Remedial Investigation/Feasibility Study Work Plan

Marshall Landfill Site
Marshall, Washington

for
Washington State Department of Ecology
Ecology Contract No. C1100145

January 28, 2015

GeoEngineers

523 East Second Avenue
Spokane, Washington 99202
509.363.3125

Remedial Investigation/Feasibility Study
Work Plan

Marshall Landfill Site
Marshall, Washington

File No. 0504-104-00

January 28, 2015

Prepared for:

Washington State Department of Ecology
Toxics Cleanup Program – Eastern Region Office
4601 North Monroe Street
Spokane, Washington 99205

Attention: Patrick Cabbage

Prepared by:

GeoEngineers, Inc.
523 East Second Avenue
Spokane, Washington 99202
509.363.3125

_____

John R. Haney, PE
Senior Environmental Engineer

_____

Bruce D. Williams
Principal

JRH:BDW:tjh

Table of Contents

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

ARAR – Applicable, Relevant and Appropriate Requirements

ASTM – ASTM International

bgs – below ground surface

CAS – Chemical Abstracts Service

CFR – Code of Federal Regulations

COC – chain-of-custody

COPCs – contaminants of potential concern

cPAH – carcinogenic polycyclic aromatic hydrocarbon

CRBG – Columbia River Basalt Group

CSM – conceptual site model

dBA - decibels

DNAPL – dense non-aqueous phase liquid

DOT – Department of Transportation

DOSH – Division of Occupational Safety and Health

DRPH – diesel-range petroleum hydrocarbons

Ecology – Washington State Department of Ecology

EDD – Electronic Data Deliverable

EIM – Environmental Information Management

EPA – Environmental Protection Agency

Fetrow – Fetrow Engineering, Inc.

FID – flame ionization detector

FS – Feasibility Study

GeoEngineers – GeoEngineers, Inc.

Golder – Golder Associates

ACRONYMS AND ABBREVIATIONS (CONTINUED)

gpm – gallons per minute

GPS – global positioning system

GRPH – gasoline-range petroleum hydrocarbons

HASP – Health and Safety Plan

HAZMAT – hazardous materials

HAZWOPER – Hazardous Waste Operations and Emergency Response

HPLC – high performance liquid chromatography

HSM – health and safety manager

IDL – instrument detection limit

IDLH – immediately dangerous to life or health

IDW – investigation derived waste

kV – kilovolts

LAWS – Land and Water Services, Inc.

LCS – laboratory control spike

LCSD – laboratory control spike duplicate

LEL – lower explosive limit

LNAPL – light non-aqueous phase liquid

MA – million years ago

MDL – method detection limit

mg/m^3 – milligrams per cubic meter

MQO – measurement quality objectives

MS – matrix spike

MSD – matrix spike duplicate

MSW – municipal solid waste

ACRONYMS AND ABBREVIATIONS (CONTINUED)

MTCA – Model Toxics Control Act

NIOSH – National Institute for Occupational Health and Safety

ORP – oxidation-reduction potential

ORPH – oil-range petroleum hydrocarbons

OSHA – Occupational Health and Safety Administration

PAHs – polycyclic aromatic hydrocarbons

PARCC – precision, accuracy, representativeness, completeness and comparability

PCBs – polychlorinated biphenyls

PCE – tetrachloroethene

PCP – pentachlorophenol

PE – professional engineer

PEL – permissible exposure limit

PGG – Pacific Groundwater Group

PID – photo-ionization detector

PM – project manager

ppb – parts per billion

PPE – person protective equipment

ppm – parts per million

PQL – practical quantitation limit

PVC – polyvinyl chloride

QA – quality assurance

QAPP – Quality Assurance Project Plan

QC – quality control

RAOs – remedial action objectives

ACRONYMS AND ABBREVIATIONS (CONTINUED)

REL – recommended exposure limit

RI – Remedial Investigation

RPD – relative percent difference

SAP – Sampling and Analysis Plan

SOPs – standard operating procedures

SPT – standard penetration test

SRHD – Spokane Regional Health District

SSO – site safety officer

STEL – short-term exposure limit

SVOCs – semivolatile organic compounds

T&E – threatened and endangered

TBD – to be determined

TCA - trichloroethane

TCE - tricholoroethene

TEE – terrestrial ecology evaluation

TLV – threshold limit value

TPH – total petroleum hydrocarbons

TRL – target reporting limit

TWA – time-weighted average

VOCs – volatile organic compounds

WAC – Washington Administrative Code

WRIA -- Water Resource Inventory Area

1.0 INTRODUCTION

This Work Plan presents the scope of services and schedule to conduct a remedial investigation and feasibility study (RI/FS) at the Marshall Landfill site in Marshall, Washington (herein referred to as "Site"). The Site location is shown on the Vicinity Map, Figure 1. The potential for soil contamination at the Site is likely based on historic operations. Additionally, groundwater contamination has been documented beneath and near the Site; however, the current nature and extent of groundwater contamination are not understood.

1.1. Work Plan Organization

This Work Plan describes the pre-field, field, and non-field activities that comprise the RI/FS scope of services, including descriptions of the methods, equipment and procedures pertaining to the field work. This Work Plan was prepared in general accordance with the requirements defined by the Model Toxics Control Act (MTCA) Regulation (Washington Administrative Code [WAC] 173-340-350), and provides details for describing the proposed field investigation, data analysis program, anticipated schedule and reporting. The project Sampling and Analysis Plan (SAP) is presented as Appendix A of this Work Plan. The project Quality Assurance Project Plan (QAPP) is presented as Appendix B of this Work Plan. GeoEngineers' site-specific Health and Safety Plan (HASP) for the project is presented as Appendix C of this Work Plan.

1.2. Scope of Services

GeoEngineers' scope of services for this project were provided to the Washington State Department of Ecology (Ecology) in our proposal dated May 1, 2014. The scope of services outlined in our proposal was based on Ecology's April 2014 "Work Plan for the Marshall Landfill Site." GeoEngineers conducted a Site visit with Ecology on June 25, 2014. We used information gathered from the Site visit and Ecology's Work Plan to prepare our draft August 7, 2014 "Pre-RI Site Assessment Work Plan." Our proposed pre-RI activities included a groundwater monitoring network data gap analysis, rehabilitation of groundwater monitoring wells (as necessary), exploratory test pits to better define the limits of waste at the Site, and surveying property boundaries/topography. Follow up discussions with Ecology resulted in their request to incorporate those pre-RI site assessment activities into this comprehensive RI/FS Work Plan.

The objectives of the Marshall Landfill RI/FS are to:

- Assess the adequacy of the existing groundwater monitoring network;
- Assess the nature and extent of remaining contamination associated with the Site to support the FS;
- Collect geotechnical data and complete geotechnical analyses to better understand the long-term stability of existing landfill slopes and to support the FS; and
- Complete an FS that evaluates cleanup technologies and alternatives, and recommends a cleanup action that meets MTCA requirements, protects human health and the environment and is appropriate for the Site.

2.0 BACKGROUND INFORMATION

2.1. Existing Site Conditions

The Site consists of two waste disposal areas: the approximate 25-acre "Main Landfill," which operated from 1970 through 1990, and an approximate 5-acre area known as the "Five-Acre Landfill," which operated from 1980 through 1984. Thickness of landfilled waste has been estimated at 100 feet in the Main Landfill and 45 feet in the Five-Acre Landfill. After disposal operations ceased in 1990, the Main Landfill was reportedly covered with a layer of fine to medium sand. A passive landfill gas venting system and a compacted-clay cap was installed in 1990 at the Five-Acre Landfill; however, the as-built condition of the clay cap is not well documented. Observations of the clay cap over the Five-Acre Landfill during recent Site visits indicate that the cap is not intact over the entire area of the landfill and some waste is exposed.

The southern and southeastern boundaries of the Main Landfill were buttressed with what appears to be a berm constructed of sandy materials from the adjacent gravel pit to the north of the site (see below). The buttress berm reportedly was constructed to add additional capacity to the Main Landfill. The design parameters and as-built constructed condition of the buttress berm are not well documented.

The area north of the Main Landfill and east of the Five-Acre Landfill currently is a gravel pit operated by Action Materials. The property adjacent to the southern boundary of the Main Landfill was operated by Spokane County as a daily-burn landfill from the 1950s until 1970. The Site is bounded on the east by South Cheney-Spokane Road and on the west by vacant land generally as depicted on Marshall Landfill Site Plan, Figure 2.

2.1.1. Geology

The Site's position near the east margin of the Columbia Plateau, combined with erosional structures associated with Pleistocene-age outburst flood events and more recent alluvial processes, has resulted in complex stratigraphic conditions beneath and adjacent to the Site. Based on our understanding of regional stratigraphy, available monitoring well logs and previous site studies (Fetrow Engineering [Fetrow], 1991; Pacific Groundwater Group [PGG], 2005), we interpret that the Site is underlain by five primary stratigraphic units. These include:

- Precambrian-age (greater than about 570 million years ago [MA]) metamorphic rocks associated with the Belt Supergroup and primarily consisting of gneiss and schist. These rocks were intruded by granitic plutonic rocks during the Mesozoic (245 to 65 MA) and Tertiary (65 to 1.5 MA). These are collectively designated "basement rocks" herein. Previous explorations have identified an intensely weathered upper section of basement rock beneath the site, variably described as clayey silt and/or saprolite and observed at a thickness of approximately 50 feet in monitoring well MW-7B.
- Miocene-age (23 to 5 MA) basalt flows associated with the Columbia River Basalt Group (CRBG). Two CRBG Formations, the Grande Ronde overlain by the Wanapum, have been identified within the Marshall area (Drost and Whiteman, 1986). We interpret that the Wanapum Basalt Formation is the primary CRBG unit penetrated by one Site monitoring well (MW-12A).
- Miocene-age Latah Formation, a sedimentary interbed within the CRBG consisting primarily of claystone, sandstone, and siltstone (PGG, 2005) (intensely weathered basement rocks).

- Pleistocene-age glaciofluvial (outburst flood) deposits, primarily composed of unsorted mixtures of silt, sand, gravel and cobbles. Flood deposits beneath the site range in thickness between about 11 feet (beneath the Five-Acre Landfill) to over 200 feet (PGG, 2005).
- Recent alluvial deposits consisting of interbedded silt, sand, and gravel deposited within the modern Minnie Creek and Marshall Creek drainages.

GeoEngineers reviewed and interpreted the boring logs provided in the PGG report and prepared geologic cross sections. The cross section transects are shown on Monitoring Wells and Cross Section Location Map, Figure 3; geologic Cross Sections A-A', B-B', and C-C' are provided in Figures 4 through 6, respectively, to aid in the visual interpretation of subsurface conditions.

2.1.2. Hydrogeology

General

The Site generally is underlain by a minimum of three hydrostratigraphic units. These aquifer systems occur within: (1) basement rocks; (2) the CRBG; and (3) glaciofluvial/alluvial sediments. A perched aquifer situated north of the Site previously was described by Buchanan (1993). This perched aquifer is not described in detail herein. The approximate boundaries of the uppermost aquifer systems underlying the area surrounding the Site, adapted from interpretations presented by Fetrow (1991), are presented in Uppermost Aquifer Boundaries, Figure 7.

The Site's position near the confluence of the Minnie Creek and Marshall Creek drainages, with upland areas situated to the north, west, and south of the Site, suggests the presence of converging groundwater flow conditions within shallow aquifer systems near the Site (PGG, 2005). Shallow groundwater flow presumably mimics topographic conditions and generally is directed from the area surrounding the Site towards discharge areas situated to the northeast. However, no groundwater elevation distribution evaluation appears to have been completed to date. As a result, specific information regarding hydraulic gradient and groundwater flow directions within specific hydrostratigraphic units appear not to be available.

Basement Rock Aquifer System

Groundwater occurs in basement rocks in fractured and/or weathered zones; these zones have variable hydraulic continuity. Porosity and permeability are generally low. The yield of water wells completed within the basement rock aquifer system typically are on the order of several gallons per minute (gpm) or less. Recharge to the upper portion of the basement rock aquifer occurs primarily within upland areas to the north, west and south, flowing laterally to discharge areas within the Minnie Creek, Marshall Creek, and/or Hangman Creek valleys.

Based on hydraulic conductivity testing in monitoring wells MW-6, MW-7A, and MW-7B, Fetrow (1991) reported basement rock hydraulic conductivities on the order of 3×10^{-3} to 3×10^{-4} feet per day. PGG (2005) estimated groundwater velocities within this hydrostratigraphic unit to be about 1 foot per year.

CRBG Aquifer System

The CRBG consists of a series of individual basalt flows. Groundwater is most readily transmitted through the broken vesicular and scoriaceous interflow zones that characterize the top of each flow. The interflow zones are separated by the less porous and less transmissive entablature and colonnade, which comprise 90 to 95 percent of the total flow volume (Whiteman et al., 1994). The flows are locally interlayered with

sedimentary deposits of the Latah Formation. This system of multiple flows and interlayered sedimentary deposits creates multiple stacked confined to semi-confined aquifers which can yield significant volumes of groundwater to wells.

Within the area surrounding the Site, the CRBG is overlain, in places, by glaciofluvial and/or alluvial deposits. In other locations, the CRBG directly crops out on the surface. Recharge to the CRBG occurs through direct precipitation, vertical infiltration from the overlying unconfined aquifer, and lateral recharge from basement rock. Discharge from the CRBG occurs through leakage to adjacent aquifers, along gaining reaches of streams, and to water supply wells.

Previous investigators (PGG, 2005) have separated the CRBG Aquifer System into two units; an upper basalt aquifer and lower basalt aquifer (presumably separated by discontinuous sedimentary deposits associated with the Latah Formation). However, this distinction is based on a paucity of hydraulic head information for the lower basalt unit and, in our judgment, likely oversimplifies the complexity of the geometry of compound flows characteristic of the CRBG system in proximity to the margin of the Columbia Plateau.

Glaciofluvial/Alluvial Sediments

Glaciofluvial/alluvial sediments typically consist of relatively free-draining sand and gravel with relatively high permeability that have filled the Minnie Creek and Marshall Creek drainages. Aquifer width ranges from 400 to 1,600 feet in width near the Site (PGG, 2005). This sedimentary aquifer system generally is unconfined and relatively susceptible to degradation from point and non-point sources of contamination because of the lack of an overlying confining unit and a generally shallow depth to the groundwater table. Recharge is primarily derived from precipitation, losing reaches of Minnie and Marshall Creeks, applied irrigation, septic systems and potentially through leakage from CRBG and basement rock aquifers. Discharge occurs through leakage to adjacent aquifers, along gaining reaches of streams, and to water supply wells. Data obtained during the RI will be used to clarify our understanding of the alluvial aquifer system.

Golder Associates (Golder) conducted a single-well pump test on well GR-2, located about 0.7 miles northeast of the Site in 1989. Based on the pump test results included in the 1991 Fetrow report, Golder estimated a hydraulic conductivity of 256 feet per day (78 meters per day) and a groundwater velocity estimate of 12 feet per day within the glaciofluvial sediments.

2.2. Key Site Investigations

Three key investigations have been conducted at the Site since 1991, including: a "Site Characterization Study Final Report" prepared by Fetrow in 1991, the "Marshall Landfill 2005 Hydrogeologic Summary" report prepared by PGG in 2005, and various groundwater monitoring reports prepared by Land and Water Environmental Services, Inc. (LAWS), the most recent ("Marshall Landfill Ground Water Monitoring Results for November 2010, Fourth Quarter Event") dated January 7, 2011. Collectively, these documents provide important information about the Site, including:

- Estimates of the types and quantities of solid and hazardous wastes disposed;

- Data from the installation and monitoring of 17 on-site monitoring wells between 1989 and 1991 (well depths ranging from between 50 and 393 feet below ground surface) and one exploratory boring (CH-1) was advanced about 335 feet below ground surface;
- Hydrogeologic information indicating that four water-bearing units are present beneath the Site (Fetrow, 1991; PGG, 2005);
- Landfill gas data collected in 1990 at locations within the Five-Acre Landfill, Main Landfill and Spokane County Landfill, which indicated the presence of volatile organic compounds (VOCs) likely associated with hazardous waste disposal;
- Groundwater quality data collected between 1989 and 2011 (22 years), including data from samples collected from select on-site monitoring wells and local water supply wells (Fetrow, 1991; LAWS, 1996 to 2012). (Note: groundwater data was not available from the Spokane County landfill); and
- Documentation of contaminant migration (VOCs) in groundwater, with generally decreasing concentrations since 2005. The current nature and extent of groundwater contamination are not known.

2.2.1.1. Existing Monitoring Well Information

In preparation for completing this Work Plan, information regarding Site monitoring wells (including construction details and condition) were compiled using historical reports and a Site visit which GeoEngineers conducted with Ecology on June 25, 2014. Results of the Site visit indicate that several wells require repair, removal of obstructions, and/or replacement. The monitoring well information is presented in Summary of Monitoring Well Construction and Condition Details, Table 1.

2.3. Site Contaminants of Concern

Previous studies identified VOCs as the primary contaminants of concern at the Site. Fetrow identified:

- 1,1,1-trichloroethane (1,1,1-TCA);
- 1,1-dichloroethane (1,1-DCA);
- Tetrachloroethene (PCE);
- Trichlorofluoromethane (CFC-11);
- Benzene;
- Toluene;
- 1,2-dichloroethane (1,2-DCA);
- Trichloroethene (TCE);
- 1,2-dichloropropane;
- 1,1,2-trichloroethane (1,1,2-TCA); and
- Chloroethane.

PGG categorized VOCs as either primary or secondary contaminants of concern based on the frequency of detection in Site groundwater samples (2005). The primary contaminants of concern (those compounds detected at a frequency of 40 percent or more in a given well) identified by PGG included:

- Ethanes: 1,1,1-TCA and 1,1-DCA;
- Ethenes: PCE and 1,1-dichloroethene (1,1-DCE); and
- Methanes: methylene chloride and CFC-11.

According to PGG (2005), the primary contaminants of concern were detected in groundwater samples collected from monitoring wells MW-1A, MW-2, MW-3, MW-5/5A, and MW-8B at concentrations greater than the Groundwater Quality Criteria established in WAC 173-200 (Water Quality Standards for Groundwaters of the State of Washington). The primary contaminants were not detected in samples collected from monitoring wells, MW-4/4A, MW-7A/B/C, MW-91, MW-11A, and MW-12A. The primary contaminants also were not detected in private or community wells at concentrations greater than the WAC 173-200 screening levels. Primary contaminant detections in Site monitoring wells are depicted on Marshall Landfill Primary VOC Contaminants, Figure 8.

PGG classified contaminants that were detected at a frequency of 40 percent but not routinely detected from multiple wells as secondary contaminants of concern. PGG identified the following as secondary contaminants of concern:

- Ethanes: 1,2-DCA;
- Ethenes: TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and total 1,2-dichloroethene (1,2-DCE);
- 1,2-dichloropropane;
- Chloroform; and
- Benzene.

Secondary contaminants of concern were detected in monitoring wells MW-1A, MW-5, and MW-11A at concentrations exceeding the WAC 173-200 applicable regulatory level. Secondary contaminants of concern detections in Site monitoring wells are depicted on Marshall Landfill Secondary VOC Contaminants, Figure 9.

Based on the historical groundwater data compiled in the most recent groundwater monitoring report available (LAWS, 2010), the semi-volatile organic compound bis(2-ethylhexyl)phthalate was detected in three monitoring wells (MW-1A, MW-3, and MW-5A) at concentrations greater than the WAC 173-200 regulatory level (6 micrograms per liter). Bis(2-ethylhexyl)phthalate also was detected in two additional wells (MW-8A and MW-9A) at concentrations less than the regulatory level. Based on the LAWS (2010) report, bis(2-ethylhexyl)phthalate has not been detected since March 1995 in monitoring well MW-8A. Dissolved iron and manganese also were reported at concentrations exceeding the WAC 173-200 regulatory level in monitoring wells MW-1A, MW-3, and MW-9A.

Based on GeoEngineers' review of information available in Ecology's file for the Site, we believe additional contaminants of concern might be present in soil, groundwater and/or surface water at concentrations exceeding regulatory cleanup levels. In our opinion, additional contaminants of concern for the Site should include the following:

- Gasoline-, diesel-, and oil-range petroleum hydrocarbons (GRPH, DRPH and ORPH, respectively);
- VOCs (in addition to those previously mentioned);

- Semi-volatile organic compounds (SVOCs);
- Polycyclic aromatic hydrocarbons (PAHs);
- Polychlorinated biphenyls (PCBs);
- Dioxins and furans;
- Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium and zinc) (also listed in the QAPP, Appendix B);
- Cyanide
- Organophosphorous pesticides;
- Organochlorine pesticides; and
- Herbicides.

In our opinion, contaminants of concern in landfill gas include:

- VOCs; and
- Methane.

3.0 PRELIMINARY CONCEPTUAL SITE MODEL

GeoEngineers prepared a preliminary conceptual site model (CSM) to describe surface and subsurface site conditions, define the nature and extent of known contamination, and to identify potential exposure pathways to Site contaminants of concern and potential receptors. GeoEngineers developed the preliminary CSM from data contained in the previous studies listed above, available monitoring well logs, and our initial observations from our June 25, 2014 Site visit. The CSM is graphically depicted in Conceptual Site Model, Figure 10.

3.1. Potential Exposure Pathways and Receptors

The source of contamination at the Site is the landfilled waste. Release mechanisms, exposure points, and exposure routes for contamination contained within the landfill generally are:

- Direct contact with waste exposed at the surface (dermal contact and inhalation/ingestion of dust and contaminants);
- Inhalation of landfill gases emanating from the landfill and potential ingestion of groundwater contaminated by interactions with landfill gas; and
- Leachate from the landfill contaminating surrounding soil, groundwater, and potentially surface water that interacts with contaminated groundwater (direct contact with contaminated groundwater, inhalation of vapors released from groundwater, ingestion of contaminated groundwater).

3.1.1. Exposed Landfill Waste

Both the Five-Acre and the Main Landfills currently have earthen covers: the Five-Acre Landfill has a clay (loess) cap and the Main Landfill has a fine to medium sand cover. However, landfill waste is exposed in portions of the Main Landfill cover. Also, the as-built thickness of the clay cap on the Five-Acre Landfill has

not been confirmed but appears to be discontinuous because waste was exposed during recent Site visits. Both conditions allow for potential direct contact with wastes contained in the landfill areas. Potential exposure pathways include dermal contact, inhalation of dusts and vapors, and ingestion of dust from landfill contaminants of concern.

3.1.2. Landfill Gas

Landfill gas consists of VOC vapors from industrial and other waste disposed in the landfills and methane generated from bacterial decomposition of landfilled wastes. Landfill gas migration from the Five-Acre Landfill to ambient air is likely minimal because the competent portions of the clay cap limit this exposure pathway. Exposure to landfill gases at the Five-Acre Landfill would be limited to point sources associated with the installed landfill gas collection system and breaches in the clay liner.

The Main Landfill is capped with a high-permeability fine to medium-grained sand cover that minimally restricts vapor migration from the landfill area, allowing landfill gas to migrate freely to ambient air. Potential receptors of landfill gas migration from the landfill directly to ambient air include both humans and biota at the ground surface.

Landfill gas also can migrate through unsaturated glaciofluvial/alluvial flood deposits below and surrounding the landfills. This type of migration provides the potential for landfill gases to interact with groundwater at the fringe zone and for VOCs to potentially dissolve into groundwater. This pathway provides another potential exposure route to human receptors and livestock from contaminated water supply wells.

Landfill gas concentrations (TCA, PCE and CFC) reported by PGG (2005) indicated a vapor plume is present in the flood deposits east of the Main Landfill and extending north of Scribner Road. A branch of the plume extends from the Five-Acre Landfill to Cheney-Spokane Road. Exact vapor concentrations were not included in the documentation; however, PGG reported that the highest TCA landfill gas concentrations were located near the Main Landfill and the highest CFC concentrations were reported near monitoring well MW-3.

3.1.3. Leachate

Leachate consists of liquid wastes directly disposed into the landfills and precipitation infiltration through the landfills that extracts solutes as it contacts solid and liquid wastes. Observations of the clay cap over the Five-Acre Landfill during recent Site visits indicate that the cap is not intact over the entire area of the landfill and some waste is exposed. Precipitation likely infiltrates through the cover and into the landfilled waste at these exposed points as well as through vegetation penetrations and animal burrows. Precipitation over the Five-Acre Landfill that does not infiltrate likely evapotranspirates or forms surface water runoff.

Infiltration through the Main Landfill is only minimally restricted by the permeable sand cover and will continue to generate leachate as precipitation migrates through the cover, the landfill, and eventually to groundwater. Contaminants in the leachate will sorb onto unsaturated soil in the migration path, leaving a zone of residual contamination. Closer to the smear zone of water table fluctuation, the residual contamination will be periodically flushed into groundwater creating a cycle of continuous groundwater contamination.

Potential receptors of leachate-impacted groundwater include downgradient surface water bodies hydraulically connected to groundwater and drinking water wells. Minnie Creek, located east of the Site across Cheney-Spokane Road, is the closest downgradient surface water body. Minnie Creek reportedly is

an ephemeral stream and also is a losing stream when flowing. Groundwater likely does not flow into nearby surface water features; therefore, this exposure pathway is considered incomplete and is not evaluated further.

PGG documented that groundwater contaminated with VOCs has been detected in nearby drinking water wells; therefore, this is considered a complete exposure pathway (PGG, 2005). Chemical analytical results from drinking water wells located near the Site indicate VOC contaminants were detected in multiple private wells, including: the Beck, Bagley, Hinrich, and Marshall Main wells (see Figure 7). Other potential contaminants from the leachate (such as metals, PAHs, PCBs and petroleum-hydrocarbons) were not analyzed and remain a data gap. Humans are the most likely potential receptors of leachate-impacted groundwater through drinking water wells, although livestock also could be potential receptors.

3.1.4. Other Contaminant Sources

Spokane County operated a separate landfill on the adjacent property to the south of the Main Landfill. Reportedly the Spokane County Landfill was a "daily burn" landfill where waste was burned each day for disposal. Incomplete combustion (like burning waste at lower temperatures) generates carcinogenic PAHs (cPAH), dioxins and furans as byproducts. There is a potential that buried waste and contaminants associated from daily burn activities (products of incomplete combustion) at the Spokane County Landfill have contaminated surrounding soil and/or groundwater beneath the Site.

4.0 DATA GAPS

Based on our review of the available data regarding the Site, we have identified the following data gaps that will be addressed during the RI:

- Chemical analytical results for each contaminants of concern listed in "Section 2.3" are not available. The nature and extent of the wastes disposed at the Site and the potential soil, vapor, and groundwater contaminants require additional study. Also, the extent of soil, landfill gas, and groundwater contamination is not adequately defined based on the existing data.
- Minimal data are available regarding potential contamination originating from the adjacent Spokane County Landfill. RI activities should include an assessment of soil, landfill gas, and groundwater at the Site and the boundaries adjacent to the Spokane County Landfill to better understand potential contaminant sources originating from the Spokane County Landfill.
- The vertical and horizontal extent of waste in the Five-Acre and Main Landfills are not well understood.
- The hydrogeology beneath the Site is not well understood. An evaluation of historic groundwater elevation data as a basis for evaluating hydraulic gradient, groundwater flow direction, and potential for/direction of groundwater exchange between hydrostratigraphic units should be completed. An evaluation of whether or not a sufficient number of monitoring wells exist, are positioned at locations likely able to observe contaminant transport, and screened at the appropriate intervals to characterize hydrogeology and contaminant migration pathways should be completed.
- The long-term slope stability of the Main Landfill and associated buttress berm on the southern and southeastern boundaries of the Main Landfill is not well understood and a slope-stability analysis should be conducted to support the options analyses in the FS.

5.0 REMEDIAL INVESTIGATION

The objectives of the RI will be to characterize the nature and extent of contamination associated with the Site to support the FS, update the CSM to identify the nature and extent of the contaminants of concern, and identify data gaps. The following RI activities were developed to meet these objectives.

5.1. Historical Research

The following tasks will be performed in support of the RI.

5.1.1. Inventory Water Supply Wells

An updated inventory (using Ecology and Spokane County file records) of water supply wells downgradient of the Site will be compiled to identify potential additions to the Site groundwater monitoring network. This inventory will include the area between the Site and the Fowler well that has been previously monitored by LAWS.

5.1.2. File Review

A background data summary of pertinent Site information useful for completion of the RI will be reviewed and compiled (as available), including:

- Ecology and Spokane Regional Health District (SRHD) files for the Site.
- Maps, aerial photos and other information showing Site features (such as topography, landfilled areas and fill progression, utilities, potential contamination sources and drainage).
- Site history and waste disposal data using information documented by PGG (2005) and supplemented by Ecology and SRHD files, as available.
- As-built plans and monitoring data for the Five Acre Landfill passive gas venting system.

5.1.3. Describe Site Geology, Hydrogeology and Hydrology

Information regarding Site and area geology, hydrogeology and surface water hydrology will be compiled from existing Site reports (Fetrow, 1991 and PGG, 2005), precipitation records, Ecology's Water Resource Inventory Area (WRIA) basin work, and other public sources. The compiled information will be used to evaluate the existing monitoring well network and the need for additional monitoring wells.

Conduct an evaluation of historic groundwater elevation data and evaluate hydraulic gradient, groundwater flow direction, and potential for/direction of groundwater exchange between hydrostratigraphic units. Additionally evaluate whether or not a sufficient number of monitoring wells exist, are positioned at locations likely able to observe contaminant transport, and screened at the appropriate intervals to characterize hydrogeology and contaminant migration pathways.

5.1.4. Update the Conceptual Site Model

The preliminary CSM presented in "Section 3.0" of this work plan will be updated based on data collected during the RI. The revised CSM will be used as a tool to describe the Site in terms of the physical and chemical characteristics associated with contaminant sources, mechanisms of releases to the environment, migration pathways, and contacts with human and environmental receptors. The CSM will also be used to guide the FS activities.

5.1.5. Compile Historical Analytical and Other Site Data

Prior analytical data (soil, groundwater, landfill gas, surface water, etc.) collected at the Site and documented in prior Site reports and regulatory files will be compiled, using electronic databases files, if available. These data will be supplemented by data collected during the RI field investigation and ultimately used to describe the nature, extent, fate and transport of Site contamination in the RI report.

5.1.6. Slope Stability Literature Review

We will review readily available information in the public domain regarding typical engineering parameters attributed to municipal solid waste (MSW). Results of the literature review in conjunction with the borings drilled within the landfill will form the basis for parameters we assign to the waste as part of our slope stability analyses.

5.2. Pre-Field Activities

Prior to conducting RI field investigation activities, the following tasks have been/will be performed:

- GeoEngineers has prepared a site-specific HASP to govern the field activities of GeoEngineers' field representatives (provided in Appendix C).
- Prepared an updated monitoring well inventory table that includes well details from historical information sources and observations from the Site visit conducted on June 25, 2014. Our inventory is presented in Table 1.
- Retain the services of an excavation contractor with 40-hour HAZWOPER-trained staff.
- Retain the services of drillers licensed in Washington for multiple drilling methods (direct-push, hollow-stem, air-rotary and sonic drilling methods at a minimum).
- Retain the services of a Professional Land Surveyor licensed in Washington.
- Confirm Site access for field activities (in coordination with Ecology).
- Request a utility locate from the public utility "One-call" service.
- Procure a private utility locating company to clear proposed exploration locations (test pits, monitoring wells, soil vapor probes and landfill gas probes).

5.3. Field Activities

5.3.1. Site Surveying and Mapping

A Washington-licensed professional land surveyor will be retained to confirm Site property boundaries and establish local bench marks (horizontal and vertical) for use in mapping of Site features, explorations (test pits, monitoring wells, gas probes, etc.), and data presentation. A mapping firm will be retained to conduct an aerial-based survey of the Site and prepare a topographic map with 2-foot contours (Note: this task was completed in December 2014). The topographic map will be used during the evaluation of remedial options for the FS.

5.3.2. Subsurface Exploration Reconnaissance

Prior to performing subsurface Site exploration activities, the following tasks will be performed:

- Mark locations of proposed test pits, landfill gas and new monitoring well locations in coordination with Ecology.
- Utilize the private utility locating company to clear proposed exploration locations concurrently.
- Evaluate need and coordinate brush clearing and/or minor access road construction for access to exploration locations.

5.3.3. Test Pits

Test pits will be excavated to evaluate the limits of waste and the nature/thickness of cover material around the perimeter and in the center of the Five-Acre Landfill and the perimeter of the Main Landfill (north, south and western boundaries; the eastern boundary is a steep slope and the toe of the slope is assumed to be the eastern extent of the landfill). Field screening will be performed to evaluate the presence/absence of buried debris, "cap material" and potential contaminants. No soil or water sample collection is anticipated. Proposed test pit locations are shown on Proposed Exploration and Monitoring Well Locations, Figure 11. Final locations will be determined based on the property boundary survey and field conditions. Specific procedures regarding the test pits are presented in the SAP (Appendix A).

5.3.4. Hydrogeologic Investigation

The following tasks will be performed to evaluate the hydrogeologic conditions at the Site.

5.3.4.1. Conduct Downhole Video Survey of On-Site Monitoring Wells

The condition of monitoring wells with accessible casings will be assessed, as identified during the June 25, 2014 Site visit (see Table 1), using a downhole video camera and recorder. Results of the downhole survey will be used to evaluate wells for potential replacement or repair as needed.

5.3.4.2. Monitoring Well Repair

The following tasks will be performed to rehabilitate the existing monitoring wells for groundwater sampling.

- Remove transducers, pumps and other blockages from monitoring wells with these issues identified during the June 25, 2014 Site visit (see Table 1) and other issues identified during the downhole video survey outlined above in. The transducers, pumps and associated piping will be salvaged and provided to Ecology (if desired), recycled (if possible), or disposed as solid waste.
- Complete repairs of protective surface casings, surface seals and well casings for monitoring wells with these identified issues (see Table 1). Repaired monitoring well casings will be surveyed to establish horizontal and vertical control by a Washington-licensed surveyor.
- Complete repairs and/or maintenance of monitoring wells as identified by the downhole video survey.
- Identify monitoring wells that cannot be successfully repaired or maintained as candidates for decommissioning, per WAC 173-160, and potential replacement.

5.3.4.3. New and Replacement Monitoring Well Installation

A Washington-licensed driller will be subcontracted to install monitoring wells using air-rotary or sonic drilling techniques (sonic preferred). Proposed monitoring well locations are shown on Figure 11; however, monitoring well locations are subject to change based on the findings of the hydrogeologic data gap analysis. A geologic log of each monitoring well boring will be prepared by an on-site GeoEngineers field representative. Upon reaching the target well depth, the well screen, sand pack, riser pipe, borehole seals

and locking surface protector casing will be installed, per WAC 173-160 resource protection well requirements. Completed monitoring wells will be developed by pumping and surging, and development water will be placed in labeled containers for subsequent characterization and disposal.

New monitoring wells will be drilled outside of the solid waste boundaries, through native soils and geologic formations. Borehole drill cuttings from the unsaturated zone above the water table will be temporarily stockpiled and later spread on the ground around the monitoring well. Drill cuttings from the saturated zone (in which the well screens will be set) potentially contain landfill-derived contaminants that have migrated through the subsurface. These cuttings will be temporarily stored in drums or roll-off containers for subsequent waste designation and disposal. Soil samples will be collected from material directly above saturated soil in each boring and preserved for chemical laboratory analysis. These samples will be analyzed for Site contaminants of concern (see Appendix A).

The rationale for the selection of new monitoring well locations and screened intervals is provided in Proposed RI Monitoring Wells and Installation Rationale for Selection, Table 2. The final locations of the monitoring wells will be selected in coordination with Ecology after completion of the downhole video, well repair tasks, and hydrogeology review.

5.3.4.4. Monitoring Well Pumping System Installation

Dedicated pumping systems will be installed in new monitoring wells and in select existing monitoring wells, to provide a consistent and reliable means of collecting groundwater samples. The systems will consist of submersible pumps powered pneumatically or by external electric generator and will include quick-connect surface adapters for low-flow purging and sampling equipment. Pump models, serial numbers and intake depths will be recorded during system installation.

5.3.4.5. Monitoring Well Sampling

Groundwater samples will be collected from selected existing monitoring wells and new monitoring wells installed as part of the RI. Groundwater samples will be collected using low-flow sampling methods, which will minimize purge water generated during sampling, utilizing dedicated pumps installed following monitoring well rehabilitation and installation. Existing and proposed monitoring wells are shown on Figure 11.

Groundwater samples, groundwater elevations and light non-aqueous phase liquids (LNAPL)/dense non-aqueous phase liquids (DNAPL) thickness (if encountered) will be measured using an interface meter at each well during sampling events. Groundwater samples will be submitted under chain-of-custody (COC) procedures to an Ecology-certified laboratory for analysis of contaminants of concern. A licensed contractor will be retained to properly dispose of purge water generated during well installation and sampling.

5.3.4.6. Locate Potential Surface Water Monitoring Points

To the extent that this activity can be done on public property, identify and photograph locations on Minnie Creek and Marshall Creek suitable as potential stations for surface water monitoring (water levels and water sampling). After locations are identified they will be surveyed and a benchmark will be installed or identified for water level reference measurements.

5.3.4.7. Surface Water Sampling

GeoEngineers anticipates collecting surface water samples from at least two locations (one upstream in Marshall Creek and one downstream in Minnie Creek). However, Minnie Creek is an ephemeral stream, so

sampling may be limited to times following rainfall events. Samples will be collected by direct filling of laboratory-supplied containers. Specific procedures for surface water sampling are presented in the SAP in Appendix A.

5.3.5. Geotechnical Explorations for Slope Stability Assessment (Buttress Berm and Landfill Slope)

GeoEngineers will retain a drilling contractor to advance seven borings within the buttress berm, three borings near the toe of the buttress berm and 10 borings within the Main Landfill. Proposed boring locations are shown on Figure 11. The 10 borings located within the landfill limits are labeled as "Landfill Gas Explorations" but these borings also will be drilled to collect geotechnical data in addition to landfill gas samples. The borings will be drilled using either a truck-mounted or track-mounted hollow-stem auger drill rig, depending on access conditions at individual boring locations. Samples of soil and waste will be collected at approximate 2½- to 5-foot-depth intervals using either a standard 2-inch outside-diameter split spoon sampler (standard penetration test [SPT]) or 3-inch outside-diameter California-style split barrel sampler.

- Buttress Berm: These borings will be advanced to depths of about 60 to 75 feet below existing grade along the top of the buttress berm and to at least 10 to 20 feet into native materials below the toe berm, or to refusal, whichever occurs first. Three borings will be advanced at the toe of the buttress berm slope to depths of about 40 feet below ground surface (bgs) or to refusal, whichever occurs first. At the completion of drilling, each boring will be abandoned in accordance with State of Washington regulations. Samples of soil collected from borings drilled within the buttress berm and near the toe of the buttress berm will be returned to our laboratory for review and testing. We will conduct laboratory testing of select samples in accordance with applicable ASTM International (ASTM) procedures. Testing likely will include: 40 to 50 moisture content and dry density determinations and about 20 sieve analyses.
- Main Landfill Explorations: These borings will be advanced through the soil cover and MSW and at least 15 feet into native soils or refusal, whichever occurs first. We anticipate the deeper borings will be 100 to 150 feet deep. (Note: refusal within the MSW is possible and there is a potential to damage or lose drill string downhole, therefore a contingency budget to cover costs associated with this scenario is recommended). Air space around the drilling augers will be monitored during drilling using a photoionization detector (PID) and a methane, carbon dioxide, oxygen and hydrogen sulfide multi-gas meter (4-gas meter) for screening and for health and safety purposes. Workers will wear appropriate personal protective equipment while drilling in the landfill. Samples of soil and waste collected from borings located within the landfill will be placed on plastic sheeting, covered with plastic, and will remain on site for subsequent burial below the soil cap at an agreed upon location following discussions with Ecology. Alternatively, drums might also be used to store cuttings until disposal. At the completion of drilling, each boring will be abandoned in accordance with State of Washington regulations.
- Soil samples will be collected from material directly below the MSW (within the first 5 feet) in each boring and preserved for chemical laboratory analysis. These samples will be analyzed for Site contaminants of concern (see Appendix A).

5.3.6. Soil/Landfill Gas Investigation

5.3.6.1. Main Landfill

GeoEngineers will field-screen each of the 10 boreholes drilled in the Main Landfill for the presence of VOCs using a PID and 4-gas meter. If possible, field-screening will occur under varying barometric conditions prior

to sampling in order to gauge the effects of barometric pressure on landfill gas movement through the landfill. Based on the results of field screening, up to five locations will be selected for installation of soil-gas monitoring wells. Locations where VOCs and methane are detected at concentrations greater than background will be considered for landfill gas sampling. Landfill gas monitoring well locations also will be recommended based on the locations, depths and VOC/methane concentrations obtained during the initial field screening. Landfill gas monitoring wells will be installed with screened intervals selected in consideration of unsaturated zone thickness and elevations of the top and bottom of buried solid waste.

Landfill gas monitoring wells will be sampled and analyzed in accordance with the procedures described in the SAP (see Appendix A).

5.3.6.2. Five-Acre Landfill

GeoEngineers will retain a drilling contractor to advance six borings in the Five-Acre Landfill for the purposes of determining the thickness of the MSW and to install landfill gas monitoring wells. Borings will be monitored during drilling using a PID and 4-gas meter. Based on the results of field screening, up to four locations will be selected for installation of soil-gas monitoring wells using the same criteria used to select locations for the Main Landfill gas monitoring wells.

Landfill gas samples will be collected from the newly installed monitoring wells and from the three existing passive gas system vents in the Five-Acre Landfill. These samples will be collected and analyzed in accordance with the procedures described in the SAP (see Appendix A). The vents will be adapted for sampling by temporarily sealing the vent pipes, to assure that representative gas samples can be collected. The sealed vents will also be allowed to stabilize to facilitate measurement of gas pressure. The vents also will be evaluated based on their condition and suitability for continued compliance gas monitoring.

5.3.7. Surveying of RI Explorations

The licensed land surveyor identified above will establish the locations and elevations of the monitoring wells (groundwater and landfill gas) and surface water stations established during the RI field investigation. The locations and elevations of pre-RI monitoring wells and the Five-Acre Landfill passive gas system vents also will be established. This survey data will be used to plot exploration locations on Site maps, prepare hydrogeologic cross sections, and prepare groundwater level contour maps. Test pits and boring locations will be recorded for horizontal control using an iPad equipped with a GPS, accurate to about 5 meters.

5.3.8. Beneficial Land and Water Use Survey

5.3.8.1. Land Use Survey

Adjacent and downgradient land use and public accessibility was evaluated during the initial Site visit and will be refined by review of aerial photos and on-Site observations during the RI field investigation. Zoning and planning documents also will be reviewed from publicly available county records.

5.3.8.2. Groundwater And Surface Water Use Survey

Existing databases and information in previous reports will be utilized to document potential users of groundwater and surface water in the Site vicinity.

5.3.8.3. Ecological Receptors

Ecological receptors (including mapped threatened and endangered [T&E] species and habitat) will be evaluated using information from existing databases.

5.3.9. Terrestrial Ecology Evaluation

A terrestrial ecology evaluation [TEE] will be completed per WAC 173-340-7490, using the guidance and resources provided on the "TEE Process" page of the Ecology website (http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/TEEHome.htm). A TEE is conducted to evaluate whether plants and animals at a site are at risk from contaminated media. Based on the historical information reviewed, it is likely contaminated soil, groundwater and vapors are present at the Site and present a risk to the ecological receptors. The TEE will be conducted to characterize the risk to ecological receptors and aid in establishing cleanup levels protective of human health and those receptors. Based on the guidance questions provided on the Ecology website, the Site qualifies for a Simplified TEE.

5.3.10. IDW Management

GeoEngineers anticipates investigation-derived waste (IDW), to include soil cuttings from the saturated zone generated during well installation activities and water from monitoring well development, pre-sample purging, and equipment decontamination. Soil cuttings will be stored in roll-off boxes or drums until waste profile sampling results are received. Development and purge/decontamination water will be stored on-site in a baker tank or drums until waste profile sampling is completed. Soil disposal profiling and subsequent disposal will be handled by a qualified subcontractor acceptable to Ecology.

5.3.11. Contingency Actions

If suspected hazardous waste is encountered during the RI, Ecology will determine that an interim action is to be implemented, provided there is an imminent threat to human health and the environment or if such a threat could develop by delaying a response. Interim actions will be implemented according to the procedures described in WAC-173-340-430. Interim actions might include characterizing and profiling the suspected waste, securing the waste to protect Site workers and reduce the risk of a release, and/or disposing the waste at a permitted facility.

6.0 PRELIMINARY CLEANUP LEVELS FOR DATA SCREENING

Preliminary cleanup levels for screening of RI chemical data were selected as follows:

- Groundwater: MTCA Method B cleanup levels from the Ecology CLARC database.
- Surface water: the lowest values of MTCA Method B cleanup level, WAC 173-201 standards, and fresh water aquatic standards (Clean Water Act).
- Landfill gas: the lower values of soil gas values in Table B-1 of the *Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* or MTCA Method B cleanup levels from the Ecology CLARC database for VOCs in indoor air multiplied by a factor of 10; methane levels from the SRHD Solid Waste Handling Standards.

Because potentially contaminated soil at the Site likely would be present at depths of 40 to 100 feet below the surface or greater, and likely would occur beneath the landfilled wastes, preliminary cleanup levels for soil have not been considered. Exposure to potentially contaminated soil is not considered a complete pathway at this time.

7.0 SLOPE STABILITY ANALYSIS

GeoEngineers will conduct slope stability analyses of the existing buttress berm and landfill slope for both static and seismic (pseudo-static) conditions. We will use a commercially available computer program, such as SLOPEW Version 7.18, developed by Geo Slope International, to conduct the analyses. The program has the capability of analyzing slope stability for two-dimension profiles under a wide range of failure surface geometries, soil layers and groundwater conditions, as well as being able to consider complex loading conditions. The soil strength parameters and water levels used in the analyses will be based on results of our field explorations, geologic reconnaissance, reviewing available information, and our understanding of local geology.

We will use topographic data collected as part of the RI/FS to develop the model surface geometry. Results of our subsurface explorations, laboratory testing program and literature review will be used to develop the subsurface unit boundaries within the model and to assign pertinent engineering parameters to those units. Results of our explorations and review of existing site data also will be used to model groundwater conditions. We will provide safety factors for critical failure surfaces for both the static and seismic conditions. We also will provide a general discussion of potential mitigation options if results indicate the existing slopes do not meet the minimum safety factors against potential slope instability.

8.0 FEASIBILITY STUDY

The FS will include development of proposed cleanup levels for the Site and evaluate hazardous substances in groundwater, surface water, and landfill gas by comparing analytical results to appropriate cleanup levels. The FS will develop and evaluate cleanup action alternatives for contaminated media so that cleanup actions may be selected. The FS will:

- Develop cleanup levels, points of compliance and establish remediation levels;
- Determine the Applicable, Relevant and Appropriate Requirements (ARARs) specific to the Site;
- Delineate affected media where evaluation of remedial action is appropriate;
- Develop remedial action objectives;
- Screen and evaluate specific cleanup alternatives and recommend a preferred alternative; and
- Present in a written report along with the results of the RI (the RI/FS report).

The following sections provide the details of the FS process that will be completed, if necessary, for the Site.

8.1. Establish Cleanup Levels, Points of Compliance and Remediation Levels

Cleanup standards, including cleanup levels and points of compliance, will be developed for groundwater, surface water, and landfill gas in accordance with MTCA requirements. Exposure pathways and receptors will be identified as part of cleanup level development. As needed, remediation levels might also be established for specific cleanup alternatives.

8.2. Determine Site Specific ARARs

The FS will describe the ARARs specific to the Site for the remediation alternatives screened. ARARs might include various permits from local, state, or federal agencies and jurisdictions. Likely agencies that might have permit requirements for the remediation alternatives screened in the FS include: Spokane County (grading permits, construction stormwater permits and noise and nuisance ordinances) and Spokane Regional Clean Air Agency (air discharge permits). Other potential ARARs will be explored during the FS.

Federal and state regulations also will be compared to determine the appropriate regulatory level for Site contaminants relative to the affected media. Regulations that might have priority include MTCA, WAC 173-200, and the Clean Water Act. The ARARs will be reviewed during the RI and Site specific cleanup levels will be determined based on the contaminant type, the effective media, the potential receptors and the applicable regulations. The chosen cleanup levels will be used to guide the selection of appropriate remediation actions selected during the FS.

8.3. Delineate Media Requiring Remedial Action

The FS will evaluate if groundwater, surface water, and/or landfill gas sample results exceed cleanup levels and, if so, identify the locations where analyses of samples exceeded applicable MTCA cleanup levels. Based on exceedances and the established points of compliance, the FS will estimate the extent of contamination that requires remedial action. Because multiple waste streams with varying constituents were historically disposed in the landfills, a large number of contaminants might be present in the affected media. To reduce costs associated with chemical analyses of numerous contaminants of concern, indicator hazardous substances might be selected during the FS. Indicator hazardous substances will be selected with Ecology after an evaluation based on the guidance presented in WAC 173-340-703.

8.4. Develop Remedial Action Objectives

Remedial action objectives (RAOs) that define the goals of the cleanup that must be achieved to protect human health and the environment will be developed for each medium and area requiring remedial action. These RAOs will be action-specific and/or media-specific. Action-specific RAOs are based on actions required for environmental protection that are not intended to achieve a specific chemical criterion. Media-specific RAOs are based on developed cleanup levels. The RAOs will present the contaminants of concern, the potential exposure pathways and receptors.

8.5. Screening Cleanup Alternatives

Cleanup alternatives will be developed for each medium of concern. Initially, general remediation technologies will be identified for the purpose of meeting RAOs for each medium. General remediation technologies consist of specific remedial action technologies and process options and will be considered and evaluated based on the media type and the properties of any contaminant(s). These might include institutional controls, containment or other engineering controls, and removal. Common remediation methods at landfills include:

- Re-grading and capping the landfills with low-permeability liners;
- Leachate collection and treatment systems;
- Landfill waste removal and disposal at a modern, lined and permitted facility; and
- Active or passive landfill gas collection and treatment.

Specific remedial action technologies and representative process options will be selected for evaluation based on documented development or documented successful use for the particular medium and contaminants of concern. Cleanup alternatives will be developed from the general and specific remedial technologies and process options consistent with Ecology expectations identified in WAC 173-340-370 using best professional judgment and guidance documents as appropriate. The selected remediation technology or process will protect human and ecological receptors and reduce or eliminate exposure pathways identified in the CSM. Specifically, the direct contact, leachate migration to drinking water, and the landfill gas migration to ambient air exposure pathways will be addressed by the selected remedy.

During the development of cleanup alternatives, both the current and planned future land use will be considered.

8.6. Evaluate Cleanup Alternatives

MTCA requires that cleanup alternatives be compared to a number of criteria as set forth in WAC 173-340-360 to evaluate the adequacy of each alternative in achieving the intent of the regulations, and as a basis for comparing the relative merits of the developed cleanup alternatives. Consistent with MTCA, the alternatives will be evaluated with respect to compliance with threshold requirements, permanence and restoration timeframe, and a disproportionate cost analysis. Additionally the alternatives will be evaluated relative to the "other requirements" listed in WAC 173-340-360 which include using permanent solutions, Site restoration in a reasonable time frame, and consideration of public comments. The results of the evaluation will be documented in the RI/FS report.

9.0 SCHEDULE AND REPORTING

Following completion of the RI field activities and receipt of analytical data, reports will be prepared as follows:

- Monthly progress memorandums describing field work conducted, analytical results obtained, and documentation prepared.
- Memoranda evaluating specific assessment results that might affect future assessment actions (as required).
- Prepare draft and final RI/FS Reports containing applicable sections as outlined in Chapter 173-340-350 of the WAC.
- Sampling data will be submitted to Ecology in both printed and electronic formats in accordance with Ecology's Toxics Cleanup Program Policy 840.

The proposed schedule for the project milestones is listed below:

- Prepare Public Review Draft RI/FS Work Plan and submit to Ecology: January 2015
- Public Comment Period: January through February 2015
- Prepare Final RI/FS Work Plan and submit to Ecology: January 2015
- RI Site Characterization Activities: February through April 2015
- Prepare Draft RI/FS Report and submit to Ecology: January through May 2015

- Ecology review of Draft RI/FS Report: May – determined by Ecology
- Prepare Public Review Draft RI/FS Report and submit to Ecology: 2 to 4 weeks after receiving Ecology's comments
- Public comment period: determined by Ecology
- Ecology Responsiveness Summary: determined by Ecology
- Prepare Final RI/FS Report and submit to Ecology: 2 to 4 weeks after receiving Ecology's comments

For the purpose of planning this Work Plan, Ecology review periods are assumed to be 30 days for draft documents and 15 days for final documents. Final schedule will be determined by Ecology based on project progress and other factors. Documents become final upon written approval by Ecology.

10.0 LIMITATIONS

We have prepared this Work Plan for use by the Washington State Department of Ecology. This Work Plan is not intended for use by others, and the information contained herein is not applicable to other sites.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this work plan was prepared. No warranty or other conditions express or implied should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc.

11.0 REFERENCES

Buchanan, John. Review of Documents Pertaining to the Geology, Hydrogeology, and Groundwater Monitoring at the Marshall Landfill, Spokane County, Washington. Prepared by John Buchanan, Cheney, Wash., for Marshall Community Coalition and the Washington State Department of Ecology, August. 1993.

Drost, B.W. and K.J. Whiteman. "Surficial Geology, Structure and Thickness of Selected Geohydrologic Units in the Columbia Plateau," U.S. Geological Survey Water Resources Investigations Report 84-4326. 1986.

Fetrow Engineering, Inc. (Fetrow), Marshall Landfill Site Characterization Study Final Report (Volume 1 and 2), Prepared for Marshall Landfill, Inc. 1991.

GeoEngineers, Inc., "Pre-RI Site Assessment Work Plan" GEI File No. 0504-104-00, prepared for Washington State Department of Ecology, dated September 15, 2014.

Land And Water Environmental Services, Inc., 1996 – 2012, Marshal Landfill Quarterly Ground Water Monitoring Reports, Prepared for the Spokane Regional Health District, Spokane, Washington. July 13, 2010.

Minimum Standards for Construction and Maintenance of Wells; WAC 173-160.

Pacific Groundwater Group. Marshall Landfill 2005 Hydrogeologic Summary, Prepared for the Spokane Regional Health District, Spokane, Washington. December 23, 2005.

U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Revision 5. 1998.

U.S. Environmental Protection Agency. Contract Laboratory Program National Functional Guidelines for Organic Data Review. 540/R-99/008. 1999.

U.S. Environmental Protection Agency. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. 540/R-04/004. 2004a.

U.S. Environmental Protection Agency. EPA Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. EPA 04-03-030. 2004b.

Washington State Department of Ecology. Model Toxics Control Act (MTCA) Cleanup Regulations, WAC, Chapter 173-340. November 2007.

Washington State Department of Ecology. Work Plan for Marshall Landfill Site, Marshall, Washington. April 2014.

Washington State Department of Ecology. Model Toxics Control Act Cleanup Regulation, chapter 173-340 Washington Administrative Code (WAC), Cleanup Levels and Risk Calculation data tables, May 2014.

Water Quality Standards for Groundwaters of the State of Washington; WAC 173-200.

Water Quality Standards for Surface Waters of the State of Washington; WAC 173-201A.

Whiteman, K.J., Vaccaro, J.J., Gonthier, J.B., and Bauer, H.H., "The Hydrogeologic Framework and Geochemistry of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho," U.S. Geological Survey Professional Paper 1413-B, 73 p. 1994.

Table 1

Summary of Monitoring Well Construction and Condition Details

Marshall Landfill

Spokane County, Washington

Well ID	Well Construction Information									Top of Casing Elevation (feet) 06/13/2010	June 25, 2014 Site Visit/Well Observations			
	Well						Monument							
	Depth (feet)	PVC Casing (inches)	Screen Slot Size (inches)	Screen Length (feet)	Screened Geologic Unit	Pump Y/N	Lock Y/N	Cap Y/N	Material Type		Depth to Water (feet)	Total Depth (feet)	Groundwater Elevation (feet)	Notes
1A	210.98	2	0.02	10	Basement	N	Y	Y	Steel above-ground	2331.98	206.01	206.34	2125.97	Bailer reportedly stuck in well
2	82.42	2	0.02	10	Sand	N	Y	Y	Aluminum flushmount	2172.42	69.55	82.95	2102.87	1 bolt missing; vacuum out threads, re-tap
2A	108.01	4	0.01	15	Sand	N	N	N	Aluminum flushmount	2172.01	69.47	113.6	2102.54	Stripped bolt holes
3	117.64	2	0.02	10	Sand	N	Y	Y	Steel above-ground	2178.64	82.97	117.81	2095.67	
4	49.54	2	0.02	10	Sand	N	Y	Y	Steel above-ground	2158.54	46.13	--	2112.41	Obstruction at 47.0; casing damaged in monument
4A	80.9	4	0.01	15	Sand	N	Y	Y	Steel above-ground	2155.75	43.16	80.06	2112.59	Solinst 3001 Transducer in well
5	120.25	2	0.02	10	Sand	N	Y	Y	Steel above-ground	2184.25	96.86	121.74	2087.39	
5A	141.44	4	0.01	15	Sand	N	Y	Y	Steel above-ground	2183.44	96.15	~142.55	2087.29	
6	253.92	4	0.01	10	Basement	N				2176.92 measured 1990				Not located
7A	392.7	4	0.01	10	Basement	--	--	--	--	2317.70	--	--	--	Well destroyed
7B	299.21	4	0.01	10	Basement	Y	Y	Y	Steel above-ground	2316.21	213.19	~300	2103.02	Pump in well
7C	226.9	4	0.01	10	Basement	--	--	--	--	2316.90	--	--	--	Well destroyed
8A	121.87	4	0.01	15	Basement	Y	Y	N	Steel above-ground	2135.87	55.41	~115.04	2080.46	Pump in well; 1" pump riser pipe
8B	91.77	4	0.01	25	Sand	N	Y	Y	Steel above-ground	2135.77	55.38	93.61	2080.39	Missing plug
9A	69.24	4	0.01	25	Sand	N	Y	Y	Steel above-ground	2153.24	38.61	72.57	2114.63	Cut lock
11A	237.3	4	0.01	30	Basement	Y	N	N	Steel above-ground	2313.3 measured 1991	200.72	245-247	2112.58	Pump in well; 1" pump riser pipe; needs long shackle lock; capped with nitrile glove
12A	136.05	4	0.01	30	Basalt	N	Y	Y	Steel above-ground	2342.05	111.60	134.60	2230.45	
MW-59A		6" Steel	--	--	--	N	--		--	--	82.95	~163	--	
No. 147		--	--	--	--	--	--		--	2328.89	--	--	--	--
No. 148		--	--	--	--	--	--		--	2326.60	--	--	--	--

Note:

Reference elevation not provided in historical reports. It is assumed elevations are referenced to North American Vertical Datum of 1988 (NAVD88).

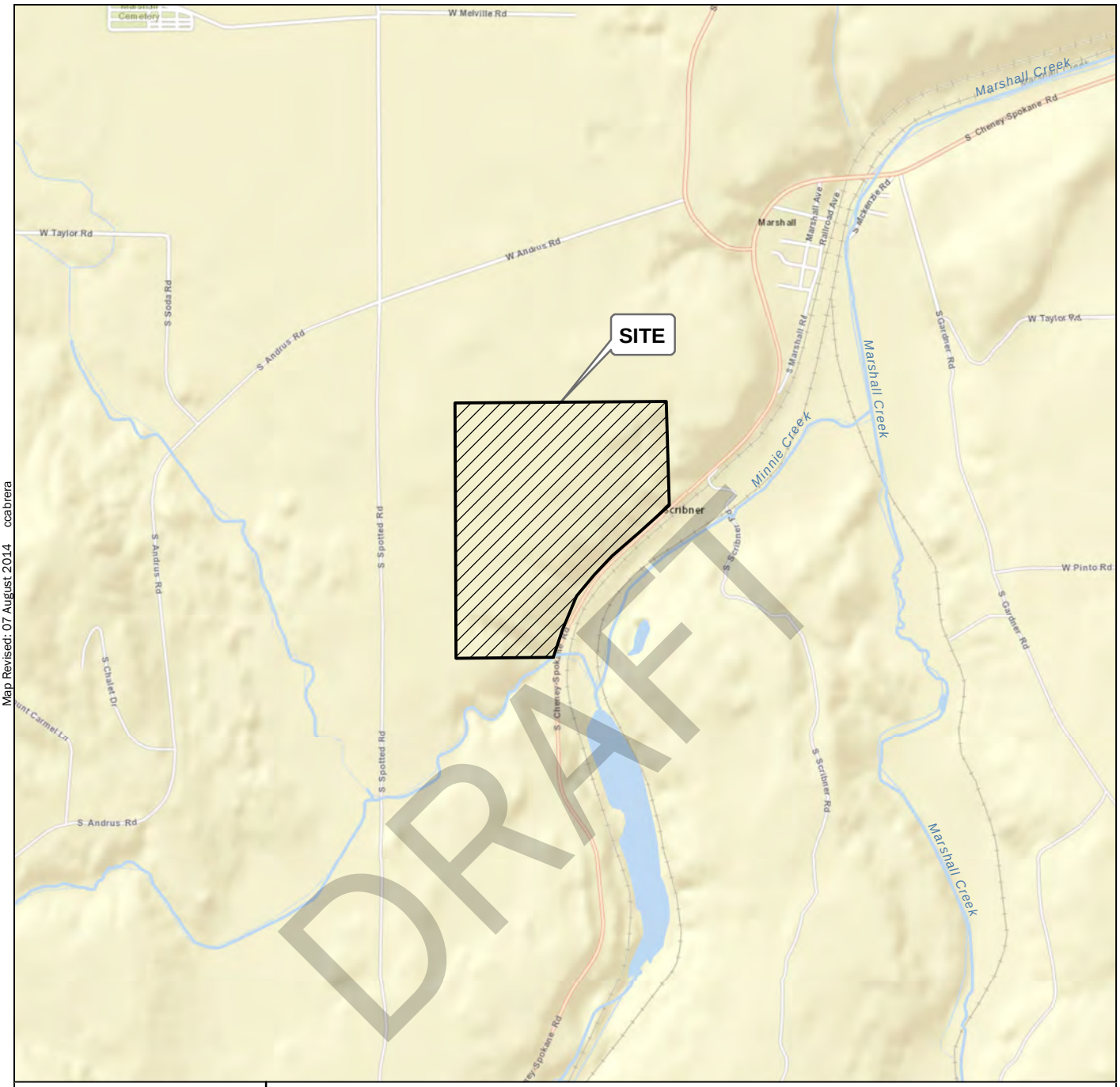
Table 2

Proposed RI Monitoring Wells and Installation Rationale for Selection

Marshall Landfill

Spokane County, Washington

Well Number	Estimated Total Depth (Feet Below Ground Surface)	Screened Interval (Feet)	Aquifer Monitored	Rationale for Selection
MW-1B	240	230 – 240	Basement Aquifer	Replace damaged MW-1A if well cannot be repaired; monitor upper part of aquifer downgradient of Five-Acre Landfill, at location of previous VOC detection.
MW-7D	240	230 – 240	Basement Aquifer	Replace destroyed MW-7C; monitor upper part of aquifer downgradient of Five-Acre Landfill.
MW-13	240	230 – 240	Sand Aquifer	New well; monitor upper part of aquifer downgradient of Five-Acre Landfill, prior to Basement Aquifer discharge into Sand Aquifer; assess natural attenuation downgradient of MW-1B. Characterize lithology between MW-1A and MW-12A (basalt transition)
MW-14	160	150 - 160	Sand Aquifer	New well; monitor groundwater between MW-11A and downgradient wells.
MW-15/15A	120/240	110-120/230-240	Sand/Basement Aquifer	New, paired wells; monitor groundwater migrating downgradient from the Main Landfill.
MW-16/16A	80/160	70-80/150-160	Sand/Basement Aquifer	New, paired wells; monitor groundwater migrating downgradient from the Spokane County Landfill.
	880	**Total estimated drilling footage**		



Data Sources: ESRI Data & Maps

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Projection: NAD 1983 UTM Zone 11N

N
W E
S

2,000 0 2,000
Feet

Vicinity Map

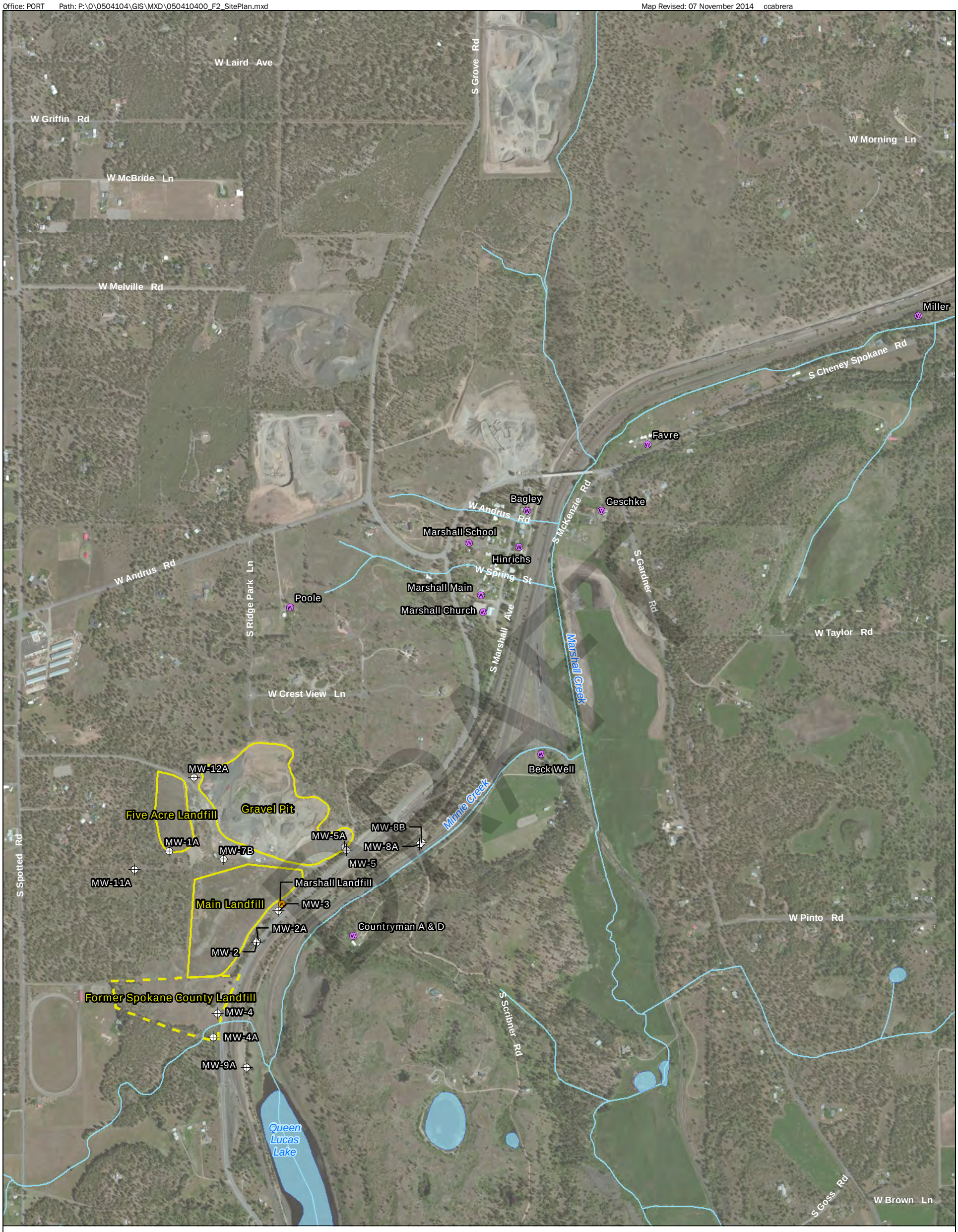
Marshall Landfill
Spokane County, Washington

GeoEngineers

Figure 1

Map Revised: 07 August 2014 ccabrera
Path: P:\0\050410400\GIS\MXD\050410400_F1_VM.mxd
Office: PORT

Office: PORT Path: P:\0\0504104\GIS\MXD\050410400_F2_SitePlan.mxd Map Revised: 07 November 2014 ccabrera



Legend

- MW-1A — Existing Monitoring Well Number and Approximate Location
- Marshall Landfill — Groundwater Supply Well Approximate Location
- Countryman A & D — Private and Community Wells Approximate Location

N / W / E / S

1,100 0 1,100
Feet

Data Source: Aerial from ESRI Data Online.
Water features from PNW Hydrography.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Projection: NAD 1983 UTM Zone 11N

Marshall Landfill Site Plan

Marshall Landfill
Spokane County, Washington

GeoEngineers

Figure 2

Office: PORT Path: P:\0\0504104\GIS\MXD\050410400_F3_MW_CrossSection.mxd Map Revised: 14 January 2015 ccabrera

Legend

- MW-1A — Existing Well Number and Approximate Location
- Marshall Landfill (W) — Groundwater Supply Well Approximate Location
- Countryman A & D (W) — Private and Community Wells Approximate Location
- CH-1 — Abandoned Exploratory Boring and Approximate Location (Fetrow, 1991)
- A — A' — Cross Section Transect

N W E S

400 0 400
Feet

Monitoring Wells and Cross Section Location Map

Marshall Landfill
Spokane County, Washington

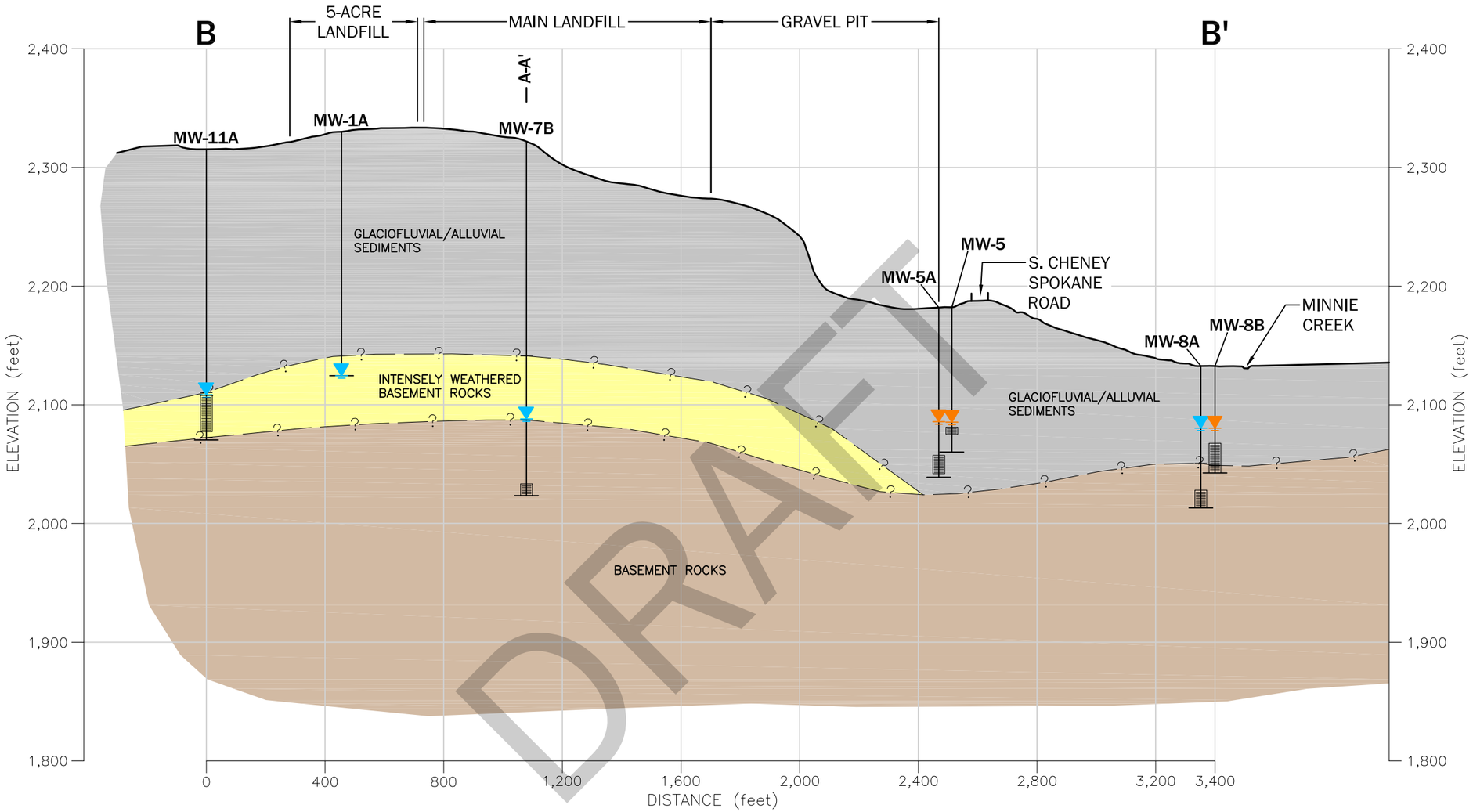
GeoEngineers

Figure 3

Data Source: Aerial from ESRI Data Online.
Water features from PNW Hydrography.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



Notes:

1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
2. Refer to Figure 3 for location of Cross Section.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.
4. Based on well installation data and historic topographic maps a LiDAR survey will be conducted as part of the remedial investigation to establish current surface contours.
5. Hydrostratigraphic interpretation is based on boring log information provided in the "Marshall Landfill 2005 Hydrogeologic Summary", Pacific Groundwater Group, December 23, 2005.

EXPLANATION:

- MW-6B — APPROXIMATE SURFACE ELEVATION
- MONITORING WELL NUMBER AND APPROXIMATE LOCATION
- HYDROSTRATIGRAPHIC CONTACT
- BASEMENT ROCKS — HYDROSTRATIGRAPHIC UNIT
- POTENTIOMETRIC LEVEL IN FLOOD DEPOSIT (SAND AND GRAVEL) HYDROSTRATIGRAPHIC UNIT (6/25/14)
- POTENTIOMETRIC LEVEL IN BASEMENT ROCK HYDROSTRATIGRAPHIC UNIT (6/25/14)
- WELL CASING
- WELL SCREENS
- BOTTOM OF BORING / WELL

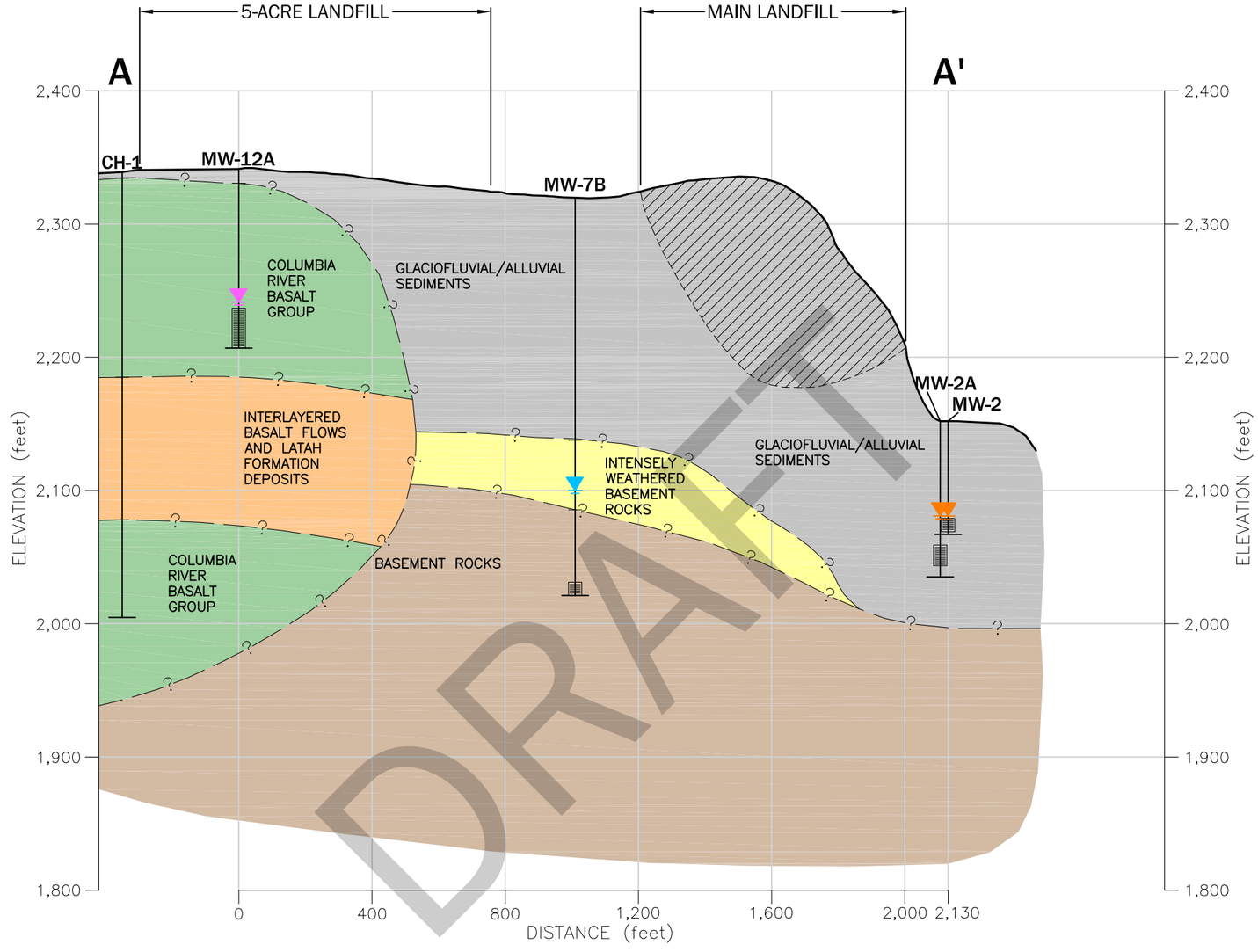
400 0 400
Horizontal Scale in Feet
100 0 100
Vertical Scale in Feet
Vertical Exaggeration: 4X

Cross Section B-B'

Marshall Landfill
Marshall, Washington

GeoEngineers

Figure 5



Notes:

1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
2. Refer to Figure 3 for location of Cross Section.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.
4. Based on well installation data and historic topographic maps a LiDAR survey will be conducted as part of the remedial investigation to establish current surface contours.
5. Hydrostratigraphic interpretation is based on boring log information provided in the "Marshall Landfill 2005 Hydrogeologic Summary", Pacific Groundwater Group, December 23, 2005.

EXPLANATION:

- APPROXIMATE SURFACE ELEVATION
- MW-2: MONITORING WELL NUMBER AND APPROXIMATE LOCATION
- HYDROSTRATIGRAPHIC CONTACT
- BASEMENT ROCKS: HYDROSTRATIGRAPHIC UNIT
- POTENTIOMETRIC LEVEL IN BASALT HYDROSTRATIGRAPHIC UNIT (6/25/14)
- POTENTIOMETRIC LEVEL IN FLOOD DEPOSIT (SAND AND GRAVEL) HYDROSTRATIGRAPHIC UNIT (6/25/14)
- POTENTIOMETRIC LEVEL IN BASEMENT ROCK HYDROSTRATIGRAPHIC UNIT (6/25/14)

- WELL CASING
- WELL SCREENS
- BOTTOM OF BORING / WELL

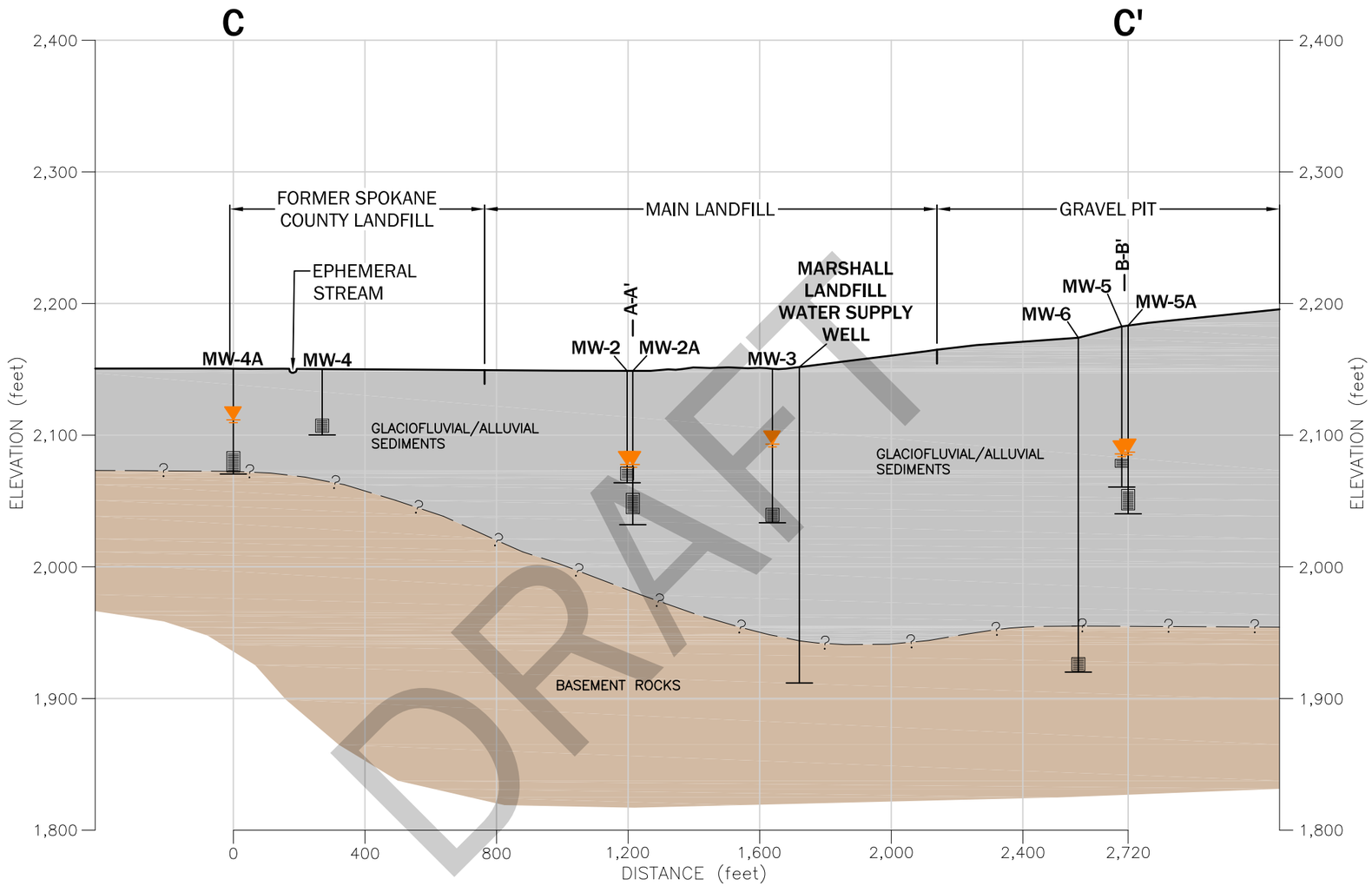
400 0 400
Horizontal Scale in Feet
100 0 100
Vertical Scale in Feet
Vertical Exaggeration: 4X

Cross Section A-A'

Marshall Landfill
Marshall, Washington

GeoEngineers

Figure 4



Notes:
1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
2. Refer to Figure 3 for location of Cross Section.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.
4. Based on well installation data and historic topographic maps a LiDAR survey will be conducted as part of the remedial investigation to establish current surface contours.
5. Hydrostratigraphic interpretation is based on boring log information provided in the "Marshall Landfill 2005 Hydrogeologic Summary", Pacific Groundwater Group, December 23, 2005.

EXPLANATION:

- MW-5A — APPROXIMATE SURFACE ELEVATION
- MONITORING WELL NUMBER AND APPROXIMATE LOCATION
- HYDROSTRATIGRAPHIC CONTACT
- BASEMENT ROCKS — HYDROSTRATIGRAPHIC UNIT
- POTENTIOMETRIC LEVEL IN FLOOD DEPOSIT (SAND AND GRAVEL) HYDROSTRATIGRAPHIC UNIT (6/25/14)
- WELL CASING
- WELL SCREENS
- BOTTOM OF BORING / WELL

400 0 400
Horizontal Scale in Feet
100 0 100
Vertical Scale in Feet
Vertical Exaggeration: 4X

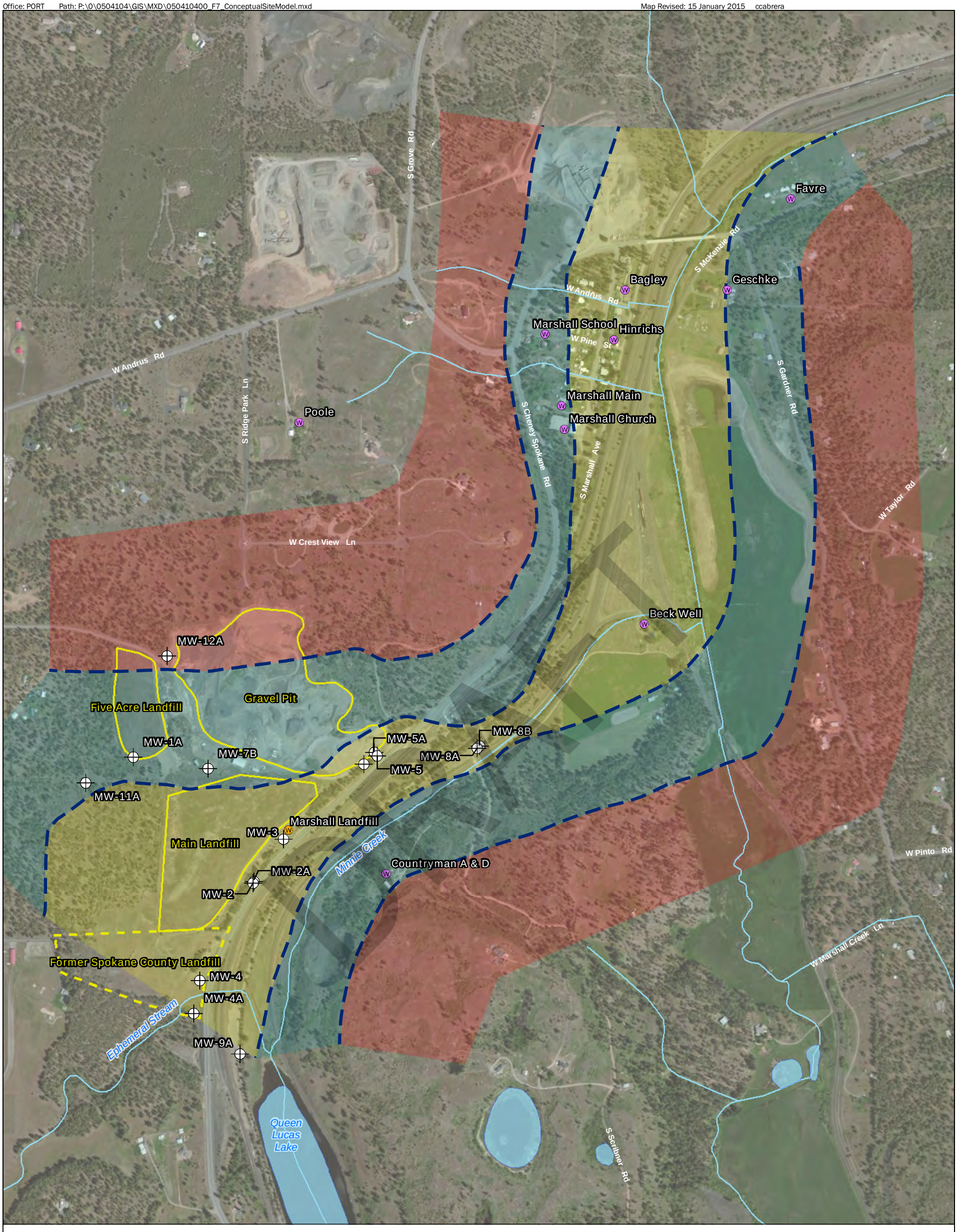
Cross Section C-C'

Marshall Landfill
Marshall, Washington

GeoEngineers

Figure 6

Office: PORT Path: P:\0\0504104\GIS\MXD\050410400_F7_ConceptualSiteModel.mxd Map Revised: 15 January 2015 ccabrera



Legend

- MW-1A — Monitoring Well Number and Approximate Location
- Marshall Landfill — Groundwater Supply Well Approximate Location
- Countryman A & D — Private and Community Wells Approximate Location
- Approximate Aquifer Boundary
- Basement Aquifer System
- Glaciofluvial/Alluvial System
- Columbia River Basalt Group Aquifer System

N W E S

800 0 800
Feet

Data Source: Aerial from ESRI Data Online.
Water features from PNW Hydrography.
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Boundaries of uppermost aquifer adapted from "Approximate Extent of Sand Aquifer", Sheet 10/13, Fetrow Engineering, Inc., June 1991.

Projection: NAD 1983 UTM Zone 11N

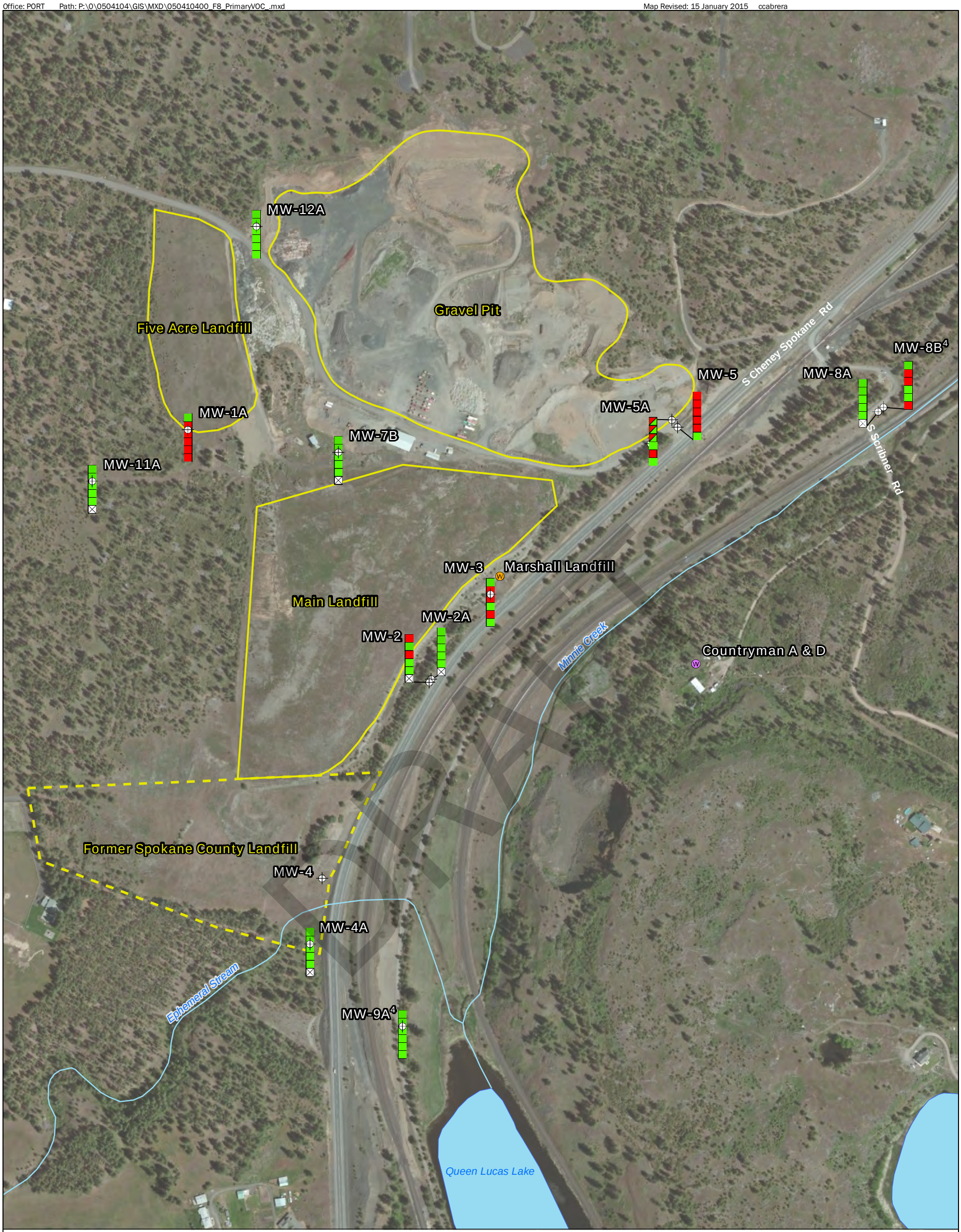
Uppermost Aquifer Boundaries

Marshall Landfill
Spokane County, Washington

GeoEngineers

Figure 7

Office: PORT Path: P:\0\0504104\GIS\MXD\050410400_F8_PrimaryVOC_.mxd Map Revised: 15 January 2015 ccabrera



Legend

- MW-1A — Existing Monitoring Well Number and Approximate Location
- Marshall Landfill — Groundwater Supply Well Approximate Location
- Countryman A&D — Private and Community Wells Approximate Location

Peak Historical Contaminant Levels (PGG, 2005; LAWS, 2010)

- 1,1,1-TCA (Screening Level: 200 ug/L)
- 1,1-DCA (Screening Level: 1 ug/L)
- PCE (Screening Level: 0.8 ug/L)
- 1,1 DCE (Screening Level: 7 ug/L)
- dichloromethane (Screening Level: 5 ug/L)
- CFC-11 (No Screening Level Established: red = detected; green = not detected)

- Exceed Cleanup Criteria Between 1989-2005
- Less Than Cleanup Criteria Between 1989-2005
- Not Tested
- Exceedance of Cleanup Criteria Between 1991-2005, Less Than Cleanup Criteria in June 2010

N W E S

400 0 400
Feet

Data Source: Aerial from ESRI Data Online.
Water features from PNW Hydrography.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Screening Criteria based off of WAC 173-200 standards.
4. Method reporting limit for Dichloromethane was greater than the screening level during some groundwater sampling events.
5. PGG = Pacific Groundwater Group
6. LAWS = Land and Water Services, Inc.

Projection: NAD 1983 UTM Zone 11N

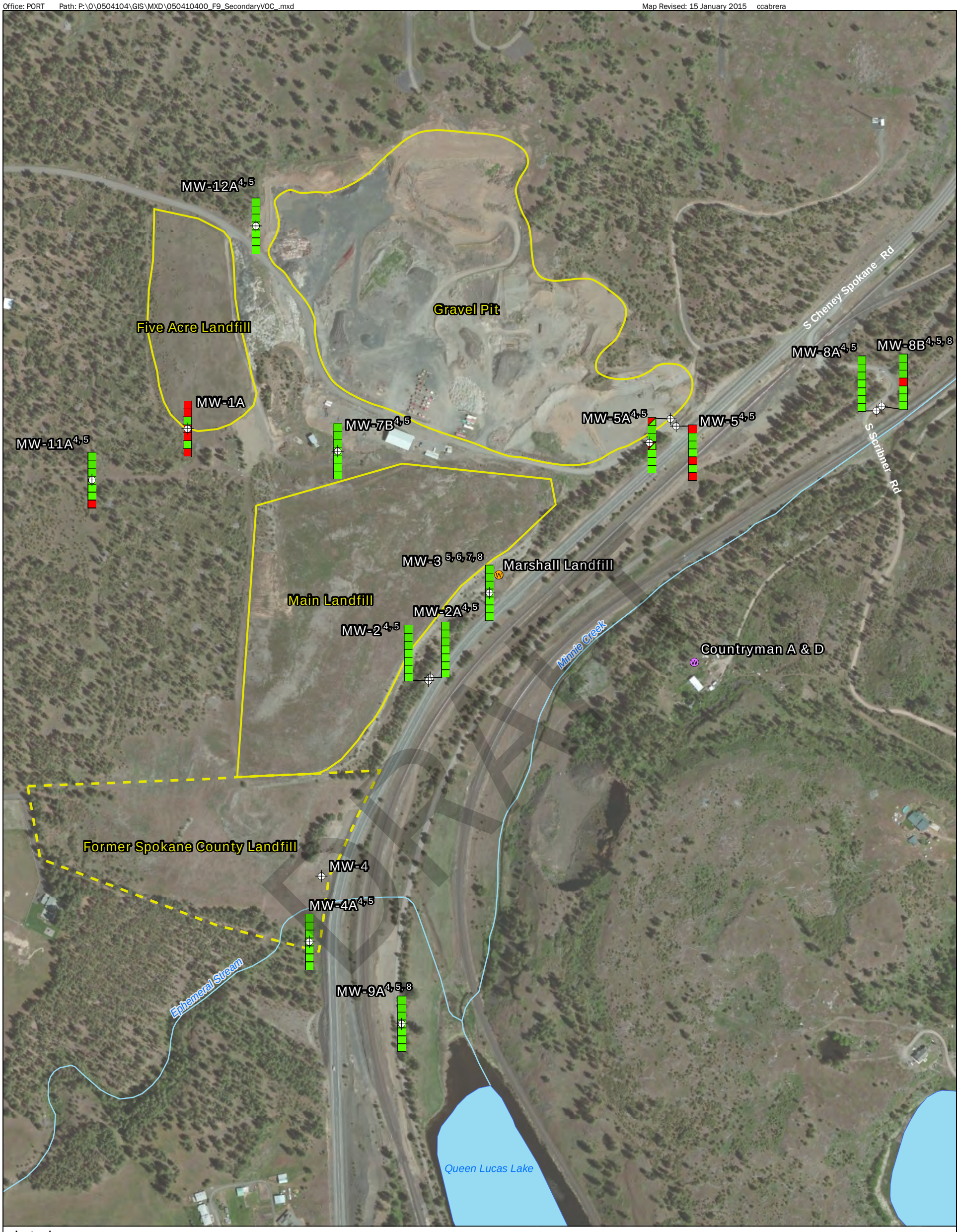
Marshall Landfill Primary VOC Contaminants

Marshall Landfill
Spokane County, Washington

GeoEngineers

Figure 8

Office: PORT Path: P:\0\0504104\GIS\MXD\050410400_F9_SecondaryVOC_.mxd Map Revised: 15 January 2015 ccabrera



Legend

MW-1A — Existing Monitoring Well Number and Approximate Location

Marshall Landfill — Groundwater Supply Well Approximate Location

Countryman A&D — Private and Community Wells Approximate Location

Peak Historical Contaminant Levels (PGG, 2005; LAWS, 2010)

- 1, 2-DCA (Screening Level: 0.5 ug/L)
- TCE (Screening Level: 3 ug/L)
- cis-1, 2-DCE (Screening Level: 70 ug/L)
- Total 1, 2 DCE (No Screening Level Established: red = detected; green = not detected)
- 1, 2-Dichloropropane (Screening Level: 0.5 ug/L)
- Chloroform (Screening Level: 70 ug/L)
- Benzene (Screening Level: 1 ug/L)

- Exceed Cleanup Criteria Between 1989-2005
- Less Than Cleanup Criteria Between 1989-2005
- Exceedances of Cleanup Criteria Between 1991-2005, Less Than Cleanup Criteria in June 2010

N W E S

400 0 400
Feet

Data Source: Aerial from ESRI Data Online.
Water features from PNW Hydrography.
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Screening Criteria based off of WAC 173-200 standards.
4. Method reporting limit (MRL) for 1,2-dichloroethane was greater than the screening level during some groundwater sampling events.
5. MRL for 1 2-Dichloropropane was greater than the screening level during some groundwater sampling events.
6. MRL for 1,2-DCA was greater than the screening level during some groundwater sampling events.
7. MRL for TCE was greater than the screening level during some groundwater sampling events.
8. Method reporting limit for Benzene was greater than the screening level during some groundwater sampling events.
9. PGG = Pacific Groundwater Group
10. LAWS = Land and Water Services, Inc.

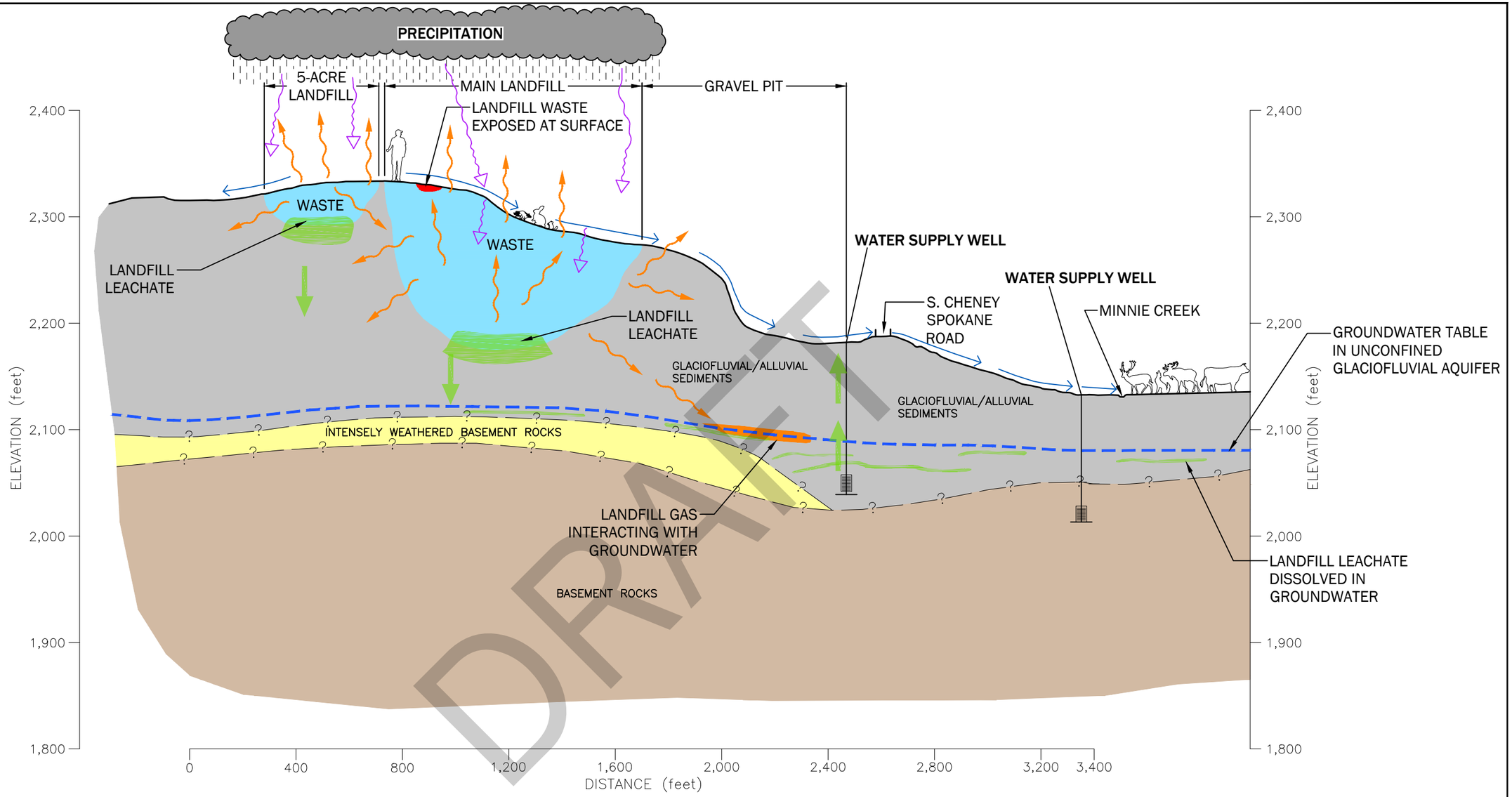
Projection: NAD 1983 UTM Zone 11N

Marshall Landfill Secondary VOC Contaminants

Marshall Landfill
Spokane County, Washington

GeoEngineers

Figure 9



Notes:
1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.
3. Hydrostratigraphic interpretation is based on boring log information provided in the "Marshall Landfill 2005 Hydrogeologic Summary", Pacific Groundwater Group, December 23, 2005.

EXPLANATION:

- WELL CASING
- WELL SCREENS
- BOTTOM OF BORING / WELL
- SURFACE WATER RUNOFF RELEASE MECHANISM
- LANDFILL LEACHATE EXPOSURE MECHANISM
- PRECIPITATION/INFILTRATION MIGRATION MECHANISM
- LANDFILL GASES MIGRATION MECHANISM

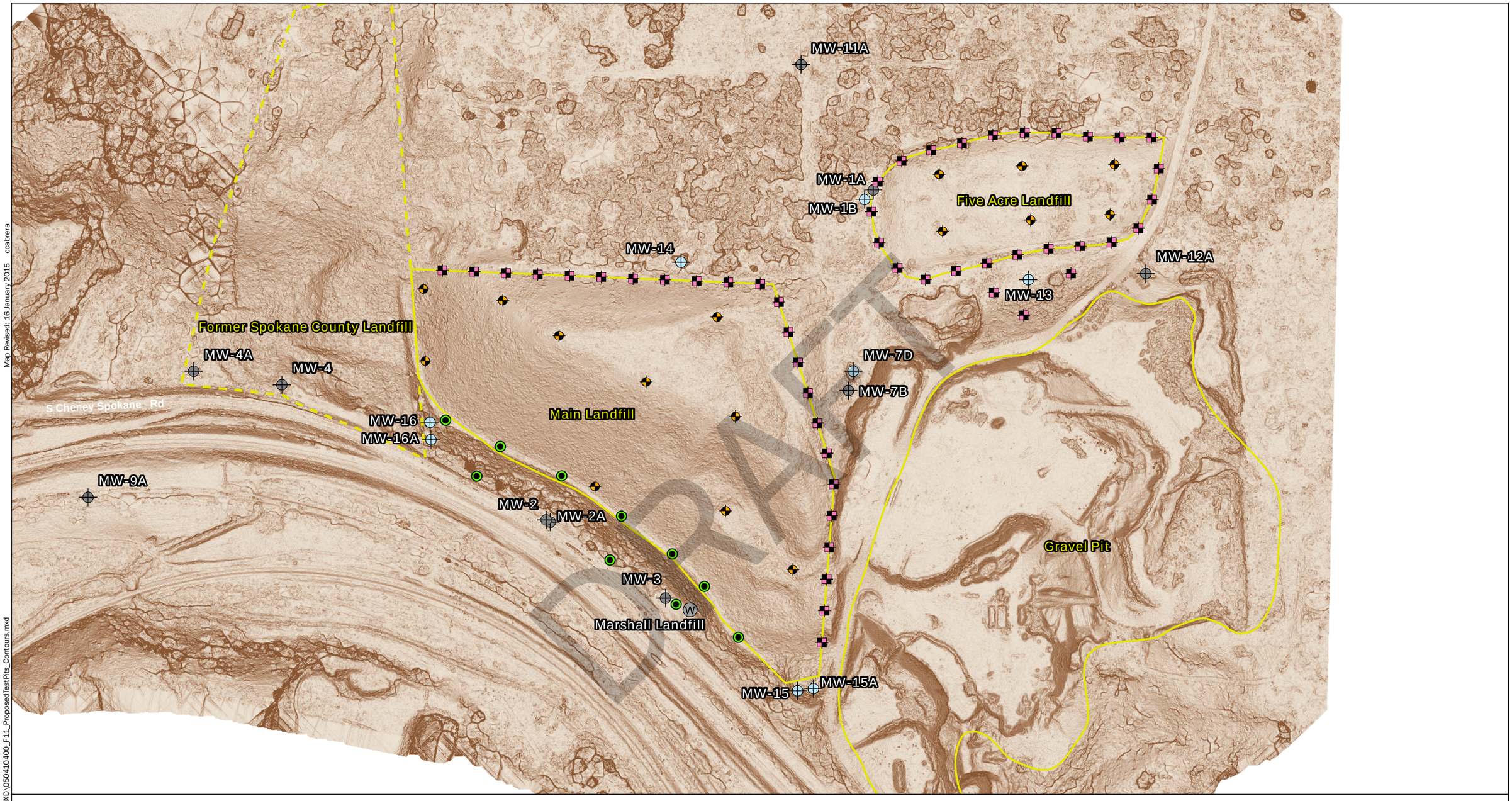
400 0 400
Horizontal Scale in Feet
100 0 100
Vertical Scale in Feet
Vertical Exaggeration: 4X

Conceptual Site Model

Marshall Landfill
Marshall, Washington

GeoEngineers

Figure 10



Data Source: Street labels from Spokane County GIS.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Projection: NAD 1983 UTM Zone 11N

Legend

- Proposed Monitoring Well Number and Approximate Location
- Proposed Test Pit Exploration Approximate Location
- Proposed Landfill Gas Exploration Approximate Location
- Proposed Geotechnical Soil Boring Approximate Location
- Existing Monitoring Well Number and Approximate Location
- Existing Well Number and Approximate Location

Proposed Exploration and Monitoring Well Locations

Marshall Landfill
Spokane County, Washington

GeoEngineers

Figure 11

Map Revised: 16 January 2015 ccabrera
Path: P:\0\0504104\GIS\MXD\0504104_F11_ProposedTestPits_Contours.mxd
Office: PORT

APPENDIX A
Sampling and Analysis Plan

APPENDIX A
SAMPLING AND ANALYSIS PLAN

INTRODUCTION

This SAP presents the details regarding methods and procedures to be employed during the RI field investigation at the Marshall Landfill (the Site) located in Marshall, Washington. The scope of the project includes excavating approximately 55 test pits, completing up to 16 hollow-stem auger borings for geotechnical data and landfill gas monitoring well installation, installing groundwater monitoring wells by air rotary or sonic drilling methods, collecting field landfill gas data from borings and from landfill gas vents (at the Five-Acre Landfill), collecting landfill gas samples for chemical analysis, collecting groundwater and surface water samples for laboratory analysis, evaluating laboratory data, and preparing a RI/FS report documenting the RI field investigation methods and results.

GENERAL SITE CHARACTERIZATION PROCEDURES

This section contains standard procedures for field data collection that are anticipated during the RI including the following:

- Test pits;
- Geotechnical/landfill gas borings;
- Landfill gas monitoring well installation, sampling and analysis;
- Monitoring well installation, development and surveying;
- Measurement of groundwater elevations;
- Groundwater sampling;
- Surface water sampling;
- Decontamination procedures;
- Handling of IDW; and
- Sample location control.

Test Pits

Test pits will be excavated using the following procedure:

- Excavate test pits at locations shown on Figure 9. Test pits will be excavated using a track-mounted excavator or wheeled backhoe, capable of reaching depths of at least 10 feet bgs.
- Conduct periodic air monitoring, using a multi-gas field meter capable of measuring methane, oxygen, carbon dioxide, hydrogen sulfide and PID to detect VOCs in the vicinity of the work area, per the HASP (Appendix B).

- Orient test pit excavations to identify the edge of waste (perpendicular to anticipated waste boundary) and extend the length of excavations to find the waste/native soil contact, as appropriate. Test pits will be excavated to an estimated maximum depth of approximately 4 feet bgs.
- Prepare a geologic log of materials observed with a specific focus on identifying buried debris as an indicated of the limits of waste (edge of the landfill).
- Photo document each test pit.
- Temporarily stockpile soil and debris from each test pit in a manner that allows excavated material to be placed back into the test pit in the approximate depth interval from which it originated.
- Backfill each test pit with the excavated material and compact the backfill with the excavator bucket in appropriate lifts.
- Re-grade the ground surface at the test pit location with the excavator bucket.
- Document the test pit location and number on a Site plan and using an iPad equipped with a GPS.

Geotechnical/Landfill Gas Borings

Geotechnical/landfill gas borings will be advanced at up to 16 locations to anticipated depths ranging between approximately 60 and 150 feet bgs using hollow-stem auger drilling equipment. These borings will be advanced through the soil cover and MSW and at least 15 feet into native soils or refusal, whichever occurs first. (Note: refusal within the MSW is possible and there is a potential to damage or lose drill string downhole). Air space around the drilling augers will be monitored during drilling using a PID and 4-gas meter for screening and for health and safety purposes. Workers will wear appropriate personal protective equipment while drilling in the landfill (see the HASP in Appendix C). Sampled material and drill cuttings will be visually observed for the types of materials contained in the landfill and materials will be documented on the boring logs. Drilling equipment will be decontaminated between each sampling attempt.

Landfill Gas Monitoring Well Installation

Permanent landfill gas monitoring wells will be installed in the landfilled areas: five monitoring wells will be installed in the Main Landfill and four monitoring wells will be installed in the Five-Acre Landfill. Landfill gas monitoring well screened interval depths will be based on initial data collected during RI field activities. Landfill gas monitoring well installation will be observed by a GeoEngineers' field representative, who will maintain a detailed log of the materials and depths of the well. Well construction details, including the depths of the well screen and filter packs, will be recorded on the well construction record.

Groundwater Monitoring Well Construction, Development and Surveying

Groundwater monitoring wells will be constructed in accordance with WAC 173-160, Section 400, resource protection well construction standards. Groundwater monitoring well installation records will be submitted in accordance with these standards. Groundwater monitoring well installation will be observed by a GeoEngineers' field representative, who will maintain a detailed log of the materials and depths of the well. Well construction details, including the depths of the well screen and filter packs, will be recorded on the monitoring well construction record.

Monitoring Well Construction

Each monitoring well will be constructed using schedule 40 or schedule 80 (depending on the depth) polyvinyl chloride (PVC) well casing; landfill gas monitoring wells will be constructed of ¾–inch-diameter PVC and groundwater well will be constructed of 4-inch-diameter PVC. The annular space in each well will be sealed between the top of the filter pack and the ground surface with bentonite to prevent infiltration into the well bore from shallower zones. A compression-type cap will be installed in the top of the PVC well casing for groundwater monitoring wells; landfill gas monitoring wells will have a PVC petcock valve and barbed fitting installed at the top of the casing. For aboveground completions, a lockable above-grade monument equipped with a watertight cover will be installed to protect the PVC well casing. A concrete surface seal will be placed around the monument at the ground surface to divert surface water away from the well location. A minimum of three bollards will be installed around above-grade monuments.

Groundwater Monitoring Well Development and Survey

Each monitoring well will be developed to remove water introduced into the well during drilling (if any), stabilize the filter pack and formation materials surrounding the well screen, and restore the hydraulic connection between the well screen and the surrounding soil.

The depth to water in the monitoring well will be measured prior to development. The total depth of the well will also be measured and recorded. The monitoring wells will be developed by pumping, surging, bailing, or a combination of these methods after construction. Development of each well will continue until the water is as free of sediment as practicable with respect to the composition of the subsurface materials within the screened interval. The removal rate and amount of groundwater removed will be recorded during well development procedures.

During well development, water will be collected and stored on site. After development, wells will be allowed to equilibrate a minimum of 72 hours prior to sampling.

The horizontal locations and elevations of the monitoring wells will be surveyed by a licensed surveyor subcontracted to GeoEngineers. A survey reference notch will be established on the north side of each monitoring well casing.

Field Hydraulic Conductivity Tests

Field hydraulic conductivity tests will be conducted in select Site groundwater monitoring wells to assess the properties of the aquifers underlying the Site. Monitoring wells selected for testing will be determined after the hydrogeologic evaluation is completed and the new monitoring wells are installed. Hydraulic conductivity tests will be completed using slug testing techniques. The slug test method will be employed in accordance with ASTM Method D 4044 - 96 (2008), Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers. Test results will be used in the RI data analysis to calculate groundwater flow velocities, and slug test data and analysis documentation will be appended to the RI/FS report.

Field-Screening Methods

Soil

Field screening tasks will be performed during Site exploration activities to evaluate the presence of contaminants in soil. Soils will be field screened during drilling and test pit activities for evidence of

petroleum or VOCs using a PID. Soils and waste materials encountered during installation of test pits, landfill gas borings, landfill gas and groundwater monitoring wells will be field-screened for the presence/absence of landfill gas and VOCs.

Initial screening will be based on visual examination; if warranted, water sheen screening and headspace vapor screening using a PID will also be conducted. Visual screening consists of inspecting the soil for discoloration indicative of the presence of petroleum material in the sample. Water sheen screening involves placing soil in water and observing the water surface for signs of sheen. Sheen classifications are as follows:

No Sheen	No visible sheen on the water surface;
Slight Sheen	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly. Natural organic matter in the soil might produce a slight sheen;
Moderate Sheen	Light to heavy sheen; might have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on water surface; and
Heavy Sheen	Heavy sheen with color/iridescence; spread is rapid; entire water surface might be covered with sheen.

Headspace vapor screening involves placing a soil sample in a plastic bag. Air is captured in the sealed bag, and the bag is shaken to expose the soil to the air trapped in the bag. The probe of a PID is inserted into the bag, and the PID measures VOC vapor concentrations in parts per million (ppm). The PID is calibrated to isobutylene. The PID is designed to quantify VOC vapor concentrations in the range between 1 ppm and 2,000 ppm with an accuracy of 10 percent of the reading, and between 2,000 ppm and 10,000 ppm with an accuracy of 20 percent of the reading. A flame ionization detector (FID) or Dreager tubes might be used in conjunction with or instead of the PID to measure volatile headspace vapors. These field screening methods will be described in a Work Plan addendum approved by Ecology prior to use.

Soil samples will be field-screened using the methods described above during exploration activities. Samples obtained from the borings which indicate VOC/petroleum contamination will be submitted for laboratory testing. Soil samples submitted for analysis also will be selected based on the location of the boring and depth of the sample in order to provide multiple data points to better understand Site conditions.

Field-screening results are site specific. The results vary with temperature, soil type, type of contaminant, and soil moisture content. Water sheen testing equipment will be disposable or decontaminated before field-screening each sample using a Liquinox® soap solution with a water rinse. Decontamination water will be stored on-site in a labeled Department of Transportation (DOT)-approved drum pending disposal with IDW.

Landfill Gas

Landfill gas will be screened in the field using a handheld GEM 2000+ meter, which is capable of measuring concentrations of methane, carbon dioxide, oxygen and hydrogen sulfide. PID readings will also be collected using the same meter described above in the "Soil" section above. Field screening for landfill gas will be performed at each test pit location, at the passive vents (Five-Acre Landfill), landfill gas borings, landfill gas monitoring wells, groundwater monitoring wells and ambient air (as specified in the HASP, Appendix C).

Field screening in test pits and passive vents will be performed by placing the meter inlet tube in the test pit void. Field screening in the passive landfill gas vents at the Five-Acre Landfill will be conducted by temporarily sealing the vent pipes. The sealed vents will be allowed to stabilize to facilitate measurement of gas pressure with a field meter. Readings will be collected upon parameter stabilization, if possible. Multiple readings may be recorded if relative stabilization does not occur.

Measurement of Groundwater Elevations

Depths to groundwater relative to the monitoring well casing rims will be measured using an electronic water level indicator. Depths to water will be measured to the nearest 0.01 foot. The electronic water level indicator will be decontaminated with Liquinox® solution wash and a distilled water rinse prior to use in each well. Groundwater elevations will be calculated by subtracting the water table depth from the surveyed casing rim elevations.

Groundwater Sampling

Groundwater samples will be collected no sooner than 72 hours after development of new and rehabilitated wells. Each groundwater sample will be collected using low-flow purging methods, unless use of low-flow procedures is not possible. During well purging, water quality parameters (temperature, pH, conductivity, dissolved oxygen, oxidation-reduction potential [ORP], and turbidity) will be monitored and recorded. The groundwater samples will be transferred in the field to laboratory-prepared sample containers and kept cool during transport to the testing laboratory. The sample containers will be filled completely to eliminate headspace in the container. COC procedures will be observed from the time of sample collection to delivery to the testing laboratory.

Additionally, measurement of VOCs in the well headspace will be taken using a PID by first inserting the PID probe into the well casing immediately after removal of the well cap. Measurement of free product, if present, will be completed using an interface probe capable of detecting LNAPL, DNAPL and water.

Landfill Gas Boring and Monitoring Well Sampling

Landfill gas borings will be advanced using hollow-stem auger drilling techniques at up to 16 locations: 10 in the Main Landfill and 6 in the Five-Acre Landfill. Samples of soil and waste will be collected at approximate 2½- to 5-foot-depth intervals using either a standard 2-inch outside-diameter split spoon sampler (SPT) or 3-inch outside-diameter California-style split barrel sampler. Soil samples will be collected from material directly below the MSW (within the first five feet) in each landfill gas monitoring well boring. Sampling equipment will be decontaminated between each sampling attempt.

Monitoring well borings will be advanced using sonic or air-rotary drilling techniques at the approximate locations shown on Figure 11. Soil samples will be obtained continuously as the drilling barrel is advanced (sonic) or every 5 feet (air-rotary). Samples will be contained in a plastic, polyethylene sleeve after retrieving the sampler from the borehole (sonic) or collected in a SPT sampler (air-rotary). Soil samples will be collected from material directly above saturated soil in each groundwater monitoring well boring. Sampling equipment will be decontaminated between each sampling attempt.

Soil selected for each sample will be removed from the sampler using a decontaminated soil knife or new, clean nitrile gloves, and transferred into a laboratory-prepared container, labeled with a water proof pen, and placed on gel ice or double bagged wet ice in a clean plastic-lined cooler. Each sample will be

documented on a daily field log including sample name, sample collection date and time, sample type, sample depth, requested analytical methods, and sampler initials. Soil samples for volatile organic compound (VOC) analyses will be collected consistent with Environmental Protection Agency (EPA) Method 5035A and preserved in accordance with Ecology Memorandum 5 (Ecology, 2004) and EPA (1998).

One soil sample from each boring will be submitted for laboratory analysis; remaining soil samples will be submitted to the laboratory and held for potential analysis. The sample coolers will be delivered to the analytical laboratory under standard chain-of-custody procedures. Samples will be analyzed for Site contaminants of concern (see Appendix B).

Each boring will be continuously monitored by a GeoEngineers field representative to observe and classify the soil encountered, and prepare a detailed log of each boring. Soil encountered in the borings will be classified in the field in general accordance with ASTM D 2488, the Standard Practice for Classification of Soils, Visual-Manual Procedure. Soil samples also will be field-screened using the procedures described in the section below.

Based on the results of field screening select locations will be identified for installation of landfill gas monitoring wells and subsequent sampling. Landfill gas samples will be collected at each location using the following protocol:

- The landfill gas meter will be connected to the petcock on the landfill gas monitoring well. The petcock will be opened to obtain a measurement of the static pressure in the gas probe. The barometric pressure measured by the gas meter will also be recorded.
- The gas meter pump will be turned on to evacuate the gas probe and allow measurement of methane, hydrogen sulfide, oxygen, carbon monoxide and carbon dioxide. A PID will also be connected to the sample train to collect field readings for VOCs. Readings will be recorded in the field notes. After the readings have stabilized, the lab petcock on the gas probe will then be closed.
- A landfill gas sample will be collected using a one-liter Summa® canister set to a flow rate of less than or equal to approximately 200 milliliters per minute. The canister will be connected to the petcock on the landfill gas monitoring well such that connections are air tight. The petcock will be opened and the canister will be filled with landfill gas for approximately 5 minutes or until the vacuum remaining in the canister is approximately 5 inches of mercury. The initial and final canister vacuum will be recorded.

Landfill gas samples will be submitted to an Ecology-certified laboratory for analysis of VOCs (EPA TO-15 method) and methane.

Decontamination Procedures

The objective of the decontamination procedure is to minimize the potential for cross-contamination between sample locations.

A designated decontamination area will be established for decontamination of drilling equipment and reusable sampling equipment. Drilling equipment will be cleaned using high-pressure/low-volume cleaning equipment.

Sampling equipment will be decontaminated in accordance with the following procedures before each sampling attempt or measurement.

1. Brush equipment with a nylon brush to remove large particulate matter.
2. Rinse with potable tap water.
3. Wash with non-phosphate detergent solution (Liquinox® and potable tap water).
4. Rinse with potable tap water.
5. Rinse with distilled water.

Handling of Investigation-Derived Waste

IDW, which consists of mainly drill cuttings and decontamination/purge water, typically will be placed in Washington State DOT-approved 55-gallon drums or roll-off boxes (soil) and poly tanks (water). Each drum will be labeled with the project name, general contents, date and source location (boring number) of contents. The drummed IDW will be stored on-site pending analysis and disposal. Cuttings from landfill gas borings will be placed on plastic sheeting, covered with plastic, and will remain on site for subsequent burial below the soil cap at an agreed upon location following discussions with Ecology. Alternatively, drums might also be used to store cuttings until disposal.

Disposable items, such as sample tubing, disposable bailers, bailer line, gloves and protective overalls, paper towels, etc., will be placed in plastic bags after use and deposited in trash receptacles for disposal.

Sample Location Control

Vertical and horizontal sample control will be maintained throughout the project. Benchmarks will be established for vertical and horizontal survey control by a Washington-licensed professional land surveyor. Horizontal and vertical control for monitoring wells will be tied to datums that are acceptable to Ecology's Environmental Information Management (EIM) System. The elevations of monitoring wells will be surveyed by the licensed surveyor. Ground elevations of direct-push explorations will be estimated from their horizontal locations and topographic survey.

Sampling and Analytical Methods

Field sampling methods, including quality control (QC) and maintenance of field instrumentation, for soil and groundwater sampling will adhere to the requirements of the QAPP (Appendix B).

Analytical methods requirements also will adhere to the QAPP. During laboratory procurement, analytical method reporting limits for each proposed analysis will be compared to the reporting limits listed in the QAPP to ensure that data generated will be sufficient for assessment purposes.

Sample Handling and Custody Requirements

Samples will be handled in accordance with the QAPP. A complete discussion of the sample identification and custody procedures is provided in the QAPP.

Field Measurements and Observations Documentation

Field measurements and observations will be recorded in project logs. Daily logs will be dated, and pages will be consecutively numbered. Entries will be recorded directly and legibly in the daily log and signed and dated by the person conducting the work. If changes are made, the changes will not obscure the previous

entry, and the changes will be signed and dated. At a minimum, the following data will be recorded in the log book:

- Purpose of activity;
- Location of activity;
- Description of sampling reference point(s);
- Sample number identification;
- Sample number and volume;
- Sample transporting procedures;
- Field measurements made;
- Calibration records for field instruments;
- Visitors to site;
- Relevant comments regarding field activities; and
- Signatures of responsible personnel.

Sufficient information will be recorded in the log book so that field activities can be reconstructed without reliance on personnel memory.

Data Management and Documentation

Data logs and data report packages will be located in the project file system in GeoEngineers' Spokane, Washington office. Data reports will be available in both hard copy and electronic formats. Laboratory data reports will include internal laboratory QC checks and sample results. Data logs and packages that are anticipated to be generated during the investigation including laboratory data report packages, boring logs, field sampling data sheets and COC forms.

Analytical data will be supplied to GeoEngineers in both Electronic Data Deliverable (EDD) format and hard copy format. The hard copy will serve as the official record of laboratory results. The EDD will be compatible with Earthsoft EQUIS environmental data management software, and will include the following minimum data requirements in unique cells within the EDD:

- Sample identification;
- The reported concentration;
- The method reporting limit;
- Any flags assigned by the laboratory;
- The sampling date and time; and
- The Chemical Abstracts Service (CAS) registry number.

Upon receipt of the analytical data, the EDD will be uploaded to an EQUIS database and reduced into summary tables for each group of analytes and media. Upon completion of the summary tables, the accuracy of the data reduction will be verified using the hard copy of the data received from the laboratory.

Any exceptions will be noted and corrections will be made. The EDD data will be submitted to Ecology's EIM system.

DATA VALIDATION AND USABILITY

Upon receipt of the sample data from the laboratory, the data will be validated and evaluated for usability in accordance with the QAPP.

APPENDIX B
Quality Assurance Project Plan

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

This QAPP was developed for RI activities at the Marshall Landfill (the Site), located in Marshall, Washington. The RI is being conducted to assist Ecology in completing characterization of the source(s) and extent of soil, groundwater, and landfill gas contamination associated with the Site. Objectives of the RI are discussed in the RI/FS Work Plan. Sampling procedures are outlined in the SAP included as Appendix A of the RI/FS Work Plan. The QAPP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into RI sampling activities. The QAPP presents the objectives, procedures, organization, functional activities, and specific QA and QC activities designed to achieve data quality goals established for the project. This QAPP is based on guidelines specified in WAC 173, Chapter 173-340-820, the US EPA's Contract Laboratory Program (EPA, 2004a) and EPA Requirements for Quality Assurance Project Plans (EPA, 2004b).

Throughout the project, environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that precision, accuracy, representativeness, completeness and comparability (PARCC) of data generated meet the specified data quality objectives.

PROJECT ORGANIZATION AND RESPONSIBILITY

Descriptions of the responsibilities, lines of authority and communication for the key positions to QA/QC are provided below. This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of QA issues before submittal.

PROJECT LEADERSHIP AND MANAGEMENT

The Project Manager's (PM) duties consist of providing concise technical work statements for project tasks, selecting project team members, determining subcontractor participation, establishing budgets and schedules, adhering to budgets and schedules, providing technical oversight, and providing overall production and review of project deliverables. John Haney, Professional Engineer (PE) is the PM for activities at the Sites. The Principal-in-Charge is responsible to Ecology for fulfilling contractual and administrative control of the project. Bruce Williams is the Principal-in Charge.

Field Coordinator

The Field Coordinator is responsible for the daily management of activities in the field. Specific responsibilities include the following:

- Provide technical direction to the field staff.
- Develop schedules and allocates resources for field tasks.
- Coordinate data collection activities to be consistent with information requirements.
- Supervise the compilation of field data and laboratory analytical results.

- Assure that data are correctly and completely reported.
- Implement and oversees field sampling in accordance with project plans.
- Supervise field personnel.
- Coordinate work with on-site subcontractors.
- Schedule sample shipments with the analytical laboratory.
- Monitor that appropriate sampling, testing and measurement procedures are followed.
- Coordinate the transfer of field data, sample tracking forms and log books to the PM for data reduction and validation.
- Participate in QA corrective actions as required.

The Field Coordinators for RI exploration activities at the site are Chelsea Voss, Katie Hall, Josh Lee, and/or Justin Rice.

QA Leader

The GeoEngineers project QA Leader is under the direction of John Haney and Bruce Williams, who are responsible for the project's overall QA. The Project QA Leader is responsible for coordinating QA/QC activities as they relate to the acquisition of field data. Mark Lybeer is the QA Leader. The QA Leader has the following responsibilities:

- Serve as the official contact for laboratory data QA concerns.
- Respond to laboratory data, QA needs, resolves issues, and answers requests for guidance and assistance.
- Review the implementation of the QAPP and the adequacy of the data generated from a quality perspective.
- Maintain the authority to implement corrective actions as necessary.
- Evaluate the laboratory's final QA report for any condition that adversely impacts data generation.
- Ensure that appropriate sampling, testing and analysis procedures are followed, and that correct QC checks are implemented.

Laboratory Management

The subcontracted laboratories conducting sample analyses for this project are required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory's QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of this position include:

- Ensure implementation of the QA Plan.
- Serve as the laboratory point of contact.
- Activate corrective action for out-of-control events.
- Issue the final QA/QC report.

- Administer QA sample analysis.
- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections.

The Laboratory QA Coordinator will be determined by the Ecology-accredited laboratory selected for the project.

Health and Safety

A site-specific HASP will be used for site characterization field activities and is presented in Appendix C. The Field Coordinator will be responsible for implementing the HASP during sampling activities. The PM will discuss health and safety issues with the Field Coordinator on a routine basis during the completion of field activities.

The Field Coordinator will conduct a tailgate safety meeting each morning before beginning daily field activities. The Field Coordinator will terminate any work activities that do not comply with the HASP. Companies providing services for this project on a subcontracted basis will be responsible for developing and implementing their own HASP. GeoEngineers will review subcontractor HASPs before commencement of their work at the site.

DATA QUALITY OBJECTIVES

The QA objective for technical data is to collect environmental monitoring data of known, acceptable and documentable quality. The QA objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting that will facilitate consistency and thoroughness of data generated.
- Achieve the acceptable level of confidence and quality required so that data generated are scientifically valid and of known and documented quality. This will be performed by establishing criteria for PARCC, and by testing data against these criteria.

The sampling design, field procedures, laboratory procedures and QC procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness and reporting limits) and qualitative factors (representativeness and comparability). The measurement quality objectives (MQO) associated with these data quality factors are summarized in Table B-1 and are discussed in the following sections.

Analytes and Matrices of Concern

Samples of soil, groundwater, surface water and landfill gas will be collected during the RI. Tables B-2 through B-31 summarize the planned analyses for soil, groundwater, surface water and landfill gas samples collected at the Site.

Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Individual instruments often can detect but not accurately quantify compounds at concentrations lower than the MDL, referred to as the instrument detection limit (IDL). Although results reported near the MDL or IDL provide insight to site conditions, QA dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL). The contract laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

Achieving a stated detection limit for a given analyte is helpful in providing statistically useful data. Intended data uses, such as comparison to numerical criteria or risk assessments, typically dictate specific project target reporting limits (TRLs) necessary to fulfill stated objectives. The TRLs were identified using the following sources:

- Groundwater: MTCA Method A (unrestricted land use), Method B cleanup levels (Direct Contact) and Water Quality Standards for Groundwaters of the State of Washington published in Chapter 173-200 WAC.
- Surface Water: MTCA Method B surface water cleanup levels; aquatic life fresh/acute and fresh/chronic and human health (fish ingestion) water quality criteria published in Chapter 173-201A WAC, and Section 304 of the Clean Water Act, and the National Toxics Rule.
- Air: MTCA Method B cleanup levels as well as Ecology Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action, Publication No. 09-09-047, October 2009.

The PQLs for Site contaminants of potential concern (COPC) are presented in Tables B-2 through B-31 for soil, groundwater, surface water and landfill gas. These reporting limits were obtained from Ecology-certified laboratories (TestAmerica, Spokane, Washington, and Environmental Science Corporation, Mt. Juliet, Tennessee) (Note: the contracted laboratories for this project are subject to change. However, laboratories subcontracted to complete these analyses will be required to meet the PQLs for Site COPC listed in Tables B-1 through B-31.)

The analytical methods and processes selected will provide PQLs less than the TRLs under ideal conditions. However, the reporting limits in Tables B-2 through B-31 are considered targets because several factors may influence final detection limits. First, moisture and other physical conditions of sample matrices affect detection limits. Second, analytical procedures may require sample dilutions or other practices to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value much higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize site conditions.

Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed

as the relative percent difference (RPD) for spike sample comparisons of various matrices and field duplicate comparisons for water samples. This value is calculated by:

$$RPD\,(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \; X \; 100,$$

Where

D_1 = Concentration of analyte in sample.

D_2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Persons performing the evaluation must review one or more pertinent documents (EPA, 1999; EPA, 2004a) that address criteria exceedances and courses of action. Relative percent difference goals for this effort are 30 percent in groundwater and surface water and 25 percent in landfill gas for all analyses, unless the duplicate sample values are within 5 times the reporting limit.

Accuracy

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported value versus the actual value and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest.

Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

Accuracy will be expressed as the percent recovery of a surrogate compound (also known as "system monitoring compound"), a matrix spike (MS) result, or from a standard reference material where:

$$Recovery\,(\%) = \frac{Spiked\ Sample\ Result - Sample\ Result}{Spike\ Amount} \; X \; 100$$

Persons performing the evaluation must review one or more pertinent documents (EPA, 1999; EPA, 2004a) that address criteria exceedances and courses of action. Accuracy criteria for surrogate spikes, MS, and laboratory control spikes (LCS) are found in Table B-1 of this QAPP.

Representativeness, Completeness and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those delineated within the SAP and this QAPP.
- Comparing analytical results of field duplicates to determine the variations in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation and reporting activities.

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. Completeness goals are 90 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy.

Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil sample is exceeded, then the possibility exists that some of the organic constituents have volatilized from the sample or degraded. Results for that analysis will be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Holding times are presented in Table B-32.

Blanks

According to the *National Functional Guidelines for Organic Data Review* (EPA, 1999), "The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks)." Trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process. A summary of blanks that will be collected and analyzed during the project is provided in Table B-33.

Analytical results for blanks will be interpreted in general accordance with *National Functional Guidelines for Organic Data Review* and professional judgment.

SAMPLE COLLECTION, HANDLING AND CUSTODY

Sampling Equipment Decontamination

The objective of the decontamination procedure is to minimize the potential for cross-contamination between sample locations.

A designated decontamination area will be established for decontamination of drilling equipment and reusable sampling equipment. Drilling equipment will be cleaned using high-pressure/low-volume cleaning equipment.

Sampling equipment will be decontaminated in accordance with the following procedures before each sampling attempt or measurement.

1. Brush equipment with a nylon brush to remove large particulate matter.
2. Rinse with potable tap water.
3. Wash with non-phosphate detergent solution (Liquinox® and potable tap water).
4. Rinse with potable tap water.
5. Rinse with distilled water.

Sample Containers and Labeling

The Field Coordinator will establish field protocol to manage field sample collection, handling and documentation. Samples obtained during this study will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in Table B-32.

Sample containers will be labeled with the following information at the time of collection:

- Project name and number;
- Sample name, which will include a reference to depth if appropriate; and
- Date and time of collection.

The sample collection activities will be noted in the field log books. The Field Coordinator will monitor consistency between the SAP, sample containers/labels, field log books and the COC.

Sample Storage

Water and soil samples will be placed in an insulated cooler with “blue ice” or double-bagged “wet ice” immediately after they are collected. The objective of the cold storage will be to attain a sample storage temperature of 4 degrees Celsius until analysis. Holding times will be observed during sample storage. Holding times for the project analyses are summarized in Table B-32.

Air samples will be collected in laboratory-supplied Summa canisters that will be sealed after collection to prevent leakage and returned to the laboratory for analysis.

Sample Shipment

The samples will be transported and delivered to the analytical laboratory in the coolers/canisters. Field personnel will transport and hand-deliver samples that are being submitted to a local laboratory for analysis. Samples that are being submitted to an out-of-town laboratory for analysis will be transported by a commercial express mailing service on an overnight basis. The Field Coordinator will monitor that the shipping container (cooler) has been properly secured using clear plastic tape and custody seals.

Measures will be implemented to minimize the potential for sample breakage, which includes packaging materials and placing sample bottles in the cooler in a manner intended to minimize damage. Sample bottles will be appropriately wrapped with protective material before being place in coolers. Trip blanks will be included in coolers with groundwater samples.

COC Records

Field personnel are responsible for the security of samples from the time the samples are taken until the samples have been received by the shipper or laboratory. A COC form will be completed at the end of each field day for samples being shipped to the laboratory. Information to be included on the COC form includes:

- Project name and number.
- Sample identification number.
- Date and time of sampling.
- Sample matrix (soil, water, etc.) and number of containers from each sampling point, including preservatives used.
- Analyses to be performed.
- Names of sampling personnel and transfer of custody acknowledgment spaces.
- Shipping information including shipping container number.

The original COC record will be signed by a member of the field team and bear a unique tracking number. Field personnel shall retain carbon copies and place the original and remaining copies in a plastic bag, placed within the cooler or taped to the inside lid of the cooler before sealing the container for shipment. This record will accompany the samples during transit by carrier to the laboratory.

Laboratory Custody Procedures

The laboratory will follow their standard operating procedures (SOPs) to document sample handling from time of receipt (sample log-in) to reporting. Documentation will include at a minimum, the analysts name or initial, time and date.

Field Documentation

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs while on-site. The field logs will be prepared on field report forms or in a bound logbook. Entries in the field logs and associated sample documentation forms will be made in waterproof ink, and corrections will consist of line-out deletions that

are initialed and dated. Individual logbooks will become part of the project files at the conclusion of the site characterization field explorations.

At a minimum, the following information will be recorded during the collection of each sample:

- Sample location and description.
- GPS-recorded location of sample and sketch of sample location, as appropriate.
- Sampler's name(s).
- Date and time of sample collection.
- Designation of sample as composite or discrete.
- Sample matrix.
- Type of sampling equipment used.
- Field instrument readings.
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.).
- Preliminary sample descriptions (e.g., lithologies, noticeable odors, colors, field-screening results).
- Sample preservation.
- Shipping arrangements (overnight air bill number).
- Name of recipient laboratory.

In addition to the sampling information, the following specific information also will be recorded in the field log for each day of sampling:

- Team members and their responsibilities.
- Time of arrival/entry on Site and time of Site departure.
- Other personnel present at the Site.
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel.
- Deviations from sampling plans, Site safety plans and QAPP procedures.
- Changes in personnel and responsibilities with reasons for the changes.
- Levels of safety protection.
- Calibration readings for any equipment used and equipment model and serial number.

The handling, use, and maintenance of field log books are the field coordinator's responsibilities.

CALIBRATION PROCEDURES

Field Instrumentation

Equipment and instrumentation calibration facilitates accurate and reliable field measurements. Field and laboratory equipment used on the project will be calibrated and adjusted in general accordance with the manufacturer's recommendations. Methods and intervals of calibration and maintenance will be based on the type of equipment, stability characteristics, required accuracy, intended use and environmental conditions. The basic calibration frequencies are described below.

The PID used for vapor measurements will be calibrated daily, if required (based on the model used), for site safety monitoring purposes in general accordance with the manufacturer's specifications. If daily calibration is not required for a specific PID model, calibration of the PID will be checked to make sure it is up to date. The calibration results will be recorded in the field logbook. The GEM 2000+ used to measure landfill gases (methane, carbon dioxide, oxygen, hydrogen sulfide) will be calibrated by the equipment supplier prior to rental.

The water quality measuring equipment (In-Situ Troll or YSI) will be calibrated/checked for calibration prior to each monitoring event in general accordance with the manufacturer's specifications. The calibration/check results will be recorded in the field report.

Laboratory Instrumentation

For analytical chemistry, calibration procedures will be performed in general accordance with the methods cited and laboratory standard operating procedures. Calibration documentation will be retained at the laboratory and readily available for a period of 6 months.

DATA REPORTING AND LABORATORY DELIVERABLES

Laboratories will report data in formatted hardcopy and digital form. Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the field sample identification, the laboratory identification, reporting units, qualifiers, analytical method, analyte tested, analytical result, extraction and analysis dates, and detection limit (PQL only). Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues. Laboratory EDD will be established by GeoEngineers, Inc., with the contract laboratory. Final results will be sent to the PM.

INTERNAL QC

Table B-33 summarizes the types and frequency of QC samples to be collected during the site characterization, including both field QC and Laboratory QC samples.

Field QC

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and the influence of off-site factors on environmental samples. Off-site factors include airborne VOCs and potable water used in drilling activities.

Field Duplicates

In addition to replicate analyses performed in the laboratory, field duplicates also serve as measures for precision. Under ideal field conditions, field duplicates (referred to as splits), are created when a volume of the sample matrix is thoroughly mixed, placed in separate containers, and identified as different samples. This tests both the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel. Field duplicate requirements are summarized in Table B-33.

A field duplicate water sample will be collected during each groundwater sampling event. The duplicate sample will be analyzed for the COPCs specified for the given well.

Trip Blanks

Trip blanks accompany groundwater and soil sample containers used for VOC analyses during shipment and sampling periods. Trip blanks will be analyzed on a one per cooler basis.

Laboratory QC

Laboratory QC procedures will be evaluated through a formal data validation process. The analytical laboratory will follow standard method procedures that include specified QC monitoring requirements. These requirements will vary by method but generally include:

- Method blanks
- Internal standards
- Calibrations
- MS/matrix spike duplicates (MSD)
- LCS/laboratory control spike duplicates (LCSD)
- Laboratory replicates or duplicates
- Surrogate spikes

Laboratory Blanks

Laboratory procedures employ the use of several types of blanks but the most commonly used blank for QA/QC assessments are method blanks. Method blanks are laboratory QC samples that consist of either a soil like material having undergone a contaminant destruction process or high performance liquid chromatography (HPLC) water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is found in the method blank then one (or more) of the following occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.

- Volatile substances in the air with high solubility or affinities toward the sample matrix contaminated the samples during preparation or analysis.

It is difficult to determine which of the above scenarios took place if blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. Given method blank results, validation rules assist in determining which substances in samples are considered "real," and which ones are attributable to the analytical process. Furthermore, the guidelines state ". . . there may be instances where little or no contamination was present in the associated blank, but qualification of the sample is deemed necessary. Contamination introduced through dilution water is one example."

Calibrations

Several types of calibrations are used, depending on the method, to determine whether the methodology is 'in control' by verifying the linearity of the calibration curve and to assure that the sample results reflect accurate and precise measurements. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

MS/MSD

MS/MSD samples are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH affects the results of SVOCs. Or, the presence of a particular compound may interfere with accurate quantitation of another analyte. MS/MSD data is reviewed in combination with other QC monitoring data to determine matrix effects. In some cases, matrix affects cannot be determined due to dilution and/or high levels of related substances in the sample. A MS is evaluated by spiking a known amount of one or more of the target analytes ideally at a concentration of 5 to 10 times higher than the sample result. A percent recovery is calculated by subtracting the sample result from the spike result, dividing by the spiked amount, and multiplying by 100.

The samples for the MS and MSD analyses should be collected from a sampling location that is believed to exhibit low-level contamination. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to determine the presence of matrix interferences, which can best be achieved with low levels of contaminants. Additional sample volume will be collected for these analyses. This MS/MSD sample will be a composite to achieve a level of representativeness and reproducibility in the data.

LCS/LCSD

Also known as blanks spikes, LCSs are similar to MSs in that a known amount of one or more of the target analytes are spiked into a prepared media and a percent recovery of the spiked substances are calculated. The primary difference between a MS and LCS is that the LCS media is considered "clean" or contaminant free. For example, HPLC water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance. LCS data must be reviewed in context with other controls to determine if out-of-control events occur.

Laboratory Replicates/Duplicates

Laboratories often utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process, but most commonly occur as a second analysis on the extracted media.

Surrogate Spikes

The purposes of using a surrogate are to verify the accuracy of the instrument being used and extraction procedures. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate is added to the sample and passed through the instrument, noting the surrogate recovery. Each surrogate used has an acceptable range of percent recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exist, although non-detected results are considered accurate.

DATA REDUCTION AND ASSESSMENT PROCEDURES

Data Reduction

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the QA Leader and PM.

Field Measurement Evaluation

Field data will be reviewed at the end of each day by following the QC checks outlined below and procedures in the SAP. Field data documentation will be checked against the applicable criteria as follows:

- Sample collection information.
- Field instrumentation and calibration.
- Sample collection protocol.
- Sample containers, preservation and volume.
- Field QC samples collected at the frequency specified.
- Sample documentation and COC protocols.
- Sample shipment.

Cooler receipt forms and sample condition forms provided by the laboratory will be reviewed for out-of-control incidents. The final report will contain what effects, if any, an incident has on data quality. Sample collection information will be reviewed for correctness before inclusion in a final report.

Field QC Evaluation

A field QC evaluation will be conducted by reviewing field log books and daily reports, discussing field activities with staff, and reviewing field QC samples (trip blanks and field duplicates). Trip blanks will be evaluated using the same criteria as method blanks.

Precision for field duplicate soil samples will not be evaluated because even a well-mixed sample is not entirely homogenous due to sampling procedures, soil conditions, and contaminant transport mechanisms.

Laboratory Data QC Evaluation

The laboratory data assessment will consist of a formal review of the following QC parameters:

- Holding times
- Method blanks
- MS/MSD
- LCS/LCSD
- Surrogate spikes
- Replicates

In addition to these QC mechanisms, other documentation such as cooler receipt forms and case narratives will be reviewed to fully evaluate laboratory QA/QC.

Table B-1

Measurement Quality Objectives

Marshall Landfill RI/FS

Spokane County, Washington

		Check Standard (LCS) %R Limits[2,3]	Matrix Spike (MS) %R Limits[3]	Surrogate Standards (SS) %R Limits[1,2,3]	MS Duplicate Samples or Lab Duplicate RPD Limits[4]	Field Duplicate Samples RPD Limits[4]
Laboratory Analysis	Analytical Method	soil/Water	Soil/Water	Soil/Water	Soil/Water	Soil/Water
Hydrocarbon Identification	Ecology NWTPH-HCID	50%-150%	50%-150%	50%-150%	≤25%	≤25%
Gasoline-range Petroleum Hydrocarbons	Ecology NWTPH-Gx	70%-130%	70%-130%	70%-130%	≤20%	≤20%
Diesel- and Heavy oil-range Petroleum Hydrocarbons	Ecology NWTPH-Dx with silica gel/acid wash cleanup	50%-150%	50%-150%	50%-150%	≤25%	≤25%
Total Metals	EPA 6000/7000 Series	80%-120%	75%-125%	NA	≤20%	≤20%
Dissolved Metals[6]	EPA 200.7/6010 and 200.8/6020	80%-120%	80%-120%	NA	≤20%	≤20%
Dissolved Iron	EPA 200.7	85%-115%	75%-125%	NA	≤20%	≤20%
Dissolved Manganese	EPA 200.7	85%-115%	75%-125%	NA	≤20%	≤20%
Dissolved Zinc	EPA 200.7	85%-115%	75%-125%	NA	≤20%	≤20%
Dissolved Lead	EPA 200.7	85%-115%	75%-125%	NA	≤20%	≤20%
VOCs	EPA 8260	varies per analyte	70%-130%	70%-130%	≤20%	≤20%
PAHs	EPA 8270SIM	varies per analyte	70%-130%	70%-130%	≤20%	≤20%
SVOCs	EPA 8270C	varies per analyte	varies per analyte	varies per analyte	varies per analyte	NA
PCBs	EPA 8082	varies per analyte	50%-150%	35%-157%	≤35%	NA
Dioxins/Furans	EPA 8290	varies per analyte	varies per analyte	NA	≤20%	NA
Organochlorine Pesticides	GS/MS/MS[5]	varies per analyte	varies per analyte	33%-133%	varies per analyte	NA
Organophosphorous Pesticides	EPA 8141A	varies per analyte	varies per analyte	49%-171%	varies per analyte	NA
Herbicides	EPA 8151A	varies per analyte	varies per analyte	39%-135%	≤30%	NA
Cyanide	EPA 335.3/9012/EPA 335.4	90%-110%	90%-110%	NA	≤10%	NA
Total Coliform	SM9223B Quanti-tray	NA	NA	NA	NA	NA
Ammonia Nitrogen	EPA 350.1	90%-110%	90%-110%	NA	≤20%	NA
Nitrate Nitrogen	EPA 300.0	90%-110%	75%-125%	NA	≤25%	NA
Nitrite Nitrogen	EPA 300.0	90%-110%	75%-125%	NA	≤25%	NA

		Check Standard (LCS) %R Limits[2,3]	Matrix Spike (MS) %R Limits[3]	Surrogate Standards (SS) %R Limits[1,2,3]	MS Duplicate Samples or Lab Duplicate RPD Limits[4]	Field Duplicate Samples RPD Limits[4]
Chloride	EPA 300.0	90%-110%	75%-125%	NA	≤25%	≤25%
Sulfate	EPA 300.0	90%-110%	75%-125%	NA	≤25%	≤25%
Chemical Oxygen Demand	EPA 410.1/EPA 410.4	90%-110%	90%-110%	NA	≤20%	≤20%
Total Organic Carbon	EPA 415.1/SM5310C	90%-110%	75%-122%	NA	≤20%	≤20%
Laboratory Analysis	Analytical Method	Air	Air	Air	Air	Air
TO-15 VOCs	EPA TO15	varies per analyte	NA	NA	≤25%	≤25%

Notes:

Method numbers refer to EPA SW-846 Analytical Methods or Washington State Department of Ecology (Ecology) recommended analytical methods.

[1]Individual surrogate recoveries are compound specific.

[2]Recovery Ranges are estimates. Actual ranges will be provided by the laboratory when contracted.

[3]Percent Recovery Limits are expressed as ranges based on laboratory control limits. Limits will vary for individual analytes.

[4]RPD control limits are only applicable if the concentration are greater than 5 times the method reporting limit (MRL). For results less than 5 times the MRL, the difference between the sample and duplicate must be less than 2X the MRL for soils and 1X the MRL for waters.

[5]Organochlorine pesticides to be analyzed using low level GC/MS/MS method.

[6]Metals include antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), vanadium (V) and zinc (Zn).

VOCs = Volatile Organic Compounds; PAHs = polycyclic hydrocarbons; SVOCs = semivolatile organic compounds; PCBs = polychlorinated biphenyls;

LCS = Laboratory Control Sample; MS/MSD = Matrix Spike/Matrix Spike Duplicate; EPA = Environmental Protection Agency; RPD = Relative Percent Difference;

NA = Not Applicable

Table B-2

Analytes and Target Reporting Limits - TPH Soil

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	Analytical Method	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Groundwater MTCA Method A Cleanup Level (mg/kg)	Groundwater MTCA Method B Cleanup Level Non-cancer (mg/kg)	Groundwater MTCA Method B Cleanup Level Cancer (mg/kg)
Total Petroleum Hydrocarbons							
TPH-Gasoline Range	NWTPH-Gx	0.1	0.0339	30	100/30	--	--
TPH - Diesel Range	NWTPH-Dx (with silica gel/acid wash cleanup)	--	4	2,000	2,000	--	--
TPH - Oil Range	NWTPH-Dx (with silica gel/acid wash cleanup)	--	10	2,000	2,000	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated .

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

TPH = total petroleum hydrocarbons

MTCA = Model Toxics Control Act

mg/kg = milligram per kilogram; "--" = not established

Table B-3

Analytes and Target Reporting Limits - Metals and Cyanide Soil

Marshall Landfill RI/FS

Spokane County, Washington

Analytes	Analytical Method	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
Antimony	EPA 6020	7440-36-0	2.10E-02	1.00E-01	3.20E+01	--	3.20E+01	--
Arsenic	EPA 6020	7440-38-2	2.50E-03	1.00E-01	6.67E-01	2.00E+01	2.40E+01	6.67E-01
Barium	EPA 6020	7440-39-3	3.20E-02	2.00E-01	1.60E+04	--	1.60E+04	--
Berylium	EPA 6020	7440-41-7	1.20E-02	1.00E-01	1.60E+02	--	1.60E+02	--
Cadmium	EPA 6020	7440-43-9	1.60E-02	1.00E-01	--	--	--	--
Chromium	EPA 6020	7440-47-3	5.40E-02	1.00E-01	--	--	--	--
Copper	EPA 6020	7440-50-8	5.20E-02	2.00E-01	3.20E+03	--	3.20E+03	--
Iron	EPA 6010B	7439-89-6	1.41E+00	1.00E+01	5.60E+04	--	5.60E+04	--
Lead	EPA 6020	7439-92-1	2.40E-02	1.00E-01	2.50E+02	2.50E+02	--	--
Manganese	EPA 6020	7439-96-5	2.50E-02	2.00E-01	1.12E+04	--	1.12E+04	--
Mercury	EPA 7471A	7439-97-6	2.80E-03	2.00E-02	2.00E+00	2.00E+00	--	--
Nickel	EPA 6020	7440-02-0	3.50E-02	1.00E-01	1.60E+03	--	1.60E+03	--
Selenium	EPA 6020	7782-49-2	3.80E-02	1.00E-01	4.00E+02	--	4.00E+02	--
Silver	EPA 6020	7440-22-4	3.10E-02	2.00E-01	4.00E+02	--	4.00E+02	--
Thallium	EPA 6020	7440-28-0	1.90E-02	1.00E-01	8.00E-01	--	8.00E-01	--
Vanadium	EPA 6020	7440-62-2	1.80E-02	2.00E-01	4.00E+02	--	4.00E+02	--
Zinc	EPA 6020	7440-66-6	2.56E-01	1.00E+00	2.40E+04	--	2.40E+04	--
Cyanide	EPA 335.4	57-12-5		1.00E+00	4.80E+01	--	4.80E+01	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit, refer to the MDLs. There may be cases where the laboratory cannot meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014).

Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-4

Analytes and Target Reporting Limits - VOCs Soil (EPA Method 8260 B)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
1,1,1,2-tetrachloroethane	630-20-6	1.99E-04	1.00E-03	3.85E+01	--	2.40E+03	3.85E+01
1,1,1-trichloroethane	71-55-6	5.16E-04	1.00E-03	2.00E+00	2.00E+00	1.60E+05	--
1,1,2,2-tetrachloroethane	79-34-5	3.29E-04	1.00E-03	5.00E+00	--	1.60E+03	5.00E+00
1,1,2-trichloro-1,2,2-trifluoroethane	76-13-1	2.47E-04	1.00E-03	2.40E+06	--	2.40E+06	--
1,1,2-trichloroethane	79-00-5	4.56E-04	1.00E-03	1.75E+01	--	3.20E+02	1.75E+01
1,1-dichloroethane	75-34-3	2.59E-04	1.00E-03	1.75E+02	--	1.60E+04	1.75E+02
1,1-dichloroethene	75-35-4	7.42E-04	1.00E-03	4.00E+03	--	4.00E+03	--
1,2,3-trichlorobenzene	87-61-6	2.31E-04	1.00E-03	--	--	--	--
1,2,3-trichloropropane	96-18-4	6.75E-04	1.00E-03	3.33E-02	--	3.20E+02	3.33E-02
1,2,4-trichlorobenzene	120-82-1	2.49E-04	1.00E-03	3.45E+01	--	8.00E+02	3.45E+01
1,2,4-trimethylbenzene	95-63-6	1.70E-04	1.00E-03	--	--	--	--
1,2-dibromo-3-chloropropane	96-12-8	1.16E-03	5.00E-03	1.25E+00	--	1.60E+01	1.25E+00
1,2-dibromoethane	106-93-4	3.15E-04	1.00E-03	5.00E-03	5.00E-03	7.20E+02	5.00E-01
1,2-dichlorobenzene	95-50-1	2.37E-04	1.00E-03	7.20E+03	--	7.20E+03	--
1,2-dichloroethane	107-06-2	5.31E-04	1.00E-03	1.10E+01	--	4.80E+02	1.10E+01
1,2-dichloropropane	78-87-5	7.51E-04	1.00E-03	2.78E+01	--	7.20E+03	2.78E+01
1,3,5-trimethylbenzene	108-67-8	2.16E-04	1.00E-03	8.00E+02	--	8.00E+02	--
1,3-dichlorobenzene	541-73-1	3.79E-04	1.00E-03	--	--	--	--
1,4-dichlorobenzene	106-46-7	2.18E-04	1.00E-03	1.85E+02	--	5.60E+03	1.85E+02
2-butanone	78-93-3	2.68E-03	1.00E-02	4.80E+04	--	4.80E+04	--
2-hexanone	591-78-6	--	--	--	--	--	--
4-chlorotoluene	106-43-4	3.21E-04	1.00E-03	--	--	--	--
4-methyl-2-pentanone	108-10-1	1.40E-03	1.00E-02	6.40E+03	--	6.40E+03	--
acetone	67-64-1	1.70E-02	5.00E-02	7.20E+04	--	7.20E+04	--
acrylonitrile	107-13-1	2.03E-03	1.00E-02	1.85E+00	--	3.20E+03	1.85E+00

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
benzene	71-43-2	3.25E-04	1.00E-03	3.00E-02	3.00E-02	3.20E+02	1.82E+01
bromobenzene	108-86-1	2.19E-04	1.00E-03	--	--	--	--
bromodichloromethane	75-27-4	3.87E-04	1.00E-03	1.61E+01	--	1.60E+03	1.61E+01
bromoform	75-25-2	5.77E-04	1.00E-03	1.27E+02	--	1.60E+03	1.27E+02
bromomethane	74-83-9	1.28E-03	5.00E-03	1.12E+02	--	1.12E+02	--
carbon disulfide	75-15-0	--	--	8.00E+03	--	8.00E+03	--
carbon tetrachloride	56-23-5	3.20E-04	1.00E-03	1.43E+01	--	3.20E+02	1.43E+01
chlorobenzene	108-90-7	2.50E-04	1.00E-03	1.60E+03	--	1.60E+03	--
chloroethane	75-00-3	5.86E-04	5.00E-03	0.00E+00	--	--	--
chloroform	67-66-3	4.11E-04	5.00E-03	3.23E+01	--	8.00E+02	3.23E+01
chloromethane	74-87-3	5.62E-04	1.00E-03	0.00E+00	--	--	--
cis-1,2-dichloroethene	156-59-2	7.23E-04	1.00E-03	1.60E+02	--	1.60E+02	--
cis-1,3-dichloropropene	10061-01-5	2.62E-04	1.00E-03	--	--	--	--
cyclohexane	110-82-7	--	--	--	--	--	--
dibromochloromethane	124-48-1	2.31E-04	1.00E-03	1.19E+01	--	1.60E+03	1.19E+01
dichlorodifluoromethane	75-71-8	3.20E-04	5.00E-03	1.60E+04	--	1.60E+04	--
ethylbenzene	100-41-4	2.26E-04	1.00E-03	6.00E+00	6.00E+00	8.00E+03	--
hexachlorobutadiene	87-68-3	3.56E-04	1.00E-03	1.28E+01	--	8.00E+01	1.28E+01
isopropylbenzene	98-82-8	2.11E-04	1.00E-03	8.00E+03	--	8.00E+03	--
m,p-xylenes	1330-20-7	4.60E-04	3.00E-03	9.00E+00	9.00E+00	1.60E+04	--
methyl acetate	79-20-9	--	--	8.00E+04	--	8.00E+04	--
methyl tert-butyl ether	1634-04-4	2.78E-04	1.00E-03	1.00E-01	1.00E-01	--	5.56E+02
methylcyclohexane	108-87-2	--	--	--	--	--	--
methylene chloride	75-09-2	6.00E-04	5.00E-03	2.00E-02	2.00E-02	4.80E+02	5.00E+02
n-butylbenzene	104-51-8	2.40E-04	1.00E-03	4.00E+03	--	4.00E+03	--
n-propylbenzene	103-65-1	1.99E-04	1.00E-03	8.00E+03	--	8.00E+03	--
o-chlorotoluene	95-49-8	2.32E-04	1.00E-03	1.60E+03	--	1.60E+03	--
o-xylene	95-47-6	--	--	1.60E+04	--	1.60E+04	--
p-isopropyltoluene	99-87-6	1.74E-04	1.00E-03	--	--	--	--
sec-butylbenzene	135-98-8	2.00E-04	1.00E-03	8.00E+03	--	8.00E+03	--

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
styrene	100-42-5	2.03E-04	1.00E-03	1.60E+04	--	1.60E+04	--
tert-butylbenzene	98-06-6	1.86E-04	1.00E-03	8.00E+03	--	8.00E+03	--
tetrachloroethene	127-18-4	2.31E-04	1.00E-03	5.00E-02	5.00E-02	4.80E+02	4.76E+02
toluene	108-88-3	1.21E-03	5.00E-03	7.00E+00	7.00E+00	6.40E+03	--
trans-1,2-dichloroethene	156-60-5	6.78E-04	1.00E-03	1.60E+03	--	1.60E+03	--
trans-1,3-dichloropropene	10061-02-6	3.60E-04	1.00E-03	--	--	--	--
trichloroethene	79-01-6	3.36E-04	1.00E-03	3.00E-02	3.00E-02	4.00E+01	1.20E+01
trichlorofluoromethane	75-69-4	2.73E-04	5.00E-03	2.40E+04	--	2.40E+04	--
vinyl chloride	75-01-4	2.87E-04	1.00E-03	6.70E-01	--	2.40E+02	6.70E-01

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-5

Analytes and Target Reporting Limits - SVOCs Soil (EPA Methods 8270SIM and 8270C)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
PAHs by EPA 8270SIM	NA	0.018081	0.141	0.1	0.1[4]	--	--
2,4,5-trichlorophenol	95-95-4	--	--	8.00E+03	--	8.00E+03	--
2,4,6-trichlorophenol	88-06-2	2.78E-02	3.30E-01	8.00E+01	--	8.00E+01	9.09E+01
2,4-dichlorophenol	120-83-2	2.44E-02	3.30E-01	2.40E+02	--	2.40E+02	--
2,4-dimethylphenol	105-67-9	3.81E-02	3.30E-01	1.60E+03	--	1.60E+03	--
2,4-dinitrophenol	51-28-5	4.08E-02	3.30E-01	1.60E+02	--	1.60E+02	--
2,4-dinitrotoluene	121-14-2	2.47E-02	3.30E-01	3.23E+00	--	1.60E+02	3.23E+00
2,6-dinitrotoluene	606-20-2	2.29E-02	3.30E-01	6.67E-01	--	2.40E+01	6.67E-01
2-chloronaphthalene	91-58-7	2.55E-02	3.30E-01	6.40E+03	--	6.40E+03	--
2-chlorophenol	95-57-8	3.10E-02	3.30E-01	4.00E+02	--	4.00E+02	--
2-methylnaphthalene	91-57-6	--	--	3.20E+02	--	3.20E+02	--
2-methylphenol	95-48-7	--	--	4.00E+03	--	4.00E+03	--
2-nitroaniline	88-74-4	--	--	8.00E+02	--	8.00E+02	--
2-nitrophenol	88-75-5	2.75E-02	3.30E-01	--	--	--	--
3,3'-dichlorobenzidine	91-94-1	3.06E-02	3.30E-01	2.22E+00	--	--	2.22E+00
3-nitroaniline	99-09-2	--	--	--	--	--	--
4,6-dinitro-2-methylphenol	534-52-1	3.97E-02	3.30E-01	--	--	--	--
4-bromophenyl phenyl ether	101-55-3	2.22E-02	3.30E-01	--	--	--	--
4-chloro-3-methylphenol	59-50-7	3.36E-02	3.30E-01	--	--	--	--
4-chloroaniline	106-47-8	--	--	5.00E+00	--	3.20E+02	5.00E+00
4-chlorophenyl phenyl ether	7005-72-3	2.53E-02	3.30E-01	--	--	--	--
4-nitroaniline	100-01-6	--	--	--	--	--	--
4-nitrophenol	100-02-7	2.67E-02	3.30E-01	--	--	--	--
acenaphthene	83-32-9	2.37E-02	3.30E-01	4.80E+03	--	4.80E+03	--
acenaphthylene	208-96-8	2.84E-02	3.30E-01	--	--	--	--
anthracene	120-12-7	2.30E-02	3.30E-01	2.40E+04	--	2.40E+04	--
benzo(a)anthracene	56-55-3	3.21E-02	3.30E-01	1.37E+00	--	--	1.37E+00
benzo(a)pyrene	50-32-8	2.68E-02	3.30E-01	1.00E-01	1.00E-01	--	1.37E-01

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
benzo(b)fluoranthene	205-99-2	3.02E-02	3.30E-01	1.37E+00	--	--	1.37E+00
benzo(ghi)perylene	191-24-2	2.89E-02	3.30E-01	--	--	--	--
benzo(k)fluoranthene	207-08-9	3.12E-02	3.30E-01	1.37E+01	--	--	1.37E+01
benzoic acid	65-85-0	--	--	3.20E+05	--	3.20E+05	--
benzyl alcohol	100-51-6	--	--	8.00E+03	--	8.00E+03	--
bis(2-chloroethoxy)methane	111-91-1	3.21E-02	3.30E-01	--	--	--	--
bis(2-chloroethyl) ether	111-44-4	2.85E-02	3.30E-01	9.09E-01	--	--	9.09E-01
bis(2-chloroisopropyl) ether	108-60-1	3.29E-02	3.30E-01	1.43E+01	--	3.20E+03	1.43E+01
bis(2-ethylhexyl) phthalate	117-81-7	6.01E-02	3.30E-01	7.14E+01	--	1.60E+03	7.14E+01
butyl benzyl phthalate	85-68-7	3.83E-02	3.30E-01	5.26E+02	--	1.60E+04	5.26E+02
carbazole	86-74-8	--	--	--	--	--	--
chrysene	218-01-9	3.53E-02	3.30E-01	1.37E+02	--	--	1.37E+02
dibenz(a,h)anthracene	53-70-3	2.81E-02	3.30E-01	1.37E-01	--	--	1.37E-01
dibenzofuran	132-64-9	--	--	8.00E+01	--	8.00E+01	--
diethyl phthalate	84-66-2	4.06E-02	3.30E-01	6.40E+04	--	6.40E+04	--
dimethyl phthalate	131-11-3	2.63E-02	3.30E-01	--	--	--	--
di-n-butyl phthalate	84-74-2	2.73E-02	3.30E-01	8.00E+03	--	8.00E+03	--
di-n-octyl phthalate	117-84-0	3.61E-02	3.30E-01	8.00E+02	--	8.00E+02	--
fluoranthene	206-44-0	2.40E-02	3.30E-01	3.20E+03	--	3.20E+03	--
fluorene	86-73-7	2.26E-02	3.30E-01	3.20E+03	--	3.20E+03	--
hexachlorobenzene	118-74-1	2.47E-02	3.30E-01	6.25E-01	--	6.40E+01	6.25E-01
hexachlorobutadiene	87-68-3	3.56E-04	1.00E-03	1.28E+01	--	8.00E+01	1.28E+01
hexachlorocyclopentadiene	77-47-4	3.49E-02	3.30E-01	4.80E+02	--	4.80E+02	--
hexachloroethane	67-72-1	3.30E-02	3.30E-01	2.50E+01	--	5.60E+01	2.50E+01
indeno(1,2,3-cd)pyrene	193-39-5	2.95E-02	3.30E-01	1.37E+00	--	--	1.37E+00
isophorone	78-59-1	3.80E-02	3.30E-01	1.05E+03	--	1.60E+04	1.05E+03
methyl naphthalene;1-	90-12-0	--	--	3.45E+01	--	5.60E+03	3.45E+01
methyl naphthalene;2-	91-57-6	--	--	3.20E+02	--	3.20E+02	--
naphthalene	91-20-3	3.97E-04	5.00E-03	5.00E+00	5.00E+00	1.60E+03	--
nitrobenzene	98-95-3	2.76E-02	3.30E-01	1.60E+02	--	1.60E+02	--
n-nitrosodimethylamine	62-75-9	4.02E-02	3.30E-01	1.96E-02	--	6.40E-01	1.96E-02
n-nitrosodi-n-propylamine	621-64-7	3.30E-02	3.30E-01	1.43E-01	--	--	1.43E-01
n-nitrosodiphenylamine	86-30-6	3.45E-02	3.30E-01	2.04E+02	--	--	2.04E+02
pentachlorophenol	87-86-5	3.11E-02	3.30E-01	2.50E+00	--	4.00E+02	2.50E+00

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
phenanthrene	85-01-8	2.48E-02	3.30E-01	--	--	--	--
phenol	108-95-2	2.88E-02	3.30E-01	2.40E+04	--	2.40E+04	--
pyrene	129-00-0	3.56E-02	3.30E-01	2.40E+03	--	2.40E+03	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Value for benzo(a)pyrene. This value will be used as Target Reporting Limit.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-6

Analytes and Target Reporting Limits - PCBs Soil (EPA Method 8082)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Practical Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
Aroclor 1016	12674-11-2	1.98E-03	1.70E-02	5.60E+00	--	5.60E+00	1.43E+01
Aroclor 1221	11104-28-2	4.90E-03	1.70E-02	--	--	--	--
Aroclor 1232	11141-16-5	7.18E-03	1.70E-02	--	--	--	--
Aroclor 1242	53469-21-9	4.88E-03	1.70E-02	--	--	--	--
Aroclor 1248	12672-29-6	2.72E-03	1.70E-02	--	--	--	--
Aroclor 1254	11097-69-1	5.01E-03	1.70E-02	5.00E-01	--	1.60E+00	5.00E-01
Aroclor 1260	11096-82-5	2.82E-03	1.70E-02	5.00E-01	--	--	5.00E-01
Total PCBs[3]	1336-36-3	2.95E-02	1.19E-01	5.00E-01	1.00E+00	--	5.00E-01

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Water samples will be analyzed for individual aroclors. Total PCBs will be calculated, as needed, by summing the individual aroclors.

mg/kg = milligram per kilogram

Dashes (–) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-7

Analytes and Target Reporting Limits - Dioxins/Furans Soil (EPA Method 8290)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Target Reporting Limit[2] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
2,3,7,8-TCDD	1746-01-6	1.00E-06	1.28E-05	--	9.30E-05	1.28E-05
1,2,3,7,8-PeCDD	40321-76-4	2.50E-06	--	--	--	--
1,2,3,6,7,8-HxCDD	57653-85-7	2.50E-06	--	--	--	--
1,2,3,4,7,8-HxCDD	39227-28-6	2.50E-06	--	--	--	--
1,2,3,7,8,9-HxCDD	19408-74-3	2.50E-06	1.61E-04	--	--	1.61E-04
1,2,3,4,6,7,8-HpCDD	35822-46-9	2.50E-06	--	--	--	--
OCDD	3268-87-9	5.00E-06	--	--	--	--
2,3,7,8-TCDF	51207-31-9	1.00E-06	--	--	--	--
1,2,3,7,8-PeCDF	57117-41-6	2.50E-06	--	--	--	--
2,3,4,7,8-PeCDF	57117-31-4	2.50E-06	--	--	--	--
1,2,3,6,7,8-HxCDF	57117-44-9	2.50E-06	--	--	--	--
1,2,3,7,8,9-HxCDF	72918-21-9	2.50E-06	--	--	--	--
1,2,3,4,7,8-HxCDF	70648-26-9	2.50E-06	--	--	--	--
2,3,4,6,7,8-HxCDF	60851-34-5	2.50E-06	--	--	--	--
1,2,3,4,6,7,8-HpCDF	67562-39-4	2.50E-06	--	--	--	--
1,2,3,4,7,8,9-HpCDF	55673-89-7	2.50E-06	--	--	--	--
OCDF	39001-02-0	5.00E-06	--	--	--	--
Total dioxin/furan as 2,3,7,8-TCDD[3]		4.45E-05	1.28E-05			

Notes:

[1]Practical Quantitation Limit (PQL) (supplied by laboratory) should be less than the Target Reporting Limit. Laboratory method detection limits are listed. There may be cases where the laboratory can not meet the Target Reporting Limit.

[2]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Standard laboratory reporting limits were stated for these analytes.

[3]Total dioxins will be calculated using the method in WAC 173-340-708.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-8

Analytes and Target Reporting Limits - Organochlorine Pesticides Soil (EPA Method 8081)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
aldrin	309-00-2	3.20E-03	2.00E-02	5.88E-02	--	2.40E+00	5.88E-02
chlordane	57-74-9	3.01E-03	2.00E-01	2.86E+00	--	4.00E+01	2.86E+00
4,4'-DDD	72-54-8	2.24E-03	2.00E-02	4.17E+00	--	--	4.17E+00
4,4'-DDE	72-55-9	2.37E-03	2.00E-02	2.94E+00	--	--	2.94E+00
4,4'-DDT	50-29-3	2.67E-03	2.00E-02	2.94E+00	3.00E+00	4.00E+01	2.94E+00
dieldrin	60-57-1	2.37E-03	2.00E-02	6.25E-02	--	4.00E+00	6.25E-02
endosulfan I	959-98-8	4.85E-04	2.00E-02	--	--	--	--
endosulfan II	33213-65-9	2.29E-03	2.00E-02	--	--	--	--
endosulfan sulfate	1031-07-8	2.35E-03	2.00E-02	--	--	--	--
endrin	72-20-8	2.40E-03	2.00E-02	2.40E+01	--	2.40E+01	--
endrin aldehyde	7421-93-4	2.07E-03	2.00E-02	--	--	--	--
endrin ketone	53494-70-5	2.55E-03	2.00E-02	--	--	--	--
heptachlor	76-44-8	2.49E-03	2.00E-02	2.22E-01	--	4.00E+01	2.22E-01
heptachlor epoxide	1024-57-3	2.68E-03	2.00E-02	1.10E-01	--	1.04E+00	1.10E-01
a-hexachlorocyclohexane	319-84-6	2.33E-03	2.00E-02	1.59E-01	--	6.40E+02	1.59E-01
b-hexachlorocyclohexane	319-85-7	2.59E-03	2.00E-02	5.56E-01	--	--	5.56E-01
d-hexachlorocyclohexane	319-86-8	6.29E-03	2.00E-02	--	--	--	--
lindane	58-89-9	2.47E-03	2.00E-02	1.00E-02	1.00E-02	2.40E+01	9.09E-01
methoxychlor	72-43-5	2.42E-03	2.00E-02	4.00E+02	--	4.00E+02	--
toxaphene	8001-35-2	2.16E-02	4.00E-01	9.09E-01	--	--	9.09E-01

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.
Concentrations of analytes detected above the MDL, but below the MRL are estimated .

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit.
For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014).
Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-9

Analytes and Target Reporting Limits - Organophosphorous Pesticides Soil (EPA Method 8141)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
methyl azinphos	86-50-0	5.50E-03	1.00E-01	--	--	--	--
bolstar (sulfopros)	35400-43-2	4.00E-03	1.00E-01	--	--	--	--
chlorpyrifos	2921-88-2	4.10E-03	1.00E-01	8.00E+01	--	8.00E+01	--
coumaphos	56-72-4	3.80E-03	1.00E-01	--	--	--	--
o,s-demeton	8065-48-3	2.18E-02	7.00E-02	3.20E+00	--	3.20E+00	--
diazinon	333-41-5	7.50E-03	1.00E-01	5.60E+01	--	5.60E+01	--
dichlorvos	62-73-7	9.90E-03	1.00E-01	3.45E+00	--	4.00E+01	3.45E+00
dimethoate	60-51-5	2.60E-03	1.00E-01	1.60E+01	--	1.60E+01	--
disulfoton	298-04-4	1.65E-02	1.00E-01	3.20E+00	--	3.20E+00	--
ethoprop	13194-48-4	1.56E-02	1.00E-01	--	--	--	--
ethyl p-nitrophenyl phenylphosphorothioate	2104-64-5	7.50E-03	1.00E-01	8.00E-01	--	8.00E-01	--
fensulfothion	115-90-2	7.30E-03	1.00E-01	--	--	--	--
fenthion	55-38-9	6.20E-03	1.00E-01	--	--	--	--
malathion	121-75-5	6.30E-03	1.00E-01	1.60E+03	--	1.60E+03	--
merphos	150-50-5	4.40E-03	1.00E-01	2.40E+00	--	2.40E+00	--
methyl parathion	298-00-0	6.80E-03	1.00E-01	--	--	2.00E+01	--
mevinphos	7786-34-7	1.05E-02	1.00E-01	--	--	--	--
parathion	56-38-2	8.30E-03	1.00E-01	4.80E+02	--	4.80E+02	--
phorate	298-02-2	1.11E-02	1.00E-01	1.60E+01	--	1.60E+01	--
ronnel	299-84-3	4.00E-03	1.00E-01	4.00E+03	--	4.00E+03	--
sulfotepp	3689-24-5	9.30E-03	1.00E-01	4.00E+01	--	4.00E+01	--
tokuthion	34643-46-4	--	--	--	--	--	--
trichloronate	327-98-0	4.50E-03	1.00E-01	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.

Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit.

For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014).

Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-10

Analytes and Target Reporting Limits - Herbicides Soil (EPA Method 8151)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (mg/kg)	Quantitation Limit/Method Reporting Limit[2] (mg/kg)	Target Reporting Limit[3] (mg/kg)	Soil MTCA Method A Cleanup Level (mg/kg)	Soil MTCA Method B Cleanup Level Non-cancer (mg/kg)	Soil MTCA Method B Cleanup Level Cancer (mg/kg)
dalapon	75-99-0	6.72E-03	8.00E-01	2.40E+03	--	2.40E+03	--
2,4-db	94-82-6	5.92E-03	7.00E-02	6.40E+02	--	6.40E+02	--
dicamba	1918-00-9	5.43E-02	7.00E-02	2.40E+03	--	2.40E+03	--
2,4-dichlorophenoxyacetic acid	94-75-7	1.22E-02	7.00E-02	8.00E+02	--	8.00E+02	--
dichloroprop	120-36-5	5.88E-03	7.00E-02	--	--	--	--
dinoseb	88-85-7	5.35E-03	7.00E-02	8.00E+01	--	8.00E+01	--
2,4,5-tp (silvex)	93-72-1	6.91E-03	7.00E-02	6.40E+02	--	6.40E+02	--
2,4,5-trichlorophenoxyacetic acid	93-76-5	9.51E-03	7.00E-02	8.00E+02	--	8.00E+02	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.

Concentrations of analytes detected above the MDL, but below the MRL are estimated .

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit.

For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014).

Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

mg/kg = milligram per kilogram

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-11

Analytes and Target Reporting Limits - TPH Groundwater

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	Analytical Method	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
Total Petroleum Hydrocarbons							
TPH-Gasoline Range	NWTPH-Gx	31.6	100	800	1,000/800[2]	--	--
TPH - Diesel Range	NWTPH-Dx (with silica gel/acid wash cleanup)	--	240	500	500	--	--
TPH - Oil Range	NWTPH-Dx (with silica gel/acid wash cleanup)	--	400	500	500	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

TPH = total petroleum hydrocarbons

MTCA = Model Toxics Control Act

µg/l = micrograms per liter; "--" = not established

Table B-12

Analytes and Target Reporting Limits - Metals and Cyanide Groundwater

Marshall Landfill RI/FS

Spokane County, Washington

Analytes	Analytical Method	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
Antimony	EPA 6020A	7440-36-0	8.00E-02	4.00E-01	6.40E+00	--	6.40E+00	--
Arsenic	EPA 6020A	7440-38-2	7.50E-01	1.00E+00	5.83E-02	5.00E+00	4.80E+00	5.83E-02
Barium	EPA 6020A	7440-39-3	5.40E-02	1.20E+00	3.20E+03	--	3.20E+03	--
Berylium	EPA 6020A	7440-41-7	1.02E-01	4.00E-01	3.20E+01	--	3.20E+01	--
Cadmium	EPA 6020A	7440-43-9	2.80E-02	4.00E-01	5.00E+00	5.00E+00	8.00E+00	--
Chromium	EPA 6020A	7440-47-3	2.70E-01	4.00E-01	5.00E+01	5.00E+01	--	--
Copper	EPA 6020A	7440-50-8	1.10E-01	1.00E+00	3.20E+02	--	3.20E+02	--
Iron	EPA 6020A	7439-89-6	5.80E+00	4.00E+01	1.12E+04	--	1.12E+04	--
Lead	EPA 6020A	7439-92-1	3.40E-02	4.00E-01	1.50E+01	1.50E+01	--	--
Manganese	EPA 6020A	7439-96-5	1.90E-01	4.00E-01	2.24E+03	--	2.24E+03	--
Mercury	EPA 200 series method	7439-97-6	1.80E+02	2.00E+02	2.00E+00	2.00E+00	--	--
Nickel	EPA 6020A	7440-02-0	4.00E-01	3.00E+00	3.20E+02	--	3.20E+02	--
Selenium	EPA 6020A	7782-49-2	7.10E-01	1.00E+00	8.00E+01	--	8.00E+01	--
Silver	EPA 6020A	7440-22-4	3.00E-02	4.00E-01	8.00E+01	--	8.00E+01	--
Thallium	EPA 6020A	7440-28-0	2.80E-01	1.00E+00	1.60E-01	--	1.60E-01	--
Vanadium	EPA 6020A	7440-62-2	9.75E-01	2.00E+00	8.00E+01	--	8.00E+01	--
Zinc	EPA 6020A	7440-66-6	1.90E+00	4.00E+00	4.80E+03	--	4.80E+03	--
Cyanide	EPA 335.4	57-12-5	8.00E-01	5.00E+00	9.60E+00	--	9.60E+00	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-13

Analytes and Target Reporting Limits - VOCs Groundwater (EPA Method 8260 B)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
1,1,1,2-tetrachloroethane	630-20-6	1.40E-01	1.00E+00	1.68E+00	--	2.40E+02	1.68E+00
1,1,1-trichloroethane	71-55-6	5.00E-01	1.00E+00	2.00E+02	2.00E+02	1.60E+04	--
1,1,2,2-tetrachloroethane	79-34-5	1.24E-01	1.00E+00	2.19E-01	--	1.60E+02	2.19E-01
1,1,2-trichloro-1,2,2-trifluoroethane	76-13-1	2.00E-01	1.00E+00	2.40E+05	--	2.40E+05	--
1,1,2-trichloroethane	79-00-5	1.40E-01	1.00E+00	7.68E-01	--	3.20E+01	7.68E-01
1,1-dichloroethane	75-34-3	1.00E-01	1.00E+00	7.68E+00	--	1.60E+03	7.68E+00
1,1-dichloroethene	75-35-4	5.00E-01	1.00E+00	4.00E+02	--	4.00E+02	--
1,2,3-trichlorobenzene	87-61-6	1.60E-01	1.00E+00	--	--	--	--
1,2,3-trichloropropane	96-18-4	5.01E-01	1.00E+00	1.46E-03	--	3.20E+01	1.46E-03
1,2,4-trichlorobenzene	120-82-1	1.00E-01	4.00E-01	1.51E+00	--	8.00E+01	1.51E+00
1,2,4-trimethylbenzene	95-63-6	4.00E-02	1.00E+00	0.00E+00	--	--	--
1,2-dibromo-3-chloropropane	96-12-8	1.08E+00	5.00E+00	5.47E-02	--	1.60E+00	5.47E-02
1,2-dibromoethane	106-93-4	5.00E-01	1.00E+00	1.00E-02	1.00E-02	7.20E+01	2.19E-02
1,2-dichlorobenzene	95-50-1	1.00E-01	4.00E-01	7.20E+02	--	7.20E+02	--
1,2-dichloroethane	107-06-2	5.00E-01	1.00E+00	4.81E-01	5.00E+00	4.80E+01	4.81E-01
1,2-dichloropropane	78-87-5	1.53E-01	1.00E+00	1.22E+00	--	7.20E+02	1.22E+00
1,3,5-trimethylbenzene	108-67-8	7.40E-02	1.00E+00	8.00E+01	--	8.00E+01	--
1,3-dichlorobenzene	541-73-1	1.00E-01	4.00E-01	0.00E+00	--	--	--
1,4-dichlorobenzene	106-46-7	1.00E-01	4.00E-01	8.10E+00	--	5.60E+02	8.10E+00
2-butanone	78-93-3	6.30E-01	1.00E+01	4.80E+03	--	4.80E+03	--
2-hexanone	591-78-6	2.30E-01	1.00E+01	--	--	--	--
4-chlorotoluene	106-43-4	3.40E-02	1.00E+00	--	--	--	--
4-methyl-2-pentanone	108-10-1	2.00E-01	1.00E+01	6.40E+02	--	6.40E+02	--
acetone	67-64-1	4.81E-01	2.50E+01	7.20E+03	--	7.20E+03	--
acrylonitrile	107-13-1	7.90E-01	3.00E+00	8.10E-02	--	3.20E+02	8.10E-02

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
benzene	71-43-2	3.20E-02	2.00E-01	7.95E-01	5.00E+00	3.20E+01	7.95E-01
bromobenzene	108-86-1	1.00E-01	1.00E+00	--	--	--	--
bromodichloromethane	75-27-4	1.05E-01	1.00E+00	7.06E-01	--	1.60E+02	7.06E-01
bromoform	75-25-2	1.70E-01	1.00E+00	5.54E+00	--	1.60E+02	5.54E+00
bromomethane	74-83-9	2.20E-01	5.00E+00	1.12E+01	--	1.12E+01	--
carbon disulfide	75-15-0	5.20E-02	1.00E+00	8.00E+02	--	8.00E+02	--
carbon tetrachloride	56-23-5	1.20E-01	1.00E+00	6.25E-01	--	3.20E+01	6.25E-01
chlorobenzene	108-90-7	6.00E-02	1.00E+00	1.60E+02	--	1.60E+02	--
chloroethane	75-00-3	2.00E-01	1.00E+00	0.00E+00	--	--	--
chloroform	67-66-3	1.20E-01	1.00E+00	1.41E+00	--	8.00E+01	1.41E+00
chloromethane	74-87-3	6.30E-02	3.00E+00	0.00E+00	--	--	--
cis-1,2-dichloroethene	156-59-2	7.50E-02	1.00E+00	1.60E+01	--	1.60E+01	--
cis-1,3-dichloropropene	10061-01-5	9.80E-02	1.00E+00	--	--	--	--
cyclohexane	110-82-7	1.40E-01	1.00E+00	0.00E+00	--	--	--
dibromochloromethane	124-48-1	1.30E-01	1.00E+00	5.21E-01	--	1.60E+02	5.21E-01
dichlorodifluoromethane	75-71-8	2.00E-01	1.00E+00	1.60E+03	--	1.60E+03	--
ethylbenzene	100-41-4	8.60E-02	1.00E+00	7.00E+02	7.00E+02	8.00E+02	--
hexachlorobutadiene	87-68-3	1.00E-01	6.00E-01	5.61E-01	--	8.00E+00	5.61E-01
isopropylbenzene	98-82-8	6.30E-02	1.00E+00	8.00E+02	--	8.00E+02	--
m,p-xylenes	1330-20-7	---	---	1.00E+03	1.00E+03	1.60E+03	--
methyl acetate	79-20-9	1.07E+00	3.00E+00	8.00E+03	--	8.00E+03	--
methyl tert-butyl ether	1634-04-4	9.00E-02	1.00E+00	2.00E+01	2.00E+01	--	2.43E+01
methylcyclohexane	108-87-2	1.20E-01	1.00E+00	0.00E+00	--	--	--
methylene chloride	75-09-2	7.00E-01	1.00E+01	5.00E+00	5.00E+00	4.80E+01	2.19E+01
n-butylbenzene	104-51-8	5.00E-02	1.00E+00	4.00E+02	--	4.00E+02	--
n-propylbenzene	103-65-1	6.30E-02	1.00E+00	8.00E+02	--	8.00E+02	--
o-chlorotoluene	95-49-8	3.90E-02	1.00E+00	1.60E+02	--	1.60E+02	--
o-xylene	95-47-6	6.20E-02	1.00E+00	1.60E+03	--	1.60E+03	--
p-isopropyltoluene	99-87-6	7.00E-02	1.00E+00	--	--	--	--
sec-butylbenzene	135-98-8	7.20E-02	1.00E+00	8.00E+02	--	8.00E+02	--

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
styrene	100-42-5	1.00E-01	1.00E+00	1.60E+03	--	1.60E+03	--
tert-butylbenzene	98-06-6	1.20E-01	1.00E+00	8.00E+02	--	8.00E+02	--
tetrachloroethene	127-18-4	7.30E-02	1.00E+00	5.00E+00	5.00E+00	4.80E+01	2.08E+01
toluene	108-88-3	3.80E-02	1.00E+00	6.40E+02	1.00E+03	6.40E+02	--
trans-1,2-dichloroethene	156-60-5	1.20E-01	1.00E+00	1.60E+02	--	1.60E+02	--
trans-1,3-dichloropropene	10061-02-6	1.54E-01	1.00E+00	--	--	--	--
trichloroethene	79-01-6	1.30E-01	1.00E+00	5.40E-01	5.00E+00	4.00E+00	5.40E-01
trichlorofluoromethane	75-69-4	1.00E+00	1.00E+00	2.40E+03	--	2.40E+03	--
vinyl chloride	75-01-4	1.30E-01	2.00E-01	2.00E-01	2.00E-01	2.40E+01	Guidance

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-14

Analytes and Target Reporting Limits - SVOCs Groundwater (EPA Methods 8270SIM and 8270C)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-Cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
PAHs by EPA 8270SIM	NA	0.26944	1.75	0.1	0.1[4]	--	--
2,4,5-trichlorophenol	95-95-4	1.00E-01	4.00E-01	8.00E+02	--	8.00E+02	--
2,4,6-trichlorophenol	88-06-2	1.00E-01	6.00E-01	3.98E+00	--	8.00E+00	3.98E+00
2,4-dichlorophenol	120-83-2	1.00E-01	4.00E-01	2.40E+01	--	2.40E+01	--
2,4-dimethylphenol	105-67-9	3.00E-01	2.00E+00	1.60E+02	--	1.60E+02	--
2,4-dinitrophenol	51-28-5	1.00E+00	5.00E+00	3.20E+01	--	3.20E+01	--
2,4-dinitrotoluene	121-14-2	1.00E-01	4.00E-01	2.82E-01	--	3.20E+01	2.82E-01
2,6-dinitrotoluene	606-20-2	1.00E-01	4.00E-01	5.83E-02	--	4.80E+00	5.83E-02
2-chloronaphthalene	91-58-7	2.00E-02	6.00E-02	6.40E+02	--	6.40E+02	--
2-chlorophenol	95-57-8	1.00E-01	4.00E-01	4.00E+01	--	4.00E+01	--
2-methylnaphthalene	91-57-6	2.00E-02	2.00E-01	3.20E+01	--	3.20E+01	--
2-methylphenol	95-48-7	1.00E-01	4.00E-01	4.00E+02	--	4.00E+02	--
2-nitroaniline	88-74-4	1.00E-01	4.00E-01	1.60E+02	--	1.60E+02	--
2-nitrophenol	88-75-5	1.00E-01	4.00E-01	--	--	--	--
3,3'-dichlorobenzidine	91-94-1	1.00E-01	2.00E+00	1.94E-01	--	--	1.94E-01
3-nitroaniline	99-09-2	1.20E-01	4.00E-01	--	--	--	--
4,6-dinitro-2-methylphenol	534-52-1	1.00E+00	4.00E+00	--	--	--	--
4-bromophenyl phenyl ether	101-55-3	1.00E-01	4.00E-01	--	--	--	--
4-chloro-3-methylphenol	59-50-7	1.00E-01	4.00E-01	--	--	--	--
4-chloroaniline	106-47-8	1.00E-01	4.00E-01	2.19E-01	--	3.20E+01	2.19E-01
4-chlorophenyl phenyl ether	7005-72-3	1.00E-01	4.00E-01	--	--	--	--
4-nitroaniline	100-01-6	1.00E-01	6.00E-01	--	--	--	--
4-nitrophenol	100-02-7	1.00E+00	3.00E+00	--	--	--	--
acenaphthene	83-32-9	2.00E-02	1.00E-01	9.60E+02	--	9.60E+02	--
acenaphthylene	208-96-8	2.00E-02	8.00E-02	--	--	--	--
anthracene	120-12-7	1.00E-02	4.00E-02	4.80E+03	--	4.80E+03	--
benzo(a)anthracene	56-55-3	2.00E-02	6.00E-02	1.20E-01	--	--	1.20E-01
benzo(a)pyrene	50-32-8	2.00E-02	4.00E-02	1.20E-02	1.00E-01	--	1.20E-02

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-Cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
benzo(b)fluoranthene	205-99-2	2.00E-02	8.00E-02	1.20E-01	--	--	1.20E-01
benzo(ghi)perylene	191-24-2	2.00E-02	6.00E-02	--	--	--	--
benzo(k)fluoranthene	207-08-9	2.00E-02	6.00E-02	1.20E+00	--	--	1.20E+00
benzoic acid	65-85-0	6.00E-01	3.00E+00	6.40E+04	--	6.40E+04	--
benzyl alcohol	100-51-6	1.00E-01	4.00E-01	8.00E+02	--	8.00E+02	--
bis(2-chloroethoxy)methane	111-91-1	1.00E-01	4.00E-01	--	--	--	--
bis(2-chloroethyl) ether	111-44-4	1.00E-01	4.00E-01	3.98E-02	--	--	3.98E-02
bis(2-chloroisopropyl) ether	108-60-1	1.00E-01	4.00E-01	6.25E-01	--	3.20E+02	6.25E-01
bis(2-ethylhexyl) phthalate	117-81-7	1.18E+00	3.00E+00	6.25E+00	--	3.20E+02	6.25E+00
butyl benzyl phthalate	85-68-7	2.00E-01	6.00E-01	4.61E+01	--	3.20E+03	4.61E+01
carbazole	86-74-8	1.00E-01	4.00E-01	--	--	--	--
chrysene	218-01-9	1.30E-02	4.00E-02	1.20E+01	--	--	1.20E+01
dibenz(a,h)anthracene	53-70-3	2.00E-02	6.00E-02	1.20E-02	--	--	1.20E-02
dibenzofuran	132-64-9	1.00E-01	4.00E-01	1.60E+01	--	1.60E+01	--
diethyl phthalate	84-66-2	1.00E-01	4.00E-01	1.28E+04	--	1.28E+04	--
dimethyl phthalate	131-11-3	1.00E-01	4.00E-01	--	--	--	--
di-n-butyl phthalate	84-74-2	1.30E-01	4.00E-01	1.60E+03	--	1.60E+03	--
di-n-octyl phthalate	117-84-0	1.80E-01	4.00E-01	1.60E+02	--	1.60E+02	--
fluoranthene	206-44-0	1.30E-02	5.00E-02	6.40E+02	--	6.40E+02	--
fluorene	86-73-7	2.00E-02	6.00E-02	6.40E+02	--	6.40E+02	--
hexachlorobenzene	118-74-1	1.00E-01	4.00E-01	5.47E-02	--	1.28E+01	5.47E-02
hexachlorobutadiene	87-68-3	1.00E-01	6.00E-01	5.61E-01	--	8.00E+00	5.61E-01
hexachlorocyclopentadiene	77-47-4	1.00E-01	2.00E+00	4.80E+01	--	4.80E+01	--
hexachloroethane	67-72-1	1.00E-01	6.00E-01	1.09E+00	--	5.60E+00	1.09E+00
indeno(1,2,3-cd)pyrene	193-39-5	2.00E-02	6.00E-02	1.20E-01	--	--	1.20E-01
isophorone	78-59-1	1.00E-01	4.00E-01	4.61E+01	--	1.60E+03	4.61E+01
methyl naphthalene;1-	90-12-0	3.00E-02	6.00E-02	1.51E+00	--	5.60E+02	1.51E+00
methyl naphthalene;2-	91-57-6	2.00E-02	2.00E-01	3.20E+01	--	3.20E+01	--
naphthalene	91-20-3	1.00E-01	4.00E-01	1.60E+02	1.60E+02	1.60E+02	--
nitrobenzene	98-95-3	1.00E-01	4.00E-01	1.60E+01	--	1.60E+01	--
n-nitrosodimethylamine	62-75-9	Need to sub	Need to sub	8.58E-04	--	6.40E-02	8.58E-04
n-nitrosodi-n-propylamine	621-64-7	1.00E-01	4.00E-01	1.25E-02	--	--	1.25E-02
n-nitrosodiphenylamine	86-30-6	1.00E-01	4.00E-01	1.79E+01	--	--	1.79E+01

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-Cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
pentachlorophenol	87-86-5	1.00E-01	7.00E-01	2.19E-01	--	8.00E+01	2.19E-01
phenanthrene	85-01-8	2.00E-02	8.00E-02	--	--	--	--
phenol	108-95-2	1.00E-01	6.00E-01	2.40E+03	--	2.40E+03	--
pyrene	129-00-0	1.30E-02	6.00E-02	4.80E+02	--	4.80E+02	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Value for benzo(a)pyrene. This value will be used as Target Reporting Limit.

µg/l = micrograms per liter

Dashes (–) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-15

Analytes and Target Reporting Limits - PCBs Groundwater (EPA Method 8082)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
Aroclor 1016	12674-11-2	6.21E-02	1.00E-01	1.12E+00	--	1.12E+00	1.25E+00
Aroclor 1221	11104-28-2	6.21E-02	1.00E-01	--	--	--	--
Aroclor 1232	11141-16-5	6.21E-02	1.00E-01	--	--	--	--
Aroclor 1242	53469-21-9	6.21E-02	1.00E-01	--	--	--	--
Aroclor 1248	12672-29-6	6.21E-02	1.00E-01	--	--	--	--
Aroclor 1254	11097-69-1	6.21E-02	1.00E-01	4.38E-02	--	3.20E-01	4.38E-02
Aroclor 1260	11096-82-5	4.34E-02	1.00E-01	4.38E-02	--	--	4.38E-02
Total PCBs[4]	1336-36-3	4.16E-01	7.00E-01	4.38E-02	1.00E-01	--	4.38E-02

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Water samples will be analyzed for individual aroclors. Total PCBs will be calculated, as needed, by summing the individual aroclors.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-16

Analytes and Target Reporting Limits - Dioxins/Furans Groundwater (EPA Method 8290)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
2,3,7,8-TCDD	1746-01-6	--	1.00E-05	6.73E-07	--	1.12E-05	6.73E-07
1,2,3,7,8-PeCDD	40321-76-4	--	5.00E-05	--	--	--	--
1,2,3,6,7,8-HxCDD	57653-85-7	--	5.00E-05	--	--	--	--
1,2,3,4,7,8-HxCDD	39227-28-6	--	5.00E-05	--	--	--	--
1,2,3,7,8,9-HxCDD	19408-74-3	--	5.00E-05	1.41E-05	--	--	1.41E-05
1,2,3,4,6,7,8-HpCDD	35822-46-9	--	5.00E-05	--	--	--	--
OCDD	3268-87-9	--	1.00E-04	--	--	--	--
2,3,7,8-TCDF	51207-31-9	--	1.00E-05	--	--	--	--
1,2,3,7,8-PeCDF	57117-41-6	--	5.00E-05	--	--	--	--
2,3,4,7,8-PeCDF	57117-31-4	--	5.00E-05	--	--	--	--
1,2,3,6,7,8-HxCDF	57117-44-9	--	5.00E-05	--	--	--	--
1,2,3,7,8,9-HxCDF	72918-21-9	--	5.00E-05	--	--	--	--
1,2,3,4,7,8-HxCDF	70648-26-9	--	5.00E-05	--	--	--	--
2,3,4,6,7,8-HxCDF	60851-34-5	--	5.00E-05	--	--	--	--
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	5.00E-05	--	--	--	--
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	5.00E-05	--	--	--	--
OCDF	39001-02-0	--	1.00E-04	--	--	--	--
Total dioxin/furan as 2,3,7,8-TCDD[4]		--	8.70E-04	6.73E-07			

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Total dioxins will be calculated using the method in WAC 173-340-708.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-17

Analytes and Target Reporting Limits - Organochlorine Pesticides Groundwater (EPA Method 8081)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
aldrin	309-00-2	7.00E-04	1.00E-02	2.57E-03	--	2.40E-01	2.57E-03
chlordane	57-74-9	1.13E-01	5.00E-01	2.50E-01	--	8.00E+00	2.50E-01
4,4'-DDD	72-54-8	2.00E-03	2.00E-02	3.65E-01	--	--	3.65E-01
4,4'-DDE	72-55-9	3.00E-03	2.00E-02	2.57E-01	--	--	2.57E-01
4,4'-DDT	50-29-3	2.00E-03	2.00E-02	2.57E-01	3.00E-01	8.00E+00	2.57E-01
dieldrin	60-57-1	2.00E-03	2.00E-02	5.47E-03	--	8.00E-01	5.47E-03
endosulfan I	959-98-8	3.00E-03	2.00E-02	--	--	--	--
endosulfan II	33213-65-9	4.00E-03	2.00E-02	--	--	--	--
endosulfan sulfate	1031-07-8	6.00E-03	2.00E-02	--	--	--	--
endrin	72-20-8	3.00E-03	2.00E-02	4.80E+00	--	4.80E+00	--
endrin aldehyde	7421-93-4	2.00E-03	5.00E-02	--	--	--	--
endrin ketone	53494-70-5	2.00E-03	2.00E-02	--	--	--	--
heptachlor	76-44-8	1.00E-03	1.00E-02	1.94E-02	--	8.00E+00	1.94E-02
heptachlor epoxide	1024-57-3	3.00E-03	1.00E-02	4.81E-03	--	1.04E-01	4.81E-03
a-hexachlorocyclohexane	319-84-6	5.00E-04	1.00E-02	1.39E-02	--	1.28E+02	1.39E-02
b-hexachlorocyclohexane	319-85-7	3.00E-03	2.00E-02	4.86E-02	--	--	4.86E-02
d-hexachlorocyclohexane	319-86-8	2.00E-03	1.00E-02	--	--	--	--
lindane	58-89-9	1.00E-03	1.00E-02	7.95E-02	2.00E-01	4.80E+00	7.95E-02
methoxychlor	72-43-5	2.00E-03	1.00E-01	8.00E+01	--	8.00E+01	--
toxaphene	8001-35-2	2.20E-01	1.00E+00	7.95E-02	--	--	7.95E-02

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-18

Analytes and Target Reporting Limits - Organophosphorous Pesticides Groundwater (EPA Method 8141)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
methyl azinphos	86-50-0	1.68E-01	2.50E+00	--	--	--	--
bolstar (sulfopros)	35400-43-2	3.14E-01	1.00E+00	--	--	--	--
chlorpyrifos	2921-88-2	3.60E-01	1.50E+00	1.60E+01	--	1.60E+01	--
coumaphos	56-72-4	1.35E-01	1.00E+00	--	--	--	--
o,s-demeton	8065-48-3	2.09E-01	3.00E+00	6.40E-01	--	6.40E-01	--
diazinon	333-41-5	1.47E-01	5.00E-01	1.12E+01	--	1.12E+01	--
dichlorvos	62-73-7	1.62E-01	5.00E-01	1.51E-01	--	4.00E+00	1.51E-01
dimethoate	60-51-5	4.49E-01	1.50E+00	3.20E+00	--	3.20E+00	--
disulfoton	298-04-4	3.22E-01	1.00E+00	6.40E-01	--	6.40E-01	--
ethoprop	13194-48-4	1.77E-01	1.50E+00	--	--	--	--
ethyl p-nitrophenyl phenylphosphorothioate	2104-64-5	1.49E-01	1.20E+00	1.60E-01	--	1.60E-01	--
fensulfothion	115-90-2	5.44E-01	2.50E+00	--	--	--	--
fenthion	55-38-9	1.54E-01	2.50E+00	--	--	--	--
malathion	121-75-5	1.33E-01	2.00E+00	3.20E+02	--	3.20E+02	--
merphos	150-50-5	1.74E-01	5.00E+00	4.80E-01	--	4.80E-01	--
methyl parathion	298-00-0	1.41E-01	4.00E+00	--	--	4.00E+00	--
mevinphos	7786-34-7	4.60E-01	6.20E+00	--	--	--	--
parathion	56-38-2	1.44E-01	1.00E+00	9.60E+01	--	9.60E+01	--
phorate	298-02-2	1.54E-01	1.20E+00	3.20E+00	--	3.20E+00	--
ronnel	299-84-3	1.16E-01	1.00E+01	8.00E+02	--	8.00E+02	--
sulfotepp	3689-24-5	1.68E-01	1.50E+00	8.00E+00	--	8.00E+00	--
tokuthion	34643-46-4	1.23E-01	1.60E+00	--	--	--	--
trichloronate	327-98-0	2.42E-01	1.50E+00	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.

Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs.

There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds.

Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-19

Analytes and Target Reporting Limits - Herbicides Groundwater (EPA Method 8151)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Groundwater MTCA Method A Cleanup Level (µg/l)	Groundwater MTCA Method B Cleanup Level Non-cancer (µg/l)	Groundwater MTCA Method B Cleanup Level Cancer (µg/l)
dalapon	75-99-0	9.10E-01	2.00E+00	2.40E+02	--	2.40E+02	--
2,4-db	94-82-6	3.60E-01	4.00E+00	1.28E+02	--	1.28E+02	--
dicamba	1918-00-9	1.50E-01	2.00E+00	4.80E+02	--	4.80E+02	--
2,4-dichlorophenoxyacetic acid	94-75-7	#N/A	#N/A	1.60E+02	--	1.60E+02	--
dichloroprop	120-36-5	6.50E-01	4.00E+00	--	--	--	--
dinoseb	88-85-7	4.50E-01	1.00E+00	1.60E+01	--	1.60E+01	--
2,4,5-tp (silvex)	93-72-1	1.70E-01	1.00E+00	1.28E+02	--	1.28E+02	--
2,4,5-trichlorophenoxyacetic acid	93-76-5	1.90E-01	1.00E+00	1.60E+02	--	1.60E+02	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (–) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-20

Analytes and Target Reporting Limits - Dissolved Metals, Ammonia Nitrogen, Nitrate, Nitrite, Chloride, Sulfate, COD, TOC, Total Coliform - Groundwater

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	Reference Method	Practical Quantitation Limit[1] (mg/l)	Target Reporting Limit[2] (mg/l)	Groundwater WQ Standards WAC 173-200 (mg/l)
Dissolved Iron	EPA 200.7	2.00E-02	0.30	0.30
Dissolved Manganese	EPA 200.7	3.00E-03	0.05	0.05
Dissolved Zinc	EPA 200.7	2.00E-02	5	5
Dissolved Lead	EPA 200.7	1.00E-02	0.05	0.05
Ammonia Nitrogen	EPA 350.1	1.00E-01	PQL	--
Nitrate Nitrogen	EPA 300.0	3.94E-02	10	10
Nitrite Nitrogen	EPA 300.0	6.89E-02	PQL	--
Chloride	EPA 300.0	1.54E-01	250	250
Sulfate	EPA 300.0	1.28E-01	250	250
Chemical Oxygen Demand	EPA 410.1/410.4	5.00E+00	PQL	--
Total Organic Carbon	EPA 415.1/SM5310C	5.00E-01	PQL	--
Total Coliform Bacteria	SM 9223B Quanti-tray	1.00E+00	1	1

Notes:

[1]Practical Quantitation Limit (PQL) (supplied by laboratory) should be less than the Target Reporting Limit. Laboratory method detection limits are listed.

[2]Target Reporting Limit is the lowest value from the listed regulatory levels. Regulatory levels were not available for all compounds.

mg/l = milligrams per liter

Dashes (--) indicate the analyte was either not listed in WAC 173-200 and/or a regulatory level was not available for the compound.

Table B-21

Analytes and Target Reporting Limits - TPH Surface Water

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	Analytical Method	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
Total Petroleum Hydrocarbons												
TPH-Gasoline Range	NWTPH-Gx	31.6	100	100	--	--	--	--	--	--	--	--
TPH - Diesel Range	NWTPH-Dx (with silica gel/acid wash cleanup)	--	240	500	--	--	--	--	--	--	--	--
TPH - Oil Range	NWTPH-Dx (with silica gel/acid wash cleanup)	--	400	500	--	--	--	--	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.
Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs.
There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds.
Refer to the laboratory reporting limits for these analytes.

TPH = total petroleum hydrocarbons

MTCA = Model Toxics Control Act

µg/l = micrograms per liter; "--" = not established

Table B-22

Analytes and Target Reporting Limits - Metals Surface Water

Marshall Landfill RI/FS

Spokane County, Washington

Analytes	Analytical Method	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
Antimony	EPA 6020A	7440-36-0	8.00E-02	4.00E-01	1.04E+03	1.04E+03	--	--	--	--	--	--	--
Arsenic	EPA 6020A	7440-38-2	7.50E-01	1.00E+00	9.82E-02	1.77E+01	9.82E-02	3.60E+02	3.40E+02	3.60E+02	1.90E+02	1.50E+02	1.90E+02
Barium	EPA 6020A	7440-39-3	5.40E-02	1.20E+00	0.00E+00	--	--	--	--	--	--	--	--
Berylium	EPA 6020A	7440-41-7	1.02E-01	4.00E-01	2.73E+02	2.73E+02	--	--	--	--	--	--	--
Cadmium	EPA 6020A	7440-43-9	2.80E-02	4.00E-01	0.00E+00	--	--	--	--	--	--	--	--
Chromium	EPA 6020A	7440-47-3	2.70E-01	4.00E-01	0.00E+00	--	--	--	--	--	--	--	--
Copper	EPA 6020A	7440-50-8	1.10E-01	1.00E+00	3.47E+00	2.88E+03	--	4.61E+00	1.30E+01	1.70E+01	3.47E+00	9.00E+00	1.10E+01
Iron	EPA 6020A	7439-89-6	5.80E+00	4.00E+01	1.00E+03	--	--	--	--	--	--	1.00E+03	--
Lead	EPA 6020A	7439-92-1	3.40E-02	4.00E-01	5.40E-01	--	--	1.39E+01	6.50E+01	6.50E+01	5.40E-01	2.50E+00	2.50E+00
Manganese	EPA 6020A	7439-96-5	1.90E-01	4.00E-01	0.00E+00	--	--	--	--	--	--	--	--
Mercury	EPA 200 series method	7439-97-6	1.80E+02	2.00E+02	1.20E-02	--	--	2.10E+00	1.40E+00	2.10E+00	1.20E-02	7.70E-01	1.20E-02
Nickel	EPA 6020A	7440-02-0	4.00E-01	3.00E+00	4.87E+01	1.10E+03	--	4.38E+02	4.70E+02	1.40E+03	4.87E+01	5.20E+01	1.60E+02
Selenium	EPA 6020A	7782-49-2	7.10E-01	1.00E+00	5.00E+00	2.70E+03	--	2.00E+01	--	2.00E+01	5.00E+00	5.00E+00	5.00E+00
Silver	EPA 6020A	7440-22-4	3.00E-02	4.00E-01	3.20E-01	2.59E+04	--	3.20E-01	3.20E+00	3.40E+00	--	--	--
Thallium	EPA 6020A	7440-28-0	2.80E-01	1.00E+00	2.16E-01	2.16E-01	--	--	--	--	--	--	--
Vanadium	EPA 6020A	7440-62-2	9.75E-01	2.00E+00	0.00E+00	--	--	--	--	--	--	--	--
Zinc	EPA 6020A	7440-66-6	1.90E+00	4.00E+00	3.23E+01	1.65E+04	--	3.54E+01	1.20E+02	1.10E+02	3.23E+01	1.20E+02	1.00E+02
Cyanide	EPA 335.4	57-12-5	8.00E-01	5.00E+00	2.20E+01	1.56E+03	--	2.20E+01	2.20E+01	2.20E+01	5.20E+00	5.20E+00	5.20E+00

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.
Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs.
There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds.
Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-23

Analytes and Target Reporting Limits - VOCs Surface Water (EPA Method 8260 B)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
1,1,1,2-tetrachloroethane	630-20-6	1.40E-01	1.00E+00	--	--	--	--	--	--	--	--	--
1,1,1-trichloroethane	71-55-6	5.00E-01	1.00E+00	9.26E+05	9.26E+05	--	--	--	--	--	--	--
1,1,2,2-tetrachloroethane	79-34-5	1.24E-01	1.00E+00	6.48E+00	1.04E+04	6.48E+00	--	--	--	--	--	--
1,1,2-trichloro-1,2,2-trifluoroethane	76-13-1	2.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
1,1,2-trichloroethane	79-00-5	1.40E-01	1.00E+00	2.53E+01	2.30E+03	2.53E+01	--	--	--	--	--	--
1,1-dichloroethane	75-34-3	1.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
1,1-dichloroethene	75-35-4	5.00E-01	1.00E+00	2.31E+04	2.31E+04	--	--	--	--	--	--	--
1,2,3-trichlorobenzene	87-61-6	1.60E-01	1.00E+00	--	--	--	--	--	--	--	--	--
1,2,3-trichloropropane	96-18-4	5.01E-01	1.00E+00	--	--	--	--	--	--	--	--	--
1,2,4-trichlorobenzene	120-82-1	1.00E-01	4.00E-01	2.03E+00	2.36E+02	2.03E+00	--	--	--	--	--	--
1,2,4-trimethylbenzene	95-63-6	4.00E-02	1.00E+00	--	--	--	--	--	--	--	--	--
1,2-dibromo-3-chloropropane	96-12-8	1.08E+00	5.00E+00	--	--	--	--	--	--	--	--	--
1,2-dibromoethane	106-93-4	5.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
1,2-dichlorobenzene	95-50-1	1.00E-01	4.00E-01	4.17E+03	4.17E+03	--	--	--	--	--	--	--
1,2-dichloroethane	107-06-2	5.00E-01	1.00E+00	5.94E+01	1.30E+04	5.94E+01	--	--	--	--	--	--
1,2-dichloropropane	78-87-5	1.53E-01	1.00E+00	4.39E+01	5.69E+04	4.39E+01	--	--	--	--	--	--
1,3,5-trimethylbenzene	108-67-8	7.40E-02	1.00E+00	--	--	--	--	--	--	--	--	--
1,3-dichlorobenzene	541-73-1	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
1,4-dichlorobenzene	106-46-7	1.00E-01	4.00E-01	2.14E+01	3.24E+03	2.14E+01	--	--	--	--	--	--
2-butanone	78-93-3	6.30E-01	1.00E+01	--	--	--	--	--	--	--	--	--
2-hexanone	591-78-6	2.30E-01	1.00E+01	--	--	--	--	--	--	--	--	--
4-chlorotoluene	106-43-4	3.40E-02	1.00E+00	--	--	--	--	--	--	--	--	--
4-methyl-2-pentanone	108-10-1	2.00E-01	1.00E+01	--	--	--	--	--	--	--	--	--
acetone	67-64-1	4.81E-01	2.50E+01	--	--	--	--	--	--	--	--	--
acrylonitrile	107-13-1	7.90E-01	3.00E+00	4.00E-01	3.46E+03	4.00E-01	--	--	--	--	--	--
benzene	71-43-2	3.20E-02	2.00E-01	2.27E+01	1.99E+03	2.27E+01	--	--	--	--	--	--
bromobenzene	108-86-1	1.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
bromodichloromethane	75-27-4	1.05E-01	1.00E+00	2.75E+01	1.36E+04	2.75E+01	--	--	--	--	--	--
bromoform	75-25-2	1.70E-01	1.00E+00	2.16E+02	1.36E+04	2.16E+02	--	--	--	--	--	--
bromomethane	74-83-9	2.20E-01	5.00E+00	9.55E+02	9.55E+02	--	--	--	--	--	--	--
carbon disulfide	75-15-0	5.20E-02	1.00E+00	--	--	--	--	--	--	--	--	--
carbon tetrachloride	56-23-5	1.20E-01	1.00E+00	4.87E+00	5.46E+02	4.87E+00	--	--	--	--	--	--
chlorobenzene	108-90-7	6.00E-02	1.00E+00	5.19E+03	5.19E+03	--	--	--	--	--	--	--
chloroethane	75-00-3	2.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
chloroform	67-66-3	1.20E-01	1.00E+00	5.50E+01	6.82E+03	5.50E+01	--	--	--	--	--	--
chloromethane	74-87-3	6.30E-02	3.00E+00	--	--	--	--	--	--	--	--	--

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
cis-1,2-dichloroethene	156-59-2	7.50E-02	1.00E+00	--	--	--	--	--	--	--	--	--
cis-1,3-dichloropropene	10061-01-5	9.80E-02	1.00E+00	--	--	--	--	--	--	--	--	--
cyclohexane	110-82-7	1.40E-01	1.00E+00	--	--	--	--	--	--	--	--	--
dibromochloromethane	124-48-1	1.30E-01	1.00E+00	2.03E+01	1.36E+04	2.03E+01	--	--	--	--	--	--
dichlorodifluoromethane	75-71-8	2.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
ethylbenzene	100-41-4	8.60E-02	1.00E+00	6.82E+03	6.82E+03	--	--	--	--	--	--	--
hexachlorobutadiene	87-68-3	1.00E-01	6.00E-01	2.97E+01	9.26E+02	2.97E+01	--	--	--	--	--	--
isopropylbenzene	98-82-8	6.30E-02	1.00E+00	--	--	--	--	--	--	--	--	--
m,p-xylenes	1330-20-7	--	--	--	--	--	--	--	--	--	--	--
methyl acetate	79-20-9	1.07E+00	3.00E+00	--	--	--	--	--	--	--	--	--
methyl tert-butyl ether	1634-04-4	9.00E-02	1.00E+00	--	--	--	--	--	--	--	--	--
methylcyclohexane	108-87-2	1.20E-01	1.00E+00	--	--	--	--	--	--	--	--	--
methylene chloride	75-09-2	7.00E-01	1.00E+01	3.60E+03	1.73E+04	3.60E+03	--	--	--	--	--	--
n-butylbenzene	104-51-8	5.00E-02	1.00E+00	--	--	--	--	--	--	--	--	--
n-propylbenzene	103-65-1	6.30E-02	1.00E+00	--	--	--	--	--	--	--	--	--
o-chlorotoluene	95-49-8	3.90E-02	1.00E+00	--	--	--	--	--	--	--	--	--
o-xylene	95-47-6	6.20E-02	1.00E+00	--	--	--	--	--	--	--	--	--
p-isopropyltoluene	99-87-6	7.00E-02	1.00E+00	--	--	--	--	--	--	--	--	--
sec-butylbenzene	135-98-8	7.20E-02	1.00E+00	--	--	--	--	--	--	--	--	--
styrene	100-42-5	1.00E-01	1.00E+00	--	--	--	--	--	--	--	--	--
tert-butylbenzene	98-06-6	1.20E-01	1.00E+00	--	--	--	--	--	--	--	--	--
tetrachloroethene	127-18-4	7.30E-02	1.00E+00	9.96E+01	5.02E+02	9.96E+01	--	--	--	--	--	--
toluene	108-88-3	3.80E-02	1.00E+00	1.89E+04	1.89E+04	--	--	--	--	--	--	--
trans-1,2-dichloroethene	156-60-5	1.20E-01	1.00E+00	3.24E+04	3.24E+04	--	--	--	--	--	--	--
trans-1,3-dichloropropene	10061-02-6	1.54E-01	1.00E+00	--	--	--	--	--	--	--	--	--
trichloroethene	79-01-6	1.30E-01	1.00E+00	1.28E+01	1.18E+02	1.28E+01	--	--	--	--	--	--
trichlorofluoromethane	75-69-4	1.00E+00	1.00E+00	--	--	--	--	--	--	--	--	--
vinyl chloride	75-01-4	1.30E-01	2.00E-01	2.50E-02	6.48E+03	2.50E-02	--	--	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-24

Analytes and Target Reporting Limits - SVOCs Surface Water (EPA Methods 8270SIM and 8270C)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
PAHs by EPA 8270SIM	NA	0.04726	1.75	0.1[4]	--	--	--	--	--	--	--	--
2,4,5-trichlorophenol	95-95-4	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
2,4,6-trichlorophenol	88-06-2	1.00E-01	6.00E-01	3.93E+00	1.73E+01	3.93E+00	--	--	--	--	--	--
2,4-dichlorophenol	120-83-2	1.00E-01	4.00E-01	1.90E+02	1.90E+02	--	--	--	--	--	--	--
2,4-dimethylphenol	105-67-9	3.00E-01	2.00E+00	5.52E+02	5.52E+02	--	--	--	--	--	--	--
2,4-dinitrophenol	51-28-5	1.00E+00	5.00E+00	3.46E+03	3.46E+03	--	--	--	--	--	--	--
2,4-dinitrotoluene	121-14-2	1.00E-01	4.00E-01	5.50E+00	1.36E+03	5.50E+00	--	--	--	--	--	--
2,6-dinitrotoluene	606-20-2	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
2-chloronaphthalene	91-58-7	2.00E-02	6.00E-02	1.04E+03	1.04E+03	--	--	--	--	--	--	--
2-chlorophenol	95-57-8	1.00E-01	4.00E-01	9.97E+01	9.97E+01	--	--	--	--	--	--	--
2-methylnaphthalene	91-57-6	2.00E-02	2.00E-01	--	--	--	--	--	--	--	--	--
2-methylphenol	95-48-7	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
2-nitroaniline	88-74-4	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
2-nitrophenol	88-75-5	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
3,3'-dichlorobenzidine	91-94-1	1.00E-01	2.00E+00	4.65E-02	--	4.65E-02	--	--	--	--	--	--
3-nitroaniline	99-09-2	1.20E-01	4.00E-01	--	--	--	--	--	--	--	--	--
4,6-dinitro-2-methylphenol	534-52-1	1.00E+00	4.00E+00	--	--	--	--	--	--	--	--	--
4-bromophenyl phenyl ether	101-55-3	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
4-chloro-3-methylphenol	59-50-7	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
4-chloroaniline	106-47-8	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
4-chlorophenyl phenyl ether	7005-72-3	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
4-nitroaniline	100-01-6	1.00E-01	6.00E-01	--	--	--	--	--	--	--	--	--
4-nitrophenol	100-02-7	1.00E+00	3.00E+00	--	--	--	--	--	--	--	--	--
acenaphthene	83-32-9	2.00E-02	1.00E-01	6.48E+02	6.48E+02	--	--	--	--	--	--	--
acenaphthylene	208-96-8	2.00E-02	8.00E-02	--	--	--	--	--	--	--	--	--
anthracene	120-12-7	1.00E-02	4.00E-02	2.59E+04	2.59E+04	--	--	--	--	--	--	--
benzo(a)anthracene	56-55-3	2.00E-02	6.00E-02	2.96E-01	--	2.96E-01	--	--	--	--	--	--
benzo(a)pyrene	50-32-8	2.00E-02	4.00E-02	2.96E-02	--	2.96E-02	--	--	--	--	--	--
benzo(b)fluoranthene	205-99-2	2.00E-02	8.00E-02	2.96E-01	--	2.96E-01	--	--	--	--	--	--
benzo(ghi)perylene	191-24-2	2.00E-02	6.00E-02	--	--	--	--	--	--	--	--	--
benzo(k)fluoranthene	207-08-9	2.00E-02	6.00E-02	2.96E+00	--	2.96E+00	--	--	--	--	--	--
benzoic acid	65-85-0	6.00E-01	3.00E+00	--	--	--	--	--	--	--	--	--
benzyl alcohol	100-51-6	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
bis(2-chloroethoxy)methane	111-91-1	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
bis(2-chloroethyl) ether	111-44-4	1.00E-01	4.00E-01	8.54E-01	--	8.54E-01	--	--	--	--	--	--
bis(2-chloroisopropyl) ether	108-60-1	1.00E-01	4.00E-01	3.70E+01	4.15E+04	3.70E+01	--	--	--	--	--	--
bis(2-ethylhexyl) phthalate	117-81-7	1.18E+00	3.00E+00	3.56E+00	3.99E+02	3.56E+00	--	--	--	--	--	--

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
butyl benzyl phthalate	85-68-7	2.00E-01	6.00E-01	8.32E+00	1.26E+03	8.32E+00	--	--	--	--	--	--
carbazole	86-74-8	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
chrysene	218-01-9	1.30E-02	4.00E-02	2.96E+01	--	2.96E+01	--	--	--	--	--	--
dibenz(a,h)anthracene	53-70-3	2.00E-02	6.00E-02	2.96E-02	--	2.96E-02	--	--	--	--	--	--
dibenzofuran	132-64-9	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
diethyl phthalate	84-66-2	1.00E-01	4.00E-01	2.84E+04	2.84E+04	--	--	--	--	--	--	--
dimethyl phthalate	131-11-3	1.00E-01	4.00E-01	--	--	--	--	--	--	--	--	--
di-n-butyl phthalate	84-74-2	1.30E-01	4.00E-01	2.91E+03	2.91E+03	--	--	--	--	--	--	--
di-n-octyl phthalate	117-84-0	1.80E-01	4.00E-01	--	--	--	--	--	--	--	--	--
fluoranthene	206-44-0	1.30E-02	5.00E-02	8.64E+01	8.64E+01	--	--	--	--	--	--	--
fluorene	86-73-7	2.00E-02	6.00E-02	3.46E+03	3.46E+03	--	--	--	--	--	--	--
hexachlorobenzene	118-74-1	1.00E-01	4.00E-01	4.66E-04	2.38E-01	4.66E-04	--	--	--	--	--	--
hexachlorobutadiene	87-68-3	1.00E-01	6.00E-01	2.97E+01	9.26E+02	2.97E+01	--	--	--	--	--	--
hexachlorocyclopentadiene	77-47-4	1.00E-01	2.00E+00	3.62E+03	3.62E+03	--	--	--	--	--	--	--
hexachloroethane	67-72-1	1.00E-01	6.00E-01	1.86E+00	2.09E+01	1.86E+00	--	--	--	--	--	--
indeno(1,2,3-cd)pyrene	193-39-5	2.00E-02	6.00E-02	2.96E-01	--	2.96E-01	--	--	--	--	--	--
isophorone	78-59-1	1.00E-01	4.00E-01	1.55E+03	1.18E+05	1.55E+03	--	--	--	--	--	--
naphthalene	91-20-3	1.00E-01	4.00E-01	4.71E+03	4.71E+03	--	--	--	--	--	--	--
nitrobenzene	98-95-3	1.00E-01	4.00E-01	1.79E+03	1.79E+03	--	--	--	--	--	--	--
n-nitrosodimethylamine	62-75-9	--	--	4.89E+00	7.98E+02	4.89E+00	--	--	--	--	--	--
n-nitrosodi-n-propylamine	621-64-7	1.00E-01	4.00E-01	8.42E-01	--	8.42E-01	--	--	--	--	--	--
n-nitrosodiphenylamine	86-30-6	1.00E-01	4.00E-01	9.45E+00	--	9.45E+00	--	--	--	--	--	--
pentachlorophenol	87-86-5	1.00E-01	7.00E-01	1.47E+00	1.18E+03	1.47E+00	2.03E+01	1.90E+01	2.00E+01	1.28E+01	1.50E+01	1.30E+01
phenanthrene	85-01-8	2.00E-02	8.00E-02	--	--	--	--	--	--	--	--	--
phenol	108-95-2	1.00E-01	6.00E-01	5.56E+05	5.56E+05	--	--	--	--	--	--	--
pyrene	129-00-0	1.30E-02	6.00E-02	2.59E+03	2.59E+03	--	--	--	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]MTCA Method A value for benzo(a)pyrene in groundwater. This value will be used as Target Reporting Limit for surface water samples.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-25

Analytes and Target Reporting Limits - PCBs Surface Water (EPA Method 8082)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
Aroclor 1016	12674-11-2	6.21E-02	1.00E-01	2.99E-03	5.85E-03	2.99E-03	--	--	--	--	--	1.40E-02
Aroclor 1221	11104-28-2	6.21E-02	1.00E-01	--	--	--	--	--	--	--	--	--
Aroclor 1232	11141-16-5	6.21E-02	1.00E-01	--	--	--	--	--	--	--	--	--
Aroclor 1242	53469-21-9	6.21E-02	1.00E-01	--	--	--	--	--	--	--	--	--
Aroclor 1248	12672-29-6	6.21E-02	1.00E-01	--	--	--	--	--	--	--	--	--
Aroclor 1254	11097-69-1	6.21E-02	1.00E-01	1.05E-04	1.67E-03	1.05E-04	--	--	--	--	--	1.40E-02
Aroclor 1260	11096-82-5	4.34E-02	1.00E-01	1.40E-02	--	--	--	--	--	--	--	1.40E-02
Total PCBs[4]	1336-36-3		7.00E-01	1.05E-04	--	1.05E-04	2.00E+00	--	--	1.40E-02	1.40E-02	1.40E-01

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Water samples will be analyzed for individual aroclors. Total PCBs will be calculated, as needed, by summing the individual aroclors.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-26

Analytes and Target Reporting Limits - Dioxins/Furans Surface Water (EPA Method 8290)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
2,3,7,8-TCDD	1746-01-6	--	1.00E-05	9.97E-09	3.63E-07	9.97E-09	--	--	--	--	--	--
1,2,3,7,8-PeCDD	40321-76-4	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDD	57653-85-7	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDD	39227-28-6	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDD	19408-74-3	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDD	35822-46-9	--	5.00E-05	--	--	--	--	--	--	--	--	--
OCDD	3268-87-9	--	1.00E-04	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDF	51207-31-9	--	1.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	57117-41-6	--	5.00E-05	--	--	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	57117-31-4	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	57117-44-9	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDF	72918-21-9	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	70648-26-9	--	5.00E-05	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	60851-34-5	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	67562-39-4	--	5.00E-05	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8,9-HpCDF	55673-89-7	--	5.00E-05	--	--	--	--	--	--	--	--	--
OCDF	39001-02-0	--	1.00E-04	--	--	--	--	--	--	--	--	--
Total dioxin/furan as 2,3,7,8-TCDD[4]	NA	--	8.70E-04									

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

[4]Total dioxins will be calculated using the method in WAC 173-340-708.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-27

Analytes and Target Reporting Limits - Organochlorine Pesticides Surface Water (EPA Method 8081)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
aldrin	309-00-2	7.00E-04	1.00E-02	8.11E-05	1.65E-02	8.11E-05	2.50E+00	3.00E+00	3.00E+00	1.90E-03	--	--
chlordane	57-74-9	1.13E-01	5.00E-01	1.32E-03	9.26E-02	1.32E-03	2.40E+00	2.40E+00	2.40E+00	4.30E-03	4.30E-03	4.30E-03
4,4'-DDD	72-54-8	2.00E-03	2.00E-02	5.00E-04	--	5.00E-04	1.10E+00	--	--	1.00E-03	--	--
4,4'-DDE	72-55-9	3.00E-03	2.00E-02	3.53E-04	--	3.53E-04	1.10E+00	--	--	1.00E-03	--	--
4,4'-DDT	50-29-3	2.00E-03	2.00E-02	3.53E-04	2.40E-02	3.53E-04	1.10E+00	1.10E+00	1.10E+00	1.00E-03	1.00E-03	1.00E-03
dieldrin	60-57-1	2.00E-03	2.00E-02	8.62E-05	2.76E-02	8.62E-05	2.50E+00	2.40E-01	2.50E+00	1.90E-03	5.60E-02	1.90E-03
endosulfan I	959-98-8	3.00E-03	2.00E-02	--	--	--	--	--	--	--	--	--
endosulfan II	33213-65-9	4.00E-03	2.00E-02	--	--	--	--	--	--	--	--	--
endosulfan sulfate	1031-07-8	6.00E-03	2.00E-02	--	--	--	--	--	--	--	--	--
endrin	72-20-8	3.00E-03	2.00E-02	2.30E-03	1.94E-01	--	1.80E-01	8.60E-02	1.80E-01	2.30E-03	3.60E-02	2.30E-03
endrin aldehyde	7421-93-4	2.00E-03	5.00E-02	--	--	--	--	--	--	--	--	--
endrin ketone	53494-70-5	2.00E-03	2.00E-02	--	--	--	--	--	--	--	--	--
heptachlor	76-44-8	1.00E-03	1.00E-02	1.31E-04	1.18E-01	1.31E-04	5.20E-01	5.20E-01	5.20E-01	3.80E-03	3.80E-03	3.80E-03
heptachlor epoxide	1024-57-3	3.00E-03	1.00E-02	6.48E-05	3.06E-03	6.48E-05	--	5.20E-01	5.20E-01	--	3.80E-03	3.80E-03
a-hexachlorocyclohexane	319-84-6	5.00E-04	1.00E-02	7.91E-03	1.60E+02	7.91E-03	--	--	--	--	--	--
b-hexachlorocyclohexane	319-85-7	3.00E-03	2.00E-02	2.77E-02	--	2.77E-02	--	--	--	--	--	--
d-hexachlorocyclohexane	319-86-8	2.00E-03	1.00E-02	--	--	--	--	--	--	--	--	--
lindane	58-89-9	1.00E-03	1.00E-02	4.53E-02	5.98E+00	4.53E-02	2.00E+00	9.50E-01	2.00E+00	8.00E-02	--	8.00E-02
methoxychlor	72-43-5	2.00E-03	1.00E-01	3.00E-02	8.10E+00	--	--	--	--	--	3.00E-02	--
toxaphene	8001-35-2	2.20E-01	1.00E+00	2.00E-04	--	4.53E-04	7.30E-01	7.30E-01	7.30E-01	2.00E-04	2.00E-04	2.00E-04

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit.
Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs.
There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds.
Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-28

Analytes and Target Reporting Limits - Organophosphorous Pesticides Surface Water (EPA Method 8141)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Practical Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Surface Water Aquatic Life Fresh/Acute 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Acute CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Acute NTR 40 CFR 131 (µg/L)	Surface Water Aquatic Life Fresh/Chronic 173-201A WAC (µg/L)	Surface Water Aquatic Life Fresh/Chronic CWA §304 (µg/L)	Surface Water Aquatic Life Fresh/Chronic NTR 40 CFR 131 (µg/L)
methyl azinphos	86-50-0	1.68E-01	2.50E+00	--	--	--	--	--	--	--	--	--
bolstar (sulfopros)	35400-43-2	3.14E-01	1.00E+00	--	--	--	--	--	--	--	--	--
chlorpyrifos	2921-88-2	3.60E-01	1.50E+00	4.10E-02	--	--	8.30E-02	8.30E-02	--	4.10E-02	4.10E-02	--
coumaphos	56-72-4	1.35E-01	1.00E+00	--	--	--	--	--	--	--	--	--
o,s-demeton	8065-48-3	2.09E-01	3.00E+00	1.00E-01	--	--	--	--	--	--	1.00E-01	--
diazinon	333-41-5	1.47E-01	5.00E-01	--	--	--	--	--	--	--	--	--
dichlorvos	62-73-7	1.62E-01	5.00E-01	--	--	--	--	--	--	--	--	--
dimethoate	60-51-5	4.49E-01	1.50E+00	--	--	--	--	--	--	--	--	--
disulfoton	298-04-4	3.22E-01	1.00E+00	--	--	--	--	--	--	--	--	--
ethoprop	13194-48-4	1.77E-01	1.50E+00	--	--	--	--	--	--	--	--	--
ethyl p-nitrophenyl phenylphosphorothioate	2104-64-5	1.49E-01	1.20E+00	--	--	--	--	--	--	--	--	--
fensulfothion	115-90-2	5.44E-01	2.50E+00	--	--	--	--	--	--	--	--	--
fenthion	55-38-9	1.54E-01	2.50E+00	--	--	--	--	--	--	--	--	--
malathion	121-75-5	1.33E-01	2.00E+00	1.00E-01	--	--	--	--	--	--	1.00E-01	--
merphos	150-50-5	1.74E-01	5.00E+00	--	--	--	--	--	--	--	--	--
methyl parathion	298-00-0	1.41E-01	4.00E+00	--	--	--	--	--	--	--	--	--
mevinphos	7786-34-7	4.60E-01	6.20E+00	--	--	--	--	--	--	--	--	--
parathion	56-38-2	1.44E-01	1.00E+00	1.30E-02	--	--	6.50E-02	6.50E-02	--	1.30E-02	1.30E-02	--
phorate	298-02-2	1.54E-01	1.20E+00	--	--	--	--	--	--	--	--	--
ronnel	299-84-3	1.16E-01	1.00E+01	--	--	--	--	--	--	--	--	--
sulfotepp	3689-24-5	1.68E-01	1.50E+00	--	--	--	--	--	--	--	--	--
tokuthion	34643-46-4	1.23E-01	1.60E+00	--	--	--	--	--	--	--	--	--
trichloronate	327-98-0	2.42E-01	1.50E+00	--	--	--	--	--	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

µg/l = micrograms per liter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-29

Analytes and Target Reporting Limits - Herbicides Surface Water (EPA Method 8151)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit[1] (µg/l)	Quantitation Limit/Method Reporting Limit[2] (µg/l)	Target Reporting Limit[3] (µg/l)	Surface Water MTCA Method B Non-cancer (µg/L)	Surface Water MTCA Method B Cancer (µg/L)	Water Aquatic Life Fresh/Acute 173-201A WAC	Water Aquatic Life Fresh/Acute CWA §304	Water Aquatic Life Fresh/Acute NTR 40 CFR 131	Water Aquatic Life Fresh/Chronic 173-201A WAC	Water Aquatic Life Fresh/Chronic CWA §304	Water Aquatic Life Fresh/Chronic NTR 40 CFR 131
dalapon	75-99-0	9.10E-01	2.00E+00	PQL	--	--	--	--	--	--	--	--
2,4-db	94-82-6	3.60E-01	4.00E+00	PQL	--	--	--	--	--	--	--	--
dicamba	1918-00-9	1.50E-01	2.00E+00	PQL	--	--	--	--	--	--	--	--
2,4-dichlorophenoxyacetic acid	94-75-7	1.62E-01	2.00E+00	PQL	--	--	--	--	--	--	--	--
dichloroprop	120-36-5	6.50E-01	4.00E+00	PQL	--	--	--	--	--	--	--	--
dinoseb	88-85-7	4.50E-01	1.00E+00	PQL	--	--	--	--	--	--	--	--
2,4,5-tp (silvex)	93-72-1	1.70E-01	1.00E+00	PQL	--	--	--	--	--	--	--	--
2,4,5-trichlorophenoxyacetic acid	93-76-5	1.90E-01	1.00E+00	PQL	--	--	--	--	--	--	--	--

Notes:

[1]The method detction limit is presented since some analytes target reporting limits (screening levels) may be lower than the laboratory method reporting limit. Concentrations of analytes detected above the MDL, but below the MRL are estimated.

[2]Practical Quantitation Limit (PQL)/MRL (supplied by laboratory) should be less than the Target Reporting Limit. For analytes with a PQL/MRL above the target reporting limit refer to the MDLs. There may be cases where the laboratory can not meet the Target Reporting Limit.

[3]Target Reporting Limit is the lowest value from the listed regulatory levels (CLARC [Cleanup Levels and Risk Calculation] database May 2014). Regulatory levels were not available for all compounds. Refer to the laboratory reporting limits for these analytes.

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-30

Analytes and Target Reporting Limits - Dissolved Metals, Ammonia Nitrogen, Nitrate, Nitrite, Chloride, Sulfate, COD, TOC, Total Coliform - Surface Water

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	Reference Method	Practical Quantitation Limit[1] (mg/l)	Target Reporting Limit[2] (mg/l)
Dissolved Iron	EPA 200.7	2.00E-02	PQL
Dissolved Manganese	EPA 200.7	3.00E-03	PQL
Dissolved Zinc	EPA 200.7	2.00E-02	PQL
Dissolved Lead	EPA 200.7	1.00E-02	PQL
Ammonia Nitrogen	EPA 350.1	1.00E-01	PQL
Nitrate Nitrogen	EPA 300.0	3.94E-02	PQL
Nitrite Nitrogen	EPA 300.0	6.89E-02	PQL
Chloride	EPA 300.0	1.54E-01	PQL
Sulfate	EPA 300.0	1.28E-01	PQL
Chemical Oxygen Demand	EPA 410.1/410.4	5.00E+00	PQL
Total Organic Carbon	EPA 415.1/SM5310C	5.00E-01	PQL
Total Coliform Bacteria	SM 9223B Quanti-tray	1.00E+00	PQL

Notes:

[1]Practical Quantitation Limit (PQL) (supplied by laboratory).

[2]Target Reporting Limit is the PQL.

µg/l = micrograms per liter

Table B-31

Analytes and Target Reporting Limits - VOCs Landfill Gas (EPA TO-15)

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	CAS RN	Method Detection Limit (µg/m^3)	Practical Quantitation Limit/Method Reporting Limit[1] (µg/m^3)	Target Reporting Limit[2] (µg/m^3)	Method B Soil Gas Screening Level [3] (µg/m^3)	Soil Gas Screening Level (Non Cancer)[4] (µg/m^3)	Soil Gas Screening Level (Cancer)[4] (µg/m^3)
Acetone	67-64-1	--	2.50E+00	1.42E+05	--	1.42E+05	--
Allyl chloride	107-05-1	--	4.00E-01	4.17E+00	--	4.57E+00	4.17E+00
Benzene	71-43-2	--	4.00E-01	3.20E+00	3.2	1.37E+02	3.21E+00
Benzyl Chloride	100-44-7	--	4.00E-01	5.10E-01	0.52	4.57E+00	5.10E-01
Bromodichloromethane	75-27-4	--	4.00E-01	3.30E-02	0.033	--	6.76E-01
Bromoform	75-25-2	--	1.20E+00	2.27E+01	23	--	2.27E+01
Bromomethane	74-83-9	--	4.00E-01	2.29E+01	--	2.29E+01	--
1,3-Butadiene	106-99-0	--	4.00E+00	8.00E-01	0.8	9.14E+00	8.33E-01
Carbon disulfide	75-15-0	--	4.00E-01	3.20E+03	--	3.20E+03	--
Carbon tetrachloride	56-23-5	--	4.00E-01	1.70E+00	1.7	4.57E+02	4.17E+00
Chlorobenzene	108-90-7	--	4.00E-01	2.29E+02	--	2.29E+02	--
Chloroethane	75-00-3	--	4.00E-01	4.57E+04	--	4.57E+04	--
Chloroform	67-66-3	--	4.00E-01	1.09E+00	1.1	4.48E+02	1.09E+00
Chloromethane	74-87-3	--	4.00E-01	1.40E+01	14	4.11E+02	--
2-Chlorotoluene	95-49-8	--	4.00E-01	--	--	--	--
Cyclohexane	110-82-7	--	4.00E-01	2.74E+04	--	2.74E+04	--
Dibromochloromethane	124-48-1	--	4.00E-01	4.50E-02	0.045	--	9.26E-01
1,2-Dibromoethane	106-93-4	--	4.00E-01	4.17E-02	--	4.11E+01	4.17E-02
1,2-Dichlorobenzene	95-50-1	--	4.00E-01	9.14E+02	--	9.14E+02	--
1,3-Dichlorobenzene	541-73-1	--	4.00E-01	--	--	--	--
1,4-Dichlorobenzene	106-46-7	--	4.00E-01	2.27E+00	--	3.66E+03	2.27E+00
1,2-Dichloroethane	107-06-2	--	4.00E-01	9.60E-01	0.96	3.20E+01	9.62E-01
1,1-Dichloroethane	75-34-3	--	4.00E-01	1.56E+01	--	--	1.56E+01
1,1-Dichloroethene	75-35-4	--	4.00E-01	9.14E+02	--	9.14E+02	--
cis-1,2-Dichloroethene	156-59-2	--	4.00E-01	--	--	--	--
trans-1,2-Dichloroethene	156-60-5	--	4.00E-01	2.74E+02	--	2.74E+02	--

Analyte	CAS RN	Method Detection Limit (µg/m^3)	Practical Quantitation Limit/Method Reporting Limit[1] (µg/m^3)	Target Reporting Limit[2] (µg/m^3)	Method B Soil Gas Screening Level [3] (µg/m^3)	Soil Gas Screening Level (Non Cancer)[4] (µg/m^3)	Soil Gas Screening Level (Cancer)[4] (µg/m^3)
1,2-Dichloropropane	78-87-5	--	4.00E-01	2.50E+00	--	1.83E+01	2.50E+00
cis-1,3-Dichloropropene	542-75-6	--	4.00E-01	6.25E+00	6.3	9.14E+01	6.25E+00
trans-1,3-Dichloropropene	542-75-6	--	4.00E-01	6.25E+00	6.3	9.14E+01	6.25E+00
1,4-Dioxane	123-91-1	--	4.00E-01	5.00E+00	--	1.37E+02	5.00E+00
Ethanol	64-17-5	--	1.26E+00	--	--	--	--
Ethylbenzene	100-41-4	--	4.00E-01	4.57E+03	--	4.57E+03	--
4-Ethyltoluene	622-96-8	--	4.00E-01	--	--	--	--
Freon-11	75-69-4	--	4.00E-01	3.20E+03	--	3.20E+03	--
Freon-12	75-71-8	--	4.00E-01	4.57E+02	--	4.57E+02	--
Freon-113	76-13-1	--	4.00E-01	1.37E+05	--	1.37E+05	--
Freon-114	76-14-2	--	4.00E-01	--	--	--	--
Heptane	142-82-5	--	4.00E-01	--	--	--	--
Hexachloro-1,3-butadiene	87-68-3	--	1.26E+00	1.10E+00	1.1	--	1.14E+00
n-Hexane	110-54-3	--	4.00E-01	3.20E+03	--	3.20E+03	--
Isopropylbenzene	98-82-8	--	4.00E-01	1.83E+03	--	1.83E+03	--
Methylene Chloride	75-09-2	--	4.00E-01	5.30E+01	53	2.74E+03	2.50E+03
Methyl Butyl Ketone	591-78-6	--	2.50E+00	--	--	--	--
Methyl Ethyl Ketone	78-93-3	--	2.50E+00	2.29E+04	--	2.29E+04	--
Methyl Isobutyl Ketone	108-10-1	--	2.50E+00	1.37E+04	--	1.37E+04	--
Methyl methacrylate	80-62-6	--	4.00E-01	3.20E+03	--	3.20E+03	--
MTBE	1634-04-4	--	4.00E-01	9.60E+01	96	1.37E+04	9.62E+01
Naphthalene	91-20-3	--	1.26E+00	7.35E-01	--	1.37E+01	7.35E-01
2-Propanol	67-63-0	--	2.50E+00	--	--	--	--
Propene	115-07-1	--	8.00E-01	--	--	--	--
Styrene	100-42-5	--	4.00E-01	4.40E+01	44	4.57E+03	--
1,1,2,2-Tetrachloroethane	79-34-5	--	4.00E-01	4.30E-01	0.43	--	4.31E-01
Tetrachloroethylene	127-18-4	--	4.00E-01	4.20E+00	4.2	1.83E+02	9.62E+01
Tetrahydrofuran	109-99-9	--	4.00E-01	--	--	--	--
Toluene	108-88-3	--	4.00E-01	2.29E+04	--	2.29E+04	--
1,2,4-Trichlorobenzene	120-82-1	--	1.26E+00	9.14E+00	--	9.14E+00	--
1,1,1-Trichloroethane	71-55-6	--	4.00E-01	2.29E+04	--	2.29E+04	--

Analyte	CAS RN	Method Detection Limit (µg/m^3)	Practical Quantitation Limit/Method Reporting Limit[1] (µg/m^3)	Target Reporting Limit[2] (µg/m^3)	Method B Soil Gas Screening Level [3] (µg/m^3)	Soil Gas Screening Level (Non Cancer)[4] (µg/m^3)	Soil Gas Screening Level (Cancer)[4] (µg/m^3)
1,1,2-Trichloroethane	79-00-5	--	4.00E-01	9.14E-01	1.6	9.14E-01	1.56E+00
Trichloroethylene	79-01-6	--	4.00E-01	1.00E+00	1	9.14E+00	3.70E+00
1,2,4-Trimethylbenzene	95-63-6	--	4.00E-01	3.20E+01	--	3.20E+01	--
1,3,5-Trimethylbenzene	108-67-8	--	4.00E-01	--	--	--	--
2,2,4-Trimethylpentane	540-84-1	--	4.00E-01	--	--	--	--
Vinyl chloride	75-01-4	--	4.00E-01	2.80E+00	2.8	4.57E+02	--
Vinyl Bromide	596-60-2	--	4.00E-01	--	--	--	--
Vinyl acetate	108-05-4	--	4.00E-01	9.14E+02	--	9.14E+02	--
m&p-Xylene	108-38-3	--	8.00E-01	4.57E+02	--	4.57E+02	--
o-Xylene	95-47-6	--	4.00E-01	4.57E+02	--	4.57E+02	--
TPH (GC/MS) Low Fraction	Not available	--	1.00E+02	--	--	--	--

Notes:

[1]Practical Quantitation Limit (PQL) (supplied by laboratory) should be less than the Target Reporting Limit. There may be cases where the laboratory cannot meet the Target Reporting Limit.

[2]Target Reporting Limit is the lowest value from the listed regulatory levels. Regulatory levels were not available for all compounds. Standard laboratory reporting limits were stated for these analytes.

[3]Review DRAFT Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action (October 2009).

[4]The soil gas screening levels are derived by multiplying the Clarc Method B Air Screening Levels (non-cancer/cancer) by a factor of 10 (May 2014).

µg/m^3 = micrograms per cubic meter

Dashes (--) indicate the analyte was either not listed in the CLARC database and/or a regulatory level was not available for the compound.

Table B-32

Sample Container and Preservative Requirements

Marshall Landfill RI/FS

Spokane County, Washington

Analyte	Media	Method	Sample Container Size	Preservative	Holding Time
Hydrocarbon Identification	Water	NWTPH-HCID	125ml amber	Cool 4° C, HCl pH<2	14 days extraction 40 days analysis
	Soil☐		4 oz cwm	Cool 4° C	14 days
Gasoline Range Organics	Water	NWTPH-Gx	40 ml VOA	Cool 4° C, HCl pH<2	14 days
	Soil☐		4 oz cwm	Cool 4° C	14 days
Diesel Range Organics	Water	NWTPH-Dx	125 ml amber glass	Cool 4° C, HCl pH<2	14 days
	Soil☐		8 oz cwm	Cool 4° C	14 days extraction 40 days analysis
Metals	Water (Filtered)	EPA 6010/6020/200 series methods	250 ml poly	HNO_3 pH<2	6 months
	Water (Un-filtered)		250 ml poly	HNO_3 pH<2	6 months
	Soil		4 oz cwm	Cool 4° C	6 months
Volatile Organic Compounds	Water	EPA 8260B	40 ml VOA	Cool 4° C, HCl pH<2	14 days
	Soil	EPA 5035/8260B	40 ml VOA	Methanol	14 days
Semi-Volatile Organic Compounds	Water	EPA 8270C/SIM	(2) 250 ml amber glass	Cool 4° C	7 days extraction 40 days analysis
	Soil		8 oz cwm	Cool 4° C	7 days extraction 40 days analysis
PCBs	Water	EPA Method 8082	125ml amber	Cool 4° C	1 year
	Soil		8 oz cwm	Cool 4° C	7 days extraction 40 days analysis
Dioxins/Furans	Water	EPA 8290	(2) 1 liter amber	Cool 4° C	30 days extraction 45 days analysis
	Soil		4 oz cwm	Cool 4° C	30 days
Organochlorine Pesticides	Water	EPA 8081	125ml amber	Cool 4° C	7 days extraction 40 days analysis
	Soil		4 oz cwm	Cool 4° C	14 days

Analyte	Media	Method	Sample Container Size	Preservative	Holding Time
Organophosphorous Pesticides	Water	EPA 8141B	(2) 1 liter amber	Cool 4° C	7 days extraction 40 days analysis
	Soil		4 oz cwm	Cool 4° C	14 days
Herbicides	Water	EPA 8151B	(2) 1 liter amber	Cool 4° C	7 days extraction 40 days analysis
	Soil		4 oz cwm	Cool 4° C	14 days
Cyanide	Water	EPA 335.3/9012/EPA 335.4	250 ml poly	Cool 4° C NaOH pH >12	14 days
	Soil		4 oz cwm	Cool 4° C	14 days
Total Coliform	Water	SM9223B Quanti-tray	100ml Bacteriological bottle	Cool 4° C	30 hours
Ammonia Nitrogen	Water	EPA 350.1	250 ml poly	Cool 4° C H2SO4 pH <2	28 days
Nitrate Nitrogen	Water	EPA 300.0	250 ml poly	Cool 4° C	48 hours
Nitrite Nitrogen	Water	EPA 300.0	250 ml poly	Cool 4° C	48 hours
Chloride	Water	EPA 300.0	250 ml poly	Cool 4° C	28 days
Sulfate	Water	EPA 300.0	250 ml poly	Cool 4° C	28 days
Chemical Oxygen Demand	Water	EPA 410.1/EPA 410.4	250 ml poly	Cool 4° C H2SO4 pH <2	28 days
Total Organic Carbon	Water	EPA 415.1/SM5310C	250 ml amber	Cool 4° C H2SO4 pH <2	28 days
Volatile Organic Compounds and Gasoline Range Organics	Soil Gas	EPA Method TO-15	1-liter Summa Canister	Maintain at ambient temperature	30 days

Notes:

EPA = U.S. Environmental Protection Agency; HDPE = High density polyethylene; cwm = clear wide mouth; PCBs = Polychlorinated biphenyls; ml = milliliter
oz = ounce; HCl = hydrochloric acid; g = gram; HNO_3 = nitric acid; °C = degrees celsius

Table B-33

Quality Control Samples Type and Frequency

Marshall Landfill RI/FS

Spokane County, Washington

Parameter	Field QC		Laboratory QC			
	Field Duplicates	Trip Blanks	Method Blanks	LCS	MS / MSD	Lab Duplicates
Hydrocarbon Identification	1/20 soil samples and 1 groundwater sample/monitoring event	NA	1/batch	1/batch	NA	1/batch
Gasoline Range Hydrocarbons	1/20 soil samples and 1 groundwater sample/monitoring event	NA	1/batch	1/batch	NA	1/batch
Diesel and Oil Range Hydrocarbons with silica gel/acid wash cleanup	1/20 soil samples and 1 groundwater sample/monitoring event	NA	1/batch	1/batch	NA	1/batch
Total Metals	1/20 soil samples and 1 groundwater sample/monitoring event	NA	1/batch	1/batch	NA	1/batch
Dissolved Metals	1 groundwater sample/monitoring event	NA	1/batch	1/batch	NA	1/batch
Diss Fe, Mn, Pb, Zn	None	NA	1/batch	1/batch	1 MS/batch	1/batch
VOCs	1 groundwater sample/monitoring event	1/cooler	1/batch	1/batch	1 set/batch	NA
PAHs	1 groundwater sample/monitoring event	NA	1/batch	1/batch	1 set/batch	NA
Semi-Volatile Organic Compounds	None	NA	1/batch	1/batch	1 set/batch	NA
PCBs	None	NA	1/batch	1/batch	1 set/batch	1/batch
Dioxins/Furans	None	NA	1/batch	1/batch	1 set/batch	1/batch
Organochlorine Pesticides	None	NA	1/batch	1/batch	1 set/batch	1/batch
Organophosphorous Pesticides	None	NA	1/batch	1/batch	1 set/batch	1/batch
Herbicides	None	NA	1/batch	1/batch	1 set/batch	1/batch
Cyanide	None	NA	1/batch	1/batch	NA	NA
Total Coliform	None	NA	1/batch	1/batch	NA	NA
Ammonia Nitrogen	None	NA	1/batch	1/batch	NA	NA
Nitrate Nitrogen	None	NA	1/batch	1/batch	NA	NA
Nitrite Nitrogen	None	NA	1/batch	1/batch	NA	NA
Chloride	None	NA	1/batch	1/batch	NA	NA
Sulfate	None	NA	1/batch	1/batch	NA	NA
Chemical Oxygen Demand	None	NA	1/batch	1/batch	NA	NA
Total Organic Carbon	None	NA	1/batch	1/batch	NA	NA
Volatile Organic Compounds and Gasoline Range Organics in Soil Gas	None	NA	1/batch	1/batch	NA	NA

Notes:

An analytical lot or batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/ MSD (or MS and lab duplicate).

No more than 20 field samples can be contained in one batch.

LCS = Laboratory control sample

MS = Matrix spike sample

MSD = Matrix spike duplicate sample

VOCs = Volatile organic compounds; PAHs = Polycyclic aromatic hydrocarbons; PCBs = Polychlorinated biphenyls

APPENDIX C
Health and Safety Plan

Site Health and Safety Plan

Marshall Landfill Site
Spokane County, Washington

File No. 0504-104-00

January 28, 2015

Approvals:

Signature: _____ Date: _____

Bruce D. Williams, Principal, GeoEngineers

Signature: _____ Date: _____

John R. Haney, PE, Senior Environmental Engineer, GeoEngineers

Signature: _____ Date: _____

Wayne D. Adams, Health & Safety Program Manager, GeoEngineers

BDW:JRH:WDA:csv:tjh

SITE HEALTH AND SAFETY PLAN

INTRODUCTION

This HASP is to be used in conjunction with the GeoEngineers Safety Program Manual. Together, the written safety programs and this HASP constitute the site safety plan for this site. This plan is to be used by GeoEngineers personnel on this site and must be available on site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included and the plan will be approved by the GeoEngineers Health and Safety Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Program Manual.

Liability Clause

If requested by subcontractors, this site safety plan may be provided for informational purposes only. In this case, Form C-3 shall be signed by the subcontractor. Please be advised that this Site Safety Plan is intended for use by GeoEngineers Employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this Site Safety Plan. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by them.

All personnel participating in this project must receive initial health and safety orientation (Form 1). Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety and Health Supervisor. The orientation and the tailgate safety meetings shall include a discussion of emergency response, site communications and site hazards.

TABLE C-1. GENERAL PROJECT INFORMATION

Project Name:	**Marshall Landfill RI/FS**
Project Number:	0504-104-00
Type of Project:	RI/FS
Project Address:	Near W Andrus and Spotted Road
Start/Completion:	To Be Determined (TBD)
Subcontractors:	TBD

WORK PLAN

The objective of this project is to complete a RI/FS for the Marshall Landfill Site (the Site). Specific tasks for this project include: assessing the adequacy of the existing groundwater monitoring network; sufficiently characterizing the nature and extent of contamination associated with the Site to support the FS; and completing an FS that evaluates cleanup technologies and alternatives, recommends a cleanup action that meets MTCA requirements, and is most appropriate for the Site. Please refer to "Section 5.0, Remedial Investigation" of the Work Plan for further details regarding the scope of work to be completed.

Site Location

The Site is located in Marshall, Washington. The Site is bounded by West Andrus Rd to the south, South Spotted Road to west, South Cheney-Spokane Road to the East, and a former County Landfill to the south.

- The Site is located in the NE quarter of Section 21, Township 24 North, Range 42 East, Willamette Meridian.
- Latitude 47.565 North and Longitude -117.499 West.

Site History

The Site consists of two waste disposal areas: the 25-acre "Main Landfill" (which operated from 1970 through 1990) and a 5-acre area known as the "Five-Acre Landfill" (which operated from 1980 through 1984). The thickness of landfilled waste has been estimated at 100 feet in the Main Landfill and 45 feet in the Five-Acre Landfill. After disposal operations ceased in 1990, the Main Landfill was reportedly covered with a layer of sand, and the Five-Acre Landfill was covered with a compacted clay cap with a passive landfill gas venting system. These features are shown on Figure 2.

The area north of the Main Landfill (east of the Five-Acre Landfill) currently is a gravel pit operated by Action Materials. Spokane County operated a landfill from the 1950s until 1970 on property adjacent to the south boundary of the Main Landfill. The Site is bounded on the east by South Cheney-Spokane Road and on the west by vacant land.

Three key investigations conducted since 1991 provide important information about the Site, including:

- Estimates of the types and quantities of solid and liquid hazardous wastes disposed;
- Groundwater monitoring data from 17 on-site monitoring wells collected between 1989 and 1991;
- Hydrogeologic information identifying four aquifers underlying the Site;
- VOCs, likely associated with hazardous waste disposal, are present in landfill gas within the Five-Acre Landfill, Main Landfill, and Spokane County Landfill;
- Groundwater quality data from local water supply wells collected between 1989 and 2011 (22 years); and
- Documentation of contaminant migration (VOCs) in groundwater, with generally decreasing concentrations since 2005.

Field Activities

The following activities are anticipated for GeoEngineers field personnel during the site assessment activities:

- Contact the one-call utility locate service;
- Drilling/monitoring well installation/well repair, as needed;
- Conduct downhole video survey of on-site monitoring wells;
- Excavate test pits to assess the nature and extent of solid waste and cap materials;

- Install gas probes in the landfills to provide deeper gas samples and soil vapor probes to assess soil and landfill gas conditions; and
- Establish site benchmarks and prepare an updated site topographic map using a licensed surveyor.

Chain of Command, Field Personnel and Training Records

TABLE C-2. ORGANIZATION CHART

Chain of Command	Title	Name	Telephone Numbers
1	Project Manager	John Haney	O: 509.363.3125 C: 509.768.5861
2	Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) Supervisor	John Haney	O: 509.363.3125 C: 509.768.5861
3	Field Engineers/Scientists	Chelsea Voss Josh Lee	O: 509.363.3125 C: 425.327.9591 O: 509.363.3125 C: 406.293.7810
4	Site Safety and Health Supervisor (Site Safety Officer; [SSO])*	John Haney	O: 509.363.3125 C: 509.768.5861
5	Site Supervisor	Josh Lee	O: 509.363.3125 C: 406.293.7810
6	Health and Safety Program Manager (HSM)	Wayne Adams	O: 425.861.6000 C: 253.350.4387

Note:

* **Site Safety and Health Supervisor –** The individual present at a hazardous waste site responsible to the employer and who has the authority and knowledge necessary to establish the site-specific health and safety plan and verify compliance with applicable safety and health requirements.

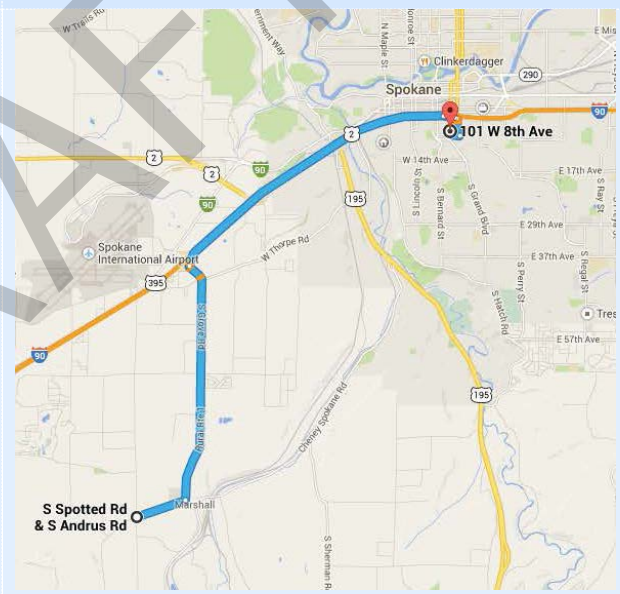
GeoEngineers employees often do not have stop work authority on projects controlled by other contractors; however, any GeoEngineers employee, regardless of job title, working in the field will be responsible for contacting the Project Manager if they observe practices on the job site that are serious safety violations that are not under their control. They will document the unsafe practices and will contact the site supervisor as identified by the client. If no one is on site, the Project Manager, once notified, will contact the client. This action establishes GeoEngineers commitment to site health and safety on all job sites as our duty of care to the public, contractors and clients.

GeoEngineers is responsible for its subcontractors and will also be providing inspections and corrections of any work that subcontractors perform around excavations.

TABLE C-3. PERSONNEL TRAINING RECORDS

Name of Employee On Site	Level of HAZWOPER Training (24-/40-hr)	HAZWOPER Supervisor	Date of 8-Hr HAZWOPER Refresher Training	First Aid/ Cardiopulmonary Resuscitation (CPR)	Date of Respirator Fit Test
Chelsea Voss	40-hr	NA	01/10/14	06/18/14	03/07/14
Josh Lee	40-hr HAZWOPER Supervisor	04/10/2013	03/17/14	05/01/13	03/18/14
John Haney	40-hr				

EMERGENCY INFORMATION

Hospital Name and Address:	Sacred Heart Medical Center 101 West 8th Avenue.
Phone Numbers (Hospital ER):	509.474.3131
Distance:	10 miles
Route to Hospital From North Location: 1. Head east on W Andrus Rd towards S Grove Rd 2. Turn left onto S Grove Rd 3. Turn right to merge onto I-90E 4. Take exit 281 for Division St toward US-2 E / US-395 N/Newport/Colville 5. Keep right at the fork, follow signs for Division St S. 6. Turn right onto South Division Street 7. Turn right onto W 8th Avenue	
Ambulance:	9.1.1
Poison Control:	800.222.1222
Police:	9.1.1
Fire:	9.1.1
Location of Nearest Telephone:	Cell phones are carried by field personnel.
Nearest Fire Extinguisher:	Located in the GeoEngineers' vehicle on site.
Nearest First-Aid Kit:	Located in the GeoEngineers' vehicle on site.

Standard Emergency Procedures

1. Get help
    a. send another worker to phone 911 (if necessary)
    b. as soon as feasible, notify GeoEngineers' project manager
2. Reduce risk to injured person
    a. turn off equipment
    b. move person from injury location (if possible)
    c. keep person warm
    d. perform CPR (if necessary)
3. Transport injured person to medical treatment facility (if necessary)
    a. by ambulance (if necessary) or GeoEngineers vehicle
    b. stay with person at medical facility
    c. keep GeoEngineers manager apprised of situation and notify human resources manager of situation

HAZARD ANALYSIS

Note: A hazard assessment will be completed at every site prior to beginning field activities. Updates will be included in the daily log. This list is a summary of hazards listed on the form.

TABLE C-4. PHYSICAL HAZARDS

Physical Hazards	
X	Drill rigs
	Overhead hazards / power lines
X	Tripping / puncture hazards (debris on-site, steep slope or pits)
X	Snow, rain, ice, freezing temperatures
X	Heat / Cold, Humidity
X	Utilities / utility locate
X	Contaminated soil
X	Contaminated groundwater
X	Landfill gas / soil vapor
X	Loud noise
X	Backhoe
X	Trackhoe
	Crane
X	Front End Loader

Physical Hazards	
X	Excavations/trenching (1:1 slopes for Type B soil)
	Shored/braced excavation if greater than 4 feet of depth

Safe Work Practices

- Verify underground utilities have been notified and marked: complete an underground utility notification and verify that all utilities that were notified have marked prior to drilling and/or excavating. If marks are not present from a notified utility, contact the utility to verify that they do not have any underground facilities near exploration locations. Maintain a list of contacts in the field for each utility notified in case of emergency.
- Lifting hazards: Use proper techniques, mechanical devices where appropriate.
- Terrain obstacles: Work will be conducted on an abandoned landfill site. Soil will be soft and unstable where fill is in place. Be mindful of scattered debris throughout the Site.
- Personnel will wear high-visibility vests for increased visibility by vehicle and equipment operators.
- Field personnel will be aware constantly of the location and motion of heavy equipment. A safe distance will be maintained between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated it is safe to do so.
- Heavy equipment and/or vehicles used on this site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch.
- Overhead Power Line Clearance Safety: Working equipment around overhead power lines requires distance and a spotter. Before a job begins, call the utility company and find out voltage in lines. Have the equipment de-energized if possible. Ensure that the equipment remains de-energized by using some type of lockout and tag procedure, and ensure that the electrician uses grounding lines when they are required.
- Keep a safe distance from energized parts which is a minimum of 10 feet for 50 kilovolt (kV) and under. The minimum distance will be more for higher voltages (above 50 kV). The only exception is for trained and qualified electrical workers using insulated tools designed for high voltage lines.
- Don't operate equipment around overhead power lines unless you are authorized and trained to do so. If an object (scaffolds, crane, etc.) must be moved in the area of overhead power lines, appoint a competent worker whose sole responsibility is to observe the clearance between the power lines and the object. Warn others if the minimum distance is not maintained.
- Never touch an overhead line if it has been brought down by machinery or has fallen. Never assume lines are dead. When a machine is in contact with an overhead line, DO NOT allow anyone to come near or touch the machine. Stay away from the machine and summon outside assistance. Never touch a person who is in contact with a live power line.
- If you are in a vehicle that is in contact with an overhead power line, DO NOT LEAVE THE VEHICLE. As long as you stay inside and avoid touching metal on the vehicle, you may avoid an electrical hazard. If

you need to get out to summon help or because of fire, jump out without touching any wires or the machine, keep your feet together, and hop to safety.

- When mechanical equipment is being operated near overhead power lines, employees standing on the ground may not contact the equipment unless it is located so that the required clearance cannot be violated even at the maximum reach of the equipment.
- When working near overhead power lines, the use of nonconductive wooden or fiberglass ladders is recommended. Aluminum ladders and metal scaffolds or frames are efficient conductors of electricity.
- Avoid storing materials under or near overhead power lines.
- Personnel will avoid tripping hazards, steep slopes, pit and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope, pier or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety and Health Supervisor in accordance with Occupational Safety and Health Administration (OSHA)/Division of Occupational Safety and Health (DOSH) regulations and the GeoEngineers Safety Program manual.
- Heat stress control measures must be implemented according to the GeoEngineers, Inc. program with water provided on site. See Additional Programs at end of this HASP.
- Excessive levels of noise (exceeding 85 decibels [dBA]) are anticipated. Personnel potentially exposed will wear ear plugs or muffs with a noise reduction rating of at least 25 dBA whenever it becomes difficult to carry on a conversation 6 feet away from a co-worker or whenever noise levels become bothersome. (Increasing the distance from the source will decrease the noise level noticeably.)
- Work may be conducted in rain, freezing rain, snow, or icy conditions. Care will be taken to wear warm water proof clothing that limits exposure to cold.

Engineering Controls

- Trench shoring (1:1 slope for Type B Soils)
- Location work spaces upwind/wind direction monitoring
- Stockpiled soil will be covered as conditions warrant
- Site controls will be implemented to restrict access to the Site from the general public
- Dust control

Chemical Hazards

The Marshall Landfill began accepting waste prior to the current regulations governing landfill operations (primarily CERCLA and RCRA). While some documentation exists disclosing what types of waste were permitted for disposal at the Site, it is possible that various unknown hazardous wastes could be encountered during site assessment activities.

TABLE C-5. CHEMICAL HAZARDS AND EXPOSURES (POTENTIALLY PRESENT AT THE SITE)

Compound/Group Description	Exposure Limits/Immediately Dangerous to Life or Health (IDLH)	Exposure Routes	Symptoms/Health Effects
Methane	OSHA PEL = None established NIOSH = None established TLV –Simple Asphyxiant LEL = 5.0%	Inhalation	Methane is non-toxic. However, it can reduce the amount of oxygen in the air necessary to support life. Oxygen-deficient environments can produce dizziness, nausea, vomiting, loss of consciousness, and death.
VOCs (Benzene-typical)	OSHA PEL = TWA 1 ppm; ST = 5 ppm NIOSH REL = TWA 0.1 ppm; ST = 1 ppm IDLH = 500 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritated eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]
Hydrogen Sulfide (H_2S)	OSHA PEL = 27.88 mg/m^3 (69.9 mg/m^3 10-minute maximum peak) NIOSH REL = 15 mg/m^s 10-minute maximum peak) IDLH = 139.39 mg/m^3	Inhalation, skin and/or eye contact	irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite
PCBs (as Aroclor 1254)	OSHA PEL = 0.5 mg/m^3 TLV 0.5 mg/m^3 NIOSH REL = 0.001 mg/m^3 IDLH 5.0 mg/m^3	Inhalation (dusts or mists), skin absorption, ingestion, skin and/or eye contact	Irritated eyes, chloracne, liver damage, reproductive effects, potential carcinogen
PAH as coal tar pitch volatiles	OSHA PEL = 0.2 mg/m^3 TLV 0.2 mg/m^3 NIOSH REL = 0.1 mg/m^3 IDLH 80 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Dermatitis, bronchitis, potential carcinogen
Pentachloro-phenol (PCP)	OSHA PEL = 0.5 mg/m^3 NIOSH REL = 0.5 mg/m^3 IDLH = 2.5 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose, throat; sneezing, cough; lassitude (weakness, exhaustion), anorexia, weight loss; sweating; headache, dizziness; nausea, vomiting; dyspnea (breathing difficulty), chest pain; high fever; dermatitis

Notes:

IDLH = immediately dangerous to life or health
mg/m^3 = milligrams per cubic meter
TWA = time-weighted average (Over 8 hrs.)
TLV = threshold limit value (over 10 hrs.)
ppm = parts per million
NIOSH = National Institute for Occupational Health and Safety
OSHA = Occupational Safety and Health Administration
LEL = lower explosive limit
PEL = permissible exposure limit
STEL = short-term exposure limit (15 min)
REL = recommended exposure limit

Polycyclic Aromatic Hydrocarbons and Carcinogenic Polycyclic Aromatic Hydrocarbons

Exposure to cPAHs can occur via inhalation of vapors, ingestion and skin and eye contact. Skin contact can result in reddening or corrosion. Ingestion can cause nausea, vomiting, blood pressure fall, abdominal pain, convulsions and coma. Damage to the central nervous system can also occur. The US Department of Health and Human Services (1989) has classified 15 PAH compounds as having sufficient evidence for carcinogenicity, while the EPA (1990) has classified at least five of the identified PAHs as human carcinogens. There is no currently assigned PEL-TWA for cPAHs, but the closely related material coal tar is listed as coal tar pitch volatiles with a PEL-TWA of 0.2 mg/m^3. PAHs and cPAHs as soil contaminants can be irritating to eyes and mucous membranes. PAHs are also formed during combustion and are linked to lung cancers with exposure to combustion byproducts. Lymphatic cancers are reported in the literature with PAHs in the presence of carbon black.

Polychlorinated Biphenyl Compounds

PCB is a generic term for a range of polychlorinated biphenyl compounds used commercially in heat transfer media and in the chemical/coatings industry. PCBs have been marketed commercially under the trade names Askarel® and Aroclor®, with a designation referring to the percent weight of chlorine. Prolonged skin contact with PCBs may cause acne-like symptoms, known as chloracne. Irritation to eyes, nose and throat may also occur. Acute and chronic exposure can cause liver damage, and symptoms of edema, jaundice, anorexia, nausea, abdominal pains and fatigue. If pregnant women accidentally ingest PCBs, stillbirth or infant skin and eye problems may occur. PCBs are a suspect human carcinogen. The EPA currently classifies PCBs as a Class B2, or probable, human carcinogen. The Washington State PEL-TWA for PCBs with 54 percent chlorine content is 0.5 mg/m^3, while the PEL-TWA for PCBs with 42 percent chlorine is 1 mg/m^3. Skin exposure may contribute significantly to uptake of these chemicals, and therefore all skin exposure to the liquid product or contaminated water, soil or dust should be strictly avoided.

Methane

Methane acts as a simple asphyxiant when inhaled. Its presence displaces air, which lowers the partial pressure of oxygen and causes hypoxia. Methane is odorless and tasteless and will not be detected by the PID. A TLV or 4-gas monitor will detect methane as a flammable gas. The LEL of methane is 5 percent and the UEL is 15 percent. A concentration of methane of 5 percent in a room would cause oxygen deficiency.

Five percent methane would displace the 21 percent oxygen in our normal atmosphere and take it to less than 19.5 percent oxygen that is required for occupational exposures. The atmosphere is 78 percent nitrogen, and presumably some of this would be replaced by the methane as well. Obviously if the methane just replaced the oxygen, the remaining 16 percent would be lower than allowable for occupational exposures.

Hydrogen Sulfide

Hydrogen sulfide is a colorless, flammable, highly toxic gas. It is shipped as a liquefied, compressed gas. It has a characteristic rotten-egg odor that is detectable at concentrations as low as 0.5 parts per billion (ppb). Inhalation is the major route of hydrogen sulfide exposure. The gas is rapidly absorbed by the lungs. The odor threshold (0.5 ppb) is much lower than the OSHA PEL of 20 ppm or the ACGIH PEL of 10 ppm. However, although its strong odor is readily identified, olfactory fatigue occurs at high concentrations and at continuous low concentrations. For this reason, odor is not a reliable indicator of hydrogen sulfide's

presence and may not provide adequate warning of hazardous concentrations. Hydrogen sulfide is slightly heavier than air and may accumulate in enclosed, poorly ventilated and low-lying areas.

Prolonged exposure to hydrogen sulfide, even at relatively low levels, may result in painful dermatitis and burning eyes. Direct contact with the liquefied gas can cause frostbite. Absorption through intact skin is minimal.

Hydrogen sulfide is produced naturally by decaying organic matter and is released from sewage sludge, liquid manure, sulfur hot springs and natural gas. It is a by-product of many industrial processes including petroleum refining, tanning, mining, wood-pulp processing, rayon manufacturing, sugar-beet processing and hot-asphalt paving. Hydrogen sulfide is used to produce elemental sulfur, sulfuric acid and heavy water for nuclear reactors.

Hydrogen sulfide is a mucous membrane and respiratory tract irritant; pulmonary edema, which may be immediate or delayed, can occur after exposure to high concentrations. Symptoms of acute exposure include nausea, headaches, delirium, disturbed equilibrium, tremors, convulsions, and skin and eye irritation.

Inhalation of high concentrations of hydrogen sulfide can produce extremely rapid unconsciousness and death. Exposure to the liquefied gas can cause frostbite injury.

- Respiratory Protection: Positive-pressure, self-contained breathing apparatus is recommended in response situations that involve exposure to potentially unsafe levels of hydrogen sulfide.
- Skin Protection: Chemical-protective clothing is not generally required because hydrogen sulfide gas is not absorbed through the skin, and skin irritation is rare. Direct contact with the liquefied gas can cause frostbite. Rescuers should have a safety line during rescue operations because of the extremely rapid toxic action of hydrogen sulfide.

AIR MONITORING PLAN

Check Instrumentation to be Used

___X___ Multi-gas Monitor (for methane, oxygen, carbon monoxide/dioxide, hydrogen sulfide and LEL)

___X___ PID (Photoionization Detector)

_____ Other (i.e., detector tubes): _____

Check Monitoring Frequency/Locations: and Type (Specify: Work Space, Borehole, Breathing Zone)

___X___ Continuous during soil disturbance activities or monitoring well repair/installation

_____ 15 minutes

_____ 30 minutes

_____ Hourly (in breathing zone during excavations, drilling, sampling)

TABLE C-6. AIR MONITORING, FREQUENCY AND ACTION LEVELS

Gas	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Methane	Gas Multi-meter	Air monitoring to begin at start of shift and continue during all excavation activities.	___ >10% LEL	Stop work and evacuate the area. Contact Health and Safety Manager for guidance.
Oxygen	Gas Multi-meter	Air monitoring to begin at start of shift and continue during all excavation activities.	<19.5% or >23.5%	Continue work if inside range. If outside range, evacuate area and contact Health and Safety Manager.
Hydrogen Sulfide	Gas Multi-meter	Air monitoring to begin at start of shift and continue during all excavation activities.	>10% LEL	Stop work and evacuate the area. Contact Health and Safety Manager for guidance.
Organic Vapors (VOCs)	PID	Air monitoring to begin at start of shift and continue during all excavation activities.	5 to 25 ppm in breathing zone	Upgrade to Level C personal protective equipment (PPE)
Organic Vapors (VOCs)	PID	Air monitoring to begin at start of shift and continue during all excavation activities.	> 25 ppm in breathing zone	Stop work and evacuate the area. Contact Health and Safety Manager for guidance.

TABLE C-7. BIOLOGICAL HAZARDS AND PROCEDURES

Y/N	Hazard	Procedures
Y	Poison Ivy or other vegetation	
Y	Insects or snakes	
	Others	

Site personnel shall avoid contact with or exposures to potential biological hazards encountered.

Additional Hazards (Update in Daily Log)

Include evaluation of:

- Physical Hazards (equipment, traffic, tripping, heat stress, cold stress and others)
- Chemical Hazards (odors, spills, free product, airborne particulates and others present)
- Biological Hazards (stinging insects, snakes, spiders, other animals, poison ivy and others present)

SITE CONTROL PLAN

An up-to-date site control plan will be developed before field activities begin to minimize employee exposure to hazardous substances and including the following: a site map is included with the Work Plan. The hospital route map is included with this HASP.

Site Work Zones

If necessary, exclusion zones will be established within approximately 10 feet around each test pit and/or boring during drilling/sampling. Only persons with the appropriate training will enter this perimeter while work is being conducted there.

Method of Delineation / Excluding Non-Site Personnel	
	Fence
X	Survey Tape
X	Traffic Cones
	Other Road Work Signs

Buddy System

Personnel on-site should use the buddy system (pairs), particularly whenever communication is restricted. If only one GeoEngineers employee is on-site, a buddy system can be arranged with subcontractor / contractor personnel.

Site Communication Plan

Positive communications (within sight and hearing distance or via radio) should be maintained between pairs on-site, with the pair remaining in proximity to assist each other in case of emergencies. The team should prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown). In these instances, consider suspending work until communication can be restored; if not, the following are some examples for communication:

1. Hand gripping throat: Out of air, can't breathe.
2. Gripping partner's wrist or placing both hands around waist: Leave area immediately, no debate.
3. Hands on top of head: Need assistance.
4. Thumbs up: Okay, I'm all right; or, I understand.
5. Thumbs down: No, negative.
6. Extended fist: Stop.

Decontamination Procedures

Personal decontamination consists of removing outer protective Tyvek clothing (if used), washing soiled boots, removing respirator (if used); hands and face will be washed in either a portable wash station or a bathroom facility in the support zone. Employees will perform decontamination procedures and wash prior

to eating, drinking or leaving the site. All disposable personal protective clothing (i.e., nitrile gloves) will be bagged with other miscellaneous waste and discarded in the appropriate refuse receptacle in the contamination reduction zone.

Waste Disposal or Storage

PPE disposal (specify): Used PPE to be placed in on-site drums pending characterization and disposal.

Drill cutting/excavated sediment disposal or storage:

X	On-site, pending analysis and further action
X	Secured (soil cuttings, monitoring well development and purge water and equipment decontamination water will be stored in secured [sealed] drums)_____
	Other (describe destination, responsible parties): _____

PERSONAL PROTECTIVE EQUIPMENT

PPE will consist of standard Level D equipment. Disposable PPE (gloves) will be placed into plastic trash bags and disposed as solid waste. Minimum level of protective equipment for these sites is Level D. After the initial and/or daily hazard assessment has been completed, select the appropriate protective gear (PPE) to preserve worker safety. Task-specific levels of PPE shall be reviewed with field personnel during the pre-work briefing conducted prior to the start of site operations.

Check Applicable Personal Protection Equipment to be Used	
X	Hardhat
X	Steel-toed boots
X	Safety glasses
X	Hearing protection
	Rubber boots (if wet conditions)
Gloves (specify)	
X	Nitrile
	Latex
	Liners
	Leather
	Other (specify) _____
Protective clothing	
	Tyvek (if dry conditions are encountered, Tyvek is sufficient)
	Saranex (personnel shall use Saranex if liquids are handled or splash may be an issue)
X	Cotton
X	Rain gear (as needed)

Check Applicable Personal Protection Equipment to be Used	
X	Layered warm clothing (as needed)
Inhalation hazard protection	
X	Level D
X	Level C (respirators with organic vapor filters / P100 filters) (if warranted)

Limitations of Protective Clothing

PPE clothing ensembles designated for use during site activities shall be selected to provide protection against known or anticipated hazards. However, no protective garment, glove, or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, site personnel shall be trained in the proper use and inspection of PPE. This training shall include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures, or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears, or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

Respirator Selection, Use, and Maintenance

GeoEngineers has developed a written respiratory protection program in compliance with OSHA requirements contained in 29 code of federal regulations (CFR) 1910.134. Site personnel shall be trained on the proper use, maintenance, and limitations of respirators. Site personnel that are required to wear respiratory protection shall be medically qualified to wear respiratory protection in accordance with 29 CFR 1910.134. Site personnel that will use a tight-fitting respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used. Respirators will be stored in a protective container.

Respirator Cartridges

If site personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated site contaminants. The respirator/cartridge combination shall be certified and approved by NIOSH. A cartridge change-out schedule shall be developed based on known site contaminants, anticipated contaminant concentrations, and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Site personnel shall be made aware of the cartridge change-out schedule prior to the initiation of site activities. Site personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or detect vapor breakthrough by smell, taste, or feel although breakthrough is not an acceptable method of determining the change-out schedule. At a minimum, cartridges should be changed a minimum of once daily.

Respirator Inspection and Cleaning

The Site Safety and Health Supervisor shall periodically (i.e., weekly) inspect respirators at the project site. Site personnel shall inspect respirators prior to each use in accordance with the manufacturer's instructions. In addition, site personnel wearing a tight-fitting respirator shall perform a positive and negative pressure user seal check each time the respirator is donned to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer's instructions.

Facial Hair and Corrective Lenses

Site personnel with facial hair that interferes with the sealing surface of a respirator shall not be permitted to wear respiratory protection or work in areas where respiratory protection is required. Normal eyeglasses cannot be worn under full-face respirators because the temple bars interfere with the sealing surface of the respirator. Site personnel requiring corrective lenses will be provided with spectacle inserts designed for use with full-face respirators. Contact lenses should not be worn with respiratory protection.

ADDITIONAL ELEMENTS

Environmental Conditions

Working in either cold or hot environments can present many hazards to site personnel. The following sections provide guidance to site personnel on identifying symptoms and measures to prevent injuries related to cold or heat related stress.

Cold Stress Related Hazards

Working in cold environments can present many hazards to site personnel that can result in frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature). The combination of wind and cold temperatures increases the degree of cold stress experienced by site personnel. Site personnel shall use the following as a guide to the signs and symptoms of cold-related illnesses and measures to prevent the onset of cold-related injuries.

TABLE C-8. COLD-RELATED ILLNESS: SYMPTOMS AND FIRST AID

Disorder	Symptoms	Signs	Causes	First Aid
Hypothermia	Chills; pain in extremities; fatigue or drowsiness.	Euphoria; slow, weak pulse; slurred speech: collapse; shivering; unconsciousness; body temperature < 95f (35c).	Excessive exposure, exhaustion or dehydration, subnormal tolerance, drug/alcohol abuse.	Move to warm area and remove wet clothing. Modest external warming (external hear packs, etc.). Drink warm, sweet fluids if conscious. Transport to hospital.
Frostbite	Burning sensation at first. Coldness, numbness, tingling.	Skin color white or grayish yellow to reddish violet to black. Blisters. Response to touch depends on depth of freezing.	Exposure to cold, vascular disease.	Move to warm area and remove wet clothing. External warming (warm water). Drink warm, sweet fluids if conscious. Transport to hospital.

Disorder	Symptoms	Signs	Causes	First Aid
Frostnip	Possible itching or pain.	Skin color white.	Exposure to cold (above freezing) and dampness.	Similar to frostbite.
Trench Foot	Severe pain; tingling, itching.	Edema; blisters; response to touch depends on depth of freezing.	Exposure to cold (above freezing) and dampness.	Similar to frostbite.

Heat Stress Hazards

Working in hot environments can present many hazards to site personnel that can result in heat related illness such as heat rash, heat cramps, heat exhaustion or heat stroke. To prevent these illnesses site safety officers shall provide plenty of liquids (other than soda pop or coffee) to jobsite employees. Ideally, plain water is the best option and shall be provided. As an alternative a commercial electrolyte replacement mix may also be used as well.

As a general guideline when in hot weather, 1 gallon of liquids shall be provided per worker per day. In the course of a day's work in the heat, a worker may produce as much as 2 to 3 gallons of sweat. Because so many heat disorders involve excessive dehydration of the body, it is essential that water intake during the workday be about equal to the amount of sweat produced. Therefore, a worker should drink 5 to 7 ounces of fluids every 15 to 20 minutes to replenish the necessary fluids in the body. Heat acclimatized workers lose much less salt in their sweat than do workers who are not adjusted to the heat.

Adequate shelter shall also be available to protect personnel from heat and direct sunlight in order to increase physical efficiency and decrease the likelihood of accidents. Field tarps or canopies can be used where other shaded rest areas are not available. Cooling fans and ventilation can help workers stay cool.

Site personnel shall use the following as a guide to the signs and symptoms of heat-related illnesses and the measures to prevent the onset of heat-related injuries.

TABLE C-9. HEAT-RELATED ILLNESS: SYMPTOMS AND FIRST AID

Heat-Related Illness	Symptoms	First Aid
Heat Fatigue	Weakness; impaired motor skills; reduced ability to concentrate.	Take a short break in a cooler area. Pushing yourself to work through the condition can lead to a more serious illness.
Heat Cramps	Painful muscle spasms caused by salt imbalances in the body because of sweating.	Drinking carbohydrate electrolyte replacement liquids may not eliminate the pain, but helps during recovery. Prevent by drinking a small cup of water every 15 to 20 minutes – even if you aren't thirsty.
Heat Rash	Irritation, especially where skin is wet with sweat or clothing is tight. Can lead to infection.	Move to cooler area. Wash and change clothing.

Heat-Related Illness	Symptoms	First Aid
Heat Collapse	A person suddenly faints. Happens when the brain doesn't get enough oxygen because the blood has pooled in the victim's arms or legs.	Remove the victim to a cooler area to lie down during recovery. Do not give liquids to an unconscious person.
Heat Exhaustion	Headache, nausea, dizziness, thirst and giddiness. Can lead to vomiting and/or fainting. Victim has pale, clammy (moist) skin.	Remove victim to a cool, shaded area. Give water if the victim is alert and not nauseated. Don't leave the person alone. Cool the victim with a spray mist or wet cloth. If the person does not feel better in a few minutes, call for emergency help.
Heat Stroke	Victim has dry, pale skin (no sweating) or hot, red skin (looks like a sunburn) and is confused. Victim may have seizures and pass out.	Call for emergency help. Remove the victim to lie down in a cool, shaded area. Don't leave the person alone. If the victim is alert and not nauseated, give water. Cool the person. Place ice packs under the arm pits and in groin area.

Emergency Response

Indicate what site specific procedures you will implement.

- Personnel on-site should use the "buddy system" (pairs).
- Visual contact should be maintained between "pairs" on-site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on-site, the entire field crew should immediately halt work and act according to the instructions provided by the SSO.
- Wind indicators visible to all on-site personnel should be provided by the SSO to indicate possible routes for upwind escape. Alternatively, the SSO may ask on-site personnel to observe the wind direction periodically during site activities.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the project manager, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the SSO and the injured person are to complete, within 24 hours, an Accident Report for submittal to the project manager, the HSM and human resources. The project manager should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

MISCELLANEOUS

Personnel Medical Surveillance

GeoEngineers' employees are not in a medical surveillance program as they do not fall into the category of "Employees Covered" in OSHA 1910.120(f)(2) which states a medical surveillance program is required for the following employees:

1. All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
2. All employees who wear a respirator for 30 days or more a year or as required by state and federal regulations; and
3. All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and
4. Members of hazardous materials (HAZMAT) teams.

Sanitation

Field staff and subcontractors must go off site to access sanitation facilities.

Lighting

Fieldwork will be conducted during daylight hours.

Excavation, Trenching and Shoring

All employees working on project sites where there is an excavation greater than 4 feet in depth shall be trained in excavation safety and shall utilize safe procedures. OSHA designates a 5-foot depth for instituting excavation safety procedures; however GeoEngineers will use the more conservative depth of 4 feet as specified by states such as Washington, Oregon and California. This program is for the protection of employees while working in excavations; however, employees should not enter excavations if there is an alternative.

GeoEngineers employees often do not have stop work authority on projects controlled by other contractors. However, any GeoEngineers employee, regardless of job title, working in the field will be responsible for contacting the Project Manager if they observe practices on the job site that are serious safety violations that are not under their control. They will document the unsafe practices and will contact the site safety coordinator as identified by the client. If no one is on-site, the Project Manager, once notified, will contact the client. This action establishes GeoEngineers' commitment to site health and safety on all job sites as our duty of care to the public, contractors and clients.

GeoEngineers is responsible for its subcontractors and will also be providing inspections and corrections of any work that subcontractors perform around excavations.

Documentation to Be Completed for HAZWOPER Projects

NOTE: The Field Log is to contain the following information:

- Updates on hazard assessments, field decisions, and conversations with subs, client or other parties.
- Air monitoring/calibration results; personnel, locations monitored, activity at the time of monitoring (if performed).
- Actions taken.
- Action level for upgrading PPE and rationale.

- Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

Required forms:

- Field Log.
- Health and Safety Plan acknowledgment by GEI employees (Form 2).
- Contractors Health and Safety Plan Disclaimer (Form 3).
- Conditional forms available at GeoEngineers office: Accident Report.

LIMITATIONS

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

FORM 1
HEALTH AND SAFETY PRE-ENTRY BRIEFING
MARSHALL LANDFILL SITE

Inform employees, contractors and subcontractors or their representatives about:

- The nature, level and degree of exposure to hazardous substances they're likely to encounter;
- All site-related emergency response procedures; and
- Any identified potential fire, explosion, health, safety or other hazards.

Conduct briefings for employees, contractors and subcontractors, or their representatives as follows:

- A pre-entry briefing before any site activity is started; and
- Additional briefings, as needed, to make sure that the Site-specific HASP is followed.

Make sure all employees working on the Site are informed of any risks identified and trained on how to protect themselves and other workers against the Site hazards and risks.

Update all information to reflect current sight activities and hazards.

All personnel participating in this project must receive initial health and safety orientation. Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety and Health Supervisor.

The orientation and the tailgate safety meetings shall include a discussion of emergency response, Site communications and site hazards.

Date	Topics	Attendee	Company Name	Employee Initials

FORM 2
SITE SAFETY PLAN – GEOENGINEERS' EMPLOYEE ACKNOWLEDGMENT
MARSHALL LANDFILL SITE

(All GeoEngineers' Site workers shall complete this form, which should remain attached to the Safety Plan and filed with other project documentation).

I hereby verify that a copy of the current Safety Plan has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge an understanding of the safety procedures and protocol for my responsibilities on Site. I agree to comply with all required, specified safety regulations and procedures.

Print Name	**Signature**	**Date**

FORM 3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM
MARHSALL LANDFILL SITE

I verify that a copy of the current Site Safety Plan has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on Site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the Site. By signing below, I agree that the safety of my employees is the responsibility of the undersigned company.

Print Name	**Signature**	**Firm**	**Date**