-02
	Magnesium	2	2	100	1.8E+04	6.2E+03	2.2E+04	2.0E+01
	Manganese	2	2	100	8.4E+00	3.1E+00	1.1E+01	2.4E-01
	Nickel	2	2	100	3.8E-01	1.6E-01	4.9E-01	1.6E-01
	Potassium	2	2	100	1.9E+03	2.8E+02	2.1E+03	1.3E+02
	Silver	2	0	0	7.5E-02	0.0E+00	--	1.5E-01
	Sodium	2	2	100	1.6E+04	1.0E+04	2.3E+04	3.3E+01
	Thallium	2	1	50	1.6E-02	1.2E-02	2.5E-02	1.5E-02
	Vanadium	2	2	100	6.5E-01	4.1E-01	9.4E-01	2.8E-01
	Zinc	2	0	0	1.2E+00	0.0E+00	--	2.4E+00
SVOCs	1,2,4-Trichlorobenzene	2	0	0	9.5E-01	0.0E+00	--	1.9E+00
	1,2-Dichlorobenzene	2	0	0	9.5E-01	0.0E+00	--	1.9E+00
	1,2-Diphenylhydrazine	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	1,3-Dichlorobenzene	2	0	0	8.3E-01	3.5E-02	--	1.7E+00
	1,4-Dichlorobenzene	2	0	0	9.5E-01	0.0E+00	--	1.9E+00
	1-Methylnaphthalene	2	0	0	1.1E+00	0.0E+00	--	2.1E+00
	2,4,5-Trichlorophenol	2	0	0	1.1E+00	0.0E+00	--	2.2E+00
	2,4,6-Trichlorophenol	2	0	0	1.1E+00	0.0E+00	--	2.2E+00
	2,4-Dichlorophenol	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	2,4-Dimethylphenol	2	0	0	3.4E+00	3.5E-02	--	6.9E+00
	2,4-Dinitrophenol	2	0	0	1.4E+00	0.0E+00	--	2.8E+00
	2,4-Dinitrotoluene	2	0	0	1.1E+00	3.5E-02	--	2.2E+00
	2,6-Dinitrotoluene	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	2-Chloronaphthalene	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	2-Chlorophenol	2	0	0	1.1E+00	0.0E+00	--	2.2E+00
	2-Methylnaphthalene	2	0	0	1.1E+00	0.0E+00	--	2.1E+00
	2-Nitroaniline	2	0	0	1.4E+00	0.0E+00	--	2.8E+00

Table 2-5. OU1 Surface Water Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
SVOCs	2-Nitrophenol	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	3,3`-Dichlorobenzidine	2	0	0	2.5E+00	3.5E-02	--	5.0E+00
	3-Nitroaniline	2	0	0	2.5E+00	3.5E-02	--	5.1E+00
	4,6-Dinitro-o-cresol	2	0	0	1.8E+00	3.5E-02	--	3.6E+00
	4-Bromophenyl phenyl ether	2	0	0	1.2E+00	0.0E+00	--	2.4E+00
	4-Chloro-3-methylphenol	2	0	0	8.0E-01	0.0E+00	--	1.6E+00
	4-Chlorophenyl phenyl ether	2	0	0	7.0E-01	0.0E+00	--	1.4E+00
	4-Nitroaniline	2	0	0	2.2E+00	0.0E+00	--	4.4E+00
	4-Nitrophenol	2	0	0	1.7E+00	0.0E+00	--	3.4E+00
	Acenaphthene	2	0	0	8.3E-01	3.5E-02	--	1.7E+00
	Acenaphthylene	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	Anthracene	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	Benzo(a)anthracene	2	0	0	2.6E+00	0.0E+00	--	5.1E+00
	Benzo(a)pyrene	2	0	0	1.2E+00	0.0E+00	--	2.4E+00
	Benzo(b)fluoranthene	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	Benzo(g,h,i)perylene	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	Benzo(k)fluoranthene	2	0	0	1.4E+00	0.0E+00	--	2.8E+00
	bis(2-chloroethoxy)methane	2	0	0	7.8E-01	3.5E-02	--	1.6E+00
	bis(2-chloroethyl)ether	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	Bis(2-chloroisopropyl)ether	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	Bis(2-ethylhexyl)phthalate	2	0	0	1.2E+00	0.0E+00	--	2.4E+00
	Butyl benzyl phthalate	2	0	0	9.5E-01	0.0E+00	--	1.9E+00
	Carbazole	2	0	0	1.4E+00	0.0E+00	--	2.7E+00
	Chrysene	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	Dibenzo(a,h)anthracene	2	0	0	9.0E-01	0.0E+00	--	1.8E+00
	Dibenzofuran	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	Dibutyl phthalate	2	0	0	1.2E+00	3.5E-02	--	2.5E+00
	Diethyl phthalate	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	Dimethyl phthalate	2	0	0	1.2E+00	3.5E-02	--	2.4E+00
	Di-n-octyl phthalate	2	0	0	8.5E-01	0.0E+00	--	1.7E+00
	Fluoranthene	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	Fluorene	2	0	0	1.2E+00	0.0E+00	--	2.4E+00
	Hexachlorobenzene	2	0	0	1.3E+00	0.0E+00	--	2.6E+00
	Hexachlorobutadiene	2	0	0	8.5E-01	0.0E+00	--	1.7E+00
	Hexachloroethane	2	0	0	8.5E-01	0.0E+00	--	1.7E+00
	Indeno(1,2,3-cd)pyrene	2	0	0	9.0E-01	0.0E+00	--	1.8E+00
	Isophorone	2	0	0	8.0E-01	0.0E+00	--	1.6E+00
	m & p-cresols	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	Naphthalene	2	0	0	1.0E+00	0.0E+00	--	2.0E+00
	Nitrobenzene	2	0	0	1.3E+00	0.0E+00	--	2.5E+00
	N-Nitrosodimethylamine	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	N-Nitrosodi-n-propylamine	2	0	0	1.2E+00	0.0E+00	--	2.3E+00
	N-Nitrosodiphenylamine	2	0	0	2.0E+00	3.5E-02	--	4.0E+00
	o-Cresol	2	0	0	1.0E+00	0.0E+00	--	2.0E+00
	p-Chloroaniline	2	0	0	1.8E+00	3.5E-02	--	3.7E+00
	Pentachlorophenol	2	0	0	1.1E+00	0.0E+00	--	2.2E+00
	Phenanthrene	2	0	0	1.3E+00	3.5E-02	--	2.6E+00
	Phenol	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	Pyrene	2	0	0	1.3E+00	0.0E+00	--	2.5E+00

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a]Non-detects evaluated at 1/2 the MDL

[b]Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 3-1. Exposure Parameters Used in USEPA's RSL Tables for a Resident

Exposure Pathway	Exposure Input Parameter	Units	RME	
			Value	Source
General	Body Weight - adult	kg	80	[1]
	Body Weight - child	kg	15	[1]
	Exposure frequency	days/yr	350	[1]
	Exposure duration - adult	yr	20	[1]
	Exposure duration - child	yr	6	[1]
	Averaging Time, Cancer	days	25,550	[2]
	Averaging Time, Noncancer	days	7,300	[2]
Ingestion of Soil	Ingestion rate - adult	mg/day	100	[1]
	Ingestion rate - child	mg/day	200	[1]
Ingestion of Water	Ingestion rate - adult	mg/day	2.5	[1]
	Ingestion rate - child	mg/day	0.78	[1]
Inhalation of Particulates	Exposure time	hr/day	24	[1]
	Particulate Emission Factor (PEF)	m^3/kg	1.36E+09	[4]
Dermal Exposure to Soil	Exposed Surface Area - adult	cm^2/event	6,032	[1]
	Exposed Surface Area - child	cm^2/event	2,373	[1]
	Adherence Factor - adult	mg/cm^2	0.07	[1]
	Adherence Factor - child	mg/cm^2	0.2	[1]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[3]
	Event Frequency	events/day	1	[3]
Dermal Exposure to Water	Exposed Surface Area - adult	cm^2/event	20,900	[1]
	Exposed Surface Area - child	cm^2/event	6,378	[1]
	Permeability Coefficient (Kp)	cm/hr	CS	[3]
	Event Frequency	events/day	1	[3]

RME = Reasonable Maximum Exposure; CS = chemical-specific

Sources:

[1] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office

[3] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

[4] USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

Table 3-2. List of Background Samples

Source	Location ID	Media Type
Groundwater Background Locations		
USEPA	CountyMW	GW
	SMW1	GW
	SMW5	GW
	SMW6	GW
Surface Water Background Locations		
USEPA	SW4-CFR	SW
	SW5-CFR	SW
	SW6-CFR	SW
	SW7-CFR	SW
	SW8-BR	SW
USGS	12340500	SW
	12334550	SW
	12331800	SW
Sediment Background Locations		
USEPA	SE7-CFR-SA	SE
	SE8-CFR-SA	SE
	SE9-CFR-SA	SE
	SE10-CFR-SA	SE
	SE11-CFR-SA	SE
	SE12-CFR-SA	SE
	SE13-CFR-SA	SE
	SE14-CFR-SA	SE
	SE15-CFR-SA	SE
	SE16-BR-SA	SE
	SE22-CFR-SA	SE
USGS	12340500	SE
	12334550	SE
	12331800	SE

Table 3-3. Background Surface Soil Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (mg/kg)	Standard Deviation (mg/kg)	Maximum Detected Concentration (mg/kg)	Average DL (mg/kg)
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	64	62	97	1.8E-07	2.6E-07	1.6E-06	--
	Toxicity Equivalence Dioxins (ND=1/2DL)	64	62	97	7.2E-07	4.6E-07	1.9E-06	--
	Toxicity Equivalence Dioxins (ND=DL)	64	62	97	1.3E-06	8.7E-07	2.9E-06	--
Metals[c]	Aluminum	112	112	100	1.6E+04	5.8E+03	3.4E+04	--
	Antimony	112	89	79	2.0E-01	1.9E-01	1.2E+00	1.0E-01
	Arsenic	112	112	100	1.1E+01	1.2E+01	8.2E+01	--
	Barium	112	112	100	2.0E+02	1.1E+02	5.8E+02	--
	Beryllium	112	112	100	6.8E-01	2.5E-01	1.4E+00	--
	Cadmium	112	97	87	2.9E-01	2.0E-01	1.1E+00	1.0E-01
	Chromium	112	112	100	2.0E+01	1.2E+01	1.3E+02	--
	Chromium (III)	112	111	99	1.9E+01	1.2E+01	1.3E+02	5.0E+00
	Chromium (VI)	112	14	13	2.1E-01	1.9E-01	1.2E+00	2.9E-01
	Cobalt	112	112	100	7.3E+00	2.8E+00	1.6E+01	--
	Copper	112	112	100	1.8E+01	1.0E+01	7.1E+01	--
	Iron	112	112	100	1.8E+04	6.8E+03	5.9E+04	--
	Lead	112	112	100	1.5E+01	6.4E+00	3.7E+01	--
	Manganese	112	112	100	5.1E+02	3.7E+02	2.9E+03	--
	Mercury	112	1	1	2.5E-02	4.1E-03	6.8E-02	5.0E-02
	Nickel	112	112	100	1.7E+01	9.5E+00	8.2E+01	--
	Selenium	112	88	79	3.8E-01	2.4E-01	1.6E+00	2.0E-01
	Silver	112	30	27	1.1E-01	8.1E-02	5.0E-01	1.7E-01
	Thallium	112	112	100	2.5E-01	1.1E-01	8.4E-01	--
	Vanadium	112	112	100	3.1E+01	1.3E+01	9.2E+01	--
	Zinc	112	112	100	6.1E+01	2.3E+01	1.5E+02	--

DL = detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a] Non-detects evaluated at 1/2 the DL.

[b] TEQ values were calculated from data used in the Montana Dioxin Background Investigation Report (MDEQ, 2011) using the 2005 World Health Organization (WHO) toxic equivalency factors (TEFs).

[c] Metals data presented in this table are from Project Report: Background Concentrations of Inorganic Constituents in Montana Surface Soils (MDEQ, 2013).

Table 3-4. Background Groundwater Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
Aroclors	Aroclor-1016	2	0	0	2.1E-02	2.5E-03	--	4.3E-02
	Aroclor-1221	2	0	0	1.3E-02	4.2E-03	--	2.6E-02
	Aroclor-1232	2	0	0	2.1E-02	3.9E-03	--	4.3E-02
	Aroclor-1242	2	0	0	2.0E-02	7.8E-03	--	3.9E-02
	Aroclor-1248	2	0	0	1.1E-02	6.4E-03	--	2.2E-02
	Aroclor-1254	2	0	0	1.5E-02	1.0E-02	--	3.1E-02
	Aroclor-1260	2	0	0	1.1E-02	4.2E-03	--	2.1E-02
	Aroclor-1262	2	0	0	1.8E-02	4.9E-03	--	3.5E-02
	Aroclor-1268	2	0	0	1.4E-02	3.2E-03	--	2.8E-02
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	5	1	20	3.7E-08	8.2E-08	1.8E-07	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	5	1	20	3.9E-07	6.0E-08	5.0E-07	--
	Toxicity Equivalence Dioxins (ND=MDL)	5	1	20	7.4E-07	3.7E-08	8.1E-07	--
Total Metals	Aluminum	1	0	0	6.0E-01	--	--	1.2E+00
	Antimony	1	0	0	1.3E-01	--	--	2.5E-01
	Arsenic	1	1	100	1.6E+00	--	1.6E+00	2.5E-01
	Barium	1	1	100	3.6E+02	--	3.6E+02	1.4E-01
	Beryllium	1	0	0	3.3E-02	--	--	6.6E-02
	Cadmium	1	0	0	1.7E-02	--	--	3.3E-02
	Calcium	1	1	100	6.0E+04	--	6.0E+04	2.5E+02
	Chromium	1	0	0	1.1E-01	--	--	2.2E-01
	Cobalt	1	0	0	1.3E-01	--	--	2.5E-01
	Copper	1	1	100	2.4E+00	--	2.4E+00	2.2E-01
	Iron	1	0	0	4.0E+00	--	--	8.0E+00
	Lead	1	0	0	2.3E-02	--	--	4.6E-02
	Magnesium	1	1	100	2.4E+04	--	2.4E+04	2.5E+02
	Manganese	1	0	0	7.0E-02	--	--	1.4E-01
	Mercury	1	0	0	1.3E-02	--	--	2.6E-02
	Nickel	1	1	100	8.0E-01	--	8.0E-01	2.3E-01
	Potassium	1	1	100	3.2E+03	--	3.2E+03	1.3E+03
	Selenium	1	0	0	1.3E-01	--	--	2.5E-01
	Silver	1	0	0	2.8E-02	--	--	5.6E-02
	Sodium	1	1	100	2.3E+04	--	2.3E+04	5.0E+02
	Thallium	1	0	0	1.3E-02	--	--	2.5E-02
	Vanadium	1	1	100	1.4E+00	--	1.4E+00	2.1E-01
	Zinc	1	0	0	1.3E+00	--	--	2.5E+00
Dissolved Metals	Aluminum	5	0	0	1.3E+00	4.0E-01	--	2.6E+00
	Antimony	1	0	0	1.3E-01	--	--	2.5E-01
	Arsenic	5	5	100	2.7E+00	1.7E+00	5.2E+00	1.4E-01
	Barium	5	5	100	2.1E+02	9.9E+01	3.7E+02	9.3E-02
	Beryllium	1	0	0	3.3E-02	--	--	6.6E-02
	Cadmium	5	0	0	1.3E-02	2.0E-03	--	2.6E-02
	Calcium	5	5	100	5.2E+04	9.3E+03	6.2E+04	1.0E+02
	Chromium	5	3	60	6.4E-01	5.1E-01	1.1E+00	1.8E-01
	Cobalt	5	0	0	7.7E-02	2.7E-02	--	1.5E-01
	Copper	5	4	80	1.8E+00	1.3E+00	3.4E+00	2.1E-01
	Iron	5	0	0	6.3E+00	1.3E+00	--	1.3E+01
	Lead	5	2	40	8.2E-02	8.1E-02	1.8E-01	4.6E-02
	Magnesium	5	5	100	1.9E+04	3.7E+03	2.3E+04	6.6E+01
	Manganese	5	1	20	3.1E-01	4.4E-01	1.1E+00	2.2E-01
	Mercury	5	0	0	1.1E-02	8.9E-04	--	2.3E-02
	Nickel	5	1	20	2.5E-01	3.8E-01	9.4E-01	1.7E-01
	Potassium	5	5	100	3.4E+03	4.6E+02	4.1E+03	3.5E+02
	Selenium	1	0	0	1.3E-01	--	--	2.5E-01
	Silver	5	0	0	6.6E-02	2.1E-02	--	1.3E-01
	Sodium	5	5	100	1.7E+04	6.8E+03	2.6E+04	1.3E+02
	Thallium	5	0	0	8.5E-03	2.2E-03	--	1.7E-02
	Vanadium	5	4	80	1.2E+00	6.5E-01	1.8E+00	2.7E-01
	Zinc	5	2	40	2.9E+00	2.4E+00	5.6E+00	2.4E+00

Table 3-4. Background Groundwater Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
SVOCs	1,2,4-Trichlorobenzene	1	0	0	1.0E+00	--	--	2.0E+00
	1,2-Dichlorobenzene	1	0	0	1.0E+00	--	--	2.0E+00
	1,2-Diphenylhydrazine	1	0	0	1.3E+00	--	--	2.6E+00
	1,3-Dichlorobenzene	1	0	0	8.5E-01	--	--	1.7E+00
	1,4-Dichlorobenzene	1	0	0	1.0E+00	--	--	2.0E+00
	1-Methylnaphthalene	1	0	0	1.1E+00	--	--	2.2E+00
	2,4,5-Trichlorophenol	1	0	0	1.2E+00	--	--	2.3E+00
	2,4,6-Trichlorophenol	1	0	0	1.2E+00	--	--	2.3E+00
	2,4-Dichlorophenol	1	0	0	1.2E+00	--	--	2.4E+00
	2,4-Dimethylphenol	1	0	0	3.6E+00	--	--	7.1E+00
	2,4-Dinitrophenol	1	0	0	1.5E+00	--	--	2.9E+00
	2,4-Dinitrotoluene	1	0	0	1.1E+00	--	--	2.2E+00
	2,6-Dinitrotoluene	1	0	0	1.2E+00	--	--	2.4E+00
	2-Chloronaphthalene	1	0	0	1.2E+00	--	--	2.3E+00
	2-Chlorophenol	1	0	0	1.2E+00	--	--	2.3E+00
	2-Methylnaphthalene	1	0	0	1.1E+00	--	--	2.2E+00
	2-Nitroaniline	1	0	0	1.5E+00	--	--	2.9E+00
	2-Nitrophenol	1	0	0	1.2E+00	--	--	2.3E+00
	3,3`-Dichlorobenzidine	1	0	0	2.6E+00	--	--	5.2E+00
	3-Nitroaniline	1	0	0	2.6E+00	--	--	5.2E+00
	4,6-Dinitro-o-cresol	1	0	0	1.9E+00	--	--	3.7E+00
	4-Bromophenyl phenyl ether	1	0	0	1.3E+00	--	--	2.5E+00
	4-Chloro-3-methylphenol	1	0	0	8.0E-01	--	--	1.6E+00
	4-Chlorophenyl phenyl ether	1	0	0	7.5E-01	--	--	1.5E+00
	4-Nitroaniline	1	0	0	2.3E+00	--	--	4.6E+00
	4-Nitrophenol	1	0	0	1.8E+00	--	--	3.5E+00
	Acenaphthene	1	0	0	8.5E-01	--	--	1.7E+00
	Acenaphthylene	1	0	0	1.2E+00	--	--	2.3E+00
	Anthracene	1	0	0	1.3E+00	--	--	2.6E+00
	Benzo(a)anthracene	1	0	0	2.7E+00	--	--	5.3E+00
	Benzo(a)pyrene	1	0	0	1.3E+00	--	--	2.5E+00
	Benzo(b)fluoranthene	1	0	0	1.3E+00	--	--	2.6E+00
	Benzo(g,h,i)perylene	1	0	0	1.3E+00	--	--	2.6E+00
	Benzo(k)fluoranthene	1	0	0	1.5E+00	--	--	2.9E+00
	bis(2-chloroethoxy)methane	1	0	0	8.0E-01	--	--	1.6E+00
	bis(2-chloroethyl)ether	1	0	0	1.2E+00	--	--	2.4E+00
	Bis(2-chloroisopropyl)ether	1	0	0	1.2E+00	--	--	2.3E+00
	Bis(2-ethylhexyl)phthalate	1	0	0	1.3E+00	--	--	2.5E+00
	Butyl benzyl phthalate	1	0	0	1.0E+00	--	--	2.0E+00
	Carbazole	1	0	0	1.4E+00	--	--	2.8E+00
	Chrysene	1	0	0	1.2E+00	--	--	2.4E+00
	Dibenzo(a,h)anthracene	1	0	0	9.5E-01	--	--	1.9E+00
	Dibenzofuran	1	0	0	1.2E+00	--	--	2.4E+00
	Dibutyl phthalate	1	0	0	1.3E+00	--	--	2.5E+00
	Diethyl phthalate	1	0	0	1.3E+00	--	--	2.6E+00
	Dimethyl phthalate	1	0	0	1.2E+00	--	--	2.4E+00
	Di-n-octyl phthalate	1	0	0	9.0E-01	--	--	1.8E+00
	Fluoranthene	1	0	0	1.3E+00	--	--	2.6E+00
	Fluorene	1	0	0	1.3E+00	--	--	2.5E+00
	Hexachlorobenzene	1	0	0	1.4E+00	--	--	2.7E+00
	Hexachlorobutadiene	1	0	0	9.0E-01	--	--	1.8E+00
	Hexachloroethane	1	0	0	8.5E-01	--	--	1.7E+00
	Indeno(1,2,3-cd)pyrene	1	0	0	9.5E-01	--	--	1.9E+00
	Isophorone	1	0	0	8.0E-01	--	--	1.6E+00
	m & p-cresols	1	0	0	1.2E+00	--	--	2.4E+00
	Naphthalene	1	0	0	1.1E+00	--	--	2.1E+00
	Nitrobenzene	1	0	0	1.3E+00	--	--	2.6E+00
	N-Nitrosodimethylamine	1	0	0	1.2E+00	--	--	2.4E+00
	N-Nitrosodi-n-propylamine	1	0	0	1.2E+00	--	--	2.4E+00
	N-Nitrosodiphenylamine	1	0	0	2.1E+00	--	--	4.1E+00
	o-Cresol	1	0	0	1.1E+00	--	--	2.1E+00
	p-Chloroaniline	1	0	0	1.9E+00	--	--	3.8E+00
	Pentachlorophenol	1	0	0	1.2E+00	--	--	2.3E+00
	Phenanthrene	1	0	0	1.3E+00	--	--	2.6E+00
	Phenol	1	0	0	1.2E+00	--	--	2.3E+00
	Pyrene	1	0	0	1.3E+00	--	--	2.6E+00

Table 3-4. Background Groundwater Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
VOCs	1,1,1,2-Tetrachloroethane	1	0	0	1.0E-01	--	--	2.0E-01
	1,1,1-Trichloroethane	1	0	0	1.0E-01	--	--	2.0E-01
	1,1,2,2-Tetrachloroethane	1	0	0	1.1E-01	--	--	2.2E-01
	1,1,2-Trichloroethane	1	0	0	1.2E-01	--	--	2.4E-01
	1,1-Dichloroethane	1	0	0	1.1E-01	--	--	2.2E-01
	1,1-Dichloroethene	1	0	0	1.1E-01	--	--	2.2E-01
	1,1-Dichloropropene	1	0	0	8.0E-02	--	--	1.6E-01
	1,2,3-Trichlorobenzene	1	0	0	1.2E-01	--	--	2.3E-01
	1,2,3-Trichloropropane	1	0	0	2.5E-01	--	--	5.0E-01
	1,2,4-Trichlorobenzene	1	0	0	1.1E-01	--	--	2.2E-01
	1,2,4-Trimethylbenzene	1	0	0	8.0E-02	--	--	1.6E-01
	1,2-Dibromo-3-chloropropane	1	0	0	3.5E-01	--	--	7.0E-01
	1,2-Dibromoethane	1	0	0	1.2E-01	--	--	2.3E-01
	1,2-Dichlorobenzene	1	0	0	1.1E-01	--	--	2.2E-01
	1,2-Dichloroethane	1	0	0	8.5E-02	--	--	1.7E-01
	1,2-Dichloropropane	1	0	0	2.1E-01	--	--	4.2E-01
	1,3,5-Trimethylbenzene	1	0	0	1.0E-01	--	--	2.0E-01
	1,3-Dichlorobenzene	1	0	0	1.1E-01	--	--	2.1E-01
	1,3-Dichloropropane	1	0	0	1.2E-01	--	--	2.4E-01
	1,4-Dichlorobenzene	1	0	0	8.0E-02	--	--	1.6E-01
	2,2-Dichloropropane	1	0	0	1.8E-01	--	--	3.6E-01
	Acetone	1	0	0	3.6E+00	--	--	7.1E+00
	Allyl chloride	1	0	0	2.9E-01	--	--	5.8E-01
	Benzene	1	0	0	1.1E-01	--	--	2.1E-01
	Bromobenzene	1	0	0	1.3E-01	--	--	2.5E-01
	Bromochloromethane	1	0	0	1.7E-01	--	--	3.4E-01
	Bromoform	1	0	0	2.1E-01	--	--	4.1E-01
	Bromomethane	1	0	0	1.8E-01	--	--	3.6E-01
	Carbon tetrachloride	1	0	0	1.8E-01	--	--	3.5E-01
	Chlorobenzene	1	0	0	1.2E-01	--	--	2.3E-01
	Chloroethane	1	0	0	1.7E-01	--	--	3.4E-01
	Chloroform	1	0	0	1.4E-01	--	--	2.7E-01
	Chloromethane	1	0	0	3.2E-01	--	--	6.4E-01
	cis-1,2-Dichloroethylene	1	0	0	1.3E-01	--	--	2.5E-01
	cis-1,3-Dichloropropylene	1	0	0	1.1E-01	--	--	2.1E-01
	Cumene	1	0	0	8.5E-02	--	--	1.7E-01
	Dibromochloromethane	1	0	0	8.0E-02	--	--	1.6E-01
	Dichlorobromomethane	1	0	0	9.0E-02	--	--	1.8E-01
	Dichlorodifluoromethane	1	0	0	2.5E-01	--	--	4.9E-01
	Dichlorofluoromethane	1	0	0	1.1E-01	--	--	2.2E-01
	Ethyl ether	1	0	0	1.9E-01	--	--	3.8E-01
	Ethylbenzene	1	0	0	1.2E-01	--	--	2.3E-01
	Hexachlorobutadiene	1	0	0	2.4E-01	--	--	4.8E-01
	m & p-Xylenes	1	0	0	2.1E-01	--	--	4.1E-01
	Methyl ethyl ketone	1	0	0	1.3E+00	--	--	2.5E+00
	Methyl isobutyl ketone	1	0	0	1.2E+00	--	--	2.4E+00
	Methylene bromide	1	0	0	1.6E-01	--	--	3.1E-01
	Methylene chloride	1	0	0	2.8E-01	--	--	5.6E-01
	MTBE (Methyl tert-butyl ether)	1	0	0	1.0E-01	--	--	2.0E-01
	Naphthalene	1	0	0	7.0E-02	--	--	1.4E-01
	n-Butyl benzene	1	0	0	4.2E-02	--	--	8.3E-02
	n-Propyl benzene	1	0	0	1.1E-01	--	--	2.1E-01
	o-Chlorotoluene	1	0	0	1.1E-01	--	--	2.2E-01
	o-Xylene	1	0	0	9.5E-02	--	--	1.9E-01
	p-Chlorotoluene	1	0	0	1.2E-01	--	--	2.4E-01
	p-Isopropyltoluene	1	0	0	8.0E-02	--	--	1.6E-01
	sec-Butyl benzene	1	0	0	8.0E-02	--	--	1.6E-01
	Styrene	1	0	0	5.5E-02	--	--	1.1E-01
	tert-Butyl benzene	1	0	0	9.0E-02	--	--	1.8E-01
	Tetrachloroethylene	1	0	0	9.5E-02	--	--	1.9E-01
	Tetrahydrofuran	1	0	0	2.0E+00	--	--	4.0E+00
	Toluene	1	0	0	6.5E-02	--	--	1.3E-01
	trans-1,2-Dichloroethylene	1	0	0	1.1E-01	--	--	2.1E-01
	trans-1,3-Dichloropropylene	1	0	0	1.1E-01	--	--	2.2E-01
	Trichloroethylene	1	0	0	7.0E-02	--	--	1.4E-01
	Trichlorofluoromethane	1	0	0	9.0E-02	--	--	1.8E-01

Table 3-4. Background Groundwater Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
VOCs	Trichlorotrifluoroethane	1	0	0	2.1E-01	--	--	4.2E-01
	Vinyl chloride	1	0	0	4.1E-02	--	--	8.1E-02
	Xylenes (total)	1	0	0	3.0E-01	--	--	6.0E-01

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a]Non-detects evaluated at 1/2 the MDL

[b]Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 3-5. Background Sediment Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (mg/kg)	Standard Deviation (mg/kg)	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
Aroclors	Aroclor-1016	2	0	0	5.7E-03	2.5E-03	--	1.1E-02
	Aroclor-1221	2	0	0	1.3E-02	6.0E-03	--	2.6E-02
	Aroclor-1232	2	0	0	5.9E-03	2.7E-03	--	1.2E-02
	Aroclor-1242	2	0	0	1.5E-02	6.8E-03	--	3.0E-02
	Aroclor-1248	2	0	0	9.7E-03	4.4E-03	--	1.9E-02
	Aroclor-1254	2	0	0	3.7E-03	1.7E-03	--	7.4E-03
	Aroclor-1260	2	0	0	3.8E-03	1.7E-03	--	7.5E-03
	Aroclor-1262	2	0	0	5.0E-03	2.3E-03	--	9.9E-03
	Aroclor-1268	2	0	0	3.4E-03	1.6E-03	--	6.8E-03
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	11	11	100	4.3E-07	4.5E-07	1.2E-06	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	11	11	100	4.6E-07	4.4E-07	1.3E-06	--
	Toxicity Equivalence Dioxins (ND=MDL)	11	11	100	4.9E-07	4.3E-07	1.3E-06	--
Metals	Aluminum	11	11	100	6.6E+03	2.6E+03	1.2E+04	7.0E+00
	Arsenic	20	20	100	1.2E+01	5.8E+00	2.1E+01	2.0E-01
	Barium	11	11	100	1.7E+02	7.7E+01	2.8E+02	1.3E-01
	Cadmium	20	19	95	1.1E+00	6.6E-01	2.4E+00	4.6E-02
	Chromium	20	20	100	1.1E+01	5.0E+00	2.2E+01	3.2E-01
	Cobalt	11	11	100	4.3E+00	1.4E+00	6.0E+00	4.1E-01
	Copper	20	20	100	1.4E+02	6.9E+01	2.3E+02	5.5E-01
	Iron	20	20	100	1.2E+04	4.1E+03	2.1E+04	4.1E+01
	Lead	20	20	100	2.5E+01	1.1E+01	4.2E+01	7.3E-02
	Manganese	20	20	100	5.9E+02	4.9E+02	1.8E+03	2.3E-01
	Mercury	11	10	91	1.9E-01	1.5E-01	4.6E-01	1.4E-02
	Nickel	20	20	100	7.5E+00	2.4E+00	1.0E+01	2.6E-01
	Silver	11	1	9	1.8E-01	2.7E-01	9.9E-01	2.0E-01
	Thallium	11	2	18	5.9E-02	4.8E-02	1.7E-01	7.3E-02
	Vanadium	11	11	100	1.5E+01	4.5E+00	2.0E+01	4.6E-01
	Zinc	20	20	100	3.1E+02	1.3E+02	4.8E+02	3.4E+00
SVOCs	1,2,4-Trichlorobenzene	2	0	0	5.3E-02	2.4E-02	--	1.1E-01
	1,2-Dichlorobenzene	2	0	0	2.1E-02	9.4E-03	--	4.2E-02
	1,2-Diphenylhydrazine	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	1,3-Dichlorobenzene	2	0	0	2.0E-02	9.2E-03	--	4.1E-02
	1,4-Dichlorobenzene	2	0	0	2.2E-02	9.7E-03	--	4.3E-02
	1-Methylnaphthalene	2	0	0	5.6E-02	2.5E-02	--	1.1E-01
	2,4,5-Trichlorophenol	2	0	0	3.9E-02	1.8E-02	--	7.7E-02
	2,4,6-Trichlorophenol	2	0	0	4.2E-02	1.9E-02	--	8.3E-02
	2,4-Dichlorophenol	2	0	0	6.1E-02	2.7E-02	--	1.2E-01
	2,4-Dimethylphenol	2	0	0	6.1E-02	2.8E-02	--	1.2E-01
	2,4-Dinitrophenol	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	2,4-Dinitrotoluene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	2,6-Dinitrotoluene	2	0	0	2.8E-02	1.2E-02	--	5.5E-02
	2-Chloronaphthalene	2	0	0	5.1E-02	2.3E-02	--	1.0E-01
	2-Chlorophenol	2	0	0	7.5E-02	3.4E-02	--	1.5E-01
	2-Methylnaphthalene	2	0	0	5.8E-02	2.6E-02	--	1.2E-01
	2-Nitroaniline	2	0	0	3.5E-02	1.6E-02	--	7.0E-02
	2-Nitrophenol	2	0	0	5.5E-02	2.5E-02	--	1.1E-01
	3,3`-Dichlorobenzidine	2	0	0	4.5E-02	2.0E-02	--	9.0E-02
	3-Nitroaniline	2	0	0	3.3E-02	1.5E-02	--	6.6E-02
	4,6-Dinitro-o-cresol	2	0	0	6.4E-02	2.9E-02	--	1.3E-01
	4-Bromophenyl phenyl ether	2	0	0	3.4E-02	1.6E-02	--	6.9E-02
	4-Chloro-3-methylphenol	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	4-Chlorophenyl phenyl ether	2	0	0	3.7E-02	1.7E-02	--	7.4E-02
	4-Nitroaniline	2	0	0	2.8E-02	1.3E-02	--	5.7E-02
	4-Nitrophenol	2	0	0	3.4E-02	1.5E-02	--	6.8E-02
	Acenaphthene	2	0	0	3.7E-02	1.7E-02	--	7.5E-02
	Acenaphthylene	2	0	0	4.2E-02	1.9E-02	--	8.5E-02
	Anthracene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Benzo(a)anthracene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Benzo(a)pyrene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Benzo(b)fluoranthene	2	0	0	4.1E-02	1.9E-02	--	8.2E-02
	Benzo(g,h,i)perylene	2	0	0	3.9E-02	1.8E-02	--	7.9E-02
	Benzo(k)fluoranthene	2	0	0	4.1E-02	1.9E-02	--	8.3E-02
	bis(2-chloroethoxy)methane	2	0	0	6.3E-02	2.9E-02	--	1.3E-01
	bis(2-chloroethyl)ether	2	0	0	2.3E-02	1.0E-02	--	4.5E-02

Table 3-5. Background Sediment Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (mg/kg)	Standard Deviation (mg/kg)	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)
SVOCs	Bis(2-chloroisopropyl)ether	2	0	0	7.5E-02	3.4E-02	--	1.5E-01
	Bis(2-ethylhexyl)phthalate	2	0	0	5.5E-02	2.5E-02	--	1.1E-01
	Butyl benzyl phthalate	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Carbazole	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Chrysene	2	0	0	4.3E-02	1.9E-02	--	8.7E-02
	Dibenzo(a,h)anthracene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Dibenzofuran	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Dibutyl phthalate	2	0	0	4.5E-02	2.0E-02	--	9.0E-02
	Diethyl phthalate	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Dimethyl phthalate	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Di-n-octyl phthalate	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Fluoranthene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Fluorene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Hexachlorobenzene	2	0	0	4.2E-02	1.9E-02	--	8.5E-02
	Hexachlorobutadiene	2	0	0	2.7E-02	1.2E-02	--	5.4E-02
	Hexachloroethane	2	0	0	2.1E-02	9.3E-03	--	4.1E-02
	Indeno(1,2,3-cd)pyrene	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Isophorone	2	0	0	5.2E-02	2.3E-02	--	1.0E-01
	m & p-cresols	2	0	0	6.4E-02	2.9E-02	--	1.3E-01
	Naphthalene-SVOC	2	0	0	6.1E-02	2.8E-02	--	1.2E-01
	Nitrobenzene	2	0	0	6.5E-02	2.9E-02	--	1.3E-01
	N-Nitrosodimethylamine	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	N-Nitrosodi-n-propylamine	2	0	0	4.4E-02	2.0E-02	--	8.8E-02
	N-Nitrosodiphenylamine	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	o-Cresol	2	0	0	7.0E-02	3.1E-02	--	1.4E-01
	p-Chloroaniline	2	0	0	5.0E-02	2.3E-02	--	9.9E-02
	Pentachlorophenol	2	0	0	1.6E-01	7.3E-02	--	3.2E-01
	Phenanthrene	2	0	0	4.6E-02	2.1E-02	--	9.2E-02
	Phenol	2	0	0	7.1E-02	3.2E-02	--	1.4E-01
	Pyrene	2	0	0	4.1E-02	1.8E-02	--	8.1E-02

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a]Non-detects evaluated at 1/2 the MDL

[b]Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 3-6. Background Surface Water Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
Aroclors	Aroclor-1016	2	0	0	2.3E-02	--	--	4.5E-02
	Aroclor-1221	2	1	50	7.5E-02	9.2E-02	1.4E-01	1.9E-02
	Aroclor-1232	2	0	0	1.8E-02	3.5E-04	--	3.7E-02
	Aroclor-1242	2	0	0	1.4E-02	--	--	2.8E-02
	Aroclor-1248	2	0	0	6.0E-03	--	--	1.2E-02
	Aroclor-1254	2	0	0	7.8E-03	3.5E-04	--	1.6E-02
	Aroclor-1260	2	0	0	7.5E-03	--	--	1.5E-02
	Aroclor-1262	2	0	0	2.1E-02	--	--	4.2E-02
	Aroclor-1268	2	0	0	1.2E-02	--	--	2.3E-02
TEQ[b]	Toxicity Equivalence Dioxins (ND=0)	5	3	60	3.7E-05	3.4E-05	6.9E-05	--
	Toxicity Equivalence Dioxins (ND=1/2MDL)	5	3	60	3.5E-06	1.7E-07	3.4E-06	--
	Toxicity Equivalence Dioxins (ND=MDL)	5	3	60	6.9E-06	3.7E-07	6.7E-06	--
Total Metals	Aluminum	5	4	80	2.7E+01	1.6E+01	4.2E+01	3.0E+00
	Arsenic	41	41	100	6.9E+00	4.6E+00	2.0E+01	--
	Barium	5	5	100	1.3E+02	7.4E+01	2.5E+02	--
	Cadmium	41	28	68	7.8E-02	8.2E-02	3.9E-01	2.8E-02
	Chromium	5	0	0	8.5E-02	--	--	1.7E-01
	Cobalt	5	0	0	6.5E-02	--	--	1.3E-01
	Copper	41	41	100	1.4E+01	1.7E+01	8.3E+01	--
	Iron	41	40	98	3.6E+02	3.7E+02	1.8E+03	1.4E+01
	Lead	41	39	95	2.1E+00	2.5E+00	1.2E+01	4.6E-02
	Manganese	41	41	100	4.8E+01	4.0E+01	1.9E+02	--
	Mercury	5	3	60	2.2E-02	1.0E-02	3.0E-02	2.2E-02
	Nickel	5	3	60	1.5E-01	6.6E-02	2.3E-01	1.6E-01
	Silver	5	0	0	7.5E-02	--	--	1.5E-01
	Thallium	5	0	0	7.5E-03	--	--	1.5E-02
	Vanadium	5	5	100	5.8E-01	1.7E-01	7.4E-01	--
	Zinc	41	39	95	1.7E+01	1.7E+01	8.2E+01	2.4E+00
Dissolved Metals	Aluminum	5	3	60	2.8E+00	1.5E+00	5.0E+00	3.0E+00
	Arsenic	41	41	100	5.5E+00	3.4E+00	1.3E+01	--
	Barium	5	5	100	1.3E+02	7.8E+01	2.6E+02	--
	Cadmium	41	14	34	2.4E-02	1.6E-02	8.3E-02	2.9E-02
	Calcium	41	41	100	3.7E+04	1.3E+04	7.2E+04	--
	Chromium	5	0	0	8.5E-02	--	--	1.7E-01
	Cobalt	5	4	80	5.7E-01	3.3E-01	8.8E-01	1.3E-01
	Copper	41	41	100	3.5E+00	3.1E+00	1.8E+01	--
	Iron	41	37	90	2.6E+01	5.5E+01	3.6E+02	1.4E+01
	Lead	41	33	80	1.6E-01	4.3E-01	2.8E+00	4.2E-02
	Magnesium	41	41	100	1.0E+04	3.1E+03	1.9E+04	--
	Manganese	41	41	100	9.5E+00	8.5E+00	4.9E+01	--
	Nickel	5	4	80	2.2E-01	9.3E-02	3.3E-01	1.6E-01
	Potassium	5	4	80	1.3E+03	9.4E+02	2.5E+03	1.3E+02
	Silver	5	0	0	7.5E-02	--	--	1.5E-01
	Sodium	5	5	100	6.8E+03	3.7E+03	1.3E+04	--
	Thallium	5	1	20	1.3E-02	1.2E-02	3.5E-02	1.5E-02
	Vanadium	5	4	80	5.0E-01	2.1E-01	6.6E-01	2.8E-01
	Zinc	41	26	63	2.9E+00	2.8E+00	1.7E+01	2.0E+00
SVOCs	1,2,4-Trichlorobenzene	2	0	0	9.5E-01	--	--	1.9E+00
	1,2-Dichlorobenzene	2	0	0	9.5E-01	--	--	1.9E+00
	1,2-Diphenylhydrazine	2	0	0	1.2E+00	3.5E-02	--	2.5E+00
	1,3-Dichlorobenzene	2	0	0	8.3E-01	3.5E-02	--	1.7E+00
	1,4-Dichlorobenzene	2	0	0	9.5E-01	--	--	1.9E+00
	1-Methylnaphthalene	2	0	0	1.1E+00	--	--	2.1E+00
	2,4,5-Trichlorophenol	2	0	0	1.1E+00	3.5E-02	--	2.2E+00
	2,4,6-Trichlorophenol	2	0	0	1.1E+00	--	--	2.2E+00
	2,4-Dichlorophenol	2	0	0	1.2E+00	--	--	2.3E+00
	2,4-Dimethylphenol	2	0	0	3.4E+00	7.1E-02	--	6.8E+00
	2,4-Dinitrophenol	2	0	0	1.4E+00	3.5E-02	--	2.8E+00
	2,4-Dinitrotoluene	2	0	0	1.1E+00	3.5E-02	--	2.2E+00
	2,6-Dinitrotoluene	2	0	0	1.2E+00	--	--	2.3E+00
	2-Chloronaphthalene	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	2-Chlorophenol	2	0	0	1.1E+00	--	--	2.2E+00
	2-Methylnaphthalene	2	0	0	1.1E+00	--	--	2.1E+00
	2-Nitroaniline	2	0	0	1.4E+00	--	--	2.8E+00

Table 3-6. Background Surface Water Summary Statistics

Analysis	Analyte	Number of Samples	Number of Detected Samples	Detection Frequency (%)	Average Concentration[a] (ug/L)	Standard Deviation[a] (ug/L)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)
SVOCs	2-Nitrophenol	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	3,3`-Dichlorobenzidine	2	0	0	2.5E+00	3.5E-02	--	5.0E+00
	3-Nitroaniline	2	0	0	2.5E+00	3.5E-02	--	5.1E+00
	4,6-Dinitro-o-cresol	2	0	0	1.8E+00	3.5E-02	--	3.6E+00
	4-Bromophenyl phenyl ether	2	0	0	1.2E+00	--	--	2.4E+00
	4-Chloro-3-methylphenol	2	0	0	8.0E-01	--	--	1.6E+00
	4-Chlorophenyl phenyl ether	2	0	0	7.0E-01	--	--	1.4E+00
	4-Nitroaniline	2	0	0	2.2E+00	3.5E-02	--	4.4E+00
	4-Nitrophenol	2	0	0	1.7E+00	--	--	3.4E+00
	Acenaphthene	2	0	0	8.3E-01	3.5E-02	--	1.7E+00
	Acenaphthylene	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	Anthracene	2	0	0	1.2E+00	3.5E-02	--	2.5E+00
	Benzo(a)anthracene	2	0	0	2.5E+00	3.5E-02	--	5.1E+00
	Benzo(a)pyrene	2	0	0	1.2E+00	--	--	2.4E+00
	Benzo(b)fluoranthene	2	0	0	1.3E+00	--	--	2.5E+00
	Benzo(g,h,i)perylene	2	0	0	1.3E+00	--	--	2.5E+00
	Benzo(k)fluoranthene	2	0	0	1.4E+00	--	--	2.8E+00
	bis(2-chloroethoxy)methane	2	0	0	7.8E-01	3.5E-02	--	1.6E+00
	bis(2-chloroethyl)ether	2	0	0	1.2E+00	--	--	2.3E+00
	Bis(2-chloroisopropyl)ether	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	Bis(2-ethylhexyl)phthalate	2	0	0	1.2E+00	3.5E-02	--	2.4E+00
	Butyl benzyl phthalate	2	0	0	9.5E-01	--	--	1.9E+00
	Carbazole	2	0	0	1.3E+00	3.5E-02	--	2.7E+00
	Chrysene	2	0	0	1.2E+00	--	--	2.3E+00
	Dibenzo(a,h)anthracene	2	0	0	9.0E-01	--	--	1.8E+00
	Dibenzofuran	2	0	0	1.2E+00	--	--	2.3E+00
	Dibutyl phthalate	2	0	0	1.2E+00	3.5E-02	--	2.5E+00
	Diethyl phthalate	2	0	0	1.2E+00	3.5E-02	--	2.5E+00
	Dimethyl phthalate	2	0	0	1.2E+00	3.5E-02	--	2.4E+00
	Di-n-octyl phthalate	2	0	0	8.5E-01	--	--	1.7E+00
	Fluoranthene	2	0	0	1.3E+00	--	--	2.5E+00
	Fluorene	2	0	0	1.2E+00	3.5E-02	--	2.4E+00
	Hexachlorobenzene	2	0	0	1.3E+00	--	--	2.6E+00
	Hexachlorobutadiene	2	0	0	8.5E-01	--	--	1.7E+00
	Hexachloroethane	2	0	0	8.3E-01	3.5E-02	--	1.7E+00
	Indeno(1,2,3-cd)pyrene	2	0	0	9.0E-01	--	--	1.8E+00
	Isophorone	2	0	0	8.0E-01	--	--	1.6E+00
	m & p-cresols	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	Naphthalene-SVOC	2	0	0	1.0E+00	--	--	2.0E+00
	Nitrobenzene	2	0	0	1.3E+00	--	--	2.5E+00
	N-Nitrosodimethylamine	2	0	0	1.2E+00	--	--	2.3E+00
	N-Nitrosodi-n-propylamine	2	0	0	1.2E+00	--	--	2.3E+00
	N-Nitrosodiphenylamine	2	0	0	2.0E+00	3.5E-02	--	4.0E+00
	o-Cresol	2	0	0	1.0E+00	--	--	2.0E+00
	p-Chloroaniline	2	0	0	1.8E+00	3.5E-02	--	3.7E+00
	Pentachlorophenol	2	0	0	1.1E+00	--	--	2.2E+00
	Phenanthrene	2	0	0	1.3E+00	3.5E-02	--	2.6E+00
	Phenol	2	0	0	1.1E+00	3.5E-02	--	2.3E+00
	Pyrene	2	0	0	1.2E+00	3.5E-02	--	2.5E+00

MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence

[a]Non-detects evaluated at 1/2 the MDL

[b]Toxic equivalency (TEQ) values were calculated using the World Health Organization (WHO) 2005 toxic equivalency factors (TEFs).

Table 4-1. OU1 Surface Soil COPC Screen Based on Residential Soil RBCs

Analysis	Analyte	Detection Frequency	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	RBC (mg/kg) [a]		COPC SELECTION STEPS					OU1 SOIL COPCs		
							Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c] Is MDL > RBC?	Background[d] Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
TEQ	Toxicity Equivalence Dioxins (ND=0)	100%	1.2E-06	--	5.1E-06	NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=1/2MDL)	100%	1.2E-06	--	5.1E-06	NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=MDL)	100%	1.3E-06	--	5.1E-06	NC	yes	yes	no				X	
Metals	Aluminum	100%	3.1E+04	5.7E+00	7.7E+03	NC	yes	yes	yes		no		X	
	Antimony	78%	2.4E-01	9.3E-02	3.1E+00	NC	yes	yes	no				X	
	Arsenic	100%	7.9E+00	1.3E-01	6.8E-01	C	yes	yes	yes		no		X	
	Barium	100%	4.3E+02	8.7E-02	1.5E+03	NC	yes	yes	no				X	
	Beryllium	100%	1.2E+00	8.4E-02	1.6E+01	NC	yes	yes	no				X	
	Cadmium	95%	2.8E-01	3.1E-02	7.1E+00	NC	yes	yes	no				X	
	Calcium	100%	2.2E+05	4.2E+01	5.0E+06	NC	yes	yes	no				X	
	Chromium[b]	95%	1.9E+01	2.1E-01	1.8E+00	NC	yes	yes	yes		no		X	
					1.2E+04	NC	yes	yes	no				X	
	Cobalt	100%	1.0E+01	2.5E-01	2.3E+00	NC	yes	yes	yes		no		X	
	Copper	98%	3.4E+01	3.7E-01	3.1E+02	NC	yes	yes	no				X	
	Iron	100%	2.2E+04	2.8E+01	5.5E+03	NC	yes	yes	yes		no		X	
	Lead	100%	2.1E+01	5.6E-02	4.0E+02	NC	yes	yes	no				X	
	Magnesium	100%	1.2E+05	1.5E+01	6.5E+05	NC	yes	yes	no				X	
	Manganese	100%	7.3E+02	2.3E-01	1.8E+02	NC	yes	yes	yes		no		X	
	Mercury	22%	8.0E-02	8.0E-03	1.1E+00	NC	yes	yes	no				X	
	Nickel	96%	1.6E+01	1.5E-01	1.5E+02	NC	yes	yes	no				X	
	Potassium	100%	4.9E+03	8.3E+01	1.9E+07	NC	yes	yes	no				X	
	Selenium	89%	1.8E+00	3.0E-01	3.9E+01	NC	yes	yes	no				X	
	Silver	0%	--	1.5E-01	3.9E+01	NC	yes	no		no			X	
	Sodium	100%	1.7E+02	2.9E+01	6.0E+06	NC	yes	yes	no				X	
	Thallium	90%	2.6E-01	3.8E-02	7.8E-02	NC	yes	yes	yes		no		X	
	Vanadium	100%	2.2E+01	2.6E-01	3.9E+01	NC	yes	yes	no				X	
	Zinc	100%	9.1E+01	1.3E+00	2.3E+03	NC	yes	yes	no				X	
SVOCs	Acenaphthene	0%	--	4.5E-04	3.6E+02	NC	yes	no		no			X	
	Acenaphthylene	0%	--	4.3E-04			no							X
	Anthracene	0%	--	3.9E-04	1.8E+03	NC	yes	no		no			X	
	Benzo(a)anthracene	0%	--	2.3E-04	1.6E-01	C	yes	no		no			X	
	Benzo(a)pyrene	0%	--	2.5E-04	1.6E-02	C	yes	no		no			X	
	Benzo(b)fluoranthene	1%	1.3E-02	4.4E-04	1.6E-01	C	yes	no		no			X	
	Benzo(g,h,i)perylene	0%	--	4.5E-04			no							X
	Benzo(k)fluoranthene	0%	--	5.1E-04	1.6E+00	C	yes	no		no			X	
	Chrysene	0%	--	3.1E-04	1.6E+01	C	yes	no		no			X	
	Dibenzo(a,h)anthracene	0%	--	5.4E-04	1.6E-02	C	yes	no		no			X	
	Fluoranthene	1%	2.9E-02	2.8E-04	2.4E+02	NC	yes	no		no			X	
	Fluorene	0%	--	3.9E-04	2.4E+02	NC	yes	no		no			X	
	Indeno(1,2,3-cd)pyrene	0%	--	4.9E-04	1.6E-01	C	yes	no		no			X	
	Naphthalene	0%	--	4.7E-04	3.8E+00	C	yes	no		no			X	
	Phenanthrene	1%	1.4E-02	3.1E-04			no							X
	Pyrene	1%	2.4E-02	3.0E-04	1.8E+02	NC	yes	no		no			X	

RBC = risk-based concentration; MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence; C = cancer; NC = non-cancer

[a]Risk-based concentrations are based on generic residential soil RSL values using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value) (USEPA 2016).

[b]Chromium was measured as total chromium in site soils. For the purposes of COPC selection, the maximum detected chromium concentration in site soil was compared to the cancer-based RBC for Cr(VI) adjusted assuming a ratio of hexavalent chromium to trivalent chromium in soil of 1:6 (USEPA 1998) and to the non-cancer based RBC for Cr(III) of 1.2E+04 mg/kg.

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 4-2. OU1 Groundwater COPC Screen Based on Residential Tapwater RBCs

Analysis	Analyte	Detection Frequency (%)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)	RBC (ug/L)[a]		COPC SELECTION STEPS					OU1 GROUNDWATER COPCs		
							Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]	Background[d]			
										Is MDL > RBC?	Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
Aroclors	Aroclor-1016	0%	--	4.0E-02	1.4E-01	NC	yes	no		no			X	
	Aroclor-1221	0%	--	3.3E-02	4.7E-03	C	yes	no		yes				X
	Aroclor-1232	0%	--	4.9E-02	4.7E-03	C	yes	no		yes				X
	Aroclor-1242	0%	--	5.1E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1248	0%	--	3.2E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1254	0%	--	4.6E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1260	0%	--	2.8E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1262	0%	--	2.9E-02			no							X
	Aroclor-1268	0%	--	3.2E-02			no							X
TEQ	Toxicity Equivalence Dioxins (ND=0)	25%	2.3E-07	--	1.2E-06	NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=1/2MDL)	25%	5.4E-07	--	1.2E-06	NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=MDL)	25%	8.5E-07	--	1.2E-06	NC	yes	yes	no				X	
Total Metals	Aluminum	50%	6.5E+00	1.2E+00	2.0E+03	NC	yes	yes	no				X	
	Antimony	50%	3.6E-01	2.5E-01	7.8E-01	NC	yes	yes	no				X	
	Arsenic	100%	4.8E+00	2.5E-01	5.2E-02	C	yes	yes	yes		no		X	
	Barium	100%	2.6E+02	1.4E-01	3.8E+02	NC	yes	yes	no				X	
	Beryllium	0%	--	6.6E-02	2.5E+00	NC	yes	no		no			X	
	Cadmium	50%	7.0E-02	3.3E-02	9.2E-01	NC	yes	yes	no				X	
	Calcium	100%	6.0E+04	2.5E+02	4.0E+05	NC	yes	yes	no				X	
	Chromium[b]	50%	3.3E-01	2.2E-01	3.5E-02	C	yes	yes	yes		no		X	
					2.2E+03	NC	yes	yes	no				X	
	Cobalt	50%	1.6E+00	2.5E-01	6.0E-01	NC	yes	yes	yes		no		X	
	Copper	100%	9.6E+00	2.2E-01	8.0E+01	NC	yes	yes	no				X	
	Iron	0%	--	8.0E+00	1.4E+03	NC	yes	no		no			X	
	Lead	0%	--	4.6E-02	1.5E+01	NC	yes	no		no			X	
	Magnesium	100%	2.1E+04	2.5E+02	5.2E+04	NC	yes	yes	no				X	
	Manganese	100%	2790	3.47	4.3E+01	NC	yes	yes	yes		yes	X		
	Mercury	0%	0.0E+00	2.6E-02	5.7E-01	NC	yes	no		no			X	
	Nickel	100%	3.8E+00	2.3E-01	3.9E+01	NC	yes	yes	no				X	
	Potassium	100%	3.9E+03	1.3E+03	1.5E+06	NC	yes	yes	no				X	
	Selenium	0%	--	2.5E-01	1.0E+01	NC	yes	no		no			X	
	Silver	0%	--	5.6E-02	9.4E+00	NC	yes	no		no			X	
	Sodium	100%	2.5E+04	5.0E+02	4.8E+05	NC	yes	yes	no				X	
	Thallium	0%	--	2.5E-02	2.0E-02	NC	yes	no		yes				X
	Vanadium	100%	2.6E+00	2.1E-01	8.6E+00	NC	yes	yes	no				X	
	Zinc	100%	3.8E+00	2.5E+00	6.0E+02	NC	yes	yes	no				X	

RBC = risk-based concentration; MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence; C = cancer; NC = non-cancer

[a]Risk-based concentrations are based on generic residential tapwater RSL values using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value) (USEPA 2016).

[b]Chromium was measured as total chromium. For the purposes of COPC selection, the maximum detected chromium concentration in site groundwater was compared to the cancer-based RBC for Cr(VI) of 3.5E-02 ug/L and to the non-cancer based RBC for Cr(III) of 2.2E+03 ug/L.

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background. The statistical comparison between site and background data for metals was based on dissolved concentrations.

Table 4-3. OU1 Sediment COPC Screen

Analysis	Analyte	Detection Frequency (%)	Maximum Detected Concentration (mg/kg)	Average MDL (mg/kg)	RBC (mg/kg)[a]	COPC SELECTION STEPS					OU1 SEDIMENT COPCs		
						Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]	Background[d]			
									Is MDL > RBC?	Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
Aroclors	Aroclor-1016	0%	--	1.4E-02	4.1E-01 NC	yes	no		no			X	
	Aroclor-1221	0%	--	3.2E-02	2.0E-01 C	yes	no		no			X	
	Aroclor-1232	0%	--	1.4E-02	1.7E-01 C	yes	no		no			X	
	Aroclor-1242	0%	--	3.6E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1248	0%	--	2.3E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1254	0%	--	8.8E-03	1.2E-01 NC	yes	no		no			X	
	Aroclor-1260	0%	--	9.0E-03	2.4E-01 C	yes	no		no			X	
	Aroclor-1262	0%	--	1.2E-02		no							X
	Aroclor-1268	0%	--	8.2E-03		no							X
TEQ	Toxicity Equivalence Dioxins (ND=0)	100%	3.1E-06	--	5.1E-06 NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=1/2MDL)	100%	3.1E-06	--	5.1E-06 NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=MDL)	100%	3.1E-06	--	5.1E-06 NC	yes	yes	no				X	
Metals	Aluminum	100%	1.4E+04	7.8E+00	7.7E+03 NC	yes	yes	yes		no		X	
	Arsenic	100%	1.3E+01	2.3E-01	6.8E-01 C	yes	yes	yes		no		X	
	Barium	100%	3.2E+02	1.5E-01	1.5E+03 NC	yes	yes	no				X	
	Cadmium	40%	6.8E-01	5.2E-02	7.1E+00 NC	yes	yes	no				X	
	Chromium[b]	100%	1.4E+01	3.6E-01	1.8E+00 NC	yes	yes	yes		no		X	
					1.2E+04 NC	yes	yes	no				X	
	Cobalt	100%	1.3E+01	4.6E-01	2.3E+00 NC	yes	yes	yes		no		X	
	Copper	100%	1.2E+02	6.2E-01	3.1E+02 NC	yes	yes	no				X	
	Iron	100%	2.5E+04	4.7E+01	5.5E+03 NC	yes	yes	yes		no		X	
	Lead	100%	2.3E+01	8.1E-02	4.0E+02 NC	yes	yes	no				X	
	Manganese	100%	4.8E+02	2.6E-01	1.8E+02 NC	yes	yes	yes		no		X	
	Mercury	20%	1.5E-01	1.5E-02	1.1E+00 NC	yes	yes	no				X	
	Nickel	100%	1.5E+01	2.9E-01	1.5E+02 NC	yes	yes	no				X	
	Silver	0%	--	2.2E-01	3.9E+01 NC	yes	no		no			X	
	Thallium	0%	--	8.1E-02	7.8E-02 NC	yes	no		yes				X
	Vanadium	100%	2.1E+01	5.2E-01	3.9E+01 NC	yes	yes	no				X	
	Zinc	100%	2.5E+02	2.5E+00	2.3E+03 NC	yes	yes	no				X	
SVOCs	1,2,4-Trichlorobenzene	0%	--	1.3E-01	5.8E+00 NC	yes	no		no			X	
	1,2-Dichlorobenzene	0%	--	5.0E-02	1.8E+02 NC	yes	no		no			X	
	1,2-Diphenylhydrazine	0%	--	3.9E-01	6.8E-01 C	yes	no		no			X	
	1,3-Dichlorobenzene	0%	--	4.9E-02		no							X
	1,4-Dichlorobenzene	0%	--	5.1E-02	2.6E+00 C	yes	no		no			X	
	1-Methylnaphthalene	0%	--	1.3E-01	1.8E+01 C	yes	no		no			X	
	2,4,5-Trichlorophenol	0%	--	9.2E-02	6.3E+02 NC	yes	no		no			X	
	2,4,6-Trichlorophenol	0%	--	9.9E-02	6.3E+00 NC	yes	no		no			X	
	2,4-Dichlorophenol	0%	--	1.5E-01	1.9E+01 NC	yes	no		no			X	
	2,4-Dimethylphenol	0%	--	1.4E-01	1.3E+02 NC	yes	no		no			X	
	2,4-Dinitrophenol	0%	--	3.9E-01	1.3E+01 NC	yes	no		no			X	
	2,4-Dinitrotoluene	0%	--	3.9E-01	1.7E+00 C	yes	no		no			X	
	2,6-Dinitrotoluene	0%	--	6.6E-02	3.6E-01 C	yes	no		no			X	
	2-Chloronaphthalene	0%	--	1.2E-01	4.8E+02 NC	yes	no		no			X	
	2-Chlorophenol	0%	--	1.8E-01	3.9E+01 NC	yes	no		no			X	
	2-Methylnaphthalene	0%	--	1.4E-01	2.4E+01 NC	yes	no		no			X	
	2-Nitroaniline	0%	--	8.4E-02	6.3E+01 NC	yes	no		no			X	
	2-Nitrophenol	0%	--	1.3E-01		no							X
	3,3`-Dichlorobenzidine	0%	--	1.1E-01	1.2E+00 C	yes	no		no			X	
	3-Nitroaniline	0%	--	7.9E-02		no							X
	4,6-Dinitro-o-cresol	0%	--	1.5E-01	5.1E-01 NC	yes	no		no			X	
	4-Bromophenyl phenyl ether	0%	--	8.2E-02		no							X
	4-Chloro-3-methylphenol	0%	--	3.9E-01	6.3E+02 NC	yes	no		no			X	
	4-Chlorophenyl phenyl ether	0%	--	8.9E-02		no							X
	4-Nitroaniline	0%	--	6.8E-02	2.5E+01 NC	yes	no		no			X	
	4-Nitrophenol	0%	--	8.1E-02		no							X
	Acenaphthene	0%	--	8.9E-02	3.6E+02 NC	yes	no		no			X	
	Acenaphthylene	0%	--	1.0E-01		no							X
	Anthracene	0%	--	3.9E-01	1.8E+03 NC	yes	no		no			X	
	Benzo(a)anthracene	0%	--	3.9E-01	1.6E-01 C	yes	no		yes				X
	Benzo(a)pyrene	0%	--	3.9E-01	1.6E-02 C	yes	no		yes				X
	Benzo(b)fluoranthene	0%	--	9.8E-02	1.6E-01 C	yes	no		no			X	
	Benzo(g,h,i)perylene	0%	--	9.4E-02		no							X
	Benzo(k)fluoranthene	0%	--	9.9E-02	1.6E+00 C	yes	no		no			X	
SVOCs	bis(2-chloroethoxy)methane	0%	--	1.5E-01	1.9E+01 NC	yes	no		no			X	
	bis(2-chloroethyl)ether	0%	--	5.4E-02	2.3E-01 C	yes	no		no			X	
	Bis(2-chloroisopropyl)ether	0%	--	1.8E-01	3.1E+02 NC	yes	no		no			X	
	Bis(2-ethylhexyl)phthalate	0%	--	1.3E-01	3.9E+01 C	yes	no		no			X	
	Butyl benzyl phthalate	0%	--	3.9E-01	2.9E+02 C	yes	no		no			X	
	Carbazole	0%	--	3.9E-01		no							X
	Chrysene	0%	--	1.0E-01	1.6E+01 C	yes	no		no			X	
	Dibenzo(a,h)anthracene	0%	--	3.9E-01	1.6E-02 C	yes	no		yes				X
	Dibenzofuran	0%	--	3.9E-01	7.3E+00 NC	yes	no		no			X	
	Dibutyl phthalate	0%	--	1.1E-01	6.3E+02 NC	yes	no		no			X	
	Diethyl phthalate	0%	--	3.9E-01	5.1E+03 NC	yes	no		no			X	
	Dimethyl phthalate	0%	--	3.9E-01		no							X
	Di-n-octyl phthalate	0%	--	3.9E-01	6.3E+01 NC	yes	no		no			X	
	Fluoranthene	0%	--	3.9E-01	2.4E+02 NC	yes	no		no			X	
	Fluorene	0%	--	3.9E-01	2.4E+02 NC	yes	no		no			X	
	Hexachlorobenzene	0%	--	1.0E-01	2.1E-01 C	yes	no		no			X	
	Hexachlorobutadiene	0%	--	6.5E-02	1.2E+00 C	yes	no		no			X	
	Hexachloroethane	0%	--	4.9E-02	1.8E+00 C	yes	no		no			X	
	Indeno(1,2,3-cd)pyrene	0%	--	3.9E-01	1.6E-01 C	yes	no		yes				X
	Isophorone	0%	--	1.2E-01	5.7E+02 C	yes	no		no			X	
	m & p-cresols	0%	--	1.5E-01	6.3E+02 NC	yes	no		no			X	
	Naphthalene	0%	--	1.4E-01	3.8E+00 C	yes	no		no			X	
	Nitrobenzene	0%	--	1.6E-01	5.1E+00 C	yes	no		no			X	
	N-Nitrosodimethylamine	0%	--	3.9E-01	2.0E-03 C	yes	no		yes				X
	N-Nitrosodi-n-propylamine	0%	--	1.1E-01	7.8E-02 C	yes	no		yes				X
	N-Nitrosodiphenylamine	0%	--	3.9E-01	1.1E+02 C	yes	no		no			X	
	o-Cresol	0%	--	1.7E-01	3.2E+02 NC	yes	no		no			X	
	p-Chloroaniline	0%	--	1.2E-01	2.7E+00 C	yes	no		no			X	
	Pentachlorophenol	0%	--	3.9E-01	1.0E+00 C	yes	no		no			X	
	Phenanthrene	0%	--	1.1E-01		no							X
	Phenol	0%	--	1.7E-01	1.9E+03 NC	yes	no		no			X	
	Pyrene	0%	--	9.7E-02	1.8E+02 NC	yes	no		no			X	

RBC = risk-based concentration; MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence; C = cancer; NC = non-cancer

[a]Risk-based concentrations are based on generic residential soil RSL values using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value) (USEPA 2016).

[b]Chromium was measured as total chromium. For the purposes of COPC selection, the maximum detected chromium concentration in sediment was compared to the RBC for Cr(VI) adjusted assuming a ratio of hexavalent chromium to trivalent chromium in soil of 1:6 (USEPA 1998), and to the non-cancer based RBC for Cr(III) of 1.2E+04.

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 4-4. OU1 Surface Water COPC Screen

Analysis	Analyte	Detection Frequency (%)	Maximum Detected Concentration (ug/L)	Average MDL (ug/L)	RBC (ug/L)[a]		COPC SELECTION STEPS: Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	OU1 SURFACE WATER COPCs: COPC	Not a COPC	Source of Uncertainty
Aroclors	Aroclor-1016	0%	--	4.6E-02	1.4E-01	NC	yes	no		no			X	
	Aroclor-1221	0%	--	2.0E-02	4.7E-03	C	yes	no		yes				X
	Aroclor-1232	0%	--	3.7E-02	4.7E-03	C	yes	no		yes				X
	Aroclor-1242	0%	--	2.8E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1248	0%	--	1.3E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1254	0%	--	1.6E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1260	0%	--	1.5E-02	7.8E-03	C	yes	no		yes				X
	Aroclor-1262	0%	--	4.2E-02			no							X
	Aroclor-1268	0%	--	2.3E-02			no							X
TEQ	Toxicity Equivalence Dioxins (ND=0)	100%	9.2E-08	--	1.2E-06	NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=1/2MDL)	100%	4.2E-07	--	1.2E-06	NC	yes	yes	no				X	
	Toxicity Equivalence Dioxins (ND=MDL)	100%	7.4E-07	--	1.2E-06	NC	yes	yes	no				X	
Total Metals	Aluminum	100%	1.3E+03	3.0E+00	2.0E+03	NC	yes	yes	no				X	
	Arsenic	100%	1.7E+00	1.1E-01	5.2E-02	C	yes	yes	yes		no		X	
	Barium	100%	2.6E+02	8.1E-02	3.8E+02	NC	yes	yes	no				X	
	Cadmium	0%	--	2.4E-02	9.2E-01	NC	yes	no		no			X	
	Chromium[b]	50%	1.2E+00	1.7E-01	3.5E-02	C	yes	yes	yes		no		X	
					2.2E+03	NC	yes	yes	no				X	
	Cobalt	50%	4.0E-01	1.3E-01	6.0E-01	NC	yes	yes	no				X	
	Copper	100%	2.1E+00	2.1E-01	8.0E+01	NC	yes	yes	no				X	
	Iron	100%	1.0E+03	1.4E+01	1.4E+03	NC	yes	yes	no				X	
	Lead	100%	6.5E-01	4.6E-02	1.5E+01	NC	yes	yes	no				X	
	Manganese	100%	2.0E+01	2.4E-01	4.3E+01	NC	yes	yes	no				X	
	Mercury	100%	3.0E-02	2.2E-02	6.3E-02	NC	yes	yes	no				X	
	Nickel	100%	1.0E+00	1.6E-01	3.9E+01	NC	yes	yes	no				X	
	Silver	0%	--	1.5E-01	9.4E+00	NC	yes	no		no			X	
	Thallium	0%	--	1.5E-02	2.0E-02	NC	yes	no		no			X	
	Vanadium	100%	1.5E+00	2.8E-01	8.6E+00	NC	yes	yes	no				X	
	Zinc	50%	5.0E+00	2.4E+00	6.0E+02	NC	yes	yes	no				X	
SVOCs	1,2,4-Trichlorobenzene	0%	--	1.9E+00	4.0E-01	NC	yes	no		yes				X
	1,2-Dichlorobenzene	0%	--	1.9E+00	3.0E+01	NC	yes	no		no			X	
	1,2-Diphenylhydrazine	0%	--	2.5E+00	7.8E-02	C	yes	no		yes				X
	1,3-Dichlorobenzene	0%	--	1.7E+00			no							X
	1,4-Dichlorobenzene	0%	--	1.9E+00	4.8E-01	C	yes	no		yes				X
	1-Methylnaphthalene	0%	--	2.1E+00	1.1E+00	C	yes	no		yes				X
	2,4,5-Trichlorophenol	0%	--	2.2E+00	1.2E+02	NC	yes	no		no			X	
	2,4,6-Trichlorophenol	0%	--	2.2E+00	1.2E+00	NC	yes	no		yes				X
	2,4-Dichlorophenol	0%	--	2.3E+00	4.6E+00	NC	yes	no		no			X	
	2,4-Dimethylphenol	0%	--	6.9E+00	3.6E+01	NC	yes	no		no			X	
	2,4-Dinitrophenol	0%	--	2.8E+00	3.9E+00	NC	yes	no		no			X	
	2,4-Dinitrotoluene	0%	--	2.2E+00	2.4E-01	C	yes	no		yes				X
	2,6-Dinitrotoluene	0%	--	2.3E+00	4.9E-02	C	yes	no		yes				X
	2-Chloronaphthalene	0%	--	2.3E+00	7.5E+01	NC	yes	no		no			X	
	2-Chlorophenol	0%	--	2.2E+00	9.1E+00	NC	yes	no		no			X	
SVOCs	2-Methylnaphthalene	0%	--	2.1E+00	3.6E+00	NC	yes	no		no			X	
	2-Nitroaniline	0%	--	2.8E+00	1.9E+01	NC	yes	no		no			X	
	2-Nitrophenol	0%	--	2.3E+00			no							X
	3,3`-Dichlorobenzidine	0%	--	5.0E+00	1.3E-01	C	yes	no		yes				X
	3-Nitroaniline	0%	--	5.1E+00			no							X
	4,6-Dinitro-o-cresol	0%	--	3.6E+00	1.5E-01	NC	yes	no		yes				X
	4-Bromophenyl phenyl ether	0%	--	2.4E+00			no							X
	4-Chloro-3-methylphenol	0%	--	1.6E+00	1.4E+02	NC	yes	no		no			X	
	4-Chlorophenyl phenyl ether	0%	--	1.4E+00			no							X
	4-Nitroaniline	0%	--	4.4E+00	3.8E+00	C	yes	no		yes				X
	4-Nitrophenol	0%	--	3.4E+00			no							X
	Acenaphthene	0%	--	1.7E+00	5.3E+01	NC	yes	no		no			X	
	Acenaphthylene	0%	--	2.3E+00			no							X
	Anthracene	0%	--	2.5E+00	1.8E+02	NC	yes	no		no			X	
	Benzo(a)anthracene	0%	--	5.1E+00	1.2E-02	C	yes	no		yes				X
	Benzo(a)pyrene	0%	--	2.4E+00	3.4E-03	C	yes	no		yes				X
	Benzo(b)fluoranthene	0%	--	2.5E+00	3.4E-02	C	yes	no		yes				X
	Benzo(g,h,i)perylene	0%	--	2.5E+00			no							X
	Benzo(k)fluoranthene	0%	--	2.8E+00	3.4E-01	C	yes	no		yes				X
	bis(2-chloroethoxy)methane	0%	--	1.6E+00	5.9E+00	NC	yes	no		no			X	
	bis(2-chloroethyl)ether	0%	--	2.3E+00	1.4E-02	C	yes	no		yes				X
	Bis(2-chloroisopropyl)ether	0%	--	2.3E+00	7.1E+01	NC	yes	no		no			X	
	Bis(2-ethylhexyl)phthalate	0%	--	2.4E+00	5.6E+00	C	yes	no		no			X	
	Butyl benzyl phthalate	0%	--	1.9E+00	1.6E+01	C	yes	no		no			X	
	Carbazole	0%	--	2.7E+00			no							X
	Chrysene	0%	--	2.3E+00	3.4E+00	C	yes	no		no			X	
	Dibenzo(a,h)anthracene	0%	--	1.8E+00	3.4E-03	C	yes	no		yes				X
	Dibenzofuran	0%	--	2.3E+00	7.9E-01	NC	yes	no		yes				X
	Dibutyl phthalate	0%	--	2.5E+00	9.0E+01	NC	yes	no		no			X	
	Diethyl phthalate	0%	--	2.5E+00	1.5E+03	NC	yes	no		no			X	
	Dimethyl phthalate	0%	--	2.4E+00			no							X
	Di-n-octyl phthalate	0%	--	1.7E+00	2.0E+01	NC	yes	no		no			X	
	Fluoranthene	0%	--	2.5E+00	8.0E+01	NC	yes	no		no			X	
	Fluorene	0%	--	2.4E+00	2.9E+01	NC	yes	no		no			X	
	Hexachlorobenzene	0%	--	2.6E+00	9.8E-03	C	yes	no		yes				X
	Hexachlorobutadiene	0%	--	1.7E+00	1.4E-01	C	yes	no		yes				X
	Hexachloroethane	0%	--	1.7E+00	3.3E-01	C	yes	no		yes				X
	Indeno(1,2,3-cd)pyrene	0%	--	1.8E+00	3.4E-02	C	yes	no		yes				X
	Isophorone	0%	--	1.6E+00	7.8E+01	C	yes	no		no			X	
	m & p-cresols	0%	--	2.3E+00	1.4E+02	NC	yes	no		no			X	
	Naphthalene	0%	--	2.0E+00	1.7E-01	C	yes	no		yes				X
	Nitrobenzene	0%	--	2.5E+00	1.4E-01	C	yes	no		yes				X
	N-Nitrosodimethylamine	0%	--	2.3E+00	1.1E-04	C	yes	no		yes				X
	N-Nitrosodi-n-propylamine	0%	--	2.3E+00	1.1E-02	C	yes	no		yes				X
	N-Nitrosodiphenylamine	0%	--	4.0E+00	1.2E+01	C	yes	no		no			X	
	o-Cresol	0%	--	2.0E+00	9.3E+01	NC	yes	no		no			X	
	p-Chloroaniline	0%	--	3.7E+00	3.7E-01	C	yes	no		yes				X
	Pentachlorophenol	0%	--	2.2E+00	4.1E-02	C	yes	no		yes				X
	Phenanthrene	0%	--	2.6E+00			no							X
	Phenol	0%	--	2.3E+00	5.8E+02	NC	yes	no		no			X	
	Pyrene	0%	--	2.5E+00	1.2E+01	NC	yes	no		no			X	

RBC = risk-based concentration; MDL = method detection limit; ND = non-detects; TEQ = Toxicity Equivalence; C = cancer; NC = non-cancer

[a]Risk-based concentrations are based on generic residential tapwater RSL values using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value) (USEPA 2016).

[b]Chromium was measured as total chromium. For the purposes of COPC selection, the maximum detected chromium concentration in surface water was compared to the cancer-based RBC for Cr(VI) of3.5E-02 ug/L and to the non-cancer based RBC for Cr(III) of 2.2E+03.

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

APPENDIX A

OU1 Data

[*See electronic file Smurfit OU1 HHRA Appendix A.xlsx*]

APPENDIX B

Screening Level Evaluations

This appendix presents a screening level evaluation of those pathways identified as "minor" in the OU1 conceptual site model (CSM) (see Figure 3-1 of the main document). These pathways include the following:

- Inhalation of soil particulates generated via wind erosion
- Inhalation of vapors released from surface soils
- Dermal contact with groundwater used in future commercial buildings
- Inhalation of volatile contaminants released indoors during water use in future commercial buildings
- Vapor intrusion

As discussed in the main text of the human health risk assessment (HHRA) for the OU1 site, ingestion is the primary pathway by which exposure to site media is expected to occur at the OU1 site. In general, the above pathways are considered minor exposure pathways when compared to the ingestion pathway. This screening level evaluation considers the relative risks from exposure to a chemical from each of the pathways listed above compared to the relative risks from exposure of the same chemical via the ingestion pathway.

Inhalation of Contaminants in Soil

As described in the main text of this HHRA, human receptors at the OU1 site may be exposed to contaminated soil via inhalation of soil particulates suspended in air by wind disturbance or via inhalation of vapors in the air emitted from soil. This section evaluates the relative comparison between the ingestion pathway and the inhalation pathway for exposures to soil. The basic equations recommended by USEPA (1989; 2009) for evaluating exposures via ingestion and inhalation are described in brief below.

<u>Ingestion Exposures</u>

The daily ingested intake for chronic exposures is calculated as (USEPA 1989):

$$DI = C \cdot (IR / BW) \cdot (EF \cdot ED / AT)$$

where:

DI = Daily intake of chemical (mg per kg of body weight per day).
C = Concentration of the chemical in the contaminated environmental medium (soil, water) to which the person is exposed. The units are mg/kg for soil and mg/m^3 for air.

IR	=	Intake rate of the contaminated environmental medium. The units are kg/day for soil and L/day for water.
BW	=	Body weight of the exposed person (kg).
EF	=	Exposure frequency (days/year).
ED	=	Exposure duration (years).
AT	=	Averaging time (days).

Inhalation Exposures

The inhaled exposure concentration (EC) for chronic exposures is calculated as (USEPA 2009):

$$EC = Ca \cdot (ET \cdot EF \cdot ED / AT)$$

where:

EC	=	Exposure Concentration ($\mu g/m^3$). This is the time-weighted concentration based on the characteristics of the exposure scenario being evaluated.
Ca	=	Concentration of the chemical in air ($\mu g/m^3$) to which the person is exposed.
ET	=	Exposure time (hours/day).
EF	=	Exposure frequency (days/year).
ED	=	Exposure duration (years).
AT	=	Averaging time (hours).

and

Ca	=	Cs / PEF or VF

where:

Cs	=	Concentration of the chemical in soil (mg/kg)
PEF	=	Particulate Emission Factor (m^3/kg)
VF	=	Volatilization Factor (m^3/kg)

To compare the relative contributions to exposure from the two pathways, non-cancer hazards and cancer risks were calculated as follows:

Non-cancer hazard quotients

$HQ = DI / RfD$ (ingestion pathway)

$HQ = EC / RfC$ (inhalation pathway)

Cancer risks

$Risk = DI \cdot SF$ (ingestion pathway)

$Risk = EC \cdot UR$ (inhalation pathway)

Based on the above equations, the relative magnitude of risks from inhalation exposures can be compared to risks from ingestion exposure by calculating the ratio as follows:

Ratio = Inhalation Risk / Ingestion Risk

Using the exposure parameters for a commercial worker presented in Table 3-1 of the main document, cancer risks and non-cancer HQ values were calculated for 2,3,7,8-TCDD (herein referred to as dioxin) as an example, assuming an arbitrary soil concentration.

Media	**Endpoint**	**Pathway**	**Ratio (Inhalation/Ingestion)**
Soil	Cancer	Inhalation (particulates)	6E-05 (<0.01%)
		Inhalation (vapor)	4E-02 (4%)
	Non-cancer	Inhalation (particulates)	3E-06 (<0.001%)
		Inhalation (vapor)	2E-03 (0.2%)

As shown in the table above, risks from inhalation exposures are small compared to risks from ingestion exposures (<5%). These findings support designating the inhalation pathways for soil exposures as minor for the purposes of this assessment.

Dermal Contact with Water

As described in the main text of this HHRA, if groundwater were used in future commercial buildings at the OU1 site, commercial workers may be exposed while washing hands. The basic equations recommended by USEPA (1989; 2004) for evaluating exposures and risk via dermal contact are described in brief below.

Dermal Exposure

The dermally absorbed dose (DAD) is quantified using an equation of the following general form (USEPA 2004):

$$DAD = DA_{event} \cdot EF \cdot ED \cdot EV \cdot SA / (BW \cdot AT)$$

where:

DAD	=	Dermally absorbed dose (mg of chemical per kg of body weight per day).
DA_{event}	=	Absorbed dose per event (mg of chemical per square centimeter of skin surface area per event).
EF	=	Exposure frequency (days/year).
ED	=	Exposure duration (years).
EV	=	Event frequency (events/day).
SA	=	Surface area (cm^2).
BW	=	Body weight of the exposed person (kg).
AT	=	Averaging time (days).

Non-cancer hazard quotients

$HQ = DAD/RfD_{ABS}$ (dermal pathway; $RfD_{ABS}=RfD \cdot ABS_{GI}$)

Cancer Risk

$Risk = DAD \cdot SF_{ABS}$ (dermal pathway; $SF_{ABS} = SF/ABS_{GI}$)

Using the exposure parameters for a commercial worker presented in Table 3-1 of the main document, a surface area of 980 cm^2 (hands only), and an exposure time of five minutes[1], dermal cancer risks and non-cancer HQ values were calculated for antimony as an example, assuming an arbitrary water concentration. The (dermal/ingestion) ratio between the non-cancer HQs for antimony is 8E-05 (0.01%). These findings support designating the dermal pathway for groundwater exposures to hypothetical future commercial workers as minor for the purposes of this assessment.

References

USEPA. 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. United States Environmental Protection Agency, Office of Emergency and Remedial Response. EPA/540/R/99/005. July.

USEPA. 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. United States Environmental Protection Agency, Office of Emergency and Remedial Response. EPA-540-R-070-002. OSWER 9285.7-82. January.

USEPA. 2016. Vapor Intrusion Screening Level Calculator (VISL). Version 3.5.1. Based on the May 2016 USEPA Regional Screening Level Tables. https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-levels-visls.

[1] The CDC recommends washing hands for at least 20 seconds (http://www.cdc.gov/features/handwashing/). A conservative estimate of 5 minutes spent washing hands during an 8 hour work day was assumed.

APPENDIX C

ProUCL Output Comparing Site and Background Data

OU1 SOIL

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	Revised Background Comparison OU1.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

ALUMINUM

Sample 1 Data: Al

Sample 2 Data: BkgAl

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	0	0
Number of Detect Data	96	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	1190	4150
Maximum Detect	30700	33700
Mean of Detects	12686	15522
Median of Detects	12150	15000
SD of Detects	6388	5758

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	8675
Standardized WMW U-Stat	-3.137
Mean (U)	5376
SD(U) - Adj ties	432.7
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	8.53E-04

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

ARSENIC

Sample 1 Data: As
Sample 2 Data: BkgAs

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	0	0
Number of Detect Data	96	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	1.1	1.5
Maximum Detect	7.9	81.9
Mean of Detects	4.176	11.41
Median of Detects	3.9	8.45
SD of Detects	1.496	11.6

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	5862
Standardized WMW U-Stat	-9.64
Mean (U)	5376
SD(U) - Adj ties	432.7
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	2.72E-22

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

CHROMIUM

Sample 1 Data: Cr

Sample 2 Data: BkgCr

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	5	0
Number of Detect Data	91	112
Minimum Non-Detect	0.16	N/A
Maximum Non-Detect	0.21	N/A
Percent Non-detects	5.21%	0.00%
Minimum Detect	1.2	3.2
Maximum Detect	18.5	130
Mean of Detects	10.84	19.6
Median of Detects	10.7	18.05
SD of Detects	3.562	12.22

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	5991
Standardized WMW U-Stat	-9.341
Mean (U)	5376
SD(U) - Adj ties	432.7
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	4.77E-21

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

COBALT

Sample 1 Data: Co
Sample 2 Data: BkgCo

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	0	0
Number of Detect Data	96	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.63	2.1
Maximum Detect	10	16.4
Mean of Detects	5.481	7.33
Median of Detects	5.2	6.9
SD of Detects	2.156	2.756

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	7995
Standardized WMW U-Stat	-4.71
Mean (U)	5376
SD(U) - Adj ties	432.7
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1.24E-06

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

IRON

Sample 1 Data: Fe
Sample 2 Data: BkgFe

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	0	0
Number of Detect Data	96	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	1660	6430
Maximum Detect	22000	59200
Mean of Detects	13048	18184
Median of Detects	12700	17650
SD of Detects	4884	6781

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	7491
Standardized WMW U-Stat	-5.873
Mean (U)	5376
SD(U) - Adj ties	432.7
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	2.13E-09

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

MANGANESE

Sample 1 Data: Mn
Sample 2 Data: BkgMn

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	0	0
Number of Detect Data	96	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	91.7	74
Maximum Detect	726	2920
Mean of Detects	329.6	508.4
Median of Detects	318.5	425
SD of Detects	144.4	369.2

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	7998
Standardized WMW U-Stat	-4.702
Mean (U)	5376
SD(U) - Adj ties	432.7
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1.29E-06

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

THALLIUM

Sample 1 Data: Th

Sample 2 Data: BkgTh

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	96	112
Number of Non-Detects	10	0
Number of Detect Data	86	112
Minimum Non-Detect	0.034	N/A
Maximum Non-Detect	0.052	N/A
Percent Non-detects	10.42%	0.00%
Minimum Detect	0.027	0.07
Maximum Detect	0.26	0.84
Mean of Detects	0.158	0.248
Median of Detects	0.165	0.235
SD of Detects	0.0413	0.112

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6565
Standardized WMW U-Stat	-8.026
Mean (U)	5376
SD(U) - Adj ties	432.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	5.04E-16

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

OU1 GROUNDWATER

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	Revised Background Comparison OU1_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

ARSENIC

Sample 1 Data: As
Sample 2 Data: BkgAs

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	8	5
Number of Non-Detects	0	0
Number of Detect Data	8	5
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.88	1.2
Maximum Detect	5	5.2
Mean of Detects	2.335	2.74
Median of Detects	1.65	1.7
SD of Detects	1.582	1.727

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	51
WMW U-Stat	15
Mean (U)	20
SD(U) - Adj ties	6.831
WMW U-Stat Critical Value (0.05)	9
Standardized WMW U-Stat	-0.81
Approximate P-Value	0.209

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	51
WMW U-Stat	15
Mean (U)	20
SD(U) - Adj ties	6.831
Lower U-Stat Critical Value (0.025)	7
Upper U-Stat Critical Value (0.975)	33
Standardized WMW U-Stat	-0.736
Approximate P-Value	0.462

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2

CHROMIUM

Sample 1 Data: Cr
Sample 2 Data: BkgCr

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	8	5
Number of Non-Detects	1	2
Number of Detect Data	7	3
Minimum Non-Detect	0.17	0.17
Maximum Non-Detect	0.17	0.22
Percent Non-detects	12.50%	40.00%
Minimum Detect	0.34	0.78
Maximum Detect	9.7	1.1
Mean of Detects	2.147	0.993
Median of Detects	0.73	1.1
SD of Detects	3.386	0.185

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.22 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	60
WMW U-Stat	24
Mean (U)	20
SD(U) - Adj ties	6.822
WMW U-Stat Critical Value (0.05)	9
Standardized WMW U-Stat	0.516
Approximate P-Value	0.697

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	0.589
Critical z (0.05)	-1.645
P-Value	0.722

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	0.589
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.556

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

COBALT

Sample 1 Data: Co
Sample 2 Data: BkgCo

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	8	5
Number of Non-Detects	5	5
Number of Detect Data	3	0
Minimum Non-Detect	0.13	0.13
Maximum Non-Detect	0.25	0.25
Percent Non-detects	62.50%	100.00%
Minimum Detect	0.6	N/A
Maximum Detect	1.6	N/A
Mean of Detects	1.01	N/A
Median of Detects	0.83	N/A
SD of Detects	0.524	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.25 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2
There are no detects in at least on of the groups - no analysis will be performed
Graphical displays may be helpful!

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	1.485
Critical z (0.05)	-1.645
P-Value	0.931

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	1.485
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.138

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

MANGANESE

Sample 1 Data: Mn
Sample 2 Data: BkgMn

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	8	5
Number of Non-Detects	2	4
Number of Detect Data	6	1
Minimum Non-Detect	0.24	0.14
Maximum Non-Detect	0.24	0.24
Percent Non-detects	25.00%	80.00%
Minimum Detect	0.69	1.1
Maximum Detect	1590	1.1
Mean of Detects	549	1.1
Median of Detects	425.5	1.1
SD of Detects	657.7	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.24 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	69
WMW U-Stat	33
Mean (U)	20
SD(U) - Adj ties	6.831
WMW U-Stat Critical Value (0.05)	9
Standardized WMW U-Stat	1.925
Approximate P-Value	0.973

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

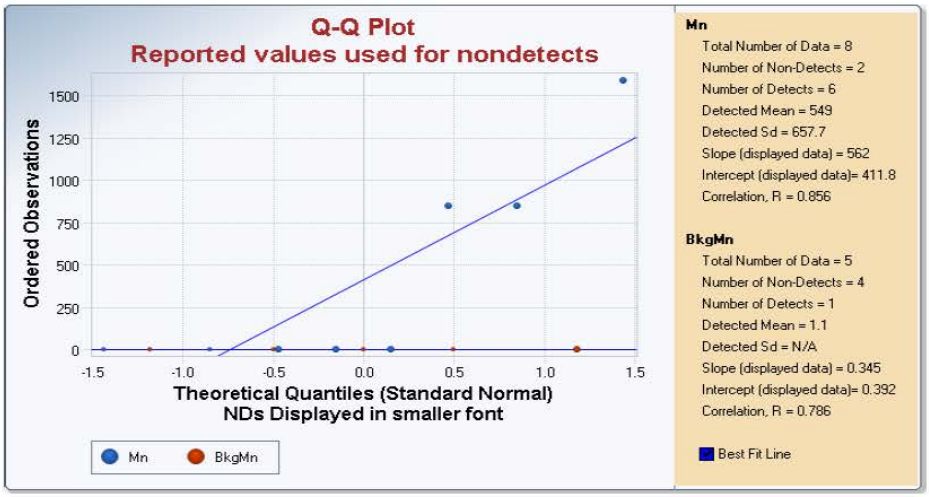
Gehan z Test Value	2.002
Critical z (0.05)	-1.645
P-Value	0.977

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	2.002
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.0453

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)


Q-Q Plot
Reported values used for nondetects
Ordered Observations
1500
1250
1000
750
500
250
0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Theoretical Quantiles (Standard Normal)
NDs Displayed in smaller font
Mn
BkgMn
Mn
Total Number of Data = 8
Number of Non-Detects = 2
Number of Detects = 6
Detected Mean = 549
Detected Sd = 657.7
Slope (displayed data) = 562
Intercept (displayed data)= 411.8
Correlation, R = 0.856
BkgMn
Total Number of Data = 5
Number of Non-Detects = 4
Number of Detects = 1
Detected Mean = 1.1
Detected Sd = N/A
Slope (displayed data) = 0.345
Intercept (displayed data)= 0.392
Correlation, R = 0.786
Best Fit Line

OU1 SEDIMENT

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	Revised Background Comparison OU1_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

ALUMINUM

Sample 1 Data: Al

Sample 2 Data: BkgAl

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	11
Number of Non-Detects	0	0
Number of Detect Data	5	11
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	7220	2170
Maximum Detect	13500	11700
Mean of Detects	9808	6568
Median of Detects	7920	6570
SD of Detects	3202	2615

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	59
WMW U-Stat	44
Mean (U)	27.5
SD(U) - Adj ties	8.827
WMW U-Stat Critical Value (0.05)	13
Standardized WMW U-Stat	1.813
Approximate P-Value	0.965

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	59
WMW U-Stat	44
Mean (U)	27.5
SD(U) - Adj ties	8.827
Lower U-Stat Critical Value (0.025)	10
Upper U-Stat Critical Value (0.975)	45
Standardized WMW U-Stat	1.813
Approximate P-Value	0.0699

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 = Sample 2

ARSENIC

Sample 1 Data: As
Sample 2 Data: BkgAs

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	20
Number of Non-Detects	0	0
Number of Detect Data	5	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	2.7	1.2
Maximum Detect	13.4	21.43
Mean of Detects	7.38	12.32
Median of Detects	4.6	13.11
SD of Detects	5.013	5.799

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	40.5
WMW U-Stat	25.5
Mean (U)	50
SD(U) - Adj ties	14.72
WMW U-Stat Critical Value (0.05)	26
Standardized WMW U-Stat	-1.699
Approximate P-Value	0.0447

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

CHROMIUM

Sample 1 Data: Cr
Sample 2 Data: BkgCr

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	20
Number of Non-Detects	0	0
Number of Detect Data	5	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	8.1	3.1
Maximum Detect	14.3	22.32
Mean of Detects	10.66	11.2
Median of Detects	10.2	10.25
SD of Detects	2.501	5.028

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	68
WMW U-Stat	53
Mean (U)	50
SD(U) - Adj ties	14.72
WMW U-Stat Critical Value (0.05)	26
Standardized WMW U-Stat	0.17
Approximate P-Value	0.567

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	68
WMW U-Stat	53
Mean (U)	50
SD(U) - Adj ties	14.72
Lower U-Stat Critical Value (0.025)	21
Upper U-Stat Critical Value (0.975)	79
Standardized WMW U-Stat	0.17
Approximate P-Value	0.865

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2

COBALT

Sample 1 Data: Co
Sample 2 Data: BkgCo

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	11
Number of Non-Detects	0	0
Number of Detect Data	5	11
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	3.3	1.6
Maximum Detect	13.2	6
Mean of Detects	7.24	4.282
Median of Detects	6.2	4.8
SD of Detects	3.832	1.427

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	58
WMW U-Stat	43
Mean (U)	27.5
SD(U) - Adj ties	8.821
WMW U-Stat Critical Value (0.05)	13
Standardized WMW U-Stat	1.702
Approximate P-Value	0.956

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	58
WMW U-Stat	43
Mean (U)	27.5
SD(U) - Adj ties	8.821
Lower U-Stat Critical Value (0.025)	10
Upper U-Stat Critical Value (0.975)	45
Standardized WMW U-Stat	1.759
Approximate P-Value	0.0787

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2

IRON

Sample 1 Data: Fe
Sample 2 Data: BkgFe

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	20
Number of Non-Detects	0	0
Number of Detect Data	5	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	8390	3780
Maximum Detect	25100	21427
Mean of Detects	14378	12263
Median of Detects	11900	12150
SD of Detects	6386	4095

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	68
WMW U-Stat	53
Mean (U)	50
SD(U) - Adj ties	14.72
WMW U-Stat Critical Value (0.05)	26
Standardized WMW U-Stat	0.17
Approximate P-Value	0.567

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	68
WMW U-Stat	53
Mean (U)	50
SD(U) - Adj ties	14.72
Lower U-Stat Critical Value (0.025)	21
Upper U-Stat Critical Value (0.975)	79
Standardized WMW U-Stat	0.204
Approximate P-Value	0.838

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2

MANGANESE

Sample 1 Data: Mn
Sample 2 Data: BkgMn

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	20
Number of Non-Detects	0	0
Number of Detect Data	5	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	61.5	112
Maximum Detect	480	1775
Mean of Detects	260.3	589.9
Median of Detects	202	495.7
SD of Detects	168.5	486.8

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	41
WMW U-Stat	26
Mean (U)	50
SD(U) - Adj ties	14.72
WMW U-Stat Critical Value (0.05)	26
Standardized WMW U-Stat	-1.664
Approximate P-Value	0.048

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	41
WMW U-Stat	26
Mean (U)	50
SD(U) - Adj ties	14.72
Lower U-Stat Critical Value (0.025)	21
Upper U-Stat Critical Value (0.975)	79
Standardized WMW U-Stat	1.597
Approximate P-Value	0.11

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2

OU1 SURFACE WATER

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options	
From File	Revised Background Comparison OU1_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

ARSENIC

Sample 1 Data: As

Sample 2 Data: BkgAs

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	2	41
Number of Non-Detects	0	0
Number of Detect Data	2	41
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	1.6	0.4
Maximum Detect	1.7	20.1
Mean of Detects	1.65	6.874
Median of Detects	1.65	5.8
SD of Detects	0.0707	4.612

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	7
Standardized WMW U-Stat	-2.163
Mean (U)	41
SD(U) - Adj ties	17.33
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.0153

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

CHROMIUM

Sample 1 Data: Cr
Sample 2 Data: BkgCr

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	2	5
Number of Non-Detects	1	5
Number of Detect Data	1	0
Minimum Non-Detect	0.17	0.17
Maximum Non-Detect	0.17	0.17
Percent Non-detects	50.00%	100.00%
Minimum Detect	1.2	N/A
Maximum Detect	1.2	N/A
Mean of Detects	1.2	N/A
Median of Detects	1.2	N/A
SD of Detects	N/A	N/A

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2
There are no detects in at least on of the groups - no analysis will be performed
Graphical displays may be helpful!

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	1.581
Critical z (0.05)	-1.645
P-Value	0.943

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	1.581
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.114

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

Table C-1. Summary of ProUCL Statistical Testing

Media	Chemical	Test	Null Hypothesis	Conclusion
Soil	Aluminum	WMW	H0: Site >= Background	Reject H0, Conclude site < background.
	Arsenic	WMW		Reject H0, Conclude site < background.
	Chromium	WMW		Reject H0, Conclude site < background.
	Cobalt	WMW		Reject H0, Conclude site < background.
	Iron	WMW		Reject H0, Conclude site < background.
	Manganese	WMW		Reject H0, Conclude site < background.
	Thallium	WMW		Reject H0, Conclude site < background.
Groundwater	Arsenic	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Chromium	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
		Gehan	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Cobalt	WMW	H0: Site >= Background	Data cannot be analyzed.
		Gehan	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Manganese	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
		Gehan	H0: Site >= Background	**Do Not Reject H0, Conclude site >= background.**
			H0: Site = Background	**Reject H0, Conclude site <> background.**
Sediment	Aluminum	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Arsenic	WMW	H0: Site >= Background	Reject H0, Conclude site < background.
	Chromium	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Cobalt	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Iron	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
	Manganese	WMW	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.
Surface Water	Arsenic	WMW	H0: Site >= Background	Reject H0, Conclude site < background.
	Chromium	WMW	H0: Site >= Background	Data cannot be analyzed.
		Gehan	H0: Site >= Background	Do Not Reject H0, Conclude site >= background.
			H0: Site = Background	Do Not Reject H0, Conclude site = background.

EPA's Response to Comments Received on the Draft Smurfit OU1 Human Health Risk Assessment

Comments Received from the Respondents

Comment #1: Page 2, Section 2.1, 3rd paragraph, 2nd sentence: "results" should be "resulted"

EPA Response: This change has been made in the revised draft.

Comment #2: Page 4, top of page: recommend that "Site activities and waste disposal practices contaminated soil, sediment, surface water and groundwater. Excess exposures to the contaminants used or produced by mill operations are known to cause a range of non-cancer and cancer effects in humans,…" be changed to "Site activities and waste disposal practices ~~contaminated~~ may have contaminated soil, sediment, surface water and groundwater. Excess exposures to the contaminants used or produced by mill operations ~~are known to cause~~ may cause a range of non-cancer and cancer effects in humans,…"

EPA Response: This change has been made in the revised draft.

Comment #3: Page 4, Section 2.5, last paragraph: reference to Figure 3-1 is incorrect [Figure 3-1 is the CSM]

EPA Response: Figure 2-3 showing sediment and surface water sampling locations has been added in the revised draft and this citation has been corrected.

Comment #4: Page 9, bottom of page: recommend rewording, "...it is anticipated that primary dermal exposure by workers…" to "dermal exposure by workers would primarily be the result of..."

EPA Response: This change has been made in the revised draft.

Comment #5: Recommend replacing "contaminant" with "chemical" throughout HHRA

EPA Response: The HHRA will maintain the use of "contaminant" to be consistent with the AOC language which refers to "hazardous substances, pollutants or contaminants" (AOC Section III, paragraph 9, Statement of Purpose).

Comments Received by Montana Department of Environmental Quality

Comments were received from MDEQ on two separate drafts. The comments directly below refer to the Draft dated 10/13/16.

1. Once changes to the draft HHRA are made, Montana Department of Environmental Quality (DEQ) would like the opportunity to review the draft final version of the HHRA before the HHRA is finalized. If EPA could provide DEQ an estimated date on when the draft final HHRA will be completed and ready for review, DEQ will try to provide comments to EPA within 10 working days.

   EPA Response: The Revised Draft Smurfit OU1 HHRA will be made available to MDEQ and the Respondents in early January 2017 for review prior to finalization.

2. According to the Missoula County Planner letter dated October 19, 2016, Operable Unit (OU) 1 is not zoned commercial as previously suggested. Because the land is un-zoned, DEQ requests that EPA re-evaluate the HHRA for residential use, for soils, groundwater and surface waters as needed.
   - At the October 13, 2016, meetings in Missoula the agencies where told verbally the land was not zoned.
   - On October 20, 2016, EPA and DEQ received a written notice from Missoula County that the land was not zoned.
   - DEQ received a draft HHRA to review on October 24, 2016.
   - Because of the timing of the receipt of new information and the draft HHRA, DEQ is focusing comment more on the draft HHRA, not the COPC Memo.
   - The draft HHRA is based on the assumption the land was zoned commercial/industrial as told to the agencies by the PRP group earlier in the year.
   - Likely the final outcome of the HHRA screening level effort will not change, but the HHRA should still be re-done to include the hypothetical future residential receptors for soil, groundwater, and surface water and documented as such to avoid public concern in the future that it was not evaluated for residential use or that the HHRA was not completed correctly.
   - Changes to the draft HHRA may justify a need to update the Conceptual Site Model (CSM) and the COPCs Memo.

   EPA Response: The Draft Smurfit OU1 HHRA has been revised to include a hypothetical future residential exposure scenario in the CSM.

3. As DEQ has indicated before, the OU1 soil should be screened using both commercial/industrial screening levels as well as construction worker screening levels as either one or the other may be the more conservative. However, because now another option is needed to screen for residential use and it is likely to demonstrate that if the concentrations in soils and groundwater at the site are protective for residential use, they would also be protective of commercial/industrial use (for that matter, all other future uses).
    - There are comments below that provide examples of site COPCs with commercial/industrial screening levels that are lower than the construction worker screening levels. It is important for this issue to be resolved now as it will likely apply to the OU2 and OU3 HHRA work effort.
    - Emails dated October 11 and 12, 2016 between the EPA and DEQ risk assessors did not fully resolve the issues before the October 13th meetings in Missoula.

    EPA Response: The Draft Smurfit OU1 HHRA has been revised to include a hypothetical future residential exposure scenario in the CSM. As such, the revised screening approach utilizes the residential receptor to represent the most conservative exposure scenario. If further risk characterization is required for OUs 2 and 3, additional consideration will be given to evaluating commercial/industrial workers and construction workers as may be appropriate.

4. Page 6, Section 3.1; people are living in a house on the west end of Loiselle Lane (as discussed in the text of the draft report, the address is 14500 Loiselle Lane, which should also be added to the text); DEQ recommends EPA have the PRPs sample the soils on the Loiselle Lane property (that is located inside of OU-1) and evaluate that data before finalizing the HHRA. If COPCs are found in any of the soils on the Loiselle Lane property, further investigation may be warranted before the HHRA may be finalized.

    EPA Response: In order to retain confidentiality the specific address of this property was not included in the risk assessment. Additional sampling at this property should be discussed by project managers.

5. Page 6, Section 3.1, 3rd paragraph: This paragraph is misleading and may not reflect additional information provided by Missoula County or the public over the course of the last few months. After the site visit on October 14, 2016, DEQ believes that the CSM may not be based upon appropriate assumptions.
    - There are viable homes in and around OU1. According to the County Planner OU1 is not zoned at all and may be used for any use.

- The potentially responsible parties (PRPs) contractor has indicated M2Green has already sold or traded some parcels in OU1, and may sell and/or subdivide other sections within OU1.
- It is unclear whether the current property owner (who is not a PRP) will consent to future Institutional Controls (ICs) on their property, if ICs are necessary to ensure protectiveness. EPA does not have any assurances from M2Green that they will refrain from disposing of additional property in OU1, either through sale or as payment for services rendered.
- In addition, the EPA does not appear to have the full cooperation of M2Green at this time. Note, DEQ does support EPA's enforcement strategy at this site.
- DEQ previously requested (verbally) that EPA re-evaluate the CSM based upon this additional information and EPA has not addressed DEQ's request.
- The risk assessment should include a full evaluation of potential residential usage.
- If the property use must be restricted, that is a risk management decision which should be made as part of the remedy determination, not as part of the risk assessment. Institutional Controls are not a "no action" alternative and, if they are required, OU1 cannot be carved out of the (Superfund) site.

EPA Response: The Draft Smurfit OU1 HHRA has been revised to include a hypothetical future residential exposure scenario in the CSM.

6. Page 6, Section 3.1, 3rd paragraph, 3rd sentence: Please add "for soil" after assessment. The residential screening assessment did not include groundwater or surface water and therefore, OU1 has not been determined to be suitable for residential, unrestricted use. Groundwater screening should also be conducted based upon EPA and DEQ-7 Standards and unrestricted use.

   EPA Response: This sentence has been deleted from the revised text. The Revised Draft includes residential-based screening assessments for all media sampled at the OU1 site.

7. Page 9, Section 3.2.2: This approach did not include screening against DEQ-7 Standards and unrestricted use as it should have. DEQ does not support the approach of calculating commercial/industrial screening levels for groundwater and surface water. This presumes that the water usage will be restricted, thus preselecting a remedy. DEQ requests the groundwater and surface water be screened with its primarily risk-based DEQ-7 human health standards or where these are unavailable the EPA tap water regional screening levels (RSLs) for residential use.

In the case of OU1, DEQ performed this appropriate screening and determined that all concentrations in groundwater and surface water are below the standards or RSLs with the exception of manganese in groundwater and dioxins/furans in surface water. Manganese exceeds the RSL of 430 micrograms/liter (µg/L) based upon a hazard quotient of 1. If the EPA RSL is used and adjusted to represent a hazard quotient of 1, groundwater use will still require restrictions. The dioxin/furan concentration in surface water exceeds the DEQ-7 standard of 5.0E-09 µg/L and requires further evaluation (e.g., comparison to background concentrations, which has not been included in text of the memo).

DEQ requests that EPA screen the groundwater against the DEQ-7 dioxin primarily risk-based human health standard and the EPA dioxin MCL and the EPA regional screening levels (RSL) for residential use. Regarding dioxins in groundwater, it is recommended to screen against all three to help improve the understanding of potential dioxin risk.

EPA Response: The Draft Smurfit OU1 HHRA has been revised to indicate that OU1 is currently not zoned and groundwater and surface water OU1 data were screened against EPA's residential tapwater screening levels. These screening levels were selected given that this is a risk-based assessment and they represent risk-based concentrations based on EPA's standard default exposure parameters. Federal and/or State ARARs will be evaluated in the RI.

8. Page 12, Section 3.3.1, 2nd sentence; DEQ does not agree that the screening process was completed with enough conservatism since the screening is based upon restricted land use. Please see previous and subsequent comments for details.

   EPA Response: The Draft Smurfit OU1 HHRA has been revised to indicate that OU1 is currently not zoned and to include a hypothetical future residential exposure scenario in the CSM. The text has been updated to reflect this change.

9. Page 13, Section 3.3.2: After the site visit on October 14, 2016, DEQ believes that the CSM may not be based upon appropriate assumptions. There are viable homes in and around OU1. According to the County Planner OU1 is not zoned commercial as previously indicated by EPA. Apparently the land owners have already sold some parcels in OU1 and intend to sell and possible subdivide others. This means that already the PRPs and EPA may not be able to apply institutional controls restricting use. DEQ requests that EPA re-evaluate the CSM based upon this additional information.

EPA Response: The Draft Smurfit OU1 HHRA has been revised to include a hypothetical future residential exposure scenario in the CSM. The text has been updated to reflect this change.

10. Page 14, Section 3.3.2, last sentence: As DEQ has previously indicated the soil must be screened using both commercial/industrial screening levels as well as construction worker screening levels as either one or the other may be the more conservative. EPA has not done so and instead has retained language that incorrectly indicates that construction worker exposure is more conservative than commercial/industrial. The following table shows screening levels for COPCs at this site for which the commercial/industrial screening levels are lower than the construction workers screening levels EPA has calculated. This is relevant because the statement in the HHRA is not correct and because DEQ does not want to see this approach used at subsequent OUs or other sites.

Analyte	Construction RBC (mg/kg)	Commercial RBC (mg/kg)
Toxicity Equivalence Dioxins	4.6E-05	2.2E-05
Chromium VI	5.9E+02	6.3E+00
Benzo(a)anthracene	4.8E+01	2.9E+00
Benzo(a)pyrene	4.8E+00	2.9E-01
Benzo(b)fluoranthene	4.8E+01	2.9E+00
Benzo(k)fluoranthene	4.8E+02	2.9E+01
Chrysene	4.8E+03	2.9E+02
Dibenzo(a,h)anthacene	4.8E+00	2.9E-01
Indeno(1,2,3-cd)pyrene	4.8E+01	2.9E+00
Naphthalene	1.1E+02	1.7E+01

EPA Response: The draft OU1 HHRA has been revised to use residential screening levels to evaluate the most conservative potential receptor, a hypothetical future resident.

11. Page 17, Section 6.0: Please correct the text of this section to address previous comments above.

EPA Response: The text has been revised accordingly.

12. In the case of OU1, it should be noted, manganese exceed the RSL of 430 micrograms/liter (µg/L) based upon a hazard quotient of 1 in well SMW-4. If the EPA risk-based concentration is used and adjusted to represent a hazard quotient of 1, groundwater use will likely require restrictions because of the manganese in one well.

EPA Response: The revised OU1 HHRA includes a screening assessment of OU1 groundwater concentrations compared to residential screening levels. Restrictions on well SMW-4 will be considered as part of the risk management decision-making process.

13. EPA should require that well SWM-4 be further evaluated.

    EPA Response: The revised OU1 HHRA includes an assessment of the available data from SMW-4. Additional sampling of SMW-4 should be discussed by the project managers.

14. Surface waters - if the dioxin/furan concentration in surface water exceeds the DEQ-7 standard of 5.0E-09 µg/L (0.005 pg/L) and requires further evaluation (e.g., comparison to background concentrations, then those evaluations should also be included in the OU-1 HHRA). If surface waters are to be compared to background, then additional surface water sampling should be conducted to help make a more robust data set for surface water evaluations.

    EPA Response: Based on EPA's residential drinking water screening levels, the maximum detected concentrations of TEQ in the two available surface water samples were found to exceed the selected RBCs. As such, available site data were compared to background data for TEQ and it was determined that site concentrations in surface waters from O'Keefe and Lavalle Creeks are comparable or below background concentrations. Uncertainties in the statistical tests based on the limited sample size are discussed in the uncertainty section. Additional surface water sampling should be discussed by the project managers.

15. Many of these DEQ comments needed to be and should be addressed now so these type of issues/concerns do not arise again during the risk assessment work effort for OU2 and OU3.

    EPA Response: The DEQ comments have been addressed as described above.

Comments were received from MDEQ on two separate drafts. Based on the above comments, USEPA prepared a revised draft HHRA that included the residential scenario. The comments below refer to the Revised Draft dated 01/04/17.

1. Page 1, Section 1.1, first paragraph—change from the use of "chemicals" to "contaminants" throughout the document. Throughout the AOC beginning in Section III, paragraph 9, STATEMENT OF PURPOSE, the document refers to "hazardous substances, pollutants or contaminants". To be consistent with the AOC language the change should be made from "chemicals" to "contaminants" or from "chemicals" to "hazardous substances, pollutants or contaminants" throughout the HHRA.

   EPA Response: EPA agrees that the HHRA should retain language consistent with the AOC.

2. Page 3, Section 2.1, add a new sentence after the first sentence on the top of page 3 "USEPA has been in consultation with MDEQ throughout the CERCLA since it began at the Site in 2011 including the development of the agreement; however, it should be noted that MDEQ is not a signatory party to the agreement between USEPA and the Respondents". Page 3, last sentence in Section 2.1; suggest changing "USEPA has divided" to "USEPA, MDEQ and the Respondents have agreed to divide". Also to consider, should it be "Site" or "site" throughout the document and this section?

   EPA Response: The text has been revised accordingly.

3. Page 3, Section 2.2, second paragraph, final sentence: DEQ suggest deleting the sentence. Expectations about future land use are speculative at this point. Current land use in the area includes residential. Also, some parcels of OU-1 have been sold or transferred by M2Green to other third parties and the agencies do not have a clear understanding at this time of the proposed uses for those parcels.

   EPA Response: The text has been revised accordingly.

4. Page 6, Figure 3-1, Conceptual Site Model, the model needs to be updated to include residents. EPA does not have a written guarantee or an agreement from the PRPs that residents do not live there now or will not live at that location in the future.

   EPA Response: The Conceptual Site Model includes the residential scenario. The figure has been modified to remove the separation of current and future use to more clearly demonstrate that the residential scenario is being evaluated in this assessment.

5. Page 7, Section 3-1, Current and Hypothetical Future Residents; in the second sentence, insert the word "verbal" in front of the word "correspondence". There are residential buildings within the Peterson ranch property located in OU-1 as discussed in the Preliminary Data Summary Report, Section 3.1.1. Some of the closest soils samples like samples SS27, 28-AG2 and SS23, 24-AG2 are at least 200 to 300 feet away from the

front and backyard areas of those OU-1 residential buildings. Soils within the yard areas have not been sampled. DEQ recommends EPA require the PRPs to collect soil samples within the residential yard areas of each potential home located within OU-1. Again, EPA does not have a written guarantee or an agreement from the PRPs that residents do not live there now or will not live at that location in the future.

EPA Response: Because none of the soil samples collected in OU1 had elevated levels of COCs, EPA does not believe that there is a need to collect soil samples at the Peterson property.

6. The PRPs have agreed to sample the drinking water wells at the ranch located in OU-1 the week of January 23, 2017. If the water is contaminated with contaminants above drinking water standards; will EPA have to go back and re-evaluate for ranchers, farmers or renters and include that evaluation in the HHRA?

   EPA Response: EPA will evaluate the groundwater analytical data from the Peterson well.

7. Page 10, Section 3.2.2, the sentence, "Hypothetical future residents or commercial workers may ingest site groundwater as drinking water" appears in the text. On January 11, 2017 the PRPs agreed to further investigate the elevated Manganese issue in monitoring well SMW-4 located within OU-1. After the results of the new investigation are known to EPA/DEQ, DEQ is wondering if the agencies may need to reevaluate the statement above and provide additional information, if needed, about the groundwater as a safe drinking water source. Example, maybe an additional sentence should be considered like "It should be noted that some areas of OU-1 may have elevated levels of naturally occurring Manganese" or something completely different if the new investigation still does not answer the question; Why are there elevated levels of Manganese in areas of OU-1, like wells SMW-4 and RE289?

   EPA Response: EPA will evaluate the memo submitted by the PRPs concerning the manganese associated with SMW-4.